Abbot Point Growth Gateway Project

Terrestrial Ecology Report

State Matters

Prepared for
Advisian

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Abbreviations and glossary

Abbreviation	Description
ASS	Acid Sulphate Soils
CEMP	Construction environmental management plans
CIA	Cumulative Impact Assessment
DEHP	Queensland Department of Environment and Heritage Protection
DIWA	Directory of Important Wetlands in Australia
DoE	Commonwealth Department of the Environment
DMCP	Dredged Material Containment Ponds
ELA	Eco Logical Australia Pty Ltd
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
GIS	Geographic Information System
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation for Australia
MSES	Matters of State Environmental Significance
NC Act	*Nature Conservation Act 1992* (Queensland)
NQBP	North Queensland Bulk Ports Corporation Ltd
OEMP	Operational environmental management plans
PASS	Potential Acid Sulphate Soils
Project Area	The footprint of the proposed Dredged Material Containment Ponds and temporary pipeline alignment
RE	Regional Ecosystem
Regional ecosystems	per the Regional Ecosystem and Remnant Mapping, Version 8.1, DEHP 2012
SEVT	Semi-evergreen Vine Thicket (a type of ecological community)
Study Area	The Port of Abbot Point and adjacent coastal woodlands, foreshore habitats, and the Caley Valley Wetland complex.
TEC	Threatened Ecological Community
The Project	Abbot Point Growth Gateway Project
WPA	Wetland Protection Area

Executive summary

The Port of Abbot Point is located approximately 25 km north of Bowen on the North Queensland coast. The Port comprises an existing coal export facility that has been in operation since 1984. In 2008, the surrounding area was defined as a State Development Area by the Queensland Government and several developments have been proposed and approved in recent years.

The Abbot Point Growth Gateway Project (the Project) has been identified by the State of Queensland as an option to beneficially reuse dredged material as landfill within the Port of Abbot Point. The Project involves the construction of dredged material containment ponds on land, avoiding direct disturbance to the Caley Valley Wetland and the placement of dredged material at sea within the Great Barrier Reef World Heritage Area.

The Project comprises the construction of dredged material containment ponds on unallocated industrial land including within the Terminal 2 area of the port, capital dredging of the Terminal 0 berth pocket and apron areas using a cutter suction dredge, pumping of dredged material ashore to the dredged material containment ponds via a temporary pipeline, discharge of return water from the dredge ponds to the Coral Sea, and ongoing management of the settled dredged material for various purposes including beneficial reuse.

This report provides information on terrestrial ecology to support the assessment of relevant State matters under Queensland legislation (Matters of State Environmental Significance; MSES). Potential impacts of the Project on aquatic and marine fauna (excluding shorebirds) are outside of the scope of this report.

The Project Area (where on-shore development works are proposed) is highly disturbed and consists primarily of non-remnant vegetation, with some patches of regrowth. The Project does not involve any disturbance of regulated vegetation, although the pipeline alignment from the Dredged Material Containment Ponds to the Coral Sea is located adjacent to small patches of the regulated vegetation.

Several other MSES are known to occur adjacent to the Project Area and are relevant environmental values for the assessment of indirect impacts of the Project. These values are mostly associated with the Caley Valley Wetland, which is a Wetland Protection Area and provides important feeding and roosting habitat for several species of birds.

Potential impacts of the Project on MSES were assessed in accordance with the Queensland Significant Residual Impact Guidelines. Consideration was given to the impacts of vegetation clearing, habitat fragmentation, earthworks, vehicle movements, dust and light emissions, construction noise, waste disposal, increased human presence and the alterations to surface hydrology, ground water and water quality. Impacts associated with ongoing management and periodic use of the dredged material containment ponds, following the completion of construction works, were also assessed.

The assessment identified there would be no direct impact of the Project on regulated vegetation or MSES connectivity areas. Potential impacts on the threatened plant *Croton magneticus* were assessed and found to be low, as the species is unlikely to occur within the Project Area. Management measures are recommended to reduce the risk of indirect impacts on habitat of the species from fire, weeds and pests on vegetation.

The assessment identified that the Project Area is located adjacent to a Wetland Protection Area, which is a MSES. Application of the Significant Residual Impact Criteria for wetlands and watercourses identified that there would not be a significant impact on the values of the wetland.

As the Project is located within a catchment adjoining the Great Barrier Reef lagoon, the State Development Assessment Provisions were also considered. The Project was assessed to be consistent with the performance objectives of the Wetlands Protection Area State Code. The adequacy of an area of terrestrial land separating the Project Area (where direct impacts will occur) and the Wetland Protection Area was assessed. The area was found to be adequate for avoiding indirect impacts on terrestrial ecology values of the wetland (wetland birds).

The Squatter Pigeon, Beach Stone-Curlew and Eastern Curlew are the only state-listed threatened species likely to utilise habitats within the Project Area (including the pipeline alignment). Several species listed as Special Least Concern (migratory birds) and the Vulnerable Australian Painted Snipe are known to occur in the Study Area, or are considered likely to be present. The Coastal Sheathtail Bat and Glossy Black-Cockatoo were assessed as having potential to occur in the Study Area.

The Project involves the disturbance of approximately 75 ha of habitat potentially suitable for the Squatter Pigeon. While there have been a small number of Squatter Pigeon sightings within in the Abbot Point region, potential impacts on the species were assessed to be low. The Squatter Pigeon is ubiquitous in this part of its geographic range and the species is not restricted by habitat availability, as it is a habitat generalist. Mitigation measures are proposed to reduce impacts on Squatter Pigeon.

Potential impacts of the Project on the Glossy Black-Cockatoo, Beach Stone-Curlew and Coastal Sheathtail Bat were assessed to be low. While the Beach Stone-Curlew is known to occur in the Abbot Point region, its sensitivity to the Project was assessed to be low, with impacts manageable through a range of mitigation measures. The Glossy Black-Cockatoo and Coastal Sheathtail Bat are unlikely to use the Abbot Point region frequently or in high numbers and were also assessed to have a low sensitivity to Project-related impacts. Impact of the Project on Special Least Concern (migratory) birds which utilise non-wetland habitats in the vicinity of the Project Area were also assessed to be low.

Indirect impacts of the Project on wetland birds were assessed, including migratory shorebirds and listed threatened species. In the absence of State guidelines for the assessment of impacts on migratory shorebirds, relevant Commonwealth guidelines were applied. Wetland birds and their habitat were also assessed to be the most relevant consideration for assessing impacts on the “habitat or life cycle of native species”, as required by the Residual Impact Guidelines (Wetland Protection Area). The Caley Valley Wetland was assessed as important habitat for migratory shorebirds, with at least 15 species present. Those species particularly relevant to the assessment of State matters were the Eastern Curlew (Near Threatened) and Australian Painted Snipe (Vulnerable).

There will be no direct disturbance of the Caley Valley Wetland from the Project. Assessment of impacts on wetland birds was therefore focussed on indirect effects associated with lighting, noise, dust and human disturbance. An area of terrestrial land ranging from 50 m to 300 m separates the Caley Valley Wetland from the Project Area. This is beyond the distance at which a flight response to disturbance has been recorded for most migratory shorebird species. Impacts of lighting the construction site at night are also likely to be completely contained with this area.

Modelling of dust deposition, dust concentration and noise created by all stages of the Project’s construction and operational stages was used to assess the potential significance of indirect impacts on wetland birds and their habitat. Several mitigation and monitoring measures were recommended to further reduce the potential for indirect impacts. Overall impacts of the Project on wetland birds were

assessed to be low, with no net residual impact. No offsets were required and the buffer distance between the Wetland Protection Area and construction site was assessed to be adequate to achieve protection of relevant MSES.

1 Introduction

1.1 Development proposal

The Port of Abbot Point is located approximately 25 km north of Bowen on the North Queensland coast (Figure 1). The Port comprises an existing coal export facility that has been in operation since 1984. In 2008, the surrounding area was defined as a State Development Area by the Queensland Government, to facilitate large-scale industrial development of regional, state and national significance.

The existing coal terminal (Terminal 1; T1) is currently owned and operated by Adani Abbot Point Terminal (AAPT). North Queensland Bulk Ports Corporation Ltd (NQBP) is the port authority for the Port of Abbot Point. T1 is strategically located to provide export capacity from coal mines in the northern Bowen Basin, with coal supplied to Abbot Point by rail. There are two approved port expansion proposals at Abbot Point – Terminal 0 (T0; Adani Coal) and Terminal 3 (T3; GVK Hancock). However, construction of these projects is yet to commence.

The Queensland Government intends the Port of Abbot Point to be declared as a Priority Port Development Area, under the Sustainable Ports Development Bill 2015 introduced into parliament in June 2015. Declaration is intended to concentrate the State's future port developments in five locations, rather than support development of many small ports along the coast, whose cumulative impacts would exceed those from a fewer number of larger ports.

Several developments have been identified in master planning processes for the proposed Abbot Point Priority Port Development Area. A substantial amount of dredging will be required to complete these developments. Placement of dredged material on land is preferred to offshore placement, to protect the World Heritage values of the Great Barrier Reef (GBR; Commonwealth of Australia 2015).

The proposed action: the Abbot Point Gateway Project (hereafter referred to as 'the Project') has been identified by the State of Queensland as an option to beneficially reuse dredged material as landfill within the Port of Abbot Point and the Abbot Point State Development Area. The Project involves the construction of a management area for dredged material on land, avoiding direct disturbance of the Caley Valley Wetland.

The Project components (Figure 2) include:

- Construction of onshore dredged material containment ponds (DMCPs) within the area previously allocated for the development of T2 and adjoining industrial land. The DMCPs will be comprised of earth embankments constructed on the existing ground profile using on-site cut and fill operations and suitable materials from onshore sources (quarries)
- Capital dredging of approximately 1.1 million m^3 *in situ* volume of previously undisturbed seabed for new berth pockets and ship apron areas required to support the development of T0. The bulked volume of dredged material (comprising sediments entrained with water and air) once pumped to the DMCPs is expected to be approximately 2.2 million m^3
- Relocation of the dredged material to the DMCPs and offshore discharge of return water via the construction and dismantling of temporary pipelines
- Ongoing management of the dredged material including its removal, treatment and beneficial reuse within the port and State Development Area, where appropriate.

Figure 1 Map showing the location of the Project Area within the Port of Abbot Point on the central coast of Queensland

Figure 2: Terrestrial Project Elements

Marine sediment studies have identified a mix of sand, clay, silt and some gravel within the area to be dredged. Sediments have been analysed in accordance with the National Assessment Guidelines for Dredging (Commonwealth of Australia 2009) and were found to have contaminants below the concentrations at which impacts on aquatic organisms can be anticipated. While there are potential acid sulphate soils (PASS) within the sediments, they have a neutralising capacity greater than their acid generating capacity (GHD 2012).

A cutter suction dredge will be used to relocate dredged material onshore, by pumping a slurry of sediment and marine waters through temporary pipelines to the DMCPs. Return water will be discharged from the DMCPs to the ocean via a temporary discharge pipe. It is expected that a liner (e.g. Low Density Polyethylene liner or similar) will be installed on the inside face of the DCMP embankments to prevent piping failure, to provide erosion control during dredging, and to minimise potential lateral seepage from the DCMPs. The floors of the DMCPs will be unlined.

The design of the DMCPs will allow for the beneficial reuse of dredged material subject to the future needs of the port. Dredged material may be treated within the DMCPs prior to its beneficial reuse or removal from the site. Pipework or other infrastructure will be incorporated into the DMCP design to manage stormwater runoff following the completion of dredging.

1.2 Designated Proponent

The designated proponent for the Project is the State of Queensland, represented by the Department of State Development.

1.3 State Assessment Process

There is no formal EIS process being undertaken at the State Government level for the Project. The Project will require development approval from the Coordinator-General under the Abbot Point State Development Area (APSDA) Development Scheme, with other permits and approvals also required as described in Section 2.

1.4 Purpose and scope of this report

The purpose of this report is to provide information regarding potential impacts of the Project on terrestrial ecology to support State Government approval and associated application requirements. Detailed baseline information and analysis of impacts is provided for:

- Matters of State Environmental Significance (MSES) as defined under the *Environmental Offsets Regulation 2014*; and
- Endangered, Vulnerable, Near Threatened (EVNT) and Special Least Concern (SLC) flora and fauna under the *Nature Conservation Act 1992*.
- Pest flora and fauna regulated under the *Land Protection (Pest and Stock Route Management) Act 2002.*

This report seeks to provide information in a manner which is appropriate to support State Government agencies in their decision making process regarding controlling provisions for MSES.

Relevant Commonwealth matters under the *Environment Protection and Biodiversity Conservation Act 1999* have been addressed in a separate report.

2 Legislative Framework

Queensland legislation relevant to ecological aspects of the Project is discussed below.

2.1 *State Development and Public Works Organisation Act 1971* (Qld)

The Abbot Point State Development Area (APSDA) is established under the *State Development and Public Works Organisation Act 1971* (Qld). The associated APSDA Development Scheme (Coordinator-General 2014) sets the strategic vision for the area, regulates development and is prepared and implemented by the Coordinator-General.

This report will inform applications to the Coordinator-General to develop the Project, such as a Material Change of Use application. The Project will then be assessed against the provisions of the APSDA Development Scheme by the Coordinator-General. The State Development Assessment Provisions (which are applied under the *Sustainable Planning Act 2009*) are likely to be used as a non-legislative guide to the assessment process in the absence of similar detailed guidelines.

2.2 *Sustainable Planning Act 2009* (Qld)

The *Sustainable Planning Act 2009* (SP Act) is the primary act that regulates planning and development in Queensland. The aim of the SP Act is to achieve sustainable planning outcomes through:

- managing the process by which development takes place
- managing the effects of development on the environment
- continuing the coordination and integration of local, regional and state planning.

The SP Act provides the legislative framework for development assessment, through the Integrated Development Assessment System (IDAS) and the assessment of applications triggered under a number of other Acts, including the *Vegetation Management Act 1999, The Fisheries Act 1994* and the *Water Act 2000*.

IDAS provisions will not apply to the onshore components of the Project as it will be assessed under the APSDA Development Scheme.

2.3 *Environmental Offsets Act 2014* (Qld)

The Queensland *Environmental Offsets Act 2014* (EO Act) came into effect as of 1 July 2014. A key part of the EO Act framework includes the new Queensland Environmental Offsets Policy (QEOP), which streamlines offset obligations under state and federal legislation. Under the QEOP framework, offsets will be required for significant residual impacts on Matters of State Environmental Significance (MSES). Significant Residual Impact Guidelines (Queensland Government 2014) are in place to guide assessment of impacts on MSES.

MSES are described in Schedule 2 of the *Environmental Offsets Regulation 2014*. MSES relevant to the Study Area assessed in this report include:

1. The following types of regulated vegetation are regulated under the *Vegetation Management Act 1999*:
   a) Endangered and Of Concern Regional Ecosystems (RE)

b) a RE that intersects with an area shown as a wetland on the vegetation management wetlands map (to the extent of the intersection);

c) An area of essential habitat that is habitat for Endangered or Vulnerable wildlife under the NC Act.

d) REs within a defined distance from defining banks of watercourses identified on the vegetation management watercourses map.

2. Connectivity Areas, as determined via the Landscape Fragmentation and Connectivity Tool available from the Queensland Government Information Service.
3. Wetlands that are Wetland Protection Areas (WPA) or wetlands of high ecological significance shown on the Map of referrable wetlands.
4. Wetlands and watercourses in high ecological value waters as per the *Environmental Protection (Water) Policy* 2009, schedule 2. This applies to Environmentally Relevant Activities under the *Environmental Protection Act 1994* only. As no ERAs are required for the onshore works, this MSES does not apply and is not mentioned further.
5. A designated precinct in a strategic environmental area. As no strategic environmental areas exist in the Study Area, these are not mentioned further.
6. Protected Wildlife Habitat, including:

e) An area that is shown as a high risk area on the flora survey trigger map and that contains plants that are Endangered wildlife or Vulnerable wildlife.

f) An area that is not shown as a high risk area on the flora survey trigger map, to the extent the area contains plants that are habitat for Endangered wildlife or Vulnerable wildlife.

g) A non-juvenile koala habitat tree in certain areas under the *South East Queensland Koala Conservation State Planning Regulatory Provisions* – This is not applicable to the Project and is not mentioned further.

h) habitat for an animal that is Endangered wildlife or Vulnerable wildlife or a Special Least Concern animal.

7. A protected area (e.g. National Park).
8. Highly protected zones of State Marine Parks. This is not relevant to this report and is addressed in the Aquatic Ecology Report (BMT WBM 2015) and the Marine State Matters Technical Memorandum (Advisian 2015).
9. Fish Habitat Areas under the *Fisheries Act 1994* – This is not relevant to this report and is addressed in the Aquatic Ecology Report (BMT WBM 2015) and the Marine State Matters Technical Memorandum (Advisian 2015).
10. A waterway providing fish passage - This is not relevant to this report and is further discussed in the Aquatic Ecology Report (BMT WBM 2015).
11. Marine plants under the *Fisheries Act 1994* - This is not relevant to this report and is addressed in the Aquatic Ecology Report (BMT WBM 2015) and the Marine State Matters Technical Memorandum (Advisian 2015)
12. Legally secured offset areas. As no existing legally secured offset areas exist in the Study Area, this is not mentioned further.

The application of each of these MSES to the Project is discussed in Section 4.6.

As outlined in Section 15 of the EO Act, the State Government is unable to impose an offset condition, if the same or substantially the same impact and the same or substantially the same prescribed environmental matter has been assessed under a relevant Commonwealth Act.

2.4 *Vegetation Management Act 1999* (Qld)

The *Vegetation Management Act 1999* (VM Act) establishes maps to identify areas of high conservation value, areas vulnerable to land degradation and remnant vegetation. The VMA does not in itself regulate vegetation management, as the trigger and process for development assessment is contained within the SP Act. However, the VM Act does provide for polices that form the basis for assessment of development that involve clearing of vegetation.

The VM Act is relevant to the Project as it supports the identification of MSES. However, permits to clear vegetation co-regulated under the VM Act / SP Act are not required for the onshore works due to the application of the APSDA Development Scheme.

2.5 *Fisheries Act 1994* (Qld)

The *Fisheries Act 1994* establishes a regime to regulate fishing, development in fish habitat areas and impacts on marine plants. Similar to the VM Act, approvals for development that impacts fish habitat areas and marine plants are regulated through the SP Act. Therefore, development approval is not required for the onshore works due to the application of the ABSDA Scheme.

Further information on the application of the *Fisheries Act 1994* is provided in the ecological assessment of aquatic ecology (BMT WBM 2014; Advisian 2015).

2.6 *Nature Conservation Act 1992* (Qld)

The object of the *Nature Conservation Act 1992* (NC Act) is to conserve nature through an integrated and comprehensive conservation strategy for the whole of Queensland.

Under the act, approval is required to:

- clear Endangered, Vulnerable or Near Threatened plants within high risks areas;
- tamper with animal breeding places; and/or
- relocate animals.

2.7 *Land Protection (Pest and Stock Route Management) Act 2002* (Qld)

The *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) provides a framework and powers for improved management of weeds, pest animals and the stock route network.

Schedule 2 of the *Land Protection (Pest & Stock Route Management) Regulations 2003* lists declared pests in three classes based on their current or potential economic, environmental or social impact. The Act operates in conjunction with the *Plant Protection Act 1989*, which provides for the control and eradication of pest plants, invertebrate animals, fungi, viruses and diseases that are harmful to crop plants.

The act classifies pests (including flora and fauna) into three classes and specifies management required for each. The classes of declared pest and management requirements specified under the act apply to the Project. The classes include:

1. Class 1 pests can cause adverse economic, environmental and social impacts. Once established in Queensland, class 1 pests are subject to eradication from the state. During construction and operations, reasonable steps must be taken to keep land free of Class 1 pests.
2. Class 2 pests established in Queensland can have adverse economic, environmental and social impacts. The management of these pests requires coordination and they are subject to programs led by local government, community or landowners. There are no specific requirements for the project for Class 2 pests.
3. Class 3 pests are established in Queensland and have, or could have, an adverse economic, environmental or social impact. Landholders are not required to control Class 3 plants unless their land is adjacent to an environmentally significant area and they are issued with a pest control notice. It is a serious offence to supply a Class 3 pest without a permit issued by Biosecurity Queensland.

3 Methodology

3.1 Nomenclature and Terminology

Within this report, the conservation status of a species is described as 'Endangered', 'Vulnerable', 'Near Threatened', 'Least Concern' or 'Special Least Concern', pursuant to the *Nature Conservation Act 1992 (*Qld; NC Act).

The term 'marine plant' includes flora species of plants that normally grow on or adjacent to tidal lands, pursuant to the definition in Section 8 of the *Fisheries Act 1994* (Qld).

Vegetation type descriptions are based on the structural types described by Neldner *et al*. (2012). Names of flora follow the Census of Queensland Flora (Bostock and Holland 2013) whilst names of fauna follow listings as per the NC Act.

As there are both terrestrial and marine ecological values within the Study Area, there is some overlap between this report and the assessment report covering impacts on aquatic ecology (WBM BMT 2015). For clarity, this report excludes marine plant communities and flora and fauna within other aquatic areas, except where they provide habitat for protected species such as shorebirds.

The term 'migratory shorebird' is used in this report to describe a shorebird that migrates to Australia from other parts of the world (see overview in Section 9.1.1). There are 36 international migratory shorebird species that regularly visit Australia each year (DEWHA 2009b), and are generally listed as Special Least Concern under the NC Act.

Within this report, the term 'database search results' refers to results from the Protected Matters Search Tool results, Wildlife Online Search results and Atlas of Living Australia Search results.

3.2 The Study Area and Project Area

Within this report, the Project Area and the Study Area represent two different areas. The Project Area includes the development footprint, which includes the area required for:

- The onshore DMCPs and associated infrastructure;
- The construction compound and materials laydown area;
- A temporary pipeline for the transport of dredged material to the DMCPs;

- The temporary return water pipeline from the DMCPs to a sub-tidal discharge location in the Coral Sea; and
- The pipework or other infrastructure built to manage stormwater runoff at the completion of dredging.

When determining the Study Area relevant to this ecological assessment, conservative consideration was given to the likely geographical extent of potential impacts (direct and indirect) on terrestrial ecology. The Study Area within this report generally includes the Project Area, other locations where expansion of the Port of Abbot Point is planned (T0 and T3), adjacent coastal woodlands and foreshore habitats, and the Caley Valley Wetland complex.

3.3 Database and Literature Review

The following databases and maps were reviewed to determine ecological values known to occur or with potential to occur:

- Regional Ecosystem Mapping (version 8.0)
- Environment Protection and Biodiversity Conservation Act Protected Matters Search
- Wildlife Online Database Search
- Atlas of Living Australia Database Search
- Essential Habitat Mapping
- Protected Plants Survey Trigger Map
- Queensland Herbarium HERBRECS Database Search
- Queensland Museum Zoology Database Search
- Aerial Imagery.

The Port of Abbot Point and adjacent Abbot Point State Development Area have been the subject of extensive environmental studies completed as part of the Abbot Point Cumulative Impact Assessment (CIA; ELA and Open Lines 2012a) and other projects that have sought approval under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) and Queensland legislation. Numerous environmental impact assessment investigations have been completed and used by the Commonwealth Government in the assessment and approval process (Table 1).

These studies have generally been made publicly available and subject to community consultation. Many of the studies were completed in support of projects that have now been approved by Commonwealth and State agencies, giving confidence that the information available is suitable for impact assessment purposes.

Table 1 Summary of relevant assessments and surveys in and around the Project Area

	Study	Description	Survey timing
1.	Ecoserve 2007	Unpublished report for Ports Corporation of Queensland. General terrestrial flora and fauna survey undertaken within limited Ecoserve Study Area covering only part of Abbot Point Project Area (mainly in and around Caley Valley Wetlands).	Wet season: 28 Mar – 4 Apr 2007 (8 days / 7 nights)

	Study	Description	Survey timing
2.	Lewis Consulting Services 2009	Associated with Proposed Water for Bowen Project. This report was not available for review. However, several documents outline the details, survey effort, and results, including a potential record of Black-throated Finch *Poephila cincta cincta* at Splitter's Creek.	Pre-wet season: 13 – 18 Oct 2007 (6 days) Post-wet season: 14 – 25 April 2008 (11 days)
3.	GHD 2009	This was a standalone Ecological Assessment that was associated with Proposed Abbot Point Multi Cargo Facility EIS. General terrestrial flora and fauna surveys within limited GHD Study Area covering only part of Abbot Point Project Area (mainly in and around Caley Valley Wetlands). Targeted searches for Black-throated Finch *Poephila cincta cincta*.	Dry season: 20 Oct – 1 Nov 2008 (13 days) Wet season: 22 Mar – 4 Apr 2009 (13 days)
4.	Coordinator-General 2010	The Department of State Development commissioned Parsons Brinckerhoff Australia Pty Ltd (PB) to undertake background investigations and prepare baseline information to inform the location of an infrastructure corridor within the APSDA, linking the northern part of the industry precinct with the proposed MCF at the port. The Australian Centre for Tropical Freshwater Research was sub-contracted by PB for wetlands assessment. Field assessment focused on transect-based flora survey methods, targeted searches and vegetation mapping.	Wet season: Jan 2009 (4 days)
5.	PB 2009	Associated with Proposed Water for Bowen Project. Targeted survey for Black-throated Finch (southern) within the proposed water for Bowen Project Area. Undertaken in response to Lewis Consulting Services 2009 report which observed a pair of Black-throated Finches. Targeted survey of breeding, foraging and watering points.	Dry season: June/July 2009 (4 days)
6.	GHD 2010	This is the terrestrial ecology section of the Abbot Point Multi Cargo Facility EIS. General terrestrial flora and fauna survey and targeted threatened species surveys at the end of the wet season. Flora and fauna assessment at One Tree Hill in the dry season, in response to corridor alignment changes.	Wet season: March/April 2010 Dry season: July 2010
7.	Unidel 2011	Terrestrial Flora and Fauna Report prepared for the Waratah Coal Pty Ltd's China First EIS at Abbot Point. The study included a desktop assessment. Eight flora and fauna sites were surveyed in October. An aerial survey for avifauna was undertaken in November 2009 via helicopter (3 hours total survey effort).	Dry season: October 2009 (2 days) Early wet season: November 2009 (3 days)

	Study	Description	Survey timing
8.	GHD 2011	Surveys undertaken for Hancock Prospecting Pty Ltd Alpha Coal Project (Rail) Supplementary EIS. Surveys covered the proposed Rail Loop only (and adjacent habitat), which includes part of the Study Area associated with the Abbot Point Growth Gateway Project. Involved habitat assessments, water quality sampling and freshwater flora and fauna surveys.	Wet season: 23 – 25 Feb 2011 (3 days)
9.	Austecology (2011)	Active searches for Black-throated Finch and Water Mouse and their habitat in the far western Caley Valley Wetlands and adjacent areas to the south-west.	Dry season: 20 – 22 May 2011 (3 days)
10.	HCIPL 2012	Associated with Abbot Point Coal Terminal 3. General terrestrial flora and fauna surveys included standardised bird surveys at six sites during the dry season, and two thirty-minute bird censuses in early morning and late afternoon. During the wet season, transects and census points set up around the Caley Valley Wetland, 10 hours total survey effort.	Dry Season: 10-11 Nov 2008 (2 days) Wet Season: 4 April 2009 (1 day) 23-25 Feb 2011 (3 days)
11.	BAAM 2012a & 2012b	Migratory Shorebird and Waterbird Surveys within Caley Valley Wetlands for the Abbot Point Cumulative Impact Assessment. Five comprehensive field surveys for migratory shorebirds and other waterbirds were undertaken in 2012 to identify habitat values and species presence within and surrounding the proposed Abbot Point Port expansion. Field surveys covered the wetland area within and surrounding the Abbot Point Port and Wetland Project development footprint; but did not cover pasture or woodland ecosystems. Coastal habitat transects, wetland perimeter transects, open water area searches, kayak transects, and soak swamp or settling pond surveys were undertaken.	Wet season (2012): 21 – 24 Feb (4 days) 5 –10 Mar (6 days) 19 – 21 Nov (3 days) 12 – 13 Dec (2 days) Dry season: 26 – 29 Jun 2012 (4 days)
12.	BMT WBM 2012	Kaili (Caley) Valley Wetlands Baseline Report. This report provides a comprehensive description of the environmental values (including wetland dependant fauna) of the Caley Valley Wetlands and adjacent areas, with a focus on the Abbot Point State Development Area. It was based on desktop information and included results of two high level fauna and flora surveys.	Late dry season: 25 – 30 Oct 2010 (6 days) Early wet season: 8 – 12 Nov 2010 (5 days)
13.	Eco Logical Australia and Open Lines Consulting 2012	Abbot Point Cumulative Impact Assessment. No field surveys were undertaken as part of the referral.	N/A

	Study	Description	Survey timing
14.	CDM Smith 2013	Terrestrial fauna surveys were carried out by CDM Smith for Terminal 0. Opportunistic bird surveys in conjunction with aquatic surveys. Good wetland condition during surveys due to higher than average rainfall earlier that year.	Dry season: 31 Jul – 3 Aug (4 days)
15.	ELA 2014a (Dredge Disposal)	Desktop and field assessment for onshore dredge disposal options in and around Caley Valley Wetlands. Parts of the assessments Study Area overlap with footprint for this project. Field assessment involved quaternary surveys, Regional Ecosystem (RE) validation assessments, habitat assessments, targeted searches for threatened flora species and incidental fauna observations.	Dry season: 18 – 20 Aug 2014 (3 days)
16.	ELA 2014b (SEVT)	Technical memo assessing the extent and ecological condition of Semi-evergreen Vine Thicket (SEVT) in the patch adjacent to Dingo Beach (north-west of the current Project Area).	Dry conditions: 11 Dec 2014 (1 day)
17.	ELA 2014c (Offsets)	Field surveys covered the impact and potential offset sites (in areas surrounding the Caley Valley Wetland) for the superseded beneficial reuse area. Determined habitat quality for marine plants and REs intersecting with Caley Valley Wetlands.	Dry conditions: 11 – 13 Dec 2014 (2 days)
18.	ELA 2014d (Owl & Bat)	Targeted field surveys for the Coastal Sheath-tail Bat *Taphozous australis* and the Rufous Owl *Ninox rufa*. The survey covered SEVT, *Melaleuca* and eucalyptus woodlands in the superseded beneficial reuse area (west and north-west of the current Project Area).	Dry conditions: 10 – 12 Dec 2014 (3 days)
19.	ELA 2014e (Protected Plant)	Timed meander flora surveys were undertaken for the section of the now superseded beneficial reuse area that overlapped with the Protected Plants Trigger Area, west of the current Project Area. The survey identified all species observed, though specifically targeted *Croton magneticus* and *Ozothamnus eriocephalus*.	Dry conditions: 10 Dec 2014 (1 day)
20.	ELA 2014f (Eastern Beach)	A small patch of vegetation formally mapped as RE11.2.2 located on the eastern beach of Abbot Point (at the location of where the proposed dredge pipeline crosses the beach) was surveyed in December 2014.	Dry conditions: 11 Dec 2014 (1 day)
21.	DSD 2015	The Abbot Point Growth Gateway Project EPBC Act Referral (Department of State Development 2015). No field surveys were undertaken as part of the referral.	N/A

The BAAM (2012) survey of shorebirds and waterbirds is particularly relevant to the Project, as it was completed recently (3 years ago) and at a time when there were significant quantities of water within the Caley Valley Wetland (leading to large numbers of shorebirds). Further details of the BAAM survey results relevant to the assessment of Project impacts is provided in Section 4.

3.4 Field Assessments

ELA has completed field work to validate Regional Ecosystem (RE) mapping of the Study Area, and an on-ground terrestrial ecological survey was completed over parts of the Study Area including sites within the Project Area (ELA 2014d). This work was further supplemented by a field survey of marine salt couch habitats adjacent to the Project Area completed by BMT WBM in June 2015 (BMT WBM 2015). ELA worked closely with BMT WBM to incorporate results of the field work into this report, where relevant to the assessment of impacts on terrestrial ecology (including shorebirds).

3.5 Impact Assessment Methodology

Potential impacts of the Project on listed species that are known, likely or have the potential to occur within the Study Area were given detailed consideration in the impact assessment. The species' ecology was described, potential impacts within the Project Area and adjacent areas were considered, mitigation and management measures were developed and residual impacts and outcomes assessed.

It is recognised that shorebirds are often treated as a group for impact assessment purposes, as they can be ecologically similar and may occupy similar habitats. Where possible, species specific habitat requirements were considered, particularly for those threatened species listed under the NC Act.

The *Queensland Environmental Offset Policy Significant Residual Impact Guideline* (DEHP 2014) provides direction to identify when a residual impact on MSES may be 'significant'. The guideline has been used within this report to assess the significance of potential impacts on MSES. Box 1 provides the definition of significant residual impact as outlined in the guideline. Impacts on each MSES are further determined by assessing the residual impact against specific criteria specified in the guideline.

Box 1: The definition of Significant Residual Impact as per the Queensland Environmental Offset Policy Significant Residual Impact Guideline (DEHP 2014)

As per Section 8 of the *Environmental Offsets Act 2014*, a significant residual impact is generally an adverse impact, whether direct or indirect, of a prescribed activity on all or part of a prescribed environmental matter that:

a) remains, or will or is likely to remain, (whether temporarily or permanently) despite on-site avoidance and mitigation measures for the prescribed activity; and
b) is, or will or is likely to be, significant.

A 'prescribed environmental matter' includes:

- a MSES, as discussed in Section 2.3 of this report;
- an accredited Matter of National Environmental Significance (MNES), should Queensland receive accreditation in relation to environmental offsets for the purpose of the EPBC Act; and
- a Matter of Local Environmental Significance (MLES), as described in Section 10(1)(c) of the *Environmental Offset Act 2014*. This refers to an environmental offset for a matter under a local planning instrument. Due to the application of the APSDA Scheme, MLES do not apply to this project.

The Project Area is located adjacent to WPA associated with the Caley Valley Wetland within the Study Area. The WPA does not extend to within the Project Area. However, as the Project is located within a

catchment adjoining the Great Barrier Reef lagoon, the State Development Assessment Provisions are relevant as a non-statutory guide (as the Project is not being assessed under the SP Act). The WPA State Code seeks to achieve several performance outcomes in relation to ecology, and has been considered in this assessment.

3.6 Reliability of information

Information utilised in the preparation of this report has been prepared by suitably qualified and experienced consultants, published in peer reviewed journals or prepared and reviewed by State or Commonwealth Government. The information utilised in this document is considered to be fit for purpose and of a nature appropriate for the assessment of impacts relating to the Abbot Point Growth Gateway Project.

4 Existing Environmental Values

4.1 Regional Ecological Context

Abbot Point is located within the Brigalow Belt North Bioregion, an environmentally sensitive area that supports a range of environmental values. The bioregion is characterised by rugged ranges and alluvial plains, with the vegetation primarily being acacia open forests and eucalypt woodlands (DoE 2008).

The Project Area is located on a cleared sandy plain broadly surround by:

- An existing operating coal terminal (T1), railway and rail loop to the east and north
- Induced grasslands to the west
- The Caley Valley Wetlands to the west and south

The Study Area:

- Occurs within and adjacent to the GBR World Heritage Area and Marine Park
- Includes the Caley Valley Wetland (a largely ephemeral wetland system) which is important for many bird species (including both threatened and migratory species)
- Supports a variety of vegetation types in different conditions including:
    - regulated vegetation
    - remnant coastal dune systems and beaches
    - woodland, riparian, mangrove and coastal areas
    - extensive areas previously used for farming
- Includes cleared areas that are used for existing industrial uses.

The current state of the environmental values at Abbot Point reflects both its proximity to some ecologically important areas, as well as its existing use as an industrial port and previous use for agricultural purposes.

Abbot Point experiences a dry tropical climate with annual rainfall of between 1,000 mm to 1,600 mm across the region (BOM 2015) and a pronounced wet season between November and March. The area is characterised by Quaternary alluvial and colluvial plains fringed by coastal and estuarine deposits, with volcanic outcrops forming low hills. The most prominent ecological feature is the Caley Valley Wetland which covers an area of 5,154 ha (Section 4.4).

The Study Area and surrounds are located within the Bogie River Hills Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion, a subregion of the Brigalow Belt North Bioregion. The sub-region has been subject to broad scale clearing primarily for agricultural activities. Despite considerable modifications to the landscape, natural habitats do persist and include areas of fragmented and connected remnant vegetation, watercourses and wetlands.

The nearest protected areas are Mount Aberdeen National Park (located 40km to the south-west), Cape Upstart National Park (located 30 km to the north-west), and Gloucester Island National Park (located 40 km to the south-east). A wildlife corridor extends in an east–west direction across the Caley Valley Wetlands. This corridor forms part of a larger wildlife movement corridor, connecting the wetlands to Mount Aberdeen National Park, 40 kilometres southwest of Bowen (BMT WBM 2012).

Remnant vegetation to the west and south of the Abbot Point Coal Terminal also forms part of a wildlife corridor, and the largely intact coastal vegetation provides relatively good habitat connectivity between the wetland and Cape Upstart National Park to the north-west (BMT WBM 2012). However, there is poor connectivity in a direct line (north to south) between the Wetlands and the ranges, due to extensive clearing for cattle grazing (BMT WBM 2012).

The terrestrial environment of Abbot Point consists of a variety of vegetation communities including sclerophyll woodland to open forest, beach scrub, saline and freshwater wetlands (NQBP 2010). Seasonal climatic variations and diverse landscape features provide a broad range of habitats for vegetation communities, plants and animals, including migratory bird species.

The condition of habitat within the Study Area varies substantially according to historical land management practices (e.g. grazing) and the abundance of weed species. For example, GHD (2009) found that the vine thicket on rocky headlands, pasture grasslands, and highly saline wetland areas had lower species diversity than the beach scrub, melaleuca regrowth, *Eucalyptus crebra* woodlands and the ephemeral creeks. Weed species occur throughout the Study Area including: Prickly Acacia (*Acacia nilotica* subsp*. indica*), Rubber Vine (*Cryptostegia grandiflora*), Chinese Apple (*Ziziphus mauritiana*) and Lantana (*Lantana camara*; Unidel 2011).

The Queensland Government's Landscape Fragmentation and Connectivity (LFC) GIS tool (as part of the Environmental Offsets Policy) has been applied to determine the level of fragmentation in the landscape of the Study Area. Figure 3 and Table 2 show that the Study Area and surrounds have a high degree of Core Habitat that is more than 500 ha in area. At the local scale (within a 5 km buffer of the Project Area), this is primarily due to the presence of the Caley Valley Wetland.

Table 2: Local Scale Fragmentation (5km buffer)

Type	Area (ha)	%
Non-remnant patches	1851.13	33%
Patch – small fragments that are completely degraded by the edge effect	0.5	0%
Edge effect zone	307.13	5%
Perforated	17.7	0%
Core (< 100 hectares): Areas outside the edge effect zone	66.15	1%
Core (> 500 hectares): Areas outside the edge effect zone	3414.45	60%
Total	5657.06	100%

Figure 3: Fragmentation across the Study Area

4.2 Vegetation

The Project Area is an allocated Port Infrastructure Zone that was heavily disturbed in the past for cattle grazing. Historical vegetation clearing in this area has created induced grasslands with regrowth woodland patches of various sizes and heights. The northern section of the Project Area contains a large patch of moderately dense regrowth woodland that is 5 to 6 m tall (Figure 4). This patch is dominated by Swamp Teatree *Melaleuca dealbata*. A second, sparser patch of regrowth woodlands occurs in the central section of the Project Area, and is dominated by both *Melaleuca dealbata* and Carbeen *Corymbia tessellaris*. A small patch of approximately 10 mature *Corymbia tessellaris* trees occurs adjacent to the central patch of woodland regrowth, near the eastern boundary of the Project Area.

Prior to disturbance, the Project Area was formerly the Least Concern Regional Ecosystem 11.2.5, which is defined as *Corymbia-Melaleuca* woodland complex of beach ridges and swales. There are no known threatened plants in the Project Area (State of Queensland 2015).

Remnant vegetation and wetlands occur adjacent to, and within 500 m of the Project Area, in all directions. These areas include (Figure 4; Table 3):

- Remnant Semi-evergreen Vine Thicket (SEVT) on coastal dune (RE11.2.3) and igneous rock (11.12.4a) within 300 m to the north and north-west, within 150 m to the south-east, and adjacent to the dredging pipeline corridor.
- Remnant grassland and herbland on fore dunes (RE11.2.2) within 300 m to the north-west, and within 150 m to the south-east
- Remnant *Corymbia tessellaris* woodlands (RE11.2.5) within 250 m to the west
- Remnant *Corymbia tessellaris* and *Melaleuca dealbata* woodlands (RE11.2.5) within 50 m to the east, south-east, and southwest
- Remnant samphire within 300 m to the west
- Remnant Marine Couch *Sporobolus virginicus* (RE11.1.1) grasslands within 50 m of the south-western edge, and within 300 m to the west
- Palustrine wetlands (RE11.3.27x1c) within 50 m of the south-western edge, within 300 m to the west, and within 250 m to the south

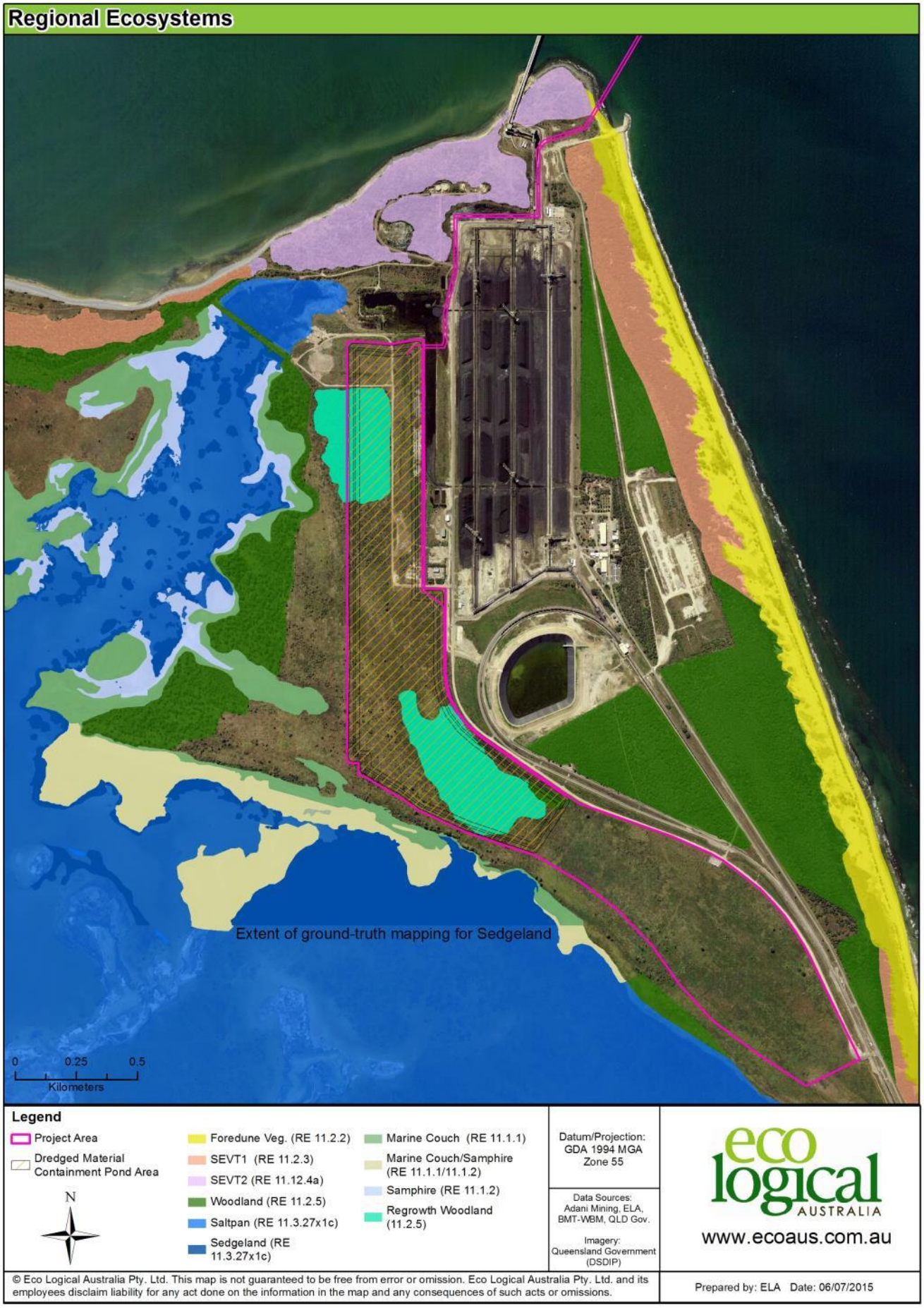

Figure 4: Remnant vegetation in the vicinity of the Project Area

Table 3: Descriptions for Regional Ecosystems in and near the Project Area.

RE ID	RE Description	VM Class[1]	BD Status[2]
11.1.1	*Sporobolus virginicus* grassland on marine clay plains	Least Concern	No concern at present
11.1.2	Samphire forbland on marine clay plains	Least Concern	No concern at present
11.2.2	Complex of *Spinifex sericeus*, *Ipomoea pes-caprae* and *Casuarina equisetifolia* grassland and herbland on foredunes	Of concern	Of concern
11.2.3	Microphyll vine forest ('beach scrub') on sandy beach ridges and coastal dunes	Of concern	Of concern
11.2.5	*Corymbia-Melaleuca* woodland complex of beach ridges and swales	Least Concern	Not of concern
11.3.27x1c	Palustrine wetland (e.g. vegetated swamp). Sedgelands to grasslands on Quaternary deposits	Least Concern	Of concern
11.12.4	Semi-evergreen vine thicket and microphyll vine forest on igneous rocks	Least Concern	No concern at present

Note: 1 = VM –vegetation management class, 2: BD – biodiversity status

Field surveys have validated vegetation in the Project Area, and remnant vegetation to the north, west and south of the Project Area (ELA 2014b). The remnant SEVT and woodland areas near the Project Area are generally in good condition, with some weed infestations (ELA 2014b). A survey of the foredune vegetation at the eastern extent of the pipeline alignment (ELA 2014e) confirmed that this area does not comprise the mapped RE 11.2.2, but is highly disturbed and comprised of Prickly Acacia and Rubber Vine.

4.3 Fauna Habitat

There is a broad diversity of flora and fauna species within the Study Area. For example, fauna surveys conducted by GHD (2009) during a previous EIS of the area found 212 terrestrial wildlife species (152 birds, 29 mammals, 24 reptiles and seven amphibians). Additional species have also been observed in the other relevant studies. There are several NC Act listed threatened terrestrial species known to occur at Abbot Point. Migratory Special Least Concern species including raptors, egrets, terns and bee-eaters are also known to occur in the region.

A total of twelve terrestrial habitat types were identified by GHD (2009) when undertaking terrestrial flora and fauna studies for the previously proposed Multi Cargo Facility EIS. This study provides an indication of the range of terrestrial habitat values present in the vicinity of the Project Area, which include:

- Beach and beach scrub
- Rocky shore
- Vine thicket on rocky substrate
- Grassland
- Saltwater and freshwater wetland
- Melaleuca
- Ephemeral and pandanus creek
- Open woodland with grassy understorey

- Rocky hillside.

The Project Area predominately provides habitat values for generalist fauna of open areas and grasslands. The small patch of remnant *Corymbia tessellaris* woodlands in the Project Area provides potential nesting and sheltering opportunities for arboreal mammals such as bats and possums, as well as nesting and perching sites for birds such as raptors, owls, and parrots (ELA 2014a). A whistling kite nest has also previously been identified in this patch (ELA 2014a).

Regrowth *Melaleuca dealbata* woodlands provide food resources for local nectivorous birds such as honeyeaters (ELA 2014a). Regrowth *Corymbia tessellaris* and *Melaleuca dealbata* woodlands provide perching and hunting sites for insectivorous and carnivorous birds such as magpies, kookaburras, and bee-eaters, as well as shelter areas for small passerines such as wrens and finches. The induced grasslands provide potential food resources for local granivorous birds such as finches and pigeons, and shelter sites for grassland-adapted reptiles such as dragons, *Ctenotus* skinks, and elapid snakes (ELA 2014a).

The soils of the Project Area and wider Study Area are characteristic of alluvial floodplain environments, with a thick accumulation of alluvial sands deposited with lenses of silty sand and clayey sand. These soils, with their tussocky grasses, provide burrowing opportunities for fossorial fauna such as goannas, skinks, and native rodents.

4.4 Caley Valley Wetland

4.4.1 Location and physical values

The Caley Valley Wetland is located to the south west of the existing coal terminal and immediately adjacent to the Project Area. The wetland covers an area of approximately 5,154 ha and is one of the largest intact wetland systems between Townsville and Bowen (BMT WBM 2010). The wetland is listed under the Directory of Important Wetlands in Australia (DIWA) as a palustrine system (modified from an original brackish wetland since the 1940s).

The wetland has gently sloping margins, separated from the Coral Sea on two sides by a beach dune barrier system to the north and east and on the western side by estuarine systems. It comprises a diversity of complex and dynamic habitat types, with three distinct wetland types or functional zones (Figure 5; BMT WBM 2012; BAAM 2012):

- Coastal water and estuarine (intertidal) zone
- Hypersaline or Open Pan Zone
- Wetland Basin Zone, comprising the:
  - Open Marsh Zone; and
  - Closed Marsh Zone.

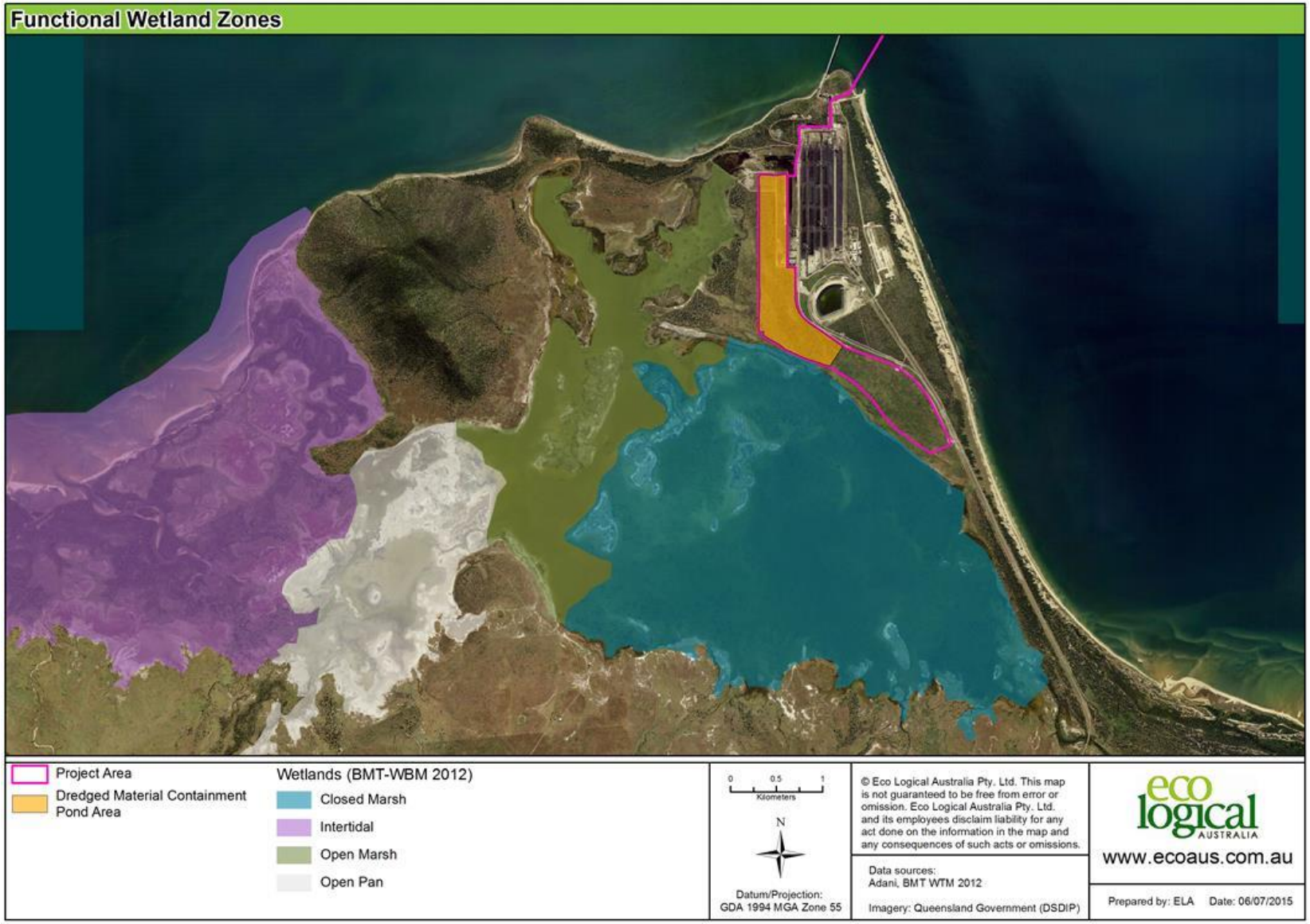

Figure 5: Map showing functional wetland zones within the Caley Valley Wetland (BMT WBM 2012; BAAM 2012).

Excess treated surface water from the existing Coal Terminal's stormwater treatment ponds enters the wetland from the north. Runoff from the elevated dunes and ridges within the Coal Terminal site enters the wetland from the east. Saltwater Creek, south east of the main body of the wetland, provides the connection between the wetland and Euri Creek. During the dry season, tidal movements dominate the system and saline water enters the wetland from Curlewis Bay.

The Caley Valley Wetland consists of both subtidal and intertidal marine and estuarine wetlands, including one large fresh and brackish water wetland contained within a partially artificial impoundment (BMT WBM 2010). A freshwater impoundment has been created by four artificial bund walls which were constructed in 1956 to enhance duck shooting opportunities (Peter Hollingsworth and Associates 1979 and 1981). The abundance and diversity of wetland birds began increasing shortly after the bund walls were constructed (BMT WBM 2012).

Tidal flushing of the wetland is partly constrained by the western bund and causeway and totally constrained by the two eastern bunds that restrict inflows from Euri Creek. The western bund partially isolates the site from tidal influences. It has also resulted in localised mangrove die-back, due primarily to root anoxia which is caused by excessive ponding of water. Tidal flows have been observed occurring both around and overtopping the western bund (WBM 2006). Similarly the causeway is overtopped during spring tide events as well as having a culvert located at the southern end that allows water exchange between the two main areas of the wetland (GHD 2009). The Project Area is above the level of tidal influence.

4.4.2 Seasonal trends

The hydrology of the Wetland undergoes dramatic seasonal and inter-annual variability. The water levels can vary substantially both among years and within the same year, being influenced by the frequency of tropical cyclones and subject to significant rainfall variability within the catchment. Seasonal changes between the wet and dry seasons greatly influence the ecology of the wetland.

Increased rainfall and flow of water from the catchment during the wet season results in the filling of the eastern wetland area and the return of substantial vegetation such as reeds, sedges and rushes (GHD 2010). In turn, this provides foraging and nesting habitats and refuge for a wide range of birds, reptiles, amphibians, fish and aquatic invertebrates. During the wet season there tends to be a reversible movement of fresh and brackish waters westwards from the wetland into Curlewis Bay.

During the dry season, however, tidal movements tend to dominate the system (GHD 2010). With very limited freshwater inflow, much of the wetland dries and loses vegetative cover. Under such dry conditions, the wetted expanse of the wetlands can contract to the area known as Lake Caley (or the Lake), in the south eastern part of the wetland. Lake Caley provides one of the only semi-permanent non-tidal waterbodies in the area.

4.4.3 Habitat values

The Caley Valley Wetland is an important habitat for many local terrestrial fauna species, providing a relatively intact environment in an otherwise disturbed landscape (BMT WBM 2012). The wetlands have high ecological value for waterbirds, and are considered a significant aggregation site for migratory shorebirds and other water birds (State of Queensland 2015). The wetland's adjacency to the ocean allows connectivity between the wetland and coastal environments of the GBR World Heritage Area, with many of the bird species inhabiting the wetland also using the beaches and intertidal areas for foraging (State of Queensland 2015). The Caley Valley Wetland is considered to contain important and significant natural habitats for *in situ* conservation of bird diversity.

Sections of the Caley Valley Wetland adjacent to the Project Area are in good condition (ELA 2014c). There is minimal grazing disturbance on the north-eastern section of the wetland, due to exclusion fencing for the coal terminal railway (ELA 2014c). In contrast, parts of the southern perimeter of the wetland have been grazed for several years, resulting in the degradation of vegetation and fauna habitat values.

The shallow water areas and fringing mudflats consist of well-vegetated areas of sedges and rushes, around the edges of the open water habitat, and mudflats bordering the wetland itself (ELA 2014a). The well-vegetated areas are used by frogs and cryptic birds such as rails and snipes for foraging, nesting and shelter, while the less-vegetated shallow water areas are used by foraging waders (ELA 2014a, ELA 2014f). Mudflats also provide foraging habitat for waders and resting habitat for shorebird species such as terns (ELA 2014a). Freshwater wetland fringes provide a water source for local birds, mammals, and reptiles (ELA 2014a).

The Study Area provides habitat for an abundance of wetland birds, estimated to be over 24,000 individuals in February and March 2012 and approximately 48,000 individuals in June 2012 (BAAM 2012). The coastal and estuarine habitats, together with the saltpans, provide feeding and roosting areas for migratory and resident shorebird and wetland species. The estuarine/brackish and freshwater sections of the Wetland represent important waterfowl feeding, roosting and breeding areas. Waterfowl, such as ducks, geese and swans can be extremely abundant in the main open water wetland area during the wet season, with hundreds of individuals recorded (ELA 2014a, BMT WBM 2012).

The Caley Valley Wetland is also an important dry season refugia for resident shorebirds and terrestrial fauna, and an important nesting area for some non-migratory shorebird species (BMT WBM 2012). The Wetlands provide one of Queensland's largest and most northerly coastal nesting areas for the Black Swan *Cygnus atratus* (BMT WBM 2012).

The wetland also provides habitat for a range of other species. Up to fifty species of mammal and reptile (including introduced species) have been found in and adjacent to the wetland, including two species of freshwater turtle. Eleven native frog species and the Cane Toad (*Rhinella marina*) have also been recorded in the wetland and surrounding vegetation (BMT WBM 2010).

Whilst there is limited information about the fish assemblages of the wetland, it appears that at least nine species occur in areas of open water and within the streams that feed into the wetland (e.g. Splitters Creek; BMT WBM 2010). The bunds within the wetland are likely to impede fish movement between the ocean and within the wetland, although there is a small culvert in the southern area of the causeway that allows some fish passage.

4.4.4 Shorebirds

The Caley Valley Wetland provides habitat for several migratory shorebirds listed under the NC Act (including Special Least Concern). Surveys of migratory shorebird and other wetland/water bird species were most recently completed by BAAM in 2012 as part of the Abbot Point CIA (BAAM 2012). These surveys provide detailed information on the abundance of various species within the Caley Valley Wetland. They were focussed on migratory shorebirds and any listed threatened wetland bird species (in particular the Australian Painted Snipe).

The BAAM (2012) survey approach was tailored to consider Commonwealth guidelines (DEWHA 2009a, b) for assessing population and habitat importance for migratory shorebirds. The baseline survey objective was to obtain an estimate, based on count data and extrapolation to any unsurveyed areas, of the total abundance of each species of migratory shorebird within the Caley Valley Wetland system. Survey effort concentrated on the central part of the wetland located adjacent to the Project

Area, referred to as the Closed Marsh and Open Marsh (BMT WBM 2012), and adjacent coastal areas. The surveys comprised five field visits during February, March (wet season), June, November and December (dry season).

There were some limitations to the extent of the BAAM survey, due to the sheer size of the Study Area, restrictions on access, and time constraints. These limitations include:

- It was necessary to extrapolate the population estimates for the main wetland area to also include unsurveyed areas. This was done according to standard industry practice and involved extrapolating the count results of surveyed sectors to unsurveyed areas using a survey sector most similar in position and habitat characteristics to the unsurveyed area.
- Extrapolation was possible for only four species, which were restricted to the perimeter fringes of the wetland basin.
- It was necessary to provide estimates of shorebird abundance for some species rather than actual counts. Estimates account for factors such as bird movements during survey periods, the cryptic nature of some species and flushing distances. Estimation was conducted by BAAM ecologists in accordance with recognised industry practice.

The BAAM (2012) survey also found the Vulnerable (NC Act) Australian Painted Snipe to be present within the wetland during both the wet and dry seasons. The February component of the wet season survey recorded three individuals and the dry season (June) recorded 24. This latter record was estimated to represent a total of 35 birds after extrapolation to unsurveyed areas.

Rainfall conditions in the 12 month period preceding the BAAM (2012) survey were likely to have resulted in the wetlands experiencing water level conditions that were optimal for migratory shorebirds and the Australian Painted Snipe. This was reflected in the high numbers of birds recorded in the BAAM (2012) surveys when compared with previous surveys.

BMT WBM (2012) also conducted shorebird and water bird surveys during October and November 2010, with the objective of describing patterns in habitat use. These surveys informed a broad baseline environmental study of the Caley Valley Wetland.

The various field surveys at Abbot Point have identified a total of 15 migratory shorebird species, as follows:

- Black-tailed Godwit
- Common Greenshank
- Common Sandpiper
- Curlew Sandpiper
- Eastern Curlew (near threatened NC Act)
- Greater Sand Plover
- Latham's Snipe
- Little Curlew
- Marsh Sandpiper
- Oriental Plover
- Pacific Golden Plover
- Red-necked Stint
- Sharp-tailed Sandpiper
- Wandering Tattler
- Whimbrel.

The results of the collective surveys and database records indicate the high diversity of migratory shorebird species using the Caley Valley Wetland. The number of species found at the wetland represents almost half the total number of migratory shorebirds listed under the EPBC Act and NC Act (Special Least Concern).

It is significant that over half the species found at Abbot Point were recorded on multiple occasions at Abbot Point. This is perhaps partly because migratory shorebirds exhibit strong site fidelity and will return to the same site year after year (Clemens *et al.* 2008), but may also be indicative of the quality and diversity of local habitat.

4.5 Weeds and Pests

A high cover of perennial weeds occurs across the grassy sections of the Project Area, particularly Buffel Grass *Cenchrus ciliaris*, Passion Flower *Passiflora foetida*, and Flannel Weed *Sida cordifolia*. Other weeds of note include Snakeweed *Stachytarpheta jamaicensis* and Mimosa Bush *Vachellia farnesiana*. Rubber Vine *Cryptostegia grandiflora* (Class 2) and Lantana *Lantana camara* (Class 3) are also likely to be present in this area. The following weed species are also known to occur in the Study Area (Ecoserve 2007, Unidel 2011, BMT-WBM 2012):

- African Tulip Tree *Spathodea campanulata* (Class 3)
- Broad-leaved Pepper *Schinus terebinthifolius* (Class 3)
- Camphor Laurel *Cinnamomum camphora* (Class 3)
- Chinee Apple *Ziziphus mauritiana* (Class 2)
- Creeping Lantana *Lantana montevidensis* (Class 3)
- Mother-of-Millions *Bryophyllum daigremontianum* x *delagoense* (Class 2)
- Parkinsonia *Parkinsonia aculeata* (Class 2),
- Phasey Bean *Macroptilium lathyroides*,
- Prickly Acacia *Acacia nilotica* (Class 2)
- Prickly Pear *Opuntia stricta* (Class 2)
- Singapore Daisy *Sphagneticola trilobata* (Class 3)

There are no records of pest fauna within the Project Area. However, several exotic fauna species are known to occur in the adjacent Caley Valley Wetlands, including the Cane Toad *Rhinella marinus*, Pig *Sus scrofa*, Rabbit *Oryctolagus cuniculus*, Black Rat *Rattus rattus*, House Mouse *Mus musculus*, Fox *Vulpes vulpes*, Asian House Gecko *Hemidactylus frenatus*, and Northern Mallard *Anas platyrhynchos* (ELA 2014f, Wildlife Online, Unidel 2011).

4.6 Matters Relevant to the State Assessment Process

This section describes MSES that are relevant to this ecological assessment.

4.6.1 Regulated Vegetation

Field surveys have revealed that the Study Area contains several regional ecosystems within close proximity to the Project Area, with the Project Area itself containing a small patch of remnant RE 11.2.5 (Table 3; Figure 4).

Despite the ground-truthing that has occurred through field surveys, only *regulated vegetation* is considered to be a MSES. Regulated vegetation is defined by the State Government via a vegetation management framework established under the VM Act. There are several categories of regulated vegetation, including:

- Category A: Vegetation offset area, Compliances Notice area and Voluntary Declaration area
- Category B: Remnant vegetation
- Category C: High-value regrowth vegetation
- Category R: Reef regrowth watercourse vegetation
- Category X: Vegetation not regulated under the VM Act

Regulated vegetation (as mapped by the State Government) may differ to on-ground vegetation as regulated vegetation is based on high level mapping. The extent of regulated vegetation is shown in Figure 6.

The Study Area includes large areas of Category B (remnant vegetation) across the Caley Valley Wetland and surrounding existing infrastructure at Abbot Point. There are no areas of Category A or C (High-value regrowth) vegetation in the Study Area. However there are some areas of Category R (reef regrowth watercourse vegetation) approximately 3.7 km to the south-west of the Project Area (Figure 7).

The entire Project Area is mapped as Category X (not regulated by the VM Act).

Figure 6: Regulated Vegetation

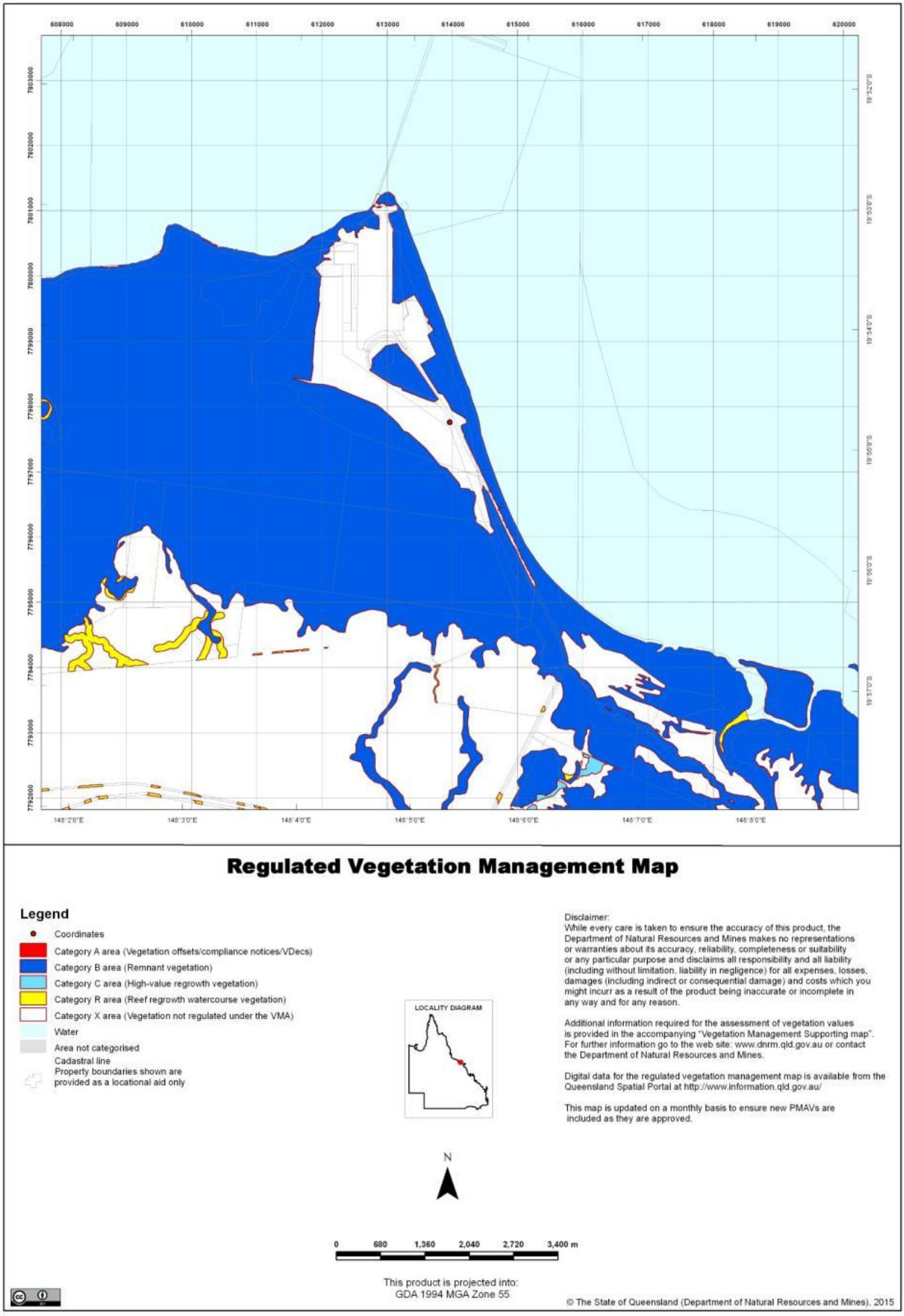

Figure 7 Map showing location of various categories of regulated vegetation across the Study Area

As described in Section 2.3, the following types of regulated vegetation, as regulated under the VM Act, are considered MSES:

- Endangered and Of Concern Regional Ecosystems (RE)
- a RE that intersects with an area shown as a wetland on the vegetation management wetlands map (to the extent of the intersection);
- An area of essential habitat that is habitat for Endangered or Vulnerable wildlife under the NC Act.
- REs within a defined distance from defining banks of watercourses identified on the vegetation management watercourses map.

Each of these types of regulated vegetation is discussed below.

Endangered and Of Concern Regional Ecosystems

The remnant vegetation in the Study Area contains predominantly 'Least Concern' regional ecosystems, with areas containing 'of concern (dominant)' regional ecosystems located along the coastline. The latter is associated with areas of RE 11.2.2 and RE 11.2.3 on beach ridges and sand dunes (Table 3). There are no Endangered REs within the Study Area and there is no regulated vegetation within the Project Area.

Vegetation Management Wetlands

Figure 6 shows REs that intersect mapped wetlands as per the vegetation management wetlands map (see definition in the VM Act, Section 20A). Two areas of RE in the Study Area (Re 11.2.27x1c) are mapped on the vegetation management wetlands map as intersecting with a wetland. These areas exist to the north west and south of the Project Area and do not exist within the Project Area.

Essential Habitat

Essential habitat is mapped within the Study Area (Figure 6). The Study Area contains essential habitat for Squatter Pigeon *Geophaps scripta scripta* (Vulnerable under the NC Act) and is associated with dry eucalypt woodland in the Study Area. No essential habitat exists within the Project Area.

Further information on the occurrence of the Squatter Pigeon is provided in Section 4.6.5.

Vegetation Management Watercourses Map

Watercourses on the Queensland Government's vegetation watercourse map are shown in Figure 7. No REs associated with these watercourses exist within the Project Area. The nearest watercourse that is mapped on the vegetation management watercourse map is approximately 3.7 km to the south-west of the Project Area.

4.6.2 Connectivity Areas

As there is no regulated vegetation within the Project Area, no MSES connectivity areas exist within the Project Area.

4.6.3 Wetland and Wetland Protection Areas

As described in Section 2.3, wetlands that are WPAs or Wetlands of High Ecological Significance shown on the Map of referrable wetlands are considered to be MSES.

Figure 8 shows that a large WPA is associated with the Caley Valley Wetland within the Study Area. The WPA does not extend to within the Project Area. However the WPA trigger area does overlay the western edge of the Project Area. However, the WPA trigger area is not considered a MSES.

As the Project is located within a catchment adjoining the Great Barrier Reef lagoon, the State Development Assessment Provisions are relevant. Assessment of the Project must be conducted in accordance with the WPA State Code when the application is assessed under the SP Act. While this is not the case for this Project, the code has been addressed in a non-statutory manner, to guide the Coordinator-General's assessment. The code seeks to achieve the following performance outcomes in relation to ecology:

- Development is not carried out in a wetland in a WPA unless there is an overriding need in the public interest, or the development is a development commitment, or the development is for community infrastructure.
- An adequate buffer to a wetland in a WPA is provided and maintained.
- Development involving the clearing of vegetation protects the biodiversity, ecological values and processes, and hydrological functioning of a wetland in WPA, including:
    - water quality values, aquatic habitat values, terrestrial habitat values and usage of the site by native wetland fauna species or communities
- Development avoids land degradation in a WPA, including mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, wind erosion or scalding; and loss or modification or chemical, physical or biological properties or functions of soils.
- Development in a WPA ensures that any existing ecological corridors are enhanced or protected, and have dimensions and characteristics that will effectively link habitats on or adjacent to the development and facilitate the effective movement of terrestrial and aquatic fauna accessing or using a wetland as habitat.
- Development does not result in the introduction of non-native pest plants or animals that pose a risk to the ecological values and processes of a wetland in a WPA.
- During construction and operation of development in a WPA, wetland fauna are protected from impacts associated with noise, light or visual disturbance.
- During construction and operation of the development in a WPA, ongoing management, maintenance and monitoring is undertaken to ensure adverse effects on hydrology, water quality and ecological processes of a wetland are avoided or minimised.

The WPA (excluding the trigger area) shown in Figure 8 is also a wetland of High Ecological Significance as per a map of referrable wetlands.

Figure 8: WPA and Wetland of High Environmental Significance with trigger area

4.6.4 State-listed EVNT Flora Species

The Protected Plant Flora Survey Trigger area is mapped in Figure 9. One high risk area exists to the north west of the Project Area, associated with a record of *Croton magneticus*, which is listed as Vulnerable under the NC Act. The specimen exists on one Tree Hill, approximately 2.63km west of the existing Abbot Point Coal Terminal in vine forest/thicket on a hilltop.

There is another record of *Croton magneticus* associated with the Protected Plant Flora Survey Trigger Map approximately 2km to the west of the aforementioned record. This appears to be an erroneous record however, as it is plotted more than 1km from the coast within the Coral Sea.

No other species of EVNT flora listed under the NC Act have been observed in the Study Area or Project Area. A likelihood assessment for other EVNT species that occur in the region is provided in Table 4. It is very unlikely that EVNT species listed under the NC Act are located within the Project Area, and only Rainforest Cassia *Senna acclinis* (Near Threatened) and *Ozothamnus eriocephalus* (Vulnerable) may occur in the wider Study Area. However, given the extent of surveys that have been undertaken, it is also considered unlikely that these two species exist in the Study Area.

4.6.5 Habitat for EVNT Fauna Species

There are three threatened species known to occur within the Study Area (see Table 5 and Figure 10 to Figure 12):

- Beach Stone-Curlew (Vulnerable)
- Eastern Curlew (Near Threatened)
- Australian Painted Snipe (Vulnerable)

These species occur primarily within the Caley Valley Wetland and adjacent coastal beach environments.

The Squatter Pigeon (Vulnerable) is considered likely to occur within the Study Area (including the Project Area), based on several sightings in the region (Figure 13).

A further two species have potential to occur within the Study Area:

- Glossy Black-Cockatoo (Vulnerable)
- Coastal Sheathtail Bat (Near Threatened)

4.6.6 Special Least Concern and Colonial Breeding Fauna

Under the *Nature Conservation Wildlife Regulation 2006*, Special Least Concern fauna include:

- Echidna (*Tachyglossus aculeatus*);
- Platypus (*Ornithorhynchus anatinus*);
- Least Concern birds that are listed under Commonwealth Government bilateral migratory bird agreements with Japan and China; and
- Least Concern birds that are listed under the *Convention on the Conservation of Migratory Species of Wild Animals*

Thirty-three species listed as Special Least Concern are known, likely or have potential to occur within the Study Area (Table 6). These are all bird species apart from the Echidna *Tachyglossus aculeatus*, and include a range of migratory shorebirds, raptors, bee-eaters, monarchs and flycatchers.

Colonial breeders are distinguished in the Department of Environment and Heritage Protection's (DEHP) *Guideline for Development of a SMP* (2013) and require specific management if breeding habitat is being disturbed during construction. A Species Management Program has been prepared for the project, to meet the requirements of the *Nature Conservation Act 1992* (ELA 2015a). Colonial breeders with some likelihood of existing in the Study Area are listed below. These are not discussed further in this assessment, with potential Project impacts addressed in the Species Management Program.

BIRDS

- Australasian Darter (*Anhinga novaehollandiae*)
- Australasian Figbird (*Sphecotheres vieilloti*)
- Australian Pelican (*Pelecanus conspicillatus*)
- Australian White Ibis (*Threskiornis molucca*)
- Black Swan (*Cygnus atratus*)
- Black-Faced Woodswallow (*Artamus cinereus*)
- Black-Winged Stilt (*Himantopus himantopus*)
- Caspian Tern (*Hydroprogne caspia*)
- Cattle Egret (*Ardea ibis*)
- Chestnut-Breasted Mannikin (*Lonchura castaneothorax*)
- Dusky Moorhen (*Gallinula tenebrosa*)
- Eastern Great Egret (*Ardea modesta*)
- Eastern Reef Egret (*Egretta sacra*)
- Glossy Ibis (*Plegadis falcinellus*)
- Great Cormorant (*Phalacrocorax carbo*)
- Gull-Billed Tern (*Gelochelidon nilotica*)
- Lesser Crested Tern (*Thalasseus bengalensis*)
- Little Black Cormorant (*Phalacrocorax sulcirostris*)
- Little Egret (*Egretta garzetta*)
- Little Pied Cormorant (*Microcarbo melanoleucos*)
- Nankeen Night-Heron (*Nycticorax caledonicus*)
- Pied Cormorant (*Phalacrocorax varius*)
- Pied Heron (*Egretta picata*)
- Purple Swamphen (*Porphyrio porphyrio*)
- Rainbow Bee-Eater (*Merops ornatus*)
- Red-Necked Avocet (*Recurvirostra novaehollandiae*)
- Royal Spoonbill (*Platalea regia*)
- Satin Flycatcher (*Myiagra cyanoleuca*)
- Straw-Necked Ibis (*Threskiornis spinicollis*)
- Tree Martin (*Petrochelidon nigricans*)
- Whiskered Tern (*Chlidonias hybrida*)
- Yellow-Billed Spoonbill (*Platalea flavipes*)

REPTILES

- Yellow-Spotted Monitor (*Varanus panoptes*)

MAMMALS

- Beccari's Free-Tail Bat (*Mormopterus beccarii*)
- Chocolate Wattled Bat (*Chalinolobus morio*)
- Eastern Bent-Wing Bat (*Miniopterus schreibersii oceanicu*s)
- Eastern Cave Bat (*Vespadelus troughtoni*)
- Gould's Wattled Bat (*Chalinolobus gouldii*)
- Little Bent-Wing Bat (*Miniopterus australis*)
- Little Red Flying Fox (*Pteropus scapulatus*)

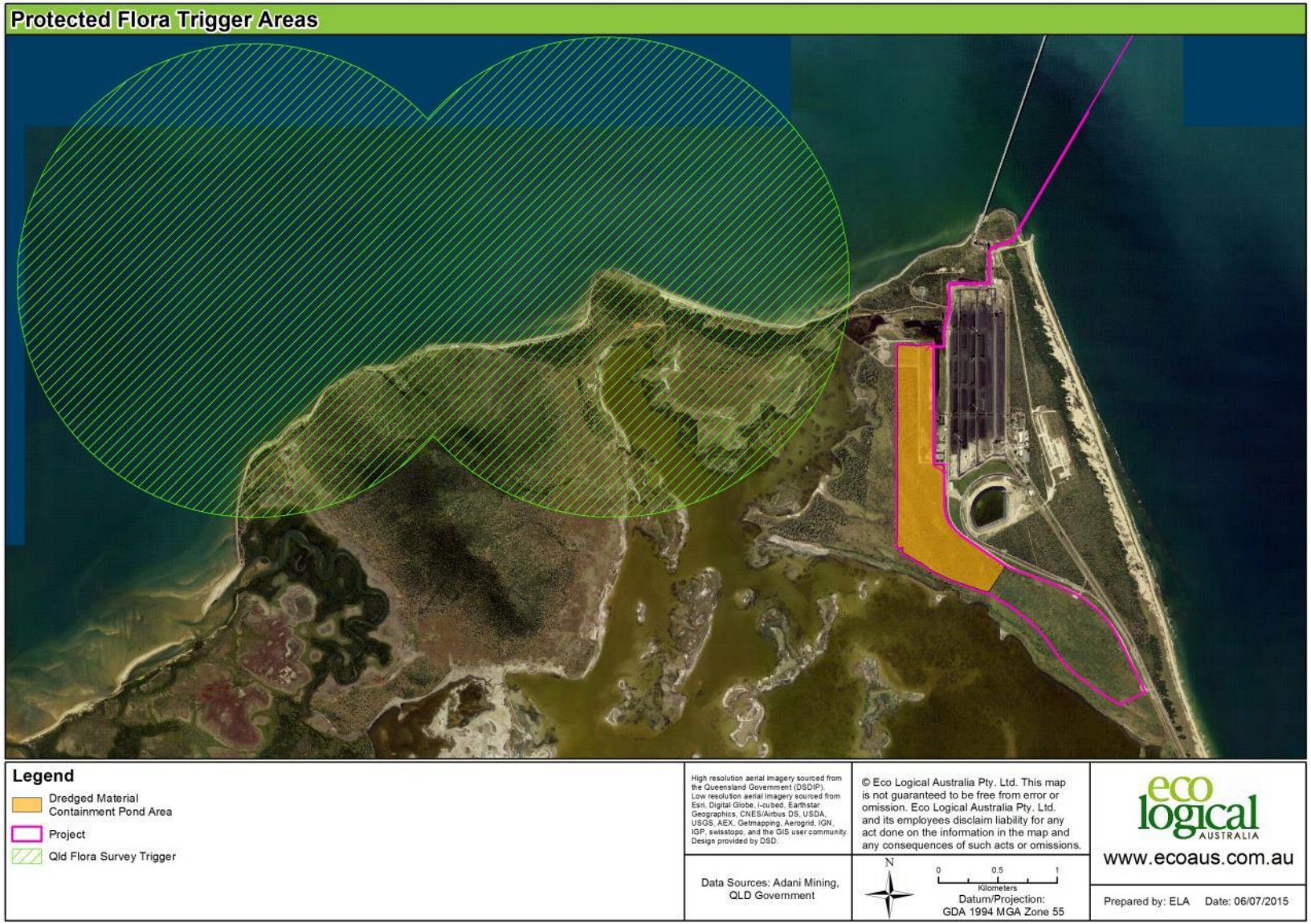

Figure 9: Flora Survey Trigger Map

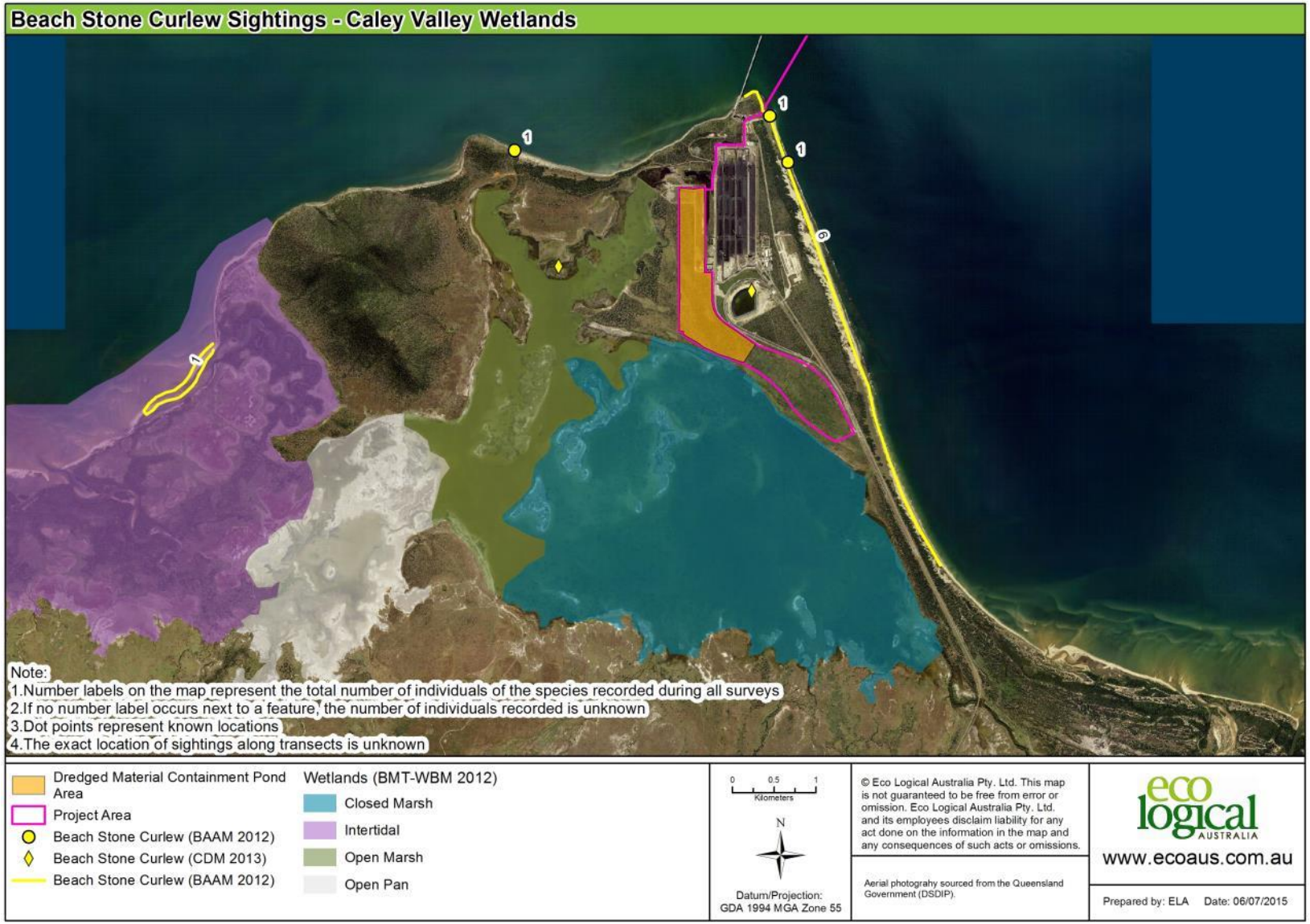

Figure 10: Observations of the Beach Stone-Curlew

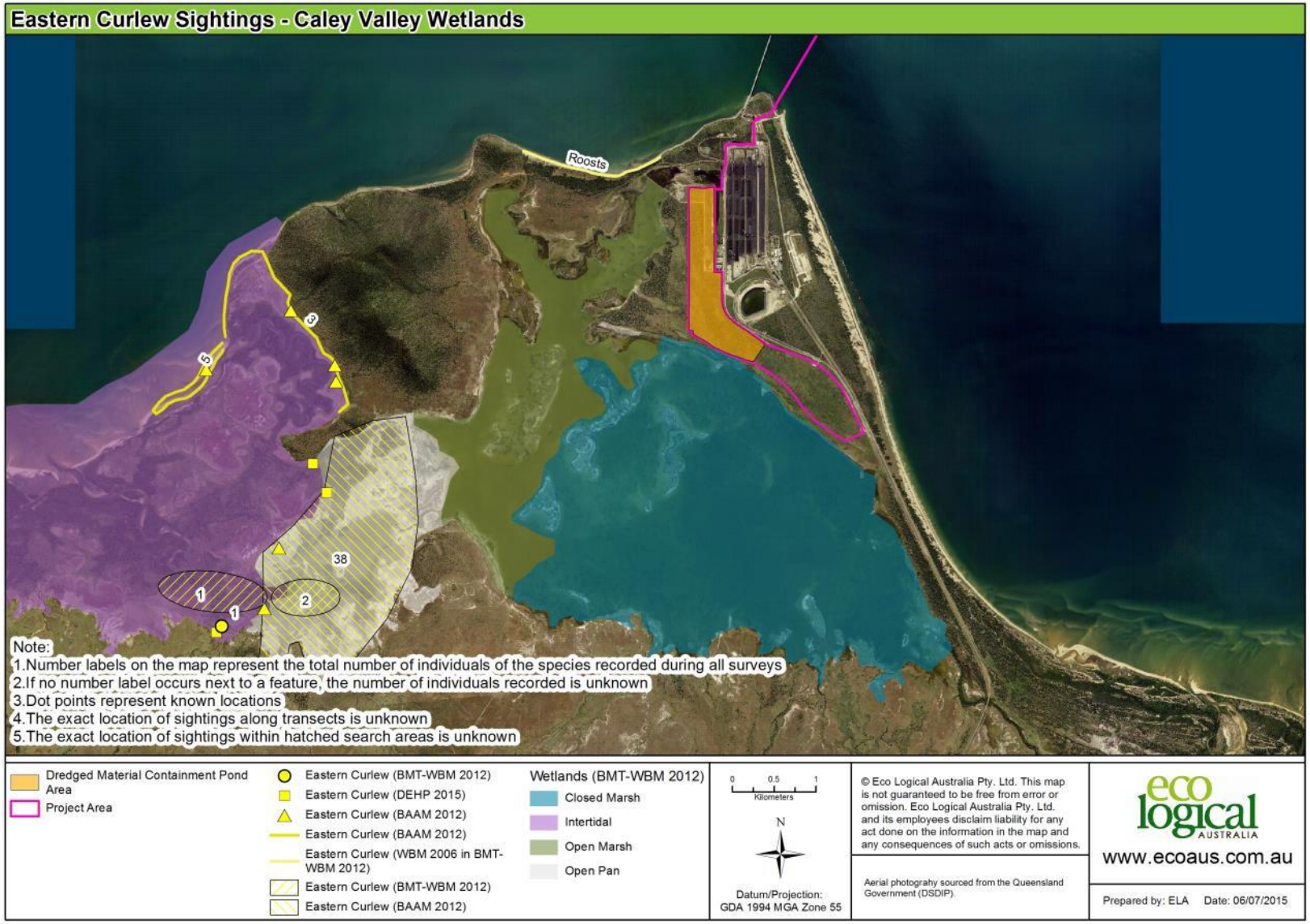

Figure 11: Observations of the Eastern Curlew

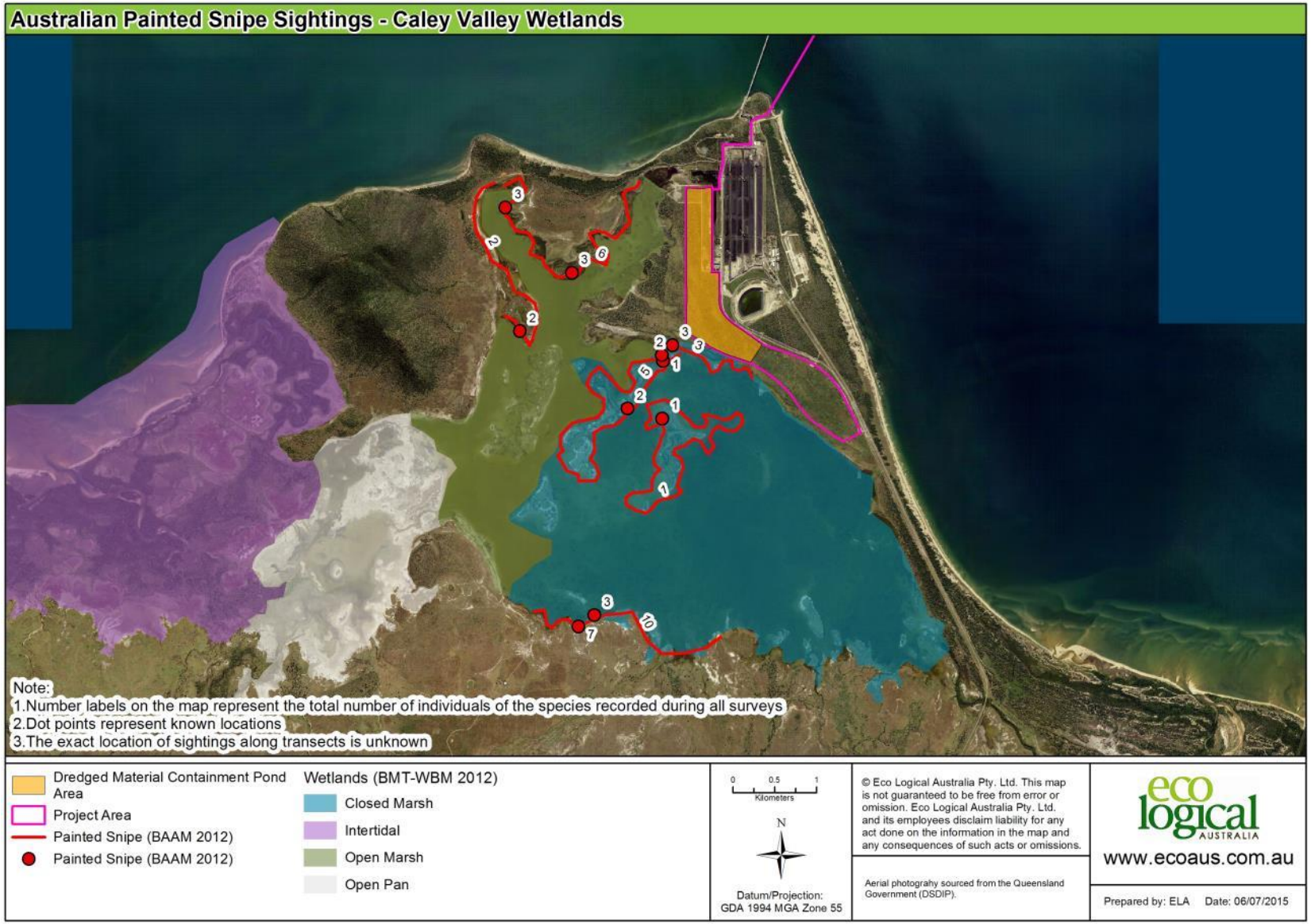

Figure 12: Observations of the Australian Painted Snipe

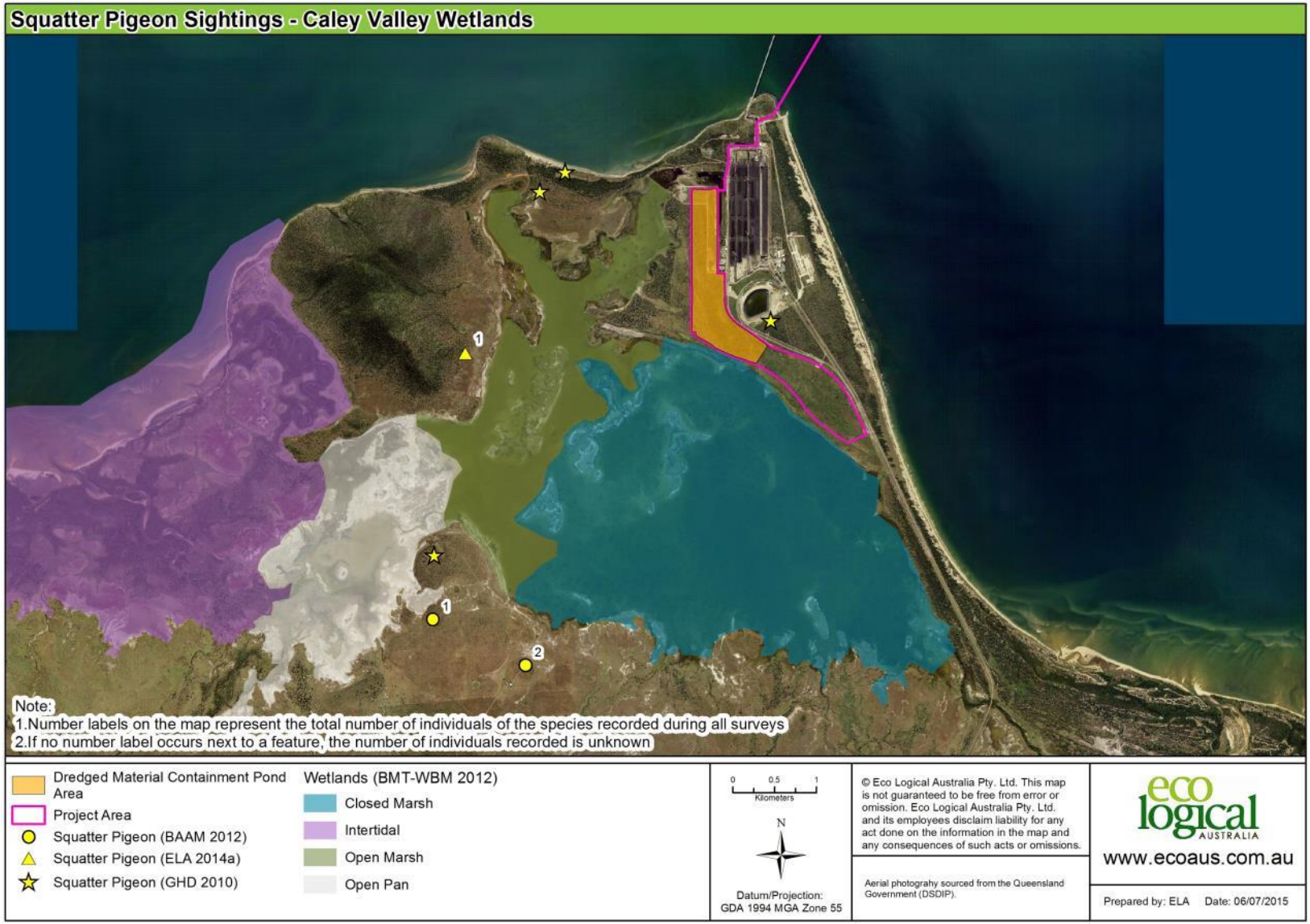

Figure 13: Observations of Squatter Pigeon

Table 4: Species Likelihood Assessment for EVNT Flora

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DMCP	Pipeline	Study Area	
Aristida granitica		Endangered	No	No	No	Occurs in sandy soils derived from granite sands in eucalypt woodland. Only known population is at the foothills of Mt Pring, 10km west of Bowen.
Croton magneticus		Vulnerable	Unlikely	Unlikely	Known	Grows in deciduous vine thickets (dry rainforest) on soils derived from sandstone, granite or acid agglomerate substrates, often in association with *Croton arnhemicu*s and *C. phebalioides*. Known to exist in the Study Area, though unlikely to exist in the Project Area. There is one record from 2012 on One Tree Hill, 2.63km west of existing Abbot Point Coal Terminal. This is within vine forest/thicket on a hilltop and was growing with *Croton arnhemicus* (Atlas of Living Australia 2015).
Eucalyptus raveretiana	Black Ironbox	Vulnerable	No	No	No	Black Ironbox has not been observed within the Abbot Point region, nor has any suitable habitat been recorded (Unidel 2011; GHD 2009; ELA 2014a).
Omphalea celata		Vulnerable	No	No	No	Only known to occur in three locations, with the nearest being Gloucester Island, 30 km to the south-east. Occurs in SEVT in steep-sided granitic gullies & gorges. Habitat is not known to occur within the Study Area.
Ozothamnus eriocephalus		Vulnerable	No	Unlikely	Unlikely	Occurs in the margins of disturbed notophyll & microphyll vine forests and gallery forest, and open eucalypt forest (DoE 2015). Not previously observed within the Abbot Point region (ELA 2014a).
Senna acclinis	Rainforest cassia	Near Threatened	No	Unlikely	Unlikely	Occurs in a range of habitats and soil types. Appears to prefer SEVT, rainforest margins and adjacent open forests. Potential to exist north of the Study Area. Unlikely to exist within the Project Area (DEHP 2015).

Table 5: Species Likelihood Assessment for EVNT Fauna

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Acanthophis antarcticus	Common Death Adder	Near Threatened	No	No	Unlikely	Known from the Whitsunday region. Little suitable habitat within the Study Area. More likely to be associated with deep leaf litter and wooded ecosystems.
Calyptorhynchus lathami	Glossy-Black Cockatoo	Vulnerable	No	No	Potential	May occur sporadically in Coastal She-Oak (*Casuarina equisetifolia)* along the beach of the Study Area (CDM Smith 2013).
Crocodylus porosus	Estuarine Crocodile	Vulnerable	No	No	Unlikely	No recorded sightings within the Abbot Point region. Possible slides were observed in Saltwater Creek, which drain into the southeast of the Caley Valley Wetlands (BMT WBM 2012). There is some historical evidence of a Saltwater Crocodile on the downstream section of Goodbye Creek, which is near Saltwater Creek. Suitable habitat includes coastal wetlands which occur adjacent to the DMCP.
Denisonia maculata	Ornamental Snake	Vulnerable	No	No	No	Suitable habitat comprises cracking clay soils which do not occur within the Study Area.
Egernia rugosa	Yakka Skink	Vulnerable	Unlikely	Unlikely	Unlikely	Suitable habitat potentially occurs within parts of the Study Area although is more commonly found inland of the coast (Ferguson and Mathieson 2014). Diurnal reptile surveys in the Abbot Point region have not detected the species.
Erythrotriorchis radiatus	Red Goshawk	Endangered	No	No	Unlikely	Sparsely distributed. Inhabits woodlands and forests. Nests in trees >20m tall in wooded and forested areas within 1 km of permanent water. Highly fragmented, but potentially suitable habitat occurs in remnant woodlands (RE11.2.5) within 300 m west of the Project Area (ELA, unpublished data).

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Esacus magnirostris	Beach Stone-Curlew	Vulnerable	No	Likely	Known	Exclusively coastal. Habitat includes beaches, islands, reefs and estuaries near mangroves. Forages in intertidal zone of beaches, estuaries, flats, banks and spits of sand, mud, gravel, rock and among mangroves. Usually alone or in pairs. Heron-like foraging strategy. Crepuscular and nocturnal. Recorded sightings in the Study Area (BAAM 2012), along Abbot Beach (CDM Smith 2013) and two records on Wildlife online since 1980.
Geophaps scripta scripta	Squatter Pigeon	Vulnerable	Likely	No	Likely	Observed all around the Caley Valley Wetlands, including within 200 m of the Project Area. Suitable habitat comprises grasslands with bare patches which occur across the Project Area and in the Study Area.
Macroderma gigas	Ghost Bat	Vulnerable	No	No	No	Known from the Whitsunday region. Not previously recorded in the Study Area or surrounds.
Neochmia ruficauda ruficauda	Star Finch (eastern/ southern)	Endangered	No	No	Unlikely	Occurs in tall grass and reed beds associated with swamps and watercourses. No confirmed sightings have been made since 1995 despite systematic searches. Not recorded previously from the Study Area or surrounds.
Ninox strenua	Powerful Owl	Vulnerable	No	No	No	Known to occur north of Eungella in coastal and upland areas. Not previously recorded in the Study Area or surrounds.
Numenius (Numenius) madagascariensis	Eastern Curlew	NT	No	Likely	Known	Occurs in the central and western sections of the Caley Valley Wetland, including (estuarine environments) 3-4 km from the Project Area. Roosts in the intertidal areas of Dingo Beach (WBM 2006), which is within 500 m of the Project Area. Suitable habitat comprises mudflats and ocean beaches which occur in western and central sections of the wetland, at Dingo Beach, and in the Pipeline foreshore area (ELA 2014e).

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Onychogalea fraenata	Bridled Nailtail Wallaby	Endangered	No	No	No	Known from Whitsunday Region. Only known wild population is in acacia scrubland in Taunton National Park and adjacent freehold land. No suitable habitat occurs in the Study Area.
Petrogale persephone	Proserpine Rock-Wallaby	Endangered	No	No	No	Known from the Whitsunday Region. Nearest population is Gloucester Island. Rocky areas, and gullies in vine thickets are preferred habitat. No suitable habitat occurs in the Study Area.
Poephila cincta cincta	Black-throated Finch	Endangered	No	No	Unlikely	Recorded from Splitters Creek to the south-west of the Study Area (Lewis 2009). Inhabits areas with suitable grasses and hollow bearing trees within 0.5 km of freshwater wetlands and drainages. Not recorded in the Study Area during multiple bird surveys over different years and seasons.
Rhinolophus philippinensis	Greater Large-eared Horseshoe Bat	Endangered	No	No	No	Occurs north of Townsville. Southern limit of distribution is yet to be clarified. No suitable roosting habitat comprising caves, mines or culverts occurs within the Study Area.
Rostratula australis	Australian Painted Snipe	Vulnerable	No	No	Known	Known from the marsh areas of the eastern Caley Valley Wetlands (BAAM 2012).This includes the area immediately adjacent to the south-west edge of the Project Area. Suitable habitat comprises wetland fringes with emergent vegetation which occurs adjacent to the DMCP.
Saccolaimus saccolaimus nudicluniatus	Bare-rumped Sheath-tailed Bat	Endangered	Unlikely	Unlikely	Unlikely	Occurs in coastal lowlands, woodland, forest and open environments. Roosts in long, wide hollows in eucalypts. Suitable roosting habitat occurs in the woodlands within 300 m west of the Project Area. Echolocation signature can be confused with three other species, none of which were detected during micro-bat auditory surveys in the Study Area (ELA 2014d).

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Taphozous australis	Coastal Sheathtail Bat	Near Threatened	No	No	Potential	Potential foraging habitat does occur in woodland habitat recorded across the Abbot Point region. This species may have potentially been recorded in a boulder pile at the base of Mt Luce, Abbot Point however a positive identification could not be confirmed from the call analysis (CDM Smith 2013). Targeted surveys for this species were undertaken by ELA in December 2014 but did not detect the species.
Tyto novaehollandiae kimberli	Masked Owl (northern)	Vulnerable	No	No	Unlikely	Not recorded south of Townsville. Suitable habitat comprising woodland near open grassland occurs within 300 m west of the Project Area.
Xeromys myoides	Water Mouse, False Water Rat	Vulnerable	No	No	Unlikely	Generally occurs further south. Suitable habitat comprises mangroves and permanent, densely vegetated freshwater swamps which occur adjacent to the Project Area. Recent surveys in suitable habitat did not find evidence of the Water Mouse (ELA 2014a).

Table 6: Species Likelihood Assessment for Special Least Concern Fauna

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Acrocephalus australis	Australian reed-warbler	SLC	No	Unlikely	Known	Found in dense, low vegetation near water. Recorded sightings in vegetation on the edges of the Wetland (BAAM 2012) and recorded in the wet season (GHD 2010).
Actitis hypoleucos	Common Sandpiper	SLC	No	Unlikely	Likely	Previously recorded in the western sections of the Caley Valley Wetlands (GHD 2010). Suitable foraging habitat comprises shallow

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
						water on bare soft mud at the edges of wetlands, which occur adjacent to the DMCP.
Anous stolidus	Common Noddy	SLC	No	No	No	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple fauna surveys. Primary habitat comprises open ocean and oceanic islands which do not occur in the Study Area.
Apus pacificus	Fork-tailed Swift	SLC	Likely	No	Likely	Recorded within 5 km of the Project Area (Wildlife Online 2015). Predominately aerial. Suitable habitat comprises coastal areas with dry and open habitat, including foothills which occur in and adjacent to the DMCP.
Ardea ibis	Cattle Egret	SLC	Likely	No	Known	Recorded in the north and the south of the Caley Valley Wetlands, including adjacent to the DMCP, and in grasslands adjacent to the south of the wetlands (GHD 2010). Suitable habitat comprises wooded areas, terrestrial wetlands, low-lying grasslands which occur in and adjacent to the Project Area.
Ardea modesta	Eastern Great Egret	SLC	No	No	Known	Abundant across the Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprises wetlands which occur adjacent to the DMCP.
Arenaria interpres	Ruddy Turnstone	SLC	No	Unlikely	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. Suitable habitat comprises rocky shores or beaches and wide mudflats, which occurs within 200 m of the DMCP, at Dingo Beach, and along the foreshore component of the pipeline alignment.
Calidris acuminata	Sharp-tailed Sandpiper	SLC	No	No	Known	Occurs across the Caley Valley Wetlands in moderate to high densities, including adjacent to the DMCP. Suitable habitat comprises muddy edges of wetlands with emergent vegetation, which occur

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
						adjacent to the DMCP.
Calidris alba	Sanderling	SLC	No	Unlikely	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. Suitable habitat comprising open sandy beaches occurs within 500 m of the DMCP (at Dingo Beach), and at the Pipeline foreshore area (ELA 2014e).
Calidris canutus	Red Knot	SLC	No	Unlikely	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. Suitable habitat comprising intertidal zone on sandy beaches occurs within 500 m of the DMCP (at Dingo Beach), and at the Pipeline foreshore area (ELA 2014e).
Calidris ferruginea	Curlew Sandpiper	SLC	No	No	Likely	Observed in the central southern area of the Caley Valley Wetlands. Suitable habitat is intertidal mudflats and non-tidal wetlands near the coast. Occurs adjacent to the DMCP.
Calidris melanotos	Pectoral Sandpiper	SLC	No	No	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. Suitable habitat comprising coastal wetlands occurs adjacent to the DMCP.
Calidris ruficollis	Red-necked Stint	SLC	No	Known	Known	Recorded mostly in the Open Pan section of the wetland, with a single record adjacent to the DMCP. Also observed on the Eastern Beach in relatively low numbers. Suitable habitat comprises coastal wetlands and ocean beaches, which occurs adjacent to the DMCP, on Dingo Beach, and in the Pipeline foreshore area.
Calidris tenuirostris	Great Knot	SLC	No	No	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. Suitable habitat comprising mudflats and sandflats occurs adjacent to the DMCP.

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Charadrius bicinctus	Double-banded Plover	SLC	Unlikely	Unlikely	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. Suitable habitat comprising open grassy areas, fresh or saline wetlands and sandy beaches occurs in the DMCP, adjacent to the DMCP and at the Pipeline foreshore area (ELA 2014e), respectively.
Charadrius leschenaultii	Greater Sandplover	SLC	No	No	Potential	Recorded from the southwest of the Caley Valley Wetlands. Suitable habitat comprising sheltered beaches with large intertidal mudflats or sandbanks occurs within 500 m of the DMCP, at Dingo Beach.
Charadrius mongolus	Lesser Sand Plover	SLC	No	Unlikely	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. Suitable habitat comprising sandy open beaches occurs at the Pipeline foreshore area (ELA 2014e).
Charadrius veredus	Oriental Plover	SLC	Potential	Potential	Potential	Recorded in the western sections of the Caley Valley Wetlands (GHD 2010). Suitable habitat comprising near-coastal grasslands, sandy beaches and wetlands occurs in and adjacent to the DMCP, and at the Pipeline foreshore area (ELA 2014e). Not recorded within 2 km of the Project Area despite multiple shorebird surveys.
Chlidonias leucopterus	White-winged Tern	SLC	Potential	No	Potential	Occurs in the central southern Caley Valley Wetlands, within 2 km of the DMCP. Suitable habitat comprises grasslands, wooded lands, wetlands which occur in and adjacent to the DMCP. Not recorded in or adjacent to the Project Area despite shorebird and other fauna surveys over multiple years and seasons.
Coracina tenuirostris	Cicadabird	SLC	No	Potential	Known	Occurs in the canopy of woodlands and mangroves. Observed at fauna observation point ANA0911 (BMT WBM November 2010).
Cuculus optatus	Oriental cuckoo	SLC	Potential	Potential	Potential	This species occurs in woodland and mangroves, and has potential to

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
						visit the woodland areas of the Study Area. There are recorded sightings in the Study Area on Birds Australia database records (BAAM 2012; CDM Smith 2013)
Egretta sacra	Eastern Reef Egret	SLC	No	Likely	Known	Recorded in the northern coastal areas of the Caley Valley Wetlands, including within 500 m of the DMCP. Suitable habitat comprises beaches which occur in the Pipeline foreshore area (ELA 2014e) and at Dingo Beach within 500 m of the DMCP.
Fregata ariel	Lesser frigatebird	SLC	No	No	No	Known from the Whitsunday region. No known records within the Study Area.
Fregata minor	Great frigatebird	SLC	No	No	No	Known from the Whitsunday region. No known records within the Study Area.
Gallinago hardwickii	Latham's Snipe	SLC	No	No	Known	Occurs across the marsh sections of the eastern Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprising ephemeral freshwater and brackish wetlands with vegetation occurs adjacent to the DMCP.
Hirundapus caudacutus	White-throated Needletail	SLC	Unlikely	No	Unlikely	Known from the Whitsundays Region. Not recorded in the Study Area despite multiple fauna surveys. Predominately aerial species. Suitable habitat comprises wooded areas which occur in and adjacent to the DMCP.
Hirundo rustica	Barn Swallow	SLC	Unlikely	No	Unlikely	Known from the Whitsundays Region. Not previously recorded in the Study Area despite multiple fauna surveys. Suitable habitat comprises freshwater wetlands, coastal lowlands, *Melaleuca* woodland, mesophyll shrub thickets and tussock grassland which occur adjacent to the DMCP.

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Hydroprogne caspia	Caspian Tern	SLC	No	Known	Known	Occurs across the Caley Valley Wetlands and coastal areas, including adjacent to the DMCP and Eastern Beach, where the Pipeline is located. Suitable habitat comprises near-coastal wetlands and shores which occur adjacent to the DMCP and in the Pipeline foreshore area (ELA 2014f).
Limicola falcinellus	Broad-billed Sandpiper	SLC	No	No	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. No suitable habitat of estuarine mudflats, saltmarshes, freshwater lagoons with sandbanks within 2 km of the Project Area.
Limosa lapponica	Bar-tailed Godwit	SLC	Unlikely	Potential	Potential	Previously recorded from the southwest of the Caley Valley Wetlands. Primary habitat comprises tidal flats and saltmarshes, located within 2 km of the Project Area. Suboptimal habitat includes sandy beaches and areas of short grass, which occurs in and within 500 m of the DMCP and in the Pipeline foreshore area (ELA 2014e). Not recorded within 2 km of the Project Area despite multiple shorebird surveys.
Limosa limosa	Black-tailed Godwit	SLC	No	No	Known	Occurs in the southern and eastern Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprises shallow, sparsely vegetated, near-coastal wetlands, which occurs adjacent to the DMCP.
Merops ornatus	Rainbow Bee-eater	SLC	Known	Known	Known	Observed across the Abbot Point area, including in and adjacent to the DMCP and the temporary Pipeline area. Suitable habitat comprises open forests and woodlands, and cleared or semi-cleared habitats which occur in and adjacent to the DMCP, and adjacent to the Pipeline foreshore area.
Monarcha	Black-faced Monarch	SLC	No	No	Likely	Recorded in the Abbot Point area by Ecoserve (2007). Suitable

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
melanopsis						habitat comprises SEVT and coastal foothills which occur within 500 m of DMCP, and adjacent to the Pipeline foreshore area.
Monarcha trivirgatus	Spectacled Monarch	SLC	No	No	No	Known from the Whitsundays Region. Not previously recorded in the Study Area despite multiple fauna surveys. No suitable habitat of wet gullies, rainforests, and mangroves occurs in the Study Area.
Motacilla flava sensu lato	Yellow Wagtail	SLC	No	No	No	Known from the Whitsunday region. Not previously recorded in the Study Area despite multiple fauna surveys. No suitable habitat comprising damp grasslands and bare open ground occurs within the Study Area.
Myiagra cyanoleuca	Satin Flycatcher	SLC	No	No	Likely	Recorded in the Abbot Point region by Ecoserve (2007). Suitable habitat comprising eucalypt forests near wetlands occurs within 200 m of the DMCP.
Numenius minutus	Little Curlew	SLC	Likely	No	Known	Recorded in the central Caley Valley Wetlands, within 500 m of the DMCP. Suitable habitat comprises short dry grassland, open woodlands with grassy understorey, and seasonally inundated floodplains, which occurs in and adjacent to the DMCP.
Numenius phaeopus	Whimbrel	SLC	No	Known	Known	Occurs predominately in the central and western sections of the Caley Valley Wetlands (estuarine environments). Also occurs in coastal areas of Abbot Point, including within 500 m of the DMCP (Dingo Beach), and on Eastern Beach, where the Pipeline is located. Suitable habitat comprises open unvegetated mudflats, sandy beaches, and saline grasslands which occurs in the Pipeline foreshore area (ELA 2014f), at Dingo Beach, and adjacent to the DMCP.

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Onychoprion anaethetus	Bridled Tern	SLC	No	No	No	Known from the Whitsundays Region. Not previously recorded within the Study Area. Suitable habitat of open ocean does not occur in the Study Area.
Oceanites oceanicus	Wilson's storm-petrel	SLC	No	No	No	Common off the coast of Queensland from May to September and known from the Whitsunday region. Not previously recorded in the Study Area. Suitable habitat comprising open ocean does not occur in the Study Area
Ornithorhynchus anatinus	Platypus	SLC	No	No	No	Known from the Whitsunday region. Not previously recorded in the Study Area. Suitable habitat comprising freshwater systems in tropical rainforest lowlands does not occur in the Study Area.
Pandion cristatus	Eastern Osprey	SLC	Likely	Known	Known	Regularly recorded in the north of Abbot Point, including the Caley Valley Wetlands, and coastal areas, including the Pipeline foreshore area. Suitable habitat comprising large areas of open water in coastal habitats and wetlands, beaches occurs adjacent to the DMCP and in the Pipeline foreshore area (ELA 2014e). Suitable nesting habitat comprises dead or partly dead trees and artificial structures which occur within 200 m of the DMCP.
Plegadis falcinellus	Glossy Ibis	SLC	No	No	Known	Occurs across the Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprising wetlands and coastal areas occurs adjacent to the DMCP.
Pluvialis fulva	Pacific Golden Plover	SLC	No	Known	Known	Recorded in high densities on Abbot Point Eastern Beach, where the Pipeline is located. Predominately coastal, but also recorded in the far southeast section of the Caley Valley Wetlands. Suitable habitat comprises beaches, mudflats, and fresh and brackish wetlands with muddy margins which occurs in the Pipeline foreshore area (ELA

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
						2014f), at Dingo Beach, and adjacent to the DMCP.
Pluvialis squatarola	Grey Plover	SLC	No	No	Unlikely	Known from the Whitsundays Region. Not recorded at Abbot Point despite multiple shorebird surveys. Suitable habitat comprises near-coastal wetlands, which occur adjacent to the DMCP.
Rhipidura rufifrons	Rufous Fantail	SLC	Likely	No	Likely	Recorded in remnant woodlands west of Dingo Beach. Suitable habitat of SEVT, *Melaleuca* thickets, regrowth forests occurs in and adjacent to the DMCP.
Phascolarctos cinereus	Koala	SLC	No	No	Unlikely	Errant Wildlife Online record (from on a coal train) within 100 m of the south-eastern section of the Project Area. No evidence of activity in the Study Area or greater Caley Valley Wetlands. No suitable habitat in the Project Area.
Stercorarius pomarinus	Pomarine Jaeger	SLC	No	No	No	Known from the Whitsundays Region. Not previously recorded in the Study Area. Suitable habitat comprising open ocean does not occur in the Study Area
Sterna dougallii	Roseate Tern	SLC	No	Unlikely	Unlikely	Known from the Whitsundays Region. Not previously recorded in the Study Area despite multiple shorebird surveys. Rarely recorded in inshore waters or near the mainland. Suitable habitat of sandy beaches occurs within 500 m of the DMCP at Dingo Beach, and in the Pipeline foreshore area (ELA 2014e).
Sterna hirundo	Common Tern	SLC	No	Unlikely	Known	Observed feeding on inshore waters around Abbot Point (WBM 2006). Not recorded again despite multiple shorebird surveys. Suitable habitat comprising ocean beaches and near-coastal wetlands occurs adjacent to the DMCP and in the Pipeline foreshore area (ELA 2014e).

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
Sterna sumatrana	Black-naped Tern	SLC	No	No	No	Known from the Whitsundays Region. Not previously recorded in the Study Area despite multiple shorebird surveys. No suitable habitat of offshore sand and coral cays, reefs, islands occurs in the Study Area.
Sternula albifrons	Little Tern	SLC	No	Known	Known	Occurs across the Caley Valley Wetlands and Abbot Point coastal areas, including adjacent to the DMCP and Eastern Beach, where the Pipeline is located. Congregates in large numbers in the far west, southwest, and south of the wetlands. Nests on the coastal area in the far west of the wetlands. Suitable habitat comprises beaches and spits on lakes which occur in the Pipeline foreshore area (ELA 2014f), and adjacent to the DMCP.
Sula dactylatra	Masked Booby	SLC	No	No	Unlikely	Recorded within 5 km of Project Area (Wildlife Online 2012). No suitable habitat of open ocean occurs in the Study Area.
Sula leucogaster	Brown Booby	SLC	No	No	Unlikely	Known from the Whitsunday region and WildNet database records. No suitable habitat occurs within the Project Area.
Sula sula	Red-footed Booby	SLC	No	No	No	Known from the Whitsunday region. Not recorded in the Study Area.
Tachyglossus aculeatus	Short-beaked Echidna	SLC	No	No	Unlikely	Known from the Whitsunday region. Not recorded in the Study Area. Known to occur in a range of habitats including forests, woodlands, heath and grasslands.
Thalasseus bengalensis	Lesser Crested Tern	SLC	No	No	Unlikely	Recorded in the coastal area in the far west of the Caley Valley Wetlands. Suitable habitat comprising sandy coasts occurs within 500 m of the DMCP at Dingo Beach, and in the Pipeline foreshore area (ELA 2014e).
Tringa brevipes	Grey-tailed Tattler	SLC	No	No	Potential	Previously recorded from the southwest of the Caley Valley Wetland.

Scientific Name	Common Name	NC Act Status	Likelihood			Justification
			DCMP	Pipeline	Study Area	
						No primary habitat of tidal mudflats occurs within 2 km of the Project Area. Suboptimal habitat of coastal wetlands occurs in and within 500 m of the DMCP. Not recorded within 2 km of the Project Area despite multiple shorebird surveys.
Tringa glareola	Wood Sandpiper	SLC	No	No	Potential	Recorded within 5 km of Project Area (Wildlife Online 2015), but not recorded during multiple bird surveys over multiple seasons. Suitable habitat comprises well-vegetated shallow freshwater wetlands and inundated grasslands which occur adjacent to the DMCP.
Tringa incana	Wandering Tattler	SLC	No	Known	Known	Restricted to the coastal habitats. Known from Abbot Point Eastern Beach and the far western coast of the Caley Valley Wetland area. Suitable habitat comprises beaches, mudflats, and fresh and brackish wetlands with muddy margins which occur in the Pipeline foreshore area (ELA 2014f) and within 500 m of the DMCP (at Dingo Beach).
Tringa nebularia	Common Greenshank	SLC	No	No	Known	Occurs across the Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprising wetlands occurs adjacent to the DMCP.
Tringa stagnatilis	Marsh Sandpiper	SLC	No	Unlikely	Known	Occurs across the Caley Valley Wetlands, including adjacent to the DMCP. Primary habitat of wetlands occurs adjacent to the DMCP. Suboptimal habitat comprising beaches occurs in the Pipeline foreshore area (ELA 2014e) and at Dingo Beach within 500 m of the DMCP. Not recorded using beach areas at Abbot Point despite multiple shorebird surveys.

5 Potential impacts of the proposed action

5.1 Description of the action

The key elements of the Project that are subject to this terrestrial ecology assessment are:

- Construction of onshore DMCPs comprised of earth embankments on the existing ground profile using on-site cut and fill operations and suitable materials from onshore sources (quarries)
- Installation and removal of temporary pipelines for the purpose of transporting dredged material to the DMCPs and facilitating the offshore discharge of return water
- Ongoing management of the dredged material including its removal, treatment and beneficial reuse within the port area and the State Development Area, where appropriate.

The Project Area comprising the DMCPs and pipeline alignment covers approximately 148 ha, 75 ha of which will be subject to direct disturbance associated with construction works. Of the remaining area to the south, most will remain undisturbed, except for the establishment of a small temporary construction office site. Habitats surrounding the Project Area may be indirectly impacted by Project activities, with the spatial extent of indirect impacts likely to vary according to the habitat requirements and ecology of MSES.

5.2 Potential impacts of the proposed action

If left unmanaged, the proposed action has the potential to result in impacts on ecologically sensitive features including MSES during construction and operations. Impacts associated with each phase of the Project are described in the following sections. Further discussion of mitigation measures that will be implemented to minimise impacts of the Project is included in Section 6, and further discussion of impacts on specific MSES is provided in Sections 7 to 9.

Impacts resulting from the proposed works have been broadly grouped into the following categories:

- Direct impacts of construction activities within the Project Area
- Indirect impacts of construction activities and operations adjacent to the Project Area
- Ongoing human presence
- Periodic and short-term operational use (works within the DMCPs to support transfer or beneficial re-use of dredged material once dried).

Overall, the analysis has concluded that the majority of impacts resulting from the Project will be associated with the construction of the DMCP and associated earthworks. Placement of dredged material into the beneficial reuse area will be a short-term activity, occurring over a few months.

Any impacts associated with the placement of dredged material will have been preceded by construction of the DMCP (i.e. vegetation clearance will already have occurred prior to the dredging project being undertaken). Therefore, it is considered that impacts on terrestrial MSES from the dredging aspects of the Project will be negligible in comparison with the construction and establishment actions of the DMCP.

Accordingly, the following sections are focused on the construction of the DMCP and temporary pipelines, which has the potential to impact MSES. Potential impacts arising from the placement of dredged material are primarily limited to:

- Generation of dust and potential acid sulphate soils from the dredged material after drying
- Noise during the dredging and pumping activity
- Disturbance from lighting of the development area at night
- Abnormal events from the risk of embankment failure or seepage into the wetland and/or groundwater.

These matters have been addressed in the following sections and a suite of appropriate management and mitigation measures have been considered as part of the relevant technical reports assessing these matters.

5.3 Construction phase impacts

If not appropriately mitigated, the construction phase of the Project is likely to result in impacts on ecologically sensitive features of the environment, primarily through vegetation clearance and works associated with the establishment of the proposed DMCPs and temporary pipelines. Construction activities with potential for significant impacts on MSES include:

- Vegetation clearance
- Fragmentation and edge effects
- Excavation
- Placement of fill
- Vehicle movements
- Dust emissions
- Light emissions
- Construction noise
- Alterations to surface water hydrology and quality
- Alternations to ground water hydrology and quality
- Waste disposal
- Increased human presence and activity

5.3.1 Vegetation clearing

Clearing vegetation to establish the DMCPs and temporary pipeline alignment will reduce vegetative cover and result in the loss of some habitat for fauna dependent on those ecosystems (i.e., cause direct impacts). Table 7 indicates the proposed extent of clearance of each vegetation community in the development footprint. For purposes of the current assessment, it is assumed that all vegetation within the footprint will be removed. The pipeline alignment has been chosen to minimise vegetation clearing. Field surveys have confirmed that the foredune vegetation at the eastern extent of the pipeline alignment does not comprise the mapped RE 11.2.2 (ELA 2014e).

Table 7. Areal extent of clearing of vegetation communities in the Project Area, from ELA and EHP habitat mapping.

Habitat Type	Associated Regional Ecosystems (RE)	Disturbed by DMCP (ha)	Pipeline Alignment (ha)	Total Area Disturbed (ha)
Grass, weeds, other	Non-Remnant	50.57	0[1]	50.57
Woodland	Regrowth 11.2.5	23.14	0	23.14

Habitat Type	Associated Regional Ecosystems (RE)	Disturbed by DMCP (ha)	Pipeline Alignment (ha)	Total Area Disturbed (ha)
Woodland	11.2.5	0.86	0	0.86

[1] The pipeline alignment includes a variety of land forms, including car parks, laydown areas, settlement ponds and roads. Some of these may comprise non-remnant vegetation in small patches.

A reduction in vegetation cover can reduce the available shelter, nesting, breeding and foraging habitat for threatened fauna (threatened and migratory species). Although there are no threatened flora species known or likely to occur in the Project Area, a number of threatened and migratory bird species are known, likely or can potentially occur (Section 4). Fauna species with narrow habitat preferences may be impacted more than others and be subject to adverse impacts such as increased competition for limited resources which can result in a reduction in local populations.

No direct clearing of regulated vegetation is expected for construction of the DMCPs or the temporary pipeline alignment.

5.3.2 Fragmentation and edge effects

There is a relatively low potential for fragmentation of landscape habitat features, due to the location of the Project Area adjacent to an existing industrialised section of the Port of Abbot Point. However, the relevance, extent and severity of impacts from fragmentation (e.g. weeds, fire, increased exposure to wind, barriers to movement of fauna) needs to be considered for each species or community. Most of the threatened and migratory species are birds for which the presence of the DMCP and temporary pipeline alignment are unlikely to comprise a significant barrier to movement.

Edge effects associated with clearing vegetation and site disturbance are important at Abbot Point due to the prevalence of several exotic weed and feral animal species that might be introduced into new areas or increase in extent (e.g. Lantana, *Parkinsonia*, rabbits, pigs, rats and cane toads). In addition, the risk of ignition and spread of fire is increased through the use of machinery and equipment that generate sparks, use of flammable chemicals and changes to the structure or composition of vegetation.

5.3.3 Excavation

The Project design identifies the use of excavation only in relation to establishing the dredged material ponds, and proposes that excavation depth will be to a level of 3.0 m RL. Existing levels on site range from 2.5 m to 5.5 m RL. The pond capacity for the storage of dredged material will be achieved through construction of embankments (to a height of 9 m RL), i.e. ponds will be largely above-ground rather than excavated into the ground. The most serious potential adverse impacts from excavation include:

- Disturbance of ASS or PASS soils, resulting in acid generation which then can indirectly impact MSES through degradation and loss of vegetation and important habitats
- Entrapment of fauna in open trenches, resulting in injury or death.

5.3.4 Placement of fill

Establishment of the DMCP will involve a substantial amount of placement of fill. Direct impacts include:

- Direct smothering of vegetation comprising important habitat for threatened fauna species, resulting in degradation or loss

- Direct smothering and destruction of nests and/or unfledged young of threatened bird species (resulting in injury or death).

Indirect impacts include smothering of vegetation, habitats or nests from sediments lost from the embankment walls if they are not adequately stabilised (e.g. with vegetation or geotextile), particularly during the wet season but also during any extended period of strong winds.

5.3.5 Vehicle movements

During construction, a large number of vehicles and heavy plant will enter, traverse and exit the Project Area, to clear vegetation, excavate DMCPs, construct embankments and complete other activities. Direct impacts from vehicle and plant movements on threatened species include:

- Damage or destruction of vegetation or fauna habitat by traversing these areas
- Fauna strike.

Indirect impacts include:

- Indirect interference/perturbation of threatened fauna through noise generated by machinery, affecting feeding, roosting, breeding or nesting behaviour
- Introducing and/or spreading weeds or feral animals carried on or in vehicles, resulting in deterioration or loss of vegetation and important fauna habitat
- Damage or destruction of vegetation and fauna habitat through smothering by dust generated by vehicles traversing the Project Area.

5.3.6 Dust emissions

Project activities have the potential to generate dust emissions, most of which will be temporary during construction. The main sources of dust will be:

- Dust lift-off from exposed surfaces such as stockpiles and other exposed areas
- Construction of the embankments, including moving, dumping and shaping material
- Vegetation and soil clearing of the land
- Wheel-generated dust from the haul roads created for the construction phase.

Excessive deposition of dust on leaves of plants can suppress growth and photosynthesis and result in reduced habitat quality for fauna. High levels of airborne dust particles can irritate the respiratory systems of fauna and potentially result in ingestion of dust-coated seeds and other foods.

Excessive deposition of dust on open water bodies may also degrade water quality, and overall habitat quality for fauna. Wetland habitats surrounding the Project Area may be particularly vulnerable. High levels of dust settling in permanent or ephemeral waterways or picked up in tidal or stormwater run-off may flow through to the shore and reduce near-shore water quality of the GBRWHA.

During construction, dust lift-off from exposed surfaces is more likely to occur after periods of hot, dry weather, particularly under strong winds. The placement and drying of dredged material within the DMCPs is not expected to be a factor in the generation of dust, due to the moisture within sediments and the formation of a crust on the surface layers of dredged material.

Sensitive receptors surrounding the Project Area will potentially be affected by dust emissions from construction if relevant air quality objectives are exceeded. Katestone Environmental (2015) noted that effects on plants from dust deposition may occur where the maximum monthly rate of deposition exceeds 200mg/m^2/day for a 120 day rolling average.

There is limited information available on the potential for dust to irritate the respiratory systems of fauna, and there are no guidelines for the avoidance of impacts on fauna. In lieu of such guidelines, human health guidelines provide some reference criteria which are likely to be conservative for the purposes of environmental assessment. These criteria are:

- TSP – 90 µg/m over an annual averaging period.
- PM_{10} – 50 µg/m over a 24 hour averaging period.
- $PM_{2.5}$ – 8 µg/m over an annual averaging period and 25 µg/m a 24 hour averaging period

Katestone (2015) undertook dispersion modelling to predict dust concentrations and deposition rates generated by Project construction activities (with and without existing background dust) in the Freshwater and Estuarine sections of the Caley Valley Wetland. The modelling assumed the application of standard dust management practices such as the wetting of soil stockpiles and haul roads.

Maximum dust deposition levels were predicted to be below the vegetation criterion of 200 mg/m^2/day (Katestone 2015). Impacts of dust deposition on vegetation including regulated vegetation and wetland flora supporting MSES are therefore not anticipated as a result of construction works.

Results of the dispersion modelling in relation to dust concentrations and human health criteria were varied. The $PM_{2.5}$ criteria were not exceeded for 24 hour or annual exposure. This is a positive result, as $PM_{2.5}$ is known to cause greater respiratory problems than the other criteria modelled. Likewise, the TSP result was below the relevant human health criterion of 90 µg/m. However, the modelled PM_{10} result was predicted to exceed the human health criterion of 50 µg/m for a distance of approximately 600 m into the wetland.

There is a moderate to high degree of uncertainty in assessing the significance of the predicted exceedance of PM_{10} dust emissions from the Project. The criteria used in the modelling are considered to be conservative when applied to human health and can also therefore be assumed to be conservative for the purposes of assessing impacts on the environment (ELA and Open Lines 2012). However, localised emissions of dust may have the potential to affect fauna utilising the eastern fringe of the wetland during the period of construction works.

Further assessment of the impacts of dust generated by the Project on migratory shorebirds is provided in Section 9.2.3.

5.3.7 Light emissions

Artificial light can affect both nocturnal and diurnal animals by disrupting natural behaviour, with quality of light (e.g. wavelength, colour), intensity and duration of exposure potentially evoking different responses. Impacts from increased light levels include disorientation from or attraction toward artificial sources of light; mortality from collisions with structures; and effects on light-sensitive cycles of species (e.g. breeding and migration for fauna and flowering in plants). An artificial increase in lighting can also influence the abundance and behaviour of predators.

The presence and intensity of artificial light within the Project Area will temporarily increase during the construction phase and vary according to the type of work being undertaken. Construction of the pond embankments will occur for at least 12 hours a day, seven days a week, and may be extended to 24 hours a day, seven days a week, if required to achieve Project schedules. The placement of dredged material will occur at night as part of a 24 hour work cycle. The disturbance footprint and surrounding areas will therefore be subject to artificial lighting for a period of several months during construction

phases of the Project. Some ongoing lighting may also be required to support long-term management of the dredged material.

Lighting will be provided by mobile light towers which provide directional lighting from a mast extending a maximum of approximately 10 m in height. Lights towers will generally comprise either four or six directional metal halide (or equivalent) lights ranging from 1,500 to 12,000 watts. Lights are adjustable and will be directed towards the area of construction activities to provide approximately 100 lux of illumination.

Some spillage of light to adjacent areas will be inevitable, with the area affected determined by the height, intensity and orientation of lights used. Manufacturers specifications indicate that for lights oriented directly at the ground from above, ambient light levels are expected to be similar to background levels at a distance of approximately 60 m from the source. For lights that are oriented towards construction activities (away from the wetland), the distance over which light spill is anticipated will be significantly reduced.

In this context, any effects from artificial lighting are most likely to be contained primarily within the buffer area between the pond embankments and the wetland, which is a minimum of 50 m at the southern edge of the DMCPs and several hundred metres in other locations. Mitigation and management measures will be applied (Section 6.7) to the use of lighting. Potential impacts associated with light emissions will be temporary and are unlikely to be significant. However there is potential for them to act cumulatively with other impacts (e.g. noise) to disturb shorebirds from wetland habitats immediately adjacent to the Project Area.

5.3.8 Construction noise

Noise levels greater than existing ambient levels are expected within and adjacent to the Project Area during construction of the DMCP and temporary pipeline alignment, during dredging operations and at stages during long term management of the dredged material. Sources of noise are likely to consist of noise in short, intense pulses from mobile plant equipment, and more prolonged noise, with consistent vibration, pitch and volume from generators and pumps, in addition to from noise from vehicles.

Both steady continuous and single noise events have the potential to lead to impacts on fauna. SLR (2015) noted the following key thresholds for potential impacts on shorebirds:

- 60 dBA LAmax for single noise events
- 65 dBA LAeq for steady continuous noise.

These thresholds are likely to be conservative in relation to potential impacts on migratory shorebirds and the Australian Painted Snipe and provide an indication of the noise levels which may cause alarm.

SLR (2015) modelled the predicted distribution of cumulative noise (which includes that produced by existing operations at T1) under three different weather conditions (neutral, inversion and inversion with a south east wind) for seven stages of the Project.

The results of noise modelling indicated that:

- noise exceeding the thresholds will extend into the Caley Valley wetland for some Project stages.
- there is only minor variability predicted in the distribution of noise contours in response to differing weather conditions.

Construction noise is expected to elicit some response from MSES utilising the wetlands and may therefore have an impact (particularly on behaviour and possible localised shifting of more noise-sensitive species and individuals away from the sources of noise). There is no potential for impact on MSES utilising the wetland during pond liner installation and dredging of the sea bed, as the model outputs predicted that noise created by the Project during these stages would be confined to the Project Area.

As construction of the DMCPs may occur during the period when migratory shorebirds visit the Caley Valley Wetland, an assessment of impacts of noise on migratory shorebirds is provided in Section 9.2.2 and for MSES where relevant.

5.3.9 Alterations to surface hydrology

Changes to hydrology (e.g. through installation of embankments that comprise obstacles to surface flows or additional stormwater run-off) can potentially impact the extent of catchments, run-off characteristics, intensity of flood flows and stability of waterways. Elevated levels of erosion transport of sediments across the Caley Valley Wetland may result in reduced biodiversity in affected areas. Sediment runoff into aquatic habitats can cause increased turbidity, decreased oxygen levels, reduced light penetration, changes in channel morphology and altered sediment composition in substrates. In addition, interference with flows may alter the local wetting and drying regime, including water heights, flow paths, retention times and ponding. Such changes can have flow-on effects on aquatic habitats, resulting in their loss or alteration and a reduction in the quality and/or quantity of important food sources.

Results of hydrological modelling indicate that there will be minimal impact of the project on surface water quality (BMT WBM 2015). Changes in salinity of approximately 2 ppt are expected around the estuarine bund area, well west of the Project Area. The key infrastructure components of the Project that may impact the hydrology of surface waters of the wetlands include the DMCP and associated infrastructure for managing stormwater. As the Project does not involve the construction of infrastructure within the Caley Valley Wetland, there is unlikely to be any impact on hydrological function of the wetland. With the application of standard mitigation and management measures (Section 6), impacts from stormwater releases will be localised and small in scale.

5.3.10 Alterations to ground water quality, movement and storage

Construction and operational activities can have adverse impacts on ground water in and adjacent to the Project Area, including water movement and aquifer storage. If impacts on ground water quality and availability are substantial, this can have significant impacts on the health of dependent ecosystems, including regulated vegetation and wetland habitats of threatened and migratory species.

AGE (2014) reviewed the geochemical characteristics of the material to be dredged and the water quality of seawater at the dredging location. The review indicated that the material to be dredged (as a bulk material) is expected to be non-acid forming, contains low concentrations of metals and metalloids and low concentrations of organic compounds.

Excavation activities during construction may intersect groundwater and expose ASS, resulting in acidification of ground water. Golders (2015) investigated material underlying the site and found that no PASS were present. No management of ASS will be required. A management plan for the DMCP and dredged material will be prepared.

5.3.11 Liquid and solid waste disposal

Inappropriate disposal of liquid and solid wastes, including spills and leaks from transfers (fuel, chemicals) and inadequate storage could result in point-source contamination of surrounding land,

including wetlands, regulated vegetation and habitats of threatened and migratory species. Direct adverse impacts include toxic impacts on vegetation (resulting in degradation or loss of SEVT and habitats), direct toxic impacts on MSES fauna (from contact, inhalation or ingestion) or indirect impacts on threatened and migratory species from habitat loss. Direct adverse impacts on surface and groundwater quality are also possible.

With the application of standard mitigation and management measures (Section 6), impacts from liquid and solid waste disposal will be avoided or localised and small in scale. Accordingly these impacts are not considered further in analysis of impacts on MSES in Sections 7, 8 and 9.

5.3.12 Increased human presence and activity

Increased activity by people within the Project Area and surrounds has the potential to disturb fauna, with wetland birds roosting or foraging in adjacent areas being particularly vulnerable. Impacts can include disruption to foraging and roosting efficiency or deterring birds from using particular areas (resulting in effective reduction in habitat availability). Vehicles deviating from established access roads can also damage habitats (indirect impact on threatened and migratory species) or kill or damage birds on impact (direct impact, vehicle strikes).

5.4 Potential impacts from the ongoing presence of infrastructure

After completion of construction, the ongoing presence of infrastructure can continue to have potential for adverse direct and indirect impacts on regulated vegetation and threatened and migratory fauna. The key continuing risks are from:

- Dust emissions (e.g. blow-off from inadequately stabilised embankments and access roads)
- Erosion of embankments, access roads or other areas of ground disturbance, resulting in substantial transfer into sensitive habitats by surface flows.

With the application of standard mitigation and management measures (Section 6) impacts from the ongoing presence of infrastructure is expected to be localised and small in scale. Accordingly these impacts are not considered further in analysis of impacts on MSES in Sections 7, 8 and 9.

5.5 Potential impacts from periodic and short term operational use

After construction of the new onshore facility, periodic short-term operational use will occur, including:

- Deposition of dredge spoil into ponds in the DMCPs and removal or relocation of fill once sediments have settled and return waters have been discharged
- Periodic release of stormwater in retention ponds
- Periodic maintenance work on the embankments, dredged material ponds and pipework
- Removal of DMCP and establishment of the final landform.

Any future projects that require the use of the dredged material will be subject to an appropriate level of impact assessment as required under relevant Commonwealth and State legislation.

These activities will involve vehicle movements, earth works, dust emissions, noise/vibration emissions and increased human presence and activity. All of these increase the risk of adverse direct and indirect impacts on threatened and migratory species (e.g. vehicle strike and interference with behaviour) and degradation of habitats of MSES species and regulated vegetation (e.g. introduction and spread of weeds and feral animals). The nature of these potential impacts is described in Section 5.3 and will be reflective of impacts during the operational phases.

As mentioned previously, potential impacts arising from the placement of dredged material will be primarily limited to:

- Dust and PASS from the dredged material after drying
- Noise during the dredging and pumping activity
- Abnormal events from the risk of embankment failure or seepage to wetland and/or groundwater.

Mitigation measures have been considered as part of the relevant technical reports assessing these matters. With the implementation of suitable measures the potential risk of impacts from these matters is considered low.

6 Mitigation and Management

The previous section indicated that the Abbot Point Growth Gateway Project has a number of unavoidable adverse impacts (e.g. vegetation clearance) and a number of other adverse impacts (e.g. mortality of threatened species through vehicle strike) that can be avoided or minimised through appropriate management and mitigation measures. The assessment has assumed a worst-case scenario where all habitat within the DMCP and temporary pipeline alignment (75 ha in area) will be removed, reclaimed or otherwise lost. The focus for mitigation and management measures to be implemented during the Project is to minimise impacts on threatened and migratory fauna and communities adjacent to the Project Area. Where it is possible to protect these values within the development footprint, relevant management measures are presented.

6.1 Mitigation of impacts from clearing vegetation

Because of the potential for vegetation clearing to have impacts on threatened species, the following measures are required to avoid or minimise the extent and severity of these impacts in adjacent areas:

- The minimum amount of clearance will be done that still enables effective completion of the construction elements and subsequent operation (to retain, if possible, vegetation and habitats within the Project Area, including the temporary pipeline alignment)
- Management actions will be implemented to reduce impacts on regulated vegetation and threatened species habitats (see Section 8 for relevant species), including allowing perturbed fauna to relocate naturally or with assistance from spotter catchers
- Residual impacts on environmental values (if present) will be adequately compensated through the provision of suitable offsets
- The severity of impacts from clearing vegetation will be minimised through the following measures:
    - Where possible, maximise the use of degraded or less sensitive environmental areas when siting infrastructure, including the temporary pipelines; and
    - Areas to be cleared must be surveyed in advance, marked-out and authorised by an appropriate person prior to clearing, to ensure no significant areas are inadvertently disturbed and no excessive clearing occurs.

6.2 Mitigation of impacts from habitat fragmentation and edge effects

Clearing of vegetation has the potential to fragment habitats of threatened species and exacerbate adverse impacts through edge effects, in particular, the introduction and spread of weeds and feral

animals. Suitable mitigation, management and monitoring measures are required, including the following:

- Measures will be taken to re-establish connectivity to the greatest realistic extent following construction and/or consolidate existing fragmented areas through restoration
- Development areas will be provided with adequate firefighting equipment and on-site staff will be adequately trained to use such equipment
- Vegetation clearance procedures will be implemented that minimise the potential to introduce and/or spread weeds or to increase the risk of subsequent disturbance, including by feral animals and fire.

The Construction Environmental Management Plan (CEMP) and Operations Environmental Management Plan (OEMP) will include development and implementation of a Weed Management Plan, Feral Animal Management Plan and Fire Management Plan, targeting protection of regulated vegetation and habitat of threatened species.

6.3 Mitigation of impacts from excavation

To avoid or minimise impacts associated with excavation, the CEMP and OEMP will be required to contain measures to ensure landform stability and avoid fauna mortality or injury.

Such measures may include:

- Deep pits and trenches (greater than 0.5 m depth) to be fenced, have infrastructure components installed in a timely fashion, be filled/rehabilitated and/or be monitored throughout each day to locate and remove any trapped fauna
- Surface of disturbed ground to be stabilised as soon as practicable (e.g. by geotextile or vegetation) to avoid erosion and transport of sediments offsite
- All construction activities will be monitored routinely for compliance with the plans above and to ensure effectiveness. Monitoring will also take place to allow detection at an early enough stage to implement effective mitigation and resolution before unacceptable and/or irreversible adverse impacts occur.

6.4 Mitigation of impacts from placement of fill

To avoid or minimise impacts associated with the placement of fill, the CEMP and OEMP will be required to contain measures to address hydrological and water quality impacts, erosion and sediment controls.

Such measures may include:

- Stabilising embankment surfaces with geotextile or vegetation as soon as practicable
- Engaging fauna handlers to monitor pits or trenches deeper than 0.5 m, to locate trapped animals and remove them in a timely manner.

6.5 Mitigation of impacts from vehicle movements

To avoid or minimise impacts associated with vehicle movements, the CEMP and OEMP will be required to contain measures to address traffic-related issues. Such measures may include:

- Appropriate speed limits should be sign-posted, included in staff inductions and enforced

- Vehicles to be limited to traversing approved roads and tracks
- No unauthorised access by vehicles unless required for construction, operation, maintenance or inspections
- In high risk areas, establishment of vehicle wash/blow-down areas and procedures, to remove weeds and their propagules
- If possible, use temporary fencing around construction areas, but minimise the use of barbed wire in fencing
- All personnel operating vehicles in and adjacent to the Project Area should be made aware of the potential for Squatter Pigeon and other threatened and migratory species to occur on-site and be encountered on vehicle tracks. Personnel should also be alerted of the Squatter Pigeon's tendency to freeze in position when danger approaches
- Prevention of fire ignition and uncontrollable fires through appropriate measures, including fire arrestors on all earth-moving equipment.

6.6 Mitigation of impacts from dust emissions

Construction activities are expected to generate temporary dust emissions. To avoid or minimise impacts associated with dust, the CEMP and OEMP will be required to contain measures to address dust-related issues. Measures are expected to include:

- Ensure that all significant earthworks are avoided where practicable during unfavourable meteorological conditions (e.g. high winds)
- Watering of haul roads to minimise wheel-generated dust
- Watering of exposed areas including cleared areas and stockpiles to minimise dust lift-off
- Minimise exposed area through progressive clearing
- Designation of appropriate maximum speed limits during construction
- Erection of physical barriers such as bunds and/or wind breaks around stockpiles
- Water spraying of nearby sensitive vegetation (particularly regulated vegetation) if visible dust sedimentation is occurring
- Use of hydraulically applied polymer agents and organic mulch to protect some surfaces.

6.7 Mitigation of impacts from light emissions

To avoid or minimise impacts associated with light emissions, the CEMP and OEMP will be required to contain measures to minimise artificial lighting of the wetland. Such measures may include:

- Use directional lighting and shrouds to protect the Caley Valley Wetland from direct light
- Use mobile light towers which can be moved and adjusted to provide lighting for construction purposes, while minimising lighting of unused areas
- Maintain a buffer area between construction lighting and the Caley Valley Wetland
- Point directional lights away from the Caley Valley Wetland

6.8 Mitigation of impacts from construction noise

To avoid or minimise impacts associated with construction noise, the CEMP and OEMP will be required to contain measures to minimise noise generation within close proximity to the Caley Valley Wetland. Such measures may include:

- Use of plant with efficient muffler design.

- Vehicles, plant and equipment will be maintained in accordance with manufacturer's specifications.
- Adjustment of reversing alarms on plant to limit the acoustic range to the immediate danger area.
- Plant and equipment of appropriate size / capacity for the task will be used.
- Use of quieter engines and newer, quieter equipment where practicable.

6.9 Mitigation of impacts from alterations to surface water

To avoid or minimise impacts associated with alterations to surface water resulting from stormwater release, a stormwater management plan is expected to be developed to the following principles:

- The DMCP has been designed with a spillway which will accommodate a 1:20 year three day storm event.
- Beyond this event a fuse plug on the south eastern corner of the pond will be utilised for emergency discharge

6.10 Mitigation of impacts from alterations to ground water

Placement of the dredged material and resultant seepage is expected to have a low to negligible impact on the existing groundwater below the DMCP (AGE 2015). Contingency management measures (for example treatment with fine ground agricultural lime) will be employed if construction measures do result in excavation of AASS and/or PASS materials. These would be expanded upon in an Acid Sulphate Soil Management Plan incorporated into the CEMP and OEMP.

6.11 Mitigation of impacts from liquid and solid waste disposal

To avoid or minimise impacts associated with waste, the CEMP and OEMP will be required to contain measures to address spills and waste management. Such measures may include:

- Package treatment plants to treat sewage from construction workers on-site
- Solid waste transported to approved facilities outside the Project Area
- Spill management procedures
- Spill kits and appropriately trained staff available on site.

6.12 Mitigation of impacts from increased human presence and activity

Adverse impacts associated with increased human presence and activity can be avoided or minimised through implementing the following mitigation measures:

- Speed limits to reduce collisions with threatened species
- Erect sound barriers around important roosting, breeding or nesting
- Fence off habitat areas to prevent unplanned impacts outside the Project Area
- Educate construction crews to avoid disturbance of sensitive habitats in the Study Area.

6.13 Monitoring requirements for proposed mitigation and management

Compliance with the requirements, agreed procedures, locations and extent of vegetation clearance in approval conditions and the CEMP and OEMP must be monitored, documented and subject to compliance audits. A reporting schedule will be required to be included in the CEMP for both routine documentation (of planned and executed clearing) as well as incident reporting (e.g. clearance outside agreed areas).

7 Assessment of Residual Impacts on MSES

This section describes the assessment of Project impacts on MSES in accordance with the Significant Residual Impact Guidelines and WPA State Code.

7.1 Regulated vegetation

The Project will not result in direct impacts (clearing) to the following types of regulated vegetation:

- Endangered or Of Concern Regional Ecosystems (RE)
- a RE that intersects with an area shown as a wetland on the vegetation management wetlands map (to the extent of the intersection);
- An area of essential habitat that is habitat for Endangered or Vulnerable wildlife under the NC Act.
- REs within a defined distance from defining banks of watercourses identified on the vegetation management watercourses map.

Any indirect impacts on surrounding regulated vegetation (e.g. changes in microclimate, dust impacts) are expected to be negligible and beneath levels of perception. With reference to the criteria within Section 2.1 of the *Significant Residual Impact Guideline* (Queensland Government 2014), the Project will not result in a significant impact on regulated vegetation (Table 8).

Table 8 Assessment of Impacts against the Significant Residual Impact Criteria for Regulated Vegetation

Criteria	Clearing in Endangered or Of Concern regional ecosystems	Clearing of regulated vegetation within a mapped wetland	Clearing of regulated vegetation within the defined distance of a watercourse
Clearing: • area greater than 5 ha where in a grassland (structural category) regional ecosystem; or • area greater than 2 ha where in a sparse (structural category) regional ecosystem; or • area greater than 0.5 ha where in a dense to mid-dense (structural category) regional ecosystem.	No impact	No impact	No impact
• Clearing within 50m of the defining bank	N/A	No impact	NA
• Clearing within 5m of the defining bank	NA	NA	No impact

7.2 Wetlands and Watercourses

No wetlands or watercourses will be directly impacted by the Project. Indirect impacts of the Project on water quality have been assessed by BMT WBM (2015) and found to be insignificant. Impacts of the Project on the habitat or lifecycle of native species have been assessed in detail in relation to wetland birds (Section 9), which are the primary taxonomic group of relevance to the assessment of terrestrial

ecology. Impacts on aquatic habitat and fauna, including fish, have been assessed by BMT WBM (2015) and found to be minor.

Table 9 presents a summary of the predicted impacts against the Significant Residual Impact Criteria for wetlands and watercourses as listed in the Significant Residual Impact Guideline (Queensland Government 2014).

Table 9 Assessment of Impacts against the Significant Residual Impact Criteria for Wetlands and Waterways

Criteria for a Significant Residual Impact	Assessment
areas of the wetland or watercourse being destroyed or artificially modified;	No impact. There is no disturbance, clearing of earthworks proposed within the wetland.
a measurable change in water quality of the wetland or watercourse—for example a change in the level of the physical and/or chemical characteristics of the water, including salinity, pollutants, or nutrients in the wetland or watercourse, to a level that exceeds the water quality guidelines for the waters; or	No impact. Modelling of water quality within the wetland predicted no significant changes as a result of the Project (only 2 ppt change to salinity in the vicinity of the eastern bund; BMT WBM 2015).
the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected; or	No impact. The key taxonomic group relevant to the assessment of terrestrial ecology is wetland birds and a detailed assessment is provided in Section 9. Impacts on aquatic fauna including fish have been assessed in a separate report (BMT WBM 2015).
a substantial and measurable change in the hydrological regime or recharge zones of the wetland, e.g. a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland; or	No impact. Modelling of the hydrological regime for surface water and ground water predicted no substantial and measurable change as a result of the Project (BMT WBM 2015). Any impact around the spillway in a flood event will be localised.
an invasive species that is harmful to the environmental values of the wetland being established (or an existing invasive species being spread) in the wetland.	No impact. Measures to control risks associated with weeds and pests are discussed in Section 8 for relevant threatened species.

The Project Area is located adjacent to a WPA associated with the Caley Valley Wetland. The WPA does not extend within the Project Area. However, as the Project is located within a catchment adjoining the Great Barrier Reef lagoon, the State Development Assessment Provisions have been considered. Assessment of the Project will make consideration of the WPA State Code (non-statutory, as assessment not under SP Act), which seeks to achieve several performance outcomes in relation to ecology. These outcomes of the assessment are presented in Table 10.

Table 10 Assessment of Project in relation to WPA State Code

Performance outcome	Assessment and proposed solution
PO1 Development is not carried out in a	The Project is consistent with the Abbot Point State Development Area Development Scheme (qualifying as a

Performance outcome	Assessment and proposed solution
wetland in a WPA unless: (1) there is an overriding need in the public interest, or (2) the development is a development commitment, or (3) the development is for community infrastructure.	development commitment). However, the proposed works have been located outside the boundary of the mapped WPA to minimise environmental impacts.
PO2 An adequate buffer to a wetland in a WPA is provided and maintained.	An alternative buffer to the 200 m specified in the acceptable outcomes for non-urban areas is proposed. The buffer has been developed in accordance with the Queensland Wetland Buffer Guideline (DERM 2011). Operating measures to avoid adverse impacts on the wetland have been developed.
PO6 During construction and operation of development in a WPA outside an urban area: (1) a wetland is not used for stormwater treatment (2) the buffer for and water quality values of a wetland are protected from stormwater impacts.	The development is located outside of a WPA. The wetland will not be used for the treatment of stormwater. The water quality values of the wetland are protected from impacts from stormwater (see assessment of BMT WBM 2015).
PO7 Development involving the clearing of vegetation protects the biodiversity, ecological values and processes, and hydrological functioning of a wetland in WPA, including: (1) water quality values (2) aquatic habitat values (3) terrestrial habitat values (4) usage of the site by native wetland fauna species or communities.	The development involves clearing of vegetation outside of the WPA. Assessment of the potential impacts of vegetation clearing indicate that there will be little to no impact on biodiversity and ecological values (see assessment in Sections 8 and 9). Aquatic ecology values and hydrological functioning of the wetland will also be maintained (BMT WBM 2015).
PO8 Development avoids land degradation in a WPA, including: (1) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, wind erosion or scalding (2) loss or modification or chemical, physical or biological properties or functions of soils.	There will be no development within the WPA. Land degradation will be avoided through the use of a buffer, erosion control measures, design of development and application of a construction environmental management plan (CEMP) and operations environmental management plan (OEMP).

Performance outcome	Assessment and proposed solution
PO9 Development in a WPA ensures that any existing ecological corridors are enhanced or protected, and have dimensions and characteristics that will: (1) effectively link habitats on or adjacent to the development (2) facilitate the effective movement of terrestrial and aquatic fauna accessing or using a wetland as habitat.	The development is located adjacent to an existing industrial precinct and will not impact on any existing ecological corridors (Section 4.6.2). Fauna movement will not be restricted by the Project.
PO10 Development does not result in the introduction of non-native pest plants or animals that pose a risk to the ecological values and processes of a wetland in a WPA.	Measures to manage the introduction of weeds and pests are discussed in Section 8 and 9. Management plans will be in place to achieve this performance outcome.
PO11 During construction and operation of development in a WPA, wetland fauna are protected from impacts associated with noise, light or visual disturbance.	Potential impacts of noise, light and visual disturbance are discussed in relation to wetland birds in Section 9. These are the primary wetland fauna relevant to the scope of terrestrial ecology. Impacts on aquatic wetland fauna are assessed by BMT WBM (2015).
PO12 During construction and operation of the development in a WPA, ongoing management, maintenance and monitoring is undertaken to ensure adverse effects on hydrology, water quality and ecological processes of a wetland are avoided or minimised.	There will be no development within the WPA. Management, maintenance and monitoring are proposed to ensure adverse impacts on wetland values are avoided or minimised. These are described in Sections 6 and 11 of this report.

7.3 Connectivity Areas

Under the provisions of the *Significant Residual Impact Guideline* (Queensland Government 2014), a development impact on connectivity areas is determined to be significant if either of the following tests are true:

- Test 1: The change in the core remnant ecosystem extent at the local scale (post impact) is greater than a threshold (see Guideline) determined by the level of fragmentation at the regional scale; or
- Test 2: Any core area that is greater than or equal to 1 hectare is lost or reduced to patch fragments (core to noncore).

Regarding both tests, no core remnant ecosystem areas will be impacted by the Project therefore there will be no change in the core remnant ecosystem extent or patch size. For this reason, the Project will not result in a significant residual impact on this MSES.

7.4 Protected Wildlife Habitat

There are three triggers under the Significant Residual Impact Guideline (Queensland Government 2014) where consideration of criteria applies. These are:

- The Project Area is adjacent to areas mapped as essential habitat for Squatter Pigeon, and adjacent to wetland habitats used by the Australian Painted Snipe (Vulnerable) and Eastern Curlew (Near Threatened)
- The Project Area may contain Vulnerable wildlife, such as the Beach Stone-Curlew and Squatter Pigeon
- The Project Area is located close to an area of habitat for several animals that are listed as Endangered or Vulnerable

While there are several Special Least Concern species located in the vicinity of the Project Area, these are all migratory species and therefore are not subject to the provisions of the Significant Residual Impact Guideline, which relates to Koala, Platypus and Echidna (non-migratory Special Least Concern; Queensland Government 2014).

For Endangered and Vulnerable wildlife habitat (including essential habitat), an action is likely to have a significant impact on Endangered and Vulnerable wildlife if the impact on the habitat is likely to:

- lead to a long-term decrease in the size of a local population; or
- reduce the extent of occurrence of the species; or
- fragment an existing population; or
- result in genetically distinct populations forming as a result of habitat isolation; or
- result in invasive species that are harmful to an Endangered or Vulnerable species becoming established in the Endangered or Vulnerable species' habitat; or
- introduce disease that may cause the population to decline, or
- interfere with the recovery of the species; or
- cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species.

These matters are assessed in Section 8.

8 Assessment of impacts on threatened species

This section assesses the potential impacts of the Project on listed threatened species known, likely or with potential to occur within the Study Area. The Australian Painted Snipe and Eastern Curlew are assessed in Section 9.

8.1 *Croton magneticus*

8.1.1 Species overview

Croton magneticus is listed as Vulnerable under the NC Act.

Croton magneticus is a small deciduous tree or shrub which grows to a height of 5 m. The species is endemic to eastern Queensland and is mainly distributed between Townsville and Proserpine. The species has been recorded in eight locations: Magnetic Island, Mount Stuart, Greenvale, Mount

Blackjack, Gloucester Island, Mount Abbot (within the Study Area), Leichardt Range and Fanning River (TSSC 2013).

8.1.2 Occurrence within the Project Area

Croton magneticus is found in deciduous vine thickets (dry rainforest) on soils derived from sandstone, granite or acid agglomerate substrates, often in association with *Croton arnhemicus* and *C. phebalioides*. There is a single record from One Tree Hill in 2012, located 2.63km west of the existing Abbot Point Coal Terminal. This record was within vine forest/thicket on a hilltop and in association with *Croton arnhemicus* (Atlas of Living Australia 2015), located greater than 1 km from the Project Area.

There is no habitat suitable for *Croton magneticus* within the Project Area.

8.1.3 Potential impacts of the project on *Croton magneticus*

Section 5 provides detailed descriptions of the direct and indirect impacts relevant to the Project. Those impacts relevant to *Croton magneticus* are indirect only, as the species does not occur within the Project Area where clearing is proposed. The known record of *Croton magneticus* is well beyond the influence of direct Project impacts, and indirect impacts are also unlikely to extend this far. While there is some suitable habitat in the SEVT closer to the Project Area, such areas have been surveyed quite intensively and the species has not been found. Potential threats to the species are therefore low and include edge effects on potential habitat, associated with weeds and fire.

Weeds

Weeds are a threat to dry rainforest habitats leading to impacts through:

- Direct competition with established plants
- Restricting native plant regeneration through competition.

Parts of the Study Area are already heavily impacted by weeds and pest animals (GHD 2009). Rubber Vine (*Cryptostegia grandiflora*) is a significant problem throughout the Study Area and has been identified within the current extent of SEVT (GHD 2009).

The Project has the potential to introduce new weeds and exacerbate existing weed problems, thereby reducing the quality of habitat for *Croton magneticus*. Mitigation and management measures (as outlined in Section 6) to reduce the potential impacts of weeds should be implemented across the Project Area.

Fire

Fire is considered a general threat to dry rainforest communities and RE 11.2.3 in particular is considered to be a fire-sensitive ecosystem (Queensland Herbarium 2012).

While the moisture holding capacity of dry rainforest communities does provide some protection from fire, the impacts of fire can include:

- A reduction in the extent (total area) of the community
- Loss of biodiversity
- Loss of connectivity between patches of dry rainforest and other vegetation communities;
- Loss of soil and nutrients
- The promotion of weeds and the encroachment of exotic grasses.

Fire protection is also reduced when the buffering effect of surrounding fire-adapted native vegetation has been removed. Areas at most risk of impacts from fire include those surrounded by exotic pasture

species as these produce higher fuel loads than native pasture species. In addition, smaller patches of dry rainforest are more susceptible to fire than larger patches, due to them having a greater exposed edge length (McDonald 2010).

Management measures to reduce fire risk are recommended.

8.1.4 Mitigation and management measures

Based on the above analysis, impacts of the Project on *Croton magneticus* are expected to be minor, with indirect impacts that are temporary and short-term in nature. Pre-clearance vegetation surveys will confirm that the species is not present within areas to be cleared, prior to works commencing. The following mitigation measures are recommended to reduce potential indirect impacts.

- Areas to be cleared within the Project Area will be surveyed, marked out and authorised by an appropriate person prior to clearing to ensure no areas of habitat that may support *Croton magneticus* are inadvertently disturbed
- All high risk materials (e.g. imported soil) should be certified as weed-free prior to acceptance on-site
- Soil and fill material from weed-affected areas within the Project should not be transported to clean sites within the Project Area
- Flammable materials should be stored correctly to avoid spills
- Fire prevention measures should be employed, which may include fitting spark arresters to equipment; avoiding where practicable the use of spark-generating machinery and equipment on all total fire ban days; and restricting employee smoking to specific areas
- Development areas should be provided with adequate fire fighting equipment.

These measures are considered adequate to avoid potential impacts on *Croton magneticus*.

8.1.5 Residual impacts and outcome

There are no direct impacts on *Croton magneticus* from the Project and indirect impacts can be managed through a range of measures. Therefore, the overall impacts on *Croton magneticus* are unlikely to be significant, and offsets are not considered necessary.

8.2 Glossy Black-Cockatoo

8.2.1 Species overview

The Glossy Black-Cockatoo *Calyptorhynchus lathami* is listed as Vulnerable under the NC Act.

The species occurs mostly from the central Queensland coast to eastern Victoria, with an outlying population on Kangaroo Island in South Australia. The Abbot Point region is at the northern extent of the species' range. The Glossy Black-Cockatoo is highly dependent on the distribution of *Allocasuarina* species and is found in woodland dominated by *Allocasuarina* and in open forests where it forms a substantial middle layer (Bird Life Australia 2015).

8.2.2 Occurrence within the Project Area

Glossy Black-Cockatoos may occur sporadically in Coastal She-Oak (*Casuarina equisetifolia)* along the beach of the Study Area (CDM Smith 2013). Glossy Black-Cockatoos are likely to be infrequent visitors to the broader Study Area. There is no suitable habitat within the Project Area where clearing is proposed.

8.2.3 Potential impacts of the project on Glossy Black-Cockatoo

Section 5 provides detailed descriptions of the direct and indirect impacts relevant to the Project. Of these impacts, those that have been identified as relevant to the Glossy Black-Cockatoo are as follows:

- Reduction in habitat quality resulting from fragmentation and edge effects due to clearing of vegetation
- Mortality or injury resulting from fauna strike (vehicles), entrapment (excavation) or collisions with structures

Habitat loss

The Project will require some clearing of vegetation within the development footprint. However, there is no habitat for the Glossy Black-Cockatoo within the development footprint. The pipeline alignment travels through coastal dune systems of Abbot Point. However, these areas are generally already cleared. Clearing of vegetation for development of the Project has the potential to fragment the landscape, which may also reduce the viability of an area by increasing the occurrence and severity of 'edge effects'.

Displacement from areas that are subject to development within the Project Area is unlikely to lead to decline, as individuals are expected to readily move to other nearby areas both within the Study Area and in the region more broadly. The species is likely to be a very infrequent visitor to the Abbot Point region, and is highly mobile.

Despite this, measures to minimise vegetation clearing are still recommended, as this will minimise the level of impact and is part of good environmental practice.

Fauna mortality

The proposed development, particularly during the construction phase, will result in an increase in the number of vehicles and other machinery using the Project Area. While the likelihood of vehicle or machinery strike on this species is considered to be very low, specific measures to manage and mitigate the risk are discussed below.

8.2.4 Mitigation and management measures

Based on the above analysis, impacts from the Project on the Glossy Black-Cockatoo and its habitat are expected to be minor, reflective of the lack of habitat for the species within the Project Area and infrequent nature of sightings within the Study Area. A suite of environmental management and impact mitigation controls will be put in place for the Project. These are part of good environmental practice, with some designed specifically to address threats to MSES. The measures recommended below are part of that suite and will contribute to minimising any potential impacts on local individuals of the Glossy Black-Cockatoo.

Habitat loss

The following general requirements will be adopted for vegetation clearing:

- Restrict clearing to the minimum required footprint that enables the construction and operation of the DMCP and pipeline infrastructure
- Survey and mark areas to be cleared to ensure no additional habitats are inadvertently disturbed; and undertake progressive rehabilitation of areas that are no longer needed for on-going operations (e.g. construction laydown areas).

Fauna mortality and nest disturbance

Construction activities will involve an increase in vehicles and machinery and this may lead to an increased occurrence of mortality through vehicle strike.

The following specific measures will be implemented to address these potential impacts:

- Personnel operating vehicles in and adjacent to the Project Area should be made aware of the presence of the Glossy Black-Cockatoo and the potential for it to be encountered on the vehicle tracks, particularly those that are not formed roads and adjacent to coastal dune systems.
- Qualified personnel should conduct thorough pre-clearance surveys of the Project Area prior to vegetation clearance.

Reduced habitat quality

Pest species management has been an important part of the ongoing management of the wetland environment at Abbot Point. Whilst primarily geared towards enhancing the wetland habitat values and decreasing existing threats to shorebirds and turtle nesting, pest management measures will also benefit the Glossy Black-Cockatoo.

8.2.5 Residual impacts and outcome

As discussed above, the impacts of the Project on the Glossy Black-Cockatoo are highly unlikely. A range of mitigation measures should nonetheless be implemented to manage any minor impacts and facilitate the potential on-going use of the Project Area by the species. Offsets are not considered necessary.

8.3 Beach Stone-Curlew

8.3.1 Species overview

The Beach Stone-Curlew *Esacus magnirostris* is listed as Vulnerable in Queensland under the NC Act.

The Beach Stone-Curlew is a large wader bird found exclusively in coastal areas. Its habitat includes beaches, islands, reefs and estuaries near mangroves. Beach Stone-Curlews forage in the intertidal zone of beaches, estuaries, flats, banks and spits of sand, mud, gravel, rock and among mangroves. They are sedentary birds which occupy a home range and are active mainly at night and at sunrise and sunset. The species breeds from September to February, usually laying a single egg on the ground (sand).

8.3.2 Occurrence within the Project Area

There are recorded sightings of the Beach Stone-Curlew in the Study Area (BAAM 2012), including along Abbot Beach (CDM Smith 2013). There have been two additional records on Wildlife online since 1980. The species is unlikely to occur within the DMCP area, but is likely to be present within the coastal foreshores adjacent to the pipeline alignment.

8.3.3 Potential impacts of the project on Beach Stone-Curlew

Section 5 provides detailed descriptions of the direct and indirect impacts relevant to the Project. Of these impacts, those that have been identified as being relevant to the Beach Stone-Curlew are as follows:

- Habitat loss resulting from clearing of vegetation or smothering during fill placement
- Mortality or injury resulting from fauna strike (vehicles), entrapment (excavation) or collisions with structures

- Reduced breeding success from destruction of ground nests
- Reduction in habitat quality resulting from fragmentation and edge effects due to clearing of vegetation (weeds and pests).

Habitat loss

The Project will require some clearing of vegetation within the development footprint. However, most of this habitat is not suitable for the Beach Stone-Curlew. Clearing and disturbance most likely to affect the species or its habitat will be associated with the pipeline alignment and associated works.

Displacement of Beach Stone-Curlews from areas that are subject to development within the Project Area is likely to be temporary and associated with noise and human presence during construction and removal of the temporary pipeline.

Measures to minimise vegetation clearing and the associated loss of habitat for the Beach Stone-Curlew within the Project Area are recommended, as this will minimise the level of impact on local individuals and is part of good environmental practice.

Fauna mortality, including destruction of nests

The proposed development, particularly during the construction phase, will result in an increase in the number of vehicles and other machinery using the Project Area. The Beach Stone-Curlew is potentially susceptible to mortality during habitat clearing and as a result of vehicle and other machinery strike during construction and operation.

Beach Stone-Curlews are ground nesting and the chicks are susceptible to entrapment in excavated ground or trampling from machinery during their early development.

Specific measures to manage and mitigate the risk of Beach Stone-Curlew strike are recommended and discussed below.

Reduced habitat quality

Clearing of vegetation for development of the Project has the potential to fragment the landscape, which may also reduce the quality of habitat by increasing the occurrence and severity of 'edge effects'. Of these edge effects, an increase in the accessibility for pest animals is most likely to be an issue for the Beach Stone-Curlew.

Feral animals are a recognised threat to the Beach Stone-Curlew due to predation (by cats and dogs). Management of pest species has been identified as beneficial to the Beach Stone-Curlew.

8.3.4 Mitigation and management measures

Based on the above analysis, impacts from the Project on the Beach Stone-Curlew and its habitat are expected to be minor. Despite this, the proposed development is still expected to have some level of impact on the species. Therefore, measures to address the following identified impacts will be implemented in order to minimise the level of impact on local individuals.

Habitat loss

The Project will require some clearing of vegetation within the Project Area and this may lead to a loss of habitat for the Beach Stone-Curlew.

The following general requirements will therefore be adopted:

- Restrict clearing to the minimum required footprint that enables the construction and operation of the DMCP and pipeline infrastructure

- Survey and mark areas to be cleared to ensure no additional habitats are inadvertently disturbed; and undertake progressive rehabilitation of areas that are no longer needed for on-going operations (e.g. construction laydown areas).

Fauna mortality and nest disturbance

Construction activities will involve an increase in vehicles and machinery and this may lead to an increased occurrence of Beach Stone-Curlew mortality through direct strike or entrapment of chicks in excavated areas. Additional vehicle and machinery equipment across the Project Area and placement of fill materials may also destroy active Beach Stone-Curlew nests on the ground.

The following specific measures will be implemented to address these potential impacts:

- Personnel operating vehicles in and adjacent to the Project Area should be made aware of the presence of the Beach Stone-Curlew and the potential for it to be encountered on the vehicle tracks, particularly those that are not formed roads in coastal areas
- Qualified personnel should conduct thorough pre-clearance surveys of the Project Area prior to vegetation clearance to flush out individuals and determine the location of any nests. If nests are located, translocation of the eggs/young should be conducted by qualified personnel to a suitable nearby habitat, if appropriate.

Reduced habitat quality

Pest species management has been an important part of the ongoing management of the wetland environment at Abbot Point. Whilst primarily geared towards enhancing the wetland habitat values and decreasing existing threats to shorebirds and turtle nesting, pest management measures will also benefit the Beach Stone-Curlew.

8.3.5 Residual impacts and outcome

As discussed above, the overall impacts on the Beach Stone-Curlew are unlikely to be significant. However, a range of mitigation measures should nonetheless be implemented to manage any minor impacts and facilitate the on-going use of the Project Area by the species. Offsets are not considered necessary.

8.4 Squatter Pigeon

8.4.1 Species overview

The Squatter Pigeon *Geophaps scripta scripta* is a medium-sized ground-dwelling pigeon listed as Vulnerable under the NC Act.

The 2010 Action Plan for Australian Birds (Garnett *et al.* 2011) downgraded the species from near threatened (per the 2000 action plan, Garnett and Crowley 2000) as there have been no recent declines and the species persists at numerous sites across a broad distribution. The IUCN Red List Guidelines (BirdLife International 2012) categorise the Squatter Pigeon as of Least Concern and state that the species has a very large range and does not approach the thresholds for listing as Vulnerable for range or population size criteria.

Squatter Pigeons are usually seen in pairs or small groups foraging on the ground for grass seeds, legumes, other herbs and forbs, acacia seeds, insects and ticks (DoE 2015). Described as locally nomadic at the species level, there is no evidence to show Squatter Pigeons undertake long-distance movements (Griffoen and Clarke 2002). The species typically breeds from late winter to summer, nesting in depressions scraped into the ground and lined with grass (DoE 2015).

The Squatter Pigeon occurs on the inland slopes of the Great Dividing Range, and is distributed from the dry tropics of central Queensland to the south-east of the state. The estimated extent of occurrence is approximately 440,000 km^2 (DoE 2015). The estimated total population of the species is considered to be of low reliability as no systematic surveys have been undertaken. However in 2000, there were estimated to be approximately 40,000 breeding birds (Garnett and Crowley 2000). Given the Squatter Pigeon's ubiquitous nature and relative abundance, the population is thought to be stable at present. It is also thought this species occurs as a single, contiguous (i.e. inter-breeding) population (DoE 2015).

8.4.2 Occurrence within the Project Area

The Squatter Pigeon has been observed regularly in small numbers within the Study Area (Ecoserve 2007, GHD 2009, BAAM 2012) and an area of Essential Habitat for the species is mapped to the east of the Project Area (Figure 6). Sightings have occurred in several habitat types, including close to the existing terminal, in coastal areas near Dingo Beach and in woodland in south-western parts of the Study Area. There are no recorded sightings within the Project Area.

Within the Abbot Point region, Squatter Pigeon has been observed in five of eight fauna surveys between 2007 and 2014. These records have been distributed across the Study Area in a variety of habitats. Overall, it is considered that the Squatter Pigeon population at Abbot Point is small and does not represent a significant part of the population because:

- The species is ubiquitous in this part of its geographic range
- The species is not restricted by habitat availability in the Study Area or within the region (this is particularly the case because the species is a habitat generalist)
- The numbers recorded at Abbot Point are small and the species is neither rare nor disjunct from the broader population (which occurs across a large range)
- It is not at the edge of the range of the species and is therefore not important in terms of range expansion and recovery
- Given the above, there is no evidence to suggest the individuals found at Abbot Point are important in terms of maintaining genetic diversity.

8.4.3 Potential impacts of the Project on the Squatter Pigeon

Section 5 provides detailed descriptions of the direct and indirect impacts relevant to the Project. Of these impacts, those that have been identified as being relevant to the Squatter Pigeon are as follows:

- Habitat loss resulting from clearing of vegetation or smothering during fill placement
- Mortality or injury resulting from fauna strike (vehicles), entrapment (excavation) or collisions with structures
- Reduced breeding success from destruction of ground nests
- Reduction in habitat quality resulting from fragmentation and edge effects due to clearing of vegetation (weeds and pests).

Habitat loss

The Project will require some clearing of vegetation within the development footprint, which may lead to a loss of habitat for the Squatter Pigeon. It has been calculated that 75 ha of potential Squatter Pigeon habitat will be lost as a result of the Project. This is made up primarily of non-remnant areas in the DMCP and pipeline alignment. However some small patches of regrowth (RE 11.2.5) occur within the DMCP and RE 11.12.4a occurs along the pipeline alignment.

This loss is unlikely to be significant in relation to the Squatter Pigeon, as habitat availability does not appear to be a limiting factor for the species. Displacement from areas that are subject to development

within the Project Area is unlikely to lead to decline, as individuals are expected to readily move to other nearby areas both within the Study Area and in the region more broadly. The following factors are relevant to this discussion:

- The species has been recorded within a variety of habitats at Abbot Point and does not appear to be more associated with or restricted to areas that are subject to development
- Habitat at Abbot Point is similar to that available throughout the region
- The species is a habitat generalist, and is known to occur within both disturbed and remnant areas.

Furthermore, the number of individuals recorded at Abbot Point is considered to be relatively small and unlikely to comprise an important population of the species (BAAM 2012).

Despite this, measures to minimise vegetation clearing and the associated loss of habitat for the Squatter Pigeon within the Project Area are still recommended, as this will minimise the level of impact on local individuals and is part of good environmental practice.

Fauna mortality, including destruction of nests

The proposed development, particularly during the construction phase, will result in an increase in the number of vehicles and other machinery using the Project Area. The Squatter Pigeon is known to freeze in its position when danger approaches, making it susceptible to mortality during habitat clearing and as a result of vehicle and other machinery strike during construction and operation.

Squatter Pigeon are ground nesting and the chicks are capable of only short flights when they depart the nest (DoE 2015). Mortality or injury of chicks from entrapment in excavated ground is therefore possible.

Specific measures to manage and mitigate the risk of Squatter Pigeon strike are recommended and are discussed below.

Reduced habitat quality

Clearing of vegetation for development of the Project has the potential to fragment the landscape, which may also reduce the viability of an area by increasing the occurrence and severity of 'edge effects'. Of these edge effects, an increase in the accessibility for pest animals is most likely to be an issue for the Squatter Pigeon.

Feral animals are a recognised threat to the Squatter Pigeon due to predation (by cats and dogs) and competition for foraging resources (from species such as rabbits; DoE 2015). Management of pest species has been identified as beneficial to the Squatter Pigeon.

8.4.4 Mitigation and management measures

Based on the above analysis, impacts from the Project on the Squatter Pigeon and its habitat are expected to be minor, reflective of the species generalist nature, tolerance of disturbed areas and the availability of suitable habitat across the region. Despite this, the proposed development is still expected to have some level of impact on the Squatter Pigeon. Therefore, measures to address the following identified impacts will be implemented in order to minimise the level of impact on local individuals.

Habitat loss

The Project will require some clearing of vegetation within the Project Area and this may lead to a loss of habitat for the Squatter Pigeon.

The following general requirements will therefore be adopted:

- Restrict clearing to the minimum required footprint that enables the construction and operation of the DMCP and pipeline infrastructure
- Survey and mark areas to be cleared to ensure no additional habitats are inadvertently disturbed; and undertake progressive rehabilitation of areas that are no longer needed for on-going operations (e.g. construction laydown areas).

Fauna mortality and nest disturbance

Construction activities will involve an increase in vehicles and machinery and this may lead to an increased occurrence of Squatter Pigeon mortality through direct strike or entrapment of chicks in excavated areas. This is particularly relevant for the Squatter Pigeon due to its behavioural trait to freeze in response to danger. Additional vehicle and machinery equipment across the Project Area and placement of fill materials may also destroy active Squatter Pigeon nests on the ground.

The following specific measures will be implemented to address these potential impacts:

- Personnel operating vehicles in and adjacent to the Project Area should be made aware of the presence of the Squatter Pigeon and the potential for it to be encountered on the vehicle tracks, particularly those that are not formed roads in woodlands
- Qualified personnel should conduct thorough pre-clearance surveys of the Project Area prior to vegetation clearance to flush out individuals and determine the location of any nests. Particular attention should be given to areas of short, dry, grass tussocks and under bushes and fallen logs. If nests are located, translocation of the eggs/young should be conducted by qualified personnel to a suitable nearby habitat, if appropriate.

Reduced habitat quality

Pest species management has been an important part of the ongoing management of the wetland environment at Abbot Point. Whilst primarily geared towards enhancing the wetland habitat values and decreasing existing threats to shorebirds and turtle nesting, pest management measures will also benefit the Squatter Pigeon.

8.4.5 Residual impacts and outcome

As discussed above, the overall impacts on the Squatter Pigeon are unlikely to be significant. However, a range of mitigation measures should nonetheless be implemented to manage any minor impacts and facilitate the on-going use of the Project Area by the species. Offsets are not considered necessary.

8.5 Coastal Sheathtail Bat

8.5.1 Species overview

The Coastal Sheathtail Bat *Taphozous australis* is listed as Vulnerable in Queensland under the NC Act.

The Coastal Sheathtail Bat roosts in caves, under rock ledges, in cracks and within piles of rocks. Colonies roost together in small or large groups, depending on the size of the roosting habitat. Foraging occurs within 1 km of the ocean, across a range of habitats including sand dunes, mangroves and open eucalypt forests. Bats feed on beetles and other insects, often returning to their roost site after catching food. Occurrence along the coast of Queensland is patchy, dictated by the presence of suitable roosting habitat close to the coast.

8.5.2 Occurrence within the Project Area

Potential foraging habitat occurs includes woodlands across the Abbot Point region. This species may have potentially been recorded in a boulder pile at the base of Mt Luce, Abbot Point however a positive identification could not be confirmed from the call analysis (CDM Smith 2013). Targeted surveys for this species were undertaken by ELA in December 2014 but did not detect the species. Use of the Project Area is unlikely.

8.5.3 Potential impacts of the Project on Coastal Sheathtail Bat

Section 5 provides detailed descriptions of the direct and indirect impacts relevant to the Project. Of these impacts, those that have been identified as being relevant to the Coastal Sheathtail Bat are as follows:

- Habitat loss resulting from clearing of vegetation or smothering during fill placement
- Mortality or injury resulting from fauna strike (vehicles), entrapment (excavation) or collisions with structures

Habitat loss

The Project will require some clearing of vegetation within the development footprint, which may lead to a loss of foraging habitat for the Coastal Sheathtail Bat. This loss is unlikely to be significant, as extensive areas of suitable foraging habitat occur throughout the Abbot Point region, and these are of a higher quality than those of the Project Area.

Despite this, measures to minimise vegetation clearing and the associated loss of habitat for the Coastal Sheathtail Bat within the Project Area are still recommended, as this will minimise the level of impact on local individuals and is part of good environmental practice.

Fauna mortality, including destruction of nests

The proposed development, particularly during the construction phase, will result in an increase in the number of vehicles and other machinery using the Project Area. The Coastal Sheathtail Bat may be susceptible to mortality from vehicle or machinery strike during habitat clearing, particularly if such works occur at night.

Specific measures to manage and mitigate the risk of Coastal Sheathtail Bat strike are recommended and are discussed below.

8.5.4 Mitigation and management measures

Based on the above analysis, impacts from the Project on the Coastal Sheathtail Bat and its habitat are expected to be minor. Despite this, the proposed development is still expected to have some level of impact on the species. Therefore, measures to address the following identified impacts will be implemented in order to minimise the level of impact on local individuals.

Habitat loss

The Project will require some clearing of vegetation within the Project Area and this may lead to a loss of foraging habitat for the Coastal Sheathtail Bat.

The following general requirements will therefore be adopted:

- Restrict clearing to the minimum required footprint that enables the construction and operation of the DMCP and pipeline infrastructure

- Survey and mark areas to be cleared to ensure no additional habitats are inadvertently disturbed; and undertake progressive rehabilitation of areas that are no longer needed for on-going operations (e.g. construction laydown areas).

Fauna mortality and nest disturbance

Construction activities will involve an increase in vehicles and machinery and this may lead to an increased occurrence of Coastal Sheathtail Bat mortality through direct strike. This is particularly relevant for night time activities involving works under lights. Personnel operating vehicles in and adjacent to the Project Area should be made aware of the presence of the Coastal Sheathtail Bat and the potential for it to be foraging around machinery at night.

8.5.5 Residual impacts and outcome

As discussed above, the overall impacts on the Coastal Sheathtail Bat are unlikely to be significant. Offsets are not considered necessary.

8.6 Special Least Concern Non-Wetland Birds

8.6.1 Species overview and occurrence

There are several species listed as Special Least Concern under the NC Act located in the vicinity of the Project Area. These are migratory birds and therefore are not subject to the provisions of the Significant Residual Impact Guideline, which relates to Koala, Platypus and Echidna (non-migratory Special Least Concern; Queensland Government 2014). However, potential impacts of the Project on these species have been considered as a group as part of sound environmental management practice.

Based on an assessment of the likelihood of species occurring in the vicinity of the Project Area (Table 6), non-wetland Special Least Concern birds in the region may include the Fork-tailed Swift, Cicadabird, Oriental Cuckoo, Rainbow Bee-eater, Satin Flycatcher and Rufous Fantail. Such species are likely to inhabit woodland and coastal areas within and adjacent to the Project Area. The ecological characteristics of each species and their potential to occur within and adjacent to the Project Area vary according to a range of factors (e.g. season, migration patterns, geographic range).

8.6.2 Potential impacts of the Project

Section 5 provides detailed descriptions of the direct and indirect impacts relevant to the Project. Of these impacts, those that have been identified as being relevant to Special Least Concern (migratory) birds are as follows:

- Habitat loss resulting from clearing of vegetation or smothering during fill placement
- Mortality or injury resulting from fauna strike (vehicles), entrapment (excavation) or collisions with structures
- Reduced breeding success from destruction of nests
- Reduction in habitat quality resulting from fragmentation and edge effects due to clearing of vegetation (weeds and pests).

Habitat loss

The Project will require some clearing of vegetation within the development footprint, which may lead to a loss of habitat for Special Least Concern birds. However, areas to be disturbed are comprised primarily of non-remnant areas in the DMCP and pipeline alignment. Some small patches of regrowth (RE 11.2.5) occur within the DMCP, and RE 11.12.4a occurs along a small section of the pipeline alignment.

Displacement from areas that are subject to development within the Project Area is unlikely to lead to decline, as individuals are expected to readily move to other nearby areas both within the Study Area and in the region more broadly.

Despite this, measures to minimise vegetation clearing and the associated loss of habitat for migratory non-wetland birds within the Project Area are still recommended, as this will minimise the level of impact on local individuals and is part of good environmental practice.

Fauna mortality, including destruction of nests

Construction activities will involve an increase in vehicles and machinery and this may lead to an increased occurrence of bird mortality through direct strike, disturbance of nests or entrapment of chicks in excavated areas.

Qualified personnel should conduct thorough pre-clearance surveys of the Project Area prior to vegetation clearance to flush out individuals and determine the location of any nests. If nests are located, translocation of the eggs/young should be conducted by qualified personnel to a suitable nearby habitat, if appropriate.

Reduced habitat quality

Clearing of vegetation for development of the Project has the potential to fragment the landscape, which may also reduce the viability of an area by increasing the occurrence and severity of 'edge effects'. This may lead to an increase in the accessibility for pest animals or an increase in weeds, reducing the quality of habitat.

8.6.3 Mitigation and management measures

A suite of environmental management and impact mitigation controls will be put in place for the Project to minimise impacts on Special Least Concern non-wetland birds. These are part of good environmental practice, with some designed specifically to address threats to MSES. The measures recommended below are part of that suite and will contribute to minimising any potential impacts on local individuals of the various migratory bird species (non-wetland).

Habitat loss

The following general requirements will be adopted for vegetation clearing:

- Restrict clearing to the minimum required footprint that enables the construction and operation of the DMCP and pipeline infrastructure
- Survey and mark areas to be cleared to ensure no additional habitats are inadvertently disturbed; and undertake progressive rehabilitation of areas that are no longer needed for on-going operations (e.g. construction laydown areas).

Fauna mortality and nest disturbance

Construction activities will involve an increase in vehicles and machinery and this may lead to an increased occurrence of mortality through vehicle strike. Personnel operating vehicles in and adjacent to the Project Area should be made aware of the presence of fauna and the potential for vehicle strike, with vehicle speed limits and access routes adhered to. Additionally, qualified personnel should conduct thorough pre-clearance surveys of the Project Area prior to vegetation clearance.

Reduced habitat quality

Pest species management has been an important part of the ongoing management of the wetland environment at Abbot Point. Whilst primarily geared towards enhancing the wetland habitat values and decreasing existing threats to shorebirds and turtle nesting, pest management measures will also benefit non-wetland bird species.

8.6.4 Residual impacts and outcome

The overall impacts on Special Least Concern non-wetland birds are unlikely to be significant. However, a range of mitigation measures should nonetheless be implemented to manage any minor impacts and facilitate the on-going use of the Project Area by the species. Offsets are not considered necessary.

9 Assessment of impacts on wetland birds

This section assesses the potential impacts of the Project on birds that are known, likely, or have the potential to utilise the Caley Valley Wetland adjacent to the Project Area, including:

- Shorebirds (both migratory and resident)
- EVNT wetland birds, namely the Eastern Curlew (Near Threatened) and Australian Painted Snipe (Vulnerable)
- Other wetland birds listed as Special Least Concern, including the Australian Reed Warbler, Cattle Egret, Eastern Great Egret, White-winged Tern, Eastern Reef Egret, Caspian Tern, Osprey, Glossy Ibis, Common Tern and Little Tern.

As the above-mentioned birds have similar wetland-dependent ecological requirements, they have been considered together in this assessment. Where appropriate, a more detailed assessment has been included for the Eastern Curlew and Australian Painted Snipe, due to their conservation status under the NC Act. A comprehensive assessment of Project impacts on migratory shorebirds has also been completed separately to address the requirements of the EPBC Act (ELA 2015b).

In addition to assessing impacts of the Project on listed MSES, this section provides information relevant to assessment criteria for the WPA (see Section 7.2), as follows:

- Determine whether the Project will have a significant residual impact by seriously affecting the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland (Significant Residual Impact Criterion for Wetlands and Watercourses)
- Ensure development involving the clearing of vegetation protects the biodiversity, ecological values and processes, and hydrological functioning of a wetland in WPA, including water quality values, aquatic habitat values, terrestrial habitat values and usage of the site by native wetland fauna species or communities (PO7 of WPA State Code).

9.1 Overview of ecology

9.1.1 Shorebirds

Thirty-six migratory shorebird species use the East Asian-Australasian flyway (listed as Special Least Concern under the NC Act). Each year these birds breed in the northern hemisphere and migrate south to Australia and New Zealand where they feed intensively, building up energy reserves to fuel their northern migration and breeding (Clemens *et al.* 2008).

The East Asian-Australasian (EAA) flyway extends from Siberia and Alaska through east and south-east Asia (most predominately China and Korea) to Australia and New Zealand. The EAA flyway is utilised by at least 5 million migratory shorebirds (Gosbel *et al*. 2004).

Migratory species using the EAA flyway undertake annual migrations of thousands of kilometres between their southern feeding areas and breeding areas in the northern hemisphere. Species have been recorded travelling over 10,000 km non-stop, with total return distances from northern breeding grounds to southern feeding areas exceeding 29,000 km (Knowler 2008).

Northward migration to the breeding grounds typically takes place from March to early June. The birds arrive for the Arctic breeding season and must breed and fledge offspring within a six to seven week window of favourable summer climatic conditions. The return migration to non-breeding or feeding areas occurs from July to October. Most migratory shorebird species have delayed maturity, and will skip their first northerly migration by staying in Australia. The young of some species will not return to breed until they are two or more years old. These immature birds may undertake partial migration from southern to northern areas of Australia.

During migration, birds move through staging areas. Staging habitat is defined as areas that meet shorebird feeding and roosting requirements during migration. Shorebirds exhibit strong site fidelity to preferred feeding and roosting areas and do not readily use alternative areas (Tudor, 2002).

Australia provides important feeding habitat for migratory shorebirds of the EAA flyway. The migratory shorebirds that regularly visit Australia have a wide variety of habitat requirements, spatial distributions and patterns of habitat use (Marchant and Higgins 1993). Migratory shorebirds start arriving in northern Australia in August, and then disperse throughout the country. Migratory shorebird habitat in Australia provides:

- Feeding areas with abundant food resources. Physical characteristics of feeding areas primarily consist of intertidal mudflats, sandy beaches, salt pans and rocky intertidal areas. The characteristics of high value feeding areas include large populations of invertebrates, low disturbance and un-degraded soils. Several species also readily feed in wet or moist substrates on coastal or inland freshwater wetlands.
- Roosting areas where migratory shorebirds can sleep and preen during non-feeding times. Roosting areas in proximity to feeding areas reduce energetic costs and maintain positive energy flow. Physical characteristics of roosting areas include little or no vegetation on open ground that remains above water during high tides (Tudor, 2002).

Queensland has significant ephemeral wetland areas both on and near the coast and inland. Ephemeral wetland environments are characterised by short, infrequent, and unpredictable water availability, which determines if and when birds are present.

The importance of ephemeral wetlands as shorebird habitat is due largely to the fact that species that utilise ephemeral wetlands have adapted to annual variation in water conditions, and are known for their flexible annual distribution patterns.

9.1.2 EVNT Species – Eastern Curlew and Australian Painted Snipe

Eastern Curlew

The Eastern Curlew is listed as Near Threatened under the NC Act. In Australia, habitat includes intertidal mud and sand flats for feeding, and sand bars and spits for roosting at high tide. In Australia,

threats to the species include human disturbance, habitat degradation, hydrological changes and invasive plants (TSSC 2015). Disturbance to pre-migratory eastern curlews can affect their ability to migrate to the northern hemisphere to breed during the Australian winter.

Surveys during 2012 recorded low numbers, except during December 2012 when 34 individuals were counted at high tide within the Open Pan section of the wetland 4 km west of the Project Area. The species prefers estuarine environments within the wetland and has not been observed immediately adjacent to the Project Area. BMT WBM (2012) noted individuals from a 2006 survey roosting on Dingo Beach 500 m from the Project Area.

Habitat preferences of the Eastern Curlew for areas located away from the Project Area make the species of low susceptibility to indirect Project impacts. Oldland *et al*. (2009) suggest the Eastern Curlew is more sensitive to human-related disturbance than other shorebird species, with a minimum buffer distance of 126 m from people recommended. All sightings of Eastern Curlew at the wetland have been recorded at distances of 500 m from the Project Area.

Australian Painted Snipe

The Australian Painted Snipe is listed as Vulnerable under the NC Act. The species occurs in shallow freshwater and brackish wetlands, and is most common in eastern Australia. The species has undergone a severe decline since the 1950s, and in particular during the past 26 years, due to loss and degradation of wetland habitats. Specific threats to habitats include changes to hydrology affecting water depth and agricultural modifications associated with cattle trampling, nutrient enrichment and increased cropping (TSSC 2013).

Abbot Point is considered important habitat for the Australian Painted Snipe. The species has been found in unusually high numbers in 2012, representing 1.8% of the total population of the species. The three Australian Painted Snipe recorded in the BAAM (2012) wet season survey were flushed in short and relatively sparsely vegetated edge habitat flooded with shallow fresh water on the southern fringe of the Closed Marsh Zone. In the BAAM (2012) dry season surveys, 24 individuals were observed equally in the Open and Closed Marsh zones of the wetland. It is notable that within the Open and Closed Marsh zones the Australian Painted Snipe was located very broadly across all areas, from the northern most section of the Open Marsh to the very southern edge of the Closed Marsh.

BAAM (2012) recorded that the species was present in family groups during the June survey. The only group observed well prior to flushing included two juvenile birds that were noticeably smaller than the attendant adult, suggesting recent breeding activity, most likely on the wetland itself (although breeding elsewhere and subsequent movement to the wetland cannot be discounted). Australian Painted Snipe are known to breed in the Caley Valley Wetland; a clutch of eggs collected on 9th April 1978 in the Caley Valley Wetland is catalogued in the Australian National Wildlife Collection (Atlas of Living Australia 2012). The breeding season at Abbot Point is likely to extend from February to September, with nesting most likely over the period from March to May.

The location and numbers of the Australian Painted Snipe found in the Study Area are presented in Section 9.4.2. Unlike other species, some precise record locations are available (rather than transect locations). These data indicate there is habitat utilised by the Australian Painted Snipe located adjacent to the Project Area, along the eastern fringe of the wetland. The species is therefore included in the assessment of indirect impacts from the Project. The species utilises salt couch on the margins of wet areas, unlike most migratory shorebirds.

9.1.3 Other Special Least Concern or notable wetland birds

Table 11 provides a list of the migratory bird species (non-shorebird) that have been identified as known, likely or with the potential to occur within the wetland habitats adjacent to the Project Area, and a summary of their ecological requirements. They include raptors, terns, egrets, flycatchers, monarchs and bee-eaters, and are listed as Special Least Concern under the NC Act.

Table 11 Ecology overview of other migratory birds

Scientific name	Common name	Species' ecology overview
Apus pacificus	Fork-tailed Swift	Non-breeding visitor Broad distribution across Australia Almost exclusively aerial No known threats in Australia (DoE 2015b)
Ardea modesta	Eastern Great Egret	Wide spread in Australia in a variety of wetland habitats Australian population estimated at 25,000 to 100,000 Most important populations occur in the northern territory (DoE 2015b)
Ardea ibis	Cattle Egret	Highly mobile, wide ranging migratory species that has been recorded throughout most of Australia Population for Australia, New Guinea and New Zealand is estimated at 100,000 birds (DoE 2015b) Found in open, grassy areas, such as pastures, meadows, marshes, flood plains and swamps Has a preference for freshwater and is rarely found near marine environments. A diurnal feeder which commonly associates with native grazing mammals or domesticated livestock (and may follow farm machinery to capture disturbed prey (Birdlife International 2012)
Chlidonias leucopterus	White-winged Black Tern	Non-breeding migrant to Australia 23,200 km² area of occupancy in Australia Populations vary greatly from year to year Forages aerially (DoE 2015b)
Egretta sacra	Eastern Reef Egret	Occurs along most of Australia's coastline in rocky shores, coral islands and reefs, but is most common on the Queensland coast (Birdlife Australia 2012) Highly territorial species with an extensive range No known population estimates (Heron Conservation 2012)
Haliaeetus leucogaster	White-Bellied Sea Eagle	Occurs along Australia's coastline, including offshore islands, 10 – 30% of the world population occurs in Australia Widespread and relatively common within the distribution but breeds in

Scientific name	Common name	Species' ecology overview
		a small part of the distribution No estimate of the area of occupancy is available, and changes in the area (DoE 2015b)
Hydroprogne caspia	Caspian Tern	While found in North America, Europe, Africa, Asia, Australia and New Zealand the Caspian Tern does not generally migrate outside its resident continent Total global population estimated to be 240,000 to 420,000 Widespread in Australia using both coastal and inland habitats Breeds on a variety of sites including low islands, cays, spits, banks, ridges, beaches of sand or shell, terrestrial wetlands and stony or rocky islets or banks. Nests may be in the open, or among low or sparse vegetation Urban encroachment is the primary threat (DoE 2015b)
Merops omatus	Rainbow Bee-Eater	Widely distributed throughout Australia and eastern Indonesia Occurs across most of mainland Australia; although extent of occurrence and areas of occupancy are not well understood The total Australian population size has not been estimated although it is thought to be reasonably large based on reporting rates (over 30,000 recorded sightings since 1998) Usually occurs in cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water Feeds on insects and less commonly earthworms, spiders and tadpoles Primary threat in north eastern Australia is the cane toad which feeds on eggs and nestlings and displaces nesting birds (DoE 2015b)
Monarcha melanopsis	Black-faced Monarch	Winters in southern New Guinea and migrates to eastern Australia to breed Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies and in more open woodland when migrating Feeds on insects (foraging and on the wing) (Birdlife Australia 2012)
Myiagra cyanoleuca	Satin Flycatcher	Inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, will use coastal areas on migration flights (DoE 2015b) Occurs along the east coast of Australia and PNG from far northern Queensland to Tasmania, including south-eastern South Australia. Not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant (Birdlife Australia 2012)
Pandion cristatus	Eastern Osprey	Global range includes Indonesia, Philippines, Palau Islands, New

Scientific name	Common name	Species' ecology overview
		Guinea, Solomon Islands, New Caledonia and Australia Global population size not precisely known, but estimated to number less than 212,000 pairs Occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands Medium-sized raptor that feeds on fish rarely taking molluscs, crustaceans, insects, reptiles, birds or mammals Considered to be moderately common, particularly in northern Australia Major threats nationally and internationally include loss, degradation and alteration of habitat for urban or tourism development. (DoE 2015b)
Plegadis falcinellus	Glossy Ibis	Highly nomadic species with an extremely large range Shows a preference for marshes at the edges of lakes and rivers (as well as lagoons, flood-plains, wet meadows swamps, reservoirs sewage ponds, and irrigated cultivation). It less often occurs in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons Population in Australia is estimated to be approximately 12% of the species' total population of 1,200,000 – 3,200,000 worldwide. (DoE 2015b)
Rhipidura rufifrons	Rufous Fantail	Has a wide range in the south-west Pacific, occurring in Indonesia, the Northern Mariana Islands the Federated States of Micronesia, Papua New Guinea, the Solomon Islands and Australia The species is common and widely distributed especially throughout north eastern Australia Inhabits rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas Feeds on insects (Birdlife Australia 2012)
Sterna albifrons	Little Tern	Widely but patchily spread through Europe, southern, eastern and south-eastern Asia, Indonesia and Australasia Global population estimates range from 140,000 to 410,000 birds Australia has both breeding and non-breeding populations. Breeding sites are widely distributed from north-western Western Australia, around the northern and eastern Australian coasts to south-eastern Australia Australia has an estimated 10% of the global population Susceptible to breeding failure due to ground nesting Inhabits sheltered coastal areas feeding primarily on small fish (DoE 2015b)
Sterna hirundo	Common Tern	Globally widespread throughout Europe and Asia Global population thought to be stable and estimated at 1,100,000 – 4,500,000

Scientific name	Common name	Species' ecology overview
		Non-breeding migrant to Australia, where it is mainly found along the eastern coast although their distribution is sparse from the Torres Strait south to Rockhampton Australian percentage of global population is not known but densities of up to 35,000 have been found in single sites on the north Queensland coast The species is marine, pelagic and coastal (DoE 2015b)
Thalasseus bengalensis	Lesser Crested Tern	Unevenly distributed from Australia to the Persian Gulf Global population estimated at 180,000 to 210,000 Breeds in subtropical coastal parts of the world mainly from the Red Sea across the Indian Ocean to the western Pacific, and Australia, (Borg, J 2012) Australian birds are thought to be sedentary, but other populations are migratory Inhabits tropical and subtropical sandy and coral coasts and estuaries, breeding on low-lying offshore islands, coral flats, sandbanks and flat sandy beaches, (foraging in the surf and over offshore waters Breeds in large dense colonies of up to 20,000 pairs. Gregarious throughout the year, foraging in single or mixed-species flocks of up to 400 individuals Diet consists predominantly of small pelagic fish and shrimps The overall population trend appears to be stable, although some details of this species' movements are poorly known (Birdlife International 2012)

Additionally, waterfowl such as ducks, geese and swans can be extremely abundant in the main open water wetland area during the wet season, with hundreds of individuals recorded (ELA 2014a, BMT WBM 2012). The wetlands provide one of Queensland's largest and most northerly coastal nesting areas for the Black Swan *Cygnus atratus* (Least Concern under the NC Act; BMT WBM 2012).

9.2 Potential impacts of the Project on wetland birds

Section 5 provides detailed descriptions of the direct and indirect impacts relevant to the Project. Of these impacts, those that have been identified as being relevant to wetland birds are as follows:

- Mortality or injury resulting from fauna strike (vehicles), entrapment (excavation) or collisions with structures
- Indirect disturbance associated with:
    - Construction noise
    - Dust
    - Increased human activity
    - Lighting
    - Changes stormwater runoff regime
    - Changes to the groundwater regime

9.2.1 Mortality or injury

The proposed development, particularly during the construction phase, will result in an increase in the number of vehicles and other machinery using the project area. Vehicles and large structures have the potential to increase bird mortality through direct strikes.

The risk of raised mortality through wetland birds striking structures is considered to be minor given that Abbot Point is used by migratory birds for feeding and roosting rather than as an EAA flyway staging or flyover area.

While the risk of vehicle strike is also considered low, there is increased potential for this to occur during construction when vehicles and machinery may be operating within and around habitat areas. Management of this potential impact is therefore recommended.

The Project design identifies the use of excavation to establish the dredged material ponds. Entrapment in open excavations may pose a risk to injured birds and other fauna.

Specific measures to manage and mitigate the risk of wetland bird strike are recommended and are discussed below.

9.2.2 Construction noise

Increased noise associated with construction within the Project Area has the potential to cause localised shifting of noise-sensitive species and individuals away from the sources of noise, thereby disrupting feeding, roosting and nesting. Studies of wetland bird responses to various types of noise disturbance indicate that the following key thresholds for potential impacts on wetland birds would apply at Abbot Point (SLR 2012; SLR 2015):

- 60 dBA for single noise events
- 65 dBA for steady continuous noise.

These criteria are general in nature, and site specific factors may contribute to higher or lower criteria under certain circumstances. For example, Hicks *et al.* (1987) found that Sooty Terns and Common Noddies on Michaelmas Cay in the GBR were far more likely to take flight from seaplanes that were taking off than those that were landing. Generally foraging birds show a greater tolerance to noise than roosting or nesting birds. For an ongoing construction project, avoidance of otherwise suitable foraging, roosting or nesting habitat is a potential mode of disturbance, which could lead to overcrowding in alternative habitats or reduced foraging efficiency.

SLR (2015) modelled the predicted distribution of cumulative noise (which includes that produced by existing operations at T1) under three different weather conditions (neutral, inversion and inversion with a south east wind) for seven stages of the Project.

These stages and their relevant noise criterion for wetland bird disturbance are summarised below:

- Topsoil stripping and stockpiling (60 dBA LAmax)
- Embankment subgrade preparation (60 dBA LAmax)
- Embankment construction (60 dBA LAmax)
- Pond liner installation (65 dBA LAeq)
- Dredging of the seabed (65 dBA LAeq)
- Management of dredged material in the DMCP (60 dBA LAmax)
- Post-dredging management of the DMCP (60 dBA LAmax)

The results of noise modelling indicate that:

- noise exceeding the criteria for wetland bird disturbance will extend into habitats of the Caley Valley Wetland for some Project stages as summarised in Table 12 and presented in Figure 14 to Figure 20
- there was little variability predicted in the distribution of noise contours in response to different weather conditions.

For each modelled Project stage, a single contour was adapted from the three weather conditions modelled, with the selected contour being that which had the maximum overlap with the wetland. This approach provided an estimate of the maximum extent of noise where disturbance is anticipated under a variety of weather conditions. While this method will overestimate the area affected by noise at any given point in time, changes in weather conditions can occur rapidly (in less than an hour) and the response of wetland birds to changes in the noise regime from varying weather conditions may take longer (days or weeks). Such a conservative approach is also most appropriate for the purpose impact assessment.

Table 12 Summary of the area of wetland habitat for wetland birds enclosed by the modelled 60/65 dBA contour for various stages of the Project's construction and operations

Project Stage	Snipes (including Australian Painted Snipe) Predicted area of wetland habitat enclosed by 60 dBA LAmax or 65 dBA LAeq contour (ha)[1]	Other migratory shorebirds Predicted area of wetland habitat (excluding salt couch) enclosed by 60 dBA LAmax or 65 dBA LAeq contour (ha)[2]
Topsoil stripping and stockpiling	21.2	14.9
Embankment subgrade preparation	21.9	15.0
Embankment construction	16.0	10.0
Pond liner installation	0.0	0.0
Dredging of the sea bed	0.0	0.0
Management of dredged material in the DMCP	12.2	6.4
Post dredging management of the DMCP	1.7	0.5

[1] Relevant to assessment of impacts on Latham's Snipe and Australian Painted Snipe. These species may utilise salt couch on the margins of wet areas.

[2] Relevant to assessment of impacts on other migratory shorebirds, for which salt couch does not represent important habitat. The mixed salt couch and samphire community has been included as habitat.

Construction noise above the criteria at which disturbance of wetland birds may be expected was predicted to extend into the wetland for construction phases of the Project and for the management of dredged material during and after dredging. Noise levels above the criteria were not predicted to extend into the wetland during pond liner installation and dredging stages of the Project.

Construction and management stages of the Project have the potential to impact on wetland bird, behaviour in a small part of the wetland (up to 0.4% of wetland area) through localised shifting of noise-sensitive species and individuals away from the sources of noise. Further assessment of the potential

for such impacts is discussed for EVNT shorebird species in Section 9.4, taking into account species-specific ecological requirements and habitat utilisation in the affected parts of the wetland.

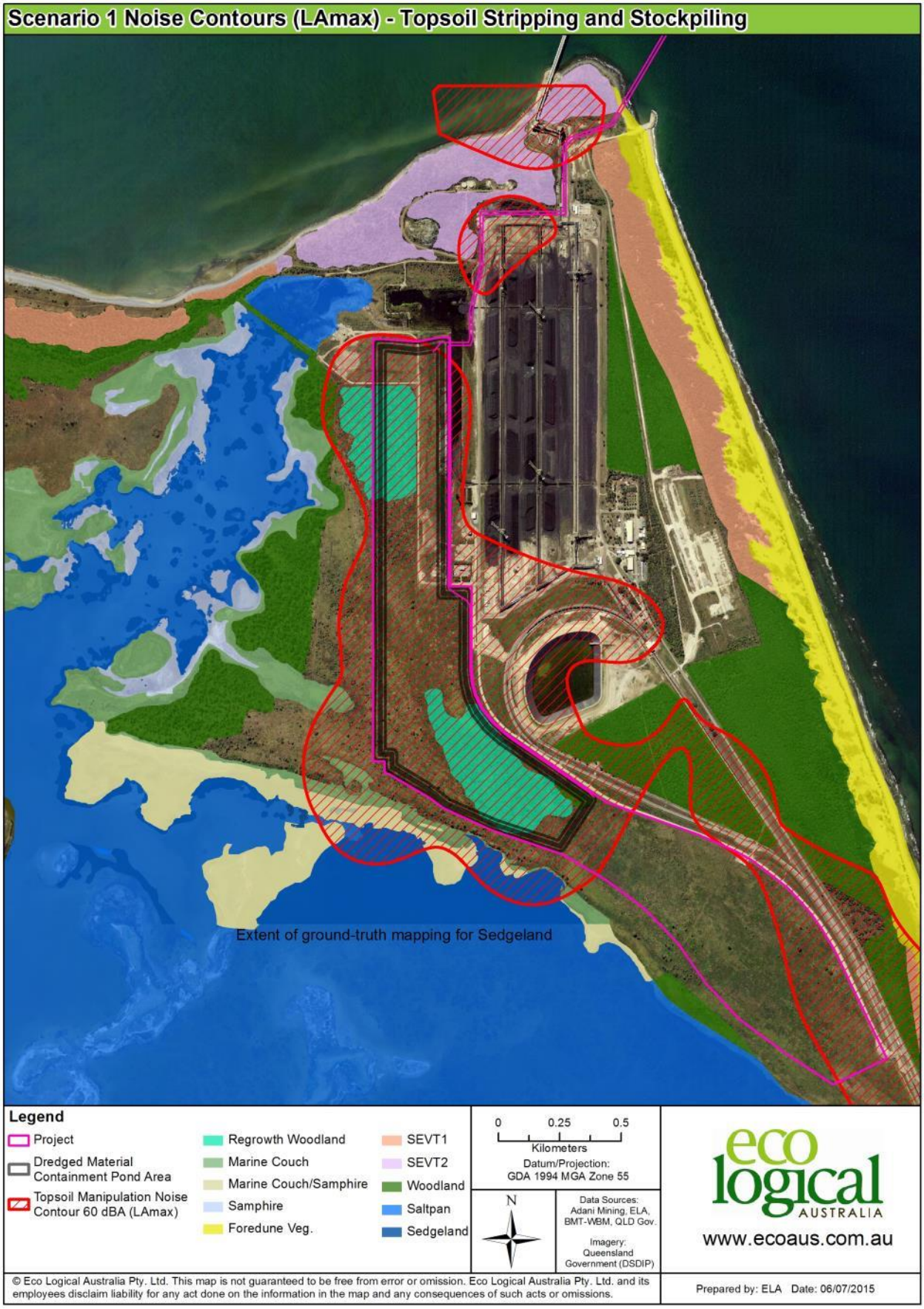

Figure 14 Map showing location of wetland habitat enclosed by the 60 dBA LAmax contour for topsoil stripping and stockpiling

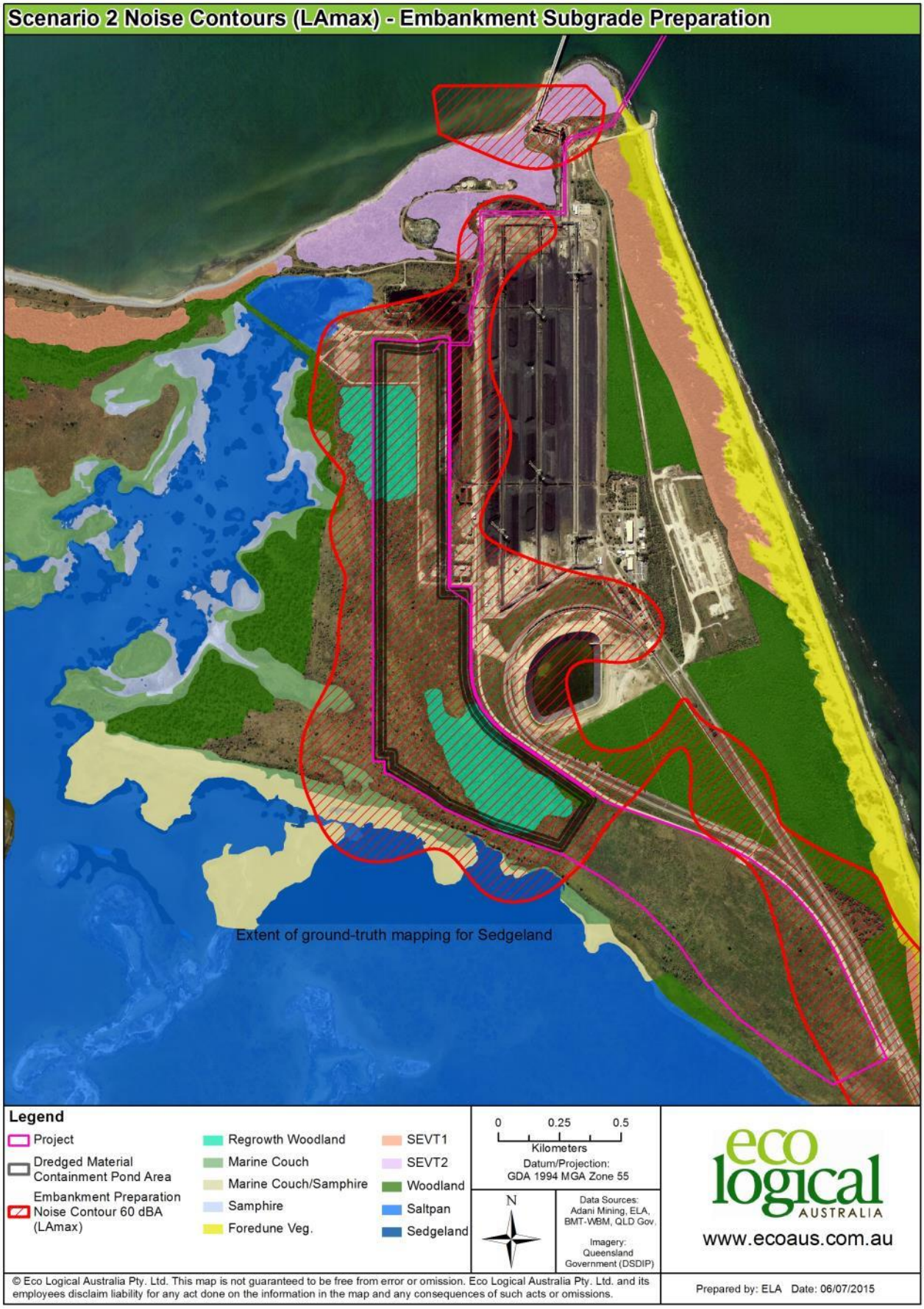

Figure 15 Map showing location of wetland habitat enclosed by the 60 dBA LAmax contour for embankment subgrade preparation

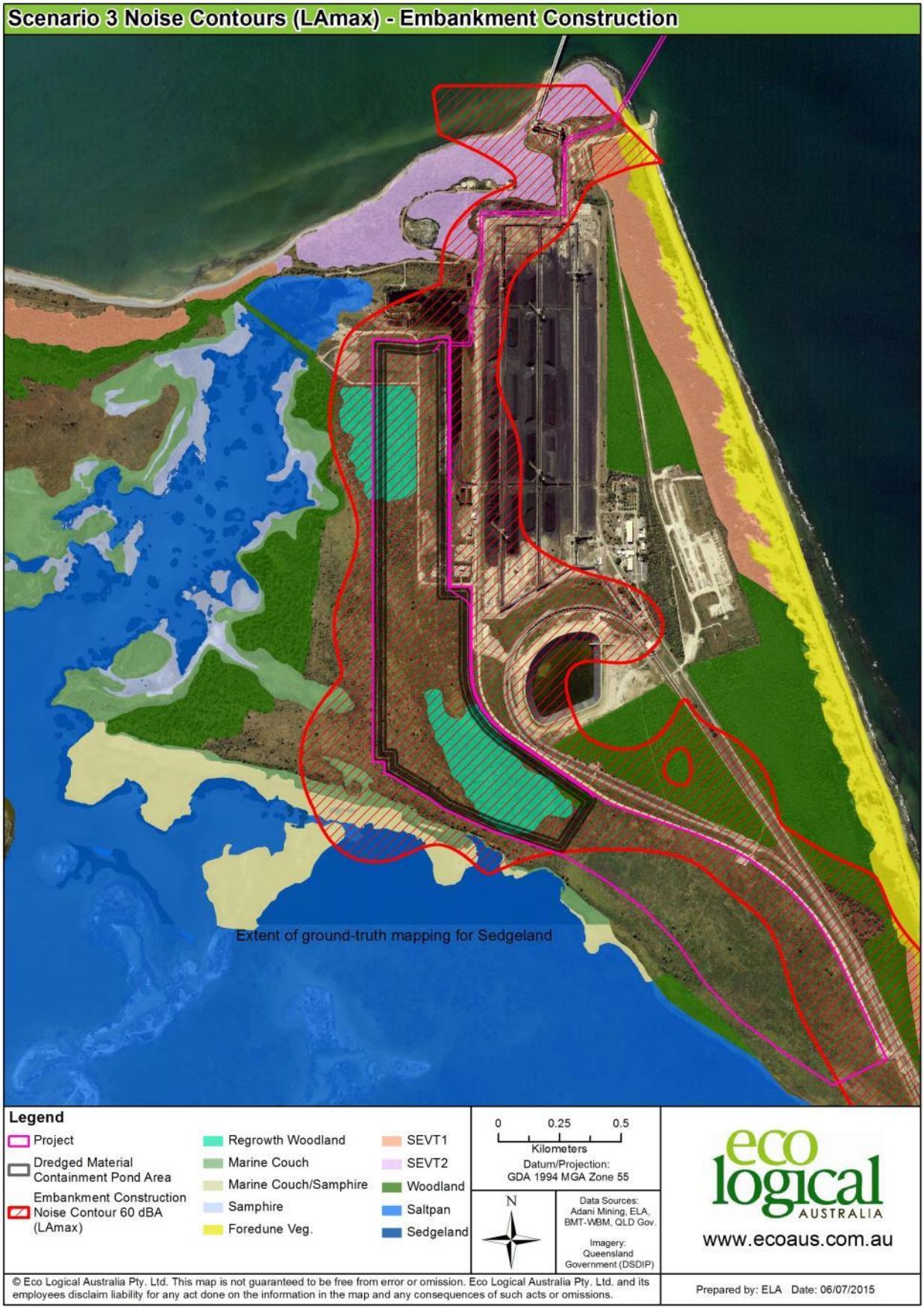

Figure 16 Map showing location of wetland habitat enclosed by the 60 dBA LAmax contour for embankment construction

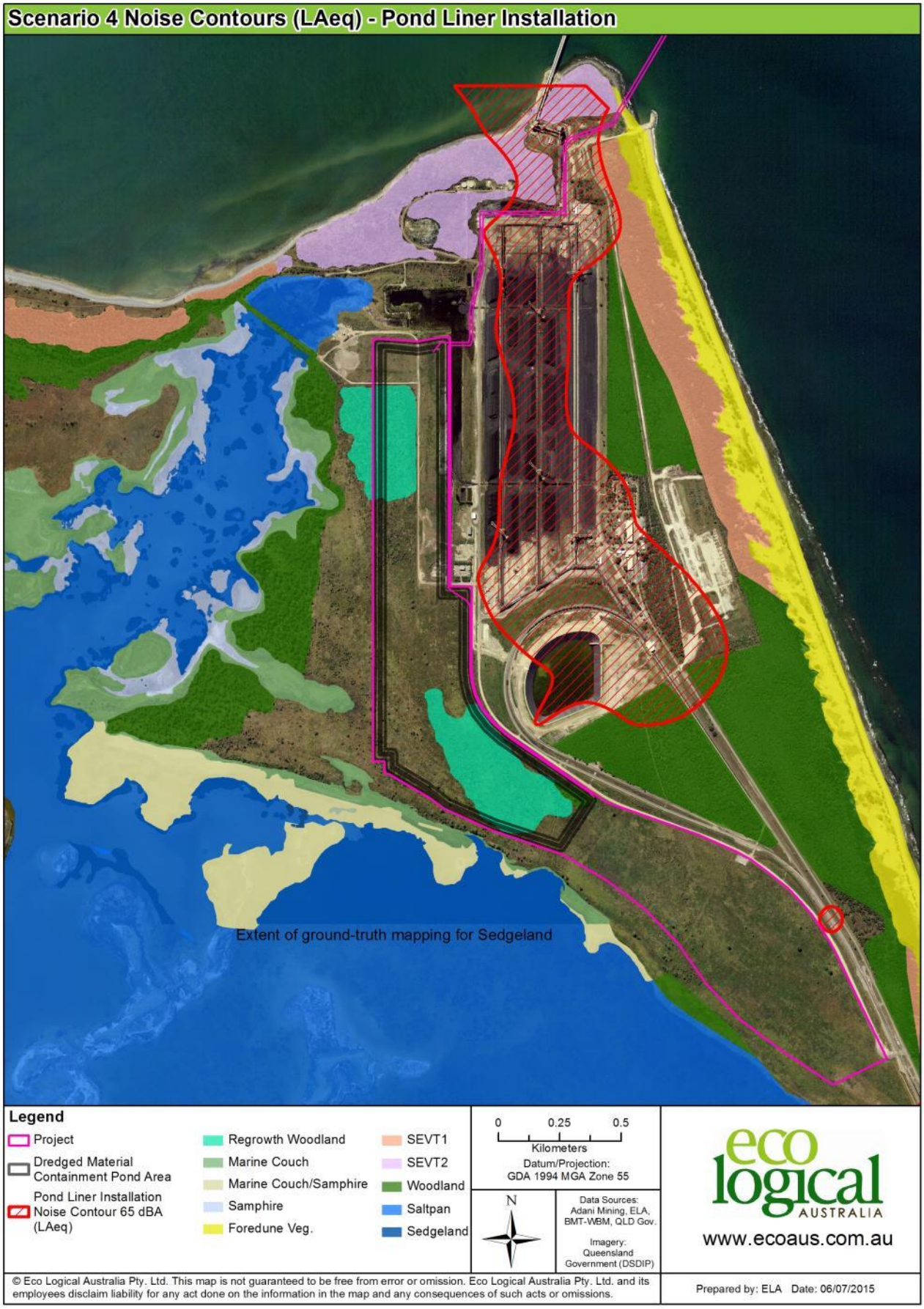

Figure 17 Map showing location of wetland habitat enclosed by the 65 dBA LAeq contour for pond liner installation

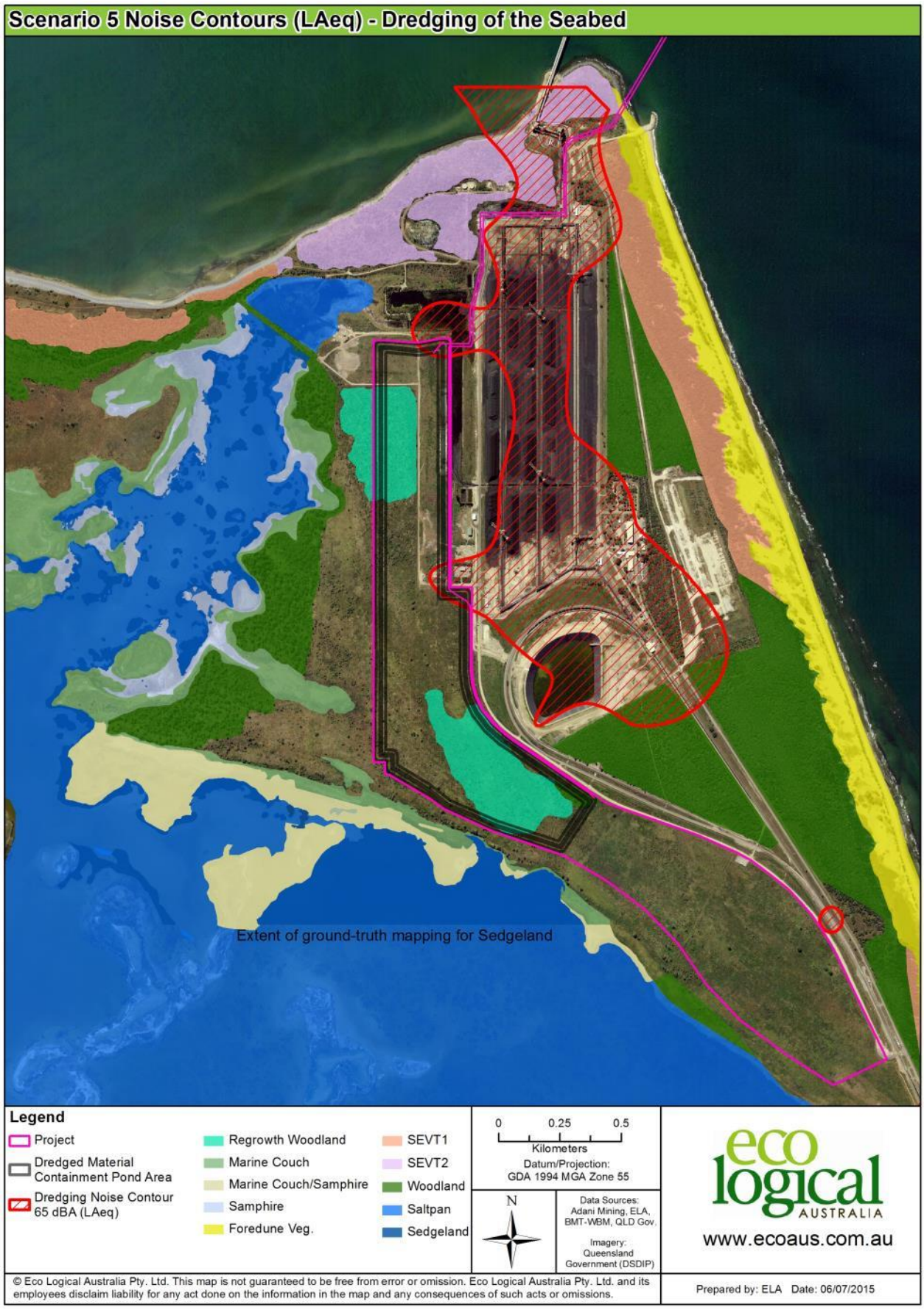

Figure 18 Map showing location of wetland habitat enclosed by the 65 dBA LAeq contour for dredging of the seabed

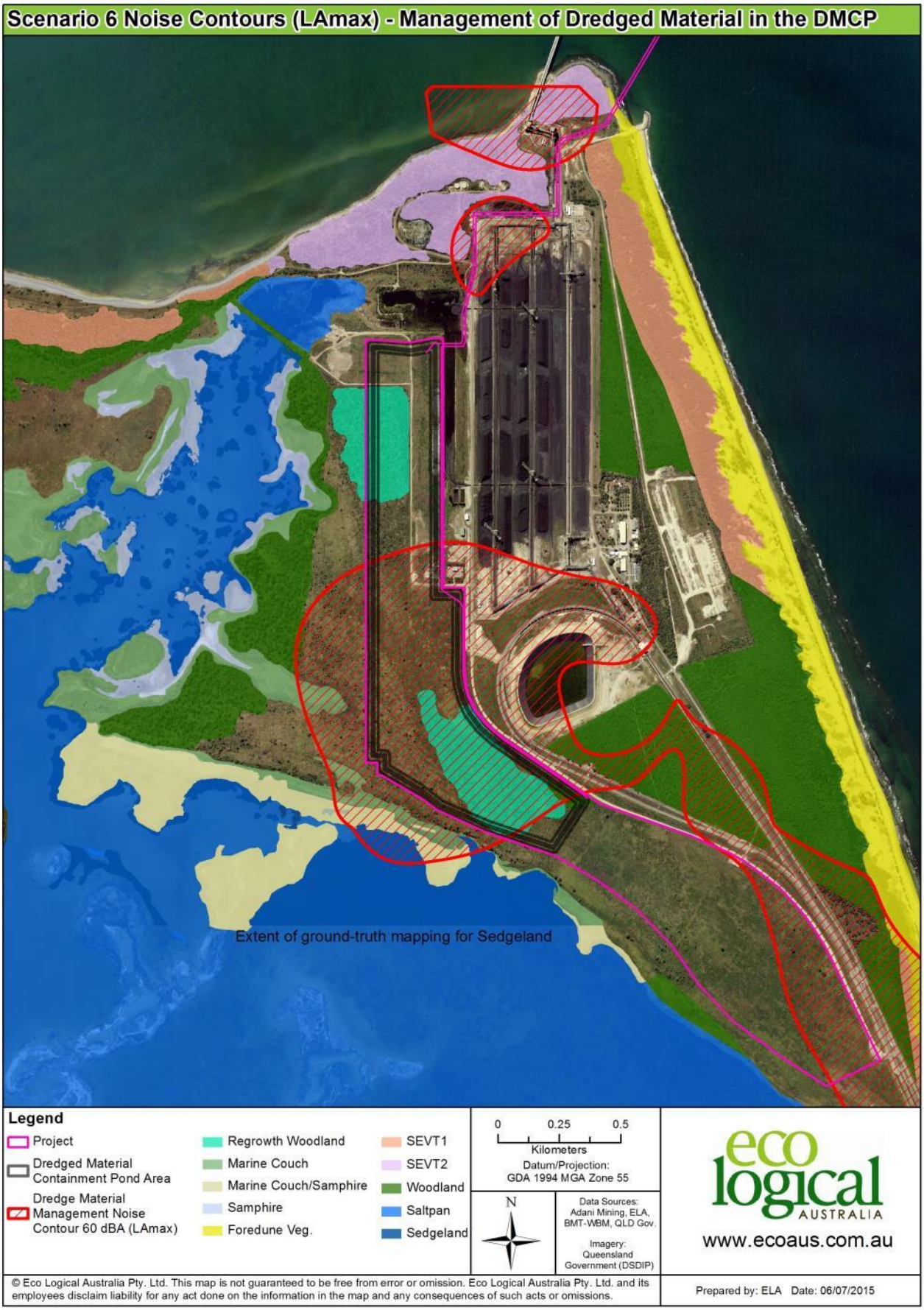

Figure 19 Map showing location of wetland habitat enclosed by the 60 dBA LAmax contour for management of dredged material within the DMCP

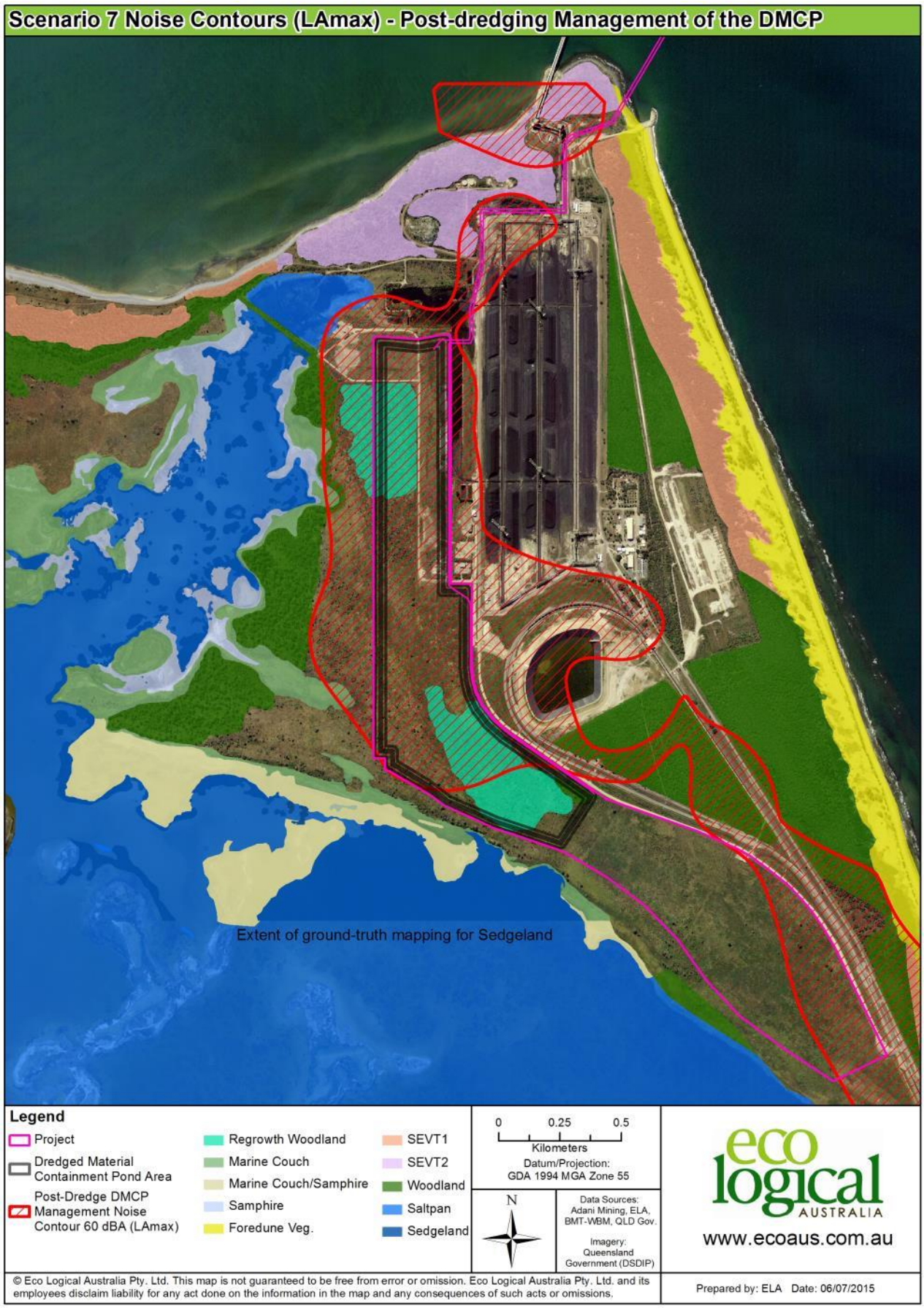

Figure 20 Map showing location of wetland habitat enclosed by the 60 dBA LAmax contour for post dredging management of the DMCP

9.2.3 Dust

Katestone (2015) undertook dispersion modelling to predict dust concentrations and deposition rates generated by Project construction activities (with and without existing background conditions) in the within the Caley Valley Wetland. The modelling assumed the application of standard dust management practices such as the wetting of soil stockpiles and haul roads.

Maximum dust deposition levels were predicted to be below the vegetation criterion of 200 mg/m^2/day (Katestone 2015). Impacts of dust deposition on flora habitats for wetland birds are therefore not anticipated as a result of construction works.

Results of the dispersion modelling in relation to dust concentrations and human health criteria were varied. The $PM_{2.5}$ criteria were not exceeded for 24 hour or annual exposure. This is a positive result, as $PM_{2.5}$ is known to cause greater respiratory problems than the other criteria modelled. Likewise, the TSP result was below the relevant human health criterion of 90 µg/m. However, the modelled PM_{10} result was predicted to exceed the human health criterion of 50 µg/m for a distance of approximately 600 m into the wetland, covering an area of approximately 111.5 ha (Figure 21).

The human health criteria for sensitive receptors (e.g. residential development) are assessed against ambient air quality objectives such as those contained within the *Environmental Protection (Air) Policy 2008* or the National Environment Protection Measure for Air. However, the potential impacts of dust on construction workers on-site are typically assessed against Workplace Exposure Standards for Airborne Contaminants published by Safe Work Australia. These are less stringent than the ambient air standards, with the Workplace Exposure Standard for rouge dust being 10,000 µg/m^3 (at ambient conditions) over an eight hour average (compared with the ambient air objective of 50 µg/m3 for a 24-hour average).

Neither of the above-mentioned approaches to assessing risks to human health from dust were developed with wetland birds in mind. The criteria used in the modelling are considered to be conservative when applied to human health and can be assumed to be conservative for the purposes of assessing impacts on the environment (ELA and Open Lines 2012). However, there is a moderate to high degree of uncertainty in assessing the significance of the predicted exceedance of PM_{10} dust emissions from the Project, and compliance with criteria for $PM_{2.5}$ and TSP.

The impact of dust particle inspiration on the health of wild birds is not well-understood (Brown *et al. 1997*, Kiama *et al*. 2008). It has been suggested that birds, moving about their environment and taking up the large amounts of oxygen required for flight, could be utilised as sensitive monitors of air quality (Brown *et al*. 1997). However, there are many distinct differences (morphologic, physiologic, and mechanical) between the bird's lung-air-sac respiratory system and the mammalian broncho-alveolar lung (Brown *et al.* 1997), which hinder the transferability of dust exposure impacts on humans, to birds.

The sites of inhaled nanoparticle deposition within the respiratory systems of wild birds are not well-known. However, in domestic chickens particles with a diameter of approximately 1.1 µm are most frequently deposited in the lungs, abdominal and post-thoracic air sacs, with larger (3.7 - 7 µm) and smaller (0.3 µm) diameter particles deposited in greater numbers in the anterior (forward) portion of the respiratory system (Hayter and Besch 1974).

Birds living in environments contaminated with aerosolized particulates show significant effects of particle inhalation after only a short duration of exposure. Examples include Kiwis foraging in loose dust and sand, birds living in or near desert-like conditions and birds exposed to volcanic ash (Brown *et al*. 1997). Birds in chronic dusty conditions such as lay-houses have significantly decreased production and other observable effects (Brown *et al*. 1997). A study monitoring the inhalation of sterile dust (mean

concentration of 101 - 103 mg/cm^3) by four-weeks-old chickens for four weeks found this caused a significant loss of hairs in the lining of the upper part of the trachea, increased mucous secretion, and inflammation of the alveoli – the areas of gas exchange (Collins 1986).

Some of the major adverse health effects of particle exposure in humans are decreased lung function, altered muco-ciliary clearance, chronic obstructive pulmonary disease, asthma, and increased mortality. Although they have different respiratory systems, the physiological impacts of short-term and chronic dust exposure for birds and humans are similar. As such, the exposure of migratory birds to dust and associated small-particles, even for short periods of time, may have adverse impacts on lung function and the capacity for long-distance movements.

An assessment of the available information indicates that dust produced by construction phases of the Project is likely to have a minor impact on wetland birds, for the following reasons:

- Modelled dust concentrations meet human health criteria for two of the three parameters assessed
- Dust concentrations are likely to comply with Workplace Exposure Standards of Work Safe Australia for construction workers on-site (not modelled in this assessment),
- The human health criteria modelled are conservative and are generally applied to activities involving long-term exposure (e.g. residential development)
- The 111.5 ha of wetland habitats where the PM_{10} criterion is predicted is equivalent to 2.2% of the Caley Valley Wetland
- Dust management strategies exceeding those assumed in the air quality model will be implemented, reducing actual dust concentrations below those of the modelled results
- Wetland birds are mobile and are unlikely to stay continuously within any areas of the wetland affected by dust
- Construction stages of the Project may be conducted during periods when the wetland is dry or migratory shorebirds are not present
- Construction activities and therefore the generation of dust may not be conducted continuously
- Dust deposition rates are below the thresholds at which impacts on wetland vegetation would occur
- Water quality (and consequently wetland bird prey) is unlikely to be affected by dust deposition

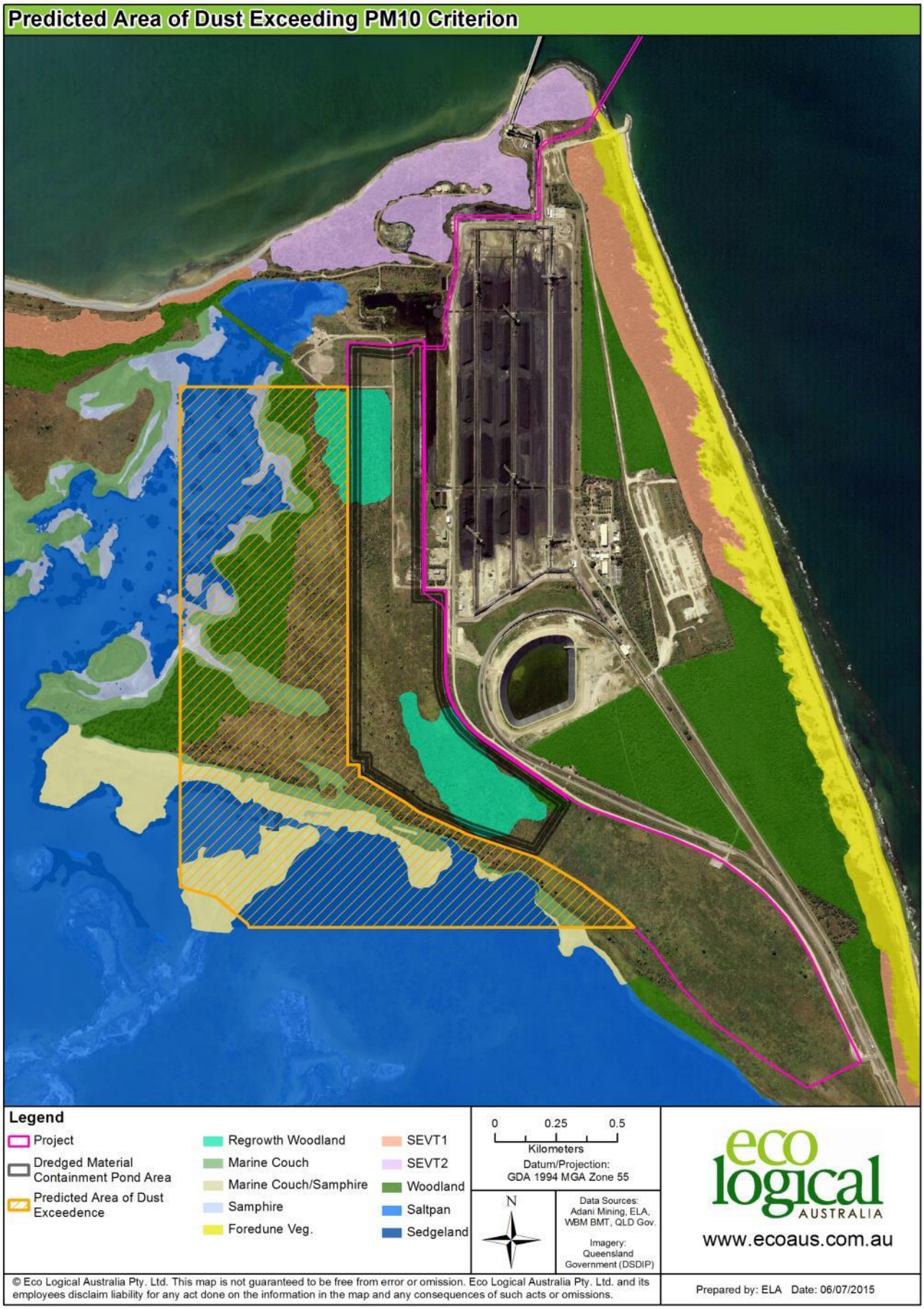

Figure 21 Predicted Area of dust exceeding PM_{10} criterion.

9.2.4 Increased human activity

Increased activity by people within the Project Area and surrounds has the potential to disturb wetland birds, and in particular, migratory shorebirds and the Australian Painted Snipe.

The major consequence of irregular disturbance is a potential shift to alternative feeding or roosting sites. The time and energy costs as a result of disturbance can be more damaging than permanent habitat loss (West and Caldow 2006).

In the case of sustained disturbance, migratory shorebirds and Australian Painted Snipe may be deterred from using certain areas through avoidance thereby marginalising some areas of habitat. The result of this avoidance and corresponding displacement may mean that additional pressure is placed on other areas of the wetland.

The response of shorebirds to disturbance varies among species. Glover *et al.* (2011) determined the distance at which shorebirds would take flight after being disturbed. Of those species relevant to the this assessment, these distances are:

- Red-necked Stint – 18.75 m
- Sharp-tailed Sandpiper - 20.20 m
- Latham's Snipe - 18.63 m.

Oldland *et al*. (2009) also described the distance at which shorebirds flee from people, with the following distances for those species present at Abbot Point:

- Latham's Snipe – 19 m
- Eastern Curlew – 126 m

These data suggest that there is variability in the response of shorebird species to disturbance, and that the area of terrestrial land between the Project Area and wetland habitats (minimum of 50 m) is likely to mitigate the risk of disturbance for all but the most sensitive of shorebird species. Indeed, in most sections of the wetland fringe, this area of impact exceeds 150 m. Management of this area during construction and operations will focus on minimising human activity, so that the area can act as a buffer for disturbance to shorebirds and other wetland birds.

It should also be noted that alert responses to disturbance (e.g. freezing or cessation of foraging) occur at distances greater than those at which a flight response is initiated (Paton *et al*. 2000). This would particularly be the case for Latham's Snipe and the Australian Painted Snipe which are known to be sensitive to disturbance. Such impacts on key shorebird species are examined in more detail in Section 9.5.

Increased activity within the buffer area between the wetland and Project Area could lead to disturbance and reduce the habitat availability for wetland birds. Managing access to the wetland is recommended for reducing the potential impacts of disturbance, particularly at the southern end of the DMCPs, where the buffer is at its narrowest (approximately 50 m).

9.2.5 Lighting

The Project Area will be lit at night during construction phases and work may continue 24 hours a day if required to meet Project construction schedules. Lighting is required for operational and safety reasons to facilitate works such as the construction of pond embankments and placement of dredged material within the DMCPs.

Birds within the Caley Valley Wetland are likely to be the most sensitive fauna for increases in Project-related lighting. Like noise and other forms of human disturbance, increased light levels at night can be expected to affect different species in different ways. Potential impacts include disruption of natural feeding and resting behaviours, increased visibility of wetland birds to predators and increased levels of general disturbance. At least some species may benefit from increased light conditions, as they are visual feeders and are more active foragers on well light nights or in areas adjacent to industrial development (e.g. Dwyer *et al*. 2013).

The Project Area is located within a port industrial precinct and immediately adjacent to the existing T1 operating coal terminal. In this context, lighting from the Project will add to that which is already present within an existing industrial landscape. There have been extensive previous studies of the predicted impacts of industrial light produced by proposed port developments at Abbot Point. These include the Abbot Point CIA (ELA and Open Lines 2012) for a multi-user port facility, and the T0 EIS (CDM Smith 2013b).

The Abbot Point CIA predicted that direct light spill into the Caley Valley Wetland from development of the T0, T2 and T3 coal terminal facilities would be approximately 0.5 ha. The T0 EIS identified direct light spill of 0.2 ha onto a turtle nesting beach during construction of a marine offloading area, and an increase in the night time sky glow of the Abbot Point region. Collectively, these studies indicate that the magnitude of light impacts from extensive development activities at the port can be expected to be relatively small, in comparison with the scale of the Caley Valley Wetland (5,154 ha).

As described in Section 5.3.7, night time construction activities will be supported by mobile and directional light towers which have an illumination footprint of approximately 60 m from the source (when facing directly down towards the ground). Lights will only be used to produce sufficient light required for safety and operational purposes, and will be directed away from the wetland, towards the work area. In this context, direct light spill from the Project is anticipated to be contained within the buffer between the wetland and Project Area. This area of indirect impacts is a minimum of 50 m and greater than 150 m along the majority of the wetland fringe and will act as a buffer from direct impacts within the Project Area.

Impacts from light on wetland birds are therefore assessed to be low. There is a high degree of certainty associated with this assessment.

9.2.6 Changes to stormwater and groundwater regime

Hydrological and groundwater modelling has predicted that there will be no impact of the Project on elements of the wetland environment important to wetland birds (AGE 2015; BMT WBM 2015). Existing groundwater levels are approximately 2.2 m to 5.4 m below existing ground level (AGE 2015), with mixed fresh and saline waters from dredged material unlikely to affect existing groundwater quality or function.

Changes in water quality within the wetland are expected to be minimal (less than 2 ppt of salinity in the eastern bund area). Changes to the hydrology of the wetland margins utilised by wetland birds are also not expected. In the event of the fuse plug being utilised for an emergency stormwater discharge, impacts will be localised and mitigated by the large amount of water flowing naturally through the wetland, given the magnitude of the rainfall event.

9.3 Mitigation and management measures

9.3.1 Mortality or injury

While mortality of wetland birds through structural or vehicular strike is not considered likely, it is recognised that construction and operational activities may lead to some level of impact.

The following specific measures will be implemented to address this potential impact:

- Personnel operating vehicles in and adjacent to the project area should be made aware of the presence of wetland birds (with particular reference to EVNT species Eastern Curlew and Australian Painted Snipe) and the potential for individuals to be encountered
- Appropriate speed limits should be sign-posted, included in staff inductions and enforced.
- Vehicles to be limited to traversing approved roads and tracks
- No unauthorised access by vehicles unless required for construction, operation, maintenance or inspections.
- A Species Management Program has been developed and will be implemented on site to minimise disturbance to animal breeding places

9.3.2 Construction noise

The following specific measures should be implemented to address the potential impact of construction noise during construction of the DMCP:

- Use of plant with efficient muffler design.
- Vehicles, plant and equipment will be maintained in accordance with manufacturer's specifications.
- Adjustment of reversing alarms on plant to limit the acoustic range to the immediate danger area.
- Plant and equipment of appropriate size / capacity for the task will be used.
- Use of quieter engines and newer, quieter equipment where practicable.

However, even with the application of these requirements some spill of noise above criteria which can be expected to result in disturbance is likely to occur.

9.3.3 Increased human activity

The extent of wetland bird alert and alarm responses to anthropogenic disturbance should be minimised through restricted access to designated areas of the wetland and the buffer between the DMCPs and wetland. However, in the event that access is essential, it is likely that any area subject to disturbance would remain in close proximity to the Project Area (for most species, less than 50 m from the edge of the development). On-site personnel should be made aware of the presence of wetland birds and avoid wandering into the wetland areas or adjacent beach habitats.

9.3.4 Lighting

The following mitigation measures will be applied to reduce the impact of Project lighting on wetland birds:

- Use directional lighting and shrouds to protect the Caley Valley Wetland from direct light
- Use mobile light towers which can be moved and adjusted to provide lighting for construction purposes, while minimising lighting of unused areas
- Maintain a buffer area between construction lighting and the Caley Valley Wetland

9.3.5 Changes to stormwater and groundwater runoff regime

Impacts associated with stormwater and groundwater changes have generally been addressed as part of the engineering design for the DMCP.

9.4 Assessment of residual impacts on EVNT species

This section extends the assessment of Potential impacts on wetland birds in Section 9.2 to consider species specific information for EVNT species (Eastern Curlew and Australian Painted Snipe).

9.4.1 Eastern Curlew

The Near Threatened Eastern Curlew utilises estuarine sections of the Caley Valley Wetland, including the Open Pan and Intertidal zones. These habitats are located at least 3 km west of the Project Area and are highly unlikely to be influenced by Project activities. The species has also been recorded roosting on Dingo Beach approximately 500 m from the Project Area (BMT WBM 2012). However, the roosting habitat is located well beyond (400 m) the predicted location of noise and dust criteria contours, and is screened by remnant SEVT and woodland vegetation (Figure 22). Accordingly, no disturbance of the roost sites utilised by the Eastern Curlew are anticipated.

While estuarine and coastal sections of the Caley Valley Wetland are utilised by the Eastern Curlew, the Project is not located in close proximity to feeding or roosting habitats of the species and several management and mitigation measures will be implemented to avoid indirect impacts in these areas. In this regard, there is a high degree of certainty that impacts of the Project (either directly or indirectly) on the species are unlikely.

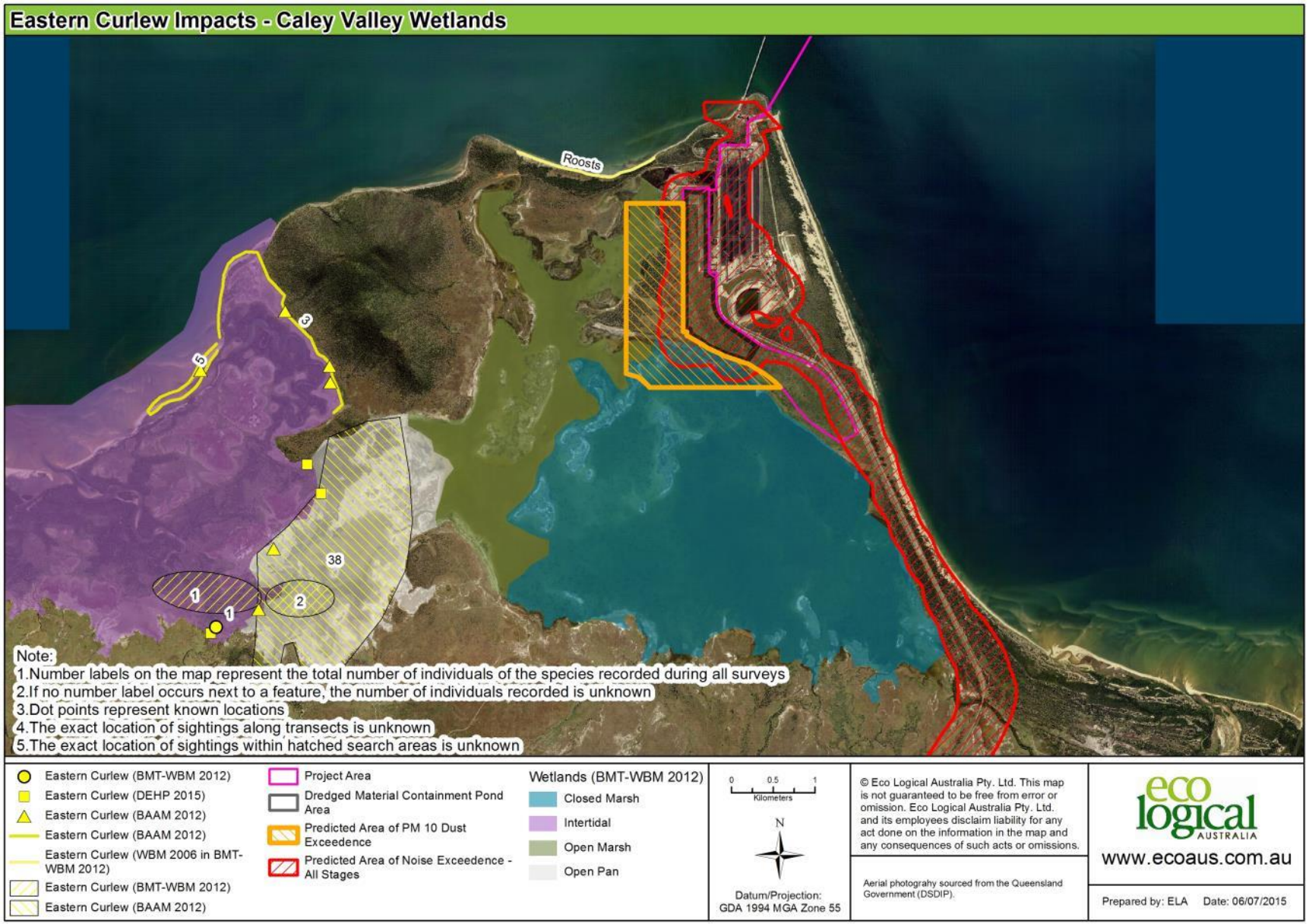

Figure 22 Map showing the location of Eastern Curlew sightings and areas of wetland predicted to be influenced by Project activities

9.4.2 Australian Painted Snipe

The Australian Painted Snipe has been sighted throughout eastern sections of the Caley Valley Wetland, utilising a range of habitats within the Open and Closed Marsh zones. The species has been sighted on seven occasions adjacent to the Project Area (Figure 23), and to the north, south and west of the Project Area. Sightings data for the Australian Painted Snipe include point locations, with a small number of confirmed sightings occurring within the area where predicted noise and PM_{10} dust contours extend (potential for indirect impacts).

Unlike most other shorebirds, the preferred habitat of the Australian Painted Snipe includes salt couch on the margins of wet areas. Such habitats occur closest to the Project Area, and would be suitable for snipe species at times when the wetland is full of water. Snipes therefore have the greatest area of suitable habitat that may be influenced by indirect impacts from the Project. The Australian Painted Snips has been demonstrated to utilise a variety of habitats throughout the eastern Caley Valley Wetland, most likely in response to the location of suitable habitat during various stages of the wetland's wetting and drying cycle.

The sighting records and habitat use for the Australian Painted Snipe indicate that the species utilise wetland habitats adjacent to the Project Area, including salt couch, and therefore has the potential to be impacted by the Project. However, these impacts will not be significant for the following reasons:

- the Project Area does not contain habitat for the species, so the only potential impacts are from disturbance.
- the strip of terrestrial land between the Project Area and the wetland (where indirect impacts on fauna could generally be expected) is not preferred habitat for the species, beyond the height of wetland inundation
- the area of habitat that may potentially be disturbed by noise/dust/light is small (21.9 ha or 0.4% of the wetland for noise; 111.5 ha or 2.2% of the wetland for PM_{10} dust) relative to the total area of habitat available and demonstrated to be used by the species
- construction activities that will generate the disturbances will be in place for a short period of time (~3 months).
- ecological values supporting foraging behaviour (e.g. macroinvertebrates) and roosting (e.g. vegetation complexes and wetland areas) are very unlikely to be degraded by construction activities and will still be available to the species following the period of temporary disturbance
- numerous management and mitigation measures will be implemented to keep disturbance to a minimum
- this species is highly mobile and can move to other areas for foraging and roosting if disturbed
- shorebirds have been shown to become habituated to noise within other port settings (e.g. at the Port of Brisbane)

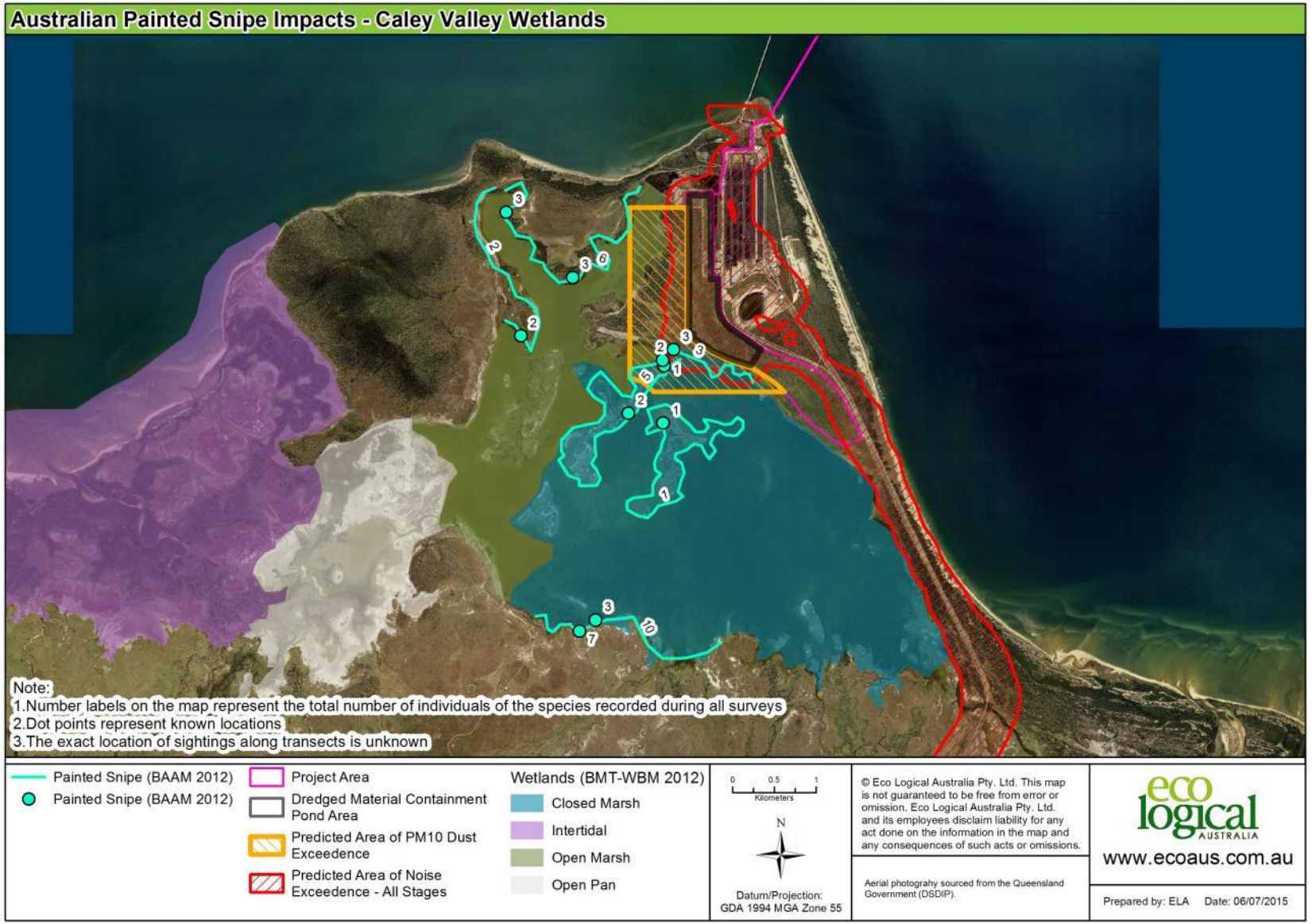

Figure 23 Map showing the location of Australian Painted Snipe sightings and areas of wetland predicted to be influenced by Project activitie

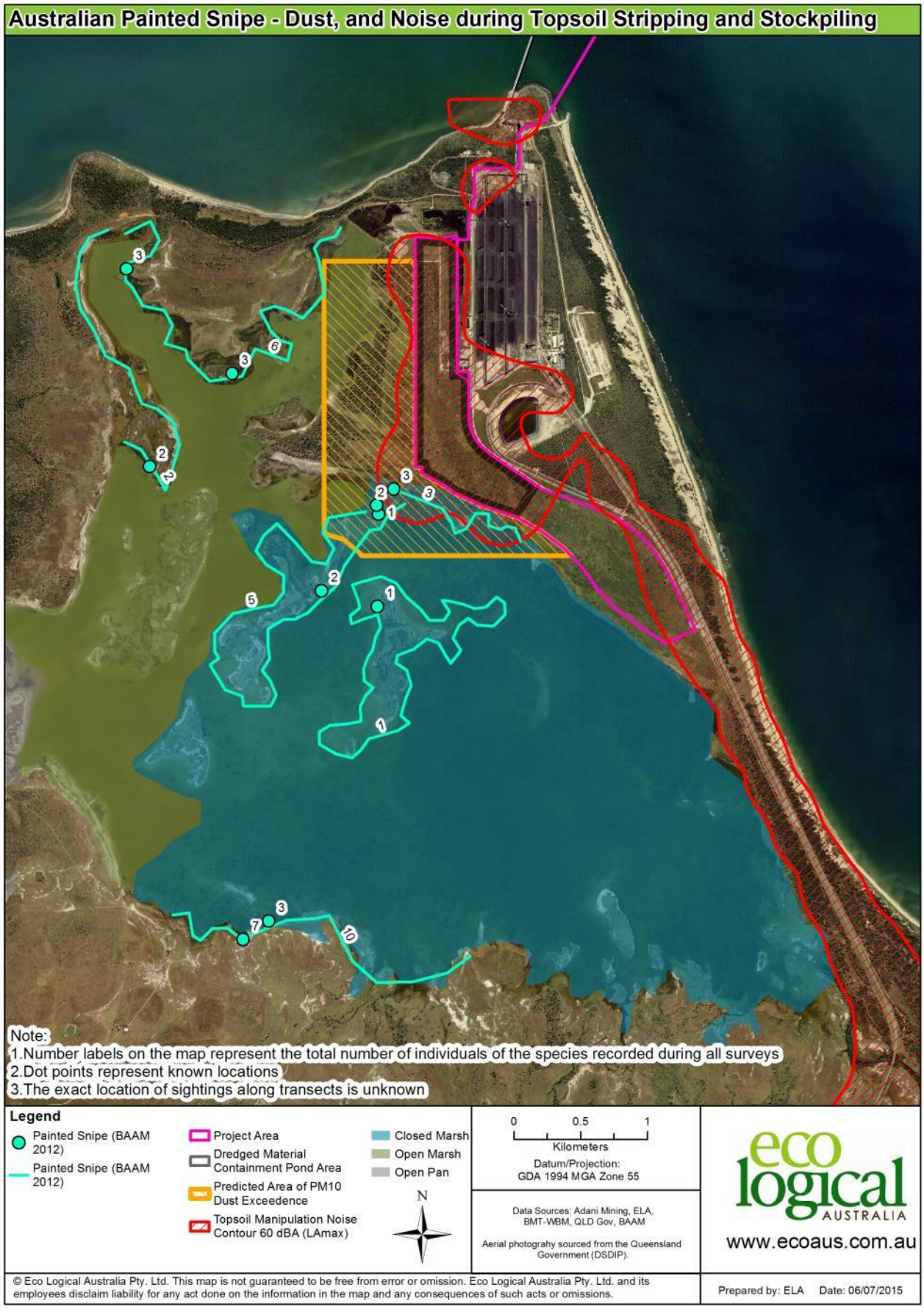

Figure 24 Enlarged map showing Australian Painted Snipe sightings and areas of wetland predicted to be influenced by topsoil stripping and stockpiling

9.5 Assessment of residual impacts on other wetland species

The sensitivity of other wetland bird species to Project related impacts is likely to be lower than the EVNT species the Eastern Curlew and Australian Painted Snipe. Two key concepts commonly applied under the EPBC Act for migratory species (DoE 2013) are also relevant for identifying species with potential sensitivities to the Project, based on their ecological characteristics. These concepts are:

- Important habitat
- Ecologically significant proportion of the population.

Where neither of these two features of a migratory species are present, impacts are generally not considered of significance under the EPBC Act (DoE 2013; DEWHA 2009a). As similar guidelines are not in place under Queensland legislation, the Commonwealth guidelines have been followed. An analysis of the potential presence of important habitat or an ecologically significant proportion of the population for migratory wetland bird species (ELA 2015b) identified the wetland:

- Is important habitat for migratory shorebirds, because is supports at least 15 migratory shorebird species, ≥ 18 individuals of Latham's Snipe and ≥ 0.1% of the flyway population the Red-necked Stint and Sharp-tailed Sandpiper.
- supports an ecologically significant proportion of Eastern Great Egret (Special Least Concern) population
- supports an ecologically significant proportion of Caspian Tern (Special Least Concern) population
- supports an ecologically significant proportion of Little Tern (Least Concern) population

Maps showing the location of these species in relation to the Project Area are presented in Appendix A. These species are expected to have similar sensitivities to indirect impacts from the Project as the Eastern Curlew and Australian Painted Snipe, as are Least Concern waterfowl such as ducks, swans and geese.

Therefore, the overall impacts of the Project on other wetland bird species and their habitat are expected to be minimal, for the following reasons:

- the Project Area does not contain habitat for wetland birds, so the only potential impacts are from disturbance.
- the area of terrestrial land between the Project Area and wetland is not preferred habitat for any species and will effectively act as a buffer from direct impacts within the disturbance footprint
- the area of habitat that may potentially be disturbed by noise/dust/light is small (up to 0.4% of wetland for noise; and 2.2% of wetland for PM_{10} dust) relative to the total area of habitat available and shown to be used by the birds
- construction activities that will generate the disturbances will be in place for a short period of time (~3 months, which is less than an entire migratory bird season) and may occur outside the season entirely
- ecological values supporting foraging behaviour (e.g. macroinvertebrates) and roosting (e.g. vegetation complexes and wetland areas) are very unlikely to be degraded by construction and will still be available to the species following the temporary disturbance period
- numerous management and mitigation measures will be implemented to keep disturbance to a minimum
- wetland birds are highly mobile and can move to other areas for foraging and roosting if disturbed

- wetland birds have been shown to become habituated to noise in other port settings (e.g. at the Port of Brisbane)

On the basis of this assessment, the following conclusions are drawn in relation to Project-related impacts on the WPA:

- the Project will not have a significant residual impact by seriously affecting the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland (Significant Residual Impact Criterion for Wetlands and Watercourses)
- development involving the clearing of vegetation will protect the biodiversity, ecological values and processes, and hydrological functioning of a wetland in WPA, including water quality values, aquatic habitat values, terrestrial habitat values and usage of the site by native wetland fauna species or communities (PO7 of WPA State Code).

However, a range of mitigation measures should nonetheless be implemented to manage any minor impacts and facilitate the on-going use of the Study Area by the species. Mitigation measures discussed in Section 6 will be sufficient to maintain impacts within acceptable levels. Offsets are not considered necessary.

10 Adequacy of Buffer from Wetland Protection Area

Performance Objective 2 of the WPA State Code states that "an adequate buffer to a wetland in a WPA is provided and maintained". 'Buffer' is defined in the code as 'the transition zone between a wetland and any surrounding land use that supports the values and processes of the wetland and protects it from external threats'. As the buffer between the Project Area and wetland is less than the 200 m specified for a non-urban area in the code, an assessment of the adequacy of alternative buffer widths should be conducted in accordance with the Queensland Wetland Buffer Planning Guideline (DERM 2011).

The first step in establishing a wetland buffer is identifying wetland environmental values. For terrestrial ecology, these relate primarily to wetland birds and their habitat, including migratory shorebirds (assessed in Section 9). Other environmental values that support wetland birds such as prey (fish, invertebrates) and water quality are outside of the scope of this terrestrial ecology report, and are assessed in BMT WBM (2015).

There will be no direct impacts of the Project on the WPA. The primary consideration in relation to buffer distances for wetland birds is therefore to separate the wetland from the effects of indirect Project impacts associated with noise, human disturbance, light and dust. Such factors were assessed in detail in relation to potential impacts on wetland birds and their habitats in Section 9.

While it has been identified that noise and dust may extend into the wetland at certain times of the Project's construction, the impact of such processes on wetland birds and their habitat was assessed to be low. In this context, the reduced buffer, which ranges from approximately 50 m to 150 m from the WPA is assessed to be adequate to maintain existing wetland values in relation to wetland birds.

Selection of a larger buffer between the WPA and Project Area was constrained by the existing geographic and infrastructure features at Abbot Point. The Project Area is bounded by an existing rail loop and coal terminal to the east, and an approved but not yet constructed coal terminal to the west. The WPA is located to the south of the Project Area, and a water treatment basin and remnant vegetation are located to the north of the Project Area. The DMCPs have been designed to maximise the buffer distance from the wetland while achieving the engineering and design features needed to store, treat and re-use dredged material.

It is also relevant to note that the Project has been proposed to facilitate the disposal of dredged material (capital dredging) on land, rather than within the Great Barrier Reef Marine Park and World Heritage Area. Establishing the DMCPs within the T2 area was required to avoid disturbance to other sections of the Caley Valley Wetland while not compromising other existing or approved developments within the Port of Abbot Point. In this context, there is no viable option to locate the DMCPs further away from the WPA. However, as discussed above, a minimum buffer of 50 m, extending to up to 150 m in places, is considered to be suitable to avoid impacts on terrestrial ecology values of the WPA.

11 Monitoring and Reporting

11.1 Objectives and purpose

Monitoring of MSES will be completed at various stages of the Project, to meet the following objectives:

- Inform the management on-ground construction works to reduce impacts on MSES
- Document any difference between predicted and actual impacts
- Identify if impacts exceed a threshold value, beyond which additional mitigation measures should be implemented
- Demonstrate compliance with environmental management commitments

11.2 Monitoring plan

Monitoring will be completed before, during and after construction works, with a focus on assessing the impacts of Project-related activities on key MSES. A description of monitoring tasks to be implemented is provided in Table 13. Monitoring activities will be focussed on:

- Identifying the location of MSES in the area to be cleared, to avoid/reduce impacts
- Monitoring of terrestrial land between the development footprint and the Caley Valley Wetland
- Monitoring fauna during construction works to minimise injury and disturbance of nests.

11.3 Reporting

The results of all monitoring activities will be provided to relevant State Government agencies in accordance with the requirements of approval conditions and as outlined in relevant environmental management plans. Monitoring results will be reported in a timely manner following their collection and analysis, to facilitate adaptive management of potential impacts on MSES.

Table 13 Monitoring measures to be implemented for the Project

Parameter	Description	Objectives	Trigger for corrective action	Timing and frequency
Pre-clearance surveys.	Survey of areas to be cleared, prior to disturbance.	Confirm the spatial extent of vegetation to be cleared. Confirm assumptions about the disturbance of MSES, including threatened species habitat. Identify regulated vegetation adjacent to the pipeline alignment (to avoid disturbance during works). Inform prioritisation of spotter-catcher effort to flush out and relocate threatened species during clearing works.	Trigger: Identification within the disturbance footprint of MSES not known at impact assessment stage. Action: Notify DoE. Review and update mitigation measures, offset strategy and environmental management plans.	One off survey not more than six months before the commencement of construction works.
Monitoring of land between wetland and Project Area (indirect impact zone).	Visual assessment of integrity of zone (undisturbed) between works site and Caley Valley Wetland.	Ensure that zone between wetland and Project Area remains undisturbed and is not subject to human activity.	Trigger: Identification of earth works moving into buffer zone. Action: Stop work. Review work site protocols to ensure buffer zone remains in place prior to recommencing work.	Weekly during the period of construction works.
Spotter-catcher surveys	Inspection of disturbed areas adjacent habitats to minimise injury to animals and disturbance of nests.	Minimise impacts of Project construction activities on fauna and nests.	Trigger: identification of fauna or nests in works area Action: relocate fauna or nest if practical. Manage any fauna injuries in accordance with Animal Welfare legislation and guidelines.	Daily during construction works and clearing activities.

Summary and Conclusion

The Queensland Department of State Development is proposing to conduct capital dredging at the Port of Abbot Point, involving the placement of dredged material on land. The Project has been designed to avoid the placement of dredged material at sea within the Great Barrier Reef World Heritage Area, and to avoid disturbance to the Caley Valley Wetland.

The information provided in this documentation specifically addressed the requirements for State approval processes, including the Significant Residual Impact Guidelines and Wetlands Protection Area State Code in relation to terrestrial ecology. The report outlines the results of extensive previous ecological surveys regarding the occurrence and potential impacts on MSES as a result of the Project. This report has provided a detailed impact assessment for key MSES considered as part of the Project.

Potential impacts of the Project have been managed according to the hierarchy of avoid, mitigate and offset, with a focus on avoidance by designing and locating the development footprint to be outside of the Caley Valley Wetland and the regulated vegetation in the region. Where indirect impacts on MSES could not be completely avoided, a range of mitigation and management measures have been proposed to reduce and manage these impacts. This report has outlined these measures in detail.

Direct impacts of the Project on MSES associated with construction and operational phases of the Project will be avoided. A detailed assessment of indirect impacts of the Project on MSES has concluded that these will be insignificant and manageable through a range of mitigation and environmental management planning processes

It is considered that the Project is unlikely to result in residual significant impacts on MSES after all measures to first avoid and then mitigate have been taken into account. Accordingly, offsets for the Project are not necessary.

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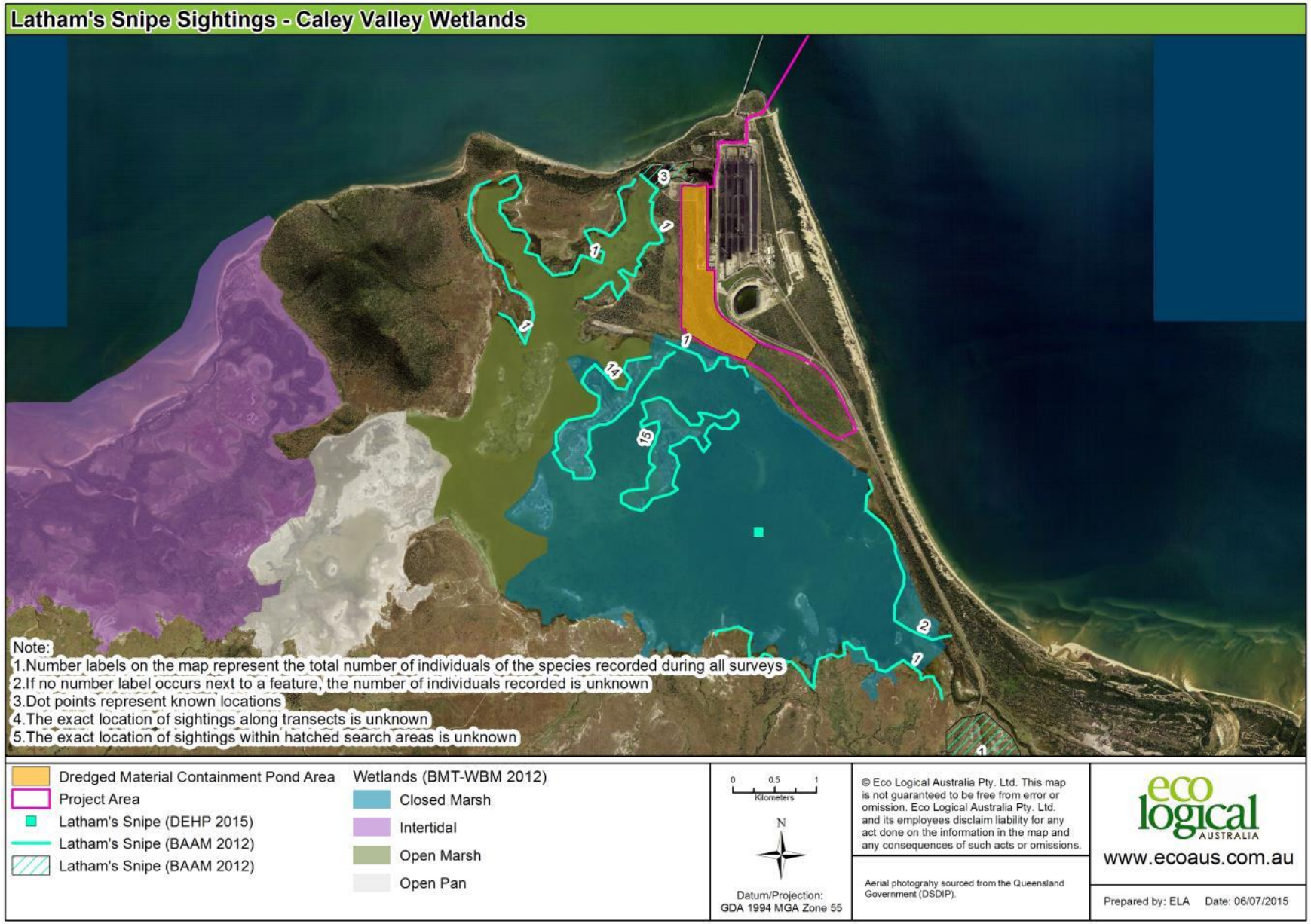
Appendix A Maps Showing Sightings of Wetland Birds

Maps of sightings of key wetland bird species identified in Section 9 (excluding those presented in main body of report).


Latham's Snipe Sightings - Caley Valley Wetlands
Note:
1.Number labels on the map represent the total number of individuals of the species recorded during all surveys
2.If no number label occurs next to a feature, the number of individuals recorded is unknown
3.Dot points represent known locations
4.The exact location of sightings along transects is unknown
5.The exact location of sightings within hatched search areas is unknown
Dredged Material Containment Pond Area
Project Area
Latham's Snipe (DEHP 2015)
Latham's Snipe (BAAM 2012)
Latham's Snipe (BAAM 2012)
Wetlands (BMT-WBM 2012)
Closed Marsh
Intertidal
Open Marsh
Open Pan
0 0.5 1
Kilometers
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Datum/Projection:
GDA 1994 MGA Zone 55
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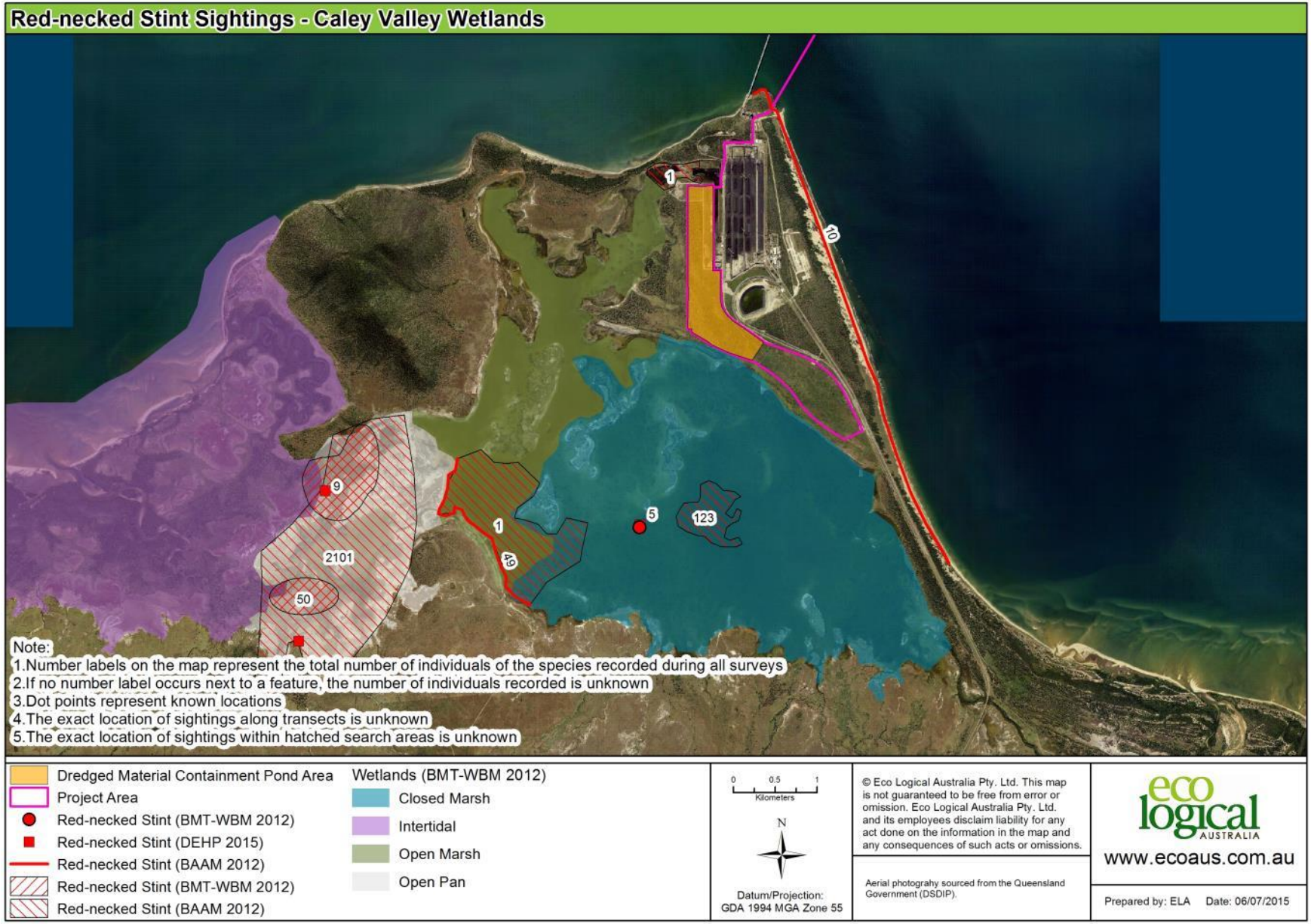
Red-necked Stint Sightings - Caley Valley Wetlands
1
10
9
2101
50
1
49
5
123
Note:
1.Number labels on the map represent the total number of individuals of the species recorded during all surveys
2.If no number label occurs next to a feature, the number of individuals recorded is unknown
3.Dot points represent known locations
4.The exact location of sightings along transects is unknown
5.The exact location of sightings within hatched search areas is unknown
Dredged Material Containment Pond Area
Project Area
Red-necked Stint (BMT-WBM 2012)
Red-necked Stint (DEHP 2015)
Red-necked Stint (BAAM 2012)
Red-necked Stint (BMT-WBM 2012)
Red-necked Stint (BAAM 2012)
Wetlands (BMT-WBM 2012)
Closed Marsh
Intertidal
Open Marsh
Open Pan
0 0.5 1
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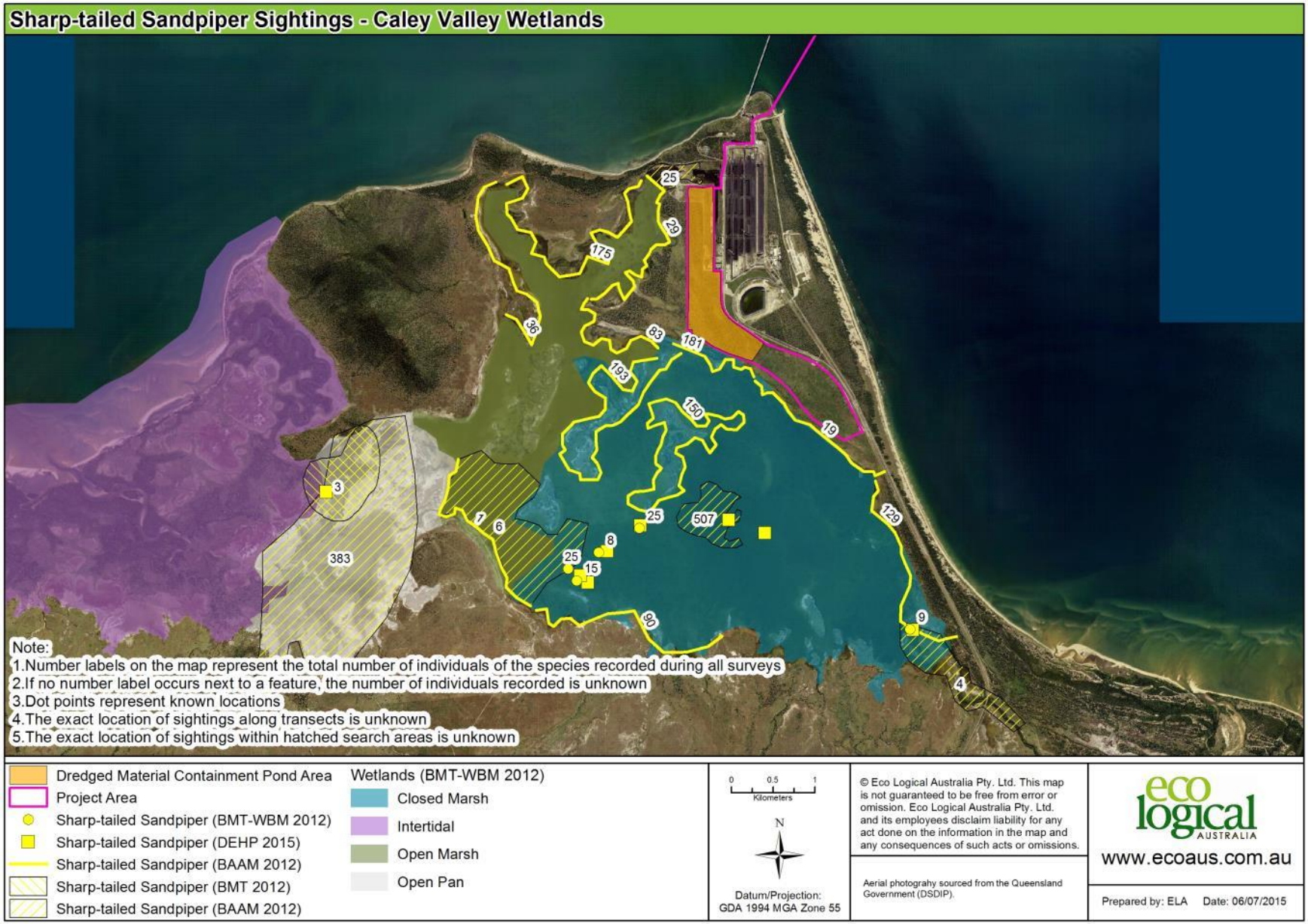
Sharp-tailed Sandpiper Sightings - Caley Valley Wetlands
25
29
175
36
83
181
193
150
79
129
3
7
6
25
507
8
25
15
383
90
9
4
Note:
1.Number labels on the map represent the total number of individuals of the species recorded during all surveys
2.If no number label occurs next to a feature, the number of individuals recorded is unknown
3.Dot points represent known locations
4.The exact location of sightings along transects is unknown
5.The exact location of sightings within hatched search areas is unknown
Dredged Material Containment Pond Area
Project Area
Sharp-tailed Sandpiper (BMT-WBM 2012)
Sharp-tailed Sandpiper (DEHP 2015)
Sharp-tailed Sandpiper (BAAM 2012)
Sharp-tailed Sandpiper (BMT 2012)
Sharp-tailed Sandpiper (BAAM 2012)
Wetlands (BMT-WBM 2012)
Closed Marsh
Intertidal
Open Marsh
Open Pan
0 0.5 1
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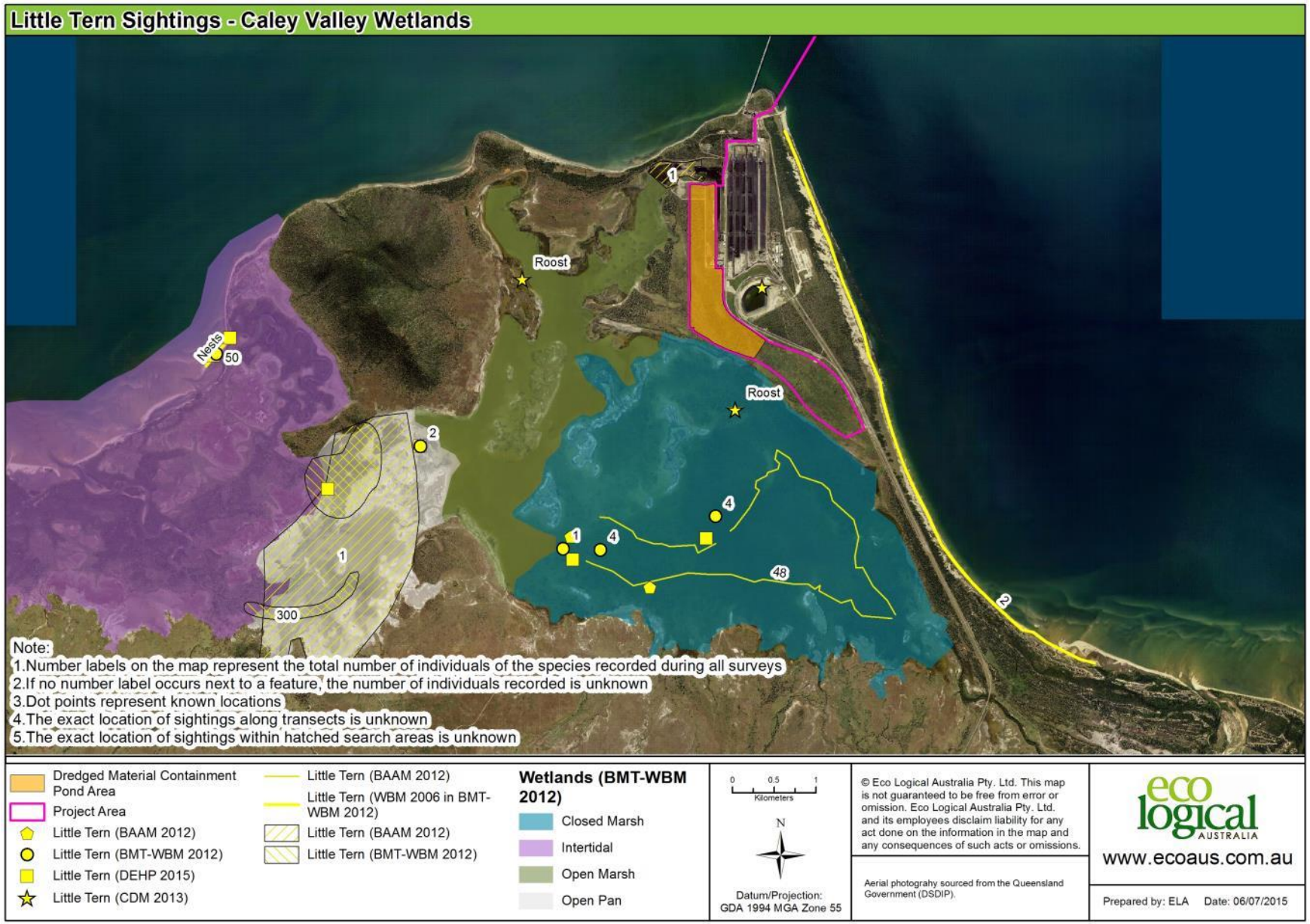
Little Tern Sightings - Caley Valley Wetlands
Roost
Nests
50
Roost
2
1
4
1
4
48
1
300
2
Note:
1.Number labels on the map represent the total number of individuals of the species recorded during all surveys
2.If no number label occurs next to a feature, the number of individuals recorded is unknown
3.Dot points represent known locations
4.The exact location of sightings along transects is unknown
5.The exact location of sightings within hatched search areas is unknown
Dredged Material Containment Pond Area
Project Area
Little Tern (BAAM 2012)
Little Tern (BMT-WBM 2012)
Little Tern (DEHP 2015)
Little Tern (CDM 2013)
Little Tern (BAAM 2012)
Little Tern (WBM 2006 in BMT-WBM 2012)
Little Tern (BAAM 2012)
Little Tern (BMT-WBM 2012)
Wetlands (BMT-WBM 2012)
Closed Marsh
Intertidal
Open Marsh
Open Pan
0 0.5 1
Kilometers
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GDA 1994 MGA Zone 55
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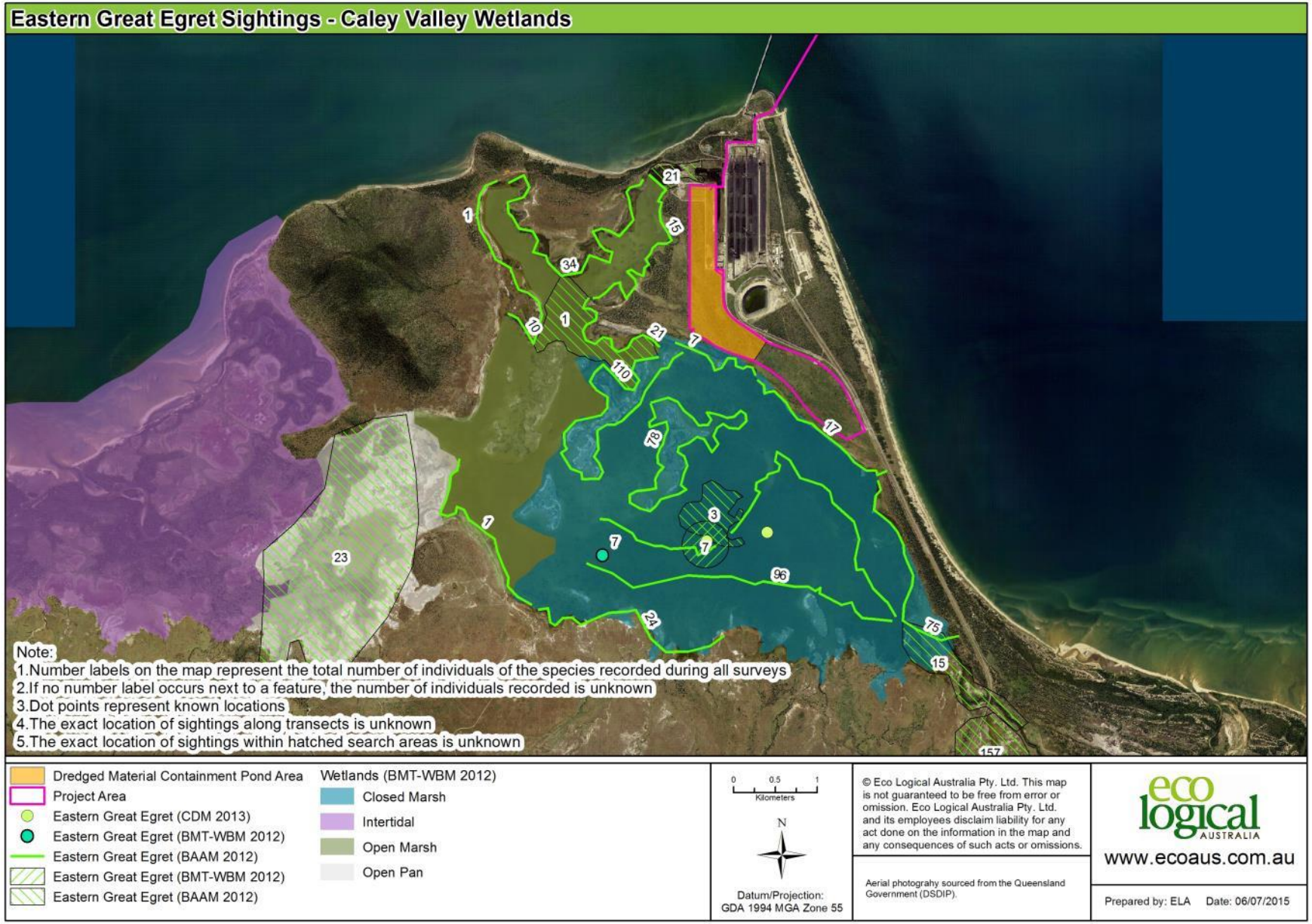
Prepared by: ELA Date: 06/07/2015


Eastern Great Egret Sightings - Caley Valley Wetlands
Note:
1.Number labels on the map represent the total number of individuals of the species recorded during all surveys
2.If no number label occurs next to a feature, the number of individuals recorded is unknown
3.Dot points represent known locations
4.The exact location of sightings along transects is unknown
5.The exact location of sightings within hatched search areas is unknown
Dredged Material Containment Pond Area
Project Area
Eastern Great Egret (CDM 2013)
Eastern Great Egret (BMT-WBM 2012)
Eastern Great Egret (BAAM 2012)
Eastern Great Egret (BMT-WBM 2012)
Eastern Great Egret (BAAM 2012)
Wetlands (BMT-WBM 2012)
Closed Marsh
Intertidal
Open Marsh
Open Pan
0 0.5 1
Kilometers
N
Datum/Projection:
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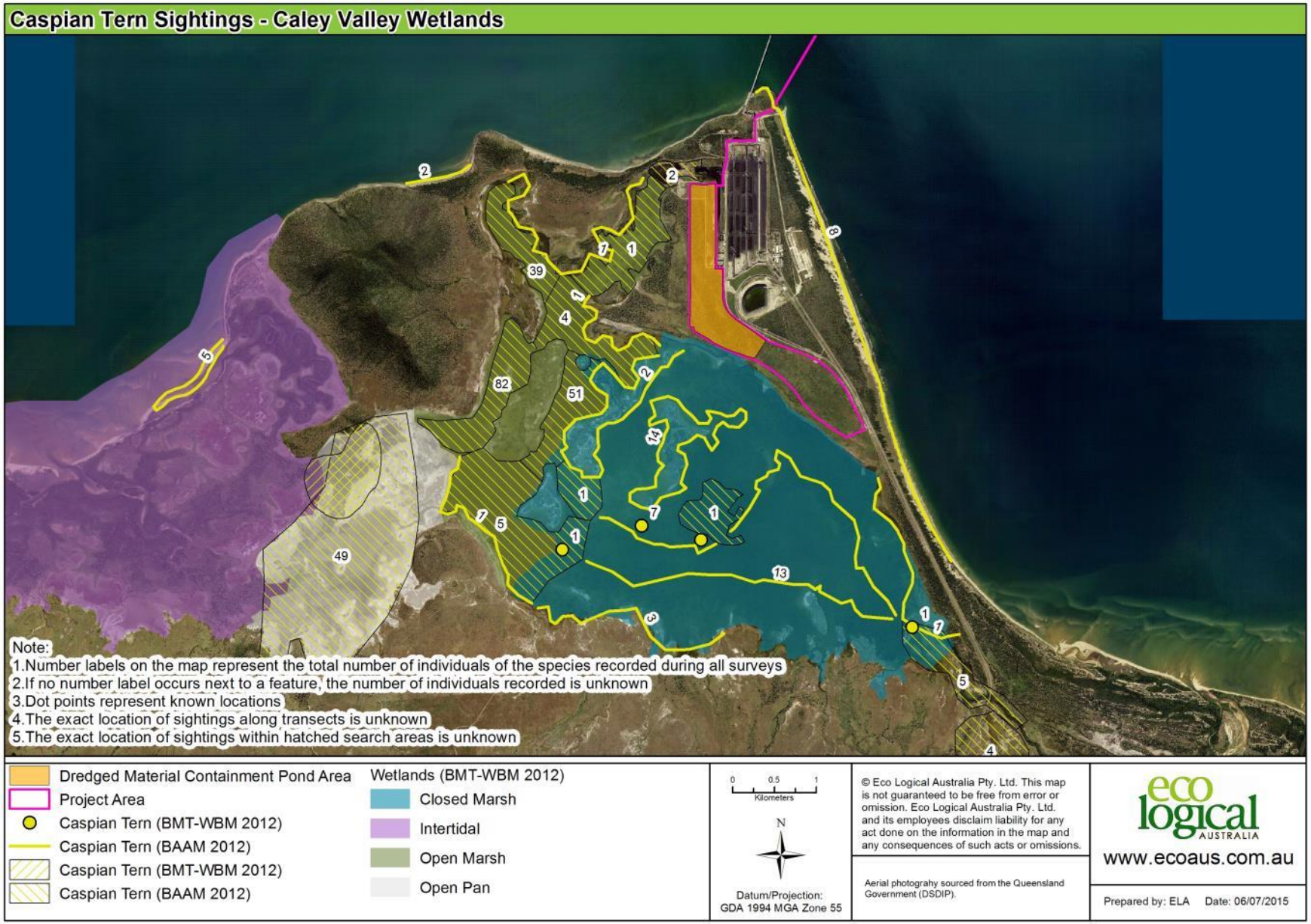
Caspian Tern Sightings - Caley Valley Wetlands
Note:
1.Number labels on the map represent the total number of individuals of the species recorded during all surveys
2.If no number label occurs next to a feature, the number of individuals recorded is unknown
3.Dot points represent known locations
4.The exact location of sightings along transects is unknown
5.The exact location of sightings within hatched search areas is unknown
Dredged Material Containment Pond Area
Project Area
Caspian Tern (BMT-WBM 2012)
Caspian Tern (BAAM 2012)
Caspian Tern (BMT-WBM 2012)
Caspian Tern (BAAM 2012)
Wetlands (BMT-WBM 2012)
Closed Marsh
Intertidal
Open Marsh
Open Pan
0 0.5 1
Kilometers
N
Datum/Projection:
GDA 1994 MGA Zone 55
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