APPENDIX 12

ARROW LNG PLANT

Interim Shorebird Technical Study

arrow energy
go further

ecosure

Arrow LNG Plant Interim Shorebird Technical Study

December 2012

Arrow CSG (Australia) Pty Ltd and

Coffey Environments Australia Pty Ltd

Executive Summary

Arrow Energy is proposing to construct a liquefied natural gas (LNG) facility on the southern side of Curtis Island, in the Port Curtis area near Gladstone, central Queensland. The key components of this project are an LNG plant on Curtis Island and associated infrastructure on the island and mainland. This includes a materials offloading facility and construction workers camp on the island, a gas pipeline and tunnel linked to the mainland, a mainland launch site to ferry staff to the LNG plant and a possible overflow or temporary workers accommodation facility on the mainland.

The study area includes all of Port Curtis, from the southern end of Curtis Island, extending north to Graham Creek and the lower Narrows, east to Facing Island, and south to Tannum Sands. The survey area includes all known and potential shorebird roost and foraging habitat from the southwestern extent of Curtis Island and includes Hamilton Point, Boatshed Point and the area southwest of Ship Hill. On the mainland, the tunnel entry shaft and tunnel spoil disposal area is southeast of Boat Creek and on the coastal side of Gladstone-Mount Larcom Road.

Coffey Environments was engaged to develop the environmental impact statement (EIS) for this project. Ecosure Pty Ltd assisted Coffey with the ecological assessment of this project in 2010-2011. The EIS was prepared under the *State Development and Public Works Organisation Act 1972* (Qld) administered by the Coordinator-General. The EIS was submitted in March 2012 and placed on public exhibition. Impacts to shorebirds listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) are assessed as part of a controlled action under a Bilateral Agreement between the Australian and Queensland Governments. As a result of a public review of the EIS, the Coordinator-General requested supplementary information, including shorebird assessment, to address the submissions received and to address information gaps. This report presents preliminary results and impact assessment based on a literature review and data from two of five proposed surveys. A final report is planned for April 2013, at the completion of field surveys in early 2013.

Port Curtis has previously been assessed as a nationally important site for shorebirds (defined at a Commonwealth level within guidelines produced under the EPBC Act) and is particularly important for large shorebirds - eastern curlew (*Numenius madagascariensis*), whimbrel (*Numenius phaeopus*) and bar-tailed godwit (*Limosa lapponica*). Recent survey and assessment as part of planning for infrastructure developments throughout the Port Curtis area has included a revision to this assessment to internationally important habitat for the eastern curlew. Key areas for shorebirds within Port Curtis include: Friend Point, Pelican Banks and Clinton ash ponds.

Approximately 60.82 hectares of regulated vegetation classified as either saltpan (Regional Ecosystem 12.1.2) or mangrove (Regional Ecosystem 12.1.3) will be cleared as part of the project. These regional ecosystems are the main regulated habitat type for both migratory and resident shorebirds within the Port Curtis area, although areas of intertidal habitat, not classified as a regional ecosystem are important. Some of the areas of regulated vegetation

are also seldom used by shorebirds in the area, hence the need for detailed assessment of the usage of areas of potential habitat within the area of disturbance of the project and any adjacent areas that may be impacted.

Foraging and roosting habitat within the survey area was divided into: important habitat (as defined under guidelines associated with the EPBC Act), secondary habitat and potential habitat. Secondary habitat was defined as areas utilised by shorebirds in numbers less than the threshold required of important habitat. Potential habitat includes areas that were not identified in the literature as important habitat for shorebirds under EPBC guidelines, nor were birds identified using the area during the first two surveys, but these areas exhibit habitat characteristics suggesting they have potential to support sufficient shorebird numbers to be classified as important at different times or under different conditions. These characteristics included: extent, vegetation, similarity to other areas within the Port Curtis region that is classified as important habitat.

Within the survey area, Clinton ash ponds, which is an artificial wetland already subject to substantial disturbance due to industry within the area, is identified as important habitat in all previous studies. Foraging habitat in the intertidal zone of Targinie wetlands located to the east of mangroves adjacent to the mainland tunnel launch site, and a roost adjacent to Flying Fox Creek (over 1 km to the southeast of the mainland tunnel launch site), are potentially important habitat. No clearing of vegetation or construction works will occur in these areas, although there is the potential for increased disturbance and degradation as a result of the project at Targinie wetlands.

A maximum of 51.9 hectares of secondary or potentially important habitat will be cleared, but this includes 45 hectares of potentially important roosting habitat that will need to be further assessed during peak season surveys in December 2012 and January 2013.

Preliminary recommendations for mitigation and management include: measures to prevent pollution and run off, particularly from hardstand surfaces in saltpan vegetation, staging and timing of construction to allow maximum available shorebird habitat at any one time and restoration of habitat.

Key information required to finalise this assessment:

- determination of current significance of Clinton ash ponds.
- determination of significance of identified potentially important habitat.

Acknowledgements

Thanks to staff at Coffey Environments, particularly Andrew Jensen for assistance, review and obtaining data for the project. Douglas Howard was extremely helpful in assisting us with OH & S requirements of the project.

Queensland Parks and Wildlife Service, in particular Michael Harte, provided data from the Curtis Coast Management Plan which greatly assisted with identification of habitat and impact assessment.

We would also like to thank the MIPEC team for driving the boat for us around the field sites so efficiently, they were also more than happy to accommodate our "specialised" requirements.

Acronyms

Abbreviation	Description
AOD	area of disturbance
APLNG	Australia Pacific LNG Project
ASS	acid sulfate soils
CAMBA	China – Australia Migratory Bird Agreement
CSG	coal seam gas
Cwlth	Commonwealth
DSEWPaC	Australian Government Department of Sustainability, Environment, Water, Population and Community
DEWHA	Australian Government Department of the Environment, Water, Heritage and the Arts (predecessor to DSEWPaC)
EAA	East Asian – Australasian flyway
EHP	Department of Environment and Heritage Protection (Qld)
EIS	environmental impact statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EVNT	'endangered', 'vulnerable' or 'near threatened' fauna and/or flora as listed under the EPBC Act and NCA
GLNG	Gladstone LNG Project
JAMBA	Japan – Australia Migratory Bird Agreement
LNG	liquefied natural gas
MNES	matters of national environmental significance
MOF	materials offloading facility
MPa	megapascal
Mtpa	million tonnes per annum (or megatonnes per annum)
NCA	*Nature Conservation Act 1992* (Queensland)
QCLNG	Queensland Curtis LNG Project
RE	regional ecosystem refers to the vegetation classification scheme under the VMA
ROKAMBA	Republic of Korea- Australia Migratory Bird Agreement
SDPWO Act	*State Development and Public Works Organisation Act 1972* (Queensland)
SREIS	supplementary report to the environmental impact statement
TWAF	temporary workers accommodation facility (7 & 8 are the two possible locations for this)
VMA	*Vegetation Management Act 1999* (Queensland)

Glossary

AOD	Area of disturbance. This is the area that will be cleared and/or directly disturbed for the construction and operation of this project
Coastal Act	*Coastal Protection and Management Act 1995* (Queensland)
EPBC guidelines	*Significant Impact Guidelines for 36 Migratory Shorebird Species: EPBC Act Policy Statement 3.21*. Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia.
Ramsar	International convention on important wetlands, signed in Ramsar, Iran, Australia is a signatory and these wetlands within Australia are covered under the EPBC Act
Study area	Port Curtis (Figures 1-3)
Survey area	All known and potential shorebird roost and foraging habitat from the southwestern extent of Curtis Island and includes Hamilton Point, Boatshed Point and the area southwest of Ship Hill. On the mainland, the mainland tunnel entry shaft and tunnel spoil disposal area is southeast of Boat Creek and on the coastal side of Gladstone-Mount Larcom Road. (Figure 3)
The project	Arrow Energy Liquefied Natural Gas Plant on Curtis Island
The region	Refers to Port Curtis encompassing the southern end of Curtis Island, extending north to Graham Creek and the lower Narrows, east to Facing Island, and south to Tannum Sands
Important habitat	Defined under the EPBC guidelines for shorebird assessment (DEWHA 2009a&b) (see 7.2 and Appendix 9- important habitat)

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1 Introduction

1.1 Overview

Arrow CSG (Australia) Pty Ltd (Arrow Energy) is investigating the development of a liquefied natural gas (LNG) facility ("the project") on Curtis Island on the central Queensland Coast, near Gladstone. The plant will be supplied with coal seam gas from gas fields in the Surat and Bowen basins via high-pressure gas pipelines to Gladstone, from which a feed gas pipeline will provide gas to the LNG plant on Curtis Island. A tunnel is proposed for the feed gas pipeline crossing of Port Curtis (Figure 1).

Coffey Environments is assisting with the preparation of a supplementary report to the environmental impact statement (SREIS), in response to comments received on the original EIS for the project. Ecosure Pty Ltd (Ecosure) has been engaged to conduct investigations into the impacts of the project on migratory shorebirds within the suitable habitat within the survey area, located within Port Curtis (Figure 1).

This assessment is based on a review of relevant literature and previously collected data and five surveys of potential habitat within the survey area. This interim report is designed to provide information on the literature review, results and analysis of two survey events carried out in August and September 2012 and provides a preliminary impact assessment. A final report will be provided in April 2013, which will include data from all five proposed surveys and any revisions to the impact assessment and recommended mitigation measures.

1.2 Supplementary Report to the Environmental Impact Assessment

An EIS (Coffey 2011) was prepared for the project and released for public exhibition on 16 April 2012. In order to respond to comments raised in public submissions and from the Department of Sustainability, Environment, Water, Population and Community (DSEWPaC), a supplementary report to the EIS (SREIS) is required that will also describe any changes made to the project description and assess the implications of those changes on the impacts of the project.

Key changes have been made to the project's area of disturbance (AOD), which include the following features:

- Layout of LNG plant components and ancillary facilities on Curtis Island;
- Reduction in footprint of mainland tunnel launch site (by approximately 20-30% from the EIS) and access to the site has been revised; and
- Dredging and disposal works - footprint and maximum scenario dredging volumes have increased from previous estimates, particularly relating to dredging for the Boatshed Point access channel and swing basin.

In addition to LNG design changes; this report assesses all potential impacts of the project on migratory and non-migratory shorebirds, on the basis that only a brief assessment of shorebird impacts was carried out as part of the original EIS (Ecosure 2011). Further detail is provided on the impact of the project as a whole on shorebirds and their habitat.

1.3 Aims

The primary aim of the assessment is to detail potential impacts on migratory and residual shorebirds of the proposed Arrow Energy LNG Plant and associated infrastructure. Migratory shorebird species are primarily protected under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act), and therefore this assessment is based on the following guidelines associated with shorebird assessment under this act:

- Significant Impact Guidelines for 36 Migratory Shorebird Species: EPBC Act policy statement 3.21 (DEWHA 2009a); and
- Significant Impact Guidelines for 36 Migratory Shorebird Species: Background paper to EPBC policy statement 3.21 (DEWHA 2009b).

Specifically this report will:

- provide background information on the requirements of migratory shorebirds and their ecology;
- review previously collected data within the study area;
- report on the first two field surveys (of five to be completed);
- assess potential impacts of the project against Commonwealth guidelines (DEWHA 2009a, b & c);
- provide a preliminary evaluation of magnitude of potential impacts; and
- provide mitigation strategies to minimise potential impacts on shorebirds within the AOD.

1.4 Scope

Assessment of the potential impacts of the project on shorebirds was carried out through literature review and field surveys of potential shorebird habitat within the survey area. Literature and publicly available data was used to assess potential impacts on sites outside of the survey area that may be impacted by the proposed LNG plant, including North China Bay.

Field surveys were designed to comply with relevant guidelines (DEWHA 2009a & b) and are being carried out over the 2012/13 winter to autumn period, with five surveys conducted in August, September, December, January and March. This schedule is designed to sample the shorebird population at key stages of their migration, specifically:

- overwintering period (non-breeding birds) (August);
- southward migration (September);
- stable, residual phase (peak season for shorebirds in Australia) (December and January); and

- return northward migration (March).

1.5 Study area, Survey Area and Area of Disturbance

The study area is located adjacent to the town of Gladstone on the Curtis Coast in central Queensland (Figure 1). It includes locations within Port Curtis that are acknowledged in the literature review but may be outside the survey area.

The survey area includes specific locations within Port Curtis where field surveys are being conducted over the 2012/13 winter to autumn period and encompasses the southern end of Curtis Island, extends north to Graham Creek and the lower Narrows, east to Facing Island, and south to Tannum Sands. Field surveys were and will be completed at suitable habitats within this area (Figure 1).

The area of disturbance (AOD) is the area that will be directly cleared or disturbed by the project (Figure 2). The survey area is that area likely to be directly or indirectly impacted by the construction and operation of the site and that is included in detailed shorebird field surveys as part of this study (Figure 2). On the mainland, the tunnel entry shaft and tunnel spoil disposal area, located within the survey area, is southeast of Boat Creek and on the coastal side of Gladstone-Mount Larcom Road (Figure 2).

A number of options have been assessed for potential laydown, vehicle parking / staging and provision for a facility for additional staff accommodation if required. The staff accommodation is referred to as temporary workers accommodation facility (TWAF). There are two sites that could be used for a temporary workers accommodation facility, these being TWAF 8 and Red Rover Rd. TWAF 7 was previously proposed as a TWAF, however, this location is no longer considered for temporary workers accommodation and is only for laydown, vehicle parking / staging

TWAF 8 lies to the west of Targinie State Forest, and launch site 1 is located at the entrance to the Calliope River (Figure 2). Both of these sites are included in the survey area. The survey area extended to the south of the AOD, along the Calliope River (Figure 3). Areas to the west of the LNG plant around North China Bay were excluded since it was not possible to obtain access to the area, however, existing data was available for these locations that enabled the impacts to be assess appropriately (e.g., URS, 2011; review in Rohweder and Charley, 2010).

The study area (Port Curtis) includes a range of land tenures and land uses, including:

- the Gladstone State Development Area (GSDA);
- Targinie State Forest;
- Garden Island Conservation Park;
- large areas of coastal wetlands, marine and intertidal habitat;
- medium to large scale industry (such as refineries) and associated infrastructure (such as conveyor belts and railways);

- freehold and leasehold land, used primarily for grazing of livestock (mostly cattle), small-scale cultivation (mostly mango orchards) and/or rural residential tenements; and
- other tenures such as state land, road reserves and infrastructure easements (such as rail, gas, power).

The study area contains a diverse range of habitats from mudflats and intertidal vegetation, stunted sclerophyllous woodlands, open forest, semi-evergreen vine thicket to disturbed farmland. The two main regulated vegetation communities (termed regional ecosystems, or REs) that are primarily utilised by shorebirds are saltpan vegetation (RE 12.1.2) and mangrove shrubland (RE 12.1.3). Intertidal mudflats are also important for shorebirds and occur throughout the Port Curtis region, but are not classified as REs. Some sites (e.g., Clinton ash ponds) are artificial wetlands that also do not have an RE classification.

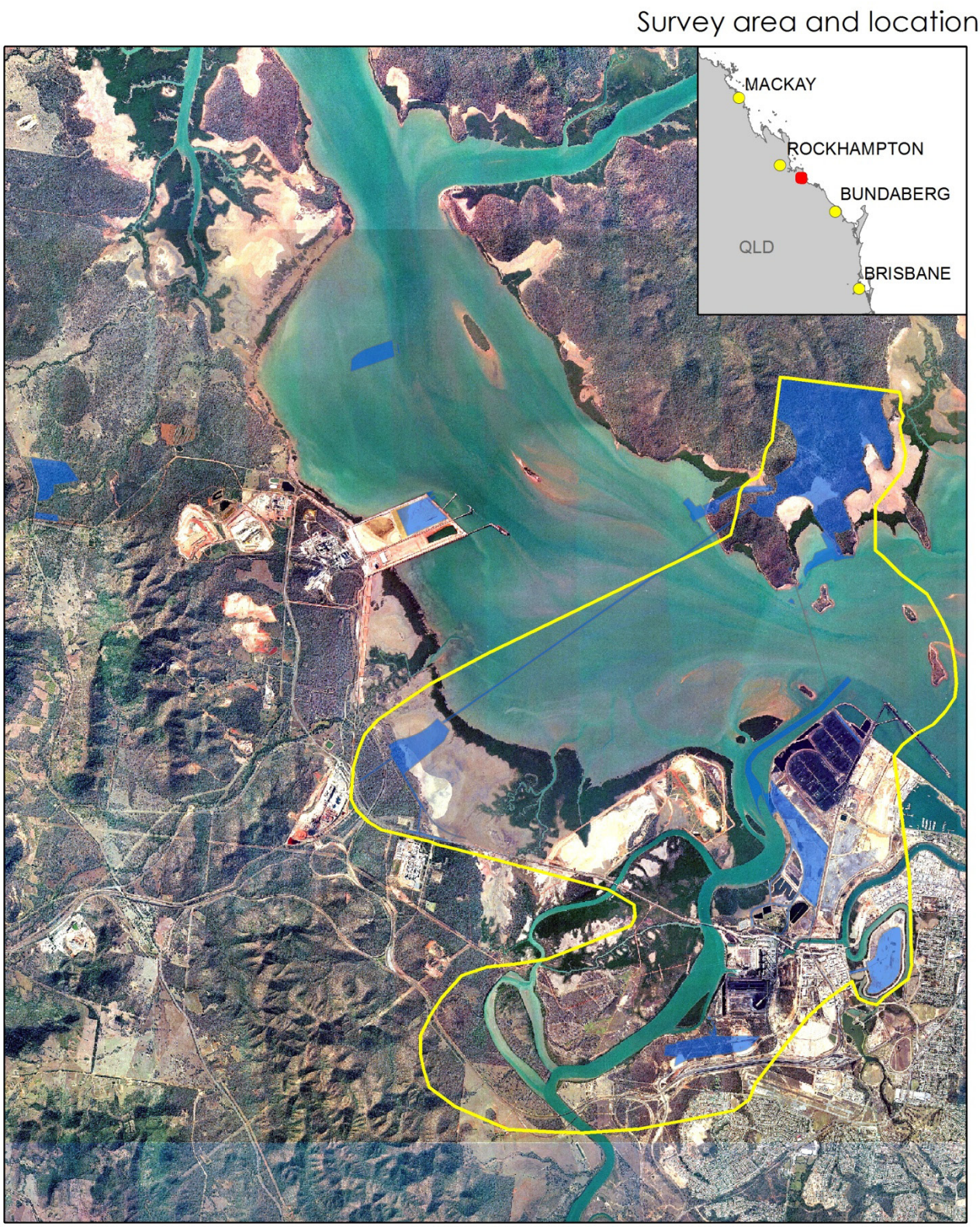

Figure 1 Study area and location

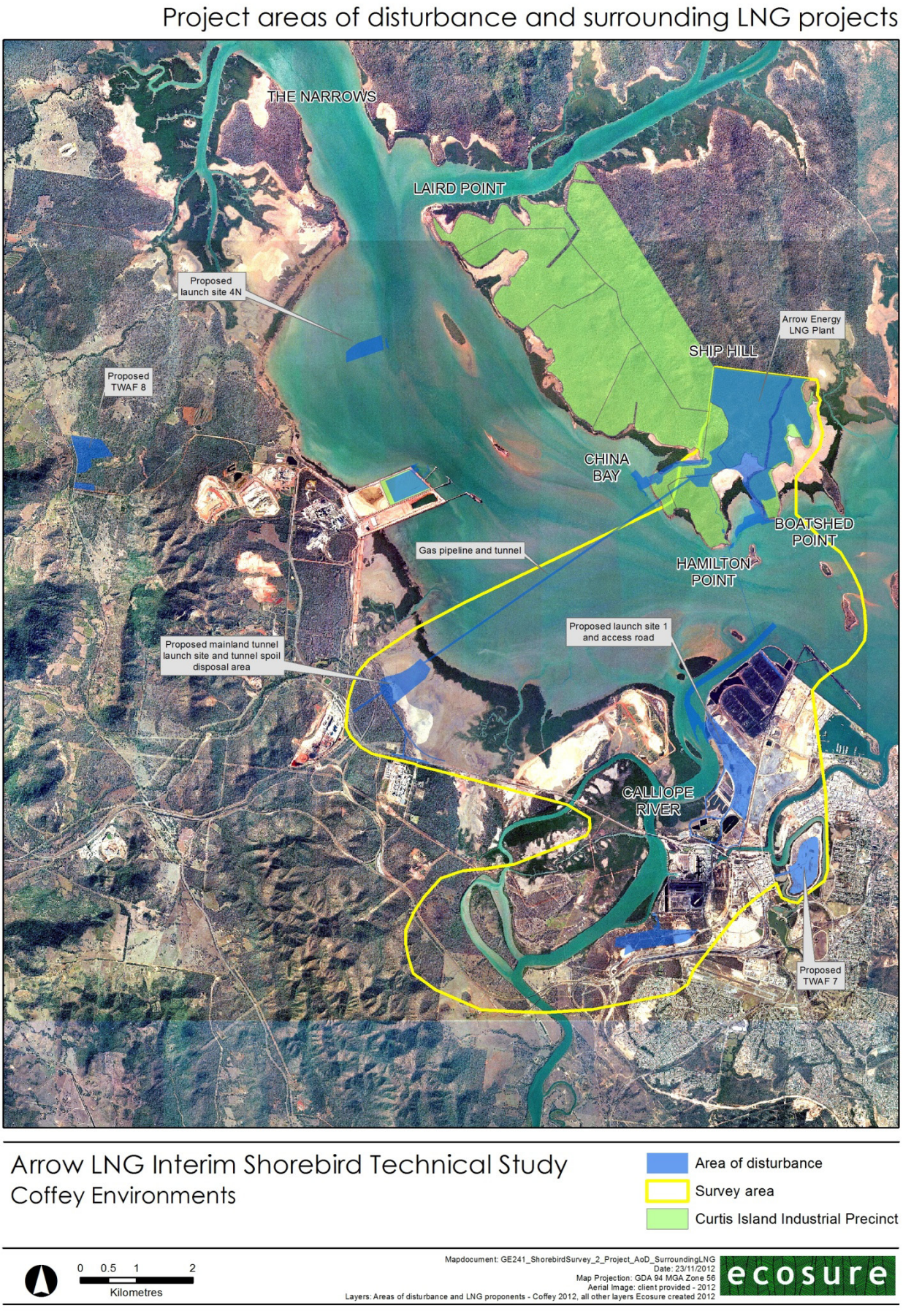

Figure 2 Project areas of disturbance and surrounding LNG projects

Figure 3 Area of disturbance and survey locations

2 Project Description

2.1 Overview

This section provides a description of the Arrow LNG Plant in terms of its key infrastructure components: LNG plant and ancillary facilities (including marine and logistics facilities), the feed gas pipeline and dredging activities. The project description reflects changes made as a result of front end engineering design (FEED) that was completed after finalisation and exhibition of the EIS. The AOD reflecting these changes is shown in Figure 2.

This section is focussed on aspects of the project that may impact on shorebirds and is not designed to be a detailed description of each of the infrastructure components.

2.2 LNG Plant and Ancillary Facilities

The following section provides a summary of the key elements of the LNG plant and ancillary facilities.

2.2.1 LNG Plant

The LNG plant will be developed in two stages, with a total capacity of four LNG trains producing up to 18 million tonnes per annum (Mtpa). Each LNG train will have a nominal capacity of 4 to 4.5 Mtpa. Major infrastructure and components required to develop the project will include LNG trains, LNG storage tanks, LNG loading lines, marine infrastructure, feed gas pipeline and tunnel crossing of Port Curtis, construction camp, a 115 m-high flare stack, power generators, administrative buildings and workshops.

Power for the LNG plant and associated site utilities may be supplied from the electricity grid (mains power), gas turbine generators, or a combination of both. The four power supply options that were assessed as part of the EIS process have been reduced to two options. These are all mechanical (previously known as power island mode) and mechanical / electrical (previously known as partial auxiliary power import mode).

2.2.2 Marine Facilities

Marine facilities will include the LNG jetty, materials offloading facility (MOF), personnel jetty and mainland launch site.

LNG will be transferred from the storage tanks on the LNG plant site to the LNG jetty via above ground LNG loading lines. Loading arms on the LNG jetty will deliver the product to an LNG carrier. The LNG jetty will be located off the northwestern corner of Hamilton Point at the southern end of North China Bay, south of the proposed GLNG jetty.

Delivery of materials to the site on Curtis Island during the construction and operations stages will be facilitated by the MOF, where a combination of roll-on / roll-off or lift-on / lift-off vessels and bulk transportation barges will dock to unload preassembled modules,

equipment, supplies and construction bulks (e.g., aggregate). The preferred MOF (at Boatshed Point) will be connected to the LNG plant site via a heavy vehicle haul road routed along the western coastline of Boatshed Point, entering the LNG plant site at the southern boundary. A quarantine area will be located south of the LNG plant and will be accessed via the northern end of the haul road.

An integrated personnel jetty will be constructed with the MOF at Boatshed Point to transfer workers from the mainland launch site to Curtis Island by fast passenger and roPax ferries. The haul road will be used to transport workers between the personnel jetty to the construction camp and LNG plant site.

On the mainland, the launch site will contain a passenger terminal and a roll-on, roll-off facility. The passenger terminal will include a jetty and transit infrastructure, waiting areas and car parking. The barge or roll-on, roll-off, lift-on, lift-off facility will have a jetty, associated laydown areas, workshops, storage sheds and bulk handling facility. Launch site 1 has increased in size from 13 hectares to 52 hectares allowing for a central laydown point on the mainland.

2.2.3 Workers Accommodation

Construction camps for up to 3,500 people will be constructed as a part of the project. The main accommodation facility will accommodate up to 2,500 workers and will be located on Curtis Island at Boatshed Point. In addition, a temporary workers accommodation facility (TWAF) for up to 1,000 workers may be constructed on the mainland, or a third party accommodation facility used to provide additional accommodation should the construction camp on Curtis Island have insufficient capacity during periods of peak construction. One TWAF location is being considered on the mainland, this being a pastoral property near Targinnie (TWAF 8) that may be used for accommodation or laydown. The former Gladstone Power Station ash pond (TWAF 7) is unlikely to be used for accommodation, but may be used for laydown or staging.

2.2.4 Laydown and Staging

Arrow Energy has identified a site on Red Rover Road, west of Gladstone Power Station, as suitable for a staging and laydown area for the early works phase of construction, and as a backup facility for the mainland launch site. The facility would accommodate car and bus parking, warehouses, laydown areas and potentially a temporary accommodation facility. Establishment of the facility would enable personnel transfers to the mainland launch site, and bulk materials launch site, which would reduce the need or amount of parking at Gladstone Marina or the bulk materials launch site.

2.2.5 Construction Schedule

The plant will be constructed in two stages.

Stage 1 will involve construction and operation of the first two LNG trains (trains 1 and 2), associated utilities and ancillary facilities. Site preparation during stage 1 will include development of cut benches for all four LNG trains.

LNG trains 3 and 4 will be constructed in stage 2, bringing the LNG plant to a total capacity of up to 18 Mtpa. First LNG from train 1 is planned for 2017, with train 2 commencing operations approximately 6 to 12 months later. Market conditions will determine the timing of the construction of stage 2, with a similar offset expected between trains 3 and 4 commencing operations.

2.2.6 Construction Method

The LNG plant will generally be constructed using a modular construction method, with preassembled modules being transported to Curtis Island from an offshore fabrication facility. There will also be a substantial amount of infrastructure stick-built or constructed on site such as LNG storage tanks, buildings, underground cabling, piping and foundations. Where practical, aggregate and all fill material for civil works will be sourced from suitable material excavated and crushed on site as part of the bulk earthworks. Aggregate and structural fill may also be sourced from mainland quarries and transported from the mainland launch site to the LNG plant site by roll-on / roll-off vessels or barges if sufficient quantities cannot be sourced from the site. Concrete production facilities (i.e., batching plants) will be established on the site.

2.2.7 Wastewater

Stormwater and surface water from the LNG plant and associated facilities will generate various kinds of wastewater that will be treated as necessary at an effluent plant / controlled discharge facility prior to discharge to Port Curtis or for re-use in amenities or irrigation. Wastewater comprising sewage and trade waste will be discharged to the Gladstone Regional Council's sewer mains on Curtis Island and returned to the mainland for treatment.

2.3 Feed Gas Pipeline

A high-pressure feed gas pipeline will supply gas to the LNG plant from its connection to the Arrow Surat Pipeline on the mainland, near Rio Tinto's Yarwun alumina refinery. The feed gas pipeline will be constructed in three sections:

- A short length of feed gas pipeline will run from the proposed Arrow Surat Pipeline to the tunnel launch shaft, which will be located on a mudflat south of Fishermans Landing, just south of Boat Creek. This section of pipeline will be constructed using conventional trenching methods within construction right of way of approximately 40 m.
- The second section of the feed gas pipeline will traverse Port Curtis in the Arrow Gladstone Harbour Tunnel (also known as The Curtis Island Link) to be bored under the harbour from the launch shaft on the mainland to a receival shaft on Hamilton Point. The tunnel under Port Curtis will have an excavated diameter of up to approximately 6 m, and will be constructed by a tunnel boring machine that will begin work at the mainland launch shaft. Tunnel spoil material will be processed through a de-sanding plant to remove bentonite and water. The spoil will comprise mainly a finely graded fill material, which will be deposited in a spoil placement area established adjacent to the launch shaft.

- From the tunnel reception shaft on Hamilton Point, the third section of the feed gas pipeline will cross the LNG loading lines to run up the western side of the proposed LNG plant to the gas inlet station, which is located west of trains 1 and 2. This section will be constructed using conventional trenching methods within an approximately 40 m wide construction right of way.

Power will be generated for site operations using gas turbine generators. Auxiliary electrical power for both construction and operations will be imported to the Arrow LNG Plant site. A permanent electrical connection will be established to Gladstone North Substation on the mainland via ducts installed by separate horizontal directional drilling (HDD) under Port Curtis to the southern end of Hamilton Point.

2.4 Dredging

Construction and operation of the Arrow LNG Plant will require dredging to provide (and maintain) shipping access to marine infrastructure sites on Curtis Island and the mainland. These sites are additional to the much larger dredging program required to improve shipping access within Port Curtis, particularly to facilitate access to the proposed LNG projects.

Five potential dredge sites were identified for the EIS by Arrow Energy. For the purposes of the SREIS, four of these five options have been investigated further, although only three sites will be required for the project. The sites include dredging in areas to provide access to launch sites 1 or 4N, to the LNG jetty, and to the MOF location at Boatshed Point. Maintenance dredging may be required in the Calliope River to provide access to launch site 1 and at the MOF and passenger jetty on Curtis Island.

The preferred option is to place dredge spoil in a combination of existing, approved disposal areas and facilities, in consultation with Gladstone Ports Corporation. Options presently under discussion include the disposal of:

- Boatshed Point MOF and passenger jetty dredge spoil to the East Banks Sea Disposal Site.
- LNG jetty dredge spoil to East Banks Sea Disposal Site or the Western Basin Reclamation Area
- Launch sites 1 and 4N dredge spoil to Wiggins Island Coal Terminal dredge placement facility.

3 Legislative Context

3.1 Overview

The primary legislation relevant to the protection of migratory shorebirds in Australia is the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) that lists migratory shorebirds as matters of national environmental significance (MNES). This Act is administered by DSEWPaC (formerly Department of Environment, Water, Heritage and the Arts (DEWHA)).

A number of the 36 migratory species identified are also listed under the EPBC Act or state *Nature Conservation Act 1992* (Qld) (NCA) as threatened. Habitat for shorebirds is protected under the NCA, *Vegetation Management Act 1999* (Qld) (VMA) and/or the *Coastal Protection and Management Act 1995* (Qld) (Coastal Act).

The EIS was prepared under the *State Development and Public Works Organisation Act 1972* (Qld) (SDPWO Act), administered by the Coordinator-General. Impacts to shorebirds listed under the EPBC Act are assessed as part of a controlled action assessed under a Bilateral Agreement between the Australian and Queensland Governments (see Chapter 2 of EIS for more information on project approvals).

3.2 EPBC Act (Commonwealth)

3.2.1 Matters of National Environmental Significance

The EPBC Act provides for the protection of the environment, especially matters of national environmental significance (MNES). There are ten MNES listed, the following four MNES have been identified as potentially impacted by the project and have been assessed in Attachment 4 of the EIS (Coffey Environments, 2011).

- World Heritage properties;
- National Heritage places;
- Listed migratory species; and
- Listed threatened species and communities

The occurrence of all four of these MNES has been examined in detail in Attachment 4 of the EIS (Coffey Environments, 2011). The last two (listed migratory species and listed threatened species and communities) are relevant to this report and are discussed in detail in this section. The Port Curtis area is part of the Great Barrier Reef Marine Park World Heritage Area but is not listed as a wetland of international importance under the RAMSAR convention (See Ecosure, 2011 for further details).

3.2.2 Listed Migratory Shorebird Species

Migratory shorebird species are listed under Section 209 of the EPBC Act and consist of:

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

The international treaties that each of migratory species is listed under is shown in Appendix 3.

Resident shorebirds listed as EVNT under state legislation (NCA) or the EPBC Act are also included in the assessment for this report (Section 4.7 has details). Their occurrence is also taken into account in determining important habitat under EPBC guidelines (See section 4.4 for further details).

3.2.3 Listed Threatened Species and Communities

As well as being listed under the above agreements, one of the migratory species is also listed as vulnerable under the EPBC Act – the Australian painted snipe (*Rostratula australis*). Once a species is listed as vulnerable, endangered or critically endangered under the EPBC Act, its recovery is promoted using conservation advice, recovery plans, and assessment and approval provisions under this act. This confers greater individual protection for this species than the provisions for migratory shorebirds.

3.2.4 Impact Assessment under the EPBC Act

Any action likely to impact on MNES must be assessed under Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (DEWHA, 2009c) which provides an assessment process for determining if the action is likely to require a referral to DSEWPaC. A referral for the project as a whole was presented to DSEWPaC, and this shorebird assessment will provide further information to assist in its assessment of the project.

To assist in determining the impacts of proposed actions on migratory shorebirds, Significant Impact Guidelines for 36 Migratory Shorebird Species (EPBC Act policy statement 3.21 (DEWHA, 2009a) and supporting background paper (DEWHA, 2009b) were developed. These documents provide a consistent approach to determining the impacts of proposed actions on migratory shorebird species and provide mitigation strategies to reduce the level or extent of those impacts. They are also designed to promote ecologically sustainable development that allows for the continued ecological functioning of important habitat for migratory shorebirds.

3.2.5 Wildlife Conservation Plan for Migratory Shorebirds

A wildlife conservation plan sets out the research and management actions required to support the survival of one or more migratory, marine, conservation-dependent or

cetacean species listed under the EPBC Act, which are not considered endangered or vulnerable, but would benefit from a national approach to their conservation. The 36 migratory shorebirds listed under the EPBC Act are covered under the Wildlife Conservation Plan for Migratory Shorebirds (DEH, 2006).

The key objectives of this plan are to:

- increase international cooperation for migratory shorebirds and ensure countries of the East Asian – Australasian flyway (EAA flyway) work together;
- identify, protect and manage a network of important habitat for migratory species, to maintain population viability;
- increase knowledge of shorebirds, their populations, habitats and threats in Australia to better inform management and support long term survival; and
- raise awareness of shorebirds and the importance of conserving them and increase engagement of decision makers and the community.

Actions relevant to this project designed to achieve these objectives include:

- agree and adopt criteria for identification of sites of national and regional importance;
- include migratory shorebirds and their habitat in environment protection arrangements at local, state and national level to avoid significant impacts on migratory shorebird populations;
- identify gaps in knowledge required for management of migratory shorebirds, their habitats and threats in Australia;
- prioritise and support research on migratory shorebirds, their population and conservation status, habitats and threats to address knowledge gaps;
- encourage ongoing population monitoring programs for species covered by this plan; and
- prepare supplementary administrative guidelines on significance for migratory shorebirds to assist with EPBC Act referrals and determining whether an action has, will have, or is likely to have a significant impact on migratory shorebirds (DEH 2006) (see Section 3.2.4).

3.3 Vegetation Management Act 1999 (Queensland)

The purpose of the Vegetation Management Act (VMA) is to regulate the clearing of native vegetation through the classification and protection of regional ecosystems (REs). REs are classified as endangered, of concern and not of concern. This state-wide mapping system ensures consistent nomenclature and provides a source of information on the remnant and high value regrowth vegetation in most areas. From this mapping, essential habitat for 'endangered', 'vulnerable' or 'near threatened' species (EVNT) listed under the NCA can also be derived.

3.4 Nature Conservation Act 1992 (Queensland)

The NCA is Queensland's principal piece of legislation for the protection of native flora and fauna and is administered by the Department of Environment and Heritage Protection (EHP). The object of the NCA is the conservation of nature and this is achieved by three key components of the Act:

- creating and managing protected areas;
- managing and protecting native wildlife; and
- managing the spread of non-native wildlife.

Protected wildlife includes every native plant and all vertebrate and some invertebrate animal species found in Queensland and is further divided into the following categories:

- extinct in the wild;
- endangered;
- vulnerable;
- near-threatened; and
- least concern.

EVNT species are listed with 'extinct in the wild' and 'least concern' species under the *Nature Conservation (Wildlife) Regulation 2006*. Essential habitat for EVNT species can be declared and is linked to the VMA and associated RE mapping.

Four shorebird species that occur or may occur within the study area are listed as EVNT under the NCA. They are:

- Australian painted snipe (*Rostratula australis*) – vulnerable (listed as a migratory species under the EPBC Act);
- eastern curlew (*Numenius madagascariensis)* - near threatened (listed as migratory under the EPBC Act);
- sooty oystercatcher (*Haematopus fuliginosus*) – near threatened; and
- beach stone-curlew (*Esacus magnirostris*) – vulnerable.

3.5 Coastal Protection and Management Act 1995 (Queensland) (Coastal Act)

The *Coastal Protection and Management Act 1995* (Qld) (Coastal Act) recognises the diverse range of coastal resources and values in the coastal zone and provides a comprehensive framework for their coordinated management.

Until recently, the Queensland Coastal Plan, comprising the State Policy for Coastal Management and State Planning Policy 3/11: Coastal Protection (SPP 3/11), provided the framework for protection of the Queensland coastal zone. On 8th October 2012, SPP 3/11

was repealed, replaced in the interim with the draft Coastal Protection State Planning Regulatory Provision. This regulatory provision applies to all local government areas in Queensland that contain a coastal zone. It contains requirements for protecting areas of high ecological value, reducing the impacts of coastal hazards, requirements of development in erosion prone area and other considerations for coastal areas.

4 Methods

4.1 Overview

The shorebird technical study consisted of a literature review, five field surveys and two reports (interim and final) (Table 1).

Table 1 Overview of tasks for this shorebird technical study.

Task	**Dates**	**Purpose/Output**
Literature review	August-October 2012	Inform surveys and impact assessment
Field surveys – 1st round	17 &18 August 2012	Overwintering individuals (usually juveniles)
Field surveys – 2nd round	20-22 September 2012	Southward migration
Interim report	November 2012	Outlining preliminary findings from the winter and spring counts, literature review and preliminary impact assessment(for input into SEIS)
Field surveys – 3rd round	December 2012	Survey during stable, residual phase (neap tide)
Field surveys – 4th round	January 2013	Survey during stable, residual phase (spring tide)
Field surveys – 5th round	March 2013	Survey during return northward migration
Final report	April 2013	Validate interim report findings, based on field surveys 3-5

4.2 Literature Review

4.2.1 EPBC Guidelines

Guidelines for the assessment of impacts on shorebirds under the EPBC Act were used to determine important habitat and to guide impact assessment for this study. The guidelines are:

- Significant Impact Guidelines for 36 Migratory Shorebird Species: EPBC Act policy statement 3.21 (DEWHA, 2009c); and
- Significant Impact Guidelines for 36 Migratory Shorebird Species: Background paper to EPBC policy statement 3.21 (DEWHA, 2009b).

4.2.2 Previous Data

Four raw data sources were consulted in the development of this report (Table 2).

Table 2 Data sources for this report.

Data Source	Date(s)	Administering Authority	Description
EPBC Protected Matters Search Tool	Obtained September 2012	DSEWPaC	The EPBC Protected Matters Search Tool provides a report on MNES significance that may occur within a designated area. Information is gathered from a range of data sources and may be projected from instruments such as recovery plans, state vegetation maps, remote sensing imagery and other sources.
Shorebird 2020 data for Port Curtis	Data range 2000-2010, obtained August 2012	Queensland Wader Study Group (QWSG)	This data comprises the most complete shorebird counts available in Australia. The data have been collected by volunteer counters and BirdLife Australia staff for approximately 150 roosting and feeding sites, mainly in coastal Australia.
Queensland Museum Collection database	August 2012	Queensland Museum	The database shows the collection location of fauna specimens in the museum collection.
Birdlife Australia Atlas GIS database	Obtained September 2012	Birdlife Australia	The Atlas database stores data from more than 420,000 bird surveys conducted by volunteers throughout Australia. The precise location of bird surveys is recorded, allowing data to be extracted for specific areas.

4.2.3 Previous Reports

The following recent reports for the Port Curtis region were reviewed as part of the preparation of this report:

- *Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations, Gladstone LNG Plant and Pipeline Curtis Island* – BAAM, (2009);
- *Gladstone Ports Corporation Migratory Shorebird Monitoring* – Surveys 1 and 2, Year 2 (Jan/Feb 2012) – Rohweder *et. al.,* (2012a);
- Gladstone Ports Corporation Migratory Shorebird Monitoring – Surveys 3, Year 2, March 2012 – Rohweder *et. al.,* (2012b);
- *Report for Migratory Shorebird Monitoring Port Curtis to Port Alma, Survey One: January* 2011– GHD, (2011a);
- *Report for Migratory Shorebird Monitoring Port Curtis to Port Alma, Survey Two* March 2011– GHD, (2011b);
- *Report for Migratory Shorebird Monitoring Port Curtis to Port Alma, Survey Three: March 2011* – GHD, (2011c);
- *Report for Migratory Shorebird Monitoring Port Curtis to Port Alma, Survey Four: November 2011* – GHD, (2011d);
- *Supplementary Survey for Powerful Owl and Migratory Shorebirds – QGC LNG Facility, Curtis Island – Rohweder and Charley*, (2008);
- *GLNG Curtis Island Marine Facilities Migratory Shorebirds Environmental Management Plan* – URS, (2011);
- *Queensland Curtis LNG Project, Gladstone. Narrows Pipeline Crossing: review of regional shorebird data and discussion of impacts* – Rohweder and Charley, (2010);

and

- *Port Curtis Shorebird Survey and Mitigation Measures for the Narrows Pipeline Crossing (draft)* – Rohweder *et. al.,* (2011).

Scientific, standard textbooks on shorebird requirements and "grey' literature were also reviewed.

Nomenclature generally followed Christidis and Boles (2008).

4.3 Field Surveys

4.3.1 Survey Conditions

Surveys were conducted during fine and mild weather in late winter and early spring. Maximum temperatures ranged from just over 20•ºC, to 25ºC while minimums were mild and ranged from just above 15ºC to 21ºC. There was no rainfall during either of the surveys (Table 3).

Table 3 Climate data (BOM, 2012) for field surveys.

Survey dates (2012)	**Wind (0900, 1500)**	**Rainfall (mm)**	**Minimum temperature (ºC)**	**Maximum temperature (ºC)**
Aug 17	WNW 6 km/hr, N 11km/hr	0.00	16.7	20.6
Aug 18	NNW 9 km/hr, N 20 km/hr	0.00	15.4	20.3
Sept 20	Calm	0.00	19.4	25.1
Sept 21	N 17 km/hr, NNE 17 km/hr	0.00	20.9	22.8
Sept 22	NNW 17 km/hr, N 26 km/hr	0.00	21.0	22.6

Note: Climate data from the closest weather station- Rundle Island, 16.3 km from Curtis Island. Rainfall data recorded at Southend, Curtis Island.

4.3.2 Tides

Surveys were timed to correspond to medium level tide heights (Table 4) to facilitate access to sites and optimise ability to count birds within the survey area; with high tides during survey times around 3.5 m and low tides from approximately 0.5-1.2 m. Spring and neap tides are scheduled for peak season in December/January to have the best chance of sampling the population at its peak.

Table 4 Tide data (MSQ 2012) (Bold denotes high tide, italics denotes low tide).

Survey period	**Survey dates (2012)**	**Time**	**Height (m)**	**Time**	**Height (m)**	**Time**	**Height (m)**
Overwintering	Aug 17	0857	**3.51**	1456	*0.55*	2111	**4.23**
	Aug 18	0933	**3.63**	1536	*0.48*	2146	**4.24**
Southward migration	Sept 20	0534	*0.65*	1201	**3.87**	1820	*0.96*
	Sept 21	0619	*0.92*	1300	**3.69**	1924	*1.21*
	Sept 22	0721	*1.17*	1414	**3.56**	2048	*1.32*

4.3.3 Habitats Surveyed

Surveys were carried out to coincide with appropriate tides depending on the type of habitat surveyed (Table 5). Most of the sites were either roosting or foraging habitat but Clinton ash ponds (Sites 5 & 6) have foraging habitat on the banks of the river and roosting habitat in an artificial wetland landward of this area. These areas were surveyed during both low and high tides.

Table 5 Details on survey time, dates and tides (See Appendix 1, 4 & 5 for more information).

Month of Survey (2012)	Date	Time	Survey site	Tide	Type of site (roosting or foraging)	Habitat
August	17th	8:00 – 8:30	1	High falling	Roosting	Claypan
August	18th	8:17 – 8:30				
September	21st	14:00-15:00				
August	18th	8:45 – 8:55	2	High falling	Roosting	Rocky beach and mudflats.
August	18th	15:34 – 15:38		Low rising	Foraging	
September	21st	5:25 – 5:35				
August	17th	8:30 – 9:15	3	High	Roosting	Rocky point and stony beach, narrow band of mudflat. Mangrove at back.
August	18th	8:30 – 8:45		High falling		
August	18th	15:32 – 15:34		Low	Foraging	
August	18th	8:55 – 9:10	4	High falling	Foraging	Rocky beach.
August	18th	15:10 – 15:20		Low falling		
September	21st	6:05 – 6:15		Low falling		
August	17th	9:15 – 9:30	5	High falling	Roosting	Rocky bank, with ponds behind.
August	18th	9:17 – 9:25		High		
August	18th	9:53 – 10:50		High falling		
	22nd	12:15 – 12:35		High		
August	18th	16:52 – 17:00		Low rising	Foraging/Roosting	
September	21st	6:20 – 6:35			Foraging	
September	21st	11:13 – 11:25		High falling		
September	21st	12:15 – 12:30			Foraging/Roosting	
September	22nd	8:20 – 8:30		Low rising		
August	17th	9:30 – 9:45	6	High falling	Roosting	Mudflat on river side, with ponds at rear.

Month of Survey (2012)	Date	Time	Survey site	Tide	Type of site (roosting or foraging)	Habitat
August	18th	9:25 – 9:40		High		
September	21st	6:35 – 6:45		Low rising	Foraging	
September	21st	12:00 – 12:15		High falling	Roosting	
September	22nd	8:30 – 8:45		Low rising	Foraging	
September	22nd	12:35 – 12:45		High	Roosting	
September	22nd	13:10 – 1400		High		
August	17th	9:45 – 11:30	7	High falling	Roosting	Mudflat with sparse mangrove.
August	18th	9:40 – 9:53				
September	21st	6:45 – 7:00		Low rising		
August	18th	9:10 – 9:17	8	High	Foraging	Rocky shoreline. High level of disturbance
August	18th	14:30 – 14:47		Low		
August	18th	16:30 – 16:50		Low rising		
September	21st	7:00 – 7:30				
August	17th	11:30 – 12:00	9	High falling	Roosting	Claypan.
August	18th	10:50 – 11:30				
September	20th	15:30 - 16:30				
August	18th	15:00 – 15:10	10	Low	Foraging	Rocky shoreline and oyster beds
September	21st	5:45 – 5:55				
September	22nd	7:20 – 7:30		Low rising		
August	18th	15:20 – 15:32	11	Low	Foraging/Roosting	Mudflats and mangrove
August	18th	15:40 – 16:30		Low rising		
September	21st	5:55 – 6:05		Low		
August	18th	14:47 – 14:50	12	Low	Foraging	Rocky beach and mudflat.
August	18th	16:50 – 16:52		Low rising		
September	21st	6:15 – 6:20		Low		
September	22nd	8:00 – 8:10		Low rising		
September	21st	11:40 – 12:00	14	High	Foraging/Roosting	Mangrove island surrounded by shallow water
August	18th	14:50 – 15:00	15	Low	Foraging	Mudflat and mangrove.
August	18th	15:38 – 15:40				
September	21st	5:35 –				

Month of Survey (2012)	Date	Time	Survey site	Tide	Type of site (roosting or foraging)	Habitat
		5:45				
September	22nd	7:30 – 8:00		Low rising		
September	22nd	8:10 – 8:20	16	Low rising	Foraging	Mudflat and mangrove.
September	21st	11:25 – 11:40	17	High	Foraging	Mudflat and mangrove.
September	22nd	8:45 – 9:15		Low rising		
September	22nd	12:45 – 13:10		High		
September	22nd	9:15 – 9:30	20 & 21	Low rising	Foraging	Sandy beach and small island

4.3.4 Survey Method

Overview

Surveys covered the area from the mainland, to Boatshed Point and surrounds on Curtis Island and along the Calliope River to the oxbow. This extended beyond the AOD, upstream along the Calliope River but did not cover areas around proposed launch site 4N and North China Bay due to access restrictions. Previously collected data was reviewed for those areas which have been recently surveyed as part of previous studies.

Surveys were conducted two hours either side of both low and high tides, with most sites accessed by boat. Surveys during low tide generally identified foraging sites and birds, while surveys on and around high tide were for roosting birds (Appendices 4 & 5).

The survey team consisting of an ornithologist and a senior ecologist collected data 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 (Appendix 7). This included:

- date;
- weather;
- time of survey;
- observers;
- GPS location (if not previously recorded);
- site number;
- shorebird behaviour (roosting or foraging);
- stage of tide (i.e., high, high rising, high falling etc);
- wind direction;
- wind speed;
- disturbance (threats and human activities);
- number of each shorebird species; and

- additional avifauna observations.

Navigation around sites was carried out using a hand held Trimble GPS with the aerial data and survey sites loaded as a map onto it. Survey sites and habitat was verified in the field by taking a GPS location and a written description of the habitat within that area.

Low Tide Counts

Foraging habitat was surveyed within two hours of low tide (Table 4) by boat only, since it was often difficult to get to shore and access on foot would have flushed birds from foraging. The boat was brought as close to the foraging habitat as possible, without disturbing birds.

The boat was then stopped or moved slowly along while birds were identified and counted. Identification and counting was undertaken using binoculars and/or a spotting scope set up on a tripod (the scope was only used if the boat was stopped and a member of the team could set the scope up on the ground adjacent to the boat). Each site surveyed for 5-30 minutes, depending on size of area and number of birds located. Habitat was described for each site.

High Tide Roosting Counts

Potential roosting sites were primarily accessed by foot, although mangrove sites were surveyed by boat (Table 6). Sites 5 & 6 which included both foraging and roosting habitat were surveyed from the boat and via walking surveys.

Most potential roosting habitat was surveyed by foot within two hours either side of high tide by approaching birds quietly and the use of a spotter scope (20-60 mm zoom) to count roosting individuals. Care was taken to avoid flushing birds, where this occurred observers stopped moving and allowed birds to resettle. If birds moved away from the site, they were tracked to prevent double counting of birds in subsequent roosting sites. Sites were surveyed for 15-45 minutes depending on birds found and/or habitat complexity.

Abundance of birds was estimated by taking the maximum count at each site (sites were usually surveyed twice in a survey period) and summing these counts together.

Table 6 Summary of methods for each site in August and September.
(site numbers are shown in Figure 3)

Access	**August survey sites**	**September survey sites**
Boat	2, 4, 5 & 6 front (area adjacent to river) 7, 8, 10, 11, 12, 15	2, 4, 5 & 6 front (area adjacent to river) 7, 8, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21
Walk in (either after accessing by boat or by car)	1, 3, back of 5 & 6, 9	1, 3, back of 5 & 6, 9,13
Foraging survey effort	6 hours	5.5 hours
Roosting survey effort	15 hours	20 hours

4.4 Impact Assessment

Overview

Impact assessment is used to identify the potential threat that activities pose to the ecological values of an area, or a particular group of organisms (such as shorebirds). The method used to assess the impacts of this project on shorebirds within the AOD is based on the method used for the EIS (Coffey Environments, 2011), but has been adapted for use in determining impact on shorebirds. For assessment of impact of shorebirds, determination of the importance of habitat to be impacted is key, and magnitude of impact on this habitat is based on the duration and severity of the potential impact.

4.4.1 Habitat within the Survey Area

Important Habitat

Assessment under EPBC guidelines (DEWHA, 2009a) requires the determination of "Important habitat" for migratory shorebirds. 'Important' habitat consists of internationally and nationally important sites, determined by DSEWPaC (DEWHA, 2009a) (Table 7).

Important shorebird habitat can be either roosting or foraging habitat and can be important for one or more species.

Habitat was classified based on data from the literature review and/or field surveys. Where there was insufficient previous data to determine its status, and where habitat structure and extent indicated it was possible it may support sufficient numbers and/or diversity of shorebirds to meet importance criteria, habitat was deemed to be "potentially important" (or 'potential habitat'). Impacts on this habitat, using EPBC guidelines (DEWHA, 2009b) was then undertaken (Section 4.3.3 Impact Assessment).

Table 7 Summary of criteria for determining important habitat under EPBC guidelines. (explained fully in Appendix 9)

Geographic scale	**Source**	**Criteria**
International	Ramsar Convention on Wetlands	· 1% of individuals of one species or subspecies of waterbird; or · total abundance of at least 20,000 shorebirds
	Bamford *et. al.*, 2008	· identified staging area as new criterion; 0.25% of a population is required for the site to be listed as internationally important
National	DEWHA (2009a) (Appendix 9)	· at least 0.1% of the EAA flyway population of a single species; or · at least 2000 migratory shorebirds; or · at least 15 species of shorebird
See Rohweder *et. al.,* (2011) for further assessment of the Port Curtis area for state or regional importance.		

Secondary Habitat

Habitats where migratory bird species were detected, but where numbers were not sufficient to be considered as 'important' under EPBC criteria were classed as:

- Secondary foraging habitat – migratory bird species were recorded foraging during August and September field surveys and habitat values were consistent with appropriate habitat for foraging by shorebirds but numbers were low and unlikely to meet criteria as important habitat, even during peak season surveys.
- Potential foraging and/or roosting habitat – no birds were recorded in these areas, however characteristics suggest there is potential for the birds to use this area after rainfall or during very high summer tides as either roosting or foraging habitat, it is possible this area could meet criteria for important habitat.
- Potentially important foraging habitat was identified from the literature review and spatial data obtained from QPWS, (2002). This data was termed 'major shorebird feed sites' however there was not enough recent survey information to confirm its status as important foraging habitat according to criteria by EPBC guidelines (Table 7); this will be determined during further survey work.
- Potentially important roosting habitat – this area was behind the intertidal area, in claypans surrounded by woodland and mangrove vegetation. Claypan habitat in the Port Curtis area has been shown to support large numbers of birds after rain (Rohweder and Charley, 2009). It was observed to be very dry, however, it is possible it supports roosting migratory birds after rain or at very high tides, which will be determined through peak season surveys.

4.4.2 Magnitude of Impact

Factors in Determining a Significant Impact

As well as defining nationally important habitat for migratory shorebirds, DSEWPaC (DEWHA, 2009b) also provides guidance on assessment of this habitat to determine if an activity will have a 'significant' impact. For this assessment, these factors are combined to determine the "magnitude" of the impact on habitat within the area and are combined with an analysis of the habitat's sensitivity to arrive at a significance of impact evaluation There are four factors to take into consideration for this magnitude assessment:

Habitat Loss

Loss of sites that support large numbers of migratory shorebirds can cause disproportionate declines in shorebirds as displaced birds may be unable to find suitable replacement habitat. Habitat loss can be through direct clearing, inundation, infilling or draining or indirectly by changes to hydrology or changes in environmental conditions (such as increased cover across important sites) (DEWHA, 2009a).

Habitat Degradation

Shorebirds are sensitive to subtle changes to their habitat, and can be displaced by loss of nearby habitat that may impact on the provision of organic matter to support invertebrate prey, invasion of intertidal mudflats by weeds such as cord grass (*Spartina sp.)* (DEWHA, 2009a).

Disturbance

Disturbance is becoming an increasingly important conservation issue for migratory shorebirds. Certain activities may interrupt their limited foraging periods, or disturb them during roosting when they are conserving energy for migration. Disturbance can result from residential and recreational activities (e.g., four wheel drives, wind or kite surfing, noise and night lighting). Larger shorebirds (e.g., whimbrels and eastern curlews), which dominate the Port Curtis area, are generally more sensitive to disturbance than smaller shorebirds (e.g., stints) (Rohweder *et. al.,* 2011) (Section 4.5). All shorebirds are more sensitive to discrete and unpredictable disturbances such as sudden noises (e.g., from demolition activities) and also from objects that approach them from water (e.g., boats) (DEWHA, 2009a).

Direct Mortality

Mortality of shorebirds can occur from a variety of activities such as bird strike from wind farms, aeroplanes and chemical or oil spills and during construction activities. Risk of strike by boats is unknown.

The above represents a departure from the determination magnitude of an impact within the EIS where geographical extent, duration and severity are used. These factors are covered within habitat loss, habitat degradation, disturbance and direct mortality which are more applicable to shorebird habitat and have been determined within EPBC guidelines (DEWHA, 2009a).

4.4.3 Sensitivity of habitat

Sensitivity of shorebird habitat was based on a simplified version of the attribute scoring system in Ecosure, (2011). Ecosure determined five criteria as a basis for determining sensitivity of all ecological values for the ecological assessment. These were:

- conservation status;
- intactness;
- uniqueness (or rarity);

- degree of non-resilience to change; and
- degree of difficulty in replacing.

For assessment of sensitivity of shorebird habitat conservation status, uniqueness, degree of non-resilience to change and degree of difficulty in replacing were used. Attributes for intactness were covered in determining the importance of the habitat (Section 4.4.1).

Each value and each attribute was scored (negligible, low, medium, high, very high) to determine an overall sensitivity score.

Conservation Status

Conservation status was based on designation of habitat under EPBC guidelines (See Table 8 Conservation status determination for details).

Table 8 Conservation status determination.

Conservation Status	Habitat Value (Table 7)
Very High (VH)	· internationally important shorebird habitat for one or more species of migratory shorebird
High (H)	· nationally important shorebird for one or more species of migratory shorebird
Medium (M)	· potential foraging or roosting habitat for shorebirds
Low (L)	· secondary habitat (see section 4.4.1)
Very Low (VL)	· non-remnant vegetation

Uniqueness (or rarity)

This is an assessment of the occurrence, abundance and distribution of the habitat within and beyond its reference area (e.g., bioregion/biosphere). A value would be considered to have a very high uniqueness where it is the only known example of that value within the Gladstone region. A value would have a very low uniqueness where it is considered common within the Gladstone region.

Non resilience to change

An ecological value is deemed less sensitive where it has a higher resilience to change. This criterion is a measure of how an area of habitat can adapt to change without adversely affecting its conservation status, uniqueness or rarity. A very high score for this criterion would be an area of habitat extremely sensitive to change. It may require 25 years or more to naturally return to a state comparable to the original. A value with a low score may be able to naturally return to original state within less than one year. A value 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 offsets within the Gladstone region. The significance of impact on habitat for shorebirds was determined by assessing the following attributes:-

- sensitivity of habitat
- extent of habitat within the survey area and Port Curtis region; and
- duration and severity of the impact.

4.4.4 Significance of impact

The sensitivity of shorebird habitat and 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 within the survey area. There were five levels of significance that could be applied for each habitat:

Major Impact Significance

Major impact significance occurs when an impact on important shorebird habitat is long term, irreversible and/or widespread. This level of impact is likely to be a key factor in the decision-making process and/or 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. Whilst 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/further degraded or becomes susceptible to further change due to the scale and nature of the works. 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 criteria as important under EPBC guidelines (DEWHA, a & b). Impacts are not considered to adversely affect its viability, provided standard environmental controls are implemented.

Negligible Impact Significance

This is an impact that will not result in any noticeable change in shorebird habitat. Typically occurs where the activities take place in industrial or highly disturbed areas.

4.4.5 Cumulative Impact Assessment

Potential projects within the Port Curtis region were reviewed, mapped and described (data from GPC, 2012). From these projects those assessed in the EIS (Coffey Environments, 2011) as having a likelihood of completion were assessed for potential impact on regulated vegetation typically utilised by shorebirds (RE 12.1.2 saltpan vegetation and RE 12.1.3 mangrove vegetation). Habitat loss for these REs was calculated for these projects.

4.5 Ecology of Migratory Shorebirds

4.5.1 Shorebirds in Australia

There are 36 species of migratory shorebird listed as MNES under the EPBC Act (Section 3). Of these species, 35 breed in the northern hemisphere and migrate to non-breeding grounds in Australia along the EAA flyway. The EAA flyway stretches from Siberia and Alaska in the north, southwards through Asia to Australia and New Zealand. The exception to this migration is the double-banded plover that migrates between Australia and its breeding grounds in New Zealand (DEWHA, 2009b). This species is commonly located throughout southeast Australian but irregularly occurs within Queensland. Observations are typically confined to southeast Queensland with sporadic records extending as far north as Mackay, Townsville and Cairns.

Australia is recognised as important in providing foraging and roosting sites and has the most number of recognised internationally important sites (118) (87%) of any country within the EAA flyway (Bamford *et. al.,* 2008). The majority of shorebirds migrating south into Australia first arrive on the extensive tidal flats of northern Australia or New Guinea. 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 areas all along their journey and 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 (Rohweder and Charley, 2010).

4.5.2 Foraging and Roosting Requirements

Migratory shorebirds in Australia have two basic habitat requirements, habitat for foraging and roosts where they can rest at high tide when foraging areas are limited. Both of these habitat requirements are important in the life cycle of migratory shorebirds to enable them to make the long journey back to their breeding grounds. Preference is given to foraging and roosting sites that are in close proximity to each other. This reduces travelling distance between the two and energy expended (Rohweder and Charley, 2010). Shorebirds show a high degree of fidelity to specific roosting and foraging sites (e.g. Rohweder *et. al.,* 2011).

Foraging is generally undertaken during low tide on intertidal mudflats and sandy beaches that provide habitat for benthic invertebrates that shorebirds consume (Lewis, 1999 *in* URS, 2011). There are two distinct styles of foraging behaviour among shorebirds (identified by Finn *in* Rohweder and Charley, 2010). The first is the "sandpiper strategy", a slow, methodical walk with periodic probing into potential prey burrows (e.g. eastern curlew and bar-tailed

godwit). The second technique is the "plover strategy", which is characterised by a "run-stop-run" approach to foraging on or near the surface (e.g. terek sandpipers and sand plovers).

Roosting sites are utilised during high tide when foraging areas are flooded. Good roosting sites are those that are in close proximity to foraging areas and have good visibility of surrounding areas (sight lines), which may have a greater chance of detecting predators or other disturbances (URS, 2011).

The long distance journeys that migratory waders undertake biannually require large reserves of energy which these species store as body fat. It is essential that migratory waders replenish fat stores during their time in the southern hemisphere so that they are successfully able to navigate the northern migration and arrive at their northern breeding grounds with sufficient condition to breed. Regular disturbance that impacts on a wader's ability to successfully forage and roost reduces their ability to efficiently replenish reserves which can result in unsuccessful migration or failed breeding attempts (Battley *et. al.*, 2010).

4.5.3 Disturbance

Disturbance to shorebirds and their habitat can occur from changes in light, noise and movement. Impacts on breeding success have been shown in the literature, with a reduction in breeding success correlated with increased disturbance (Rohweder and Charley, 2010). Such an impact on migratory species that do not breed in Australia has been suggested but there is more flexibility for roosting and foraging birds since they are not tied to the same location, as is the case for breeding birds (Rohweder and Charley, 2010). Birds have greater flexibility during foraging, since they have a choice of sites and are generally moving around to forage anyway. Roosting birds need sites that are close to foraging resources so that they conserve energy consumed during foraging. Foraging birds have also been shown to be more tolerant to disturbance, while roosting species are likely to flush when the most sensitive species reacts (Rohweder and Charley, 2010). Measures of tolerance to disturbance such as the distance that birds respond to stimuli is correlated with body mass (reviewed in Glover *et. al.*, 2011) Species such as eastern curlews took flight when a stimulus was an average of 126 metres from the bird, while smaller species such as the red-necked stint allowed the stimulus to get within 19 metres of the bird before flushing.

Disturbance may be detrimental if it prevents birds from foraging and resting for prolonged periods or forces them to abandon roosting sites and take flight, since flying is 5-8 times more energetic than foraging and roosting activities (Rogers *et. al.*, 2006). However, shorebirds have been shown to habituate to disturbance, especially to predictable sounds and light (such as construction activities rather than recreational activities) and recent studies suggest that the occurrence of disturbance itself is not sufficient to infer impact (reviewed in Rohweder and Charley, 2010).

Disturbance to shorebirds and habitat in the Port Curtis area consists of recreational and commercial vessels (including disturbance to foraging habitat from boat wash), construction activities, fishing, light aircraft and walking Rohweder and Charley, 2010). 'Excessive lighting' is also a potential source of disturbance (DEWHA 2009b).

4.6 Regional Context

4.6.1 Existing Environment

Infrastructure

Port Curtis contains Gladstone Harbour, which is the site of Queensland's largest commodity port and the world's fourth largest coal export terminal, with coal making up 70% of current exports from the harbour. Major imports include bauxite and petroleum products with miscellaneous cargo also received. Current infrastructure includes ship loading facilities for coal and aluminium as well as residential community surrounding the Port Central areas (GPC, 2012) (Table 9) (Figure 4).

Figure 4 Existing and planned developments in Port Curtis

Table 9 Summary of key components of existing infrastructure within Port Curtis

Area/Precinct	Key existing components
Curtis Island	· construction has commenced for 3 of 4 proposed LNG plants (APLNG, GLNG, QCLNG)
Fishermans Landing	· currently being reclaimed · four shipping berths
RG Tanna Coal Terminal	· coal export facility · four berths, three ship loaders
South Trees and Boyne Wharves	· south trees wharf is a cargo loading facility, primarily bauxite, aluminium and caustic soda · Boyne Island supports an aluminium smelter with accompanying wharf
Port Central	· Barney Point Coal terminal · Auckland Point wharves support clean bulk trade

Natural Environment

There are more than 10 different REs classified in the survey area, and many more throughout the Port Curtis region, however the majority of these are woodland and other vegetation not regularly utilised by shorebirds. The two main REs used by shorebirds are 12.1.2 (saltpan vegetation) and 12.1.3 (mangroves). The intertidal area, not mapped as regulated vegetation, also provides habitat for shorebirds within the study area (Figure 5).

4.6.2 Shorebirds in Port Curtis (Study Area)

Data from shorebird surveys undertaken between 2000 and 2011, as part of planning for infrastructure developments and as part of regular surveys carried out by QWSG and AWSG in Port Curtis, was reviewed and summarised in Appendix 7. Recent surveys in January 2011 throughout Port Curtis show a maximum population estimate of 2,986 individuals and 25 species (migratory shorebirds accounting for 18 of these species and 2,666 individuals (Rohweder *et. al.,* 2011).

Previously, Bamford *et al.,* (2008) recognised Port Curtis as nationally significant for the following species: eastern curlew, whimbrel and bar-tailed godwit. These three larger shorebird species still dominate most survey counts in the area (Rohweder and Charley, 2010). Port Curtis has recently been recognised as internationally significant for the eastern curlew (GHD, 2011a; Rohweder *et al.,* 2011). Other common species recorded within the area are terek sandpipers, red-necked stints (especially in claypans moistened by rain) and grey-tailed tattlers. Section 5.3 provides a summary of key species within Port Curtis (Table 10). Rare visitors and those resident shorebirds are also assessed (Table 10).

4.6.3 Significant Shorebird Areas within Port Curtis

Overview

Within the Port Curtis area a large degree of variability exists in the quality of shorebird

habitat. There are large areas supporting extensive important foraging habitat and nationally important roost sites (Rohweder and Charley, 2010) (Figure 6), (e.g., Friend Point and Pelican Banks) and other areas with low habitat quality and consistently low numbers of surveyed birds (i.e., North China Bay) (URS, 2011). In general, the lower port area (i.e., Southend, Facing Island and Pelican Banks) supports greater numbers of birds than the upper port (i.e., Friend Point, the Narrows and Calliope area) which contains the survey area. The lower port area has larger areas of intertidal habitat, a greater diversity of substrates and greater tidal flushing than the upper port as well as less overall disturbance (Rohweder *et. al.,* 2011). In the past, Laird Point has also periodically had large numbers of whimbrel recorded. It has accordingly been classified as nationally important (Rohweder and Charley, 2009), although recent data suggests that populations have declined in this area (Rohweder *et. al.,* 2011). The key areas containing significant numbers of birds are:

Pelican Banks and South End Claypan (Curtis Island)

This area regularly supports 800-1200 individuals of 12 species of shorebird (Rohweder and Charley, 2009; Rohweder *et. al.*, 2011). The extensive sandflats are utilised for foraging and during spring tides birds roost in the claypan at the rear of this area. This area has supported high numbers of bar-tailed godwit during various surveys (e.g., a maximum count of 919 individuals by QWSG, 2010).

Friend Point

Friend Point is considered to be the most important roost site for shorebirds in the upper port and the third most important for the Port Curtis region. It meets the criteria of nationally important habitat under the EPBC guidelines (DEWHA, 2009a). Single counts of almost 450 birds have been made in this area during a spring high tide and 15 species have also been recorded (Rohweder *et. al.,* 2011). Use of the Friend Point roosts is influenced by tide height, during neap tides birds roost on the mudbank near the shoreline, but move inland to the rear claypan as tide height increases. Claypans in this area are also used for foraging during and after rain events (Rohweder and Charley, 2009). At low tides birds move on to the mudflats of Fishermans Landing or disperse up towards the Narrows area (Rohweder *et. al.,* 2011).

Facing Island

The northern and western side of Facing Island contains several known roosts and extensive adjoining foraging resources (mudflats, sandflats, shingle beds and rocks), making it the second most important area for shorebirds in Port Curtis). This area supports particularly high numbers of terek sandpiper and lesser sand plover (Rohweder *et. al.,* 2011).

Clinton ash ponds (within AOD of this project)

This area is the most regularly surveyed area for shorebirds (with more than 45 separate surveys for some of the ponds in this area) (QWSG, 2010) and consists of eight artificial ponds within a highly disturbed industrial environment. The ponds are used primarily for roosting. This area is considered nationally important habitat, meeting criteria under the EPBC guidelines (Section 4.4.1 and Appendix 9). Surveys in this area have found maximum counts for Port

Curtis of red-necked stint, black-tailed godwit, eastern curlew, whimbrel and bar-tailed godwit (QWSG, 2009). Recent surveys suggest that shorebirds have declined rapidly in this area with sufficient numbers of only eastern curlew to support the continued classification as nationally important habitat (Rohweder *et. al.,* 2011). Maximum counts for all species during peak survey times in mid-January 2012 reached just 189 birds, compared with previous maximum counts of 1,420 for a single species (red-necked stints).

North China Bay (within AOD of this project)

Surveys of this area since 2008 have consistently found low numbers of shorebirds in the North China Bay area with just two species (eastern curlew and whimbrel) recorded in January 2011. Maximum numbers of birds per site were just 12, with similar figures recorded in 2008 by Rohweder and Charley, (Rohweder and Charley, 2010). The whole area of North China Bay, including the area closest to the project is considered low quality habitat for shorebirds (Rohweder and Charley, 2010). This site was not included in the surveys due to access constraints, but publicly available data was accessed (URS, 2011).

The Port Curtis area is part of a much larger area, the Curtis Coast containing significant shorebird habitat which extends from Port Alma to Rodd's Peninsula, discussion on important areas for shorebird is reviewed elsewhere (e.g., GHD 2011).

4.7 Target Species

4.7.1 Overview

There are 36 species of migratory shorebirds listed under the EPBC Act, with a total of 25 species that occur or may occur within the Port Curtis area (Table 10 &11) and 18 species with recent population estimates from a number of sources (Rohweder *et. al.,* 2011; GHD, 2011a: QWSG). Seven resident shorebirds also occur regularly (Table 12). Migratory species that have important habitat within Port Curtis and thus occur in large numbers are summarised below.

4.7.2 Eastern Curlew

The eastern curlew has a relatively low flyway population meaning that the numbers for 1% of the flyway population are relatively low compared to other species (the occurrence of 380 individuals constitutes internationally important habitat for this species). Recent population estimates exceed this figure for Port Curtis (e.g., 515 (QWSG, 2009)).

In Port Curtis, large numbers have been recorded at Pelican Banks, Chinaman Island, Southend and Clinton ash ponds. Clinton ash ponds is the only one of these sites that occurs within the survey area. All of these locations have had more than 38 individuals recorded as a maximum count (Rohweder and Charley, 2010), making them all nationally significant sites.

4.7.3 Whimbrel

Estimates of population size for whimbrel within Port Curtis range from 328-560 individuals,

well above the nationally important habitat threshold, but not within a range considered internationally important (Table 10). Key sites for this species are similar to those for eastern curlew (they are often found in mixed flocks) - Pelican Banks and Chinaman's Island.

4.7.4 Bar-tailed godwit

Population estimates for this species vary widely between reports and years for Port Curtis with a maximum recorded by QWSG in 2009 of 1,509. This exceeds the criteria for nationally important habitat, but is still less than half that required to be considered internationally important. Pelican Banks, Chinaman's Island and Clinton ash ponds are key sites for this species (Table 10).

4.7.5 Grey-tailed Tattler

The flyway population for this species is also relatively low, meaning that the criteria for a site to be considered nationally or internationally important is lower than some other species within the study area (Table 10). Estimates have declined since Driscoll, (1997) (*in* Rohweder and Charley, 2010) estimated a population size of 880 for the whole of Port Curtis, with estimates around 300-400 individuals recently recorded (Table 8). Key sites include Pelican Banks, Southend and Chinaman's Island and Queensland Alumina.

4.7.6 Red-necked stint

This species does not occur in large numbers but is commonly recorded. Important areas are Friend Point and Clinton ash ponds (Table 10).

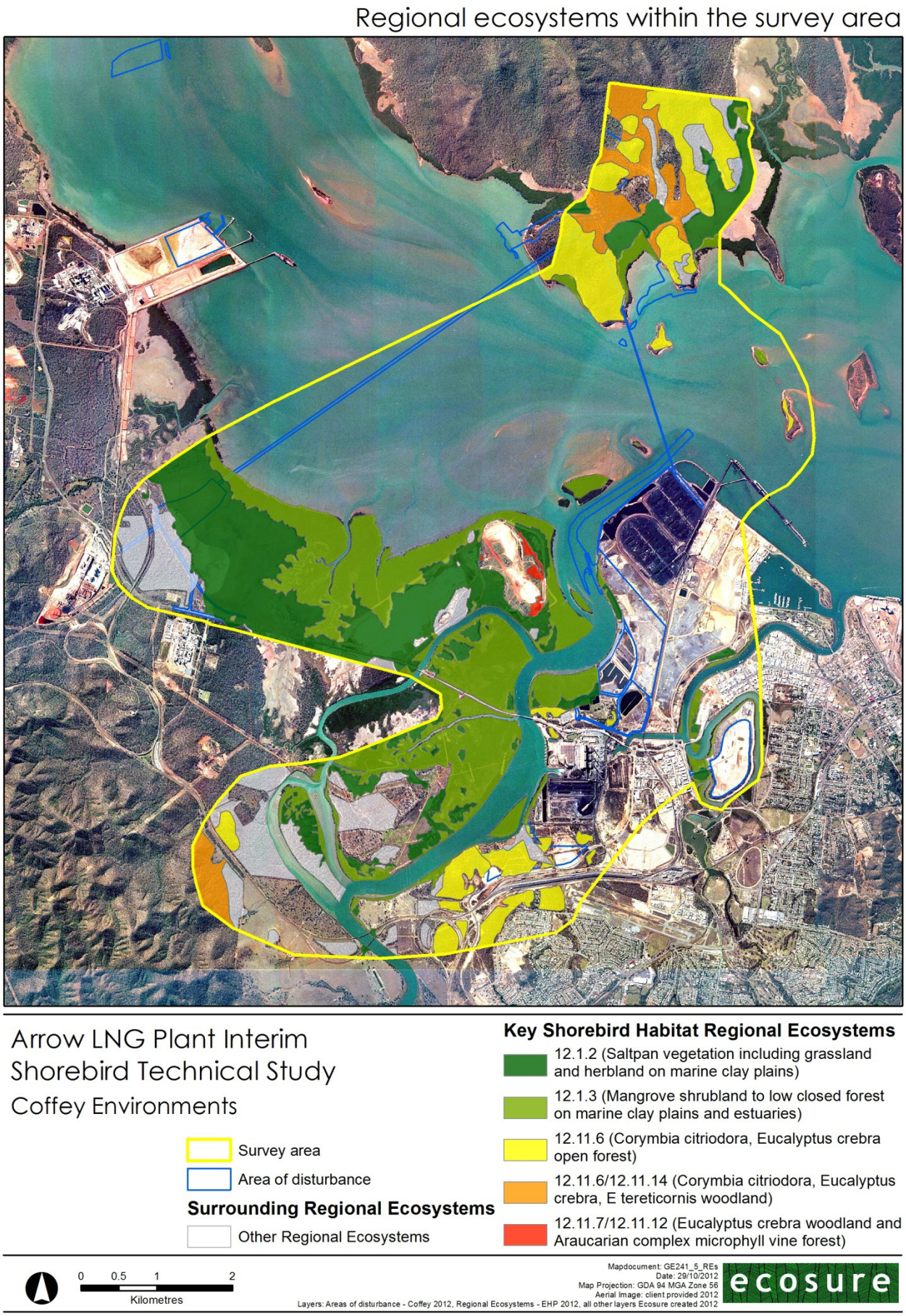

Figure 5 Regional ecosystems within the study area.

Figure 6 EPBC Important shorebird habitat in Port Curtis

Table 10 Migratory shorebird species listed under the EPBC Act, their status, habitat requirements and recent population estimates within the Port Curtis Region (where available)

(Mi - Migratory, Mar - Marine, V - vulnerable, E - endangered, NT - near threatened)

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder et. al., (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Actitis hypoleucos	common sandpiper	Mi, Mar	-	Utilises a wide range of coastal wetlands with varying levels of salinity, mostly muddy margins rarely mudflats. Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves (Higgins & Davies, 1996).	Breeds in Arctic Siberia. Widespread summer migrant to coastal and inland Australia (Aug-Apr). Some overwinter (Pizzey and Knight, 2007).	Uncommon, occurs in low numbers, no real important areas.	1	Not assessed	1	25	250	
Arenaria interpres	ruddy turnstone	Mi		Mainly found on coastal regions with exposed rock coast lines or coral reefs. Occasionally in estuaries, harbours, bay among low saltmarsh. Roosts on beaches, above the tideline, among rocks, grassy tussocks, on mudflats and sandflats (Higgins & Davies, 1996).	Breeds in Arctic from Spitsbergen to Iceland. Regular summer migrant to coastal Australia (Sep-May). Occasional inland and some overwinter (Pizzey and Knight, 2007).	Passage Islands	6	7	N/A	35	350	

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder *et. al.*, (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Calidris acuminata	sharp-tailed sandpiper	Mi		Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh, saltpans. Use intertidal mudflats in sheltered bays, inlets, estuaries or seashores. Roost at edges of wetlands, on wet open mud or sand, in sparse vegetation such as saltmarsh (Higgins & Davies, 1996).	Breeds around Arctic circle. Regular summer migrant to mostly coastal Australia (Aug-Apr). More abundant in north and less in south and inland. Some overwinter (Pizzey and Knight, 2007).	None, strong holds in other parts of Curtis Coast	0	0	1	160	1,600	
Calidris alba	sanderling	Mi, Mar		Regular summer migrant found on broad ocean beaches of firm sand, also inhabits tidal mudflats and coastal lagoons (Pizzey and Knight, 2007). They roost on/behind bare sand high on the beach, coastal dunes, rocky reefs and ledges (Higgins & Davies, 1996).	Breeds in Siberia. Widespread, common summer migrant to coastal and inland Australia (Aug-Apr). Some overwinter (Pizzey and Knight, 2007).	Small Calidris species are generally not common in the Port Curtis area	0	48	N/A	22	220	

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder *et. al.*, (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Calidris canutus	red knot	Mi		Inhabits intertidal mudflats, sandflats and sandy beaches, in estuaries, bays and harbour. Roosts on sandy beaches, spits and mudflats, preferring open areas far away from cover for predators but close to feeding grounds (Rogers, 2001).	Breeds in Arctic Siberia and Alaska. Abundant summer migrant to coastal and inland Australia (Aug-Apr); mostly in northwest and southeast. Many overwinter (Pizzey and Knight, 2007).	Southend	4	16	N/A	220	2,200	
Calidris ferruginea	curlew sandpiper	Mi		Widespread records along the Queensland coast south of Cairns and around Australian coast. Mainly occurs on tidal mudflats as well as swamps, lagoons and wetlands near the coast (Pizzey and Knight, 2007; DSEWPaC, 2012).	Breeds in Siberia. Abundant summer migrant to coastal and inland Australia (Aug-Apr); mostly in northwest and southeast. Many overwinter (Pizzey and Knight, 2007).	Other parts of the Curtis Coast are important for this species, seldom recorded in Port Curtis (Clinton ash ponds, Boyne Island)	1	0	N/A	180	1,800	

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder *et. al.*, (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Calidris ruficollis	red-necked stint	Mi		Found mostly on coastal sandy beaches, intertidal mudflats and sandbanks, sheltered estuaries and lagoons. Will utilise rocky outcrops, rock platforms and reefs and are found on coastal saltmarshes, saltfields and ephemeral wetlands. Usually forage on mudflats or sands exposed by the tides (Higgins & Davies, 1996).	Breeds in Arctic Siberia and Alaska. Abundant summer migrant to coastal and inland Australia (Aug-Apr); mostly in northwest and southeast. Many overwinter (Pizzey and Knight, 2007).	Friend Point, Clinton ash ponds	249	27	222	325	3,250	270,000

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder *et. al.*, (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Calidris tenuirostris	great knot	Mi		Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons and sometimes exposed reefs or rock platforms (Morris, 1989; Higgins & Davies, 1996).	Breeds in Siberia. Abundant summer migrant to coastal and inland Australia (Aug-Apr); mostly in northwest and southeast. Many overwinter (Pizzey and Knight, 2007).	Chinaman's Island, Pelican Banks, The Oaks	98	0	230	380	3,800	
Charadrius bicinctus	double-banded plover	Mi		Annual winter migrant, mainly to southern Australia. Favours wide beaches, tidal mudflats, shallow saline and freshwater wetlands as well as paddocks with sparse vegetation (Pizzey and Knight, 2007). This species is a rare visitor to the Gladstone area	Breeds in NZ and islands. Annual migrant to mostly southern Australia (Feb – Sep). Most common in south-east Australia; including inland Vic, NSW and SA. Some north to Cairns Qld and west to Shark Bay WA (Pizzey and Knight, 2007).	One record (Driscoll, 1997). Rare visitor to Port Curtis.	0	0	N/A	50	500	

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder et. al., (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Charadrius leschenaultii	greater sand plover	Mi		Mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons (Pizzey and Knight, 2007). Usually roost on sand-spits and banks on beaches or in tidal lagoons(DSEWPaC, 2012a).	Breeds from Turkey to south Siberia. Regular summer migrant to Australia (Aug-May). Most common in north-west WA; some in all states and overwinter (Pizzey and Knight, 2007).	No strongholds	3	0	N/A	110	1,100	
Charadrius mongolus	lesser sand plover	Mi		Inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries and occasionally sandy ocean beaches, coral reefs. Roost near foraging areas on beaches, banks, spits, islets or reefs (Marchant & Higgins, 1993; McGill & Keast, 1945).	Breeds in central and northeast Siberia. Regular summer migrant to mostly coastal Australia (Aug-May); some scattered inland occurrences (Pizzey and Knight, 2007).	Friend Point, Boyne Island, Clinton ash ponds, Queensland Alumina	248	133	9	130	1,300	

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder *et. al.*, (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Heteroscelus brevipes	grey-tailed tattler	Mi, Mar		Often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. Occasionally found near coastal wetlands. It usually roosts in mangroves but also known on beaches and reefs or artificial structures (Higgins & Davies, 1996).	Breeds in central and eastern Siberia. Regular summer migrant to coastal Australia (Sep-Apr); Common from Shark Bay WA to Sydney NSW, less common on south coast. Some overwinter, mainly in the north (Pizzey and Knight, 2007).	Pelican Banks, Southend/Chinaman Island, Queensland Alumina	290	389	115	50	500	
Limicola falcinellus	broad-billed sandpiper	Mi		Occurs in sheltered parts of the coast, favouring estuarine mudflats among or fringed by mangroves. (Higgins & Davies, 1996) Roost on banks of sheltered sandy, shelly or shingly beaches on the ground, frequently on top of a tussock (Cramp, 1985).	Breeds in Arctic Eurasia. Scarce summer migrant to mostly coastal Australia (Sep-Apr); small numbers inland (Pizzey and Knight, 2007).	Very small numbers, no known strongholds	7	0	N/A	25	250	

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder et. al., (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Limosa lapponica	bar-tailed godwit	Mi		Mainly found on intertidal mud and sand flats but will use open sandy beaches, estuaries, coastal lagoons and saltmarshes. Roosts sites are usually open sandy islands, beaches or claypans (DSEWPaC, 2012b).	The race *baueri* breeds in northeast Siberia and north-west Alaska. It is a widespread summer migrant to mostly coastal eastern Australia (Sep-Apr); often overwinter. The race *menzbieri* breeds in central Siberia and occurs in WA (Pizzey and Knight, 2007).	Pelican Banks, Clinton ash ponds, Facing Island	599	530	1,509	325	3,250	185,000
Limosa limosa	black-tailed godwit	Mi		Commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud. Also near coastal wetlands, such as saltmarsh, saltflats, swamps, lagoons and floodplains (Higgins and Davies, 1996).	The race *melanuroides* breeds from Mongolila to northeast Siberia. Regular summer migrant to Australia (Sep-May); common from northwest WA to the Great Barrier Reef Qld and central NSW coast; scarce southern Australia. Some overwinter (Pizzey and Knight, 2007).	Rare in the area	0	Not assessed	None recorded	160	1,600	

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder et. al., (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Numenius madagascariensis	eastern curlew	Mi, Mar	NT	Inhabits intertidal flats, sheltered estuaries, harbours and coastal inlets or lagoons. Roost sites are sandy spits, areas of low saltmarsh dominated by samphire or salt water couch, and amongst mangroves (Rohweder & Charley, 2010, Geering et al., 2007, Higgins and Davies, 1996).	Breeds in northeast Asia. Common summer coastal migrant to Australia (Aug-May). Less common in SA and south WA; seldom inland. Many overwinter (Pizzey and Knight, 2007).	Clinton ash ponds, Pelican Banks, Southend, Chinaman's Island	407	429	515	38	380	28,000
Numenius phaeopus	whimbrel	Mi, Mar		Inhabits intertidal mudflats, sheltered estuaries, bays, inlets and lagoons. Uses a variety of roost types including saltmarsh, sandspits and bars, ocean beaches and mangroves (Higgins & Davies, 1996).	Race *variegatus* breeds in northeast Siberia. Regular summer coastal migrant to Australia (Aug-Apr). Common in north and east; uncommon in southeast and southwest; casual Bass Strait and Tas. Many overwinter (Pizzey and Knight, 2007).	Pelican Banks, Southend/Chinaman's Island, Clinton ash ponds	560	453	450	100	1000	10,000

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder *et. al.*, (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Pluvialis fulva	pacific golden plover	Mi, Mar		Usually occur on beaches, mudflats and sandflats, in sheltered areas including harbours, estuaries and lagoons. Usually roost near foraging areas, on sandy beaches and spits or rocky points (Marchant & Higgins, 1993).	Breeds in northeast Siberia and west Alaska. Regular common summer migrant to Australia and islands. Mostly coastal but many inland records. Some overwinter in coastal areas, especially Qld (Pizzey and Knight, 2007).		16	Not assessed	7	100	1000	
Pluvialis squatarola	grey plover	Mi, Mar		Inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons (Marchant & Higgins, 1993). Usually roost in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches (Jaensch *et al*., 1988).	Breeds around the Arctic. Regular summer migrant to Australia (Aug-Apr), Mostly coastal and islands, occasional inland. Some young overwinter (Pizzey and Knight, 2007).	No strongholds	9	92	14	125	1,250	

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder *et. al.*, (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Tringa glareola	wood sandpiper	Mi		Occurs in a variety of habitats including mangroves and the margins of mudflats subject to tidal inundation (Pizzey and Knight, 2007).	Breeds in north Eurasian to northeast Siberia. Regular summer migrant to Australia (Sep-Apr). Moderately common in northern Australia, uncommon in southern Australia; sparse inland (Pizzey and Knight, 2007).	No strongholds	0	Not assessed	N/A	100	1,000	
Tringa nebularia	common greenshank	Mi		Inhabits intertidal mudflats and other sheltered coastal and inland freshwater wetlands. Will readily use artificial wetlands, dams and settlement ponds with fringing vegetation (Higgins & Davies, 1996).	Breeds from Scotland to south and northeast Siberia. Regular, widespread summer migrant to Australia (Sep-Apr). Mostly coastal, occasional inland. Some overwinter (Pizzey and Knight, 2007).	Pelican Banks, Chinaman's Island, Clinton ash ponds	24	43	198	60	600	19,000

Scientific Name	Common Name	EPBC Act Status	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Recent maximum counts within Port Curtis and source			0.1% EAA flyway population (national criteria)	1% flyway population	Australian population
							Rohweder *et. al.*, (2011)	GHD, (2011a)	QWSG data (2000-2010) –			
Tringa stagnatilis	marsh sandpiper	Mi		Lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. Roosts on tidal mudflats (DSEWPaC, 2012c).	Breeds in Austria to north Mongolia. Regular summer migrant to mostly coastal Australia (Aug-May). Widespread but very scattered inland; common in north but uncommon in south and Tas (Pizzey and Knight, 2007).	No strongholds	9	51	6	100	1,000	
Xenus cinereus	terek sandpiper	Mi, Mar		Mostly forages in the open, on wet intertidal mudflats or in sheltered estuaries, harbours or lagoons. Recorded on islets, mudbanks, sandbanks, and spits, near mangroves and occasionally in samphire (Marchant & Higgins, 1993).	Breeds from Finland to northeast Siberia. Regular summer migrant to coastal Australia (Aug-Apr). Common from north WA to Hunter NSW; mostly scarce and/or local elsewhere. Some overwinter (Pizzey and Knight, 2007).	Boyne Island, South Passage Island	135	420	50	50	500	

Table 11 Listed species not commonly found in Port Curtis

Listed species that are rarely if ever recorded in Port Curtis						
Scientific Name	**Common Name**	**EPBC Act Status**	**NCA Status**	**Range**	**Habitat Description**	**Population Estimates for the Port Curtis region**
Calidris melanotos	pectoral sandpiper	Mi, Mar	LC	Breeds northeast Siberia and America Arctic. Regular, uncommon summer migrant to inland and coastal Australia (Aug-May). Mostly southeast Australia, Murray Darling Basin and western Vic (Pizzey and Knight, 2007).	Found at coastal lagoons, bays, swamps, estuaries, saltmarshes and creeks. Prefers wetland that have fringing mudflats with samphire (Higgins & Davies, 1996).	Not significant species in Port Curtis
Calidris subminuta	long-toed stint	Mi, Mar	LC	Breeds Siberia to far north Pacific. Regular, uncommon summer migrant to inland and coastal Australia (Aug-Apr). Most abundant in WA. Some overwinter (Pizzey and Knight, 2007).	Prefers shallow freshwater or brackish wetlands, also fond of areas of muddy shoreline, growths of grass, reeds, stunted samphire (Higgins & Davies, 1996).	Not significant species in Port Curtis
Charadrius veredus	oriental plover		LC	Breeds in Mongolia and Manchuria. Regular summer migrant to Australia (Sep-Mar). Records in all states; most abundant across coastal and north inland (Pizzey and Knight, 2007).	Regular summer migrant Found in tidal mudflats and bare claypans, as well as margins of coastal marshes (Pizzey and Knight, 2007).	Not significant species in Port Curtis
Gallinago hardwickii	Latham's snipe	Mi, Mar	LC	Breeds in Japan. Regular summer migrant to eastern Australia (Jul-Aug). Mostly coastal and subtropical, but substantial inland movement through Murray-Darling region. Some overwinter (Pizzey and Knight, 2007).	Usually occur in open, freshwater wetlands, although sometimes in saline or brackish water such as saltmarsh, mangrove creeks and at tidal rivers (Frith et al., 1977, Naarding, 1983).	Not significant species in Port Curtis
Gallinago megala	Swinhoe's snipe	Mi, Mar	LC	Breeds central Siberia and Mongolia. Regular summer migrant to tropical northern Australia (Pizzey and Knight, 2007).	Habitat includes dense clumps of grass and rushes around fresh and brackish wetlands. Also found in claypans and inundated plains (Higgins and Davies, 1996).	Not significant species in Port Curtis
Gallinago stenura	pin-tailed snipe	Mi, Mar	LC	Breeds from northeast Russia to north Siberia. Regular, uncommon summer migrant to coastal Australia (Aug-Mar). Found northwestern and western from Darwin NT to Kimberley WA. Casual south to Perth (Pizzey and Knight, 2007).	Occurs in or at the edges of shallow freshwater swamps, ponds and lakes with sparse to dense cover of grass/sedge, or in more open wetlands such as claypans (Higgins & Davies, 1996).	Not significant species in Port Curtis

Listed species that are rarely if ever recorded in Port Curtis						
Scientific Name	**Common Name**	**EPBC Act Status**	**NCA Status**	**Range**	**Habitat Description**	**Population Estimates for the Port Curtis region**
Glareola maldivarum	oriental pratincole	Mi, Mar	LC	Breeds in Pakistan, India and parts of southeast Asia, China, Japan and Philippines. Migrant to northern Australia (Nov-Feb or later); nomadic according to rainfall. Some coastal southwest, southeast and eastern Australia (Pizzey and Knight, 2007).	Rare, nomadic wader. Found on plains, shallow edges of open wetlands, tidal mudflats and beaches (Pizzey and Knight, 2007).	Not significant species in Port Curtis
Limnodromus semipalmatus	Asian dowitcher	Mi, Mar	LC	Breeds central and east Siberia, northeast China and Mongolia. Scarce but regular summer migrant to coastal northern Australia (Pizzey and Knight, 2007).	Found in sheltered coastal lagoons, estuaries and tidal creeks, exposed mudflats or sandflats (Higgins & Davies, 1996).	Not significant species in Port Curtis
Numenius minutus	little curlew	Mi, Mar	LC	Breeds in Arctic Siberia. Migrant to northern Australia (Sep-Apr). Very large numbers over grasslands of north WA, NT and northwest Qld in wet season; small parties to central, eastern and southeastern Australia (Pizzey and Knight, 2007).	Lives around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. The species prefers pools with bare dry mud (including mudbanks in shallow water)(Higgins and Davies, 1996).	Not significant species in Port Curtis
Phalaropus lobatus	red-necked phalarope	Mi, Mar	LC	Breeds around the Arctic, Irregular summer migrant to Australia (Aug-Apr). Regular to northwest WA but also occasionally to southeast Australia. Some overwinter (Pizzey and Knight, 2007).	Recorded at inland and coastal lakes/swamps including highly saline waters and artificial wetlands notably saltfields (Higgins & Davies, 1996).	Not significant species in Port Curtis
Philomachus pugnax	ruff	Mi, Mar	LC	Breeds France to northeast Siberia. Regular, uncommon summer migrant to Australia (Sep-Apr). Mostly coastal, some inland (Pizzey and Knight, 2007).	Found on fresh, brackish of saline wetlands with exposed mudflats. Forages on exposed mudflats in shallow water and on dry mud (Higgins & Davies, 1996).	Not significant species in Port Curtis

Listed species that are rarely if ever recorded in Port Curtis						
Scientific Name	**Common Name**	**EPBC Act Status**	**NCA Status**	**Range**	**Habitat Description**	**Population Estimates for the Port Curtis region**
Rostratula australis	Australian painted snipe	M, Mar, V	V	Mostly southeast Australia from Brisbane Qld to Adelaide SA. Scarce over much of inland, north Qld, NT and coastal WA, vagrant to Tas. Responsive to rainfall; possibly part migratory moving north into Qld during summer (Pizzey and Knight, 2007).	Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands. Breeding habitat includes shallow wetlands with bare wet mud and upper and canopy cover nearby (Rogers et al., 2005).	Not significant species in Port Curtis
Tringa incana	wandering tattler	Mi,	LC	Breeds in northeast Siberia, Alaska and north Canada. Uncommon to regular summer migrant to coastal Australia (Sept-Mar). From Great Barrier Reef to coasts of north and east Australia from Darwin NT to northern NSW (Pizzey and Knight, 2007).	Found on rocky coasts, points, spits, offshore islands. Tends to avoid mudflats. Foraging among shallow pools at edges of reef or beach (Higgins & Davies, 1996).	Not significant species in Port Curtis
Tringa totanus	common redshank	Mi, Mar	LC	Breeds from British Isles to east Asia. Uncommon to regular summer migrant to coastal Australia from Broome WA to Darwin NT. Also occasional Cairns Qld and casual to south Australia. Some overwinter (Pizzey and Knight, 2007).	Found at sheltered coastal wetlands, river estuaries, saltmarsh with bare open flats and banks of mud or sand (Higgins and Davies, 1996), around muddy islets and estuarine sandbars.	Not significant species in Port Curtis

4.8 Resident Shorebirds

There are resident shorebird species that occur within the Port Curtis area (Table 12). The beach stone-curlew is listed as vulnerable under the NCA, and the sooty oystercatcher is listed as near threatened. The others are listed as least concern.

Table 12 Resident shorebird species – listed under the NCA, their status, habitat requirements and recent population estimates within the Port Curtis Region (where available)

(V - vulnerable, NT - near threatened, LC – least concern).

Species	**Common name**	**NCA Status**	**Habitat Requirements**	**Range**	**Key areas in Port Curtis**	**Population Estimates for the Port Curtis region**		
						Rohweder *et. al.*, (2011)	**GHD (2011a)**	**QWSG data (2000-2010)**
Esacus magnirostris	beach stone-curlew	V	Coastal habitats including undisturbed islands, reefs, sandbanks, spits or islands in estuaries and beaches with mangroves or estuaries close by (Garnett and Crowley, 2000).	Coastal northern and eastern Australia and coastal islands, from Exmouth Gulf WA to Nambucca Heads NSW. Casual south to Norah Heads, south coast to east Vic. Rare south of Cairns. Sedentary (Pizzey and Knight, 2007).	Mainland coastline and at the mouth of Graham Creek, Curtis Island. It has also been recorded in the survey area on Curtis Island, as well as mainland north of Fishermans Landing (QGC, 2009).	6	4	3
Burhinus grallarius	bush stone-curlew	LC	Natural habitats such as open woodlands, dry watercourses, sandplains, coastal scrub and mangrove fringes. Also found within timber remnants on roadsides and in areas such as golf courses within towns or cities (Pizzey and Knight, 2007).	East, southeast, north coastal WA, coastal islands, vagrant to Tas. Abundant in subtropics and across northern Australia. Rare to extinct in settled parts of coastal southeast Australia. Absent from south inland and the Nullarbor. Sedentary, locally dispersive (Pizzey and Knight, 2007).	Generally solitary or in pairs, Facing Island and Southend.	5	0	N/A

Species	Common name	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Population Estimates for the Port Curtis region		
						Rohweder *et. al.*, (2011)	GHD (2011a)	QWSG data (2000-2010)
Haematopus longirostris	pied oystercatcher	LC	Tidal mudflats or estuaries, sandbars and undisturbed beaches. Occasionally rocky reefs or shores and brackish or saline wetlands. Also found in grassy paddocks, parks or golf courses near coast (Pizzey and Knight, 2007).	Coastal and islands of Australia. More common in south Australia than in north; vagrant to inland. Sedentary, and dispersive (Pizzey and Knight, 2007).	Occurs widely, especially Southend, Friend and Laird Points and Passage Island.	72	78	27
Haematopus fuliginosus	sooty oystercatcher	NT	Intertidal rocky shorelines and coral reefs, as well as other marine habitats (Marchant and Higgins, 1993).	Inhabits coasts and islands of Australia. Sedentary (Pizzey and Knight, 2007).	Generally restricted to Lower Port, i.e., Facing Island and Pelican Banks. Given its preference for rocky platforms, normally found in the lower parts of estuaries.	3	3	2
Himantopus himantopus	black-winged stilt	LC	Tidal estuaries, mudflats, saltmarsh, fresh or brackish swamps, shallow rivers or lakes and flooded claypans. Also manmade dams, sewage ponds and commercial saltfields (Pizzey and Knight, 2007).	Widespread across mainland Australia, except waterless deserts and the Nullarbor Plain. Scarce Kimberley region WA and parts of Cape York Qld. Seasonally dispersive or nomadic, according to rainfall (Pizzey and Knight, 2007).	Sporadically recorded, especially at Queensland Alumina, Southend and adjacent to Clinton ash ponds.	17	0	29

Species	Common name	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Population Estimates for the Port Curtis region		
						Rohweder *et. al.*, (2011)	GHD (2011a)	QWSG data (2000-2010)
Vanellus miles	masked lapwing	LC	Stony ground and areas of short grass such as paddocks, plains and airfields. Also margins of dry swamps and occasionally beaches (Pizzey and Knight, 2007).	Nominate race: breeds tropical Australia from Dampier WA to Cairns Qld. *Novaehollandiae* race: all south east Australia north to Cairns Qld. Both casual to south WA. Common, sedentary, nomadic or part migratory (Pizzey and Knight, 2007).	Adjacent to Clinton ash ponds, and occasionally at Laird Point.	17	7	15
Charadrius ruficapillus	red-capped plover	LC	Inland and coastal areas such as sandy and shelly beaches and dunes, saline wetlands and lakes, saltmarsh, tidal mudflats and sandflats. Occasionally shallow freshwater wetlands (Pizzey and Knight, 2007).	Coastal and inland Australia. Sedentary, nomadic (Pizzey and Knight, 2007).	Occurs in moderate numbers, especially Wiggins Island, North and South Passage Island and Laird Point.	181	61	5

Species	Common name	NCA Status	Habitat Requirements	Range	Key areas in Port Curtis	Population Estimates for the Port Curtis region		
						Rohweder *et. al.*, (2011)	GHD (2011a)	QWSG data (2000-2010)
Elseyornis melanops	black-fronted dotterel	LC	Shallow bare freshwater wetlands, sandbars, margins of rivers, receding floodwaters and inland claypans. Also sewage ponds, farms dams, stone and gravel roads. Occasionally on saltmarsh, brackish lakes, mudflats and sandy seashores (Pizzey and Knight, 2007).	Widespread throughout Australia, except for waterless regions. Sedentary, locally dispersive (Pizzey and Knight, 2007).	Small numbers occur sporadically, Clinton ash ponds and Queensland Alumina are key sites.	2	N/A	2

5 Field Survey Results

5.1 Habitat Description

The key habitats for shorebirds within the study area are saltpan and mangrove shrubland vegetation (REs 12.1.2 and 12.1.3) intertidal areas with no regional ecosystem classification and artificial and highly disturbed ponds, also not classified, such as Clinton ash ponds (Appendix 2; Figure 5).

There is also a small area of shallow sandy beach (Site 20) that is rare in the rest of the study area, which potentially provides some limited habitat for several species such as sanderling, terek sandpiper and stint.

Foraging and roosting habitat was surveyed in detail and actual and potential foraging and roosting habitat was delineated as part of field assessments (Figure 7). The key components and what type of habitat may be impacted by the project is shown in (Table 13).

Table 13 Key components of the project, and which surveys sites and vegetation will potentially be impacted.

Infrastructure component (see Section 3 Project Description	**Survey sites potentially impacted (Refer to Figure 3)**	**Shorebird habitat type (from literature and preliminary field data) (Figure 6)**
Curtis Island		
LNG plant	1,2,3,4,10,13,15	Potential roosting habitat, secondary foraging habitat
Mainland		
Mainland tunnel launch site	9,11	Potential roosting habitat, potentially foraging habitat
TWAF 7 and TWAF 8	Not within shorebird habitat area refer to EIS (Coffey Environments 2012) for further assessment of this area	
Launch site 1 and access Road	5,6,7,8,12,14,16,17,18,19,20,21	5&6 important roosting site (Clinton ash ponds)
Launch site 4N	Not part of survey area	Not classified

A total of 1,094 hectares of potential or actual shorebird habitat was identified within the survey area (Table 14), with potentially important foraging habitat comprising the majority of this (683.7 hectares). Potential roosting habitat also covered a large area (307 hectares) (Table 13 & 14).

A small oxbow on the Calliope River that was identified as being potentially impacted by changes in water levels as a result of dredging of the main channel was examined during September surveys. This area was identified as potential foraging habitat but further surveys are required to investigate this. This is planned for December/January surveys but the area may be difficult to access around low tide when foraging occurs.

The examination of an updated hydrodynamic model that considered changes in extreme low tide levels due to dredging, and subsequent review of previous and recent field surveys allowed the re-assessment of impacts on this oxbow. The conclusion from these analyses is

that there is no change in the magnitude and significance of the impact from the EIS.

The conclusion was based on the fact that the intertidal area that mangroves inhabit is well above the region affected by the drop in the extreme low tide levels and that the increase in the area and time of exposure was deemed small and not detectable to affect intertidal communities.

(Appendix 2 has full RE description)

Table 14 Foraging and roosting habitat within the survey area and corresponding REs

Habitat type	**Data source**	**Area of habitat in survey area (hectares)**	**Survey sites (Figure 3)**	**Corresponding REs (Figure 5)**
Important roosting habitat	Numerous (e.g. QWSG, reviewed in Rohweder and Charley, 2010 and others)	24.6	6 (Clinton ash ponds)*	Not mapped (artificial wetland)
Potentially important foraging habitat	QPWS (2002)	683.7	11 & 12	Not mapped (intertidal)
Secondary foraging habitat	Ecosure field surveys	70.7	8,15,16	Mostly unmapped, but some 12.1.3 and small amount 12.1.2
Potential roosting and foraging habitat	Ecosure field surveys	7.5	7	12.1.2 & 12.1.3
Potential roosting habitat	Ecosure field surveys	307.3	1,9,13	12.1.2
Total		**1,093.8**		

*Note recent addition of mulch in this area that is a risk to the quality of this habitat for shorebirds. The origin of the mulch is unknown but is not associated with any project activity.

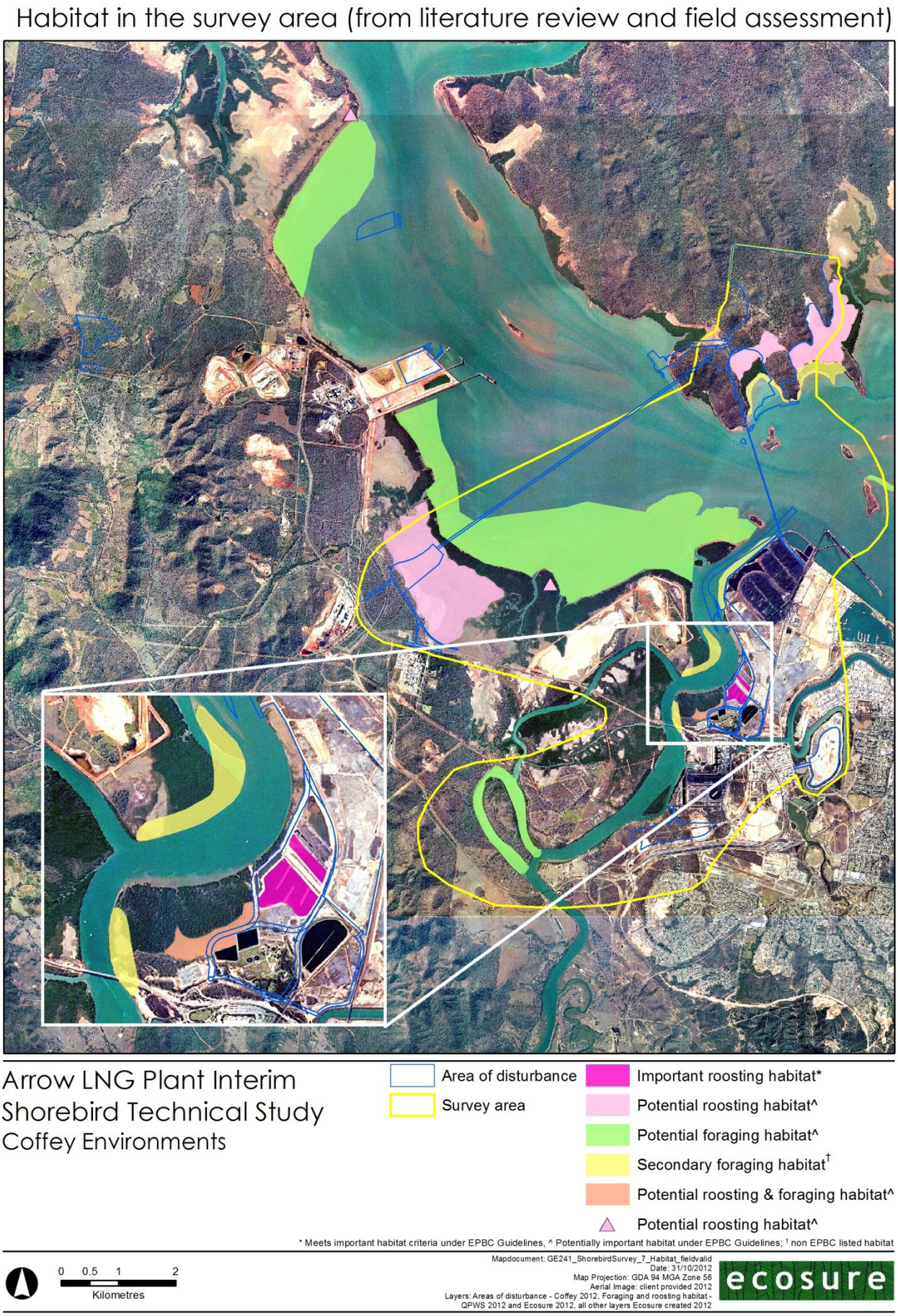

Figure 7 Habitat in the study area

5.2 Shorebirds within the Survey Area

A total of 13 species of shorebird were recorded during August and September field surveys, within the survey area. In August, three migratory and six resident species were recorded, while in September seven migratory and five resident species were recorded (Table 15).

As expected, abundance was lowest in August during overwintering, with an estimate of 83 shorebirds within the survey area. Numbers increased in September with a total abundance of 213 birds (Table 15).

Bar-tailed godwit (*Limosa lapponica*) was most abundant at three sites during the August survey (sites 5, 6 &11) compared to other species. In comparison, the total number of migratory species for the September surveys was eight with the sum of maximum counts being 497 birds. Eastern curlew *(Numenius madagascariensis)* was the most numerous migratory shorebird in September, with numbers exceeding the criteria for a nationally important site (Clinton ash ponds, site 5 & 6). Beach stone-curlews were only detected in August with a pair of common sandpipers detected only in September (Table 15).

Table 15 Species and maximum counts for August and September surveys

(Details in Appendices 4 & 5). Migratory shorebirds flyway population from Bamford *et al.*, (2008), resident shorebird flyway population from Watkins, (1993).*Exceeds criteria as nationally important site for eastern curlew.

Species	**Common name**	**August 2012 surveys**	**September 2012 surveys**	**0.1% EAA flyway population (national criteria)**	**1% flyway population**
Migratory shorebirds					
Actitis hypoleucos	common sandpiper	-	2	25	250
Charadrius mongolus	lesser sand plover	-	30	130	1,300
Limosa lapponica	bar-tailed godwit	36	38	325	3,250
Numenius madagascariensis	eastern curlew	24	68*	38	380
Numenius phaeopus	whimbrel	1	46	100	1000
Pluvialis fulva	Pacific golden plover	-	2	100	1000
Tringa nebularia	common greenshank	-	3	60	600
Total		**61**	**189**		
Resident shorebirds					
Charadrius ruficapillus	red capped plover	12	15	95	950
Elseyornis melanops	black-fronted dotterel	2	1	17	170
Esacus giganteus	beach stone-curlew	2	-	1	10
Haematopus longirostris	pied oystercatcher	2	11	11	110
Himantopus	black-winged	-	4	532	5,320

Species	Common name	August 2012 surveys	September 2012 surveys	0.1% EAA flyway population (national criteria)	1% flyway population
himantopus	stilt				
Vanellus miles	masked lapwing	4	1	287	2,870
Total Residents		**22**	**32**		
Overall total		**83**	**213**		

5.3 Roosting and Foraging Counts

Counts for roosting and foraging are summarised below. Results of field surveys are shown in Appendix 4 & 5. Counts of roosting birds were much greater than for foraging birds in both August and September. Foraging counts were down compared with roosting counts. Only two sites contained more than ten foraging individuals of any one species, both of these were along the Calliope River (sites 12 and 16). Clinton ash ponds (sites 5 and 6) supported comparatively large numbers of roosting birds (Table 16).

Table 16 Counts of roosting and foraging birds for both August and September surveys

Site	Behaviour (foraging (f), roosting (r)	Common Name	Maximum counts at each site
August surveys			
1	r	eastern curlew	2
1	r	masked lapwing	4
4	f	eastern curlew	1
5	r	bar-tailed godwit	36
5	r	whimbrel	1
5	r	eastern curlew	24
5	f	black-fronted dotterel	1
5	r	masked lapwing	2
6	r	bar-tailed godwit	32
6	r	black-fronted dotterel	2
6	r	eastern curlew	3
6	r	masked lapwing	2
6	r	red-capped plover	12
9	r	red-capped plover	8
10	f	eastern curlew	2
11	f	eastern curlew	1
11	f	whimbrel	1
11	f	bar-tailed godwit	9
12	f	beach stone-curlew	2
12	f	eastern curlew	2
12	f	masked lapwing	3

Site	Behaviour (foraging (f), roosting (r)	Common Name	Maximum counts at each site
15	f	eastern curlew	4
September surveys			
2	f	eastern curlew	7
2	f	pied oystercatcher	1
2	f	whimbrel	2
5	r	eastern curlew	54*
5	r	whimbrel	11
6	r	bar-tailed godwit	38
6	r	common greenshank	3
6	r	eastern curlew	68*
6	r	masked lapwing	1
6	r	red-capped plover	15
6	r	Pacific golden plover	2
6	r	lesser sand plover	30
7	flyover	whimbrel	1
10	f	eastern curlew	8
11	f	eastern curlew	6
12	f	bar-tailed godwit	3
12	f	eastern curlew	10
12	f	red-capped plover	1
12	f	whimbrel	11
15	f	eastern curlew	7
15	f	pied oystercatcher	1
15	f	whimbrel	1
16	f	common sandpiper	2
16	f	eastern curlew	2
16	f	red-capped plover	4
16	f	whimbrel	46
20	f	eastern curlew	1
20	f	pied oystercatcher	11
20	f	black-winged stilt	3

6 Impact Assessment

6.1 Introduction

Migratory shorebirds are assessed under the EPBC Act and in particular Significant Impact Guidelines for 36 Migratory Shorebird Species: EPBC Act policy statement 3.21. 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, 2009a).

In determining impacts on migratory shorebirds, the key component is impacts on important habitat as defined in DEWHA (2009a) (Appendix 9).

6.2 Impacts within the AOD

6.2.1 Clearing of Regional Ecosystems

This section is confined to addressing regulated vegetation clearance only, noting that areas of habitat that are not mapped as REs (e.g., intertidal areas) are also used regularly by shorebirds. The AOD for the project requires the clearing of a total of approximately 60.82 hectares of saltpan (RE 12.1.2) and mangrove vegetation (RE 12.1.3). The majority of clearing is of saltpan vegetation (55.51 hectares) (Table 16). This vegetation includes areas that have been determined to be of relatively low habitat value for shorebirds, such as the North China Bay area (Figure 6) (URS, 2011; Rohweder *et. al*., 2011), so in some cases may be an over-estimate of habitat that supports reasonable numbers of shorebirds. However, intertidal mudflats and sandy beaches are generally not classified as a regional ecosystem but still provide shorebird habitat. For this reason, calculations based on determination of habitat as either providing foraging or roosting resources is provided in Section 6.2.2.

Table 17 Clearing amounts for saltpan and mangrove REs within the AOD

Project component	**Saltpan vegetation cleared (RE 12.1.2) (hectares)**	**Mangrove vegetation cleared (RE 12.1.3) (hectares)**	**Total**
LNG plant	15.6	0.79	16.39
LNG Jetty	1.89	1.69	3.58
Mainland tunnel launch site, including potential laydown and staging areas	32.5	0	32.5
Launch site 1 (and haul roads)	4.50	2.01	6.51
Red Rover Road site	0.5	0.61	1.11
TWAF 7 and access	0.52	0.21	0.73
Total (hectares)	**55.51**	**5.31**	**60.82**

6.2.2 Impacts on Foraging and Roosting Habitat

Four factors to assist in determining a 'significant' impact on important habitat for migratory shorebirds have been developed by DSEWPaC (DEWHA, 2009a). They are: habitat loss, habitat degradation, disturbance and direct mortality (Section 4.4). The category that specific project impacts (i.e., vegetation clearance, habitat fragmentation and increased risk of pollution of habitat) fit into is shown in (Table 18).

Using these factors, impacts on shorebirds within the survey area have been assessed (Table 18) based on the type of habitat (foraging or roosting) and its importance (either internationally or nationally important habitat under EPBC guidelines (DEWHA, 2009a)). Impacts on secondary and potential habitat were also assessed. Secondary habitat is utilised by shorebirds but not in the numbers required to constitute important habitat, while potential habitat has characteristics suggesting it could be important or secondary, but further information is required to confirm this (Section 4.3 provides further detail on these definitions). The magnitude of potential impact was classified as of major, high, moderate, minor or negligible impact significance (Section 4.4).

Table 18 Summary of main potential impacts to shorebirds from the project.

Impacts	Related project activities	Description	Impact category (From EPBC guidelines)
Vegetation clearing	· Vegetation clearing for access and construction purposes.	· Clearing may be either permanent or temporary (the community will be restored to original state as far as practicable).	· Habitat loss
Habitat fragmentation and impacts on wildlife corridors	· Vegetation clearing for access and construction purposes.	· Clearing may be either permanent or temporary.	· Habitat degradation
Introduced flora and fauna	· Construction of tracks for vehicle movement · Construction camps. · Vegetation clearing for access and construction purposes.	· Vehicles (including ships) and people may be vectors for pest flora. · The presence of people increases the amount of waste food, which may attract pest fauna. · Vegetation clearing may open up the canopy, increasing establishment/ growing conditions for pest flora.	· Disturbance, direct mortality and habitat degradation
Changes to hydrology and pollution	· Earthworks. · Spoil stockpiles. · Redirection/alteration of watercourse.	· Earthworks and spoil stockpiling potentially cause ASS issues, sediment mobilisation (airborne and	· Habitat degradation

Impacts	Related project activities	Description	Impact category (From EPBC guidelines)
	· Construction of hardstand areas.	waterborne). · Hardstand areas may channel stormwater runoff and decrease soil absorption.	
Direct disturbance to shorebirds	· Construction and operational lighting. · Construction and operational noise. · Vehicle movements, shorebirds are particularly sensitive to approach from the water (boats) (DEWHA, 2009b)	· Lighting and noise can have a more indirect effect. ·	· Disturbance and direct mortality

6.2.3 Important Habitat

No known important habitat will be cleared as part of the project. However there is a risk of increased disturbance around Clinton ash ponds, identified as important roosting habitat.

Clinton Ash Ponds

Key roosting habitat at Clinton ash ponds (determined to provide nationally important habitat for eastern curlew (Rohweder *et. al.,* 2011) and found to support the highest number of roosting shorebirds during current surveys will not be cleared as part of the project, however, a track to allow access to launch site 1 is proposed that will add to the already highly disturbed nature of this area. It is very important to note that not all track options are proposed to pass through this area. If this increased disturbance reduces the importance of this habitat then it would constitute a significant impact. The area is an artificial pond system that has a history of disturbance but has had recent counts in the range for nationally important habitat (Section 4.6). 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 station activities. This reclamation process is an ongoing activity at Clinton ash ponds.

It may be that birds are acclimatised to disturbance and increased traffic in this area will not significantly impact on them. However, there is a risk that disturbance from this project will elevate the site's overall disturbance to beyond a threshold that the local population of shorebirds can tolerate and will therefore become a significant impact to this area. This risk is difficult to quantify at this stage but upcoming surveys will assist in determining if there is a long term decline in this population.

Mainland Tunnel Launch Site:

The risk of a significant impact on potentially important foraging habitat (Targinie wetlands

area) is considered to be low since the area adjacent to this site, on the landward side of the mangroves, will be used as the tunnel launch site and installation of the tunnel will mean it will cross Targinie wetlands underground (approximately 35 metres below the surface). Traffic to the tunnel will be from the landward side, so that there will be a minor risk of potential pollution from construction activities and ongoing operational impacts such as runoff from hard surfaces(Table 18).

Potential roosting habitat is primarily identified at the landward side of the foreshore on Curtis Island and behind Targinie wetlands at the mainland tunnel launch site. At present these areas are primarily dry claypans and do not appear to support any shorebirds, however this could change during peak season, especially after rain. If this area met the criteria for important habitat under EPBC guidelines, even just briefly during the year after rainfall, there is potential that impacts to the shorebirds that utilise these areas could be significant where project works are planned, since such habitat is limited in the survey area (Appendix 1). At this time, it is expected that these areas will not provide habitat for sufficient numbers or diversity of shorebirds to meet important habitat criteria, however surveying these areas after rain during peak season over a number of visits, as proposed for the remainder of this study, are required to confirm this assessment.

6.2.4 Secondary Habitat

Secondary Foraging Habitat

The area of secondary foraging habitat that will be cleared (2.8 hectares) occurs at the LNG plant on Curtis Island. This area is saltpan vegetation (12.1.2), and has had shorebirds recorded there in low numbers (during these field surveys and by other studies – e.g., URS, (2011); BAAM, (2008)). Low numbers over time in this area, identified through several different surveys, suggest that this area is of only low to medium quality habitat for shorebirds and there will be only a small area of removal (Table 17). Impacts on surrounding areas, especially as some of this habitat will be reclaimed, are a possibility with increased run off from hardstand surfaces and increased usage by boats and personnel. No secondary roosting habitat was identified during surveys.

A small area of potential foraging or roosting habitat has been identified at site 7, adjacent to the Clinton ash ponds (site 5 and 6). This area may be used for foraging during very high tides when other areas are inaccessible, or as roosting habitat after rainfall. Field surveys to date have not detected any shorebird species, but this may change after rainfall or during peak season spring tides.

6.3 Significance of impacts to Migratory shorebirds

Significance of impacts had two main components, sensitivity of the habitat and magnitude of the impact.

6.3.1 Sensitivity

Each of the defined habitat types within the survey area were assigned a sensitivity score, based on conservation status, uniqueness/rarity non resilience to change and difficulty in replacing (Table 19). Overall sensitivity varied among habitats from high down to low, with established important habitat scoring high, down to low for secondary foraging habitat. There were no areas of very high sensitivity.

Table 19 Summary of sensitivity values for all habitats within the survey area

Habitat	Conservation Status	Uniqueness/rarity	Non resilience to change	Difficulty in replacing	Overall sensitivity
Potential foraging habitat	Medium	Medium-high -Six areas of similar habitat found within Port Curtis (Figure 8).	Medium -high non resilience, susceptible to pollution and degradation	Medium – high although foraging habitat exists within Port Curtis and surrounds, it is already heavily utilised. Also difficult to build/replicate.	Medium-high
Important roosting habitat	High	Medium – more than 10 nationally important roosting sites are recognised within the Port Curtis area (Figure 8).	Low - medium this area is an artificial wetland subject to a high level of disturbance, however the point that this disturbance is detrimental to the birds is not known.	Low-medium – shorebird roost sites are limited in Port Curtis, however enhancement or construction of compensatory habitat is possible and has been done successfully.	Medium - high
Secondary foraging habitat	Low	Low- similar habitat throughout study area.	Medium non resilience, susceptible to pollution and degradation	Medium – secondary foraging habitat exists throughout study area, however, is finite and difficult to build/replicate	Low - medium
Potential roosting habitat	Medium	Medium – some similar habitat but only limited saltpan habitat in close proximity to appropriate foraging areas	Unknown at this stage	Unknown at this stage	Unknown at this stage.
Potential roosting and foraging habitat	Low-medium	Low- similar habitat throughout study area, relatively small area.	Medium non resilience, susceptible to pollution and degradation	Medium – similar habitat exists throughout study area, however, is finite and difficult to build/replicate	Low- medium

Table 20 Summary of significance of impacts on shorebird habitat

(Figure 6).

*This is the percentage of clearing of the total in the survey area for that habitat (see Table 14).

	Project phase	Potential foraging habitat (QPWS data)#	Important roosting habitat (Ecosure data and literature)	Secondary foraging habitat (Ecosure data)	Potential roosting and foraging habitat (Ecosure data)	Potential roosting habitat# (Ecosure data)	Total area cleared
Key sites (Refer to Table 13 for further information)		11 & 12	5 &6 (Clinton ash ponds)	2,8,10,15,16,20	7	1,9,13	
Key components of the project that may impact on this habitat (Figure 2) (Table 13)		Tunnel launch site and proximity to proposed launch site 4N	Proposed launch site 1	LNG plant foreshore area, indirect impacts from dredging down Calliope River	Access track to launch site 1	Tunnel launch site and spoil area, LNG plant	
Sensitivity		Medium – high	Medium - high	Low - medium	Medium	Unknown at this stage	
Habitat loss (hectares)	All	0	0	2.8 (4%) *	1.4(20%)	45.0 (15%)*	51.9 (5%)*
Habitat degradation	Construction- Expected duration: 40 months)	Potential disturbance to surrounding habitat from changes to hydrology and fragmentation of habitat as well as changed hydrology regimes in this area.	Potential changes in hydrology and sedimentation/pollution from construction activities in surrounding areas, including a track for vehicles adjacent the Clinton ash ponds	Infilling and reclamation to occur in a small area of site 10, may lead to fragmentation and pollution in other parts of this area	Potential indirect impacts on the habitat from excavation and construction of the track. Increased potential sedimentation and run off	Increased fragmentation and pollution/run off in surrounding areas, if water quality affected, may extend to areas well away LNG plant or tunnel launch site, risk of damage to vegetation and encroachment of weeds from unofficial track making through vegetation from construction staff and others	

	Project phase	Potential foraging habitat (QPWS data)#	Important roosting habitat (Ecosure data and literature)	Secondary foraging habitat (Ecosure data)	Potential roosting and foraging habitat (Ecosure data)	Potential roosting habitat# (Ecosure data)	Total area cleared
	Operation - Expected duration: 30 years)	Possible increase in pollution and sedimentation runoff for surrounding habitat	Habitat fragmentation and risk of encroachment from vehicles going off designated tracks, risk of pollution and sedimentation	Low level ongoing impacts from hardstands surfaces in this area (pollution and sedimentation), covers only a small area though.	On-going increased pollution and sedimentation from track, including oil and grease from vehicles.	Increased risk of runoff causing pollution of surrounding habitat and water	
Disturbance	Construction- Expected duration: 40 months).	Noise, light and activity disturbance from construction activities potentially significant for nearby areas.	Noise, light and activity disturbance from construction activities potentially significant for nearby areas.	Noise, light and activity disturbance from construction activities potentially significant for nearby areas.	Noise, light and activity disturbance from construction activities potentially significant for nearby areas, may contribute to disturbance of Clinton Ash Pond populations.	Noise, light and activity disturbance from construction activities potentially significant for nearby areas.	
	Operation- Expected duration: 30 years)	Increased long term activity, from boats and other vehicles. Particularly in the launch site near Friend point (if that goes ahead).	Increase in activity of vehicles within the area, however this area already subject to reasonably high levels of vehicle usage at peak times in surrounding areas.	Increased ongoing activity, especially boat traffic onto and off Curtis Island	Increased personnel and vehicle traffic, artificial light from cars at night utilising the track, already subject to relatively high levels of activity, although slightly removed from existing tracks, compared to site 5 & 6.	Increased human and vehicle traffic in surrounding areas, possible disturbance from flare and artificial lighting.	
Direct mortality	Construction- Expected duration: 40 months).	Slightly increased risk of bird strike during construction activities and increased numbers of boats in the area.	Greater risk of bird strike during construction activities and increased numbers of boats in the area.	Greater risk of bird strike during construction activities and increased numbers of boats in the area. Slight increase in risk of death from chemical or oil spilling into the water.	A small risk of bird strike from construction activities but given it is a small track through this area; it is likely birds would avoid the track through this area.	Greater risk of bird strike from construction activities and increased numbers of boats in the area. Slight increase in risk of death from chemical or oil spilling into the water.	

	Project phase	Potential foraging habitat (QPWS data)#	Important roosting habitat (Ecosure data and literature)	Secondary foraging habitat (Ecosure data)	Potential roosting and foraging habitat (Ecosure data)	Potential roosting habitat# (Ecosure data)	Total area cleared
	Operation- Expected duration: 30 years)	An unknown, but probably small risk of bird strike with boats and other vehicles accessing launch and tunnel sites, and permanent infrastructure.	Slightly increased risk of bird strike due to use of vehicles along the track adjacent to this area.	Potential increased risk of strike by a boat. The magnitude of this risk is unknown.	If this area is periodically used by shorebirds, there is an increased risk of motor vehicle strike during those times.	Main ongoing disturbance would be increased vehicle (car and boat) traffic, though some species have been shown to habituate (e.g. bar-tailed godwits (Rohweder and Charley 2010).	
Significance of potential (unmitigated)l impact		Moderate potential impact. No habitat will be cleared. However, there is a high risk of habitat degradation in surrounding areas and disturbance to birds foraging nearby.	Moderate– high: overall impact will depend on further information regarding: a) confirmation of Clinton ash ponds as a nationally important shorebird roosting site (surveys in peak season will assist in confirming this) b) ability of birds to acclimatise to increased disturbance from usage of the vehicle track.	Minor potential impact. This habitat does not constitute important foraging habitat under EPBC guidelines (DEWHA 2009a), but is utilised by shorebirds as determined during field surveys (Appendix 4 & 5).	Minor - moderate, unlikely to be important habitat and if it is, would be only used sporadically during wet conditions. It is not yet known if shorebirds utilise this site so difficult to predict impacts, however area to be removed is small but the area is a small discrete area anyway so may lose any habitat value. Further investigation after rain and at different tide lengths required. It is likely that birds use this area only sporadically, if at all.	Impact to these areas is unknown at this stage due to unknown quality of the habitat. Further information will be gathered during wet season (peak period) surveys. If These areas are important, even only periodically then there is a high potential impact. Given size of these areas and proximity to areas recently regularly surveyed as part of the approval process for other LNG plants, it seems unlikely that these areas would support sufficient numbers of birds to be considered important habitat, however it cannot be ruled out at this stage.	

	Project phase	Potential foraging habitat (QPWS data)#	Important roosting habitat (Ecosure data and literature)	Secondary foraging habitat (Ecosure data)	Potential roosting and foraging habitat (Ecosure data)	Potential roosting habitat# (Ecosure data)	Total area cleared
Specific Mitigation Measures (further detail and general mitigation in Section 7)		This area will require strict adherence to CEMP requirements, use of no-go zones and in particular sediment and pollution management strategies, use of low impact lighting during construction also important.	• 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). • 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.	General mitigation measures as per Section 7 of this report and Chapter 17 of EIS (Coffey Environments, 2012).	General mitigation measures as per Section 7 of this report and Chapter 17 of EIS (Coffey Environments, 2012).	Most of this area will be cleared, so few mitigation measures for that particular area. If determined to be important, provision of additional habitat in the Clinton ash ponds areas (see important roosting habitat), may be sufficient to offset impacts within this area.	
Significance of residual impacts		Assuming minimal runoff and pollution, which is critical factor, a minor impact significance to this area could be obtained.	Moderate – still requires investigation of significance but given it will not be cleared, mitigation measures should be able to reduce impact to acceptable levels.	Minor impact.	Minor impact.	Unknown at this stage.	

#assessed as if it is important roosting habitat however, this is to be determined during peak season surveys. No published data identifies these areas as important habitat, however habitat assessment during August and September suggests there is potential for these areas to be used for short term roosting during very high tides or rain.

6.4 Impacts on NCA Listed Threatened Species

One migratory and two resident shorebird species that have been recorded within Port Curtis are listed under the NCA: eastern curlew, beach stone-curlew and sooty oystercatcher (Table 10 and 12). Beach stone-curlew is listed as vulnerable under the NCA and occurs singly or in pairs, in low numbers throughout the Port Curtis area, particularly in the Graham Creek and mainland coastline areas. Population estimates for this species in Port Curtis are low (around six individuals) (Rohweder *et. al.,* 2011)(Table 12), with surveys in 2012 estimating a population of nine individuals (Ecosure unpublished data 2012). Some individuals may forage within areas that will be cleared or disturbed as part of the project, but they are more frequently located north of the study area. Mitigation measures to protect migratory shorebird habitat proposed as part of this project (Section 8), will also assist in reducing any residual impacts on this species.

The sooty oystercatcher is listed as near threatened under the NCA and generally occurs on reefs, rock platforms and sandy beaches, only occasionally occurring in estuaries (Table 11). This species is unlikely to rely on the habitat that occurs within the AOD. Although an occasional visitor may be recorded in and around this area, it is unlikely that clearing and disturbance would impact significantly on this species. Mitigation measures recommended for migratory shorebirds will also assist in reducing any residual impacts on this species.

The eastern curlew is listed as near threatened under the NCA. This species is well-represented in Port Curtis with the site recording sufficient numbers of this species to be internationally important. Clinton ash ponds and the opposite bank of the Calliope River are key areas for this species within the survey area. Protection of this area and important habitat for this species across Port Curtis, as per EPBC guidelines (DEWHA, 2009a), will ensure that there is no significant impact on this species.

The Australian painted snipe is also listed under both the EPBC Act and NCA, however as discussed in Section 4.7 there is no habitat for this species within the AOD and so it is not being assessed in this report.

6.5 Management Measures

6.5.1 Further Survey and Assessment

Further surveys taking place in late 2012/early 2013 will determine the importance of potential roosting habitat behind Boatshed Point on Curtis Island and potential roosting and foraging habitat near Targinie wetlands. If potential roosting areas are utilised by significant numbers of shorebirds after wet weather then they will be assessed against EPBC criteria (DEWHA, 2009b) regarding its importance. Counts of foraging birds at Targinie wetlands will also assist in determining if this area is important habitat for foraging shorebirds.

Further roosting surveys will also assist in determining the current importance of Clinton ash ponds and if recent surveys showing fewer birds are the beginning of a trend down in this area or just an anomaly.

6.5.2 Preliminary Recommendations for Management

Due to the interim nature of this assessment, it is not possible to determine definitively at this time if there will be significant impact to shorebird habitat, however there are a number of mitigation measures that will reduce the impact of the project on shorebird habitat, regardless of the final potential impact.

Mitigation measures proposed are consistent with those presented in the EIS, and the commitment number from the EIS given thereafter in parentheses. New mitigation measures proposed for consideration in the SREIS to address impacts identified in the shorebirds technical study, are those without a commitment number in parentheses after the mitigation measure.

Arrow Energy will develop a shorebird management and monitoring plan for approval prior to construction commencing, integrated with current similar projects being undertaken within the study area and surrounds. The plan will include the following mitigation measures applicable to all types of shorebird habitat in and adjacent to the project area:

- Arrow Energy will develop a monitoring program to assess impacts on the shorebird population, if the final report identifies significant impacts on the shorebird population of Port Curtis are likely.
- 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).
- Test and treat all discharges to Port Curtis to meet water quality criteria, as required, prior to discharge (C16.04).
- 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 (C13.12).
- Develop an acid sulphate 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 (C12.17).
- Direct lighting for the access track to launch site 1 away from the adjacent ash ponds. Determine areas (if any) requiring to be offset in consultation with DERM and DSEWPC and other government stakeholders prior to commencement of construction (C17.02).

7 Regional and Cumulative Impacts

7.1 Overview

The Port Curtis area is currently undergoing significant expansion and further works are planned over the next 30 years (GPC, 2012). There are significant expansions within the study area planned, including Wiggins Island Coal Export Terminal (WICET), Fishermans Landing, Western Basin Dredging and Disposal Project and the LNG precinct on Curtis Island (three other LNG plants are currently being constructed adjacent to the proposed site of this project) (Figure 4 & 8; Table 18). These projects are likely to require clearing of intertidal vegetation and saltpan vegetation on both the mainland and Curtis Island, as well as create disturbance for shorebirds roosting nearby.

Of particular concern are areas of intertidal vegetation that are currently undisturbed that are slated for large, new infrastructure projects (e.g., Wiggins Island and Friend Point). Although not necessarily a significant impact to shorebirds of the area on their own, they present a potentially significant cumulative effect. The magnitude of this effect is difficult to determine without detailed knowledge on all proposed projects, however if most of the proposed projects go ahead, areas of existing habitat will be cleared and the numbers of ships using the harbour will greatly increase. This brings potential disturbance to birds and increased pollution that is likely to degrade shorebird habitat in many areas of Port Curtis.

Planned projects do however leave large areas of shorebird habitat uncleared (e.g., Pelican Banks (Figure 4), and in Port Curtis and beyond (Figure 8)). The continued protection of these and other areas around Port Curtis deemed to be important or potentially important habitat for shorebirds will be critical to the protection of important habitat in this area.

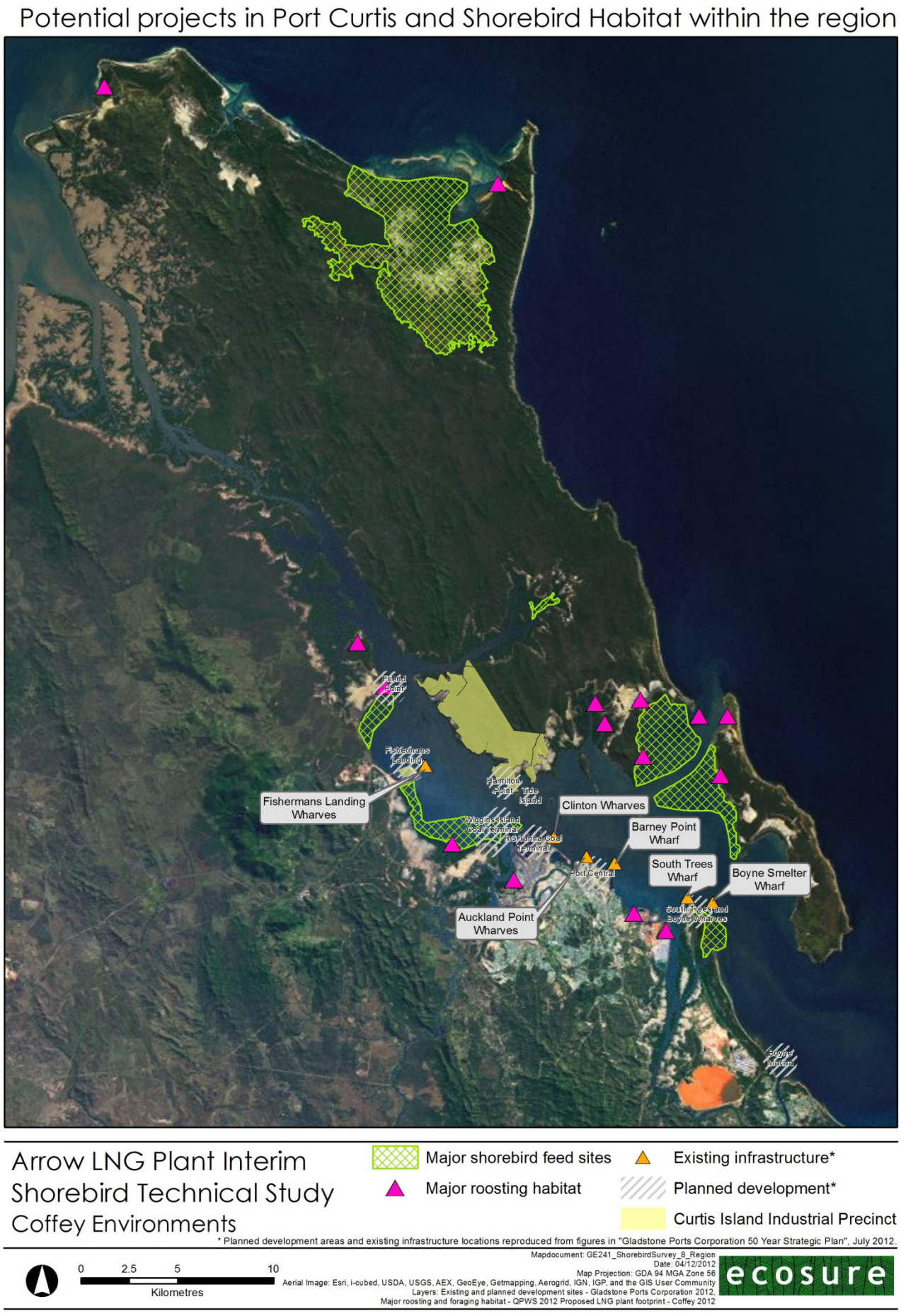

Figure 8 Potential projects in Port Curtis and shorebird habitat

Table 21 Summary of key proposed projects within Port Curtis (source: GPC, 2012)
(Refer to Figure 4&8 for locations).

Area/Precinct	Key proposed project components
Curtis Island	· LNG Precinct this project is proposed to be added to this precinct, creating four LNG plants within the same small area (Figure 4) · 300 hectares is earmarked for development at Hamilton point, including 4 receiving berths · road and rail bridge proposed
Friend Point	· proposed development planned to service the Targinie precinct of Port Curtis · bulk solid or liquid cargo · storage facility
Wiggins Island Coal Export Terminal	· coal export terminal that will double coal export capacity · first shipment planned for 2015 · designed to take advantage of main road and rail line in close proximity · within the survey area of this project
Tide Island	· natural water depth makes it an ideal location for bulk liquid berth facilities · Storage for this facility will be located on Curtis Island · pipelines from storage to the berth facilities will be designed to preserve access by small craft
Channel Duplication	· a duplication of the current excavated channel (Gatcombe and Golding channels)is proposed adjacent to it · the entire outer harbour channel may require duplication in the future
Fisherman's Landing	· plans are for a total of 11 (now 4) berths · possible commodities include bulk, break bulk and liquid bulk · will include a public boat ramp
RG Tanna Coal Terminal	· a fifth berth is planned, taking annual capacity from 75 Mtpa to 90-100 Mtpa

7.2 Impacts of Secured Projects on Shorebirds

As part of the cumulative impact assessment completed for the terrestrial assessment for this project, Ecosure (2011) assessed 15 projects within the Port Curtis region that were sufficiently progressed to be likely to proceed. Vegetation clearance for each of these projects was calculated and divided based on regional ecosystem classification. This will not cover all potential habitat, since much prime foraging habitat is intertidal and therefore not included in regulated vegetation classification. However, clearing of saltpan (RE 12.1.2) and

mangrove (RE 12.1.3) gives some indication of the cumulative impacts of these projects.

A total of 121 hectares of saltpan vegetation will be cleared, which includes clearing for this project, Australia Pacific LNG and Gladstone Nickel Project (Coffey Environments, 2012). The total clearing for all projects for mangrove vegetation is 20 hectares, with most of this occurring as a result of this project and the other LNG plants on Curtis Island. This does not take into account impacts on unregulated vegetation, especially intertidal mudflats that may be directly or indirectly impacted by the clearing of this vegetation since it is adjacent to these REs.

Indirect impacts, such as increased disturbance and potential habitat degradation to shorebirds and their habitat as a result of all these projects, cannot be quantified based on available information, but are likely to add to the cumulative impacts within this region. Intertidal vegetation clearance is not included in this estimate, but is an important foraging resource for shorebirds and likely to be impacted to some degree if adjacent saltpan and mangrove vegetation is being removed.

8 Discussion and Conclusion

8.1 Summary of Results

The objective of this study is to summarise relevant existing data for shorebird presence and potential impacts and to provide an interim report on field surveys carried out within the survey area for the project and any areas that are at risk of being impacted by the project (Port Curtis region was assessed as part of literature review, referred to as the study area).

Two out of five planned surveys have been carried out during the overwintering season (August) and at the beginning of the southward migration (September), and the data for these surveys along with a summary of previous reports and existing data was presented.

Low species richness and overall abundance of shorebirds were detected during August, which expected during the over-wintering period when populations are comprised primarily of non-breeding individuals (often juveniles) of most species (Rohweder and Charley, 2010). Shorebirds were more numerous in September and eight species, as opposed to three in August, were recorded. Abundance was also higher in September with an estimate of 189 individuals, versus 61 in August. Further surveys are scheduled for peak season and northward migration of 2012/13.

The Port Curtis area has been recently surveyed regularly for shorebirds due to the many planned infrastructure developments occurring (e.g., extending the shipping channel, three other LNG developments on Curtis Island). As a result of the findings of these additional surveys, Port Curtis now qualifies as an internationally important site for the eastern curlew (Rohweder *et. al.,* 2011). It had previously been recognised as nationally significant due to the occurrence of at least;

- 15 species of migratory shorebirds.
- 2000 migratory shorebird individuals.

Recent surveys in January 2011 throughout Port Curtis show a maximum population estimate of 2,986 individuals and 25 species (migratory shorebirds accounting for 18 of these species and 2,666 individuals (Rohweder *et. al.,* 2011)) and the area has been upgraded to an internationally important site for eastern curlew.

Surveys to date indicate the occurrence of important roosting habitat and potential foraging and roosting habitat within the area surveyed. No areas defined as important under EPBC guidelines will be cleared for the project, however there is potential for disturbance and habitat degradation to important roosting habitat at the Clinton ash ponds (an artificial, highly disturbed roosting habitat).

Field surveys for this study detected the most number of birds at these two locations and enough eastern curlews to meet the criteria as nationally important habitat for this species at Clinton ash ponds. This finding concurs with findings in Rohweder *et. al.*, (2011), which found this site was still nationally important habitat for the eastern curlew, but counts for all

species at this site were down compared with previous years (a total of 189 individuals and only eight species, compared with previously recorded maximum counts of up to 1,420 for a single species and more than 15 species). Data from field surveys during peak season as part of the current study will be used to determine if this trend is on-going, or an anomaly.

Areas of potential roosting habitat were also identified, although no birds were present at the time of survey. These areas constituted the largest area of potential or actual habitat to be removed. Unlike many other sites within the study area, it appears that this habitat has rarely received targeted surveys for migratory shorebirds, which may only utilise the site rarely, perhaps after rain and/or during particularly high spring tides in peak season. A key component of finalising this impact assessment will be determining if these areas are used and if so, by how many birds.

8.2 Potential Impacts

Potential impacts to important shorebird habitat were assessed using four criteria: habitat loss, habitat degradation, disturbance and direct mortality (DEWHA, 2009b). No loss of previously determined important habitat will occur as a result of the project. However, there is a risk of degradation and disturbance. Assuming that appropriate management plans for potential threats such ASS, degraded water quality and weeds, are developed and adhered to, there should be minimal residual impact.

There is the potential for disturbance and indirect impacts from increased travel in the vicinity of important roosting habitat as a result of one of the options for an access track to launch site 1 passing Clinton ash ponds (refer to Section 4.6.3 for site description of the Clinton ash ponds i.e., artificial ponds within a highly disturbed industrial environment.).

Secondary foraging habitat was defined as habitat that is unlikely to support the numbers of birds required to be defined as important habitat, but still supports small numbers of foraging birds; and potential habitat. Potential roosting habitat occurs in claypan areas behind the foreshore on Curtis Island and potential foraging habitat adjacent to Targinie wetlands.

Areas of potential roosting habitat did not support any shorebirds when surveyed, but it is possible that they would utilise these sites after rain (claypans have been shown to support increased numbers after rain in the Port Curtis area (Rohweder and Charley, 2009)). Surveys during the peak season in December/January will assist in determining the use of this area during spring tides, and possibly also after rain. Determination of the significance of this habitat is essential, as any potential subsequent determination as important habitat could result in the identification of a significant impact. Potential foraging habitat adjacent to Targinie wetlands will not be cleared and the risks of disturbance or degradation to the habitat in that area can be managed by adhering to standard environmental guidelines for the management of ASS, erosion and sediment control and construction hours. Further surveys will attempt to determine the importance of this area in case of some residual impact.

8.3 Compliance with EPBC Survey Guidelines for Migratory Shorebird Assessment

EPBC guidelines (DEWHA, 2009a and b) provide detailed guidance on the requirements of surveys carried out as part of impact assessment for migratory shorebirds. Key components for survey effort and reporting identified within the EPBC guidelines for migratory birds (DEWHA, 2009b) include: minimum survey coverage; survey timing (including surveying birds at times of lowest possible disturbance to record the highest numbers of birds supported by a site); survey effort; data requirements; and number of observers and experience level.

How each of the requirements has been or will be addressed as part of this study is shown in Appendix 6. This study has been designed to ensure it meets all requirements for shorebirds surveys as listed in EPBC Act guidelines (DEWHA, 2009b) (Appendix 6).

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Appendix 1
Habitat Descriptions for each Site Surveyed

(Refer to Figure 3 for site locations and aod locations and key components of infrastructure for each site is shown in Table 12)

Site Reference and location	Habitat Description	RE	Photos
1 – LNG plant, Curtis Island	Claypan, some inundation in August but dried out in September. Little vegetation in centre, low shrubs. Potential roosting habitat after rain or very high tides. Surrounded by *Eucalyptus crebra woodland*.	12.11.6/12.11.14 *Eucalyptus crebra, E. tereticornis* woodland on metamorphics ± interbedded volcanics.	

Site Reference and location	Habitat Description	RE	Photos
2 - LNG plant, Curtis Island	Rocky beach with mudflats at low tide.. Signs of disturbance, including a path. Mangroves at rear extend back by >300m. Foraging habitat.	12.1.3 and 12.11.6 Mangrove shrubland to low closed forest on marine clay plains and estuaries.	
3 – LNG plant, Curtis Island (Boatshed Point)	Rocky point and stony beach, very narrow band of mudflat and low coastal woodland at rear. Foraging habitat.	12.1.2 and 12.11.6/12.11.14- Contains saltpan vegetation including grassland, herbland and sedgeland on marine clay plains.	

Site Reference and location	Habitat Description	RE	Photos
4 – LNG plant, Curtis Island	Rocky beach with very sparse woodland behind. Limited potential foraging habitat.	12.11.6 *Corymbia citriodora, Eucalyptus crebra* open forest on metamorphics ± interbedded volcanic.	
5 – Launch Site 1, Clinton ash ponds and riparian area adjacent to Calliope River.	Steep rocky habitat on riverside of this area. Mangrove that has been cleared and disturbed. Muddy flat adjacent to river with some samphire vegetation, marginal foraging habitat, better foraging habitat, good roosting site at rear in artificial ponds. Good roosting habitat on rising tide at back of this area. Flooded at full high tide. Good potential habitat for common sandpiper and grey-tailed tattler.	12.11.6	

Site Reference and location	Habitat Description	RE	Photos
6 - Launch Site 1	Narrow band of mudflat on river side of this area. Clinton ash ponds at rear. Artificial wetland habitat in and around several ponds. Note recent addition of mulch. Limited foraging habitat, good roosting habitat.	N/A	
7- Launch Site 1	Mudflat with sparse mangrove interspersed. Potential foraging and/or roosting habitat adjacent to site 6 down Calliope on other side of fence. May flood in spring high tide in summer, especially after rain.	12.1.3	

Site Reference and location	Habitat Description	RE	Photos
8 - Launch Site 1	Rocky shoreline, steep rocky bank with little vegetation at rear. In front of processing facility. Marginal foraging habitat. High level of disturbance.	N/A	
9 - Mainland tunnel launch site	Claypan with mangrove surrounding. Very dry with many piles of dumped household waste and other disturbance (tyre tracks), less disturbed toward water. Potential roosting habitat.	12.1.2 Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains.	

Site Reference and location	Habitat Description	RE	Photos
10 – LNG plant, Curtis Island	Oyster beds. Narrow band of rocky shoreline next to claypan. Hill behind, vegetation very low. Vegetation along shore. Mangrove to west. Foraging habitat.	12.1.2 and 12.1.3	
11 –Tunnel launch site (with tunnel underground)	Intertidal mudflats appear to be quite extensive, although accessed at high tide so need to be confirmed during peak surveys by riding the tide into this area. Potentially important foraging habitat. Mangrove at rear. Roosting habitat at rear, with strip of mangrove between this area and Site 9.	N/A (is periodically inundated part of harbour)	

Site Reference and location	Habitat Description	RE	Photos
12 – adjacent to Launch site 1, but no clearing	Narrow band of primarily rocky beach with some mudflat. Stunted mangrove at rear. Limited Foraging habitat.	N/A	
13 LNG plant, Curtis Island	Claypan, dry, possibly important in summer/after rain but not in use at time of surveys. Potential roosting habitat.	12.11.6/12.11.14 *Corymbia citriodora, Eucalyptus crebra* open forest on metamorphics ± interbedded volcanic, surrounding this claypan.	

Site Reference and location	Habitat Description	RE	Photos
14 – no AOD in vicinity, potential impact from altered water levels as a result of dredging at mouth of Calliope	Mangrove island, shallow potential foraging habitat surrounding this island, accessed at high tide, need to confirm foraging habitat in peak season surveys. Potential sandpiper roost on island.	12.3.3/12.1.2/12.1.3	
15 – adjacent to LNG plant, Curtis Island	Mudflat at low tide. Signs of disturbance-path. Mangroves extend back by >300m. Flat mangrove area. Primarily foraging habitat.	12.1.3 Mangrove shrubland to low closed forest on marine clay plains and estuaries.	

Site Reference and location	Habitat Description	RE	Photos
16 - no AOD in vicinity, potential impact from altered water levels as a result of dredging at mouth of Calliope	Narrow band of mud flat, with mangrove at rear. Some areas stripped of vegetation and quite disturbed. Limited foraging habitat	12.1.3	
17 - no AODF in vicinity, potential impact from altered water levels as a result of dredging at mouth of Calliope	Narrow band of mud flat, with mangrove at rear. Provides limited potential foraging habitat. Cranes at back of this area, but quite adjacent to the river. Limited foraging habitat.	12.1.3 Mangrove shrubland to low closed forest.	
18- no AOD in vicinity, potential impact from altered water levels as a result of dredging at	Some mudflat and mangrove, very disturbed sections. Limited potential foraging habitat.	12.1.3/12.1.2 Combination of vegetation with mostly mangrove shrubland to low closed forest followed by saltpan vegetation including grassland and herbland on	No photo available

Site Reference and location	Habitat Description	RE	Photos
mouth of Calliope		marine clay plains.	
19- no AOD in vicinity, potential impact from altered water levels as a result of dredging at mouth of Calliope	Mangrove island and limited disturbed areas of mudflat along river. Limited potential foraging habitat.	12.1.3/12.11.6/11.12.1 Mangrove shrubland to low closed forest on marine clay plains and estuaries with *Corymbia citriodora, Eucalyptus crebra* open forest further inland. Transmission line crossing and substation. Vegetation on either side has strip of mangrove through into open woodland.	No photo available
20 - outside of AOD, may be impacted by increased waterway traffic	Area has sandy beach at the front followed by water and a rocky beach with woodland. This area provides good potential habitat for sanderling, terek sandpiper and stints.	12.11.6	

Site Reference and location	Habitat Description	RE	Photos
21- outside of AOD, may be impacted by increased waterway traffic	Small island consisting of mangrove shrubland to low closed forest on marine clay plains and estuaries. Limited, if any foraging habitat. Unlikely to be utilised by anything but an occasional shorebird	12.1.3	No photo available

Appendix 2 Key Regional Ecosystem Descriptions

Regional Ecosystem	Short Description	Detailed Description	Vegetation Management Status	Biodiversity Status
Shorebird Habitat				
12.1.2	Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	Saltpan vegetation comprising *Sporobolus virginicus* grassland and samphire herbland. Grasses including *Zoysia macrantha* subsp. macrantha sometimes present in upper portions of tidal flats. Includes saline or brackish sedgelands. Occurs on Quaternary estuarine deposits. Marine plains/tidal flats.	'Least Concern'	'No Concern at present'
12.1.3	Mangrove shrubland to low closed forest on marine clay plains and estuaries	Mangrove shrubland to low closed forest. Occurs on Quaternary estuarine deposits.	'Least Concern'	'No Concern at present'
Adjacent REs				
12.11.6 (and 12.11.14)	*Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics	Open-forest to woodland of *Corymbia citriodora* generally with *Eucalyptus crebra*. Other species such as *Eucalyptus fibrosa* subsp. fibrosa, *E. exserta, E. tereticornis, E. moluccana, E. melanophloia, Angophora leiocarpa* may be present in scattered patches or in low densities. Understorey grassy or shrubby. Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics. Drier habitats than RE 12.11.5.	'Least Concern'	No Concern at present
12.11.7 (and 12.11.12)	*Eucalyptus crebra* woodland on metamorphics +/- interbedded volcanics	*Eucalyptus crebra* woodland. Other species such as *Corymbia clarksoniana* may be present in low densities or in patches. Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics. (BVG1M: 13c)	'Least concern'	'No concern at present'

Regional Ecosystem	Short Description	Detailed Description	Vegetation Management Status	Biodiversity Status
12.11.12	Araucarian complex microphyll vine forest on metamorphics +/- interbedded volcanics; northern half of bioregion	Microphyll and microphyll/notophyll vine forest +/- *Araucaria cunninghamii*. Characteristic species include *Archidendropsis thozetiana, Argyrodendron* sp. (Kin Kin W.D.Francis AQ81198), *Croton acronychioides, Cupaniopsis simulata, Dendrocnide photinophylla, Diospyros geminata, Drypetes deplanchei, Ficus virens, Cryptocarya bidwillii, Planchonella myrsinifolia, Pleiogynium timorense, Vitex lignum-vitae* and *Vitex acuminata*. In places this RE is actively invading adjacent eucalypt forest in absence of fire (e.g. Goodnight Scrub). Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics. (BVG1M: 5a)	'Of concern'	'Of concern'
12.11.14	*Eucalyptus crebra, E. tereticornis* woodland on metamorphics ± interbedded volcanics.	*Eucalyptus crebra, Eucalyptus tereticornis* grassy woodland. Other species including *Eucalyptus melanophloia, Corymbia clarksoniana, C. erythrophloia, C. tessellaris* and Angophora spp. may be present in low densities or in patches. Mid-layer generally sparse but can include low trees such as *Acacia bidwillii, Capparis* ssp., *Dodonaea triquetra, Alphitonia excelsa* and *Xanthorrhoea* spp. Occurs on mid and lower slopes on Paleozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics.	'Of Concern'	'Of Concern'

Appendix 3
Listing of Migratory Species under International Treaties

Scientific Name	Common Name	Agreement/Convention			
		Bonn	CAMBA	JAMBA	ROKAMBA
Actitis hypoleucos	common sandpiper	A2H		Listed	
Arenaria interpres	ruddy turnstone	A2H	Listed	Listed	Listed
Calidris acuminate	sharp-tailed sandpiper	A2H	Listed	Listed	Listed
Calidris alba	sanderling	A2H	Listed	Listed	
Calidris canutus	red knot	A2H	Listed	Listed	Listed
Calidris ferruginea	curlew sandpiper	A2H	Listed	Listed	Listed
Calidris melanotos	pectoral sandpiper	A2H		Listed	Listed
Calidris ruficollis	red-necked stint	A2H	Listed	Listed	Listed
Calidris subminuta	long-toed stint	A2H	Listed	Listed	Listed
Calidris tenuirostris	great knot	A2H	Listed	Listed	Listed
Charadrius bicinctus	double-banded plover	A2H			
Charadrius mongolus	lesser sand plover	A2H	Listed	Listed	Listed
Charadrius veredus	oriental plover	A2H		Listed	Listed
Gallinago hardwickii	Latham's snipe	A2H	Listed	Listed	Listed
Gallinago megala	Swinhoe's snipe	A2H	Listed	Listed	Listed
Gallinago stenura	pin-tailed snipe	A2H	Listed	Listed	Listed
Glareola maldivarum	oriental pratincole		Listed	Listed	Listed
**Heteroscelus brevipes/Tringa brevipes*	grey-tailed tattler	A2H		Listed	
Heteroscelus incanus	wandering tattler	A2H		Listed	
Limicola falcinellus	broad-billed sandpiper	A2H	Listed	Listed	Listed
Limnodromus semipalmatus	Asian dowitcher	A2H	Listed	Listed	Listed
Limosa lapponica	bar-tailed godwit	A2H	Listed	Listed	Listed
Limosa limosa	black-tailed godwit	A2H	Listed	Listed	Listed
Numenius madagascariensis	eastern curlew	A2H	Listed	Listed	Listed
Numenius minutus	little curlew	A2H	Listed	Listed	Listed
Numenius phaeopus	whimbrel	A2H	Listed	Listed	Listed
Phalaropus lobatus	red-necked phalarope	A2H	Listed	Listed	Listed
Philomachus pugnax	ruff	A2H	Listed	Listed	Listed
Pluvialis fulva	Pacific golden plover	A2H	Listed	Listed	Listed
Pluvialis squatarola	grey plover	A2H	Listed	Listed	Listed
Tringa brevipes			Listed		Listed
Tringa glareola	wood sandpiper	A2H	Listed	Listed	Listed
***Tringa incanus*	wandering tattler		Listed		
Tringa nebularia	common greenshank	A2H	Listed	Listed	Listed
Tringa stagnatilis	marsh sandpiper	A2H	Listed	Listed	Listed
Tringa totanus	common redshank	A2H	Listed		Listed
Xenus cinereus	Terek sandpiper	A2H	Listed	Listed	Listed

*refer to *Tringa brevipes* for CAMBA and ROKAMBA listing;**refer to *Tringa incanus* for JAMBA listing A2H: species is member of a family listed in Appendix 2 of the Bonn Convention.

Appendix 4
Total Species for August (all avian species seen are recorded)

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Notes	Survey effort (estimate)	
											Roosting	Foraging
17/08/2012	8:00	rising	<5	S-SW	1	*Numenius madagascariensis*	eastern curlew	2	R			
17/08/2012	8:00	rising	<5	S-SW	1	*Vanellus miles*	masked lapwing	4	R			
17/08/2012	9:15	high falling	<5	S-SW	5	*Limosa lapponica*	bar-tailed godwit	36	R			
17/08/2012	9:15	high falling	<5	S-SW	5	*Numenius madagascariensis*	eastern curlew	24	R			
17/08/2012	9:15	high falling	<5	S-SW	5	*Numenius phaeopus*	whimbrel	1	R			
17/08/2012	9:15	high falling	<5	S-SW	5	*Vanellus miles*	masked lapwing	2	R			
17/08/2012	9:30	high falling	<5	S-SW	6	*Charadrius ruficapillus*	red capped plover	12	R	Male, Female, Juvenile. Possible breeding site		
17/08/2012	9:30	high falling	<5	S-SW	6	*Elseyornis melanops*	black-fronted dotterel	2	R			
17/08/2012	9:45	high falling	<5	S-SW	7	*Ardea alba*	great egret	1	R			
17/08/2012	11:30	falling	5 - 10	N	9	*Charadrius ruficapillus*	red capped plover	2	R	Pair	4	
18/08/2012	8:17	high	<5	N	1	*Numenius madagascariensis*	eastern curlew	2	R			
18/08/2012	8:17	high	<5	N	1	*Vanellus miles*	masked lapwing	4	R			
18/08/2012	9:53	high	<5	N	5	*Limosa lapponica*	bar-tailed godwit	32	R	Flew from ashponds when spooked by hawk		
18/08/2012	9:17	high	<5	N	5	*Numenius*	eastern	21	R			

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Notes	Survey effort (estimate)	
											Roosting	Foraging
						madagascariensis	curlew					
18/08/2012	9:25	high	<5	N	6	*Ardea alba*	great egret	1	F			
18/08/2012	9:25	high	<5	N	6	*Charadrius ruficapillus*	red capped plover	11	F/R			
18/08/2012	9:25	high	<5	N	6	*Elseyornis melanops*	black-fronted dotterel	2	F/R			
18/08/2012	9:25	high	<5	N	6	*Limosa lapponica*	bar-tailed godwit	32	R			
18/08/2012	9:25	high	<5	N	6	*Numenius madagascariensis*	eastern curlew	3	R			
18/08/2012	9:25	high	<5	N	6	*Vanellus miles*	masked lapwing	2	R/F			
18/08/2012	10:50	high falling	<5	N	9	*Charadrius ruficapillus*	red capped plover	8	F/R		3.5	
17/08/2012	15:00	low	5 - 10	N	10	*Butorides striata*	striated heron	2	F			
17/08/2012	15:00	low	5 - 10	N	10	*Numenius madagascariensis*	eastern curlew	1	F			
18/08/2012	15:25	low falling	5 - 10	NE	10	*Numenius madagascariensis*	eastern curlew	2	F			
18/08/2012	15:10	low falling	<5	NE	11	*Limosa lapponica*	bar-tailed godwit	8	F			
18/08/2012	15:40	low	5 - 10	N	11	*Limosa lapponica*	bar-tailed godwit	9	F			
18/08/2012	15:10	low falling	<5	NE	11	*Numenius madagascariensis*	eastern curlew	1	F			
17/08/2012	15:40	low	5 - 10	N	11	*Numenius madagascariensis*	eastern curlew	1	F			
17/08/2012	15:40	low	5 - 10	N	11	*Numenius phaeopus*	whimbrel	1	F	Could not get close access by boat		
18/08/2012	14:47	low falling	<5	N	12	*Esacus giganteus*	beach thick-knee	2	F			
18/08/2012	16:50	low rising	5 - 10	N	12	*Esacus giganteus*	beach thick-knee	2	F			
18/08/2012	14:47	low falling	<5	N	12	*Haematopus longirostris*	pied oystercatcher	2	F			
17/08/2012	16:49	low rising	5 - 10	N	12	*Haematopus longirostris*	pied oystercatcher	1	F			

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Notes	Survey effort (estimate)	
											Roosting	Foraging
18/08/2012	14:47	low falling	<5	N	12	*Numenius madagascariensis*	eastern curlew	2	F			
17/08/2012	16:50	low rising	5 - 10	N	12	*Numenius madagascariensis*	eastern curlew	1	F			
17/08/2012	16:49	low rising	5 - 10	N	12	*Vanellus miles*	masked lapwing	3	F			
17/08/2012	14:50	low	5 - 10	N	15	*Numenius madagascariensis*	eastern curlew	2	F			
18/08/2012	15:38	low falling	5 - 10	NE	15	*Numenius madagascariensis*	eastern curlew	4	F			
17/08/2012	15:10	low	5 - 10	N	4	*Numenius madagascariensis*	eastern curlew	1	F			
18/08/2012	15:16	low falling	5 - 10	NE	4	*Numenius madagascariensis*	eastern curlew	1	F			
17/08/2012	16:52	low rising	<5	N	5	*Butorides striata*	striated heron	1	F			
17/08/2012	16:52	low rising	<5	N	5	*Elseyornis melanops*	black-fronted dotterel	1	F			3
Total								252			7.5	3
											x2 people	
Grand total											15	6

Appendix 5
Total Species for September

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
20/09/2012	16:00:00	falling	<5	N	9	None			Roosting			2	
21/09/2012	5:45:00	falling	<5	N	2	*Numenius madagascariensis*	Eastern Curlew	7	Foraging	Calm and quiet	2 croc slides		
21/09/2012	5:55:00	low	<5	N	2	*Haematopus longirostris*	Pied oystercatcher	1	Foraging				
21/09/2012	5:55:00	low	<5	N	2	*Numenius phaeopus*	whimbrel	2	Foraging				
21/09/2012	5:55:00	low	<5	N	2	*Gelochelidon nilotica*	gull-billed tern	2	flying				
21/09/2012	5:55:00	low	<5	N	2	*Egretta novaehollandiae*	white-faced heron	1	Foraging				
21/09/2012	5:55:00	low	<5	N	2	*Egretta garzetta*	little egret	3	Foraging				
21/09/2012	5:55:00	low	<5	N	15 & 2	*Phalacrocorax carbo*	great cormorant	1	foraging				
21/09/2012	5:55:00	low	<5	N	10	*Egretta garzetta*	little egret	1	foraging				
21/09/2012	5:55:00	low	<5	N	11	*Gelochelidon nilotica*	gull-billed tern	2	foraging				
21/09/2012	5:55:00	low	<5	N	11	*Numenius madagascariensis*	Eastern Curlew	6	foraging				
21/09/2012	5:55:00	low	<5	N	11	*Chroicocephalus novaehollandiae*	silver gull	1	foraging				
21/09/2012	6:05:00	low	<5	N	4	*Phalacrocorax varius*	pied cormorant	2	flying				
21/09/2012	6:05:00	low	<5	N	12	*Numenius phaeopus*	whimbrel	1	Foraging				

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
21/09/2012	6:05:00	low	<5	N	12	*Chroicocephalus novaehollandiae*	silver gull	20	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Numenius madagascariensis*	Eastern Curlew	1	Foraging		white-breasted woodswallow		
21/09/2012	6:05:00	low	<5	N	12	*Egretta novaehollandiae*	white-faced heron	1	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Todiramphus chloris*	collared kingfisher	2	Foraging		mangrove honeyeater		
21/09/2012	6:05:00	low	<5	N	12	*Numenius phaeopus*	whimbrel	9	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Haliaeetus leucogaster*	white bellied sea eagle	2	Foraging		adult +juv		
21/09/2012	6:05:00	low	<5	N	12	*Platalea regia*	royal spoonbill	3	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Numenius madagascariensis*	Eastern Curlew	3	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Gelochelidon nilotica*	gull-billed tern	1	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Hydroprogne caspia*	caspian tern	1	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Chroicocephalus novaehollandiae*	silver gull	23	Foraging		WPT 504		
21/09/2012	6:05:00	low	<5	N	12	*Anhinga novaehollandiae*	Australasian darter	2	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Charadrius ruficapillus*	red-capped plover	1	Foraging		WPT 504		
21/09/2012	6:05:00	low	<5	N	12	*Ardea alba*	great egret	1	Foraging				
21/09/2012	6:05:00	low	<5	N	12	*Butorides striata*	striated heron	1	Foraging				
21/09/2012	6:45:00	low	<5	N	5	*Numenius phaeopus*	whimbrel	2	Foraging		505 in GPS		
21/09/2012	6:45:00	low	<5	N	5	*Threskiornis molucca*	white ibis	1	Foraging				

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
21/09/2012	6:45:00	low	<5	N	5	*Chroicocephalus novaehollandiae*	silver gull	14	flying		Pied cormorant fly over		
21/09/2012	6:45:00	low	<5	N	6	*Ardea alba*	great egret	1	Foraging				
21/09/2012	6:45:00	low	<5	N	6	*Numenius phaeopus*	whimbrel	1	Foraging				
21/09/2012	6:45:00	low	<5	N	6	*Todiramphus chloris*	collared kingfisher	4	Foraging				
21/09/2012	6:45:00	low	<5	N	6	*Threskiornis molucca*	white ibis	1	Foraging				
21/09/2012	6:45:00	low	<5	N	6	*Numenius madagascariensis*	eastern curlew	1	Foraging				
21/09/2012	6:45:00	low	<5	N	6	*Limosa lapponica*	bar tailed godwit	1	Foraging				
21/09/2012	6:45:00	low	<5	N	7	*Numenius phaeopus*	whimbrel	1			additional species Ibis flyover 507WPT		
21/09/2012	7:00:00	low	<5	N	8	*Anhinga novaehollandiae*	australasian darter	1	Foraging	coal port ramp/ferry	Marginal habitat - Rocky. Little egret flew over		3
21/09/2012	11:13:00	rising	<5	N	5	*Numenius madagascariensis*	eastern curlew	54	Roosting	noise from sites nearby	good roosting site		
21/09/2012	11:13:00	rising	<5	N	5	*Numenius phaeopus*	whimbrel	11	Roosting				
21/09/2012	11:25:00	rising	<5	N	opp 6	*Numenius phaeopus*	whimbrel	46	Roosting		507 WPT		
21/09/2012	11:40:00	rising	light breeze	N	14	*Phalacrocorax varius*	pied cormorant				Curlew calling from bank		
21/09/2012	11:40:00	rising	<5	N	14	*Egretta novaehollandiae*	white-faced heron	1	resting		photo of both sides of river near oxbow		
21/09/2012	12:00:00	rising	light breeze	N	6	*Numenius madagascariensis*	eastern curlew	68	roosting	quiet area around plant not operational			

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
21/09/2012	12:00:00	rising	light breeze	N	6	*Charadrius mongolus*	lesser sand plover	30	Roosting	small trucks	WPT 509		
21/09/2012	12:00:00	rising	light breeze	N	6	*Chroicocephalus novaehollandiae*	silver gull	60	Roosting	helicopter	pond in front of		
21/09/2012	12:00:00	rising	light breeze	N	6	*Gelochelidon nilotica*	gull-billed tern	12	Roosting	middle			
21/09/2012	12:00:00	rising	light breeze	N	6	*Hydroprogne caspia*	caspian tern	6	Roosting				
21/09/2012	12:00:00	rising	light breeze	N	6	*Limosa lapponica*	bar tailed godwit	31	Roosting				
21/09/2012	12:00:00	rising	light breeze	N	6	*Charadrius ruficapillus*	red-capped plover	15	Roosting				
21/09/2012	12:00:00	rising	light breeze	N	6	*Egretta novaehollandiae*	white-faced heron	1	Roosting		in drainage line between 6 and 5		
21/09/2012	12:00:00	rising	light breeze	N	6	*Tringa nebularia*	common greenshank	3	Roosting				
21/09/2012	12:00:00	rising	light breeze	N	6	*Pluvialis fulva*	Pacific golden plover	2	Roosting				
21/09/2012	12:00:00	rising	light breeze	N	6+5	*Egretta garzetta*	little egret	1	Roosting		WPT510	5.5	
22/09/2012	7:30:00	low/rising	light	N/W	10	*Numenius madagascariensis*	eastern curlew	8	Foraging	low, manta ray docked nearby. Clearing and work going on nearby	Oyster beds only		
22/09/2012	7:30:00	low/rising	light	N/W	10	*Chroicocephalus novaehollandiae*	silver gull	2	Foraging				
22/09/2012	7:30:00	low/rising	light	N/W	10	*Hydroprogne caspia*	caspian tern	1	flying				

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
22/09/2012	7:30:00	low/rising	light	N/W	10	*Gelochelidon nilotica*	gull-billed tern	2	flying				
22/09/2012	7:30:00	low/rising	light	N/W	15	*Numenius madagascariensis*	eastern curlew	7	Foraging				
22/09/2012	7:30:00	low/rising	light	N/W	15	*Numenius phaeopus*	whimbrel	1	Foraging				
22/09/2012	7:30:00	low/rising	light	N/W	15	*Gelochelidon nilotica*	gull-billed tern	2	Foraging				
22/09/2012	7:30:00	low/rising	light	N/W	15	*Thalasseus bergii*	crested tern	1	Foraging				
22/09/2012	7:30:00	low/rising	light	N/W	15	*Haematopus longirostris*	Pied oystercatcher	1	Foraging				
22/09/2012	7:30:00	low/rising	light	N/W	15	*Chroicocephalus novaehollandiae*	silver gull	1	Foraging				
22/09/2012	8:00:00	low/rising	light	N/W	12	*Limosa lapponica*	bar tailed godwit	3	Foraging		White-breasted woodswallow		
22/09/2012	8:00:00	low/rising	light	N/W	12	*Numenius phaeopus*	whimbrel	11	Foraging		4 collared kingfishers		
22/09/2012	8:00:00	low/rising	light	N/W	12	*Numenius madagascariensis*	eastern curlew	10	Foraging				
22/09/2012	8:00:00	low/rising	light	N/W	12	*Anhinga novaehollandiae*	Australasian darter	1	Foraging				
22/09/2012	8:00:00	low/rising	light	N/W	12	*Haliastur indus*	brahminy kite	1	Foraging				
22/09/2012	8:00:00	low/rising	light	N/W	12	*Charadrius ruficapillus*	red-capped plover	9	Foraging		Flat at back surveyed for MCJV, lots of birds in summer.		
22/09/2012	8:00:00	low/rising	light	N/W	12	*Thalasseus bergii*	crested tern	12	Foraging				
22/09/2012	8:00:00	low/rising	light	N/W	12	*Gelochelidon nilotica*	gull-billed tern	6	Foraging				

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
22/09/2012	8:00:00	low/rising	light	N/W	12	*Egretta novaehollandiae*	white-faced heron	7	Foraging				
22/09/2012	8:00:00	low/rising	light	N/W	12	*Butorides striata*	striated heron	1	Foraging				
22/09/2012	8:00:00	low/rising	light	N/W	12	*Ardea alba*	great egret	1	Foraging		Area further down Calliope on same side as 12 there is habitat but also lots of disturbance		
22/09/2012	8:30:00	low/rising	moderate	N/W	opp 5	*Numenius phaeopus*	whimbrel	4	Foraging	little disturbance in this area once further down river	Mangrove flat more than 6. mangrove margin		
22/09/2012	8:30:00	low/rising	moderate	N/W	opp 5	*Numenius madagascariensis*	eastern curlew	2	Foraging				
22/09/2012	8:30:00	low/rising	moderate	N/W	opp 5	*Charadrius ruficapillus*	red-capped plover	4	Foraging				
22/09/2012	8:30:00	low/rising	moderate	N/W	opp 5	*Chroicocephalus novaehollandiae*	silver gull	40+	Foraging				
22/09/2012	8:30:00	low/rising	moderate	N/W	opp 5	*Butorides striata*	striated heron		Foraging				
22/09/2012	8:30:00	low/rising	moderate	N/W	opp 5	*Ardea alba*	great egret		Foraging				
22/09/2012	8:30:00	low/rising	moderate	N/W	5	*Butorides striata*	striated heron	3	Foraging		good common sandpiper habitat at first then very steep banks		
22/09/2012	8:30:00	low/rising	moderate	N/W	5	*Threskiornis molucca*	white ibis	1	Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	6	*Egretta novaehollandiae*	white-faced heron	1	Foraging				

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
22/09/2012	8:45:00	low/rising	moderate	N/W	6	*Numenius phaeopus*	whimbrel	2	Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	6	*Numenius madagascariensis*	eastern curlew	1	Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	6	*Limosa lapponica*	bar tailed godwit	1	Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	6	*Platalea regia*	royal spoonbill		Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	opp 6	*Phalacrocorax varius*	pied cormorant	1	Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	opp 6	*Ardea alba*	great egret	1	Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	opp 6	*Egretta garzetta*	little egret	1	Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	opp 6	*Microcarbo melanoleucos*	little pied cormorant	1	Foraging				
22/09/2012	8:45:00	low/rising	moderate	N/W	opp 6	*Actitis hypoleucos*	common sandpiper	2	Foraging				
22/09/2012	9:15:00	rising	moderate	N/W	additional island No. 1	*Haematopus longirostris*	pied oystercatcher	11	Foraging		WPT 513 Area has sandy beach in front then water and rocky beach and woodland behind. Good spot for sanderling, terek sandpiper and stints.		
22/09/2012	9:15:00	rising	moderate	N/W	additional island No. 1	*Phalacrocorax varius*	pied cormorant	1	Foraging				
22/09/2012	9:15:00	rising	moderate	N/W	additional island No. 1	*Numenius madagascariensis*	eastern curlew	1	Foraging		on rocky island adjacent. GPS point taken		2.5

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
22/09/2012	12:35:00	rising	moderate shore	N	5	*Numenius madagascariensis*	eastern curlew	1	flying/roosting				
22/09/2012	12:35:00	rising	moderate shore	N	5	*Egretta novaehollandiae*	white-faced heron	2	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Numenius madagascariensis*	eastern curlew	53	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Tringa nebularia*	common greenshank	2	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Limosa lapponica*	bar tailed godwit	38	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Chroicocephalus novaehollandiae*	silver gull	80	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Hydroprogne caspia*	caspian tern	1	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Numenius phaeopus*	whimbrel	8	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Gelochelidon nilotica*	gull-billed tern	23	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Charadrius ruficapillus*	red-capped plover	8	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Ardea alba*	great egret	1	Roosting				

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
22/09/2012	12:35:00	rising	moderate shore	N	6	*Vanellus miles*	masked lapwing	1	Roosting				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Himantopus himantopus*	black winged stilt	1	fly over				
22/09/2012	12:35:00	rising	moderate shore	N	6	*Butorides striata*	striated heron	1	Roosting				
22/09/2012	12:45:00	rising	moderate shore	N	opp 6/7	*Numenius phaeopus*	whimbrel	36	Roosting		WPT515	2.5	
22/09/2012	13:10:00	rising	moderate shore	N	ashpond back of 6. full of water, adjacent to smoke stack	*Elseyornis melanops*	black fronted dotterel	1					
22/09/2012	13:10:00	rising	moderate shore	N	as above	*Himantopus himantopus*	black-winged stilt	3					
22/09/2012	13:10:00	rising	moderate shore	N	as above	*Aythya australis*	hardhead	30	na				
22/09/2012	13:10:00	rising	moderate shore	N	as above	*Anas superciliosa*	pacific black duck	15	na				
22/09/2012	13:10:00	rising	moderate shore	N	as above	*Tachybaptus novaehollandiae*	Australasian grebe	30	na				

Date	Time	Tide	Wind Speed (knots)	Wind Direction	Location	Species	Common Name	Count	Behaviour	Disturbance	Notes	Survey effort (estimate)	
												Roosting	Foraging
22/09/2012	13:10:00	rising	moderate shore	N	as above	*Anas gracilis*	grey teal	50	na		Potential habitat adjacent to 6, down Calliope on other side of fence. May flood in spring high tide in summer.		
	Total							981				10	5.5
	x2 people												
	grand total											20	11

Appendix 6 Compliance with EPBC Guidelines

The following section shows all the survey ***requirements*** within the Draft Background Paper to EPBC Act Policy Statement 3.21 – Significant Impact Guidelines for 36 Migratory Shorebird Species (DEWHA 2009a) (shown in bold and underline) and how Ecosure has met or will meet these requirements (shown in italics).

Survey recommendations for tidal areas

1) Survey coverage

At a minimum survey coverage should include:

- all of the habitat thought to be used by the same population of shorebirds, and
- the entire area of contiguous habitat where shorebirds may occur.
- all habitat that may be used regularly by shorebirds and that may be impacted by the project (Figure 3 & 7).

This will require consideration of the regional context of the wetland and may include multiple discrete roosts and feeding areas.

Regional context considered in the report (See section 5.2), surveys were carried out in sufficient detail to delineate roosting and foraging, some habitat has been determined to be potential habitat to be confirmed during wet season surveys.

2) Survey timing

Surveys should be conducted during:

- The period when the majority of migratory shorebirds are present in the area to obtain data on the total population using the site. This period will vary across Australia. For instance, key staging sites often in the north of the country that are used by shorebirds during inbound and outbound migration should be surveyed at the beginning or end of the non-breeding season. Local knowledge should be sought to determine the appropriate time period, and
- The northern hemisphere breeding season (mid-April to mid-August) to obtain data on non-breeding, non-migrating immature populations of migratory shorebirds at the site, as well as double-banded plover.
- Experienced ornithologists who have worked within the study area previously were used for surveys and for consultation on methodology. Surveys are scheduled for December and January when shorebirds are at their maximum within the study area. Double-banded plovers are rare visitors to the Port Curtis region.
- Surveys for roosting shorebirds should be conducted as close to the time of high tide as practicable and at a maximum of no more than two hours either side of high tide (unless local knowledge indicates a more suitable time).

- Surveys for foraging shorebirds should be conducted as close to the time of low tide as practicable and at a maximum of no more than two hours either side of low tide (unless local knowledge indicates a more suitable time).
- Surveys have been confined to two hours either side of high and low tide. Surveys during this same time period are proposed for the remainder of surveys
- Surveys should not be undertaken during periods of high rainfall or strong winds. Both surveys conducted to date have occurred during fine and mild weather. This is proposed for the remainder of the surveys.
- Surveys should not be undertaken when activities are taking place which cause disturbance to the birds.

Survey sites are not yet being developed for this project and surveys have occurred during periods of lower activity in work sites surrounding some of the areas (e.g. September surveys were conducted Thurs –Saturday during a time when workers on nearby sites were between shifts and thus only skeleton staff were on site). So far surveys have been carried out during times of least disturbance possible, however Gladstone Harbour is a relatively busy port (See sections 7.3 & 7.4) so there is always significant boat traffic in some areas of the harbour. Remaining surveys will be timed as much as possible during periods of potential lower disturbance.

3) Survey effort

- Minimum of four surveys for roosting shorebirds during the period when the majority of shorebirds are present in the area. Replicate surveys over this period are important in obtaining adequate data. For example, one survey in December, two surveys in January and one survey in February.
- Four surveys are planned in the period when the majority of shorebirds are present (September (completed), December, January and March).
- Minimum of four surveys for foraging shorebirds including two surveys at spring low tide and two surveys at neap low tide. *As above*
- Minimum of one survey during the northern hemisphere breeding season to capture birds that remain in Australia during the breeding season as well as the double-banded plover (mid-May to mid-September). *An additional survey in August of over-wintering and resident birds was carried out*

For large sites or for sites where large numbers of birds are expected, it is recommended that at least two people undertake the counts and agree on the number of birds and the number of species present. *At least two people have been and will be used for surveys, this will continue for the remainder of the surveys.*

4) Minimum data requirements

The following should be included in the survey report:

Shorebird statistics relating to roosting sites:

- total abundance – total number of birds present across all species

- species richness – number of species observed, and
- species abundance – number of birds of each species present.

See data for the first two surveys (Appendices 3 and 4) this has been undertaken.

Shorebird behaviour: activity at site – roosting only, foraging only, roosting and foraging, and foraging location – spatial data of the area used by shorebirds for feeding to enable mapping of foraging habitat.

Survey conditions:

- date, time of day
- tide height, and
- weather conditions:
- Temperature
- Precipitation
- Wind Speed, and
- Wind Direction.
- Number of observers and experience level.
- Habitat Characteristics:
- dominant landform type
- site hydrology
- dominant terrestrial and aquatic vegetation types
- intertidal substrate characteristics
- invasive species
- current disturbance regime (see below), and
- presence of suitable nocturnal roost sites (see below).
- Method used to conduct the survey.

Appendix 7 Summary of Existing Information for Surveys in Port Curtis Area

Title of report	Proponent	Areas covered	Species recorded	Abundance	Dates of surveys	Key findings	Mitigation recommended
Supplementary Survey for Powerful Owl and Migratory Shorebirds – QGC LNG Facility, Curtis Island	QCLNG	South End, Friend to Laird Pts and Calliope	16	Not available	Oct-08	> surveys counts insufficient to derive population estimates > subject site and adjacent intertidal habitat support a very small proportion of the migratory shorebird population in the region	> the proposed QGC LNG facility and associated wharves will not have a detrimental effect on the migratory shorebird population on Port Curtis. Long term monitoring is therefore unnecessary.
		Friend Pt, Friend Pt claypan, Laird Pt, Passage Islands, Grahams Creek	15	1,114 ind	Feb-09	> shorebirds are likely to continue to use this habitat, albeit in lower numbers > the small number of birds displaced at high tide and low tide are likely to find alternative site to roost and forage	
		central Port Curtis	12	Not available	Sep-09	> LNG facility may render the clay pan habitat unsuitable for only a very small number of individual shorebirds > major high tide roosts occur at Friend Point, Lairds Point, South Passage island and near mouth of the Calliope River > impacts on shorebirds may be greater if the mainland access road and bridge are constructed or if the proposed pipeline affects the Friend Point roost	
Curtis Island Water Mouse, Powerful Owl and wading bird investigations	GLNG	Southern Curtis island from Graham Creek to West side of Compigne Island	22	Not available	Dec-08	> wader shorebird species observed in relatively low numbers within the study area > habitat values appeared to be low for many species > abundant habitat elsewhere on Curtis	> further research to ascertain the use of the study area by wader species, particularly in regards to roosting at high tide > proposed works should minimise disturbance to the foreshore/intertidal zone within the study area

Title of report	Proponent	Areas covered	Species recorded	Abundance	Dates of surveys	Key findings	Mitigation recommended
Gladstone LNG project: EPBC Controlled Action Assessment Report	GLNG	Hamilton Point West site adjacent to China Bay	0	0		> potential impact on wader bird habitat or migratory wader species is considered to be low	None
Migratory Shorebird Monitoring Port Curtis to Port Alma Survey 3- March 2011.	Gladstone Ports Corporation	Port Alma & Rodds Peninsula, encompassing Port Curtis and eastern side of Curtis island	28 (9 resident and 19 migratory)	14,582 ind	January-March 2011	> the study area contains Internationally significant populations of seven species, Lesser Sand Plover, Eastern Curlew, Whimbrel, Terek Sandpiper, Grey-tailed Tattler, Red-necked Stint and Australian Pied Oystercatcher. > disturbances [noise, light, movement] are not considered to pose a significant threat to shorebird populations > a loss or reduction of all existing available shorebird habitats within Port Curtis suggest long term impacts are likely > survey found that no roosts would be directly affected by the Western Basin Dredging Project	> consideration should be given to maintaining sufficient habitat for shorebirds across the Port Curtis in the face of current, proposed and future developments. > Ongoing monitoring through construction into operation will provide greater support in assessing whether any detrimental impacts to shorebirds are being realised by comparing collected data with the baseline information presented here
GLMG Curtis island marine facilities migratory shorebirds environmental management plan March 2011	GLMG	Hamilton Point (low tide) China Bay (high tide)	4	16 ind	18-20 January 2011	> it is evident that superior roosting habitat is present elsewhere in Port Curtis and that China Bay and environs do not support a large diversity and abundance of migratory shorebirds.	> a range of mitigation strategies to minimise impacts to migratory shorebirds: loss and fragmentation of habitat; disturbance to shorebird roosting and feeding; light impacts; noise impacts; predation; water quality and sedimentation; monitoring and auditing; reporting and corrective action
APLNG Construction operation and decommissioning migratory shorebird management plan- LNG facility May 2011	APLNG		0	0		> the cumulative impacts of the projects outlined above on migratory shorebirds and their habitats within a Nationally significant site are likely to be substantial. Yet, the contribution of the Australia Pacific LNG Project on Curtis Island to this cumulative impact is relatively small.	

Title of report	Proponent	Areas covered	Species recorded	Abundance	Dates of surveys	Key findings	Mitigation recommended
MSBMP QCLNG Whole of project Migratory Shorebird Management Plan Sept 2011	QCLNG	Narrows	0	0			> mitigation recommended for Narrows crossing: monitoring, onstruction management plan, post construction regeneration
Migratory shorebird Monitoring Port Curtis to Port Alma Survey 4 November 2011	Gladstone Ports Corporation	Curtis coast	26	6585 ind	August 2011 (winter survey)	> the Curtis Coast Region supports important over-wintering populations of Eastern Curlew, Lesser Sand Plover, Grey-tailed Tattler and Red-necked Stint.	None
Narrows Pipeline Crossing - Review of Regional Shorebird Data and discussion of impacts	QCLNG	Marshland and Narrows. Friend Pt			no survey	> focus on five species: Eastern Curlew, Red-necked stint, bar-tailed godwit, whimbrel, common greenshank. > Friend Point supports Nationally important populations of Eastern Curlew and Whimbrel and state significant threatened species > Friend Point is rated highest using state criteria and 7th using National and Regional criteria.	> monitor the effect of pipeline construction and all associated activities on roosting and foraging shorebirds > minimise disturbance and loss of the mangrove communities adjacent to the shoreline roost at Friend Point >re-establish any removed or disturbed mangrove communities upon completion of work so as to restore previous sight lines.

Title of report	Proponent	Areas covered	Species recorded	Abundance	Dates of surveys	Key findings	Mitigation recommended
Port Curtis Shorebird Survey and Mitigation Measures for the Narrows Pipeline Crossing (2011)	QCLNG	Narrows, Southend to Graham Creek, northern side of Facing island, Friend Pt	26 spp	2969 ind	Jan-11	> population of Eastern Curlew in Port Curtis exceeds 1% of the flyway populations > the majority (75%) of shorebird pop recorded in lower port in the South End/Facing island area > the passage islands/Grahams creek area was used mostly during the neap tide phase > at low tide the highest number of birds was recorded at Pelican Banks, followed by facing island, friend point and Calliope/Wiggins then passage > Friend point roosts were of national, state and regional importance and ranked as the third most important roosting area in Port Curtis after Southend claypan and Facing island claypan	> avoid disturbance, survey, monitor, erect screen along pipeline corridor, avoid night work, adaptive management, minimise loss of mangrove communities, restrict access to Laird Point during construction, restrict all machinery and personnel to pipeline corridor.

Appendix 8 Sample Data Sheet

Tide times – Low tide:
High tide:
Low tide:
High tide:

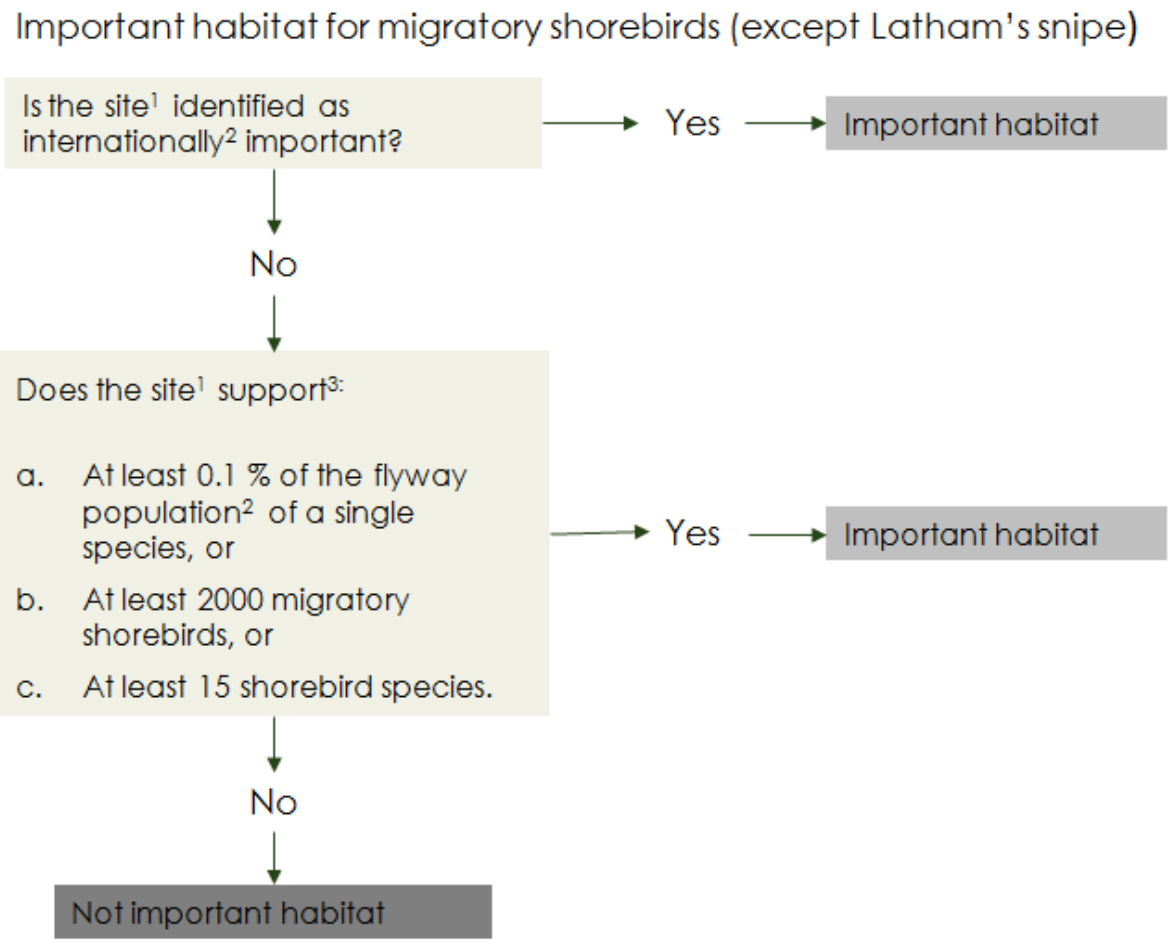
Shorebird survey data sheet

Job # GE241 | Month_____ | Year_____ | Weather_____ | Tide cycle _____ | Observers_____

Date	Time	Tide	WS	WD	Location	Map Ref	Species	Count	Behaviour (F/D (incl. # flights)	Photo number	Notes (including those on habitat condition)

K:\Coffey Environments\GE241 Shorebird Assessment\Deliverables\appendices\GE241 Shorebird survey data sheet.xlsx

Appendix 9 Criteria for Important Habitat



1. 'Site' is defined for migratory shorebirds: *the entire (discrete) area of contiguous habitat used by the same group of migratory shorebirds, which may include multiple roosts and feeding area.* The area covered by a migratory shorebird 'sire' may extend beyond the boundaries of a property or project area, and my also extend beyond Ramsar boundaries for internationally important areas. Appropriate surveys can determine the extent of a migratory shorebird 'sire'.
2. The list of internationally important sites and flyway population estimates, as at 2008, are at: www.environment.gov.au/biodiversity/migratory/publications/shorebirds-ease-asia.html

   Local and/or more recent information should be sought during the project planning phases to determine the likelihood of important habitat for migratory shorebirds being present within or near the proposed project site.

   - Where population estimates are presented as a population range, the lowest estimate in the range should be used to calculate the population percentage..
3. 'Support' is defined differently depending on whether the habitat is considers permanent or ephemeral.
   - For permanent wetlands, support is defined as: *migratory shorebirds are recorded during surveys and/or known to have occurred at the site within the previous five years.* Refer to the background paper to this policy statement for information regarding survey methodology.
   - For ephemeral wetlands, support is defined as : *habitat that migratory shorebirds have ever been recorded in, and where that habitat has not been lost permanently due to previous actions.*

Revision History

Revision number	Revision date	Details	Prepared by	Reviewed by	Approved by
00	16/10/12	Draft Interim Shorebird Assessment Report	Elvira Lanham (Senior Ecologist) and Emily Hatfield (Ecologist)	Jess Boswell, Senior Wildlife Biologist	Phil Shaw Director
01	01/11/2012	Draft Interim Shorebird Assessment Report Revision 1	Elvira Lanham (Senior Ecologist)	Phil Shaw Director	Phil Shaw Director
02	22/11/2012	Final Interim Shorebird Assessment Report	Elvira Lanham (Senior Ecologist) and Emily Hatfield (Ecologist)	Phil Shaw Director	Phil Shaw Director
03	4/12/2012	Final Interim Shorebird Assessment Report	Jess Baglin (Senior Ecologist)	Elvira Lanham (Senior Ecologist)	Scott Hetherington (Regional Manager)

Distribution List

Copy number	Date	Type	Issued to	Name
1	4/12/2012	electronic	Coffey Environments	A.Jensen
2	4/12/2012	electronic	Ecosure	Administration

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