AI Railway Corridor – Caley Valley Wetland Freshwater Aquatic Flora and Fauna Assessment for Rail Loop

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Hancock Prospecting Pty Ltd

Report for Alpha Coal Project (Rail) Supplementary Environmental Impact Statement

Caley Valley Wetland Freshwater Aquatic Flora and Fauna Assessment for Rail Loop

June 2011

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Acronyms and Abbreviations

Acronym / Abbreviation	Interpretation
ANZECC	Commonwealth Australian and New Zealand Environment and Conservation Council
APCT	Abbot Point Coal Terminal
APSDA	Abbot Point State Development Area
ASS	Acid Sulfate Soil
cm	centimetre
DERM	Queensland Department of Environment and Resource Management
DSEWPC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EIS	Environmental Impact Statement
EPBC	Commonwealth *Environment Protection and Biodiversity Conservation (Act) 1999*
GBR	Great Barrier Reef
ha	hectare
HES	High Environmental Significance
m	metre
MCF	Multi-cargo Facility
Mg/L	Milligrams per litre
NC Act	Queensland *Nature Conservation Act 1992*
MNES	Matters of National Environmental Significance
NQBP	North Queensland Bulk Ports
NTU	Nephelometric turbidity units
SEIS	Supplementary Environmental Impact Statement
SPP	State Planning Policy
TPH	Total Petroleum Hydrocarbons
°C	Degrees Celsius
%sat	Percent saturation

Acronym / Abbreviation	Interpretation
µg/L	Micrograms per litre
µS/cm	Microsemens per centimetre

Executive Summary

The Alpha Coal Project (Rail) is a standard gauge, 495 km long railway line stretching between the Alpha coal mine and the Abbot Point coal export terminal. An Environmental Impact Statement (EIS) has been prepared for the Project which included an assessment of the aquatic ecology values within the EIS assessment area. In response to a request, additional information has been sought for the rail loop infrastructure proposed at the Abbot Point coal export terminal which is the subject of this report, and will comprise a component of the supplementary EIS documentation. This additional investigation included a review of existing information about the area, field survey and data analysis, and the identification of potential impacts and mitigation measures specific to the rail loop infrastructure construction and operation. A risk assessment was undertaken on the identified potential impacts.

Review of existing information sources and field surveys focussed on describing the aquatic ecology values and surface water quality of the rail loop study area.

The study area intersects a wetland listed as nationally important by the Department of Sustainability, Environment, Water, Population and Communities; the Caley Valley Wetland. The wetland features a range of habitats which in combination provide for a diverse aquatic environment that is recognised as an area of importance for waterbirds and migratory species. The system undergoes seasonal fluctuation in water level and extent of the waterbody.

The aquatic ecology of the study area is dominated by one aquatic habitat type described as palustrine wetland. This habitat provides for a range of native flora and fauna species including a number of birds listed under the EPBC Act and NCA. Adjacent to the study area are similar habitat values and field studies of the area have confirmed the presence of a range of fish, turtle, bird and macrophyte species. Upslope of the wetland the landscape is cleared pasture, though native species fringe the wetland (e.g. salt couch and water couch). Vegetation containing marine plants occurs within, and adjacent to, the areas mapped as wetland in the study area. These areas are dynamic with the fluctuations of the wetland.

The water quality of the wetland area is highly seasonally variable with exceedences in guideline limits in both physiochemical and chemical parameters. The dynamics of the wetland is a key driver in water quality conditions. Within the study area, water quality conditions are similar to those in the adjacent wetland area.

The potential impacts associated with the Project are mainly associated with direct loss of aquatic habitat and degradation of adjacent habitats as a result of construction and operation. There is also potential disturbance to local fauna as a result of noise, vibration and lighting that will be required. Mitigation measures have been recommended and are expected to minimise the potential impacts of the construction and operation of the rail loop infrastructure. A number of management and monitoring plans are proposed, which are consistent with the overarching Environmental Management Plan for the Project. Overall with the implementation of appropriate management and mitigation the Project is unlikely to have a significant impact on the aquatic environment. The construction and operation of the rail loop will consider potential for impacts and implement mitigation measures. This will include consideration of

measures to avoid impacts upon protected matters, such as avifauna, given the significance of this environment for these species. Monitoring and adaptive management approaches will be required with respect to some avifauna.

1. Introduction

1.1 Project Background

The Alpha Coal Project (Rail) (hereafter referred to as the Project) is a standard gauge, 495 km long railway line that stretches between the Alpha Coal Mine near the township of Alpha and the Abbot Point Coal Export Terminal north of Bowen, Queensland (Figure 1). An Environmental Impact Statement (EIS) has been prepared for the Project which included an assessment of the aquatic ecology values within the EIS assessment area. This report forms a component of the Supplementary EIS (SEIS) for the Project.

The rail terminates at Abbot Point where a rail loop (and coal loading facility) are proposed in the vicinity of the Caley Valley Wetland, a wetland to the south west of the existing Abbot Point Coal Terminal (APCT). Two options for the rail at Caley Valley Wetland were considered and discussed in the EIS (see Figure 2). Alignment 1 incorporates a large loop around the wetland while Alignment 2 is a smaller loop located at the eastern boundary of the wetland immediately south of the existing APCT. Hydrological assessment was undertaken of both loop alignments to determine the relative impact on flow due to the development. In addition, for Alignment 2, two drainage configurations were investigated; the construction of two bridges in the loop within the wetland and the second involving the construction of multiple culverts within the loop. Modelling of both options produced similar results in terms of general impacts within the wetland (Appendix G Abbot Point Surface Water Model). The surfacewater model is discussed in further detail in Appendix G Abbot Point Surface Water Model of the EIS. The preferred alignment was chosen based on environmental and engineering considerations. As the footprint of Alignment 2 within the wetland is smaller than for Alignment 1, Alignment 2 was identified as the preferred option.

The aquatic ecology of the site with respect to the preferred loop option (Alignment 2) was assessed during the EIS using a combination of desktop data collection, literature review and wet season field survey. Given the length of the proposed alignment from an inland environment to the coast, a diversity of aquatic habitats were described and identified to provide habitat values for aquatic flora and fauna. The Alpha Coal Project (Rail) Freshwater Aquatic Flora and Fauna Report (August 2010), documents the results of the assessment, the existing aquatic ecology values and provides an impact and risk assessment for these values.

In response to a request for additional information, this report focuses on the aquatic ecology values of the rail loop infrastructure proposed at the northern end of the rail alignment (Figure 3). Additional information for this area has been sought from the review and integration of existing studies with newly available seasonal data, additional field survey and design information. It should also be noted that a description of the terrestrial ecological values of the site and management of potential impacts is covered in Appendix AE Updated Terrestrial Ecology Report and Appendix FB EPBC Report (Rail) of the SEIS.

1.2 Study Area and Rail Loop Footprint

The rail loop and surrounding environment (hereafter referred to as the *study area* and shown in Figure 3) is located at Abbot Point adjacent to the existing Abbot Point Coal Terminal (APCT); it intersects a small area of the Caley Valley Wetland system (Figure 3). The *footprint* of the rail loop comprises:

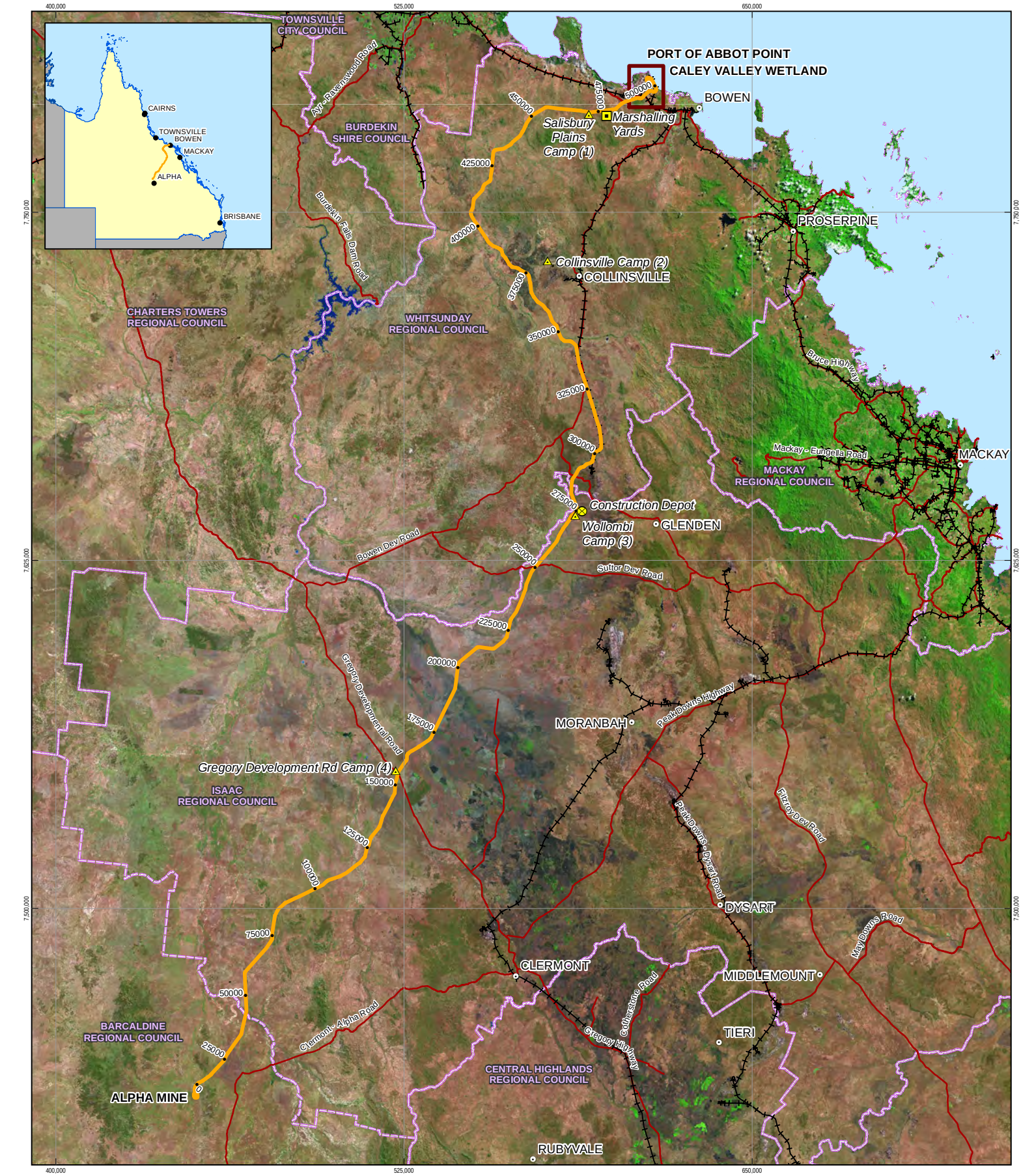
- The footprint of the rail infrastructure, wash down bay and dump station, including gauge width and berm;
- Local construction access tracks (to be used during construction only); and
- Local maintenance access track (that will be used and maintained through the operation phase).

The infrastructure footprint will have a:

- Temporary maximum width of approximately 55.5 m; and
- Permanent maximum width of approximately 43.5 m.

These figures are based on preliminary design and have been used in this report for the purposes of calculating approximate disturbance areas. These values may change slightly following final detailed design.

It should be noted that separate assessment and approval process will be undertaken for the port aspects of the Alpha Coal Project and the rail component of the Project (the subject of this report) is restricted to the rail loop, coal dump station and wash down bay. Infrastructure outside this scope, including connecting infrastructure (e.g. water treatment and settlement ponds) will be dealt with as part of the port infrastructure approval process.



LEGEND

- Town
- Camp
- Marshalling Yards
- Construction Depot
- Proposed Alignment
- State Road
- Existing Railway
- Local Government Area
- Caley Valley Wetland Region

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0 5 10 20 30 40 50

Kilometres

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Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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Alpha Coal Project
Supplementary Environmental Impact Statement

PROJECT RAIL ALIGNMENT AND EIS ASSESSMENT AREA

Job Number	41-23742
Revision	B
Date	04-08-2011

Figure: 1

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LEGEND

- Proposed Rail Alignment
- Alternate Large Rail Loop Option
- State Road
- Road
- Track
- Railway
- Creek / Watercourse

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Kilometres

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ALTERNATE RAIL LOOP OPTION

Job Number	41-23742
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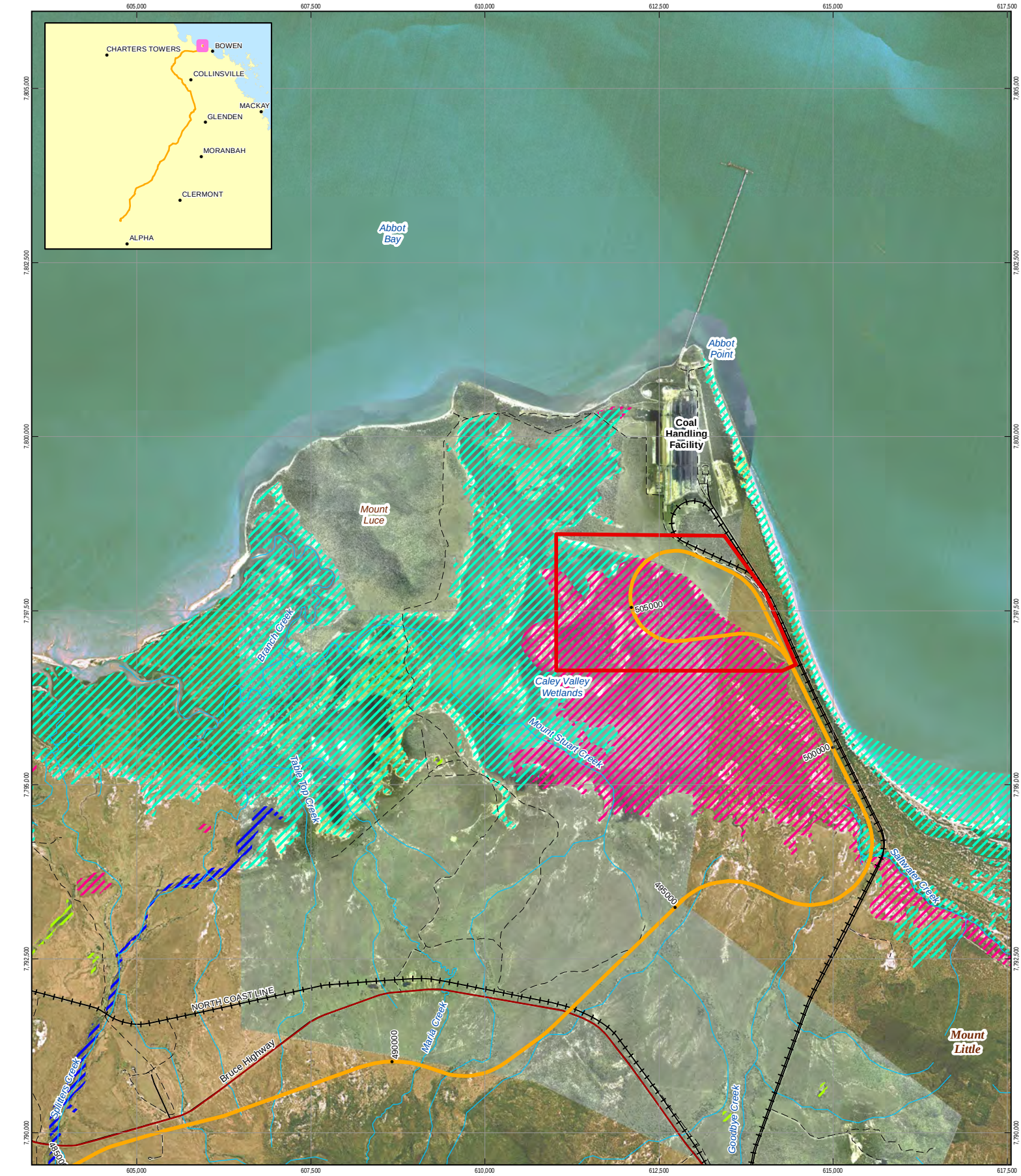

LEGEND

- Proposed Rail Alignment
- State Road
- Railway
- Road
- Track
- Creek / Watercourse

Wetland Area

- Estuarine Waterbody
- Lacustrine Waterbody
- Palustine Waterbody
- Riverine Waterbody

Study Area

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RAIL LOOP STUDY AREA

Job Number	41-23742
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2. Methodology

2.1 Summary

This assessment provides additional information specific to the rail loop at Abbot Point and identifies the potential impacts associated with its construction and operation. To achieve this, the following tasks were undertaken:

- Review of previous studies and existing information – available studies were reviewed and data considered relevant to the study area collated for the purposes of describing the existing aquatic environment within the study area.
- Field assessment – an ecological field survey was conducted within the rail loop footprint and adjacent area during February 2011. This assessment involved habitat assessments, water quality sampling and flora and fauna surveys.
- Impact and risk assessment – potential impacts including direct and indirect impacts of the project as well as likelihood and consequence of potential impacts were assessed.

Concept design information provided in June 2011 has been included and considered where appropriate to enable full consideration of the rail loop impacts, however whole of project information has not been repeated here. The reader should be familiar with earlier reports relating to the project (refer Section 2.3 for a list of key information of relevance).

2.2 Nomenclature

Scientific names for aquatic species are consistent with those used in the following sources:

- Freshwater Fishes of North-Eastern Australia (Pusey *et al*. 2004)
- A Field Guide to Reptiles of Queensland (Wilson 2005)
- A Field Guide to the Birds of Australia (Pizzey and Knight 2007) and
- Waterplants in Australia (Sainty and Jacobs 2003)

2.3 Existing Information of Relevance to the Project

The key sources of existing information reviewed as part of this assessment included:

- Hancock Prospecting Pty Ltd Alpha Coal Project (Rail) Freshwater Aquatic Flora and Fauna Report (GHD 2010a)
- North Queensland Bulk Ports Corporation Limited Proposed Abbot Point Multi Cargo Facility (MCF) Environmental Impact Statement, November 2010 (GHD 2010b)
- Hancock Prospecting Pty Ltd Alpha Coal Project (Rail) Environmental Impact Statement (GHD 2010c)
- Baseline Profile for the Kaili Valley Wetlands, September 2010 (BMT WBM 2010)

- Outcomes of workshop undertaken (27/05/2011) in conjunction with the construction team to identify relevant construction activities and design features

Other sources included:

- BMT WBM Kaili (Caley) Valley Wetland Draft Environmental Management Plan (BTM WMB 2011)
- Outcomes of assessment undertaken for Hancock Prospecting Pty Ltd Terminal 3 Project
- Directory of Important Wetlands listing for the Abbot Point – Caley Valley Wetland
- Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters search and Queensland Wildlife Online database search
- Regional Ecosystem (RE) mapping and other vegetation community mapping

2.4 Field Assessment

Areas of relevance to the project have been surveyed under a number of previous studies (refer Section 3.2). To supplement existing datasets, additional targeted surveys were undertaken specifically for the compilation of this report and these are described below. Field surveys were conducted in February 2011. Where relevant, the survey design has considered existing data formats to allow for suitable comparison. Survey sites are shown in Figure 4.

2.4.1 Weather Conditions

Weather conditions during field surveys in February 2011 included rainfall prior to and during survey. During the week prior to survey 18.4 mm was received (as recorded by BOM, Bowen Airport weather station). Maximum temperatures ranged between 27.4 and 30.6 ˚C degrees during the time of survey. Wind conditions ranged between 13 and 39 km/h, primarily from the SE. Rainfall occurred on the 23rd and 24th February, BOM recorded 20.5 mm and 3.3 mm respectively.

These supplementary field surveys occurred during the wet season and findings are comparable to wet season results of previous studies.

2.4.2 Habitat Assessments

Habitat assessment was conducted within the study area where it intersected aquatic environments on the 23rd – 25th February 2011. The assessment was conducted using an approach consistent with data collected during the main EIS and adapted from the Queensland AusRivAS habitat assessment technique. Habitat characteristics recorded in the study area included:

- Habitat types (e.g. pool, run, dry)
- Water velocity and flow level (i.e. no-flow, low, moderate, high, flood)
- Substrate description (i.e. bedrock, boulder, cobble, pebble, gravel, sand, silt/clay)
- Erosion and deposition
- Snags and woody debris (i.e. detritus, sticks, branches, logs)

- Habitat attributes (e.g. algae, macrophytes, bank overhang vegetation, trailing bank vegetation, blanketing silt, substrate anoxia)
- Presence of algae (i.e. on substrate, in water column) and macrophytes (i.e. submerged, floating, emergent)
- Adjacent landuse, human impacts, degradation from pastoral animals and
- Presence of pest/introduce flora and fauna species

2.4.3 Fauna Sampling

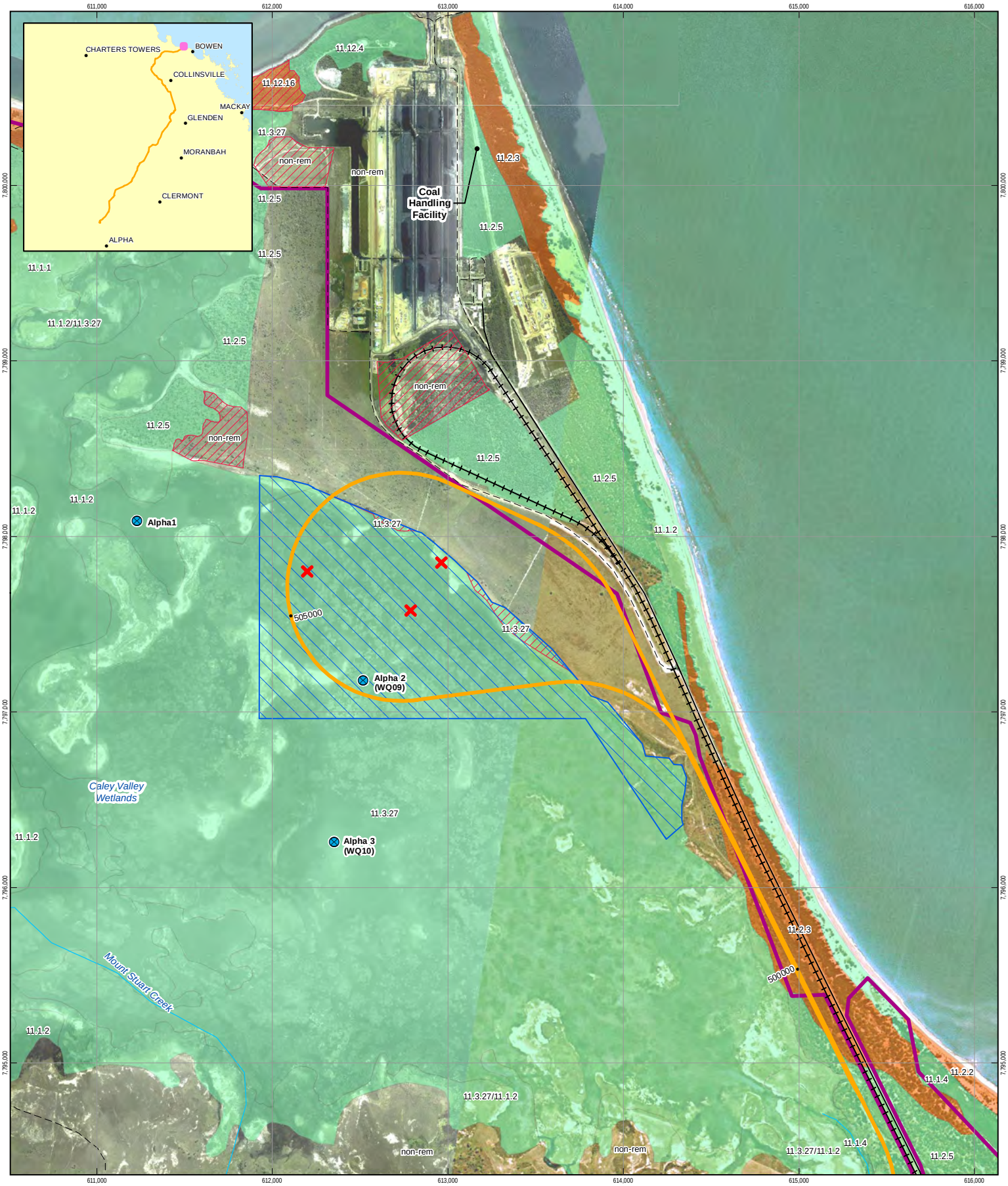
Aquatic fauna sampling was undertaken at three sites within the rail loop footprint (Figure 4) on the 23rd – 25th February 2011. Sampling consisted of deployment of a combination of box (or bait) and opera house traps. Baited traps remained submerged for approximately two hours before being checked and rebaited. A total of 29 traps were deployed during the sampling period.

Opportunistic observations of water bird species, or evidence of their presence (e.g. nests, feathers), were also recorded during aquatic field investigations within the study area. Habitat utilisation was also observed and recorded.

Sampling was undertaken in accordance with the GHD Standard Operating Procedures for fauna survey and under DEEDI General Fisheries Permit (permit number 113990) and methods considered previous survey approaches to allow for comparable data.

2.4.4 Flora

Flora investigations were conducted within the study area. The random meander technique was applied, which involved traversing sections of the study area and recording vegetation type and vascular flora species along each traverse. A species inventory was recorded for the study area. Plant species were either identified *in situ* or collected for later identification.



LEGEND

- Water Quality Sampling Location
- Fish Trap Site
- Proposed Rail Alignment
- State Road
- Road
- Track
- Railway
- Creek / Watercourse
- Amended Regional Ecosystems
- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Not of Concern
- Clear
- Amended RE Patch
- Abbot Point State Development Precinct
- Habitat Assessment Area

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RAIL LOOP FOOTPRINT AND SAMPLING LOCATIONS

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2.4.5 Water Quality

Surfacewater quality sampling was undertaken during the February 2011 surveys at two locations within the rail loop footprint (Figure 4). Sampling included physicochemical parameters using a hand held meter and the collection of laboratory samples for analysis of chemical parameters. Survey design considered the parameters and techniques used in previous water sampling for the EIS and other relevant studies in order to allow for comparison.

Physiochemical parameters measured included:

- Dissolved oxygen (% sat)
- Conductivity (µS/cm)
- pH
- Turbidity (NTU)

Chemical parameters measured included:

- Total suspended solids (mg/L)
- Nutrients (mg/L) – total nitrogen, ammonia, nitrate, nitrite, reactive phosphorus, total phosphorus
- Chlorophyll a (µg/L)
- Suite of metals (mg/L)

Sampling was undertaken in accordance with the Department of Environment and Resource Management (DERM) Monitoring and Sampling Manual 2009.

The results of this sampling supplement the data collected in the previous six month sampling program to obtain information on seasonal conditions within the study area.

Water Quality Guidelines

There are no defined water quality guidelines for the aquatic environment associated with the rail loop footprint and study area. Based on physical and environmental characteristics of the sampling locations the following guideline values are considered appropriate for comparison.

- ANZECC 2000 Guidelines for Tropical Australia – Wetlands – for physical and chemical stressors
- ANZECC 2000 Ecosystem Freshwaters 95% level of protection – for toxicants

2.4.6 Summary of Survey Effort

A summary of the survey effort is provided in Table 1. This summary considers the work previously undertaken for studies in the area (see Section 3.2) and its timing.

Table 1 Summary of Survey Effort

Assessment	Hancock Rail EIS (this study)	Abbot Point Multi Cargo Facility EIS	Abbot Point Terminal 3 Project
Aquatic Habitat Assessment	Assessment within and adjacent to the rail loop in February 2011 Assessment of available dry season aerial photography to gauge extent of wetland inundation	Assessment across the mid and lower reaches of the wetland in March/April 2009	
Fauna Sampling	29 traps set at three sites within the rail loop in February 2011 Opportunistic bird surveys in February 2011	56 traps set at 16 sites across the wetland March/April 2009 Bird surveys across the wetland in November 2008 and March/April 2009	Opportunistic bird surveys in February 2011
Flora Assessment	Within the rail loop in February 2011	Flora and vegetation communities in the wetland and surrounds in November 2008 and March/April 2009	Flora and vegetation communities within the rail loop in February 2011
Water Quality	Sampling at two locations for parameters consistent with the MCF program within and adjacent to the rail loop in February 2011	Monthly sampling at 14 locations across the wetland from February – July 2010	

Seasonality of Effort

An assessment of the dynamics of the wetland has been undertaken using aerial photography and information from previous studies and is discussed in Section 3.3.2. Field assessments undertaken during this and previous studies occurred during wet wetland conditions however previous studies and aerial photography also indicate that during drought the wetland recedes to varying extents. The wetland has been reported to recede to a small lake in the centre of the area, under which conditions, the rail loop , would be located in an area that is dry during the dry season.

2.5 Impact and Risk Assessment Approach

To allow for meaningful comparison and association with the impact and risk assessment conducted for the Project EIS the risk categories and impact assessment approach remains consistent. Environmental risks associated with the construction and operation were identified and classified into one of four risk categories (High, Medium, Low and Very Low). The classifications allowed priorities to be set for addressing and mitigating environmental risks. The risk assessment process included:

1. Identification of Risk
2. Risk Analysis: to determine the likelihood of occurrence and its consequences. A qualitative description of the likelihood and consequences for each risk enabled a semi-quantitative method to be used to calculate a 'score' for each risk. Definitions and scales for consequence and likelihood ratings are shown in Table 2 and Table 3 while the risk assessment matrix is described in Table 4.
3. Calculation of Risk Level: two levels of risk were implemented. The primary level of risk is a conservative measures based on the impact of the Project. The residual risk level calculates the risk when mitigation and control measures have been applied.

Table 2 Consequence Rating

Consequence	Rating	Description
Nil	0	No impact
Minor	1	Minor temporary environmental damage or disturbance
Moderate	2	Minor permanent environmental damage or disturbance
Significant	3	Reduction in habitat range/breeding success/abundance
Major	4	Significant loss of community or habitat potentially leading to the loss of a species
Critical	5	Total loss of a species or ecosystem

Table 3 Likelihood Rating

Likelihood	Rating	Likelihood Calculator
Rare	1	The risk may occur only in exceptional circumstances (The risk is not likely to occur in the next 25 years)
Unlikely	2	The risk could occur at some time (The risk is likely to occur once in the next 5-25 years)
Possible	3	The risk might occur at some time (The risk is likely to occur once in the next 2-5 years)
Likely	4	The risk will probably occur in most circumstances (The risk is likely to occur in the next 1-2 years)
Almost Certain	5	The risk is expected to occur in most circumstances (The risk is likely to occur in the next 12 months)

Table 4 Risk Assessment Matrix

Likelihood	Consequence					
	Critical (5)	Major (4)	Significant (3)	Moderate (2)	Minor (1)	Nil (0)
Almost Certain (5)	High	High	High	Medium	Medium	Very Low
Likely (4)	High	High	Medium	Medium	Low	Very Low
Possible (3)	High	Medium	Medium	Low	Low	Very Low
Unlikely (2)	Medium	Medium	Low	Low	Very Low	Very Low
Rare (1)	Medium	Low	Low	Very Low	Very Low	Very Low

3. Existing Aquatic Ecological Values

3.1 Regional Environment

The study area is located within the Brigalow Belt bioregion. This region, covering 135,500 km^2, comprises coastal areas, rugged ranges and alluvial plains that support open forests, woodlands, and small patches of semi-evergreen vine thicket (Young *et al.* 1999). The region experiences a distinct wet and dry season contributing to seasonal fluctuation in species abundance and composition, availability and suitability of habitat and ecological values. The seasonality of the area is discussed in Section 3.3.2.

The study area lies within the East Asian-Australasian Flyway which is a corridor through which waterbird migrate. The flyway spans from the Arctic Circle, through East and South-east Asia, to Australia and New Zealand (DSEWPC, 2009).Protected Areas

3.1.1 National Important Wetland

The study area is associated with the Caley Valley Wetland system, which is listed as a nationally important wetland under the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Directory of Important Wetlands. The system covers an area of approximately 5150 ha and is located adjacent to the Abbot Point Coal Terminal (APCT) facility north of Bowen (DSEWPC 2010).

The catchment area is approximately 830 km^2 and receives water from local runoff, freshwater creek systems (e.g. Saltwater Creek), tidal waters from Mt Stuart Creek and water from a detention pond at the APCT (GHD 2010b). These inputs, in combination with seasonal rainfall volumes, result in a high degree of seasonal variability in water quality, especially with respect to salinity (GHD 2010b).

The wetland features a combination of permanent estuarine waters, intertidal mud and sand flats, mangroves, saltmarshes, freshwater marshes and freshwater impoundments. It is recognised to be an area of importance for waterbirds and migratory species due to the mix of permanent water, range of wetland habitats and availability of food resources and breeding and roosting sites (DSEWPC 2010).

The defined seasonal fluctuation of the region leads to wet season filling of the wetland driving a freshwater system that provides habitat for a range of aquatic species, including freshwater fish and reptiles. The dry season experiences a reduction in wetland expanse generating a more saline environment as a result of tidal influence upon the area and restricted freshwater availability. Adjacent to the wetland there is extensive grazing.

3.1.2 Wetlands in Great Barrier Reef Catchments

The footprint intersects an area mapped as Great Barrier Reef (GBR) Wetland Protection Area on the DERM Map of Referable Wetlands. The mapping is shown in Appendix A. This mapping applies to the Temporary State Planning Policy 1/11: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments (DERM 2010).

3.1.3 Great Barrier Reef Marine Park

The Great Barrier Reef Marine Park (GBRMP) is a Matter of National Environment Significance (MNES) under the Environment *Protection and Biodiversity Conservation Act 1999* (EPBC Act). The area is listed as both a World Heritage Area and National Heritage Place.

The rail loop is not located within the GBRMP however the Caley Valley Wetland drains into this protected area.

3.1.4 Fish Habitat Areas

No fish habitat areas are located within or adjacent to the Project footprint. Protected areas are declared under the Queensland Government *Fisheries Act 1994* and play a key role in sustaining local and regional fisheries values.

3.2 Background Information

3.2.1 Alpha Coal Project (Rail) Freshwater Aquatic Flora and Fauna Report

Relevance to the Study Area

The Alpha Coal Project (Rail) Freshwater Aquatic Flora and Fauna Report (GHD 2010a) identifies habitat types and listed species with suitable habitat within the rail loop study area, which include the Caley Valley Wetland. The wetland is listed as a Nationally Important Wetland by DSEWPC. The study area intersects a small area of the wetland, and these habitats and conservation significant species are considered during this assessment of the rail footprint study area.

Summary of Assessment

The assessment investigated the aquatic ecology values along the proposed 495 km rail alignment of which the rail loop is located at the northern end (Figure 1).

It involved desktop and literature review as well as field survey in the wet season. Habitat assessment and surface water quality sampling was conducted in April 2010 along the length of the alignment. Twenty-two sites were chosen for assessment to represent the diversity of aquatic habitats within the rail alignment corridor (Figure 1). At each site the following information was collected:

- Habitat assessment to describe existing values of aquatic habitats. Included information such as habitat types, substrate, erosion and deposition, presence of algae, riparian characteristics and stream profile.
- Surfacewater quality was described using *in situ* measurements at sites where water was present at the time of survey. Physicochemical parameters were collected using a hand-held meter. Other water characteristics observations were also recorded such as water colour, water odour, macrophytes, human impacts and weather.

Ephemeral riverine habitats dominated the assessment area, which were characterised by a uniform channel with a sandy/gravel substrate and little instream habitat. Riverine habitats were generally ephemeral, with permanent pools providing important refuge habitats for aquatic species during the dry

seasons. Smaller areas of estuarine and lacustrine/palustrine habitats were also recorded.

The aquatic habitats assessment along the length of alignment identified values that provide habitat for a range of generalist fauna and flora species. Fifty-five fish species were considered likely to occur within the aquatic environments along the length of the alignment (either previously recorded or predicted to occur based on habitat requirements and distribution), including two endemic species. No listed threatened fish species have been previously recorded in the assessment area.

Specific to the rail loop study area, the EIS assessment identified estuarine, lacustrine and palustrine habitats as part of the Caley Valley Wetland complex. Although covering a small portion of the EIS assessment area these habitats provide important spawning, breeding and nursery habitat for many fish species and are particularly important habitat for waterfowl and shorebirds.

Aquatic reptiles and their habitat were detected throughout the EIS assessment area. This included the identification of suitable habitat for the estuarine crocodile (*Crocodylus porosus*) in the estuarine areas of the Caley Valley Wetland. This species is listed as 'Marine' and 'Migratory' under the EPBC Act and 'Vulnerable' under the *Nature Conservation Act 1992* (NC Act). No estuarine habitats are within the rail loop footprint.

3.2.2 Abbot Point Multi Cargo Facility Environmental Impact Statement

Relevance to the Study Area

A data sharing agreement framework between Hancock Pty Ltd and North Queensland Bulk Ports Pty ltd (NQBP) has allowed for relevant data to be used as part of this report.

Field assessments undertaken for the Abbot Point Multi Cargo Facility (MCF) investigated terrestrial and aquatic values within and surrounding Caley Valley Wetland. These assessments were undertaken in a number of locations, some of which are relevant to the rail loop study area. The characteristics of these sections of wetland are analogous to that of the rail loop study area as they contain similar habitat (i.e. palustrine wetland) and have similar seasonal influences (receives freshwater input from rainfall events during the wet season, and completely dries out during the dry season). For more mobile species, in particular birds, assessments conducted in the wider wetland provide relevant information to assessments in the rail loop study area, as comparable habitats and resources are present.

The relevant flora and fauna information from the MCF EIS is considered in this report in association with the findings of the aquatic assessments undertaken for the rail loop study area.

The rail loop footprint lies within the marine/freshwater interface zone of the wetland where seasonal rainfall, range in tidal influence and input from the detention ponds at the APCT contribute to the water quality conditions. Two sampling locations from the six month water quality sampling program undertaken occur in proximity to the rail loop footprint. Results obtained from the two sampling locations are considered relevant in describing the existing environment of the study area. This includes WQ09 and WQ10. The results of the sampling undertaken at these locations have been included in analysis for this report. These results assist in describing the temporal variability in water quality in the study area.

Summary of Assessment

Among other disciplines, the MCF EIS assessed the existing aquatic ecology and surfacewater values of the MCF study area. The MCF study area encompassed a mix of grazing land, coastal shrubland and the ephemeral Caley Valley Wetland. Studies included terrestrial and aquatic flora and fauna assessment and a six month water quality monitoring program.

Aquatic Flora and Fauna

Aquatic assessments were conducted to gain an understanding of the aquatic ecosystems, dynamics, and spatial relationships of the wetland system in differing hydrological states, and determine the potential impacts of the MCF on these values.

Field surveys were conducted in the wet and dry seasons to document seasonal changes in aquatic flora and fauna assemblages, habitat conditions and utilisation. Timing and details of field surveys are shown in Table 5.

Table 5 Timing of Surveys

Season	Dates	Field Assessments	Notes
Dry	11/11/2008 – 13/11/2008	Bird surveys at 6 sites	Extremely low water levels constrained use of techniques such as fish trapping
Wet	12/03/2009 – 4/04/2009	Bird surveys at transects and census points Aquatic habitat assessments Fish and crustacean trapping	

Bird surveys consisted of 30 minute censuses conducted twice each day. All birds that were heard and observed within a 200 x 100 m strip were recorded. Birds were surveyed either on foot or from vantage points around the perimeter of the wetland using binoculars and a spotting scope. Call playback was also undertaken to enable the detection of cryptic wetland species, and sessions lasted approximately one hour.

Habitat assessments recorded information such as physical characteristics, vegetation, topographical features, land use, potential for change in the seasonal variation and other disturbance.

Fish and crustacean trapping included a combination of box (or bait traps) and opera house traps. The species, number and size of each individual captured were noted before being released at the point of capture. In total, 56 aquatic fauna traps were deployed.

Bird surveys, habitat assessments, and fish and crustacean trapping recorded a large number of species across the wetland. Seasonal differences showed that there was a greater diversity and abundance of species during the wet season. Results of these assessments are discussed in association with the results of the fauna and habitat assessments in the study area, in Sections 3.3 and 3.5.

Non-systematic Sampling

Opportunistic observations of birds and aquatic fauna, or signs of their presence (e.g. scats, tracks, nests), were recorded while conducting activities in the wetland. Non-systematic sampling included diurnal and nocturnal searching. Observations of bird or aquatic fauna contributed to the species lists generated for sampling sites.

Surfacewater Quality

The water quality assessment aimed to develop an understanding of values of the Caley Valley Wetland and investigate the potential impacts of the MCF on these values. The Caley Valley Wetland complex comprises a variety of aquatic conditions including estuarine area in the west, a marine/freshwater interface in the main body of the wetland and freshwater inflow from Saltwater Creek in the east (GHD 2010b).

A six month sampling program was undertaken at 14 monitoring locations across the wetland system from February to July 2010. Sampling locations represented the diversity of aquatic habitat in the wetland including marine waters, freshwaters and the marine/freshwater mixing zone where the wetland widens. The program included sampling for physiochemical and chemical parameters and was collected, preserved and transported in accordance with the requirements of the DERM Monitoring and Sampling manual 2009 (DERM 2009a). The parameters collected on a monthly basis included:

- Physiochemical parameters measured
  - Temperature (°C)
  - Turbidity (NTU)
  - Dissolved oxygen (% sat)
  - Electrical conductivity (µS/cm)
  - pH
- Chemical parameters measured
  - Total suspended solids (mg/L)
  - Total nitrogen as N (mg/L)
  - Total phosphorus as P (mg/L)
  - Chlorophyll α (µg/L)

A supplementary suite of parameters was also sampled for on three occasions for parameters less susceptible to change. This included a suite of metals, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs), and cations and anions.

The results of the sampling program confirmed that the waterbody is highly variable across spatial and temporal scales noting that the program did not capture data during drier months. During the dry season it is expected the wetland dries to a small shallow area in the centre.

Temporal trends were observed with respect to conductivity and turbidity which is considered to relate to tidal influences from the bottom of the catchment and freshwater inflows from Saltwater Creek. Conductivity above freshwater conditions was evident across the wetland during seasonal inundation

and some areas of the wetland experience marine water conductivity even during heavy rain periods.

Nutrient parameters sampled exceeded guidelines values on a number of occasions with a number of potential contributors identified (e.g. high bird population, cattle grazing, upstream runoff). Metal results exceeded guideline values for six parameters: aluminium, cobalt, copper, lead and zinc.

The program identified the high degree of variability and recognised the difficulty in applying existing guideline values to a dynamic system such as this. Site specific and baseline data was considered more appropriate to detect and manage impacts.

3.2.3 Abbot Point Terminal 3 Project Ecological Assessment Report

The Abbot Point Terminal 3 Project (T3) commissioned by Hancock Pty Ltd intersects the study area with rail loop infrastructure. The T3 survey study area assessment considered flora and vegetation communities within the rail loop. The assessment involved sampling targeted sites within representative REs, random meanders and observations of the distribution and composition of vegetation communities. This groundtruthing of the certified RE mapping identified variations relating to:

- Incorrect RE designations
- Areas mapped as RE that are shown to be cleared on aerial photography

The amended RE mapping produced in the T3 report and the assessment of vegetation communities has been used to support this report for the rail loop infrastructure.

3.2.4 Baseline Profile for the Kaili Valley Wetlands

To Baseline Profile for the Kaili Valley Wetlands (BMT WBM 2010) report provides supporting information for the Kaili (Caley) valley Wetlands Draft Environmental Management Plan (BMT WBM 2011). The assessment included baseline data collation and review for the wetland and provides a profile description on the basis of existing information.

This baseline profile provides supporting information in relation to the wetland ecosystems, flora and fauna as well as describing key environmental values for the wetland.

3.3 Aquatic Habitats

3.3.1 Study Area Habitats

Aquatic habitats within the rail loop study area can be classified into one broad habitat type only, palustrine wetland. Palustrine habitats are characterised by gilgai's, swamps, billabongs and wetland (DERM 2009b), and are seasonally inundated during the wet season and gradually dry out as rainfall declines. This type of habitat generally supports a high diversity of aquatic macrophytes. Microhabitats within these environments provide seasonal breeding and larval habitat for diverse communities of aquatic macroinvertebrates. A description of the palustrine habitat in the study area is presented in Table 6.

The area of palustrine habitat that will be permanently directly impacted by the rail loop is approximately 11.5 ha. This area is based on the extent of wetland mapped in the DERM wetland mapping layer and design information identifying a maximum footprint width of approximately 43.5 m. The palustrine habitat area inside the rail loop is approximately 104 ha. The extent of palustrine wetland in the study area is shown in Figure 3.

South of the rail loop study area, a bridge crossing will be constructed at Saltwater Creek. Saltwater Creek is considered part of the Caley Valley Wetland, however, the aquatic habitat in this location is estuarine rather than palustrine. The aquatic habitat values of estuarine habitats have been previously discussed in the Alpha Coal Project (Rail) Freshwater Aquatic Flora and Fauna Report (GHD 2010a) and are not discussed further in this report. The area of estuarine habitat within the footprint at the bridge crossing at Saltwater Creek is approximately 1.9 ha.

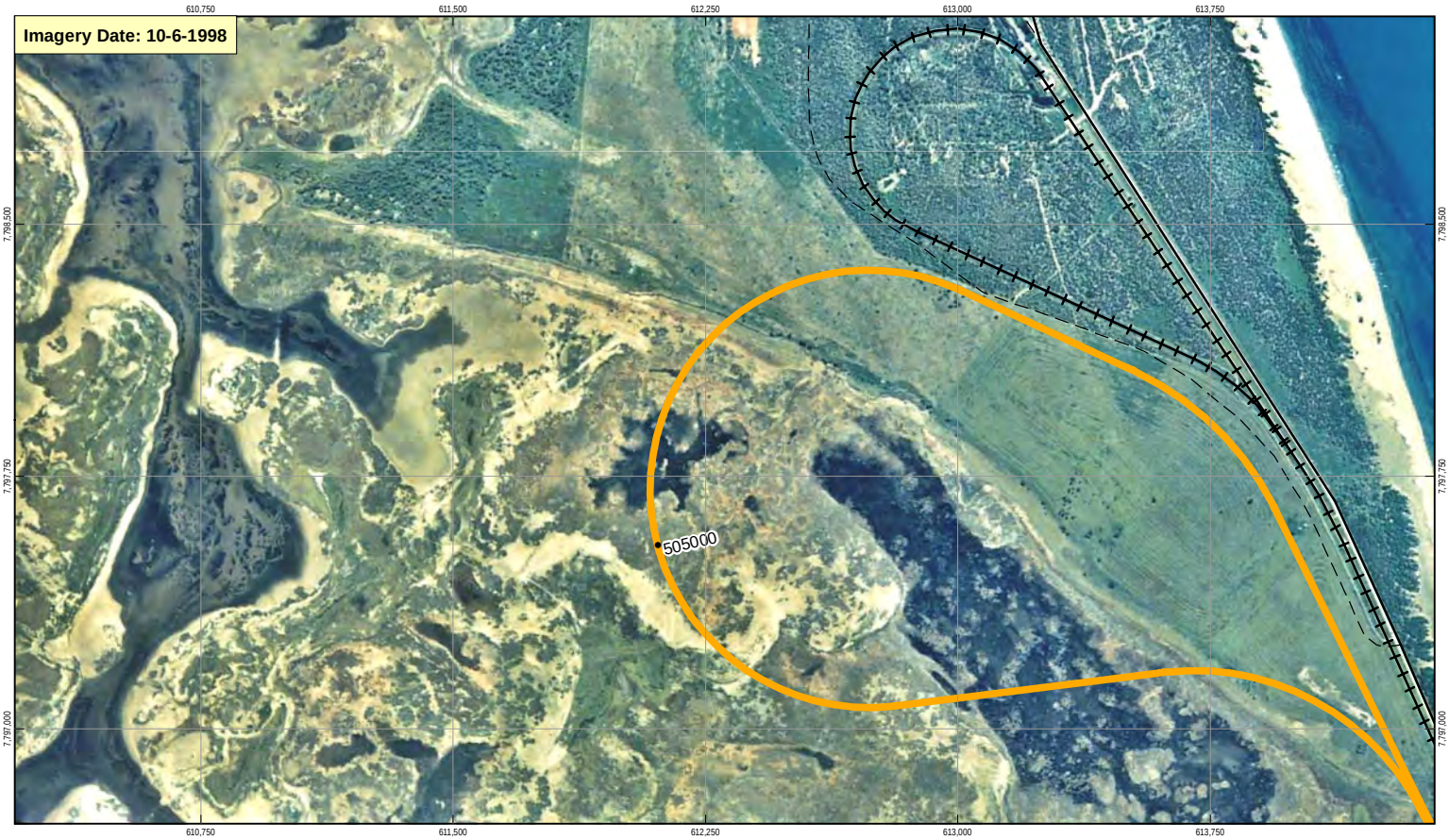
Table 6 Habitat Characteristics within the Study Area

Assessment Site	General Habitat Characteristics	Comments	Photos
Rail Loop study area – palustrine habitat	Waterway morphology – Large wide wetland expanse with gently sloping banks. Depth ranges between 10 and 150 cm Habitat types – shallow to medium depth wetland. Edges are shallow with large amounts of tall reeds/grasses. Submerged macrophytes present in most areas of shallow and deep waters Velocity – no flow Substrate description – 100% silt. Substrate is very soft and fine. Appears brown on surface layers and black beneath Erosion and deposition – No evidence of erosion. Fine silt deposits Snags and wood debris – little in wetland. Some wood debris around edges Habitat attributes – no overhanging vegetation; little trailing bank vegetation; no undercut banks Moderate algae on substrate and in water column; moderate to extensive emergent, submerged and floating macrophytes. Groups of tall reeds in wetland are used by birds to form nests Riparian characteristics – wetland is located adjacent to cleared land (grazing land), occasional eucalypts with banks dominated by grasses and sedges Adjacent land use – grazing Water surface is condition is normal in most areas, but slick around the edges of wetland. Some algae on substrate	The wetland is shallow to medium depth, with relatively clear water. Tall grasses; emergent, submerged and floating macrophytes are abundant along margins, and also extend into the wetland. Emergent macrophytes cover approximately 40% of wetland. Submerged macrophytes in open water areas. Land around the wetland is heavily grazed. Waterbirds observed nesting in 'islands' of tall grasses within the wetland. Waterbirds observed foraging within the wetland, and large numbers were observed to take flight upon approach.	 

3.3.2 Habitat Dynamics and Seasonality

The study area is situated in a wetland that experiences dramatic seasonal changes in aquatic habitat conditions. During the wet season the wider wetland receives freshwater from rainfall and surrounding rivers; none of these rivers are located in the immediate vicinity of the study area and so influence from these to the study area is indirect via connectivity across the wetland. This periodic inundation is important to recharge water levels, provides flushing and allows for biological connectivity with other areas of the wetland. During the dry season, the study area can receive little rainfall and very limited, if any, inputs of water from upstream areas. As a result, the wetland environment dries out and the water body contract to receive water from downstream tidal sources only. Toward the end of the dry season the habitat is characterised by cracking soils and salt pans supporting saltmarsh vegetation (GHD 2010b).

A review the Bureau of Meteorology median rainfall data for the previous 50 years indicates that the dry period is June to October/November however there are unseasonal years when these typically dry months experience substantial rainfall, for example total rainfall recorded in September 2010 was almost 120 mm in comparison to the 50 year median of less than 5 mm (BOM 2011). The majority of the field assessments have been undertaken when the rail loop footprint is inundated however historical aerial photography indicates that the wetland retracts substantially during dry periods. Available aerial photography has been assessed and the extent of the inundation of the wetland digitised (Figure 5) which depicts examples of the variation in inundation. The wetland is wide and shallow and it is expected that as aquatic availability reduces as it dries the characteristics of these habitats do not substantially change.



LEGEND

- Proposed Rail Alignment
- Railway
- Road
- Track

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1:15,000 (at A3)

0 0.25 0.5 0.75

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N W E S

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

COMPARATIVE DRY SEASON EXTENT OF CALEY VALLEY WETLANDS

Job Number	41-23742
Revision	A
Date	04-08-2011

Figure: 5

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3.4 Water Quality

Saltwater Creek enters the wetland in the south east providing a connection between the main wetland body and Euri Creek (Figure 3). During wetter months, Saltwater Creek transfers freshwater from Euri Creek into the wetland while drier months identify with lower freshwater inflows and tidal waters from Curlewis Bay inflow and dominate the wetland system (DSEWPC 2010). The seasonal variability in water input sources and volume plays an important role in driving water quality conditions and influences aquatic ecosystem values at the rail loop footprint and adjacent wetland.

Sampling undertaken in February 2011 within and adjacent to (sites Alpha 1 and 2 respectively), the rail loop footprint recorded results consistent with the sampling program undertaken for the MCF EIS. These two sites are located in the central area of the wetland in the marine/freshwater mixing zone where the wetland widens (Figure 4).

3.4.1 Physiochemical Parameters

Results of the *in situ* sampling undertaken in February 2011 is summarised and considered in conjunction with results of the previously sampled six month program (February 2010 – July 2010). In general the results of the sampling undertaken in February 2011 demonstrate the findings are relevant and currently applicable to describe the study area surfacewater quality.

Dissolved oxygen results ranged from 57 to 142 % saturation (Figure 6). Records ranged above and below guideline limits indicating a system variable in dissolved oxygen temporally and spatially. No clear seasonal trends were identified.

Conductivity results ranged between 587 and 8 524 µS/cm (Figure 7), with seasonal variation depicting a general increase in conductivity through the sampling program into drier months.

pH results ranged between 7 and 10.4 (Figure 8). Records ranged above or within guideline limits with a number of high records above 9. Further discussion on this is provided below.

Turbidity results ranged between 0 and 274 NTU (Figure 9). The turbidity of the wetland system is recognised to be highly variable seasonally and spatially. Rainfall, wind conditions, tidal influence and other input flow variability (catchment flow and settlement pond discharges), as well as sampling site depth and macrophyte coverage influence the turbidity of the wetland.

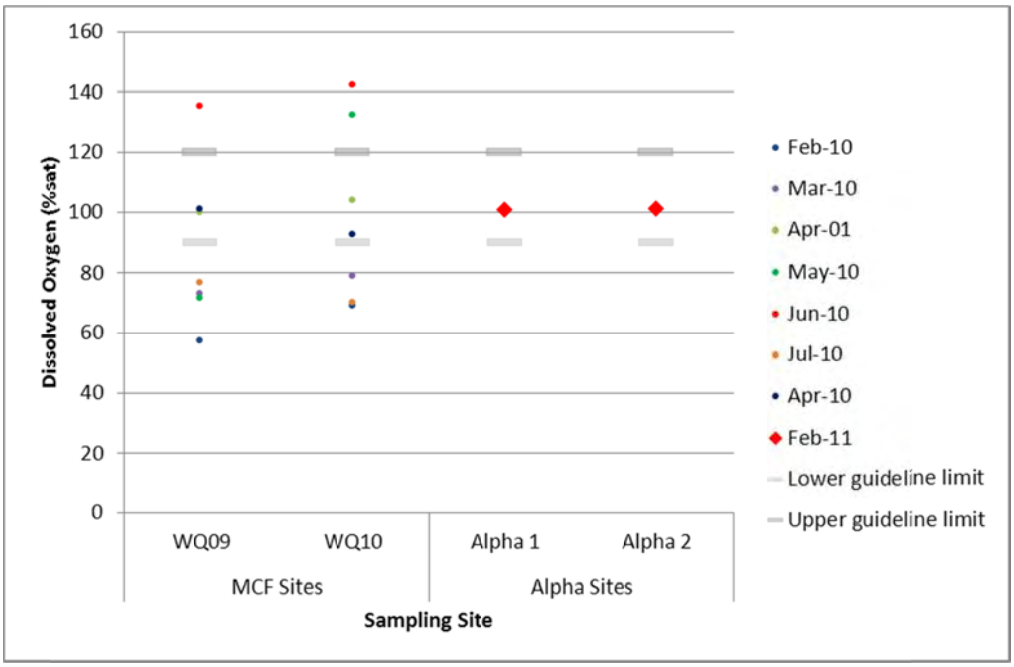

Figure 6 Dissolved Oxygen (% saturation) Records within the Study Area

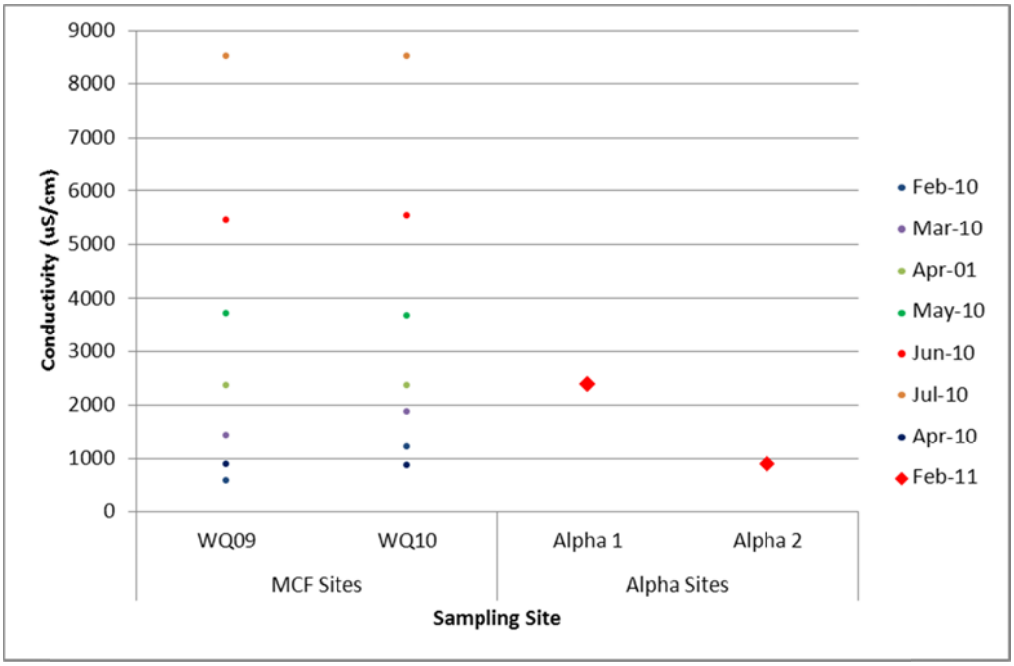

Figure 7 Conductivity (µS/cm) Records within the Study Area

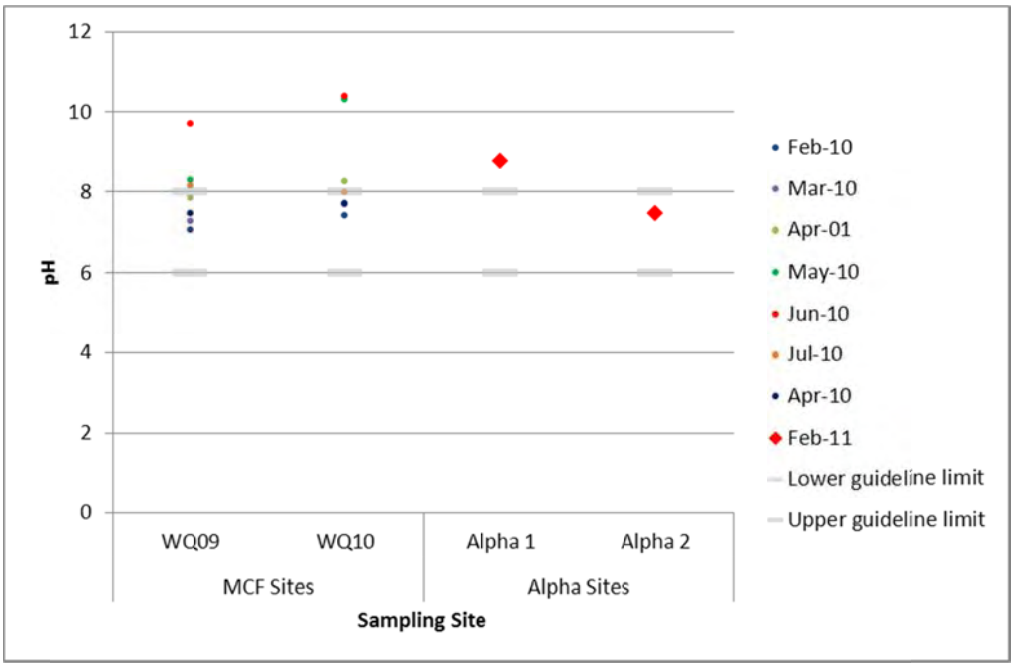

Figure 8 pH Records within the Study Area

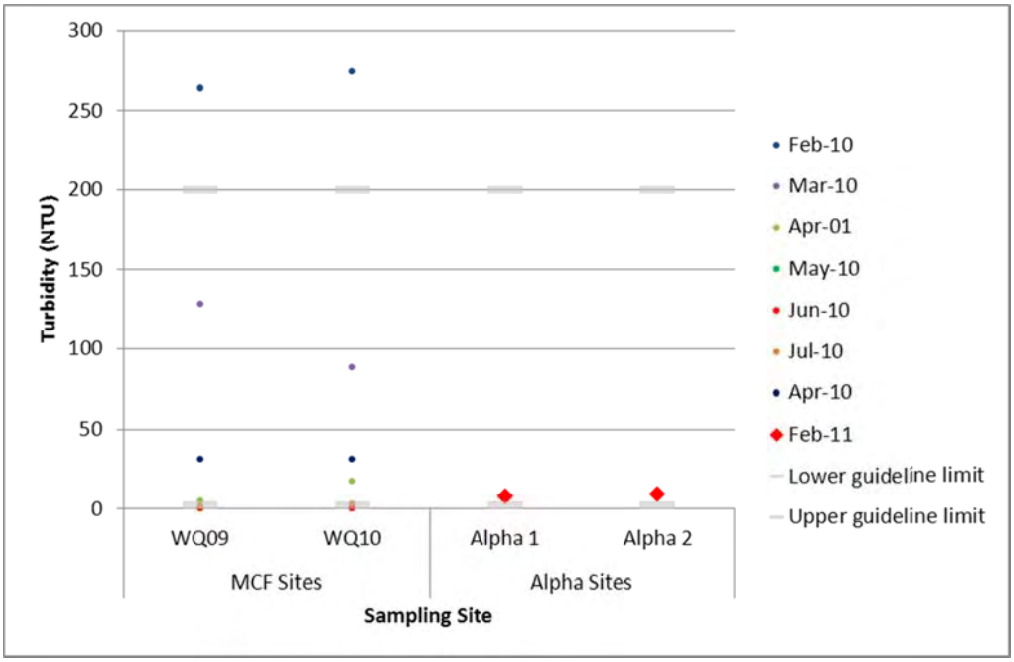

Figure 9 Turbidity (NTU) Records within the Study Area

Summary

In situ water quality measured within the rail loop footprint and adjacent ranged above and below guideline limits for dissolved oxygen and turbidity. Considering seasonal data from the wetland, *in situ* water quality parameters undergo seasonal variation and can often fall outside guideline limits. Seasonal trends in electrical conductivity were evident with a trend towards more freshwater conditions during wetter months. Freshwater inputs from Saltwater Creek and other runoff during these periods are expected to dilute saline influences from tidal intrusion downstream. During drier months when rainfall is reduced, the tidal inflow from downstream contributes to greater salinity.

pH records were within or above guideline limits, with a maximum of 10.4. The pH of most natural freshwaters range between 6.5 and 8.0 while the pH of marine waters is close to 8.2 (ANZECC 2000). This parameter can change diurnally, especially in poorly buffered waters where there is high primary productivity occurring (ANZECC 2000). Similarly, geological, agricultural and acid sulfate soils (ASS) can contribute to pH. Analysis of pH records in other areas of the wetland indicates a similar level of variation both up and downstream of the study area.

3.4.2 Chemical Analyte Results

Chemical analyte testing was undertaken in conjunction with *in situ* sampling. Results at sites Alpha 1 and Alpha 2 exceeded guideline limits for aluminium and copper (shown in dark orange shade in Table 7). Results were recorded outside guideline limits during the six months sampling program for a number of nutrient and toxicant parameters.

Results at Alpha 1 and Alpha 2 were often recorded at the lower end of the ranges of seasonal results obtained at WQ09 and WQ10, though never outside the range recorded. Given the seasonal variability of the wetland this is expected as the Alpha sampling reflects one temporal condition only.

Parameters where all results were recorded below laboratory limits of reporting have not been shown here. This included analysis for antimony, cadmium, mercury and tin. Raw data results are provided in Appendix A.

Table 7 Laboratory Sampling Results (dark orange shade highlights exceedence of guideline limits; light orange shade highlights exceedence of guideline limits during 6 month sampling program)

Parameter	ANZECC Guideline Limit	Alpha 1	Alpha 2	Results Range at WQ09	Results Range at WQ10
TSS (mg/L)		9	8	2-34	4-50
Nitrogen (Total) (mg/L)	1.2	0.67	0.85	0.54-0.74	0.5-1.16

Parameter	ANZECC Guideline Limit	Alpha 1	Alpha 2	Results Range at WQ09	Results Range at WQ10
Nitrite (mg/L)		<0.002	0.003	<0.002-0.128	<0.002-0.182
Nitrate (mg/L)	0.7	<0.002	<0.002	<0.002-0.139	<0.002-0.251
TKN as N (mg/L)		0.67	0.85	0.47-0.65	0.41-1.16
Reactive phosphorus (as P) (mg/L)	0.025	0.001	0.003	<0.001-0.05	0.001-0.34
Total phosphorus (mg/L)	0.05	0.006	0.021	0.012-0.192	0.006-0.188
Ammonia as N (mg/L)	0.01	<0.005	<0.005	<0.005-0.042	<0.005-0.062
Chlorophyll α (µg/L)	10	2	5	1-6	<1-13
Aluminium (mg/L)	0.055	0.235	0.2	0.09-8.28	7.51-9.16
Arsenic (mg/L)	0.024	0.002	0.0015	0.0015-0.0023	0.002-0.0029
Boron (mg/L)	0.37	0.171	0.069	0.064-0.095	0.11-0.317
Chromium (mg/L)		0.0003	0.0003	0.0182-0.0189	<0.0002-0.0185
Cobalt (mg/L)		0.0004	0.0005	0.0038-0.0041	0.0003-0.0044
Copper (mg/L)	0.0014	0.0014	0.0005	0.0076-0.0091	<0.0005-0.0085
Iron (mg/L)		0.471	0.878	8.23-8.84	0.133-9.08
Lead (mg/L)	0.0034	0.0003	0.0001	0.0029-0.0035	0.0002-0.0043
Manganese (mg/L)	1.9	0.0252	0.184	0.095-0.105	0.0109-0.109
Molybdenum (mg/L)		0.0019	0.0009	0.001-0.0024	0.002-0.0032
Nickel (mg/L)	0.011	0.001	0.0008	0.0069	0.0013-0.0071
Selenium (mg/L)	0.11	<0.0002	<0.0002	<0.0002-0.0003	<0.0002
Vanadium (mg/L)		0.0018	0.0012	0.019-0.023	0.0009-0.0238
Zinc mg/L	0.008	<0.001	<0.001	0.012	0.002-0.012

3.5 Species Diversity

Results of previous surveys of the wider wetland area are summarised in Table 8. Previous surveys of the wider wetland during wet and dry seasons found 166 aquatic fauna and bird species (GHD 2010b). During the 2011 survey of the rail loop study area, 18 species were recorded, majority of which were recorded in previous surveys. However, additional species found in previous surveys within palustrine wetland habitats not recorded in February 2011 also have the potential to occur within and adjacent to the study area. The different species groups, and their occurrences, are described in greater detail in the sections below.

Table 8 Fauna Recorded in Previous and Present Surveys

Fauna Group	Database records (Wildlife Online)	Broader wetland area surveys (MCF)	Survey Results within the Study Area
Fish	0	8	4
Aquatic reptiles	2	2	1
Macroinvertebrates	0	3	0
Birds	154	153	13

3.5.1 Fish

Four species of fish were recorded during sampling within the study area. The most abundant species recorded was the *Ambassis* species (glassfish), with over 600 individuals captured during the survey period. The other species captured included *Leipotherapon unicolour* (spangled perch), *Hypseleotris compressa* (empire gudgeon) and *Gambusia holbrooki* (mosquitofish). The latter species is an introduced species, and was recorded in relatively high abundance.

Previous surveys within the wider wetland area have recorded eight fish species (GHD 2010b). The dominant species was *L. unicolour*, which is extremely hardy, occurs in a wide range of habitats, and can tolerate a wide range of salinity, pH and temperature conditions. This species was recorded in the western area of the wetland. Other species recorded within this area include *Terapon jaruba* (crescent perch), *Mugil cephalus* (sea mullet), *Scatophagus argus* (spotted scat) and *Selenotoca multifasciata* (banded scat). In the upper freshwater wetland area, where habitat is similar to that within the study area, species found include *Lates calcarifer* (barramundi), *A. agassizii* (Agassiz's glassfish). In the estuarine and saline influenced wetland area in the northern section of the wetland, high abundances of *Lutjanus russelli* (Moses perch) and *Terapon jaruba* (crescent perch) were detected, however these

species are not considered likely to be abundant within or adjacent to the study area as it is less influenced by saline waters.

3.5.2 Reptiles

One turtle was captured within the study area; *Chelodina rankini* (Rankin's turtle – formerly *Chelodina canni*), as shown in Figure 10. This species is listed as 'Least Concern' under the NC Act, though is expected to have a restricted distribution along the coast of eastern Queensland, from Rockhampton in the south to the Cape in the north (Cann 2008). Similar to other long necked turtles in the region, this species is likely to be affected by the drying of lagoons. Increased development, atypical weather patterns and increased predation pressure are all likely to adversely affect some populations of *C. rankini* (Cann 2008).

Other studies within the wider wetland area have recorded *C. rankini* and *C. longicolis* (eastern snake-necked turtle) (GHD 2010b). An adult *C. longicolis* was observed moving through coastal scrub around the eastern side of the wetland. These two species are expected to utilise the wetland habitat in the study area throughout the wet season and be restricted to small water bodies or moister vegetation communities outside the study area during the dry season.

Crocodylus porosus (estuarine crocodile) is listed as 'Marine' and 'Migratory' under the EPBC Act and 'Vulnerable' under the NC Act. The EPBC Protected Matters Search tool identified the estuarine crocodile as a 'Migratory' and 'Marine' species which has the potential to occur within the study area. This species has not previously been found in the study area (DERM Wildlife Online, GHD 2010a, GHD 2010b). No crocodiles were observed during surveys, however there is potential for them to occur in the wetland. The highest value habitat for this species in the wetland is considered to be in the estuarine regions of the wetland downstream of the study area.

Figure 10 *Chelodina rankini* (Rankin's turtle) Captured within the Study Area

3.5.3 Macroinvertebrates

No macroinvertebrates were captured during field surveys within the study area. However crabs have been observed elsewhere in the wetland; such as the *Uca* sp. (fiddler crab), *Grapsidae* sp. (shore crab) and *Scylla serrate* (mud crabs) were observed in the estuarine areas to the west of the study area where the habitat includes mudflats (GHD 2010b). The study area does not include any mudflat habitats.

3.5.4 Aquatic Flora

The study area is currently mapped as containing two REs (DERM RE and Essential Habitat mapping, Version 6.0b, 2009). Ground trothed palustrine wetland (RE 11.3.27) is the dominant vegetation type and is mapped over the areas of lower elevation. Two narrow strips of Corymbia-Melaleuca woodland (RE 11.2.5) were mapped on the edge of the wetland within the study area. However field investigations for the T3 project did not identify remnant vegetation 11.2.5 in these patches. These areas were more characteristic of palustrine wetland (11.3.27x1c) or non-remnant vegetation. The description of the regional ecosystem is provided in Table 9. The amended RE mapping generated during the T3 project is shown in Figure 4.

Table 9 Regional Ecosystems within the Study Area

RE ID	Description	VMA class	
11.2.5	Corymbia-Melaleuca woodland complex of beach ridges and swales	Least Concern	
11.3.27x1c	Palustrine wetland (e.g. vegetated swamp). Mixed grassland or sedgeland with areas of open water +/- aquatic species. Dominated by a range of species including *Eleocharis spp., Nymphoides spp. and sometimes Phragmites australis*. Occurs on closed depressions on alluvial plains that are intermittently flooded in inlands parts of the bioregion.	Least Concern	

Fringing Vegetation

Vegetation adjacent to the wetland within the study area varied with elevation and distance from the water's edge. Upslope to the east of the wetland was cleared and contained pasture, with a range of weed species including *Macroptilium lathyroides* (phasey bean), *Passiflora fotetida* (stinking passionflower) with a number of young *Corymbia tesselaris* (Moreton Bay Ash) present. These appeared to be dead or in declining health. A number of weed species from the improved pasture had spread downslope and encroached on the edge of the wetland. Native species at the wetland fringe included *Pandanus spiralis* (screw pine), with relatively dense layer of native grasses including *Sporobolus virginicus* (salt couch) and *Paspalum diffusum* (water couch).

Macrophytes

Within the rail loop footprint, emergent macrophytes made up to 40% cover, and majority of the open water areas contained submerged and floating macrophytes. Emergent macrophytes consisted predominantly of stands of *Scoenoplectus littoralis*. *Eleochaeris sphaculata* (tall spike rush) was found in lower abundance in stands in shallower water toward the edge of the wetland. Submerged macrophytes, particularly *Najas tenuifolia (*waternymph), and to a lesser extent *Blyxa auberti*, were found throughout the study area. The floating macrophyte, *Marselia mutica* (banded nardoo) were quite common.

Marine Plants

A marine plant is defined in the *Fisheries Act 1994* as a plant (a tidal plant) that usually grows on or adjacent to, tidal land, whether it is living, dead, standing or fallen. The definition also includes material of a tidal plant, or other plant material on tidal land as well as a plant, or material of a plant, prescribed under a regulation of a management plan to be a marine plant. Plants that meet the definition of 'marine plants' under the *Fisheries Act 1994* were recorded during field investigations.

Vegetation containing marine plants occurs within, and adjacent to, the areas mapped as wetland in the study area. The areas mapped as palustrine wetland (RE 11.3.27x1c) comprise marine plants. It must be noted however, that these areas that contain marine plants are highly variable depending upon seasonal hydrological variation. It is noted that no mangrove communities occur in the study area.

3.5.5 Birds

A total of 13 bird species were recorded within the vicinity of the study area and are shown in Table 10. Three of these species are listed 'Marine' species, and one is a listed 'Marine' and 'Migratory' (under the EPBC Act). Generally the species found in the study area are relatively common in the wetland habitats within the bioregion. Habitat within the study area was observed to provide foraging, breeding and roosting habitat for these species. Specifically, nests and young of *Cygnus atratus* (black swan) and *Dendrocygna eytoni* (plumed whistling duck) were observed in the reed beds, while roosting was observed on the raised areas of dry land within the wetland. Flocks of approximately 200 plumed whistling ducks were observed

foraging in the open areas of the wetland while wader species, such as egrets were observed foraging along the shallow margins of the wetland. Terns were also observed in relatively high abundance.

Previous bird surveys in Caley Valley Wetland have found a large abundance and diversity of bird species (GHD 2010b). Within the broader wetland area, 153 bird species have been recorded, including the following four threatened species:

- *Geophaps scripta scripta* (squatter pigeon - southern race) listed as 'Vulnerable' under the EPBC Act and NC Act
- *Ephippiorhynchus asiaticus* (black-necked stork), listed as 'Near Threatened' under the NC Act and
- *Numenius madagascariensis* (eastern curlew), listed as 'Near Threatened' under the NC Act
- *Sterna albifrons* (little tern), listed as 'Endangered' under the NC Act

Species found in previous surveys within the wider area, and those within the vicinity of the study area, are detailed in Appendix C (GHD 2010b).

Many of the bird species recorded within the broader wetland are known to utilise a range of habitats including the Melaleuca woodland and palustrine wetland habitats represented in the study area. Of the protected species, only *E. asiaticus* was observed in the vicinity of the study area, and is considered to have habitat in the study area.

The abundance and diversity of bird species differed seasonally; a larger number of species were recorded during wet season surveys (133 species) than dry season surveys (111 species). The additional species recorded were mostly breeding wetland birds. Dry season surveys recorded 31 species of birds specifically within wetland habitat, most of which were found among mangroves and adjoining tidal flats. These habitats did not occur in the study area. The habitat used by birds during the dry season is reduced to small patches outside the study area. Elsewhere, bird species diversity and abundance were low.

Wet season surveys in the upper reaches of the wetland recorded high abundances of waterfowl species such as *Cygnus atratus* (black swan), *Dendrocygna arcuata* (wandering whistling duck), *Anas gracilis* (grey teal) and *Anas superciliosa* (Pacific black duck) seen during surveys (GHD 2010b). Similar to dry season surveys, *Anthus novaeseelandiae* (Richard's pipit) and *Mirafra javanica* (singing bushlark) were abundant in grassland adjoining the wetland. Other wetland species were observed breeding at this time, including:

- *Dendrocygna eytoni* (plumed whistling-duck)
- *Vanellus miles* (masked lapwing)
- *Charadrius ruficapillus* (red-capped plover)
- *Podiceps cristatus* (great crested grebe) and
- *Gallirallus tenebrosa* (dusky moorhen)

The latter three species were not observed within the study area during recent surveys (2011). The plumed whistling duck was observed in large numbers within the study area. Masked lapwings were observed on the dry grasslands immediately adjacent to the study area.

The following species of conservation significance were not recorded during any field surveys within the rail loop footprint but may potentially occur there based on suitable habitat availability (EPBC Protected Matters Search Tool and Wildlife Online, Appendix B):

- *Esacus magnirostris* (beach stone curlew – 'Vulnerable' under NC Act); this species has been recorded in the broader area (Wildlife online) and suitable habitat exists within the rail loop footprint
- *Rostratula australis (*Australian painted snipe – 'Vulnerable' under EPBC Act and NC Act); no previous records (Wildlife Online) however suitable habitat exists within the rail loop footprint
- *Nettapus coromandelianus albipennis* (Australian cotton pygmy goose – 'Near Threatened' under NC Act); no previous records (Wildlife Online) however suitable habitat exists within the rail loop footprint.

Table 10 Bird Species Observed in the Study Area

Common Name	Species Name	Status	Notes
Black swan	*Cygnus atratus*		Observed in open areas
Eurasian coot	*Fulica atra*		
Great egret	*Ardea alba*		Observed in small reeds
Gull bill tern	*Gelochelidon nilotica*		Observed foraging in open areas
Little black cormorant	*Phalacrocorax sulcirostris*		
Magpie goose	*Anseranas semipalmata*	Marine	
Masked lapwing	*Vanellus miles*		
Pacific black duck	*Anas superciliosa*		
Pied cormorant	*Phalacrocorax varius*		
Plumed whistling duck	*Dendrocygna eytoni*		Observed in open areas
Purple breasted swamp hen	*Porphyrio porphyrio*		
Whistling kite	*Haliastur sphenurus*	Marine	

Common Name	Species Name	Status	Notes
White bellied sea eagle	*Haliaeetus leucogaster*	Marine, Migratory (CAMBA)	

Migratory and Marine Bird Species

The Australian Government has entered into three bilateral agreements to protect migratory bird species. These agreements are the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA) and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA). Migratory species are also protected under the Bonn Convention. This is an international convention on the Conservation of Migratory Species of Wild Animals (DEWHA 2008). All migratory bird species listed in the annexes to these bilateral agreements and conventions are protected in Australia as Matters of National Environmental Significance (MNES) under the EPBC Act.

As mentioned above, the field survey recorded three 'Marine' bird species and one 'Marine' and 'Migratory' bird species within the rail loop footprint, and an additional 48 bird species listed as 'Marine' and/or 'Migratory' under the EPBC Act have been recorded in the wider wetland area (GHD 2010b). Forty-six of these were recorded during the wet season, highlighting the importance of the study area for waterfowl. Thousands of ducks, swans and magpie geese were seen utilising the Caley Valley Wetland for breeding and foraging (GHD 2010b). Habitat within the wetland was also utilised by other listed migratory waterbirds including *Plegadis falcinellus* (glossy ibis), *Ardea alba* (great egret), *Hydroprogne caspia* (Caspian tern), *Chlidonias leucopterus* (white-winged black tern) and *Ardea ibis* (cattle egret). For *Hydroprogne caspia* (Caspian tern), habitat within the wetland may be of regional importance with c. 150 birds recorded roosting and/or feeding during wet season surveys (GHD 2010b).

Of these 'Marine' and 'Migratory' species, only 15 were shorebird species. Numbers of 'Migratory' shorebird species within the wider wetland were generally low. *Calidris acuminata* (sharp-tailed sandpiper) was the most abundant migratory shorebird species recorded during wet season surveys with around 50 birds observed. Other shorebird species were less abundant during wet season surveys (between 1 and 10 individuals) (GHD 2010b).

The study area provides habitat for numerous 'Migratory' and 'Marine' bird species, many of which utilise other regions in the wider wetland and are present on a seasonal basis only. The study area contains important habitat for breeding, nesting and foraging for high abundance of birds, however suitable habitat is also available in the wider wetland.

Field investigations have shown that the aquatic ecological values of the study area include palustrine wetland habitat supporting a variety of fish, reptile and bird species. The seasonal changes associated with this dynamic habitat within the study area will influence the abundance and diversity of aquatic flora and fauna between wet and dry seasons. In general, flora and fauna species recorded greater abundance and diversity within the study area

during the wet season, while the water body contracted during the dry season and fauna species were less abundant in the study area. The available evidence indicates that the study area is important habitat to numerous species, particularly in the wet season, however these species are also found in similar habitats elsewhere in the wetland. The wider wetland supports a high diversity of habitats, with a large extent of palustrine wetland such as that represented in the study area. The aquatic ecological characteristics found within the study area are not considered to be unique to the rail loop footprint, as the species within the study area were also observed elsewhere in similar habitat.

4. Potential Impacts and Mitigation Measures

4.1 Introduction

The rail loop footprint traverses both terrestrial and aquatic environments. The values of the aquatic environment have been described in Section 3 and broadly include:

- Study area intersects a section of wetland system listed under the directory of Nationally Important Wetlands. This listing is based on a number of features including availability of foraging resources, sheltered roosting and breeding values of importance for waterbirds. These resources are represented within the study area as well as the adjacent wetland.
- A seasonally dynamic aquatic environment that undergoes wet season filling, and contraction of the wetland extent of water during drier months. The study area is not expected have standing water throughout the year.
- The permanent footprint of the rail loop includes approximately 11.5 ha of area mapped as palustrine wetland (according to DERM wetland mapping layer 2011). There will be approximately 3.2 ha of additional wetland area temporarily disturbed during construction. This equates to approximately 14.7 ha of palustrine habitat in the wetland to be impacted by the rail loop. All of these areas are mapped as marine plant remnant communities. Associated with the rail loop development and wetland environment is additional direct impact upon aquatic habitat resulting from a bridge crossing at Saltwater Creek. This will permanently affect 1.9 ha of aquatic habitat, including marine plant communities, and will temporarily affect an additional 0.5 ha during construction. Accordingly approximately 16.6 ha and 3.7 ha of aquatic marine plant communities are expected to be permanently and temporarily impacted by this development, respectively. Temporary impacts will be rehabilitated and are expected to be in effect for no more than 3 years.
- Temporally variable surfacewater quality conditions. Results within the wetland have demonstrated exceedences of guideline limits for a number of nutrient and toxicant parameters. Hence site specific threshold values and baseline data are considered more appropriate management tools to facilitate detection and management of site specific impacts.
- Habitat for a variety of native fish, turtle and bird species. Some of which use the wetland on a seasonal basis, mostly occurring during wet season months when the wetland is at its greatest expanse.

The rail loop infrastructure has the potential to influence the aquatic environment of the wetland as a result of construction and operation activities. The identification of potential impacts and the development of targeted mitigation measures aim to reduce the risk of the rail loop construction and operation impacting aquatic environmental values. Mitigation and management measures have been developed using Australian and Queensland standards, guidelines and policies where relevant and these have been identified.

The rail loop infrastructure intersects approximately 14.7 ha of wetland area (based on DERM

wetland mapping layer 2011), which includes both permanent and temporary disturbance. The wetland is highly dynamic and retracts during drier months. During drier months the wetland extent contracts and entire rail loop will not be in standing water.

The proposed rail line will be standard gauge which offers a number of advantages in terms of managing coal dust (including but not limited to improved wagon design and reduced material spillage typical when unloading over narrow gauge rails). The standard gauge line incorporates a dump station on the approach and a wheel wash facility immediately following and has configured the loop such that only empty (washed) trains will travel along the section of the rail loop that is within the wetland boundary. Detailed design will incorporate a range of measures to manage runoff from developed surfaces as well as the dump station.

Potential impacts of the Project on aquatic habitats outside the rail loop study area (including Saltwater Creek) are discussed in the Alpha Coal Project (Rail) Freshwater Aquatic Flora and Fauna Report (GHD 2010a) and are, therefore, not considered here. Mitigation measures nominated here regarding marine plant community impacts, including the need for offsetting of permanent losses, implementation of erosion and sediment control management measures etc., are considered consistent with measures nominated under GHD 2010a for protection of the aquatic habitat values to be impacted as a consequence of the bridge development at Saltwater Creek.

Environmental management of the rail loop will be consistent with the measures to be adopted to address identified impacts during the construction and operation of the rail component of the Alpha Coal Project. The framework for this is provided in Appendix AC Railway Corridor Environmental Management Plan of the SEIS. The mitigation measures below and sub-plans will be incorporated or associated with the Project EMP. The Project EMP will be submitted to DERM for approval prior to any disturbance.

4.2 Construction Phase Impacts and Mitigation

The construction of the rail loop and management of terrestrial areas adjacent to the wetland will be required to limit direct and indirect impacts to the aquatic ecosystem.

Construction is proposed to occur over approximately two years with activities occurring throughout the year, 24 hours a day and seven days a week. It is anticipated that the construction phase will commence March 2012.

The stretch of the rail loop that bisects the wetland will be constructed upon a rock and earth bund for the majority of the loop. A bottom dump station will be established on the entrance to the loop and a wash bay will be established following the dump station outside the inundation area of the wetland. Detailed design of the dump station and wash bay will provide for appropriate runoff and wastewater management (such as sediment ponds) with no discharge into the wetland.

In accordance with the hydrodynamic modelling of the wetland, preliminary designs have provision for two sections of the rail loop will be laid upon a series of culverts such that water

flows into/out of the area enclosed by the rail loop are maintained. Indicatively each section will consist of a series of approximately 20 box culverts (1.5 m x 0.9 m) sized to facilitate water flows and fauna movement (see Appendix E). The final sizing, configuration and features may vary during the detailed design phase and in accordance with further consultation with Queensland Fisheries.

To achieve this the construction phase of the Project broadly includes:

- Establishment of rock base for footprint of bund in areas subject to water inundation involving:
    - Dumping of aggregate for the loop footprint
    - Compaction and rock settlement period
    - Establishment of culvert structures
- Construction of earth fill on rock base and installation of service road and rail line top side infrastructure
- Installation of a washdown bay
- Excavation of cavity and construction of other associated infrastructure for dump station

Areas to be impacted will be used as laydown areas for construction infrastructure. Personnel will be housed offsite and all waste materials will be exported offsite for management.

Direct and indirect impacts to the aquatic environment have the potential to occur as a result of construction activities. These include:

- Removal of habitat for aquatic flora and fauna
- Fauna mortality due to increased vehicle traffic and potential for strike
- Disturbance to aquatic species during construction activities as a result of increased noise, light and vibration
- Alteration to hydrology
- Degradation of surfacewater quality as a result of increased sedimentation, dust and other runoff
- Degradation of surfacewater quality as a result of disturbance to ASS or other contaminants
- Increased abundance and diversity of introduced species

Each of these impacts and the proposed mitigation measures are described following.

4.2.1 Removal of Habitat for Aquatic Flora and Fauna

Potential Impacts

Construction of the rail loop will disturb approximately 14.7 ha of palustrine wetland area (includes both permanent and temporary disturbance). Of this area approximately 3.7 ha is

temporary disturbance during construction and will not be permanently removed. The habitat within the footprint provides foraging and breeding habitat for fish, reptiles and birds, including EPBC listed 'Migratory'/'Marine' bird species. The north-eastern section of the rail loop will be constructed within existing cleared areas of land adjacent to the Abbot Point road, with the aim of minimising the habitat loss and/or damage of additional wetland habitat during the construction process.

Habitat loss and fragmentation is identified as a key threat to the wetland in the Kaili (Caley) Valley Wetlands Draft Environmental Management Plan (BMT WBM 2011). The loss of habitat as a result of the Project has the potential to result in significant ecological consequences as a result of reduced availability in foraging and breeding habitat, including for conservation significant species.

Bird communities have been known to coexist with industrial land uses, including previous observations of birds adapted to the current disturbances at the APCT (numbers of species nesting and utilising the sediment ponds adjacent to the existing port facilities).

Mitigation Measures

A number of mitigation measures have been proposed to reduce the likelihood of habitat loss risk. The design proposed has considered environmental impacts and has selected the option which will provide the functional delivery of the rail infrastructure with the smallest disturbance (temporary and permanent) footprint. During the final detailed design and construction phases of the project, any reduction in the project footprint will be incorporated where possible. Notwithstanding, the project will result in a footprint will result in a loss of aquatic habitat and offsets will be required.

In addition to offsetting, mitigation measures against construction works potential impacts will include:

- Construction of rail loop sections incorporating culvert structures to maintain flow regime to the area (approximately 10.4 ha) to be bunded by the rail loop (as modelled in Appendix G Surfacewater Modelling of the EIS). Resultant effect is that habitat within the rail loop will not be lost thereby reducing overall area of potential direct and indirect impact considerably to only that area under the rail loop footprint.
- Use of erosion and sediment control devices during bund construction in accordance with the criteria identified in Appendix AD Erosion and Sediment Control Criteria of the SEIS to minimise impacts from degraded water quality on wetland environment resulting in indirect habitat losses.
- Foundation for the rail loop will be achieved via end dumping of aggregate rock from land build off points. Vehicles will move along the rail loop as the lay-down progresses to minimise the need for additional access tracks within the wetland to reduce fragmentation of habitat and unnecessary egress into the wetland during construction.
- Construction areas and sites will be clearly marked on construction plans and on the ground and restrict to minimal amount necessary within the wetland bed.

- Additional construction areas, such as soil stockpiles, machinery/equipment storages, will be located away from sensitive environmental receptors.
- Rehabilitation of areas that are temporarily disturbed during construction will be undertaken to re-establish habitat and/or limit degradation of adjacent habitats. Rehabilitation will consider the Kaili (Caley) Valley Wetlands Draft Environmental Management Plan (BMT WBM 2011) objectives.
- Revegetation of berm structure will be undertaken to provide erosion and sediment control management (as identified in Appendix E Soils and Contamination of the EIS) to mitigate risk of ongoing water quality impacts to wetland environment.

Recognising that the loss of habitat directly under the bund footprint is not able to be mitigated environmental offsets will need to be achieved. The Offset Strategy for the Project (refer to Volume 2, Appendix X of the SEIS) will take into account all impacts unable to be mitigated, including the area of wetland habitat to be offset. This strategy will be finalised in consultation with regulatory agencies to meet legislative requirements.

4.2.2 Fauna Mortality

Potential Impacts

Aquatic fauna likely to occur within the rail footprint include a variety of native fish, reptile, bird and macroinvertebrate species. Construction machinery and the dumping of rock aggregate have the potential to result in direct mortality of individuals if construction is undertaken when the footprint is inundated. This mortality has the potential to reduce local species populations, however, as the aquatic environment is ephemeral and the waterbody fluctuates in extent the opportunity for impacting aquatic fauna within this footprint is restricted to the wet months when the footprint may be underwater.

Mitigation Measures

Mitigation measures to limit the risk of fauna mortality include:

- A Species Management Plan will be developed and submitted to DERM for approval prior to any disturbance, consistent with Appendix AA of the SEIS.
- Programme construction works to minimise in-water activities during wet season/footprint inundation to reduce risk of contact with fauna.
- Erect temporary bunding (e.g. consider silt curtains or other) around aquatic habitats within the construction zone to exclude aquatic fauna and manage any risks of impact beyond footprint of works.
- Engage a qualified fauna spotter to be present on site prior to and during construction works in accordance with the management actions outlined in the Kaili (Caley) Valley Wetland Management Plan (BMT WBM 20011). Construction works will temporarily cease if fauna move into direct path of harm; and recommence works once fauna has moved out of construction footprint. Relocate any species out of construction area, as required if

required using appropriate fauna handling procedures.

- Educate employees of environmental responsibilities during inductions including requirement of zero harm and treatment of all native fauna species as protected.
- Develop a fauna mortality register to determine the location, frequency of mortality, and types of species most susceptible, to enable additional mitigation measures to be implemented where necessary and facilitate adaptive on site management of construction works to reduce repetition of impactive activities.

4.2.3 Noise, Light, Vibration and Visual Disturbance

Potential Impacts

Activities undertaken during construction will result in a localised increase in noise, vibration, artificial lighting and visual disturbance. During this period there is expected to be a constant localised disturbance to aquatic habitat, fauna and in particular bird behaviour and dynamics within and adjacent to the footprint. The Kaili (Caley) Valley Wetland Management Plan (BMT WBM, 2011) management objectives for the purposes of preserving existing natural values, which includes the objective to:

'*protect native flora and fauna species from disturbance by domestic animals and APSDA users and industries*' (BMT WBM, 2011)

Disturbance to avifauna and other fauna group behaviours can reduce breeding success as well as other behaviours such as feeding, leading to displacement of the communities (Francis *et al*. 2009; Benitez-Lopez *et al*. 2010). The construction phase is expected to run for up to two years and although temporary disturbance from construction spans a substantial period.

Noise, vibration, visual and light disturbances are discussed in further detail as part of operational impacts assessment (Section 4.3.2) with management proposed using a combination of design strategies, scheduling strategies and ongoing monitoring to allow for adaptive management. The wetland bird community is at most risk of these impact during construction however given the temporary nature of these impacts, construction occurring in the dry season when the rail loop area is not manadated and with appropriate mitigation it is expected these impacts can be minimised.

Mitigation Measures

Mitigation measures to reduce localised noise, light, dust and vibration impacts include:

- Programme construction works to minimise in-water activities during wet season/footprint inundation to reduce risk of contact with fauna. Avoiding these 'wet' periods when constructing in the wetland area will assist in minimising impact to large numbers of fauna and species during breeding/roosting seasons.
- Monitor seasonal occupation of the wetland by waterbirds and undertake adaptive management if populations are considered to be impacted by train noise, vibration, visual

disturbance and required lighting. Monitoring should be frequent enough to detect short and long term disturbance of bird populations as a result of the train movements. Should monitoring determine an adverse impact to population additional measures are to be developed and consequently monitored for effectiveness. Measures could include installation or modification of infrastructure (e.g. line of sight barrier to limit visual disturbance to fauna during sensitive periods, sound barriers), reduced train speed limits or changes to lighting infrastructure.

- Minimise lighting to that required for safe construction where possible.
- Employ directional lighting with protective guards around the construction to reduce and avoid light spill into wetland areas adjacent to the construction footprint, thereby minimising potential for disturbance to roosting/nocturnal species.

4.2.4 Barrier to Movement and Hydraulic Flows

Potential Impacts

During construction activities, rock base will be placed within the mapped boundaries of the wetland to construct the bund on which the rail infrastructure will be developed. This aggregate will be built up to above flood water level, which will generate a barrier to natural water flows. The construction process conceptually identifies land based construction with end dump processes resulting in a build out of the loop. Hence, as the construction progresses the barrier to flows and hydrological regimes will increase as the length of the bund increases.

Alteration of flows has the potential to change flushing regimes and in turn degrade local water and habitat quality. A reduction in water quality is expected to have flow on negative effects for flora and fauna communities in the vicinity. Barriers to aquatic fauna (fish, crustaceans and reptiles) movement may also be realised as wetland habitats are fragmented.

The long term impacts of alteration of flows as a result of the infrastructure are discussed in more detail in Section 4.3.3.

There is potential for a change in groundwater level as a result of construction. This change has potential to have flow on impacts to the ecology of the wetland if the wetland is dependant on groundwater flows. The level of potential for impact on groundwater during construction is dependent on whether groundwater is abstracted for construction purposes. Abstraction of groundwater could impact on water table levels, local flora and fauna (aquatic, terrestrial and subterranean), as well as surrounding groundwater users. Irrespective of whether groundwater is abstracted, construction of new infrastructure, such as culverts, cuttings, embankments and bridges, has the potential to result in short term, localised impacts on shallow groundwater. Mitigation and management of the impacts on groundwater have been discussed in the EIS and supplementary documentation.

Mitigation Measures

Mitigation measures to limit the potential impacts of altered hydrology during construction include:

- Programme works to minimise loop construction activities during wet season/footprint inundation to reduce direct interruptions to aquatic habitat connectivity.
- Undertake installation of bund rock base construction progressively via end dumping from land build off point to limit staged interruptions to flows from loop construction.
- Install series of culvert structures in appropriate sections (as modelled in Appendix G Surface Water Model of the EIS) of the rail loop to enable flow connectivity and exchange between habitats inside and outside of the rail loop and in accordance with the results of the hydrological modelling. Construct structures during periods of least flow to assist in minimising scour and other localised hydrological alterations during installation of appropriately designed culvert structures. Design culvert structures appropriately to maintain flows, water quality conditions, habitat connectivity and fauna movements between habitats inside and outside of the rail loop.
- Design rail loop bund such that stormwater run-off is managed to not negatively influence the water quality inside or outside of the rail loop. Consider use of erosion and sediment control options including revegetation of bund and use of a berm to capture scree run-off.

4.2.5 Degradation of Surfacewater Quality due to Sedimentation, Dust and Runoff

Potential Impacts

Construction of the rail loop within and adjacent to the wetland has the potential to reduce water quality as a result of point source pollution from sedimentation, run-off and dust. The wetland is highly susceptible to these point source impacts given low flow conditions, seasonal volume changes and reduced opportunity for flushing.

Sedimentation can increase turbidity, decrease oxygen levels and reduce light penetration. It can also smother vegetation and habitat used by burrowing animals resulting in a loss of biodiversity. The turbidity of the wetland is highly variable seasonally, however, depending on the timing of construction turbidity levels can be relatively low during some months. Increased turbidity can have a flow on effect to aquatic habitat values by reducing potential for photosynthesis and primary production. Sedimentation has the potential to arise as the result of:

- Localised erosion from exposed terrestrial construction areas.
- Sediment plumes generated during aggregate dumping in the bed of the wetland area where fine sediments are dominant.
- Increased dust generated as a result of increased vehicle traffic to the area.
- Release of fines from material brought in for the infrastructure such as rock base and earth for the berm.

The use of construction machinery in and around aquatic systems has the potential to result in the introduction of contaminants. Machinery and some activities require the use of fuels, chemicals and other contaminants that, if introduced in sufficient volumes, can result in long term degradation of habitat and water quality. This would also have flow on affects for biodiversity, likely resulting in significant reductions in biodiversity and alteration of community structures with potential for long term affects if contaminants become bound within wetland sediments.

Mitigation Measures

To reduce the potential for sedimentation, dust and runoff (including contaminants) leading to degradation of water quality and aquatic habitats recommended mitigation measures include:

- Preparation and implementation a Construction Erosion and Sediment Control Management Plan that includes:
  - Use of silt curtain or similar sediment containment device when constructing in wetted areas to contain sediment plume and restrict contaminant/runoff into adjacent wetland environment.
  - Rehabilitation of exposed terrestrial ground surfaces as soon as is practical to minimise exposed surface periods and potential for erosion and sediment transport.
  - Dust suppression techniques for activities occurring in and adjacent to the wetland bed. This may include restricted speed limits for vehicles and wetting of exposed road surfaces, noting that potential for runoff would need to be managed to not result in reduced water quality from wetting activities.
  - Locate and construction plant/stockpiles sufficiently far from the wetland area to manage risk of dust impacts upon wetland.
  - Dust suppressions measures such as wet down whereby runoff is directed to suitable management ponds.

  Criteria for erosion and sediment controls are detailed in Appendix AD Erosion and Sediment Control Criteria. The plan will aim to limit adverse impacts to the aquatic ecosystems as a result of sediment transport or erosion.
- Preparation and implementation of a Construction Waste and Hazardous Materials Management Plan for the site to include:
  - Fuel and chemical storage protocols to avoid potential for impacts from contaminants upon the natural environment. This may include no refuelling of equipment at the wetland construction site.
  - Emergency spill response procedures.
  - Training for all site staff in implementation of emergency response procedures.
  - Protocols for ensuring machinery/plant/equipment are in sound working order (e.g. no oil leaks etc) to avoid potential for impacts from contaminants upon the natural environment.

The plan will be prepared prior to construction commencing and be consistent with the *Environment Protection Act 1994* and the Environmental Protection (Waste Management) Policy 2000. Refer to Section 16 Waste of the EIS for further detail.

Detailed design will manage runoff and limit sediment transport and positioning and design of contaminant containment areas. This is further discussed as part of operation phase recommendations in Section 4.3.4.

4.2.6 Degradation of Surfacewater Quality due to Disturbance of Acid Sulfate Soils

Potential Impacts

Acid sulfate soils (ASS) are generally confined to low-lying coastal areas of Holocene to Quaternary-aged marine and estuarine sediments. An assessment of ASS was undertaken as part of the Project EIS where the potential for the presence of ASS was identified. Excavation and filling activities required for the construction of the rail loop have the potential to disturb these soils (GHD 2010d). Disturbance to ASS has the potential to generate sulphuric acid and if not managed appropriately has the potential to degrade surfacewater quality, impact upon biodiversity and community structure. Degradation is primarily related to the introduction of sulphuric acid to the waters, however, there are a range of flow on effects to water quality that can occur such as fish kills and algal blooms. Further detail on the potential for ASS generation as a result of Project activities can be found in the Project EIS Chapter 5 Soils, Topography and Land Disturbance. Appendix Z Acid Sulfate Soils Framework of the SEIS outlines the principles for testing, validation and monitoring.

Mitigation Measures

Further ASS investigations to those completed for the EIS to date will be undertaken following detailed design. This will enable areas to be directly targeted for excavation/construction works to be assessed in a manner appropriate for legislative requirements If ASS or potential acid sulfate soils are identified it will lead to development of a detailed Acid Sulfate Soils Management Plan in accordance with the Queensland Acid Sulfate Soil Technical (QASSIT) Manual and Queensland State Planning Policy 2/02: Planning and Managing Development Involving Acid Sulfate Soils to be approved by DERM prior to work commencing. That plan will address measures to manage risk for sulphuric acid generation and discuss how measures will mitigate potential flow affects to biodiversity.

4.2.7 Increased Abundance and Diversity of Introduced Species

Potential Impacts

The study area contains a number of weed species within the vegetation fringing the wetland. This includes *Macroptilium lathyroides* (phasey bean) and *Passiflora fotetida* (stinking passionflower). No pest aquatic fauna species were detected during survey though introduced terrestrial species (e.g. pig, toad) have been detected in previous surveys of the area (GHD 2010b).

Project construction can facilitate the introduction and spread of weed and pest species. Weeds can be introduced or spread by machinery and vehicles or on workers clothing. Studies have found that weed species invade areas of ground where road soil or construction waste is stored more readily that undisturbed areas (Dong *et al.* 2008). Weed introduction can also occur as a result of the use of contaminated construction fill.

Pest species have the potential to predate or out compete native species. At constructions sites, unmanaged waste can encourage opportunistic fauna species which are often pests.

Weed and pest species are identified as key threats to native flora and fauna communities within the Caley Valley Wetland and surrounds in the Kaili (Caley) Valley Wetlands Draft Environmental Management Plan (BMT WBM 2011). Terrestrial plant species listed under the Land Protection (Pest and Stock Route Management) Act 2002 and feral animal species have been recorded in the wetland area (BMT WBM 2011). The ecological consequences of an increase in abundance and diversity of introduced weed and pest species can be significant with the reduction in native species abundance and breeding success.

Mitigation Measures

The key measure to manage the introduction and spread of weed and pest species is the development and implementation of a Project specific Weed and Pest Management Plan for construction activities. This is also required for operation activities and is discussed in Section 4.3.6. Measures during construction may include measures such as:

- Weed free certification of all construction fill to be used during construction.
- Use of native species for rehabilitation of exposed soil areas.
- Education of construction personnel during site inductions regarding the weed and pest species of the area.
- Appropriate washdown of vehicles prior to entry into the construction site.
- Develop and implement a weed and pest monitoring program. This is to enable additional mitigation measures to be implemented where necessary and facilitate adaptive on site management of construction works to limit the spread of weeds or pests.
- Appropriate disposal of all rubbish and waste.

4.3 Operation Phase Impacts and Mitigation

The operation of the rail loop has the potential to impact upon the values of the aquatic environment that intersects the footprint. Management of terrestrial areas adjacent to the wetland, as with construction impacts, will be required to limit indirect impacts to the aquatic ecosystem.

Operation of the rail loop will involve 24/7 train traffic undertaking:

- Coal dumping at the dump station.

- Wheel washdown of trains moving through the loop.

Trains will be continuously moving, even during dumping and wheel wash and will not stop along the rail loop. These activities will occur 24 hours per day and 7 days per week.

Maintenance and other traffic via the service access road will also occur during operation.

Direct and indirect impacts to the aquatic environment have the potential to occur as a result of operation activities. These include:

- Removal of habitat for aquatic flora and fauna. This impact has been discussed in Section 4.2.1 and impacts and mitigation measures are applicable to both the construction and operation phases.
- Fauna mortality.
- Disturbance to aquatic fauna species as a result of increased noise, light and vibration.
- Long term alteration to hydrology and barrier to movement.
- Degradation of surfacewater quality as a result of increased dust and runoff.
- Degradation of air quality as a result of coal dust or other emissions.
- Increased abundance and diversity of pest species.

4.3.1 Fauna Mortality

Potential Impacts

Fauna mortality as a result of train strike or maintenance vehicle strikes has the potential to occur, in particular for freshwater turtles. Other fauna groups such as birds and fish are highly mobile and more likely to escape prior to impact. The risk of turtle mortality is most likely to occur during rain when long-necked species undertake overland migrations. It is considered likely that a small number of turtles will be killed during the operation of the Project though population abundance is unlikely to be affected as other banks of the wetland may also provide pathways for overland migrations. The ecological consequence of this mortality is considered to be minor as permanent impacts to abundance are not considered likely.

Mitigation Measures

To reduce the likelihood of mortality during operation the following mitigation measures are recommended:

- Monitoring turtle mortality rates within the rail loop.
- Developing and installing turtle exclusion barriers in areas of the loop that demonstrate a high risk of mortality to turtles.

4.3.2 Noise, Light, Vibration and Visual Disturbance

Potential Impacts

The aquatic habitat within the study area is listed as nationally important and is known to provide foraging and breeding habitat for 'Migratory' and 'Marine' bird species. The main noise, vibration and visual disturbances during the operation phase of the Project will be train movement around the rail loop.

Noise and vibration has the potential to inhibit communication between animals, disrupt breeding and nesting (Francis *et al*. 2009) or startle some fauna species resulting in displacement and in some cases a long term decrease in habitat use, or population decline (Benitez-Lopez *et al*. 2010). The impact of noise and vibration on wildlife populations has not been extensively investigated. The rail loop will be located in an existing industrial noise environment and previous studies (GHD 2010b) have observed birds adapted to the existing conditions (numbers of species nesting and utilising the sediment ponds adjacent to the existing port facilities). The operation of the rail loop is such that no shunting will be conducted in this area with trains moving around the loop at slow speed to allow for the dumping of coal progressively and wagons moving through the washdown facility; however train movement in general will generate some noise and vibration disturbance locally.

The train movement also has the potential to generate a visual disturbance to wetland fauna. Fauna often move away from approaching or encroaching human activities which can lead to negative influences on foraging success, occupation, breeding and abundance (Ruddock and Whitfield 2007), however there is little information on fauna adaptation to regular visual disturbances as experienced by the slow train travel around the loop throughout the day and night period.

Lighting will be required along the rail loop during all hours of operation, which may impact upon locally resident fauna. Artificial lighting has the potential to influence aquatic species, and migrating bird species behaviours.

Artificial lighting associated with operation of the rail loop has potential to have adverse effects on aquatic invertebrates and fish whose movement, foraging and reproduction is associated with light levels. Fish behaviour, including foraging, schooling, spawning and vertical movement, is influenced by natural diel and lunar cycles of light (Moore *et al*. 2006; cited in Rich and Longcore 2006). Many freshwater fish have low light thresholds for foraging, some of which are less than that of moonlight (e.g. pike, minnow, coho salmon, carp, bream and perch) (Blaxter 1975; Townsend and Risebrow 1982; Bergman 1988; cited in Rich and Longcore 2006). Fish communities within Caley Valley Wetland comprise mostly of small fishes which feed on invertebrates (see Section 3.5.1), and therefore are unlikely to be as susceptible to changes in light conditions as larger fish. Vertical distribution of some fishes is altered by artificial lighting, especially in clear water habitats (e.g. Bonneville cisco congregate at the lake bottom during a full moon, Luecke and Wurtsbaugh 1993; cited in Rich and Longcore 2006). Due to the relatively shallow water environment of the study area, it is unlikely that vertical distribution of fishes currently occurs.

Artificial night lighting is also known to attract migrating birds and may have adverse consequences (Gauthreaux 2006; cited in Rich and Longcore 2006). Little is known about the mechanism of how birds are attracted to artificial lighting, however evidence indicates that the use of artificial light at night is having adverse effects on populations of birds, particularly those that migrate at night (Verheijen 1985; cited in Rich and Longcore 2006). Lighting may result in spatial disorientation, as birds use lights as visual cues to the horizon (Herbert 1970; cited in Rich and Longcore 2006). Studies on flood lights and search lights have demonstrated that these light beams can attract birds, cause mortality (due to collisions), cause wide variation shifts in flight direction and reduced flight velocity (Bruderer *et al.* 1999; cited in Rich and Longcore 2006).

Given these potential influences on behaviours the lighting associated with operation of the rail loop are not expected to deter wetland birds however there is potential that foraging or movement behaviours may be influenced locally as a result of altered lighting cues. The existing infrastructure at the APCT incorporates some night lighting. The lighting required for the proposed rail loop is not expected to require lighting intensity to the extent of search lights, however locally, within the footprint of the rail loop, artificial lighting will be required.

Mitigation Measures

Mitigation and management of noise, vibration and visual related disturbance to wetland ecology will be undertaken by a combination of design strategies, scheduling strategies and ongoing monitoring to allow for adaptive management.

- Program any maintenance works to minimise in-water activities, when greater numbers of fauna are present, during wet season/footprint inundation and to reduce risk of contact with fauna.
- Manage maintenance of trains and service vehicles to minimise machinery noise and vibration where possible.
- Monitor seasonal occupation of the wetland by waterbirds and undertake adaptive management if populations are considered to be impacted by train noise, vibration, visual disturbance and required lighting. Monitoring should be frequent enough to detect short and long term disturbance of bird populations as a result of the train movements. Should monitoring determine an adverse impact to population additional measures are to be developed and consequently monitored for effectiveness. Measures could include installation or modification of infrastructure (e.g. visual screens to limit visual disturbance to fauna, sound barriers), reduced train speed limits or changes to lighting infrastructure.
- Minimise lighting to that required for safe operation where possible and consider the use of motion sensing or timed lighting in areas where constant lighting is not required.
- Utilise lower intensity lighting where possible and limit perimeter lighting to that required.
- Employ directional lighting with protective guards around the structure where operational lighting is necessary to reduce and avoid light spill into wetland areas adjacent to the construction footprint, thereby minimising potential for disturbance to roosting/nocturnal

species.

The ongoing monitoring is an important component of managing the impact to wetland fauna. Prior to construction a monitoring program will be developed in consultation and with approval by relevant agencies to outline monitoring requirements, reporting requirements and corrective actions/adaptive management procedures.

4.3.3 Barrier to Movement and Hydraulic Flows

Potential Impacts

The rail loop infrastructure will create a barrier to wetland flows, and flora and fauna movement through the study area.

Hydrological modelling undertaken as part of the Project EIS investigated flood afflux in the wetland as an indicator of Project impacts on flow (GHD 2010c). Modelling incorporated the proposed rail structure and assessed culvert structure options. The study concluded that the infrastructure is not expected to significantly alter the hydrological regime of the wetland or local creeks (GHD 2010c).

Within the study area the rail infrastructure will be built up to above the flood water level and will restrict flows to the habitat within the loop (approximately 104 ha of habitat). Reduced water movement to this area will limit natural flushing of the system that maintains water quality and restrict flora and fauna movement into and out of the habitat. These impacts can have flow on effects to the aquatic biodiversity by reducing aquatic environmental values and limiting breeding and resource opportunities for fauna moving through the area. Limitations on flushing may result in accumulation of sediments locally.

Mitigation Measures

To limit the potential impact of alterations to hydrology a minimum of two sections of the loop with a series of culverts will be included in detailed design to allow for a suitable amount of water movement to the centre of the rail loop. At each section there will be 20 culverts of 1.5 x 0.9 m opening sizing and approximately 35 m in length. Detailed design and construction of these structures will also consider:

- Fish passage requirements in accordance with the Queensland Department of Primary Industries and Fisheries Fish Habitat Guidelines such as:
  - Light availability through the culvert.
  - Substrate/texture of the floor of culvert.
  - Maximum flow velocities through the culvert.

  Culvert designs may require alteration to incorporate these requirements, for example, sky lighting in the culverts. This will be determined during detailed design.
- Culvert location selection to optimise opportunity for inflows and draining by using modelling undertaken for the EIS.

- The Project EMP will include an appropriate culvert maintenance program to maintain culvert operation as design intends, i.e. no clogging of the culverts with material that may lead to accumulation or erosion of sediments.

4.3.4 Degradation of Surfacewater Quality due to Sedimentation, Dust and Runoff

Potential Impacts

Operation of the rail loop within and adjacent to the wetland has the potential to reduce water quality as a result of point source pollution from sedimentation, run-off and dust. Degradation of the water quality by increased turbidity, decrease in oxygen, reduced light penetration or an introduction of contaminations can lower the environmental values of the aquatic system, in turn potentially contributing to a decrease in biodiversity. Water quality changes such as these can result in:

- Smothering of vegetation and benthic habitat making it unviable for use by fauna.
- Reduced photosynthesis and primary production as a result of reduced light penetration.
- Contamination by toxicants leading to mortality of flora and fauna.

The wetland experiences low flows which reduces opportunity for flushing of suspended or blanketing sediments and contaminants.

Activities during operation of the rail infrastructure that may lead to sedimentation, dust or runoff generation include:

- Movement of the trains around the rail loop. Carriages may transport loose sediments and dust that may be dislodged along this section of the rail alignment.
- Movement of maintenance vehicles and maintenance activities may lead to the generation of dust or disturbance of surfaces susceptible to erosion.
- Runoff from the maintenance and rail tracks, berm, dump station, wheel wash and wetland banks as a result of rainfall or wind.
- Coal laden trains are likely to have coal and other dusts on carriages that have the potential to be dislodged during transit. Refer to Section 4.3.5 for discussion specific to coal dust.

Mitigation Measures

To reduce the potential for dust and runoff leading to degradation of water quality and aquatic habitats recommended mitigation measures include:

- Including design features in detailed design to contain runoff from infrastructure surfaces (e.g. berm, maintenance track) and prevent runoff directly to the wetland such as:
    - Location of the wash down bay following carriage dump but prior to entering the wetland area of the loop to remove dust and sediments.
    - Allowing no stormwater runoff into the wetland by installing diversion

mechanisms (e.g. small berm) around the base of the bund to direct runoff from the rail line, bund wall and access track away from the wetland.

- Preparation and implementation of an Operation Erosion and Sediment Control Management Plan that includes:
  - Appropriate storage and discharge of wastewaters from the wash down bay and treatment through settlement ponds.
  - Stormwater runoff management via settlement ponds or other mechanisms that do not discharge into the wetland unless of suitable water quality.
  - Dust suppression techniques for activities occurring in and adjacent to the wetland bed. This may include restricted speed limits and watering unsealed roads if observed to be generating dust levels of concern.
  - Hydromulch or similar to be used to stabilise bund slopes, using local species where possible to revegetate bare areas.
  - Restricted vehicle access to all areas other than established tracks and roads to prevent disturbance to adjacent areas.
- Preparation and implementation of a Waste and Hazardous Materials Management Plan for the site to include:
  - Fuel and chemical storage protocols to avoid potential for impacts from contaminants upon the natural environment. This may include no refuelling of equipment at the wetland construction site.
  - Emergency spill response procedures.
  - Training for all site staff in implementation of emergency response procedures.
  - Protocols for ensuring machinery/plant/equipment are in sound working order (e.g. no oil leaks etc) to avoid potential for impacts from contaminants upon the natural environment.
- Establishing a Water Quality Monitoring Plan (adequate baseline information will be required) to monitor the composition and condition of the nationally important Caley Valley Wetland. The monitoring plan will identify water quality triggers for the wetland and actions to be undertaken in the event of an exceedence.

4.3.5 Coal Dust Emissions

Potential Impacts

The potential impact of coal dust emissions on aquatic habitat was investigated in the Freshwater Aquatic Flora and Fauna Report (GHD 2010a) and Appendix AE Updated Terrestrial Ecology Report of the SEIS. Sources of coal dust emissions include the surface of loaded wagons, doors of loaded wagons (leakage), wind erosion of coal spilled onto the rail line and residual coal on unloaded wagons (including sills, doors, shear plates) (Connell Hatch 2008).

Coal dust emissions from loaded coal trains generate potential issues within every railway system within central Queensland in terms of economic loss, public nuisance and potential impact on the environment. High levels of coal dust from trains, emitted either by train movement or wind erosion, have the potential to directly impact flora species and communities adjacent to railway systems. A portion of the rail loop is within the wetland area and the approach to the dump station is adjacent to the wetland. Excessive dust settling on water bodies such as the wetland area has the potential to decrease aquatic habitat value within the immediate and downstream areas primarily as a result of reduced water quality. Similarly, dust deposition on leaves can reduce the photosynthetic quality of the flora and impede plant growth.

An environmental evaluation, commissioned by QR, reviewed the available literature for the impacts of coal dust on flora and fauna, crops and livestock. A review, by Connell Hatch (2008), found that the air quality goals or standards to protect human health and amenity were sufficient for the protection of flora, fauna, crops and livestock against dust impacts, as no goals and standards have otherwise been set for these categories.

Studies reviewed by Connell Hatch (2008) on coal dust deposition on cotton crops concluded a dust deposition rate of 500 mg/m^2/day can be used as a threshold for adverse impacts on crops and vegetation. Feed preference, palatability, quantity of feed eaten and quantity of milk produced were not affected when livestock were exposed to feed containing coal dust at rates of no dust, 4,000 and 8000 mg/m^2/day. Dispersion modelling undertaken for the study estimated dust emission rates and meteorological data representative of conditions in Mackay and Gladstone. Results indicated that the greatest coal deposition rates, of about 90 mg/m^2/day, occur within 3 m of the rail track edge with rates dropping quickly with distance from the corridor, down to 30 mg/m²/day at 10 m from the track edge (Connell Hatch 2008). Although no literature has been found on the impacts of coal dust on aquatic flora and fauna communities, the deposition zone is considered likely to be appropriate in assessing the indirect impact zone of coal dust for the Project.

The rail alignment travels adjacent to the wetland for approximately 2.5 km on the approach to the rail loop. Along this stretch the rail corridor there is potential for coal dust to disperse into the wetland waterbody however considering the results of the Connell Hatch study that identifies deposition rates dropping quickly from 3 m from the rail track it is consider likely that any deposition will be low and below the threshold for adverse impacts on vegetation. There is a terrestrial buffer that varies in width along this stretch but is in the order of 50 – 100 m from the wetland in most sections.

At the rail loop the alignment travels within the wetland area limiting the potential for a buffer width between the wagons and the waterbody. In this area there is greater potential for coal dust to be transferred to the water body and have potential adverse impacts to water quality and reduce photosynthetic potential of flora as a result of smothering. Reductions in water quality and flora function are likely to reduce the values of the area as aquatic habitat, and potentially reduce biodiversity.

The key factor that contributes to the emission rate of coal dust is the train speed and ambient wind speed (Connell Hatch 2008). On the approach to the rail loop and around the rail loop trains will be travelling at slower speed than during general transit, hence the overall emission rate of coal dust is expected to be lower in this area.

These results suggest that coal dust deposition is likely to be localised and at a low rate and therefore consequences to aquatic ecosystem values at the Caley Valley Wetland are not considered to be significant.

Mitigation Measures

Measures to reduce coal dust emissions include:

- Use of train carriages with dust suppression devices. Standard gauge train line is proposed for the Project which has advantages in containing coal dust.
- Design of the dump station to consider dust emissions to minimise the risk of this impact during unloading. Stormwater and runoff management for the dump station and wash down area will be a closed system that does not discharge into the wetland.
- Wagon wheel wash will occur immediately following coal unloading and prior to wagons entering the loop within the wetland area.
- Only empty wagons will traverse the stretch of rail loop that is within the wetland area.
- Appropriate stormwater and runoff management of the rail berms will be designed to divert runoff potential containing coal dust away from the aquatic environment.

4.3.6 Increased Abundance and Diversity of Introduced Species

Introduced flora and fauna species have the potential to reduce native species diversity, degraded wetland habitats, degrade surrounding habitats and compete with native species for resources. The development of a Weed Plan consistent with Appendix AG of the SEIS will assist in minimising the potential for an increase in the abundance of these species within the study area and manage the potential for introduction of new pest species. The plan will be implemented before the operation of the facility and measures will include:

- Revegetation of available areas with locally native species to prevent establishment of pest species.
- Monitoring of revegetated areas to detect effectiveness of revegetation activities and identify encroachment of pest species. Results of monitoring to allow for identification of areas where alternative revegetation approaches are required or weed/pet control strategies are required.
- Onsite waste management and storage protocols.

4.4 Decommissioning

The design life of the Project is at least 30 years however third party usage of the

infrastructure is expected to result in the effective life of the rail line beyond the expected life of the Alpha Coal Project (Mine). Following the operational life if the rail loop requires decommissioning, protection of the environment and the wetland values must be considered. The potential impacts of decommissioning the infrastructure are dependent on the extent the surrounding aquatic ecosystem has adapted to the infrastructure. In the long term aquatic species have the potential to adapt to the introduced structures, for example:

- Rock aggregate may provide habitat for aquatic fauna and stable substrate for flora.
- Rehabilitated berm surfaces may provide foraging habitat for birds.

Furthermore, the removal of the structure has the potential to generate disturbance to the aquatic environment as a result of machinery required and exposed surfaces following removal of the structure.

The approach to decommissioning should incorporate an assessment of options that considers the impact to the aquatic ecology and an appropriate decommissioning strategy should be developed taking impact mitigation measures and environmental values into account. The strategy should incorporate suitable monitoring of the wetland environmental values to allow for adaptive management of the decommissioning process and any rehabilitation after deconstruction.

4.5 Cumulative Impacts

The rail loop is located within the Abbot Point State Development Area (APSDA). The declaration of this area enables the State to manage planned development and operation of infrastructure and industry in this area. It is recognised that the nature of this declaration provides for the potential for other development to occur in the vicinity hence the potential for cumulative impacts. As such, the objectives and strategies of the Kaili (Caley) Valley Wetlands Draft Environmental Management Plan (February 2011) (BMT WBM 2011) have been considered in assessing the potential impact of the proposed rail loop.

4.6 Summary of Impacts to Protected Areas and Important Species

4.6.1 Matters of National Environmental Significance

Matters of National Environmental Significance (MNES) of relevance to the study area include the potential habitat for the estuarine crocodile (*Crocodylus porosus*) and Australian painted snipe (*Rostratula australis*) and habitat for the 'Migratory' bird community of the wetland.

Estuarine Crocodile (Crocodylus porosus)

The estuarine crocodile is listed as 'Marine' and 'Migratory' under the EPBC Act and 'Vulnerable' under the NC Act. The study area is connected to habitat suitable for the species, being the tidal creeks discharging from the Caley Valley Wetland. Given the distance of the site to the suitable habitat, impacts to the species as a result of construction and operation of the Project are associated with the potential for indirect degradation of suitable habitat. These

impacts have been assessed against the DSEWPC Significant Impact Guidelines for MNES (DEWHA 2009) criteria for listed migratory species. Based on the assessment against the guideline no significant impact to the species is expected.

Table 11 MNES Significant Impact Criteria Assessment – Listed Migratory Species

MNES Significant Impact Criteria	Estuarine Crocodile (*Crocodylus porosus*)
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.	**No significant impact -** No important estuarine crocodile habitat occurs within the study area footprint, though habitat is present within the Caley Valley Wetland system. Protection from indirect impacts to this habitat includes maintaining hydrological flows and minimising runoff and sedimentation that can influence downstream water quality as described in the mitigation and management measures described in sections 4.2 and 4.3.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	**No significant impact** – A Weed and Pest Management Plan will be developed for both construction and operation phases of the Project that include measures to manage the increase in abundance and diversity of introduced species within the study area footprint. Weed and pest species known to occur in the area based on previous surveys are not expected to pose a direct risk to the species. Increased abundance and diversity of pest species may alter the native species community composition that may have flow on effects to the forage resources available for the species downstream however the likelihood of this is low with the implementation of the management measures described in sections 4.2.7 and 4.3.6.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	**No significant impact** - Habitat degradation, as a result of increased sedimentation, run-off and dust; coal dust emission and noise, light and vibration disturbance, has the potential to disrupt estuarine crocodile behaviour if individuals are present adjacent to the footprint or if runoff/sedimentation reaches habitat of value to the species in the surrounds. Most suitable habitat for this species is located downstream of the study area and the likelihood of impact is considered to be low. Mitigation measures include lighting and noise management techniques and the implementation of a Sediment and Erosion Control Plan to protect the water quality of the wetland as described in sections 4.2 and 4.3.

Australian Painted Snipe (Rostratula australis)

The Australian painted snipe is listed as 'Vulnerable' and 'Migratory' under the EPBC Act, and 'Vulnerable' under the NC Act. The species was not detected during field survey, however, is considered to have potential to occur in the Project footprint and surrounds based on the suitability of habitat. The species is most commonly found in shallow wetlands, freshwater or brackish, that are permanent or temporarily inundated (DEWHA 2003).

Impacts to the species as a result of construction and operation of the Project are associated with the potential for habitat loss and indirect degradation of suitable habitat. The significance of these impacts has been assessed against the DSEWPC Significant Impact Guidelines for MNES (DEWHA 2009) criteria for threatened species.

Table 12 MNES Significant Impact Criteria Assessment – Listed Threatened Species

MNES Significant Impact Criteria	Australian Painted Snipe (*Rostratula australis*)
Lead to a long-term decrease in the size of an important population of a species	**No significant impact** - While potential habitat for the species occurs within the footprint and surrounds this species has not been recorded in the study area (Wildlife Online, MCF Survey). It is therefore considered unlikely that the Project will directly impact the population of this species leading to a long-term decrease in the size of an important Australian painted snipe population.
Reduce the area of occupancy of an important population	**No significant impact** - There have been no previous sightings of the species within the study area suggesting that it does not support an important population. Approximately 11.5 ha of potential habitat will be removed as a result of the Project; this represents approximately 0.2% of the wetland area. As there have been no previous records it is considered unlikely that the Project will reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	**No significant impact** – There have been no previous sightings of the species within the study area suggesting that it does not support an important population. The removal of habitat occurs at the edge of the wetland is not considered to be located such that areas of the wetland will be fragmented.
Adversely affect habitat critical to the survival of a species	**No significant impact** - The lack of sightings within the study area suggests that the habitat is not critical for the survival of the species.

MNES Significant Impact Criteria	Australian Painted Snipe (*Rostratula australis*)
Disrupt the breeding cycle of an important population	**No significant impact** – There have been no previous sightings of the species within the study area. Based on habitat suitability, the Project will require removal of some potential breeding habitat for the species. If individuals occur noise, vibration and light disturbance may disrupt roosting individuals or breeding behaviours however a lack of sightings in the area suggests the habitat is not high value for the species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**No significant impact** - There have been no previous sightings of the species within the study area. Based on habitat suitability approximately 11.5 ha of potential habitat will be removed as a result of the Project, this represents approximately 0.2% of the wetland area. It is considered unlikely that the Project will reduce the habitat availability resulting in species decline. There is potential for indirect impacts to adjacent suitable habitat. Indirect impacts as result of the Project include degradation of water quality, increased noise, light and vibration disturbance and increased weeds and pests (refer Sections 4.2 and 4.3). It is not considered likely that adjacent suitable habitat will be modified to the extent that the species is will decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**No significant impact** - The construction and operation of the rail loop has the potential to allow for increased abundance and diversity of introduced species. Management and mitigation proposed will minimise this risk and when implemented these measures are considered to limit potential harm to threatened species. Management includes the development of a Weed and Pest Management Plan for the Project to manage introduction and spread of invasive species (refer Sections 4.2.7 and 4.3.6). With management the risk of impact to threatened species is low.
Introduce disease that may cause the species to decline	**No significant impact** - The construction and operation of the rail loop is unlikely to introduce disease that may cause the species to decline. A Weed and Pest Management Plan will be developed for the Project to manage introduced species (refer Sections 4.2.7 and 4.3.6).

MNES Significant Impact Criteria	Australian Painted Snipe (*Rostratula australis*)
Interfere substantially with the recovery of the species	**No significant impact** - There have been no previous sightings of the species within the study area suggesting that it does not support an important population. The construction and operation of the rail loop is unlikely to interfere with the recovery of the species, as the Project is not expected to have significant impacts on this bird.

Marine and Migratory Birds

Field surveys recorded three 'Marine' bird species and one 'Marine' and 'Migratory' bird species within the rail loop footprint. An additional 48 wader bird species listed as 'Marine' and/or 'Migratory' under the EPBC Act have been recorded in the wider wetland area (GHD 2010b). The study area provides habitat for these species, many of which utilise other areas of the wider wetland and are present on a seasonal basis.

Impacts to the 'Marine' and 'Migratory' birds as a result of construction and operation of the Project are generally associated with the habitat loss within the footprint, potential for indirect degradation of suitable habitat in the wider wetland area, and disturbances as a result of noise, vibration and light. The significance of these impacts has been assessed against the DSEWPC Significant Impact Guidelines for MNES (DEWHA 2009) criteria for listed 'Migratory' species.

Impacts to the values of the East Asian-Australasian Flyway are not expected, as the suitability of the Caley Valley wetland as habitat for migratory birds (especially shorebirds) is expected to be maintained. Physical disruption to this flyway from the rail infrastructure is not anticipated.

Table 13 MNES Significant Impact Criteria Assessment – Listed Migratory Species

MNES Significant Impact Criteria	Migratory Birds
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.	**No significant impact** – A small area of habitat (approximately 0.2 % of the Caley Valley Wetland or 11.5 ha of habitat) suitable for roosting and foraging for migratory birds will be removed as a result of the Project. The remaining wetland area provides values for migratory species and alternative habitat for individuals that may relocate during construction of the rail loop. The habitat loss is not considered significant in the context of the greater wetland and its habitat values. The removal of this area will not isolate of destroy the main area of habitat within the wetland though has the potential to modify it as a result of indirect impacts including sedimentation and runoff degrading water quality, noise, light and vibration disturbance, and increased abundance and diversity of pest species.. Habitat is present within the Caley Valley Wetland system and protection from indirect impacts to this habitat is considered in the mitigation and management measures described in sections 4.2 and 4.3. With management the risk of impact to migratory birds is low.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	**No significant impact** - The construction and operation of the rail loop has the potential to allow for increased abundance and diversity of introduced species. Management and mitigation proposed will minimise this risk and when implemented these measures are considered to limit potential harm to migratory birds. Management includes the development of a Weed and Pest Management Plan for the Project to manage introduction and spread of invasive species (refer Sections 4.2.7 and 4.3.6). With management the risk of impact to migratory birds is low.

MNES Significant Impact Criteria	Migratory Birds
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	**No significant impact** – A small area of habitat (approximately 0.2 % of the Caley Valley Wetland or 11.5 ha of habitat) suitable for roosting and foraging for migratory birds will be removed as a result of the Project. The remaining wetland area provides values for migratory species and alternative habitat for individuals that may relocate during construction and operation of the rail loop. The loss of roosting habitat has the potential to disrupt the lifecycle of breeding populations of migratory species within the wetland however in the context of the greater wetland the area of loss is not considered significant. Indirect impacts including noise, vibration and light impacts to roosting habitat have the potential to disrupt breeding, feeding and resting behaviour if these disturbances are substantial. Mitigation measures are proposed to minimise these impacts where possible. In conjunction a monitoring program is recommended to detect changes to the migratory bird populations and trigger an adaptive management response if applicable. With this approach the risk of impact to migratory birds is low.

4.6.2 Nationally Important Wetlands

The Caley Valley Wetland is described in Section 3.1.1. Its values provide important habitat for a range of native species including a population of waterbirds. The wetland experiences distinct seasonal changes with wet season rainfall providing a freshwater environment for fish, turtles and water birds. During drier months the extent of the wetland waterbody contracts with reduced rainfall inputs though continues to provide important habitat for aquatic fauna in remaining wet areas. The wetland provides important spawning, breeding and nursery habitats for many commercially and recreationally important fish species including barramundi (*Lates calcarifer*) and mangrove jack (*Lutjanus argentimaculatus*) (GHD 2010a). Downstream from the Project at the outlet of the wetland, the estuarine tidal channels provide potential habitat for the estuarine crocodile.

Approximately 11.5 ha of the palustrine wetland area will be intercepted by the Project footprint (based on DERM wetland mapping 2011). Activities undertaken within the wetland are considered to pose a high risk to the wetland ecosystem prior to mitigation. This includes construction and operation activities within the wetland that have the potential to:

- Degrade wetland water quality

- Alter wetland hydrology
- Destroy aquatic flora anda fauna
- Disturb wetland values via increase noise, light and vibration
- Increase weed and pest abundance and diversity

To mitigate these potential impacts specific management plans will be developed including an Erosion and Sediment Control Plan, Waste and Hazardous Materials Management Plan, Acid Sulfate Soils Management Plan and a Weed and Pest Management Plan to reduce the risk of indirect impacts to the wetland system and its values. Design features will consider hydrological flows, stormwater diversion and minimising footprint while water quality and bird monitoring will allow for adaptive management for improved approaches. Sections 4.2 and 4.3 consider the values of the wetland and management required to reduce this risk. By applying suitable management and mitigation the residual impact to the values of the wetland is considered to be low.

4.6.3 Great Barrier Reef

The Great Barrier Reef Marine Park (GBRMP) is a matter of national environment significance under the EPBC Act. Furthermore, the area is listed as both a World Heritage Area and National Heritage Place. The rail loop is located within the wetland area that drains into the GBRMP. There will be no direct impacts to the GBRMP however there is potential for indirect impacts.

Construction phase activities include that may indirectly impact upon the GBRMP include the impact clearing of vegetation, cut and fill, construction of the rail loop, alteration of the wetland flow regime and other earth works. This has potential to lead to increased sediment load and runoff, alteration of flows and degradation of water quality in the marine park.

The operation of the Project has the potential to result in a long term alteration to hydrology and degradation of water quality if there is a risk of spills or leaks from trains.

The mitigation and management measures described in Section 4.2, 4.3 and 4.4 will avoid/minimise/reduce impacts to this sensitive environment, including the MNES that contribute to its values. Refer to Appendix FB EPBC Report (Rail) of the SEIS.

In accordance with the Commonwealth Department of SEWPAC *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* (DEWHA 2009), *an action is likely to have a significant impact on the World Heritage values if there is a real chance or possibility that it will cause:*

- *One or more of the World Heritage Values to be lost,*
- *One or more of the World heritage values to be degraded or damaged, or*
- *One or more of the World Heritage values to be notably altered, modified, obscured or diminished (DEWHA 2009)*

An assessment of the potential impacts to each of the World Heritage values has been summarised in Table 14. No significant impact on the GBRMP or world heritage area is expected from the rail loop.

Table 14

Significant Impact Criteria	Potential for Rail Loop to influence values	Assessment of impact
Great Barrier Reef World Heritage Area		
One or more of the World Heritage values to be lost	**No significant impact** The rail loop is within the Caley Valley Wetland which drains into the Great Barrier Reef World Heritage Area (GBRWHA) and Great Barrier Reef Marine Park (GBRMP) however is not located within these protected areas.	
One or more of the World Heritage values to be degraded or damaged or One or more of the World Heritage values to be notably altered, modified, obscured or diminished	**No significant impact** There will be no direct damage to any values of the GBRWHA as the rail loop is located outside the boundary. Given that the rail loop is located within a catchment that drains into this area, there is potential that downstream impacts of the construction and operation may degrade the values of the GBRWHA. The potential downstream impacts relate to an increase in sediment loads and other runoff, degradation of water quality as a result of contamination and a change to flows. These aspects are unlikely to cause the degradation or damage to the values representing a major stage of evolutionary history, geological processes or reef assemblages or features of exceptional natural beauty. The downstream impacts (indirect) have the potential to influence significant natural habitats however this is considered unlikely. Similarly, mitigation measures to limit downstream potential impacts have been developed and are described above.	

4.6.4 Wetlands in Great Barrier Reef Catchments

The footprint of the proposed rail loop intersects area mapped as GBR Wetland Protection Area which is administered through the Temporary State Planning Policy 1/11: Protecting Wetlands of High Ecological Significance (HES) in GBR Catchments (DERM 2010). The State Planning Policy required assessment against the development code has been provided in Table 15.

Table 15 Development Outcomes for the Temporary SPP 1/11

DO	Development Outcome (DO)	Compliance with Acceptable Outcomes or Proposed Acceptable Outcomes
1	Development is not carried out in a HES wetland	***AO1.1 Development outside the wetland / alternative boundary*** The Project footprint intersects 11.5 ha of area mapped as GBR Wetland Protection Area. The rail loop design has minimised the footprint of the impact to the wetland by achieving hydrological flows through the rail loop. This design limits the loss of wetland habitat to that beneath the rail footprint only and protects water quality and ecological values within the habitat in the loop. Refer to sections 4.2 and 4.3 for mitigation measures to protect the values of the wetland. These include the management of sedimentation and runoff to protect water quality, culvert design to allow for hydrological flows and connectivity within the loop, management of noise light air and visual disturbances and weed and pest management. There will be a permanent loss of 11.5 ha of GBR Wetland Protection Area and an offset will be required. The offset must be consistent with the Queensland Government Environmental Offsets Policy 2008 and corresponding policies. The Project Offsets Strategy (Appendix X of the SEIS) includes the requirement for this offset.
2	An adequate buffer to a HES wetland is provided	AO2.1-2.2 A minimum buffer of 200 m is required in a non-urban area. The 200 m buffer width required is not achievable given the location of the Project within an area of the wetland. Provision of a buffer would require a greater area of wetland to be disturbed. The Project design will incorporate infrastructural elements to buffer the wetland from runoff and other indirect impacts. These include: ◗ Stormwater management ◗ Revegetation of bund surfaces to limit sedimentation of the waterway ◗ Use of silt fences (or similar) during construction to manage potential for sediment plume
3	The existing surfacewater hydrological regime of the GBR wetland protection area is maintained or enhanced	To **avoid** adverse effects: ◗ AO3.1 Surfacewater - Hydrological modelling has been undertaken as part of the Project EIS (GHD 2010d). Surfacewater flows into and out of the wetland will not be impacted by the Project. The Project is located on the edge of the wetland and will not inhibit the overall hydrological regime of the wetland.

DO	Development Outcome (DO)	Compliance with Acceptable Outcomes or Proposed Acceptable Outcomes
4	The existing groundwater hydrological regime of the GBR wetland protection area is protected and enhanced	To **avoid** adverse effects: ◗ AO4.1-4.3 Groundwater – Groundwater flows into and out of the wetland are unlikely to be impacted by the Project.
5	During construction and operation of development: ◗ A wetland is not used for stormwater treatment ◗ The buffer and water quality values of a HES wetland are protected from stormwater impacts	To **avoid** adverse effects: ◗ AO5.1 o Stormwater management for the Project will be achieved using establishment of gravity fed stormwater dams o Exposed surfaces will be rehabilitated in accordance with an Erosion and Sediment Control Plan to control potential runoff impacts from structures like the rail loop bund. Design considerations will include the need for structural solutions such as berms to manage stormwater drainage away from sensitive environmental receptors. Water quality monitoring will be completed during construction and operation to enable management of site water quality therefore and potential flow on effects to the wetland
6	Development involving clearing of vegetation protects biodiversity, ecological values and processes, and hydrological functioning of a HES wetland	To **avoid** adverse effects: ◗ AO6.1 Vegetation clearing will be required within the wetland. The clearing to be undertaken will be limited to the rail loop footprint, located at the edge of the wetland. Hydrological modelling undertaken indicates that the hydrological functioning of the wetland will not be significantly altered. The vegetation to be removed is well represented across the wetland and its removal is unlikely to result in a reduction in biodiversity or ecological processes across the wetland. Impacts will be localised.

DO	Development Outcome (DO)	Compliance with Acceptable Outcomes or Proposed Acceptable Outcomes
7	Development avoids land degradation in a GBR wetland protection area	To **avoid** adverse effects: ◗ AO7.1 The rail loop is not located on steep slopes though the constructed bund will have steep slopes constructed. A Erosion and Sediment Control Plan will be developed and implemented for construction and operation phases of the Project to limit the potential for and manage erosion or other sediment transport and the slopes of the bund will be revegetated. Similarly, further Acid Sulfate Soils investigations will be undertaken and if required an approved ASS management Plan will be implemented. See Section 4.2.5, 4.2.6 and 4.3.4.
8	Existing ecological corridors are protected or enhanced and have dimensions and characteristics that will: ◗ Effectively link habitats on and/or adjacent to the site ◗ Facilitate the effective movement of terrestrial and aquatic fauna accessing and/or using the site as habitat	To **avoid** adverse effects: ◗ AO8.1 the Project will not impact upon connectivity between wetlands, or between the wetland and other natural habitats. It is located between the wetland and existing infrastructure at the APCT. Design has considered fauna movement using culvert structures to connect the wetland with the habitat within the rail loop.
9	Development does not result in pest management impacts that pose a risk to the ecological values and processes of a HES wetland	To **avoid** adverse effects: ◗ AO9.1 A Weed and Pest Management Plan will be developed for the Project to manage introduced species (refer Sections 4.2.7 and 4.3.6). With appropriate management the risk of this impact is low.

DO	Development Outcome (DO)	Compliance with Acceptable Outcomes or Proposed Acceptable Outcomes
10	During construction and operation of development wetland fauna values are protected from impacts associated with noise, light or visual disturbance	To **minimise** adverse effects: ◗ 10.2-10.3 The impact of noise lighting and visual disturbance has been identified in sections 4.2.3 and 4.3.2 and mitigation measures have been proposed. The value of the wetland to migratory birds in particular is recognised and a monitoring program is recommended to allow for adaptive management if noise, light or visual disturbance contributes to changes in these populations. Mitigation measures recommended include: o Programme any maintenance works to minimise in-water activities, when greater numbers of fauna are present, during wet season/footprint inundation and to reduce risk of contact with fauna. o Manage maintenance of trains and service vehicles to minimise machinery noise and vibration where possible. o Minimise lighting to that required for safe construction where possible. o Employ directional lighting with protective guards around the construction to reduce and avoid light spill into wetland areas adjacent to the construction footprint, thereby minimising potential for disturbance to roosting/nocturnal species. ◗ 10.4 The visual disturbance to resident bird communities as a result of construction and operation will be monitored through the monitoring program described above. An adaptive management approach will allow for the installation of visual barriers if required during sensitive periods (e.g. breeding season).

DO	Development Outcome (DO)	Compliance with Acceptable Outcomes or Proposed Acceptable Outcomes
11	Ongoing management, maintenance and monitoring is undertaken to ensure adverse effects on hydrology, water quality and ecological processes of a HES wetland are avoided or minimised during construction and operation of the development	To **avoid** or **minimise** adverse effects: ◗ AO11.1 A Construction Management Plan and an Operation Management Plan will be developed for implementation during the phases of the Project. The plans will be approved by the relevant agencies prior to implementation and will incorporate management, maintenance and monitoring commitments ◗ AO11.2 Management plans developed for the site will include both reporting and review requirements. This may require regular reporting to relevant agencies Identified commitments to be included, but not limited to: ◗ Water quality monitoring ◗ Wetland bird monitoring ◗ Erosion and sediment management ◗ Acid Sulfate Soils management ◗ Waste and hazardous materials management ◗ Weed and pest management

4.6.5 Marine Plants

Marine plants are protected under the *Fisheries Act 1994* and are located within the study area, within the boundaries of the mapped wetland and adjacent. The areas mapped as palustrine wetland (RE 11.3.27x1c) comprise marine plants. The extent of this community is highly variable depending upon seasonal hydrological variation.

Based on design information provided (Calibre 07/05/2011) approximately 11.5 ha of marine plants will be permanently removed. Design has minimised the area to be impacted and no further mitigation strategies are achievable. Offsets are required for the removal of marine plants and have been considered in the Offsets Strategy (Appendix X of the SEIS) for the Project to address loss of marine plants that will be removed in the rail loop footprint.

5. Risk Assessment

An impact and risk assessment was undertaken to assess the risk of the construction and operation of the proposed rail loop on the aquatic environmental values of the study area. Environmental risks associated with Project construction and operation were identified and classified into one of four risk categories (High, Medium, Low and Very Low), as described in Section 2.5. This risk assessment approach remains consistent with the assessment undertaken for the Freshwater Aquatic Flora and Fauna Report (GHD 2010a). This assessment should be considered in conjunction with that report.

Table 16 details the ecological risks for the Project. Five construction impacts were considered to have High risk prior to mitigation, these included:

- Removal of aquatic habitat
- Barrier to movement and hydraulic flows
- Degradation of surfacewater quality due to sedimentation, dust and runoff
- Degradation of surfacewater quality due to disturbance of acid sulfate soils
- Noise, light, vibration and visual disturbance

Following implementation of mitigation measures all construction phase risks were reduced to Medium or Low risk.

Operational impacts considered to have High risk prior to mitigation included:

- Noise, light, vibration and visual disturbance
- Barrier to movement and hydraulic flows

Following implementation of mitigation measures, all impacts were reduced to a Medium risk or lower (Table 16).

Table 16 Risk Assessment for Aquatic Environmental Values

Activity	Potential Impact	Preliminary Risk Level (Likelihood, Consequence)	Mitigation Measures	Residual Risk Level (Likelihood, Consequence)
Construction	Permanent removal of approximately 11.5 ha of aquatic flora and fauna habitat Temporary removal of approximately 3.7 ha of aquatic flora and fauna habitat	5, 3 High	◗ Design rail loop to incorporate flow structures to limit the loss of habitat within the rail loop ◗ Use erosion and sediment controls to minimise indirect habitat loss ◗ Lay rock base via end dumping to reduce requirement for establishment of additional construction access within the wetland bed ◗ Clearly identify the extent of vegetation clearing and earthworks on construction plans and in the field. The extent of construction is to be restricted to the minimal amount necessary ◗ Locate any additional construction areas such as soil stockpiles and machinery/equipment storages, within existing cleared areas and away from the wetland ◗ Rehabilitate all areas (terrestrial and aquatic) temporarily disturbed during construction ◗ Include offsets for marine plants in Project Offsets Strategy	4, 3 Medium
	Fauna mortality	4, 3 Medium	◗ Programme construction works to minimise in-water activities during wet season/footprint inundation to reduce risk of contact with fauna ◗ Engage a suitably qualified fauna spotter to be located on site prior to and during early works (rock base dumping) if activities occur within the wetted area ◗ Erect temporary bunding around	2, 3 Low

Activity	Potential Impact	Preliminary Risk Level (Likelihood, Consequence)	Mitigation Measures	Residual Risk Level (Likelihood, Consequence)
			aquatic habitats within the construction zone to exclude aquatic fauna ◗ Educate employees of environmental responsibilities during inductions including treating all native fauna species as protected ◗ Develop a fauna mortality register to determine the location, frequency of mortality, and types of species most susceptible, to enable additional mitigation measures to be implemented where necessary	
	Noise, light, air quality, vibration and visual disturbance	4, 4 High	◗ Programme construction works to minimise in-water activities during wet season/footprint inundation to reduce risk of contact with fauna. ◗ Include dust suppression techniques in the Environmental Management Plan for the Project ◗ Manage maintenance of construction vehicles and machinery to minimise machinery noise and vibration where possible ◗ Minimise lighting to that required for safe construction where possible ◗ Monitor seasonal occupation of the wetland by waterbirds and undertake adaptive management if populations are considered to be impacted by construction noise, vibration, required lighting or visual disturbance Employ directional lighting with protective guards around the construction to reduce and avoid light spill into wetland areas adjacent to the construction footprint, thereby minimising	3, 4 Medium

Activity	Potential Impact	Preliminary Risk Level (Likelihood, Consequence)	Mitigation Measures	Residual Risk Level (Likelihood, Consequence)
			potential for disturbance to roosting/nocturnal species	
	Alteration to wetland hydrology	5, 3 High	◗ Programme works to minimise loop construction activities during wet season/footprint inundation to reduce direct interruptions to aquatic habitat connectivity ◗ Undertake installation of bund rock base construction progressively via end dumping from land build off point to limit staged interruptions to flows from loop construction ◗ Install culvert structures in the rail loop to enable flow connectivity and exchange between habitats inside and outside of the rail loop Construct structures during periods of least flow to assist in minimising scour and other localised hydrological alterations during installation of appropriately designed culvert structures. ◗ Design culvert structures appropriately to maintain flows, water quality conditions, habitat connectivity and fauna movements between habitats inside and outside of the rail loop ◗ Design rail loop bund such that stormwater run-off is managed to not negatively influence the water quality inside or outside of the rail loop. Consider use of erosion and sediment control options including revegetation of bund and use of a berm to capture scree run-off	3,3 Medium
	Degradation of surfacewater quality due to	5, 3 High	Prepare and implement a Construction Sediment and Erosion Control Plan to include: ◗ Use of silt curtain or similar	3,3 Medium

Activity	Potential Impact	Preliminary Risk Level (Likelihood, Consequence)	Mitigation Measures	Residual Risk Level (Likelihood, Consequence)
	sedimentation, dust and runoff		when constructing in wetted areas; ◗ Appropriate sediment and erosion controls on terrestrial work areas; ◗ Rehabilitation of exposed ground surfaces as soon as practical; ◗ Appropriate dust suppression techniques; and ◗ Develop a Waste and Hazardous Materials Management Plan which will include fuel and chemical storage protocols and spill responses.	
	Degradation of surface water quality due to disturbance of acid sulfate soils	5, 3 High	Further acid sulfate soils investigation will be undertaken. If identified a detailed Acid Sulfate Soils Management Plan will be developed for approval by DERM prior to work commencing. It is expected that all ASS or potential ASS matters will be effectively managed through that management plan and the residual risk ranking has been determined under that expectation. The ranking would require revisitation if that assumption is not found to hold true.	3,3 Medium
	Increased abundance and diversity of introduced species	4, 3 Medium	Developing a Weed and Pest Management Plan for implementation throughout the construction phase. Management actions will including: ◗ Weed free certification of all construction fill brought to site; ◗ Rehabilitation of exposed soil areas with local native species; ◗ Appropriate disposal of all rubbish and waste; ◗ Education of site personnel;	2, 3 Low

Activity	Potential Impact	Preliminary Risk Level (Likelihood, Consequence)	Mitigation Measures	Residual Risk Level (Likelihood, Consequence)
			◗ Appropriate washdown of vehicles and machinery; and ◗ Development of a weed and pest monitoring program.	
Operation	Fauna mortality	3, 2 Low	◗ Monitor turtle mortality rates at the rail loop; and ◗ Developing and installing turtle exclusion barriers in areas of the loop that demonstrate high risk of mortality.	2, 2 Low
	Noise, light and vibration disturbance	4, 4 High	◗ Manage maintenance of trains and service vehicles to minimise machinery noise and vibration where possible; ◗ Monitor seasonal occupation of the wetland by waterbirds to undertake adaptive management if populations are considered to be impacted by train noise, vibration and required lighting; ◗ Limiting lighting to that which is safe for operation and employing directional lighting; ◗ Employ directional lighting with protective guards along and leading up to the rail loop; and ◗ Restrict speed limits where appropriate.	3, 4 Medium
	Alteration to hydrology	5, 3 High	Install a minimum of two culvert structure to allow for suitable water movement through the loop area. Design will consider: ◗ Fish passage requirements; and ◗ Best location to maximise opportunity to maintain flows and flushing.	2, 3 Low
	Degradation of surfacewater quality due to	4, 3 Medium	Infrastructure design features to include: ◗ Washbay located leading up to the line section where trains will	2, 3 Low

Activity	Potential Impact	Preliminary Risk Level (Likelihood, Consequence)	Mitigation Measures	Residual Risk Level (Likelihood, Consequence)
	sedimentation, dust and runoff		be moving across the wetted area ◗ No stormwater runoff from the rail line by using diversion mechanisms discharging away from the wetland Preparation of Operation Erosion and Sediment Control Management Plan including: ◗ Appropriate discharge and storage of wastewaters and from the washdown bay; ◗ Stormwater runoff management; ◗ Dust suppression techniques; ◗ Hydromulch of berm slopes; ◗ Restrict access outside established tracks/roads. Preparation of Waste and Hazardous Materials Management Plan including: ◗ Fuel and chemical storage protocols; ◗ Emergency spill response procedures; ◗ Training of staff in emergency response; ◗ Maintenance and cleaning of trains and maintaining trains to minimise the introduction of contaminants such as oil and fuel; and ◗ Establishing a Water Quality Monitoring Plan (adequate baseline information will be required) to monitor the composition and condition of the nationally important Caley Valley Wetland.	
	Coal dust emission	5, 2	◗ Use of dust suppression devices;	4, 2

Activity	Potential Impact	Preliminary Risk Level (Likelihood, Consequence)	Mitigation Measures	Residual Risk Level (Likelihood, Consequence)
		Medium	◗ Suitably designed dump station to limit dust emissions; ◗ Washdown bay for trains; and ◗ Diversion mechanisms for stormwater runoff to discharge away from the wetland.	Medium
	Increased abundance and diversity of introduced species	4, 3 Medium	Developing a Weed and Pest Management Plan for implementation throughout the operation phase, including: ◗ Revegetation with native species ◗ Monitoring of revegetated areas ◗ Waste management	2, 3 Low

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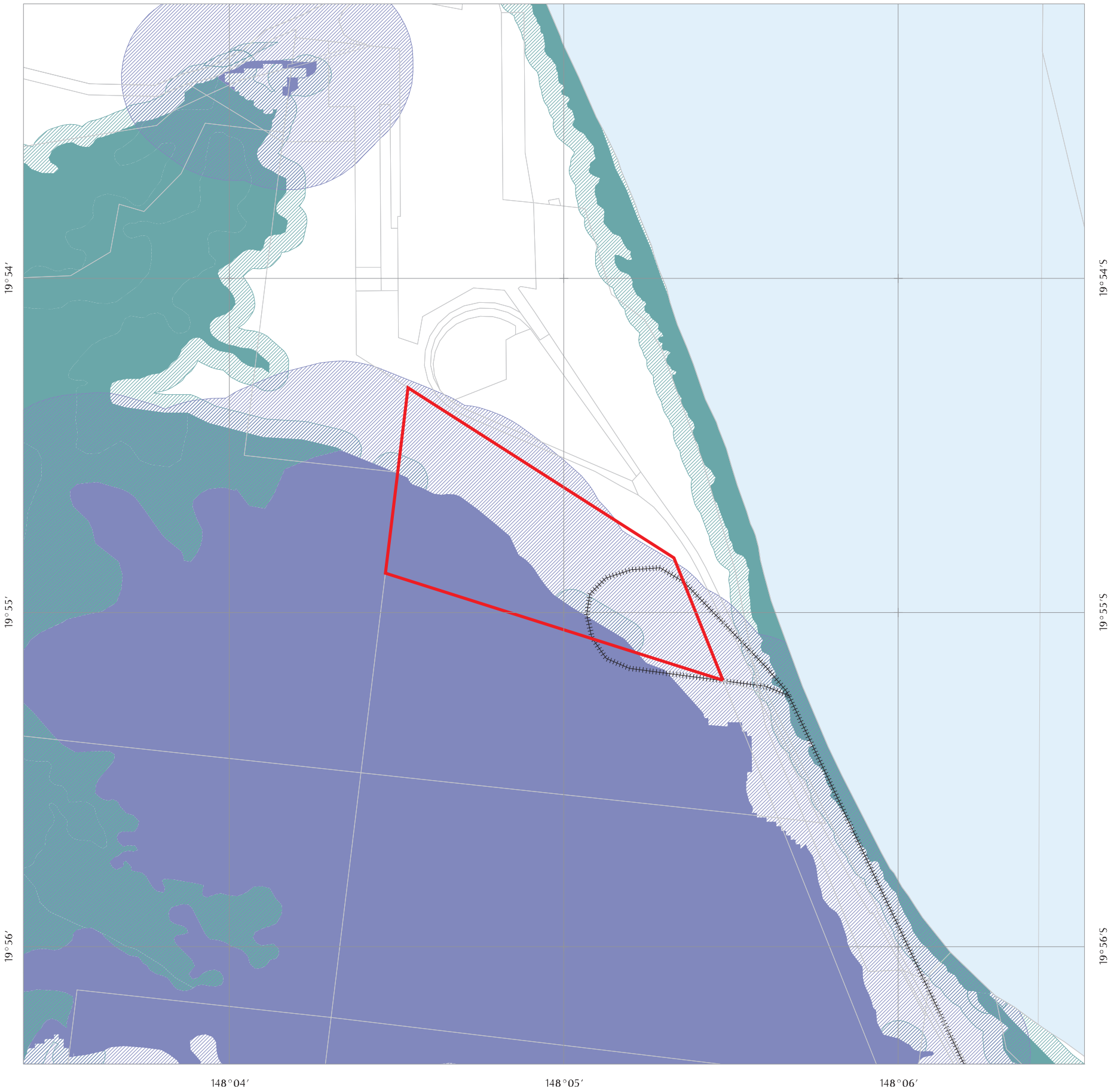
Appendix A

Wetland in GBR Catchment Mapping



Map of Referable Wetlands

Requested By: KATHERINE.TASKE@GHD.COM
Date: 03 Jun 11 Time: 13.53.00

Centered on Lot on Plan:
1 RP745292

Legend

- Selected Land Parcel
- Property Boundary

GBR Wetland Protection Area

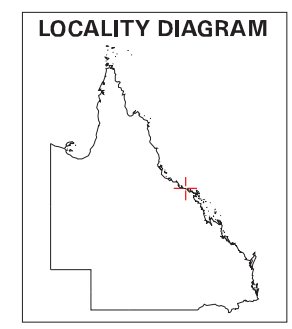
- Wetland
- Trigger Area

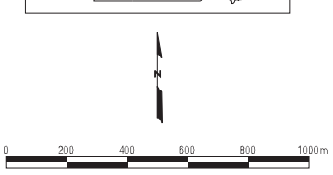
Wetland Management Area

- Wetland
- Trigger Area

Queensland Government

LOCALITY DIAGRAM





This scale bar is approximate only
Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)
This product is unprojected and is not suitable for measuring distances

This map should only be used to apply policies outlined in the Temporary State Planning Policy: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments (SPP for GBR Wetlands).

Information shown on the map includes multiple spatial datasets that define policies stated in the Temporary State Planning Policy: Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments (SPP for GBR Wetlands). Datasets include wetlands, roads, rail lines and cadastral boundaries.

All datasets are current as at 30 April 2010.

The maps are produced at a scale relevant to the size of the lot on plan identified and should be printed as A4 size in portrait orientation. Consideration of the effects of mapped scale is necessary when interpreting data at a large scale i.e. property level. For property assessment, digital linework should be used as a guide only.

The Wetlands Regulatory Map is A4 portrait and should be printed at this size.

For further information or assistance with interpretation of this product, please contact the Department of Environment and Resource Management at planning.support@derm.qld.gov.au

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Appendix B

Desktop Search Results

EPBC Protected Matters Search Tool

DERM Wildlife Online

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

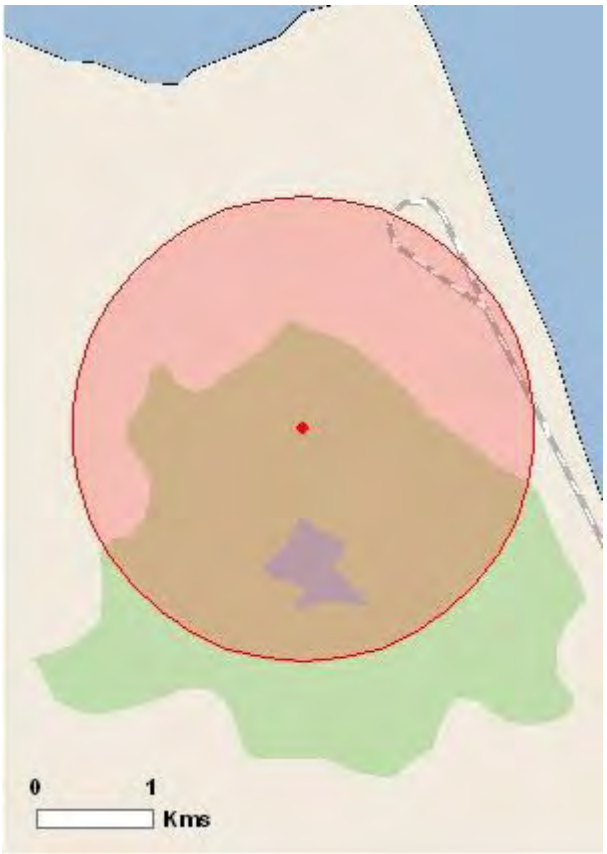
EPBC Act Protected Matters Report: Coordinates

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Report created: 01/06/11 15:29:32



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 2.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar Wetlands):	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communitites:	None
Threatened Species:	8
Migratory Species:	18

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None

Critical Habitats:	None
Commonwealth Reserves:	None

Report Summary for Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	None
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	1

Details

Matters of National Environmental Significance

Threatened Species		**[Resource Information]**
Name	Status	Type of Presence
BIRDS		
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
MAMMALS		
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat may occur within area
Pteropus conspicillatus Spectacled Flying-fox [185]	Vulnerable	Species or species habitat may occur within area
Xeromys myoides Water Mouse, False Water Rat [66]	Vulnerable	Species or species habitat likely to occur within area
PLANTS		
Croton magneticus [16681]	Vulnerable	Species or species habitat likely to occur within area
REPTILES		
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat likely to occur within area

Migratory Species		**[Resource Information]**
Name	Status	Type of Presence
Migratory Marine Birds		

Apus pacificus	
Fork-tailed Swift [678]	Species or species habitat may occur within area
Ardea alba	
Great Egret, White Egret [59541]	Species or species habitat may occur within area
Ardea ibis	
Cattle Egret [59542]	Species or species habitat may occur within area
Sterna albifrons	
Little Tern [813]	Species or species habitat may occur within area
Migratory Marine Species	
Crocodylus porosus	
Salt-water Crocodile, Estuarine Crocodile [1774]	Species or species habitat likely to occur within area
Migratory Terrestrial Species	
Haliaeetus leucogaster	
White-bellied Sea-Eagle [943]	Species or species habitat likely to occur within area
Hirundapus caudacutus	
White-throated Needletail [682]	Species or species habitat may occur within area
Hirundo rustica	
Barn Swallow [662]	Species or species habitat may occur within area
Merops ornatus	
Rainbow Bee-eater [670]	Species or species habitat may occur within area
Monarcha melanopsis	
Black-faced Monarch [609]	Breeding may occur within area
Monarcha trivirgatus	
Spectacled Monarch [610]	Breeding likely to occur within area
Myiagra cyanoleuca	
Satin Flycatcher [612]	Species or species habitat likely to occur within area
Migratory Wetlands Species	
Ardea alba	
Great Egret, White Egret [59541]	Species or species habitat may occur within area
Ardea ibis	
Cattle Egret [59542]	Species or species habitat may occur within area
Gallinago hardwickii	
Latham's Snipe, Japanese Snipe [863]	Species or species habitat may occur within area
Nettapus coromandelianus albipennis	
Australian Cotton Pygmy-goose [25979]	Species or species habitat may occur within area
Rostratula benghalensis s. lat.	
Painted Snipe [889]	Species or species habitat may occur within area
Tringa stagnatilis	
Marsh Sandpiper, Little Greenshank [833]	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species **[Resource Information]**

Name	Status	Type of Presence

Birds

Anseranas semipalmata	
Magpie Goose [978]	Species or species habitat may occur within area
Apus pacificus	
Fork-tailed Swift [678]	Species or species habitat may occur within area
Ardea alba	
Great Egret, White Egret [59541]	Species or species habitat may occur within area
Ardea ibis	
Cattle Egret [59542]	Species or species habitat may occur within area
Gallinago hardwickii	
Latham's Snipe, Japanese Snipe [863]	Species or species habitat may occur within area
Haliaeetus leucogaster	
White-bellied Sea-Eagle [943]	Species or species habitat likely to occur within area
Hirundapus caudacutus	
White-throated Needletail [682]	Species or species habitat may occur within area
Hirundo rustica	
Barn Swallow [662]	Species or species habitat may occur within area
Merops ornatus	
Rainbow Bee-eater [670]	Species or species habitat may occur within area
Monarcha melanopsis	
Black-faced Monarch [609]	Breeding may occur within area
Monarcha trivirgatus	
Spectacled Monarch [610]	Breeding likely to occur within area
Myiagra cyanoleuca	
Satin Flycatcher [612]	Species or species habitat likely to occur within area
Nettapus coromandelianus albipennis	
Australian Cotton Pygmy-goose [25979]	Species or species habitat may occur within area
Rostratula benghalensis s. lat.	
Painted Snipe [889]	Species or species habitat may occur within area
Sterna albifrons	
Little Tern [813]	Species or species habitat may occur within area
Tringa stagnatilis	
Marsh Sandpiper, Little Greenshank [833]	Species or species habitat likely to occur within area

Reptiles

Crocodylus porosus	
Salt-water Crocodile, Estuarine Crocodile [1774]	Species or species habitat likely to occur within area

Extra Information

Invasive Species **[Resource Information]**

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence

Mammals	
Felis catus	
Cat, House Cat, Domestic Cat [19]	Species or species habitat likely to occur within area
Oryctolagus cuniculus	
Rabbit, European Rabbit [128]	Species or species habitat may occur within area
Vulpes vulpes	
Red Fox, Fox [18]	Species or species habitat may occur within area
Plants	
Acacia nilotica subsp. indica	
Prickly Acacia [6196]	Species or species habitat may occur within area
Cryptostegia grandiflora	
Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]	Species or species habitat may occur within area
Hymenachne amplexicaulis	
Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]	Species or species habitat likely to occur within area
Lantana camara	
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]	Species or species habitat may occur within area
Parkinsonia aculeata	
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]	Species or species habitat may occur within area
Parthenium hysterophorus	
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]	Species or species habitat likely to occur within area
Salvinia molesta	
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]	Species or species habitat may occur within area

Nationally Important Wetlands	**[Resource Information]**
Abbot Point - Caley Valley, QLD	

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of

International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-19.91744 148.07304

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme

-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111 ABN

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: 19.9174
Longitude: 148.073
Distance: 2
Email: melissa.tan@ghd.com
Date submitted: Wednesday 01 Jun 2011 14:32:04
Date extracted: Wednesday 01 Jun 2011 14:46:28

The number of records retrieved = 167

Disclaimer

As the DERM is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

The State of Queensland does not invite reliance upon, nor accept responsibility for this information. Persons should satisfy themselves through independent means as to the accuracy and completeness of this information.

No statements, representations or warranties are made about the accuracy or completeness of this information. The State of Queensland disclaims all responsibility for this information and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Acanthizidae	*Gerygone levigaster*	mangrove gerygone		C		1
animals	birds	Acanthizidae	*Gerygone albogularis*	white-throated gerygone		C		2
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		16
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		72
animals	birds	Accipitridae	*Circus approximans*	swamp harrier		C		1
animals	birds	Accipitridae	*Aviceda subcristata*	Pacific baza		C		1
animals	birds	Accipitridae	*Haliaeetus leucogaster*	white-bellied sea-eagle		C		25
animals	birds	Accipitridae	*Accipiter cirrocephalus*	collared sparrowhawk		C		4
animals	birds	Accipitridae	*Hieraaetus morphnoides*	little eagle		C		1
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		96
animals	birds	Accipitridae	*Accipiter fasciatus*	brown goshawk		C		1
animals	birds	Accipitridae	*Pandion cristatus*	eastern osprey		C		19
animals	birds	Accipitridae	*Elanus axillaris*	black-shouldered kite		C		1
animals	birds	Accipitridae	*Haliastur indus*	brahminy kite		C		54
animals	birds	Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler		C		1
animals	birds	Alaudidae	*Mirafra javanica*	Horsfield's bushlark		C		4
animals	birds	Anatidae	*Anas castanea*	chestnut teal		C		3
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		1
animals	birds	Anatidae	*Malacorhynchus membranaceus*	pink-eared duck		C		1
animals	birds	Anatidae	*Nettapus pulchellus*	green pygmy-goose		C		1
animals	birds	Anatidae	*Dendrocygna arcuata*	wandering whistling-duck		C		8
animals	birds	Anatidae	*Dendrocygna eytoni*	plumed whistling-duck		C		5
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		16
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		8
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		8
animals	birds	Anatidae	*Anas rhynchotis*	Australasian shoveler		C		3
animals	birds	Anatidae	*Aythya australis*	hardhead		C		6
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		9
animals	birds	Anseranatidae	*Anseranas semipalmata*	magpie goose		C		13
animals	birds	Apodidae	*Apus pacificus*	fork-tailed swift		C		1
animals	birds	Ardeidae	*Ardea ibis*	cattle egret		C		6
animals	birds	Ardeidae	*Egretta garzetta*	little egret		C		7
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		11
animals	birds	Ardeidae	*Butorides striata*	striated heron		C		1
animals	birds	Ardeidae	*Ardea intermedia*	intermediate egret		C		5
animals	birds	Ardeidae	*Ardea modesta*	eastern great egret		C		12
animals	birds	Ardeidae	*Ardea pacifica*	white-necked heron		C		2
animals	birds	Artamidae	*Artamus cinereus*	black-faced woodswallow		C		3
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		1
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		33
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		5
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		33
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		42
animals	birds	Burhinidae	*Burhinus grallarius*	bush stone-curlew		C		1
animals	birds	Burhinidae	*Esacus magnirostris*	beach stone-curlew		V		1
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		24

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo		C		10
animals	birds	Campephagidae	*Lalage sueurii*	white-winged triller		C		1
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		47
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		7
animals	birds	Campephagidae	*Lalage leucomela*	varied triller		C		66
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		11
animals	birds	Charadriidae	*Erythrogonys cinctus*	red-kneed dotterel		C		1
animals	birds	Charadriidae	*Charadrius ruficapillus*	red-capped plover		C		3
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		7
animals	birds	Ciconiidae	*Ephippiorhynchus asiaticus*	black-necked stork		NT		6
animals	birds	Cisticolidae	*Cisticola exilis*	golden-headed cisticola		C		6
animals	birds	Columbidae	*Ducula bicolor*	pied imperial-pigeon		C		2
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		21
animals	birds	Columbidae	*Geopelia humeralis*	bar-shouldered dove		C		16
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		84
animals	birds	Columbidae	*Geophaps scripta*	squatter pigeon		C		1
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		35
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		99
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		2
animals	birds	Cuculidae	*Cuculus optatus*	oriental cuckoo		C		1
animals	birds	Cuculidae	*Eudynamys orientalis*	eastern koel		C		3
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		9
animals	birds	Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		C		14
animals	birds	Cuculidae	*Chalcites minutillus minutillus*	little bronze-cuckoo		C		1
animals	birds	Cuculidae	*Cacomantis flabelliformis*	fan-tailed cuckoo		C		4
animals	birds	Cuculidae	*Cacomantis variolosus*	brush cuckoo		C		39
animals	birds	Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo		C		8
animals	birds	Cuculidae	*Chalcites lucidus*	shining bronze-cuckoo		C		3
animals	birds	Dicruridae	*Dicrurus bracteatus*	spangled drongo		C		67
animals	birds	Estrildidae	*Neochmia modesta*	plum-headed finch		C		1
animals	birds	Estrildidae	*Taeniopygia guttata*	zebra finch		C		6
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		16
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		6
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		16
animals	birds	Falconidae	*Falco longipennis*	Australian hobby		C		1
animals	birds	Falconidae	*Falco peregrinus*	peregrine falcon		C		2
animals	birds	Gruidae	*Grus rubicunda*	brolga		C		5
animals	birds	Haematopodidae	*Haematopus longirostris*	Australian pied oystercatcher		C		1
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		41
animals	birds	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra		C		27
animals	birds	Halcyonidae	*Todiramphus sanctus*	sacred kingfisher		C		7
animals	birds	Halcyonidae	*Todiramphus macleayii*	forest kingfisher		C		14
animals	birds	Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		C		1
animals	birds	Hirundinidae	*Hirundo neoxena*	welcome swallow		C		37
animals	birds	Hirundinidae	*Petrochelidon ariel*	fairy martin		C		6
animals	birds	Hirundinidae	*Petrochelidon nigricans*	tree martin		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Jacanidae	*Irediparra gallinacea*	comb-crested jacana		C		1
animals	birds	Laridae	*Chlidonias hybrida*	whiskered tern		C		1
animals	birds	Laridae	*Sternula albifrons*	little tern		E		3
animals	birds	Laridae	*Gelochelidon nilotica*	gull-billed tern		C		1
animals	birds	Laridae	*Chroicocephalus novaehollandiae*	silver gull		C		3
animals	birds	Laridae	*Hydroprogne caspia*	Caspian tern		C		5
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		19
animals	birds	Megapodiidae	*Alectura lathami*	Australian brush-turkey		C		12
animals	birds	Meliphagidae	*Myzomela obscura*	dusky honeyeater		C		17
animals	birds	Meliphagidae	*Lichenostomus fasciogularis*	mangrove honeyeater		C		1
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		101
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		49
animals	birds	Meliphagidae	*Lichenostomus frenatus*	bridled honeyeater		C		1
animals	birds	Meliphagidae	*Ramsayornis fasciatus*	bar-breasted honeyeater		C		11
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		5
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		75
animals	birds	Meliphagidae	*Lichenostomus flavus*	yellow honeyeater		C		113
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		52
animals	birds	Meliphagidae	*Philemon buceroides*	helmeted friarbird		C		63
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		9
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		C		70
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		27
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		24
animals	birds	Monarchidae	*Monarcha melanopsis*	black-faced monarch		C		1
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		5
animals	birds	Nectariniidae	*Nectarinia jugularis*	olive-backed sunbird		C		65
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		41
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		6
animals	birds	Oriolidae	*Sphecotheres vieilloti*	Australasian figbird		C		65
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		2
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		12
animals	birds	Pachycephalidae	*Colluricincla megarhyncha*	little shrike-thrush		C		3
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		1
animals	birds	Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		C		10
animals	birds	Phalacrocoracidae	*Phalacrocorax varius*	pied cormorant		C		2
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		7
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		7
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		1
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		7
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		25
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		32
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		39
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus nuchalis*	great bowerbird		C		15
animals	birds	Rallidae	*Gallinula tenebrosa*	dusky moorhen		C		7
animals	birds	Rallidae	*Porphyrio porphyrio*	purple swamphen		C		3
animals	birds	Recurvirostridae	*Himantopus himantopus*	black-winged stilt		C		6

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		31
animals	birds	Rhipiduridae	*Rhipidura rufifrons*	rufous fantail		C		2
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		22
animals	birds	Scolopacidae	*Tringa nebularia*	common greenshank		C		7
animals	birds	Scolopacidae	*Calidris acuminata*	sharp-tailed sandpiper		C		8
animals	birds	Scolopacidae	*Calidris ferruginea*	curlew sandpiper		C		4
animals	birds	Scolopacidae	*Gallinago hardwickii*	Latham's snipe		C		1
animals	birds	Scolopacidae	*Calidris ruficollis*	red-necked stint		C		1
animals	birds	Scolopacidae	*Tringa stagnatilis*	marsh sandpiper		C		9
animals	birds	Scolopacidae	*Numenius phaeopus*	whimbrel		C		1
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		18
animals	birds	Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		C		1
animals	birds	Threskiornithidae	*Plegadis falcinellus*	glossy ibis		C		3
animals	birds	Threskiornithidae	*Platalea regia*	royal spoonbill		C		13
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		31
animals	birds	Timaliidae	*Zosterops lateralis*	silvereye		C		1
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		C		1
animals	reptiles	Chelidae	*Chelodina canni*	Cann's longneck turtle		C		1
animals	reptiles	Chelidae	*Emydura macquarii krefftii*	Krefft's river turtle		C		1
plants	higher dicots	Byttneriaceae	*Melochia corchorifolia*			C		1/1
plants	higher dicots	Fabaceae	*Desmodium triflorum*		Y			1/1
plants	higher dicots	Malvaceae	*Sida cordifolia*		Y			1/1
plants	higher dicots	Onagraceae	*Ludwigia perennis*			C		1/1
plants	higher dicots	Phyllanthaceae	*Sauropus trachyspermus*			C		1/1
plants	higher dicots	Rhamnaceae	*Ziziphus mauritiana*	Indian jujube	Y			1/1
plants	higher dicots	Sparrmanniaceae	*Triumfetta rhomboidea*	chinese burr	Y			2/2
plants	higher dicots	Zygophyllaceae	*Tribulus cistoides*	bulls head vine		C		1/1
plants	monocots	Cyperaceae	*Cyperus conicus*			C		1/1
plants	monocots	Cyperaceae	*Schoenoplectus erectus*		Y			1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix C

Bird Species Recorded in Previous Surveys

MCF report

Table 17 Bird Species Recorded in Previous Surveys

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Accipiter fasciatus	brown goshawk	LC	MA/MI*	✓	✓			open forest/wetland/woodland
Acrocephalus stentoreus	clamorous reed-warbler	LC	MA/MI		✓			wetland
Actitis hypoleucas	common sandpiper	LC	MA/MI		✓			wetland
Alectura lathami	Australian brush-turkey	LC		✓	✓			littoral rainforest
Anas gracilis	grey teal	LC	MI*	✓	✓			wetland
Anas superciliosa	Pacific black duck	LC	MI*	✓	✓	✓	✓	wetland
Anhinga melanogaster	darter	LC			✓			wetland
Anseranas semipalmata	magpie goose	LC	MA		✓	✓	✓	wetland
Anthus novaeseelandiae	Richard's pipit	LC	MA	✓	✓	✓	✓	grassland/ wetland
Aprosmictus erythropterus	red-winged parrot	LC		✓	✓			open forest

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Aquila audax	wedge-tailed eagle	LC	MI*	✓	✓	✓		open forest/woodland/grassland
Ardea ibis	cattle egret	LC	MA/MI		✓			grassland
Ardea intermedia	intermediate egret	LC	MA		✓	✓	✓	wetland
Ardea modesta	great egret	LC	MA	✓	✓	✓	✓	wetland
Ardea pacifica	white-necked heron	LC			✓			wetland
Ardeotis australis	Australian bustard	LC		✓	✓	✓		grassland
Artamus cinereus albiventris	black-faced woodswallow (east-central Queensland)	LC		✓	✓			grassland/ woodland
Artamus leucorynchus	white-breasted woodswallow	LC		✓	✓			grassland/wetland
Aythya australis	hardhead	LC	MI*	✓	✓			wetland
Butorides striatus	striated heron	LC			✓			wetland
Cacatua galerita	sulphur-crested cockatoo	LC		✓	✓	✓	✓	open forest/woodland/grassland
Cacatua roseicapella	galah	LC			✓			grassland
Calidris acuminata	sharp-tailed sandpiper	LC	MA/MI		✓			wetland

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Calidris ruficollis	red-necked stint	LC	MA/MI		✓			wetland
Calyptorhynchus banksii banksii	red-tailed black-cockatoo (Cape York & Eastern Aust)	LC		✓	✓			open forest
Caprimulgus macrurus	large-tailed nightjar	LC			✓			littoral rainforest
Centropus phasianinus	pheasant coucal	LC		✓	✓			woodland/open forest
Chalcites basalis	Horsfield's bronze-cuckoo	LC	MA	✓	✓			woodland/open forest
Chalcites minutillus minutillus	little bronze-cuckoo	LC	MA	✓	✓			woodland/open forest
Charadrius ruficapillus	red-capped plover	LC	MA/MI*	✓	✓			wetland
Charadrius veredus	oriental plover	LC	MA/MI	✓				grassland
Chenonetta jubata	Australian wood duck	LC	MI*		✓			wetland
Chlidonias hybrida	whiskered tern	LC	MA		✓			wetland
Chlidonias leucoptera	white-winged black tern	LC	MA/MI*		✓			wetland
Chroicocephalus novaehollandiae	silver gull	LC	MA	✓	✓			wetland/ coastal waters

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Chrysococcyx lucidus	shining bronze-cuckoo	LC	MA		✓			wetland
Cincloramphus cruralis	brown songlark	LC		✓	✓			grassland/wetland
Circus approximans	swamp harrier	LC	MA/MI*		✓			wetland
Circus assimilis	spotted harrier	LC	MI*	✓	✓			open forest/wetland/woodland
Cisticola exilis	golden-headed cisticola	LC		✓	✓			grassland
Colluricincla harmonica	grey shrike-thrush	LC		✓	✓			open forest/wetland/littoral rainforest
Colluricincla megarhyncha	little shrike-thrush	LC		✓	✓			littoral rainforest
Coracina novaehollandiae	black-faced cuckoo-shrike	LC	MA	✓	✓	✓	✓	open forest/ woodland
Coracina papuensis	white-bellied cuckoo-shrike	LC	MA	✓				open forest
Coracina tenuirostris	cicadabird	LC	MA	✓	✓			open forest
Corvus coronoides	Australian raven	LC		✓	✓			grassland/woodland/open forest

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Corvus orru	Torresian crow	LC		✓	✓	✓	✓	open forest/woodland/grassland
Coturnix ypsilophora	brown quail	LC		✓	✓			grassland/wetland
Cracticus nigrogularis	pied butcherbird	LC		✓	✓	✓	✓	woodland/open forest
Cracticus tibicen	Australian magpie	LC		✓	✓	✓	✓	grassland/open forest/ woodland/ wetland
Cracticus torquatus	grey butcherbird	LC			✓			woodland/open forest
Cuculus pallidus	pallid cuckoo	LC	MA		✓			woodland/open forest
Cygnuc atratuc	black swan	LC	MA/MI*		✓	✓	✓	wetland
Dacelo leachii	blue-winged kookaburra	LC		✓	✓			open forest/woodland
Dacelo novaeguineae	laughing kookaburra	LC		✓	✓	✓	✓	open forest
Dendrocygna arcuata	wandering whistling duck	LC	MA/MI*		✓	✓	✓	wetland
Dendrocygna eytoni	plumed whistling-duck	LC	MA/MI*	✓	✓			wetland/grassland

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Dicaeum hirundinaceum	mistletoebird	LC		✓	✓			open forest/ littoral rainforest
Dicrurus bracteatus bracteatus	spangled drongo (eastern Australia)	LC	MA	✓	✓	✓		open forest/littoral rainforest
Ducula bicolor	pied imperial pigeon	LC	MA		✓			open forest
Egretta garzetta	little egret	LC	MA	✓	✓			wetland
Egretta novaehollandiae	white-faced heron	LC		✓	✓	✓	✓	wetland/open forest
Egretta sacra	eastern reef egret	LC	MA/MI*	✓		✓		wetland
Elseyornis melanops	black-fronted dotterel	LC	MI*	✓	✓	✓		wetland
Entomyzon cyanotis	blue-faced honeyeater	LC		✓	✓			open forest/woodland
Ephippiorhynchus asiaticus	black-necked stork	R		✓	✓	✓		wetland
Eudynamys orientalis	common koel	LC	MA	✓				littoral rainforest/open forest
Eurystomus orientalis	dollarbird	LC	MA	✓	✓	✓	✓	littoral rainforest/open forest
Falco berigora	brown falcon	LC	MI*	✓	✓			woodland

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Falco cenchroides	nankeen kestrel	LC	MA/MI*	✓	✓			grassland/woodland/wetland
Falco longipennis	Australian hobby	LC	MI*	✓	✓			woodland
Gallinago hardwickii	Latham's snipe	LC	MA/MI		✓			wetland
Gallinula tenebrosa	dusky moorhen	LC			✓	✓	✓	wetland
Gallirallus philippensis	buff-banded rail	LC	MA	✓	✓			wetland
Geopelia humeralis	bar-shouldered dove	LC		✓	✓	✓		littoral rainforest/ open forest/wetland
Geopelia striata	peaceful dove	LC		✓	✓	✓	✓	open forest/ grassland/ woodland/ wetland
Geophaps scripta scripta	squatter pigeon (southern subspecies)	V	V	✓	✓			grassland/woodland
Gerygone levigaster	mangrove gerygone	LC		✓	✓			wetland
Grallina cyanoleuca	magpie-lark	LC	MA	✓	✓	✓		wetland/grassland/ woodland
Grus rubicunda	brolga	LC	MI*	✓	✓	✓		wetland
Haematopus longirostris	pied oystercatcher	LC			✓			wetland

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Haliaeetus leucogaster	white-bellied sea-eagle	LC	MA/MI	✓	✓	✓	✓	coastal waters/wetland
Haliastur indus	brahminy kite	LC	MA/MI*	✓	✓			wetland
Haliastur sphenurus	whistling kite	LC	MA/MI*	✓	✓	✓	✓	grassland/wetland/ open forest/woodland
Heteroscelus incanus	wandering tattler	LC	MA/MI		✓			foreshore
Himantopus himantopus	black-winged stilt	LC	MA/MI*		✓			wetland
Hirundo neoxena	welcome swallow	LC	MA	✓	✓			wetland
Hydroprogne caspia	Caspian tern	LC	MA/MI	✓	✓			wetland/ coastal waters
Lalage leucomela	varied triller	LC		✓	✓			littoral rainforest/open forest/wetland
Lichenostomus fasciogularis	mangrove honeyeater	LC		✓	✓			wetland/open forest
Lichenostomus flavus	yellow honeyeater	LC		✓	✓	✓	✓	open forest; littoral forest
Lichmera indistincta	brown honeyeater	LC		✓	✓			woodland/wetland

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Malurus melanocephalus	red-backed fairy-wren	LC		✓	✓			grassland/open forest
Manorina flavigula	yellow-throated miner	LC		✓	✓			open forest/woodland
Meliphaga lewinii	Lewin's honeyeater	LC		✓	✓			littoral rainforest/open forest
Melithreptus albogularis	white-throated honeyeater	LC		✓	✓			open forest
Merops ornatus	rainbow bee-eater	LC	MA/MI	✓	✓			wetland/open forest/woodland
Microeca flavigaster	lemon-bellied flycatcher	LC		✓				littoral rainforest
Milvus migrans	black kite	LC	MI*	✓	✓			grassland/wetland/ open forest
Mirafra javanica	singing bushlark	LC		✓	✓			grassland/wetland
Myiagra inquieta	restless flycatcher	LC		✓				woodland
Myiagra rubecula	leaden flycatcher	LC			✓			open forest/wetland
Myzomela obscura	dusky honeyeater	LC		✓	✓			littoral rainforest
Myzomela sanguinolenta	scarlet honeyeater	LC		✓				open forest

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Nectarinia jugularis	olive-backed sunbird	LC		✓	✓	✓		littoral rainforest/open forest/wetland
Neochmia modesta	plum-headed finch	LC			✓			wetland
Ninox novaeseelandiae	southern boobook	LC	MA	✓	✓			open forest
Numenius madagascariensis	eastern curlew	R	MA/MI	✓	✓			wetland
Numenius phaeopus	whimbrel	LC	MA/MI	✓	✓			wetland/foreshore
Nycticorax caledonicus	nankeen night heron	LC	MA	✓	✓			wetland
Nymphicus hollandicus	cockatiel	LC		✓	✓			woodland/open forest
Ocyphaps lophotes	crested pigeon	LC		✓	✓	✓	✓	grassland/ woodland/ wetland
Oriolus sagittatus	olive-backed oriole	LC		✓	✓			open forest
Pandion haliaetus	osprey	LC	MI		✓			coastal waters/foreshore
Pardalotus striatus	striated pardalote	LC			✓			open forest
Pelecanus conspicillatus	Australian pelican	LC	MA	✓	✓			wetland

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Petrochelidon ariel	fairy martin	LC		✓				wetland
Phalacrocorax melanoleucas	little pied cormorant	LC			✓	✓		wetland
Phalacrocorax sulcirostris	little black cormorant	LC			✓	✓	✓	wetland
Phalacrocorax varius	pied cormorant	LC		✓	✓			wetland/coastal waters
Philemon buceroides	helmeted friarbird	LC		✓	✓			littoral rainforest/open forest
Philemon citreogularis	little friarbird	LC		✓	✓	✓		littoral rainforest/open forest/woodland
Philemon corniculatus	noisy friarbird	LC		✓	✓	✓		open forest/woodland
Platalea regia	royal spoonbill	LC			✓	✓		wetland
Platycercus adscitus palliceps	pale-headed rosella (southern form)	LC		✓	✓			open forest/littoral rainforest
Podargus strigoides	tawny frogmouth	LC		✓	✓			open forest/woodland
Podiceps cristatus	great crested grebe	LC			✓			wetland
Porphyrio porhyrio	purple swamphen	LC	MA		✓			wetland

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Porzana tabuensis	spotless crake	LC	MA	✓				wetland
Ptilinopus superbus	superb fruit-dove	LC	MA		✓			littoral rainforest
Ptilonorhynchus nuchalis	great bowerbird	LC		✓	✓	✓		open forest/littoral rainforest
Rhipidura leucophrys leucophrys	willie wagtail (southern)	LC		✓	✓			woodland/wetland
Rhjipidura rufifrons	rufous fantail	LC	MA/MI		✓			wetland
Scythrops novaehollandiae	channel-billed cuckoo	LC	MA	✓	✓			open forest/woodland
Smicrornis brevirostris	weebill	LC		✓	✓			open forest
Sphecotheres vieilloti	figbird	LC		✓	✓			littoral rainforest/open forest
Sterna albifrons	little tern	E	MA/MI		✓			wetland
Strepera graculina graculina	pied currawong (eastern Australia)	LC		✓	✓			open forest/littoral rainforest/wetland
Tachybaptus novaehollandiae	Australasian grebe	LC		✓	✓			wetland
Taeniopygia bichenovii	double-barred finch	LC		✓	✓	✓		woodland/open forest

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Taeniopygia guttata	zebra finch	LC		✓	✓			wetland
Threskiornis molucca	Australian white ibis	LC	MA	✓	✓			wetland/grassland
Threskiornis spinicollis	straw-necked ibis	LC	MA	✓	✓			grassland
Todiramphus macleayii	forest kingfisher	LC	MA	✓	✓			littoral rainforest/open forest
Todiramphus sanctus	sacred kingfisher	LC	MA		✓			wetland/ open forest/wetland
Trichoglossus haematodus moluccanus	rainbow lorikeet	LC		✓	✓	✓	✓	open forest
Tringa nebularia	common greenshank	LC	MA/MI		✓			wetland
Turnix maculosa	red-backed button-quail	LC			✓			grassland
Turnix pyrrhothorax	red-chested button-quail	LC		✓	✓			grassland
Vanellus miles	masked lapwing	LC	MI*	✓	✓	✓	✓	grassland/wetland
Vanellus tricolor	banded lapwing	LC	MI*	✓	✓		✓	grassland
Zosterops lateralis	silvereye	LC		✓	✓			wetland/open forest
Zosterops luteus	yellow white-eye	LC		✓				wetland

Scientific name	Common name	NC Act status	EPBC Act status	Wider wetland area		Within the vicinity of the Study Area		Habitat(s)
				Dry season survey	Wet season survey	Dry Season	Wet Season	
Total	**153**			**111**	**143**	**40**	**25**	

Appendix D

Water Quality Data

Alpha 1, Alpha 2 (February 2011) and WQ09, WQ10 (six month sampling program)

					WQ09				WQ10						Alpha 2	Alpha 1
		EQL	**ANZECC Ecosystems Fresh Water (95%)**	*ANZECC 2000 Tropical Australia Wetlands*	25/02/2010	30/03/2010	21/04/2010	26/05/2010	25/02/2010	30/03/2010	21/04/2010	26/05/2010	30/06/2010	27/07/2010	16/02/2011	16/02/2011
Chlorophyll α	µg/L	1		*10*	3	6	2	1	4	<1	4	2	<1	*13*	5	2
Ammonia as N	mg/L	0.005		*0.01*	*0.042*	*0.032*	<0.005	<0.005	*0.062*	*0.025*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrate as N	mg/L	0.002	**0.7**		0.139	0.074	<0.002	<0.002	0.251	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Nitrite as N	mg/L	0.002			0.128	<0.002	<0.002	<0.002	0.182	<0.002	<0.002	<0.002	<0.002	0.002	0.003	<0.002
Total Nitrogen	mg/L	0.01		*1.2*	0.74	0.56	0.54	0.65	0.84	0.51	0.5	0.76	0.93	1.16	0.85	0.67
Reactive Phosphorus as P	mg/L	0.001		*0.025*	0.018	*0.05*	0.002	<0.001	*0.025*	*0.034*	0.005	0.001	0.002	0.004	0.003	0.001
TKN as N	mg/L	0.01			0.47	0.49	0.54	0.65	0.41	0.51	0.5	0.76	0.93	1.16	0.85	0.67
TSS	mg/L	1			16	34	4	2	20	50	9	4	4	5	8	9
Aluminium	mg/L	0.005	**0.055**		**7.510**	**9.160**	-	-	**8.280**	**5.220**	-	-	-	**0.090**	**0.200**	**0.235**
Arsenic	mg/L	0.0002	**0.024**		0.0015	0.0023	-	-	0.0029	0.002	-	-	-	0.002	0.0015	0.002
Boron	mg/L	0.005	**0.37**		0.064	0.095	-	-	0.110	0.121	-	-	-	0.317	0.069	0.171
Chromium (III+VI)	mg/L	0.0002			0.0189	0.0182	-	-	0.0185	0.0106	-	-	-	0.0001	0.0003	0.0003
Cobalt	mg/L	0.0001			0.0041	0.0038	-	-	0.0044	0.0023	-	-	-	0.0003	0.0005	0.0004
Copper	mg/L	0.0005	**0.0014**		**0.0091**	**0.0076**	-	-	**0.0085**	**0.0056**	-	-	-	<0.0005	0.0005	**0.0014**
Iron	mg/L	0.002			8.840	8.230	-	-	9.080	4.630	-	-	-	0.133	0.878	0.471
Lead	mg/L	0.0001	**0.0034**		**0.0035**	0.0029	-	-	**0.0043**	0.0018	-	-	-	0.0002	0.0001	0.0003

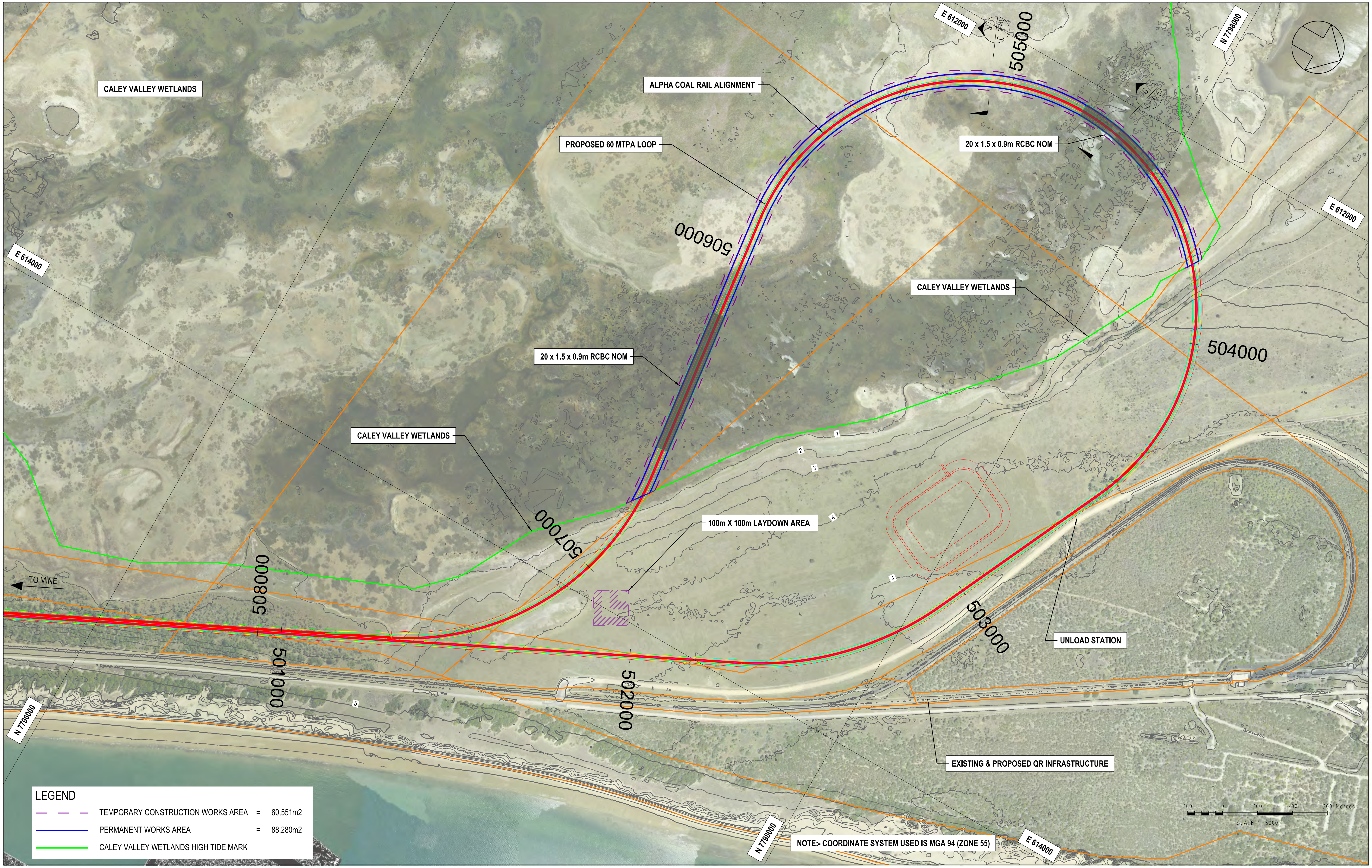
					WQ09				WQ10						Alpha 2	Alpha 1
		EQL	**ANZECC Ecosystems Fresh Water (95%)**	*ANZECC 2000 Tropical Australia Wetlands*	25/02/2010	30/03/2010	21/04/2010	26/05/2010	25/02/2010	30/03/2010	21/04/2010	26/05/2010	30/06/2010	27/07/2010	16/02/2011	16/02/2011
Manganese	mg/L	0.0005	**1.9**		0.105	0.0945	-	-	0.109	0.0628	-	-	-	0.0109	0.184	0.0252
Molybdenum	mg/L	0.0001			0.001	0.0024	-	-	0.002	0.0032	-	-	-	0.0032	0.0009	0.0019
Nickel	mg/L	0.0005	**0.011**		0.0069	0.0069	-	-	0.0071	0.0048	-	-	-	0.0013	0.0008	0.001
Phosphorus	mg/L	0.005		*0.05*	*0.192*	*0.096*	0.015	0.012	*0.188*	*0.070*	0.027	0.010	0.006	*0.065*	0.021	0.006
Selenium	mg/L	0.0002	**0.011**		0.0003	0.0001	-	-	0.0003	0.0001	-	-	-	0.0001	0.0001	0.0001
Vanadium	mg/L	0.0002			0.023	0.019	-	-	0.0238	0.0117	-	-	-	0.0009	0.0012	0.0018
Zinc	mg/L	0.001	**0.008**		**0.012**	**0.012**	-	-	**0.012**	0.007	-	-	-	0.002	<0.001	<0.001

Appendix E

Loop General Arrangement

Drawing supplied by Calibre for information 07/06/11

NOT TO BE SCALED NOT TO BE SCALED



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Document Status

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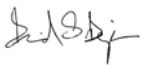
		Name	Signature	Name	Signature	Date
0	Katherine Taske	Kerry Neil		Phil Bradley		16/06/2011
1	Katherine Taske	David Dique		Phil Bradley		05/08/2011