Australia Business Unit East

Migratory Shorebird Management Plan

- Operations

ABUE-450-EN-V01-C-00002

AUSTRALIA PACIFIC LNG

Operated by ConocoPhillips

Next Review Due: 1-Sept-2019

Contents

List of Appendices

List of Tables

List of Figures

1. Introduction

1.1. Background

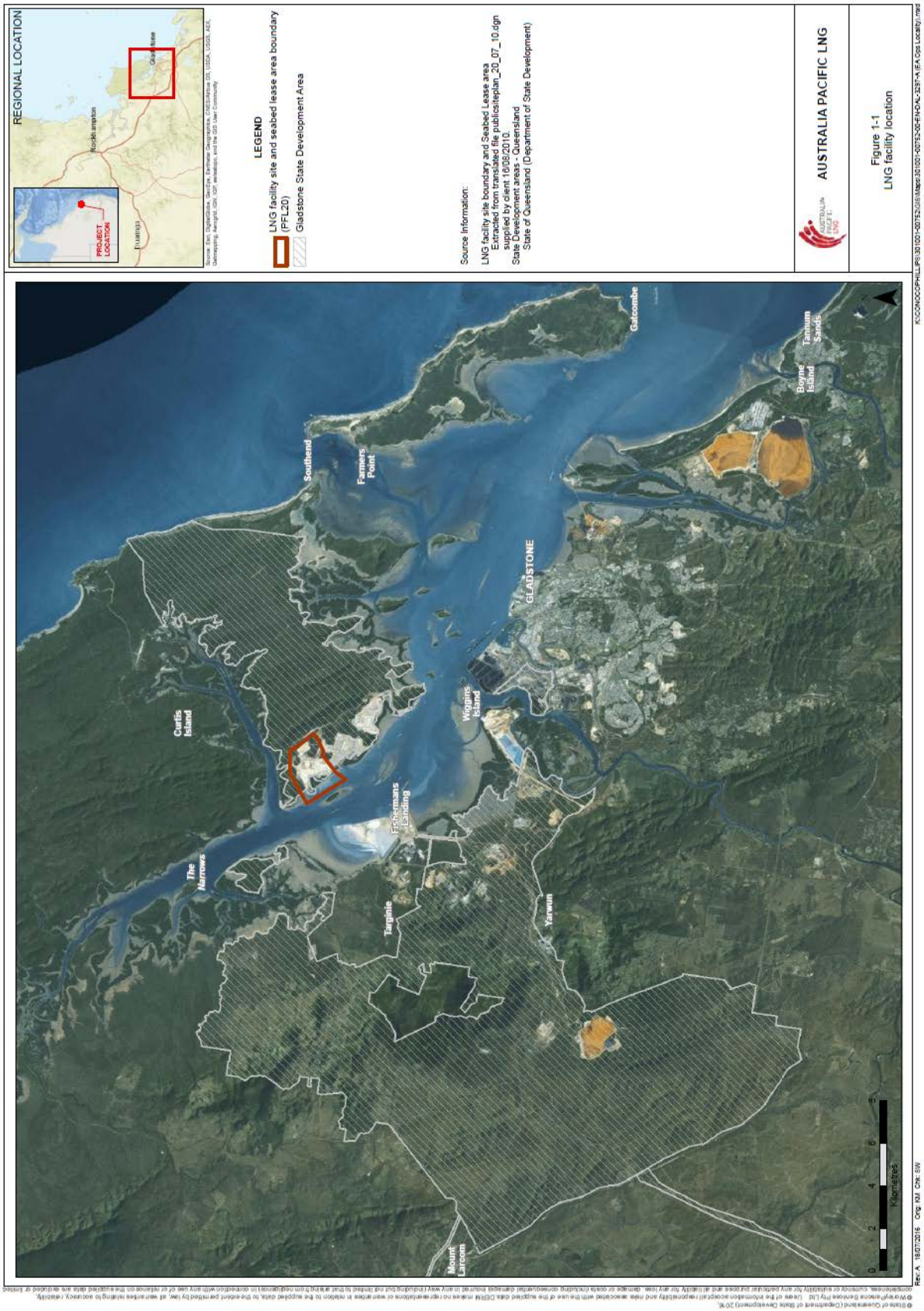
As part of the wider Australia Pacific LNG (APLNG) Project and on behalf of the APLNG Project joint venture shareholders Origin Energy Limited (Origin; 37.5% interest), ConocoPhillips Australia Pacific LNG Pty Ltd (ConocoPhillips; 37.5% interest) and China Petrochemical Corporation (SINOPEC Group; 25% interest); ConocoPhillips Australia Pty Ltd (COPA) as the Downstream Operator for APLNG operates a coal seam gas (CSG) to Liquefied Natural Gas (LNG) production and marine export facility on Curtis Island near Laird Point, Queensland. The APLNG Project has a life of at least 30 years, and is made up of three primary elements:

- Gas fields in the Bowen and Surat Basins of south-west and central Queensland;
- A 530km high pressure gas transmission pipeline from the gas fields to Curtis Island, near Gladstone in Central Queensland; and
- The Facility (APLNG Facility), which is ultimately to comprise four liquefaction trains each producing (at design capacity) approximately 4.5 million metric tonnes per annum (Mtpa) of LNG, up to 20Mtpa in total. The APLNG Facility includes gas processing plant, utilities such as power generation and distribution and marine and ancillary facilities required to support facility operations.

Origin is responsible for the 'upstream' component of the APLNG Project which includes gathering, gas and water facilities, electrification and water treatment. COPA is responsible for the 'downstream' component of the APLNG Project, which includes the development, construction, operation and decommissioning of the APLNG Facility on Curtis Island. Figure 1-1 presents the regional setting and location of the APLNG Facility.

The APLNG Facility is located on Lot 3 on Survey Plan 228454, Lot 3 on Survey Plan 228186 and Lot 3 Survey Plan 235971 within the Curtis Island Industry Precinct of the Gladstone State Development Area (GSDA), approximately 13km north-west of Gladstone (refer to Figure 1.1: Australia Pacific LNG Facility lease and surrounds). The APLNG Facility is authorised by a Petroleum Facility License (PFL 20) and Environmental Authority No. EPPG00715613 (EA), as well as Approval No. 2009/4977 under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (the EPBC Act Approval).

Figure 1.1: Australia Pacific LNG Facility lease and surrounds



1.2. Scope

This Migratory Shorebird Management Plan (MSMP) has been prepared to address potential impacts associated with the operation of the APLNG Facility on migratory shorebirds utilising suitable habitat within and adjoining Petroleum Facility Lease (PFL20) on Curtis Island (the Shorebird Management Area (SMA)). The definition of migratory shorebirds includes 'shorebirds of the intertidal zone that are listed as migratory species under the provisions of the EPBC Act', only.

This Plan fulfils the relevant operational requirements of EPBC Act Approval condition 50 including:

a) Managing the impacts of the action on listed migratory shorebirds including but not limited to the whimbrel (*Numenius phaeopus*) and the terek sandpiper (*Xenus cinereus*).
b) Determining baseline population densities and habitat utilisation for migratory shorebirds on or contiguous to the proponent's LNG facility site including, at a minimum, undertaking annual/twice annual surveys during northwards and southwards migrations.
c) Minimising impacts from noise and light on the feeding and roosting sites of listed migratory shorebirds.

Requirements relevant to the construction, commissioning and start-up phases of the Project have been addressed in the Migratory Shorebird Management Plan (APLN-000-EN-R01-D-10438) and include condition 50:

d) Monitoring the effect of the construction of the marine facilities on shorebirds, including but not limited to, and to the extent relevant:
    i. dredge vessel movement
    ii. pile driving
    iii. construction dredging
    iv. noise impulse levels
    v. light spill
    vi. water quality reduction
    vii. decreased access to intertidal foreshore habitat
    viii. increased sedimentation
    ix. displacement.

The term of this Plan is for the duration of the operational phase of the APLNG Facility. A separate Migratory Shorebird Management Plan will be prepared prior to decommissioning activities.

1.3. Responsibilities

Table 1.1 defines the roles and responsibilities related to native terrestrial fauna management at the APLNG Facility as at the date this plan was prepared.

Table 1.1: Environmental roles and responsibilities

Responsible Party /Entity	Responsibilities
Australia Pacific LNG Pty Limited	Holder of EPBC Act approval.
Operator (ConocoPhillips Australia)	• Develop, implement, monitor and maintain effectiveness of the MSMP. • Obtain necessary environmental approvals. • Liaise with relevant organisations in relation to environmental approvals. • Identify, record, report (as required) and rectify non-conformances. • Investigate and report migratory shorebird related incidents to APLNG. • Report migratory shorebird related incidents to regulatory agencies.
ConocoPhillips	
Downstream Operations Manager	Resourcing and implementation of this MSMP.
APLNG Operations Team Lead	• Air, water, light, noise and vibration emissions controls are managed appropriately.
Maintenance and Reliability Manager	• Air, water, light, noise and vibration emissions controls are maintained appropriately. • Implementation of management procedures during work execution.
ABUE Supply Chain Manager	Implementation of management procedures.
Engineering Manager	• Engineer air, water, light, noise and vibration emissions controls that are in accordance with the MSMP. • Implementation of management procedures during work execution.
Shutdown Manager	Develop and implement shutdown management plans which include consideration of air, water, light, noise, vibration and waste management controls that are in accordance with the MSMP.
Training and Competency Lead	• Provide the resources and training systems to develop, schedule and deliver induction to all staff and contractors including site induction and any relevant site specific training. • Record training events and maintain personnel records in the Competency Management System.
General Manager HSE	• Implementation of the provisions of this MSMP. • Resource the review and update of this MSMP as required. • Establish the resources for the monitoring, auditing and reporting required under this plan. • Oversee migratory shorebird related incident investigations and corrective actions implementation. • Training requirements such as inductions for all staff and contractors are identified.
HSE Functional Excellence Lead	Conduct annual audits and verify implementation of corrective actions.

Responsible Party /Entity	Responsibilities
Environmental Lead	• Provide environmental, technical and regulatory compliance support. • Facilitate the undertaking of monitoring, assessment, and reporting. • Liaise with regulatory authorities. • Coordinate the review and update of this MSMP as required.
All personnel	• Adhere to the general environmental duty as specified under Section 319 of the *Environmental Protection Act 1994* (EP Act) • Implement the provisions of this plan where they apply to their day to day activities. • Participate in training as relevant. • Raise non-conformances with this Plan.

1.4. Acronyms, Terms and Definitions

Table 1.2 lists the acronyms and terms used throughout this procedure and their definitions

Table 1.2: Acronyms, Terms and Definitions

Term	Definition
ABUE	Australia Business Unit East of ConocoPhillips Australia
APLNG Facility	Australia Pacific LNG Facility as per the EPBC Act Approval
APLNG Facility lease	Petroleum Facility Lease (PFL20) area
CSG	Coal seam gas
DotE	Commonwealth Government Department of the Environment
EA	Environmental Authority No. EPPG00715613, granted under the EP Act
EHP	Queensland Government Department of Environment and Heritage Protection
EP Act	*Environmental Protection Act 1994* (Qld)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPBC Act Approval	Approval No. 2009/4977, granted under the EPBC Act
LNG	Liquefied natural gas
MNES	Matter of National Environmental Significance
MSMP	Migratory Shorebird Management Plan
NC Act	*Nature Conservation Act 1992*
OEMP	Operational Environmental Management Plan

1.5. Related Documents

This MSMP is to be read in conjunction with the following documents:

- Australia Business Unit East, Operational Environmental Management Plan (OEMP) (ABUE-450-EN-N05-C- 00001).
- Australia Business Unit East, Shipping Activity Management Plan (ABUE-450-EN-V01-C-00005).
- Australia Pacific LNG, Environmental Offset Strategy (APLN-000-EN-R01-D-10201).

The following legislation, policies and international agreements are relevant to the identification and protection of migratory shorebirds in Australia:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth).
- *EPBC Act Policy Statement 3.21 2015 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebirds.*
- *Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention or CMS) (International)
- *Japan-Australia Migratory Bird Agreement* (JAMBA) (International)
- *China-Australia Migratory Bird Agreement* (CAMBA) (International)
- *Republic of Korea-Australia Migratory Bird Agreement* (ROKAMBA) (International)
- Queensland *Nature Conservation Act 1992 (NC Act)*

2. Shorebird Management Area

Curtis Island is approximately 40km long and 20km wide (at its widest point) and forms part of the eastern edge of Port Curtis. Port Curtis is a partially enclosed embayment comprised of a natural deepwater harbour, shallow estuaries, small continental rocky islands, intertidal flats and estuarine islands. The harbour is protected by Curtis and Facing Islands to the east and Rodd's Peninsula to the south-east, and supports a reasonably high diversity of regional coastal vegetation and landscape types including rocky coastlines, rock platforms, mud flats, saltpans and marine plains.

For the purposes of this MSMP, the SMA is regarded as the intertidal area utilised by shorebirds that are potentially influenced by operations at the APLNG Facility, extending from Laird Point in the north (Sector 2), to the southern boundary of the APLNG Facility in the south (Sector 3), and including North Passage Island (Sector 4), with Graham Creek (Sector 1) included as a reference location, see Figure 2.1.

The SMA falls within the Port Curtis shorebird area, which is recognised as a nationally important site for migratory shorebirds (Clemens *et al*. 2008) under Commonwealth guidelines (DotE 2015, DEWHA 2009). The Port Curtis shorebird area extends from Tannum Sands in the south to the Narrows in the north, and from the mainland in the west to the western shores of Curtis and Facing Islands in the east.

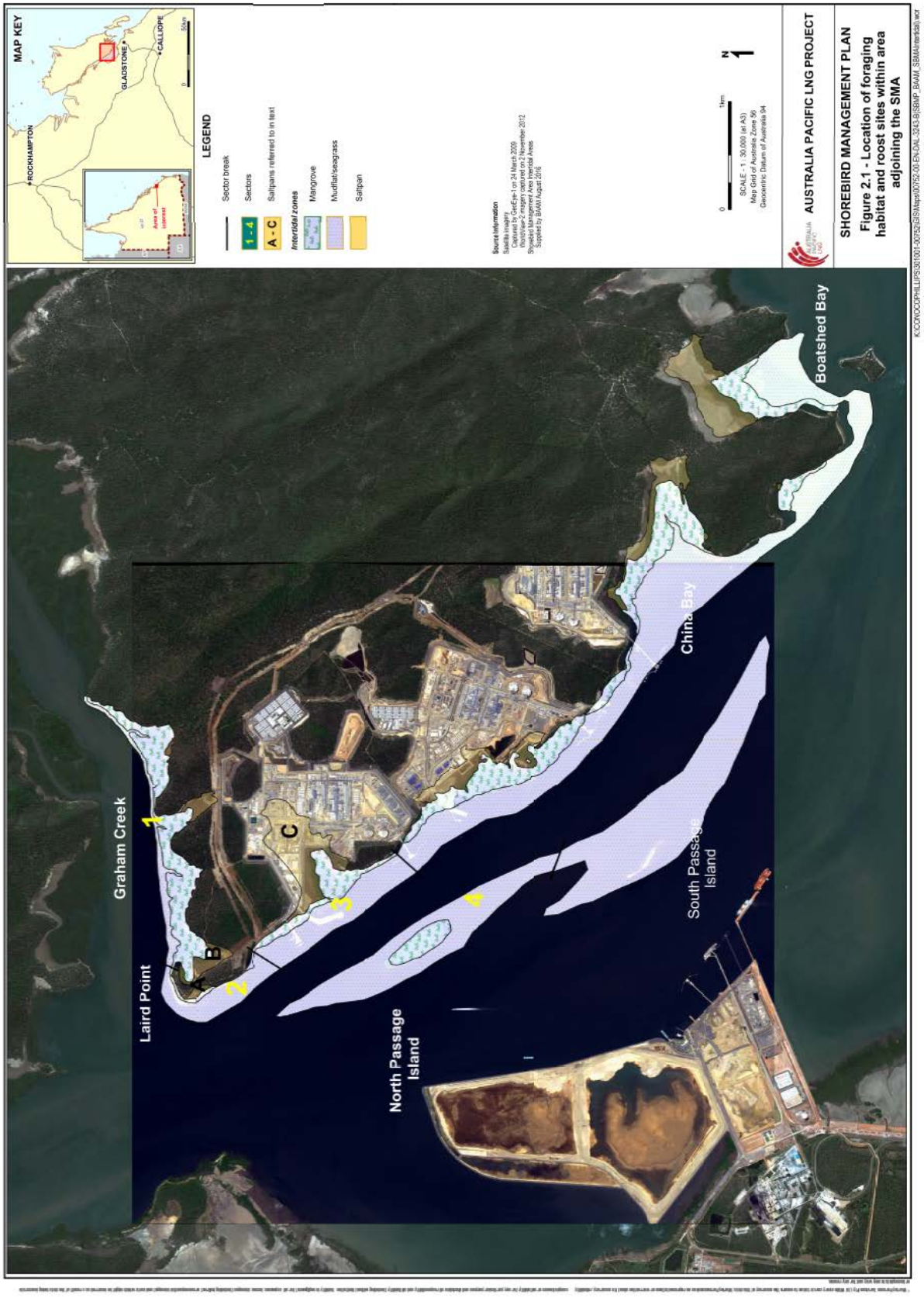
Four main intertidal habitats occur within the SMA:

1) Mudflats and seagrass beds that are exposed at low tide but inundated at high tide;
2) Mangroves;
3) Salt pans and saltmarsh; and
4) Sandy beaches and rocky shores (BAAM 2010).

These habitats are utilised by shorebirds for two main purposes, namely foraging during the low-tide phase of the tide cycle, and roosting (i.e. resting) during the high-tide phase while foraging habitat is inundated.

None of the migratory shorebird species addressed in this MSMP breed within Australia.

Figure 2.1: Curtis Island Shorebird Management Area survey sectors



2.1. Pre-Construction Utilisation of the SMA

Pre-construction use of the SMA by shorebirds was extensively investigated by BAAM Ecological Consultants (2010) on the following dates 17-19 November 2009, 15-16 December 2009, 20-21 January 2010, 10-11 February 2010 and 24-25 March 2010. Also relevant are surveys undertaken by Sandpiper Ecological Services (2009a).

Since this time, twenty-four 1-day monitoring surveys have been conducted by BAAM during the construction phase to date, as follows:

- 2011 – December
- 2012 – January, February, March, April, May, September, October, November and December
- 2013 – January, February, March, April and December
- 2014 – January, February, March, October and December
- 2015 – January, March and December
- 2016 – January.

Based on the results of the desk top assessment reported in BAAM (2010), 25 migratory shorebird species were identified as known, or expected to occur in the vicinity of the SMA (Appendix 1). Past monitoring of shorebirds within the Port Curtis shorebird area recorded 25 shorebird species (including 18 migratory shorebird species) using the area, with a maximum recorded abundance of 5,168 shorebirds (including 4,900 migratory shorebirds) (Clemens *et al*. 2008).

Pre-construction surveys confirmed that seven migratory shorebird species regularly utilise intertidal habitats within the SMA for foraging or roosting (BAAM 2010) and baseline population sizes were determined for these species, and are summarised in Table 2.1 and Table 2.2 and discussed in more detail under Section 2.2.

Table 2.1: Migratory shorebirds foraging on mudflats during the pre-construction low tide surveys, November 2009 - March 2010*

Scientific Name	Common Name	Sectors (mudflat/seagrass area in ha)			
		1 (13ha)	2 (24 ha)	3 (38 ha)	4 (69 ha)
Charadrius leschenaultii	Greater sand plover				2.5 14
Limosa lapponica	Bar-tailed godwit				12.7 23
Numenius phaeopus	Whimbrel	2.6 5	1.7 2	3.7 6	7.5 10
Numenius madagascariensis	Eastern curlew	0.5 3	0.5 1	2.6 5	3.8 6
Xenus cinereus	Terek sandpiper				3.6 14
Calidris ruficollis	Red-necked Stint		0.8 3	0.1 1	9.5 47
OVERALL		3.2 6	3.1 6	6.5 9	39.8 92

* For each species and all species overall, the average number and highest total for 11 surveys is given.

Table 2.2: Migratory shorebirds roosting in mangroves and on saltpans during the pre-construction high tide surveys, November 2009 - March 2010*

Scientific Name	Common Name	Sectors			
		1	2	3	4
Numenius phaeopus	Whimbrel	1.7 4	9.6 37	2.8 8	4.8 12
Numenius madagascariensis	Eastern curlew		0.9 2		
Xenus cinereus	Terek sandpiper				0.3 3
Actitis hypoleucos	Common sandpiper		0.2 1		

* For each species, the average number and highest total for 10 surveys is given.

2.2. Current Utilisation of the SMA

Since the commencement of construction, regular migratory shorebird surveys have confirmed that the SMA is utilised by nine (9) migratory shorebird species as listed in Table 2.3.

Table 2.3: Migratory shorebirds confirmed to be utilising the SMA during construction (2009-2016)

Scientific Name	Common Name	EPBC Act Listing
Numenius phaeopus	Whimbrel	Migratory, Marine
Numenius madagascariensis	Eastern curlew	Critically Endangered, Migratory, Marine
Xenus cinereus	Terek sandpiper	Migratory, Marine
Charadrius leschenaultii	Greater sand plover	Vulnerable, Migratory, Marine
Actitis hypoleucos	Common sandpiper	Migratory, Marine
Charadrius mongolus	Lesser sand plover	Endangered, Migratory, Marine
Pluvialis fulva	Pacific golden plover	Migratory, Marine
Limosa lapponica baueri	Bar-tailed godwit	Vulnerable, Migratory, Marine
Calidris ruficollis	Red-necked stint	Migratory, Marine

A further sixteen (16) species are assessed as likely to utilise the SMA, and are included in the Migratory Shorebird Species list in Appendix 1; however, none have been encountered to date.

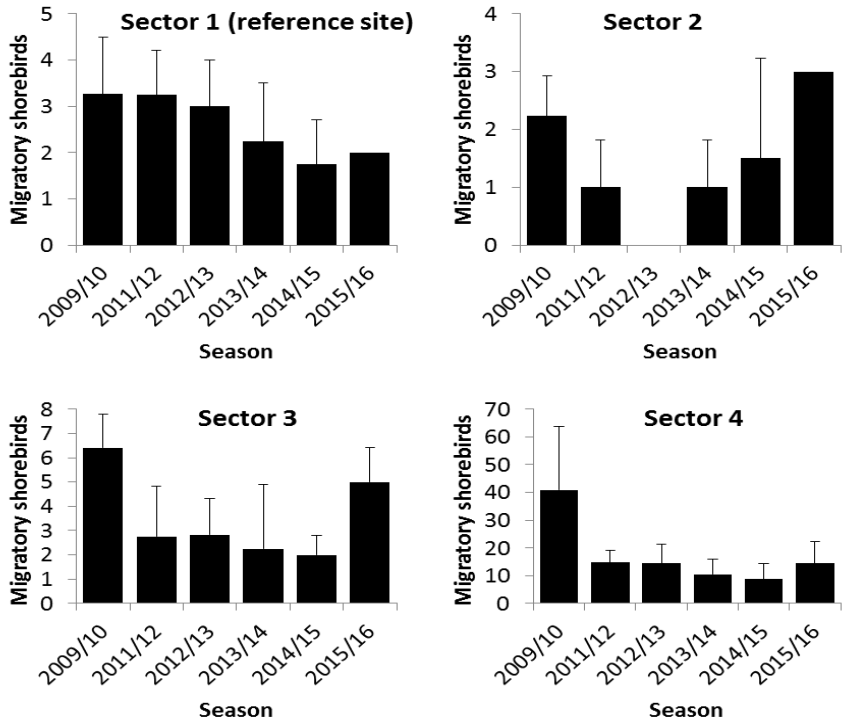
2.3. Habitat Use

2.3.1. Low Tide

During low tide, migratory shorebirds have been observed utilising all exposed areas of mudflat and seagrass within the SMA. The total number of migratory shorebirds utilising the mudflat/seagrass habitats of the SMA varies through the season, increasing at the onset of the season and decreasing towards the end as would be expected.

Figure 2.2 provides a comparison of migratory shorebird numbers at low tide (when birds are actively foraging) by sector between the 2009/10 season baseline survey prior to construction, and each of the season-surveys conducted during construction and early operations since the 2011/12 season.

Figure 2.2: Migratory shorebird numbers (average +1 standard deviation) observed foraging at low tide (2009-2016)



Migratory shorebird numbers foraging at low tide in the 2015/16 season conducted during construction activities and operational activities to support LNG production in Train 1, were comparable to the numbers recorded in the 2009/10 baseline (preconstruction) in Sectors 1 to 3, and show a recovery by comparison with lower numbers recorded during the 2011/12 to 2014/15 seasons (during construction). By contrast, numbers foraging in Sector 4 (North Passage Island) remain substantially lower than those recorded during the 2009/10 baseline with the initial reduction coinciding with a loss of seagrass cover between November 2009 and November 2011 (Davies *et al*. 2012) associated with significant regional flooding events (BAAM, 2016).

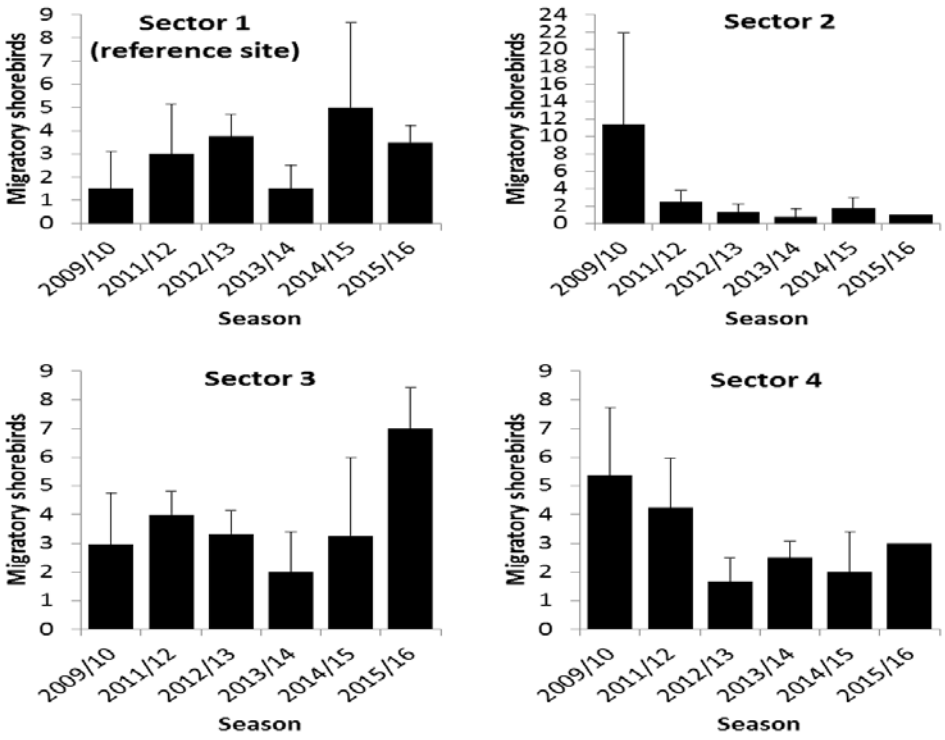
The sector directly impacted by construction activities at the Australia Pacific LNG Facility (Sector 3), where impacts included the loss of some intertidal foraging habitat, experienced a modest decline in migratory shorebird numbers foraging in the area during the construction phase, from an average of around six birds in the baseline 2009/10 season to an average of two to three birds during the 2011/12 to 2014/15 seasons. However, an increase to an average of five birds was seen in the 2015/16 season. Given the relatively low numbers of birds recorded utilising this areas, the observed variability is not considered significant.

2.3.2. High Tide

During the high tide phase of the tide cycle, migratory shorebirds have been observed utilising three different habitats within the SMA, namely mangroves on the seaward edge, salt pans and rocky/sandy shorelines.

Figure 2.3 provides a comparison of migratory shorebird numbers at high tide (when birds are roosting) by sector between the 2009/10 season baseline survey prior to construction, and each of the seasonal-surveys conducted during construction (2011/12 to 2014/15); and construction and operations (2015/16).

Figure 2.3: Migratory shorebird numbers (average +1 standard deviation) observed roosting at high tide (2009-2016)



Numbers of migratory shorebirds roosting in the different sectors were generally variable.

2.3.2.1. Mangroves

The number of migratory shorebirds (mostly Whimbrels) roosting in water-side mangroves in Sector 3 has remained relatively stable and comparable with baseline numbers during the construction period, and even showed a slight increase in 2015/16 over baseline counts, despite this area experiencing the largest disturbance from construction activities.

2.3.2.2. Salt Pans

Pre-construction surveys found migratory shorebirds roosting at three different salt pan areas that had the potential to be affected by activities at the APLNG Facility: a small salt pan at the edge of the shoreline at Laird Point; a larger salt pan behind Laird Point; and a large salt pan within the APLNG Facility site adjoining an area of mangroves.

Notably, during the 2009/10 baseline surveys larger numbers of migratory shorebirds were observed roosting occasionally in the pan at Sector 2 (Laird Point) when the pan was inundated on spring high tides (BAAM 2010). This behaviour has so far not been observed during the annual monitoring surveys conducted during construction or operations, despite several surveys coinciding with spring high tides that were as high as or higher than the spring high tides experienced during the baseline surveys.

2.3.2.3. Rocky and Sandy Beach Shorelines

Migratory shorebirds are rarely observed roosting on the rocky or beach shorelines within the SMA.

3. Threatening Processes

During operations there are unlikely to be significant interactions with migratory shorebirds. However, activities that have the potential to affect the intertidal area require consideration and have been addressed below.

3.1. Operational Activities and Threatening Processes

Operational activities at the APLNG Facility and associated potential threatening processes in relation to migratory shorebirds are described below and are summarised in Table 3.1.

Table 3.1: Operational activities and potential threatening processes

Site Activities	Potential Threatening Processes
Shipping and support vessel activities	Disturbance resulting in displacement from intertidal habitats Erosion of intertidal areas from bow wash reducing invertebrate food availability and foraging habitat
Flaring, light spill, noise and vibration	Behavioural changes including attraction, disorientation and/or disturbance. Light spill to mangroves and mudflats at night leading to collisions with illuminated structures
Stormwater management	Altered mangrove and marine ecology and a potential reduction of invertebrate food availability in intertidal foraging habitats
Helicopter traffic	Disturbance resulting in displacement from intertidal habitats
Presence of overhead cables	Injury or fatality caused by flying into overhead wire cables, if installed
Movement of people, vehicles and equipment	Disturbance resulting in displacement from intertidal habitat Introduction or spread of weeds or pests to, or around, the Facility Vehicle strike causing injury or death
Docking facilities and infrastructure across intertidal zone	Disturbance and loss of habitat due to physical presence of structures
Waste and hazardous materials management	Inappropriate disposal of solid waste, dangerous goods or hazardous materials, contaminating water quality or degrading habitat, reducing food availability Increased resources (food, water, shelter) encouraging potential predators

3.2. Observed Responses to Disturbance

During construction and the early operational phase, monitoring has been conducted to assess the effect of:

- Vessel movements including construction dredging;
- Light spill;
- Noise impulse levels such as during pile driving;
- Changes in water quality and potential sedimentation and/or erosion of habitat resulting from stormwater discharges, dredging and other sources;
- Helicopter movements;
- Overhead cables;
- People, equipment and machinery operating in or near the intertidal zone; and
- Decreased access to intertidal habitat through the presence of physical structures.

The behavioural responses of birds were categorised prior to, during and after any potential disturbances, as detailed in the following sections.

3.2.1. Shipping and Support Vessel Movements

Slow-moving shipping traffic is generally considered less disturbing to shorebirds than other forms of disturbance. However, shipping activities were expected to cause 'flighty' migratory shorebird species such as eastern curlew and whimbrel to take flight within an approach distance of 100-200m.

During the monitoring surveys foraging shorebirds were observed within 100m of operating marine vessels with no resultant disturbance. This result is consistent with findings through-out the construction phase, where vessel movements were rarely observed to result in disturbance of foraging shorebirds; and the findings of Smit and Visser 1993, West *et al*. 2002 and Baudains and Lloyd 2007, which concluded that shorebirds readily habituate to repetitive, non-lethal disturbance stimuli.

3.2.2. Flaring and Light Spill

Bright light spill on flight paths at night, together with sudden light surges and noise from gas flaring may impair shorebird vision and disorientate birds, causing them to collide with illuminated structures (Jones and Francis 2003). However, most reported incidents of this nature are associated with brightly-lit offshore oil platforms and lighthouses.

Many shorebird species have the ability to switch between visual foraging techniques and tactile (touch) foraging techniques with little loss in foraging efficiency (Robert and McNeil 1989), yet artificial illumination of feeding habitat may also assist the foraging efficiency of species with a predominantly visual foraging strategy. One study of the influence of artificial illumination from street lighting on shorebird foraging efficiency found that artificial illumination had a positive effect on the nocturnal foraging of shorebirds, but on the other hand may draw them to degraded habitat areas close to the sources of illumination, and potentially raises their exposure to predators (Santos *et al*. 2009).

There have been no reported incidents of injury or fatality of a migratory shorebird within the APLNG Facility lease since the initiation of construction, indicating that potential light spill at night has not resulted in disorientation to the extent that collision with illuminated structures has occurred.

3.2.3. Noise and Vibration

Seabirds exhibit alert behaviours to most levels of noise exposure, but begin to take flight in response to noise exposure levels greater than 85dBA (Brown 1990), consistent with observations that sound levels of 43-87dBA have limited effects on foraging shorebirds, but sound levels of 84-100dBA cause most shorebirds in an habituated population to leave the area of disturbance (Smit and Visser 1993). Disturbance reactions are generally stronger when disturbing sounds are combined with visual disturbance (Smit and Visser 1993).

The low noise levels from general construction and operational activities have not been observed to impact upon shorebird foraging at any stage during monitoring. During the 2015/16 monitoring events, the presence of a group of up to six to eight Whimbrels and Terek Sandpipers roosting in the mangroves behind the MOF indicated that the prevailing noise levels were not disturbing roosting shorebirds.

Disturbance has been observed during the commencement of some activities with elevated noise levels including: pile driving where start-up on one occasion flushed two migratory shorebirds from roosting habitat at 500m; and the sudden start-up of boat engines at 100m which caused disturbance to one migratory shorebird who then resettled nearby. Some habituation may be occurring to more regular

intermittent noises, such as marine vessel horns, which have not been observed to cause disturbance during surveys in the last few seasons.

3.2.4. Stormwater Management

Changes in hydrology and water quality may affect the relative abundance of benthic invertebrates that migratory shorebirds feed on. A reduction in benthic invertebrate abundance on a mudflat will likely lead to a reduction in migratory shorebird use of that mudflat. A review of water quality monitoring results in Port Curtis (Hale 2013) found that:

- Suspended sediments (turbidity) within Port Curtis are from two predominant sources, being inflows from the catchment and resuspension from the seabed either by natural forces of waves and currents or human forces such as dredging;
- Water turbidity has regularly exceeded Queensland water quality guidelines, with increased turbidity in the Western Basin primarily as a consequence of flood events from late 2009 to 2012, although there were sustained increases in turbidity in the Western Basin during dredging operations;
- Nutrient concentrations have fluctuated in response to catchment inputs from river discharges, but, with the exception of some exceedances in nitrite-nitrite and total phosphorus, have generally been within water quality guidelines; and
- Concentrations of dissolved metals were low and mostly below limits of reporting, but there were some isolated exceedances of water quality guidelines for dissolved aluminium, arsenic, copper, mercury and zinc. These exceedances spanned all types of sites, including control and offshore sites and were not persistent.

Similar results have been obtained by the Australia Pacific LNG receiving environment monitoring program which assess water quality in the Western Basin and at reference sites in the Narrows (WorleyParsons 2015).

3.2.5. Disturbance from Helicopter Traffic

Flying helicopters have been observed to be highly disturbing to shorebirds (Smit and Visser 1993; Rogers *et al*. 2006). At a location in Holland where disturbance from jets and helicopters had occurred over an extended period of time and was frequent, helicopters caused up to 50-60% of roosting bar-tailed godwit to react (walk or fly) within approach distances of up to 700m (Smit and Visser 1993). Eurasian curlew were less tolerant of this disturbance (Smit and Visser 1993). In Switzerland, the minimum flight altitude at which a helicopter did not cause a change in behaviour of waterbirds (mostly ducks, grebes, cormorants, herons and gulls) was 450m above ground level (Komenda-Zehnder *et al*. 2003).

Helicopters are used at the Australia Pacific LNG Facility generally only in the event of an emergency. Therefore, disturbance to shorebirds from helicopter traffic will occur only rarely, and when it does occur, disturbance will be of short duration.

3.2.6. Overhead Cables Causing Injury and Mortality

Shorebirds can be injured or killed by flying into overhead wire cables present in the intertidal zone at night when their vision is more restricted. During surveys, shorebirds have been observed flying over open water and intertidal areas only, and not over inland areas of the lease.

Given that there are no overhead cables present in intertidal habitat, and that there have been no reported incidents of injury or fatality of a migratory shorebird within the APLNG Facility lease since the initiation of construction, the risk associated with this threatening process is considered negligible.

3.2.7. Movement of People, Vehicles and Equipment

During the approach of a disturbance agent, foraging shorebirds reduce their foraging activity to become more vigilant and will typically begin to move away from the approach. If the approach continues, they will eventually take flight to a new location. Disturbance causes birds to spend energy flying away and to lose feeding time while relocating to different feeding areas, where the increased bird densities may intensify competition from interference and, if of sufficient duration, from prey depletion (Goss-Custard *et al*. 2006).

Shorebirds living in environments that are heavily used by humans and exposed to repetitive, non-lethal disturbance stimuli experience energetic costs associated with their responses to disturbance (West *et al*. 2002; Goss-Custard *et al*. 2006). To reduce these costs, shorebirds are expected to habituate to repetitive stimuli that do not present a direct mortality risk (Deniz *et al*. 2003). Many studies have demonstrated the ability of many shorebird species to habituate to many forms of repetitive disturbance (Smit and Visser 1993; West *et al*. 2002; Baudains and Lloyd 2007), although the process of habituation may require lengthy exposure to repetitive disturbance stimuli (Komenda-Zehnder *et al*. 2003).

Strict access restrictions apply to all areas external to the LNG Facility fence (including areas adjacent to intertidal habitat and marine waters) as specified in the ABUE Standard Operating Procedure for Environmental Access Approval (ABUE-450-EN-N05-C-00026) and as specified in the Environmental Protection Code of Conduct (ABUE-450-EN-N05-C-00002). No movement of people or machinery has observed in intertidal habitats during monitoring surveys.

3.2.8. Decreased Access to Habitat

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

The loss, fragmentation and disturbance of intertidal mudflat habitat in the SMA (and areas affected by other projects) has likely caused migratory shorebirds normally utilising those mudflats to move elsewhere in the search for foraging opportunities. Depending on the number of birds displaced, this can be expected to lead to increased competition for food resources, and potentially reduced feeding rates, and ultimately reduced survival rates among birds utilising the remaining mudflats (West *et al*. 2002; Goss-Custard *et al*. 2006).

If feeding habitat availability in eastern Australia limits migratory shorebird populations, as suggested by a study of inland wetlands (Nebel *et al*. 2008), then a precautionary approach would be to assume an eventual reduction in overall migratory shorebird population size equivalent to the number of shorebirds displaced by mudflat habitat loss, degradation or disturbance. On the other hand, the substantial recent declines in the numbers of migratory shorebirds visiting Australia have been strongly linked to extensive and ongoing feeding habitat loss at key migration stopover sites in the Yellow Sea (Wilson et al. 2011; Yang et al. 2011; Murray et al. 2014; Clemens et al. 2016; Moores et al. 2016; Piersma et al. 2016), meaning that coastal feeding habitat within Australia is likely to now be underutilised by migratory shorebirds.

The construction of marine infrastructure across the intertidal zone may have displaced foraging from the impacted area. However, the continued presence of these structures has not been observed to cause disturbance, for example shorebirds have been observed foraging within 30-50m of the Material Offloading Facility on occasion.

3.2.9. Waste and Hazardous Materials Management

The release of wastes or hazardous materials from the site could have the potential to degrade intertidal habitat, potentially causing toxicological effects reducing benthic invertebrate abundance. A reduction in benthic invertebrate abundance on a mudflat will likely lead to a reduction in migratory shorebird use of that mudflat.

3.3. Cumulative Impacts

The Australian populations of 12 of the 19 migratory species have undergone significant declines in abundance over the period 1973-2014, with estimated average rates of decline of 2.0% to 9.5% each year over this period (Clemens et al. 2016). These declines have been strongly linked to extensive and ongoing feeding habitat loss at key migration stopover sites in the Yellow Sea (Wilson et al. 2011; Yang et al. 2011; Murray et al. 2014; Clemens et al. 2016; Moores et al. 2016; Piersma et al. 2016), with some evidence of declines of inland resident shorebirds linked to the loss of inland wetlands in Australia (Nebel *et al*. 2008, Clemens et al. 2016). Migratory shorebird populations are particularly susceptible to loss of feeding habitat or food resources on over-wintering and stopover sites, where they must feed voraciously before undertaking long migrations of up to tens of thousands of kilometres. If their feeding rates are reduced and they do not manage to lay down sufficient reserves of fat, their subsequent survival on migration is severely compromised (Baker *et al*. 2004).

EPBC Act Policy Statement 3.21 provides significant impact guidelines for 36 migratory shorebird species (DotE 2015). Importantly, this policy statement defines a 'site' for migratory shorebirds as the entire (discrete) area of contiguous habitat used by the same group of migratory shorebirds, which may include multiple roosts and feeding areas over an area that may extend beyond the boundaries of a property or project area. Under these guidelines, the Australia Pacific LNG Project Area, together with the rest of the Curtis Island Industry Precinct, falls within a 'site' (the Port Curtis shorebird area) that is recognised as being of National importance for migratory shorebirds (Clemens *et al*. 2008). Furthermore, by virtue of its location within a 'site' of National importance, all migratory shorebird foraging and roosting habitat within and adjoining the Australia Pacific LNG Project Area is regarded as 'important habitat' under the *EPBC Act*.

An impact on important habitat is regarded as a 'significant impact' under the *EPBC Act* if it results in: (i) the loss of important habitat; or (ii) degradation of important habitat leading to a substantial reduction in migratory shorebirds using important habitat; or (iii) increased disturbance leading to a substantial reduction in migratory shorebirds using important habitat (DotE 2015).

The numbers of shorebirds directly impacted upon during the operation of the LNG Facility on Curtis Island (see Tables 2.1 and 2.2) are small compared to the total numbers of shorebirds supported by the Port Curtis shorebird area. However, these impacts do need to be considered in relation to the cumulative impacts of a number of other industrial and port projects operating within the Port Curtis shorebird area. These other include the following:

- Wiggins Island Coal Terminal (WICT);
- Fisherman's Landing Port (FLP);
- Port of Gladstone Western Basin Strategic Dredging and Disposal Project (WBSDDP);
- Queensland Curtis LNG; and
- Gladstone LNG.

The cumulative impacts of the above operations on migratory shorebirds and their habitats within a Nationally significant site for migratory shorebirds are likely to be reduced, compared to the construction phase of each project.

4. Management Actions

4.1. Objectives and Targets

Objectives and targets for environmental management associated with migratory shorebirds are identified in Table 4.1.

Table 4.1: Migratory shorebird objectives and targets

Objectives	Targets
Minimise disturbance to migratory shorebirds from operational activities	No loss of populations due to operational activities No death of migratory shorebird species

4.2. Environmental Control Measures

The environmental control measures to be implemented on site to prevent or mitigate potential impacts from the APLNG Facility operation on migratory shorebirds are detailed in Table 4.2.

Table 4.2: Environmental control measures

Activities	Environmental Control Measure
General	Where possible, intertidal zone disturbance activities will be timed to avoid the migratory shorebird season (from August through to April/May).
Training	Provide personnel involved in activities with the potential to affect intertidal areas with job specific training, as required, for: • Interacting with, and reporting interactions with, migratory shorebirds; • Minimising noise and vibration, lighting and traffic impacts and scheduling high risk activities outside active periods where practicable; • Minimising impacts from shipping activities including reduced vessel speeds; • Access restriction for areas adjacent to intertidal habitat and waters within 100 metres of the LNG site, except for activities directly relating to operational activities, as included in the Environmental Protection Code of Conduct (ABUE-450-EN-N05-C-00002).
Shipping and support vessel activities	Managing shipping activities in accordance with the Shipping Activity Management Plan – Section 13 (ABUE-450-EN-N05-C-00015) to minimise disturbance to shorebirds including: • The proponent must not bring private watercraft into waters within 100m of the LNG Facility boundary except for activities relating to surveys, site clearance and operation of the LNG plant and auxiliary onshore marine facilities. • Limiting speeds to a maximum of 6 knots in the proximity of intertidal habitat to minimise disturbance.
Flaring	Note: Process area flares are at ground level and fenced off with louvered (air gaps) panels to reduce light spill to surrounding areas.
Light spill	When undertaking temporary works in areas adjoining mangrove habitats: • Avoid non safety-essential lighting; • Ensure lights are shielded and directed onto work areas; and • Position lights at a height designed to reduce spill. Lighting is managed in accordance with the Operational Environmental Management Plan – Section 8 (ABUE-450-EN-N05-C- 00001).

Activities	Environmental Control Measure
	Note: Lighting around the Facility has been strategically placed to limit light spill outside of the site. Note: Mangroves outside of the disturbance footprint have been retained to provide habitat for migratory shorebirds and a screen and light barrier between the APLNG Facility and coastal environment.
Noise and Vibration	Schedule abnormal activities with the potential to generate high levels of noise adjacent to mangrove and intertidal areas for daylight hours, where practicable. Manage noise and vibration in accordance with the Operational Environmental Management Plan – Section 6 (ABUE-450-EN-N05-C- 00001).
Stormwater Management	Manage potential water quality changes in accordance with the Operational Environmental Management Plan – Sections 7, 11 and 12 (ABUE-450-EN-N05-C-00001). Manage and monitor stormwater runoff in accordance with the Stormwater Management Plan (APLN-000-EN-R01-D-00077) and the Environmental Authority (EPPG00715613, APLN-000- EN-C02-D-10502). Monitor marine water quality and mangrove habitat on the APLNG lease in accordance with the Receiving Environment Monitoring Program (APLN-000-EN-V01-D- 10160).
Helicopter movements	The potential for disturbance from helicopter traffic will be minimised by the use of helicopters generally only in the event of an emergency. Therefore, disturbance will occur only rarely, and will be of short duration.
Elevated Wire Cables	No elevated cables have been installed in intertidal habitat. In the unlikely event that an installation is required, bird scaring devices will be attached to minimise the risk of collision.
Movement of people, vehicles and machinery	Note: Access restrictions apply to all areas external to the LNG Facility fence (including areas adjacent to intertidal habitat and marine waters) as specified in a permitting procedure for access, and as specified in the Environmental Protection Code of Conduct (ABUE-450-EN-N05-C-00002). Note: Speed limits are enforced in a vehicle access and safe driving procedure and a perimeter fence has been installed and is maintained to minimise access to intertidal areas.
Docking facilities and infrastructure across intertidal zone – Decreased access to habitat	Note: The offset requirements associated with this plan have been approved by the Department of the Environment (DotE, APLN-DOTE-APLN-L-000005, 27 September 2013) and are being implemented.
Waste and hazardous materials management	Manage solid waste and feral animals in accordance with the Operational Environmental Management Plan – Sections 8 and 12 (ABUE-450-EN-N05-C-00001), the Biosecurity Management Plan – Section 3.5 (APLN-000-EN-R01-D-10175) and the Environmental Protection Code of Conduct (ABUE-450-EN-N05-C-00002). Manage dangerous goods and hazardous materials in accordance with the Operational Environmental Management Plan (ABUE-450-EN-N05-C-00001).

4.3. Corrective Actions

Corrective actions are identified and implemented as described in Table 4.3.

The suitability and effectiveness of all corrective actions will be periodically reviewed and adjustments will be made accordingly.

Table 4.3: Corrective actions

Aspect	Corrective Action
Injured or deceased migratory shorebirds	Any fauna injury or death related to site activities will be investigated, corrective actions will be identified to prevent reoccurrence and site procedures will be revised in accordance with an Incident Reporting and Investigation Procedure. Intact dead native vertebrates can be sent to the Queensland Museum Vertebrate Laboratory (contact on 07 3840 7555 prior to sending) or disposed of as determined by the Environmental Specialist or FSC. If any person has concerns about any aspect of an activity that may impact on shorebirds, they should contact the nominated site environmental officer or supervisor. Advice should be sought from a suitably qualified ecologist should any concerns regarding management actions be reviewed and deemed to be insufficient.
Behavioural changes including attraction, disorientation and/or disturbance.	Lighting or light spill will be reviewed where adverse impacts are implicated as contributing to an incident, or are recorded from the results of shorebird monitoring. Recommendations for altered lighting will be developed in consultation with a suitably qualified ecologist and may include, but not be limited to: • installation of additional light shields • review directional lighting • reduce light heights Abnormal high noise activities will be scheduled for daylight hours, where practicable.
Adverse impact to migratory shorebirds detected through monitoring program (in addition to above)	Where an impact to migratory shorebirds is observed, work will stop and changes will be implement based on incident investigation (e.g. identify activities occurring during disturbance, identify opportunities, for example working during times of low shorebird activity). Where evidence of impact of marine vessel movements on migratory shorebirds is identified; vessel movements, speeds, timing, stop work distances and adequacy of exclusion buffer will be reviewed in consultation with a suitably qualified ecologist, and recommended actions implemented. Where impacts to migratory shorebirds are observed as a result of helicopter movements, flight plans will be reviewed and revised where possible to avoid shorebird sites. Reinforce marine exclusion buffer, restricted access to intertidal areas and no domestic pests' rules via additional training if necessary in accordance with the Environmental Protection Code of Conduct (ABUE-450-EN-N05-C-00002).

5. Monitoring and Reporting

Monitoring for migratory shorebirds and shorebird habitat condition is to be conducted annually during the operations phase, between the months of September and March (inclusive), preferably as close as possible to the spring tides in January.

Subject to obtaining satisfactory agreement with GPC, the monitoring program will be integrated with the Western Basin Strategic Dredging and Disposal Project Migratory Shorebirds monitoring program.

Monitoring can also reference, as required, the following:

- Lighting design specifications;
- Flaring facility design specifications; and
- Incidents related to vehicles, watercraft traffic or feral animals which are to be recorded for reference in the shorebird monitoring program and for annual reporting to regulators.

Within 24 hours of becoming aware if an incident resulting in injury to, or mortality of, any fauna species caused by operational activities, including migratory shorebird collision incidents, EHP's Wildlife Management Unit will be notified at wildlife.management@ehp.qld.gov.au (In accordance with Environmental Authority conditions A27 and F10).

In the event of injury to, or mortality of, an individual or individuals of EPBC listed threatened or migratory species caused by Operational activities, the Commonwealth Environment Minister also be notified within one business day of becoming aware of the incident (in accordance with EPBC Act Approval conditions 25(c) and 28).

6. Auditing and Review

Audits will be conducted as specified in the annual audit program.

Third party audits will be carried out as per the condition requirements of the EA (Condition A9 to A14) and the EPBC Act Approval 2009/4977 (Conditions 76 to 81) for the operation of the APLNG Facility.

The Migratory Shorebird Management Plan will be reviewed annually, or in response to incidents or requests from regulatory agencies, and revised to reflect changes and new activities or developments, as per Conditions 68 to 71 of EPBC Act Approval 2009/4977.

During the review of the Plan the following items will be considered:

- Incidents and response actions
- Results of monitoring and auditing conducted
- Assessment of the performance criteria
- Assessment of opportunities for improvement of environmental performance
- Suggested amendments required.

Amendments to the Migratory Shorebird Management Plan must not contravene or create inconsistency with any condition of the Environmental Authority or EPBC Act Approval 2009/4977.

7. References

The following documents have been referenced in the development of this Plan:

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Appendix 1: Migratory Shorebirds Known or Likely to Occur in Shorebird Management Area

Scientific name	Common name	*EPBC Act*	*NC Act*	Feeding in SMA	Roosting in SMA
Pluvialis fulva	Pacific golden plover	M	S	Yes	No
Pluvialis squatarola	Grey plover	M	S	No	No
Charadrius bicinctus	Double-banded plover	M	S	No	No
Charadrius mongolus	Lesser sand plover	M, E	S	Yes	No
Charadrius leschenaultii	Greater sand plover	M, V	S	Yes	No
Gallinago hardwickii	Latham's snipe	M	S	No	No
Limosa limosa	Black-tailed godwit	M	S	No	No
Limosa lapponica baueri	Bar-tailed godwit	M, V	S	Yes	No
Numenius minutus	Little curlew	M	S	No	No
Numenius phaeopus	Whimbrel	M	S	Yes	Yes
Numenius madagascariensis	Eastern curlew	M, CE	V	Yes	Yes
Xenus cinereus	Terek sandpiper	M	S	Yes	Yes
Actitis hypoleucos	Common sandpiper	M	S	No	Yes
Tringa brevipes	Grey-tailed tattler	M	S	No	No
Tringa incanus	Wandering tattler	M	S	No	No
Tringa nebularia	Common greenshank	M	S	No	No
Tringa stagnatilis	Marsh sandpiper	M	S	No	No
Arenaria interpres	Ruddy turnstone	M	S	No	No
Calidris tenuirostris	Great knot	M, CE	S	No	No
Calidris canutus	Red knot	M, E	S	No	No
Calidris alba	Sanderling	M	S	No	No
Calidris ruficollis	Red-necked stint	M	S	Yes	No
Calidris acuminata	Sharp-tailed sandpiper	M	S	No	No
Calidris ferruginea	Curlew sandpiper	M, CE	S	No	No
Limicola falcinellus	Broad-billed sandpiper	M	S	No	No

Data Sources: Department of Environment and Resource Management WildNet database; Birds Australia New Atlas 1998-2006 database; EPBC Protected Matters Search Tool; BAAM (2010).

Status: **EPBC Act**: CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory. **NC Act**: E = Endangered; V = Vulnerable; S = Special Least Concern.

Appendix 2. Migratory Shorebird Monitoring Program

Migratory Shorebird Monitoring Program

This migratory shorebird monitoring program will be implemented to monitor migratory shorebird numbers, habitat utilisation, habitat condition and extent within the Shorebird Management Area (SMA) as a means to assess the impacts of the operation of the LNG Facility on migratory shorebirds.

Monitoring of shorebird numbers against the pre-disturbance baseline and construction data, together with incidental observations of shorebird responses to operation activities, will provide the basis for assessing the net effect of operational activities on migratory shorebird use of habitats within the SMA.

Monitoring survey methods

The locations, frequency and methods for migratory shorebird monitoring are prescribed in Table 7.1.

Shorebird numbers and habitat utilisation

The most effective method for surveying migratory shorebirds within the SMA is by boat (BAAM 2010). High tide surveys of mangrove roosting habitat will be conducted by driving a small boat within 20m of the edge of the mangroves at a speed of 10-15 knots, which causes the shorebirds to flush from the mangroves and be counted. Potential salt-pan roost sites will be accessed on foot from land, and roosting birds will be counted from a distance using a telescope to minimise disturbance. Low tide surveys of foraging habitat will similarly be conducted by driving a small boat alongside mudflat habitat at a low speed, pausing at regular intervals to scan for and count shorebirds foraging on the mudflats. Low tide surveys will be conducted from a sufficient distance to minimise disturbance to foraging shorebirds.

Habitat condition

Habitat condition will be recorded at each of the monitoring locations in order to document changes over time.

Contribution to a whole-of-Port-Curtis monitoring survey

The direct and indirect impacts of operation activities of the Australia Pacific LNG Facility, together with those of the other activities within the Port of Gladstone, are expected to displace migratory shorebirds to other areas within the Port Curtis shorebird area, where they will compete with other migratory shorebirds for available foraging resources. The flow-on effects of these impacts are best examined through longer-term monitoring of migratory shorebird numbers and habitat utilisation within the broader Port Curtis shorebird area as a whole.

Monitoring of migratory shorebird use of the broader Port Curtis shorebird area is being undertaken by the Gladstone Ports Corporation as a condition of approval for the WBSDDP (SEWPaC 2010). Monitoring undertaken within the SMA will contribute to the broader Port Curtis monitoring survey.

Table 7.1: Migratory Shorebird Monitoring Program

Location	Method	Frequency
OPERATION PHASE		
Within the SMA (Figure 2.1) within (1) mudflats that are exposed at low tide but inundated at high tide; (2) mangroves; (3) salt pans and saltmarsh; (4) sandy beaches and rocky shores; and (5), shallow open waters fringing the mudflats.	• Shorebird species counts within each sector of the SMA. • Record of shorebird behaviour in response to marine vessel movements, helicopter movements, operational noise, night lighting, gas flaring and vehicle and personnel movements. • Record of the condition of each sector of the SMA, including photographic records and noting: — mangrove condition (e.g. dieback or recruitment) — evidence of mudflat erosion or accretion — evidence of predation — any other factors of significance to shorebird habitat	Annually as close as possible to the spring tides in January.