Limitations of this Report

Client: Mt Carlton
Prepared by Northern Resource Consultants (NRC)

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Introduction

1. Project Description

The Mt Carlton Operation (MCO) is a gold, silver and copper mining project in North Queensland. The mine has been in operation since early 2013. Water used in processing at the site is sourced from pit dewatering bores and from rainfall across the lease that is collected in the main site water dam (MSWD).

As part of MCO’s ongoing water supply strategy, a 400 ML raw water allocation has been secured from an adjoining landholder of the project. Through negotiations with the landholder of Strathalbyn Station, which lies due west of ML10343 and underlies MLA10375, MCO have arranged to utilise the landholder’s existing water allocation from the Burdekin River up to 400ML annually.

This EA Amendment application is for the construction and operation of a 225mm subterranean HDPE pipeline and associated pumping infrastructure, to carry river water from the Burdekin River to the MSWD at MCO for processing. The proposed pipeline will be approximately 39km long. Approximately 15km of that pipeline will follow the existing pipeline corridor that branches off ML10343 which hosts the King Creek substation power line and under which the raw water pipeline is also approved as an external water pipeline infrastructure corridor as per Schedule A of the site’s EA EPML00982113. The remaining 24km of pipeline that is the subject of this application for a mining lease will branch off from Johnny Cake Road and then follow the Strathalbyn Station Access Driveway across Strathalbyn Station to the Burdekin River.

The proposed mining lease will be 8m wide along the remaining 24km, comprising an additional 19.2ha of disturbance under the site’s EA. Utilisation of pumping infrastructure already in place at the Burdekin River is included in the agreement between MCO and the landholder, though MCO intend to upgrade some of the pumping equipment to ensure most effective performance and monitoring of water uptake.

The excavation of the pipeline corridor, laying of the piping and rehabilitation of the excavation trench is expected to take 18 weeks in total and will be carried out in stages to minimise the risk of environmental harm. The proposed activity is considered to have a relatively low risk of environmental harm given the linear nature of the disturbance, the decision to bury the pipeline to a depth of approximately 300mm and the intent to rehabilitate the pipeline trench progressively.

This document has been prepared as part of the overall application to amend MCO’s Environmental Authority (EA) EPML00982113. This report addresses the Department of Environment and Heritage Protection (EHP) Guideline EM961: Application Requirements for Activities with Impacts to Land. Two technical reports are provided as appendices to this guidelines response:

- Burdekin River Pipeline Project Soil and Land Use Technical Report (NRC 2014)
2. Regulatory Framework

Environment impacts to land associated with environmentally relevant activities in Queensland are regulated under the EP Act 1994 and subordinate legislation including the Environmental Protection Regulation 2008. Impacts to land may also occur through notifiable activities, if occurring on the proposed land.

2.1 Commonwealth Legislation

Environmental Protection and Biodiversity Conservation Act 1999 (Cwlth)

The Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) is administered by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of national environmental significance (MNES). The MNES listed in the EPBC Act that are relevant to this report are:

- nationally threatened species and ecological communities
- migratory species

Database searches and field assessments should be conducted as part of any flora and fauna impact assessment. The results of these assessments can be used to determine the presence or likelihood of the presence of any MNES within a proposed development area. If any species or communities listed under the EPBC Act are present or likely to be present, an assessment of significance is required. If the proposed action may have a significant impact on a MNES, it must be referred to SEWPaC for assessment. If SEWPaC determines that the proposed action is likely to have significant impacts, the project will be considered as a Controlled Action and will require formal assessment and approval. If the proposed action is not likely to be significant, approval is not required if the action is taken in accordance with the referral. Consequently, the action can proceed, subject to any state or local government requirements.

2.2 State Legislation

Environmental Protection Act 1994 (Qld)

The Environmental Protection Act 1994 (EP Act) is intended “to protect Queensland’s environment while allowing for development that improves total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development)”. The Act regulates environmentally relevant activities (ERAs), which includes provisions relating to the environmental management of mine sites. EHP assesses applications to undertake ERAs, and issues environmental authorities (EAs) that identify environmental conditions to be met to ensure the prevention or minimisation of environmental harm caused by authorised ERAs. An environmental impact assessment process is required as part of the EA application.
When making application to EHP for EAs for mining activities, the applicants are required under the Environmental Protection Regulation 1998 to identify ESAs within or adjacent to the proposed mining tenement. An ESA is defined as a location that:

- Has environmental values that contribute to maintaining biological diversity and integrity,
- Has intrinsic or attributed scientific, historical or cultural heritage value
- Is important to providing amenity, harmony or sense of community.

Three categories of ESA exist:

- **Category A**: areas that have significant ecological values including national parks, marine parks, conservation parks, forest reserves, the Wet Tropics World Heritage Area and the Great Barrier Reef region.
- **Category B**: areas that include REs with an Endangered biodiversity status, Ramsar wetlands (as per the Ramsar Convention on wetlands of international importance, especially as waterfowl habitat), state forest parks, wilderness areas, areas seaward of the highest astronomical tide, fish habitat areas and areas containing marine plants.
- **Category C**: areas that include nature refuges, state forests, timber reserves, declared catchment areas, river improvement areas, and resource reserves.

**Environmental Protection Regulation 2007 (Qld)**

The *Environmental Protection Regulation 2008* (EPR) defines the nature of Environmentally Relevant Activities (ERA), and the process required for the preparation and submission of Environmental Impact Statements (EIS), Terms of Reference (TOR) and Environmental Authority (EA) applications.

The EPR provides a decision-making framework for the determination of applications made under the EP Act, sets fees payable and requirements for financial assurance, identifies environmental values, waste and waste disposal requirements, addresses environmental nuisance and complaints management and process for appeal under the EP Act.

**Vegetation Management Act 1999 (Qld)**

The *Vegetation Management Act 1999* (VMA) is administered by the Queensland Department of Natural Resources and Mines (DNRM) and protects Queensland’s biodiversity by conserving native vegetation and addressing land degradation issues.

Queensland’s vegetation management framework under the VMA regulates the clearing of certain native vegetation. The framework includes legislation, regional vegetation management codes, a regrowth vegetation code and an offsets policy.

The VMA incorporates the regional ecosystem (RE) classification scheme to regulate the clearing of native vegetation. REs are remnant vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. Remnant vegetation is defined under the VMA as vegetation where the dominant canopy has greater than
70% of the height and greater than 50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation’s undisturbed canopy.

The Queensland Herbarium has mapped the remnant extent of regional ecosystems for much of the state using a combination of satellite imagery, aerial photography and on-ground studies (ground-truthing). Regional ecosystem maps published by the Department of Environment and Heritage Protection (EHP) describe the extent and conservation status of remnant vegetation as regional ecosystems. REs are classified in the following vegetation management class and biodiversity status categories:

- Endangered
- Of Concern
- Least Concern/Not of Concern

**Nature Conservation Act 1992 (Qld)**

The *Nature Conservation Act 1992* (NC Act) is administered by EPH and provides the framework for the declaration and management of protected areas, and protection of wildlife listed under the *Nature Conservation (Wildlife) Regulation 2006* (NC Regulation). The purpose of the NC Regulation is to prescribe wildlife as one of the following classes of wildlife:

- extinct in the wild
- endangered
- vulnerable
- near threatened
- least concern

Threatened wildlife under the NC Act is wildlife that is prescribed under the Act as extinct in the wild, endangered or vulnerable. All native flora and fauna species are protected under the act and permits to ‘take’ protected wildlife are required from EHP.

EHP provides the Wildlife Online database, which can be searched to generate a list of all species recorded within a specified area. This tool is useful for determining the presence or likelihood of occurrence of threatened species in an area.

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

The *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act) provides a framework for the management of weeds, pest animals and the stock route network. It governs actions with respect to the control and management of declared plants and animals in the state and provides local governments with a legal instrument to enforce the management of high-priority weeds and pest animals.
There are three classes of declared pests under the LP Act and the species within these classes have been targeted for control because they have, or could have, serious economic, environmental or social impacts. There are legal obligations associated with the control, supply, sale, keeping and transport of declared plants in Queensland. Declaration under state legislation imposes various legal responsibilities for control by landowners on land under their management, including all landowning state agencies.

The three categories of declared plants in Queensland are:

- **Class 1**: A pest that has the potential to become a very serious pest in Queensland in the future. All landholders are required by law to keep their land free of Class 1 pests.

- **Class 2**: A pest that has already spread over substantial areas of Queensland, but its impact is so serious that control is required to avoid further spread. By law, all landholders must try to keep their land free of Class 2 pests and it is an offence to possess, sell or release these pests without a permit.

- **Class 3**: A pest that is commonly established in parts of Queensland but its control by landowners is not necessary unless the plant is impacting, or has the potential to impact, on a nearby ‘environmentally significant area’ (e.g. a national park).

**State Planning Policy (December 2013) (Qld)**

In December 2013, the Department of State Development, Infrastructure and Planning released a single State Planning Policy to replace the multiple policies previously in existence. This replaces policies listed in the DEHP Guideline (EM961) such as SPP2/02 Planning and Managing Development Involving Acid Sulfate Soils, SPP1/92 Guidelines for the Identification of Good Quality Agricultural Land and SPP1/12 Protection of Strategic Cropping Land.

**Wild Rivers Act (2005) (Qld)**

The Wild Rivers Act was established to provide a mechanism for protecting the natural values of rivers that have all, or almost all, of their natural values intact and to specifically provide for the preservation of the natural values of rivers in the Lake Eyre basin. This is achieved by creating a framework that assesses the impacts of proposed development on the natural values of these areas. The Wild Rivers Code (2007) is a primary component in ensuring the objectives of the Act are achieved by providing assessment criteria in the form of acceptable outcomes for identified development projects.

**Guidelines and Policies**

The guidelines and standards referred to in generating this report include:


- Australian Soil and Land Survey Field Handbook (McKenzie et al., 1990)
- Australian Soil and Land Survey: Guidelines for Survey Soil and Land Resources (McKenzie et al., 2008)

- Australian Soil Survey and Land Survey Field Handbook (National Committee on Soil and Terrain, 2009)

- Australian Soil Classification (Isbell, 2002)

- Land Suitability Assessment Techniques (Department of Mines and Energy, 1995)

- Interpreting Soil Test Results: What do all the numbers mean? (Hazelton & Murphy, 2007)


3. Environmental Objective

The environmental objective of the Burdekin pipeline project is to protect the environmental values associated with the receiving environment. Given the nature of the proposed project, the receiving environment of both land and water are considered to be at greatest risk of environmental impact. In the case of land this includes soils, subsoils, land forms and associated flora and fauna.

There are two separate elements of the proposed project: the construction of the pipeline and associated pumping infrastructure, and the operation of the pipeline and associated pumping infrastructure.

The construction of the pipeline is envisaged to take 18 weeks. The intention is to construct in the dry season, before the onset of the heavy wet season rains. This should mitigate risks of erosion and soil dispersal during the disturbance caused by construction.

The proponent also proposes to construct the pipeline in progressive stages, excavating the trench, laying the pipeline and backfilling and grading the backfilled soil promptly. This will minimise the duration of time the trench is open and soil is stockpiled and weathering, and narrow the window of risk for rain and wind to contribute to erosion of stockpiled soil. It will also minimise impacts to flora and fauna in the region.
Environmental Values of the Site

1. Site Description

1.1 Site Location

MCO is a relatively isolated mining project. The closest townships to ML10343 are:

- Dalbeg – approximately 25km to the west,
- Collinsville – approximately 45km to the southeast,
- Gumlu – approximately 45km to the north northeast,
- Bowen – approximately 80km to the northeast.

A map of the proposed pipeline course is included in the appendices of this document.

1.2 Pipeline Existing and Previous Land Use

The course of the proposed pipeline follows an existing pipeline corridor, MLA10375, then branches off from Johnny Cake Road and follows the Strathalbyn Station Access Driveway across Strathalbyn Station to the Burdekin River. The land surrounding the existing mining leases and underlying the course of the proposed mining lease is used as low intensity cattle grazing land. There are a number of large beef cattle properties surrounding and underlying the proposed lease, including Strathalbyn station, King Creek station, Desmond station, Johnny Cake station, Mt Wickham station, Spring Creek station, Strathmore station and Table Top station. Water catchments within the receiving environment, especially the King Creek catchment, are typically used for stock drinking purposes.

The MCO project area is located within the traditional homelands of the Birri People. The Birri People have a registered Native Title claim over the project (Claim No. QUD6244/98) and have an existing Indigenous Land Use Agreement for mineral exploration. A comprehensive field survey was carried out over the proposed mine site and corresponding power line corridor in 2004 and a total of 93 Aboriginal cultural heritage sites and values were recorded. These findings included stone artefact scatters, isolated artefact finds, scarred trees and a large (andesite) rock platform with axe grinding grooves.

Due to its previous anthropogenic land use, the MCO site maintains cultural heritage significance for indigenous people and communities for social, spiritual and historical reasons. Indigenous people must be effectively involved in decisions affecting their heritage, and in managing places meaningful to them. Land managers must respect the rights of indigenous people to make decisions about their own heritage. Given the route of the proposed pipeline ML...
is an 8m corridor starting at the edge of the existing access roads and mostly disturbing pre-cleared verges vegetated with introduced pasture grass species, the disturbance associated with construction of the corridor is not expected to have any cultural heritage impacts.

Two pastoral stations occupy the underlying land of the proposed mining lease. These pastoral stations include:

- Strathbogie Station – also underlies the MCO mining lease
- Strathalbyn Station

The lot on plan numbers for these stations are provided in Table 1. The pipeline will track alongside existing access roads, utilising pre-cleared verges to minimise environmental impacts.

Table 1: Lot on plan for the underlying pastoral stations

<table>
<thead>
<tr>
<th>STATION</th>
<th>LOT ON PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strathbogie Station</td>
<td>4899 SB7665</td>
</tr>
<tr>
<td>Strathalbyn Station</td>
<td>7 SB730</td>
</tr>
<tr>
<td></td>
<td>507 SP17655</td>
</tr>
</tbody>
</table>

The Soil and Land Use Technical Report (NRC, 2014) provided as an appendix to this guideline response identifies the route of the proposed pipeline corridor as ‘moderately to highly disturbed land’, with sources of disturbance including stock grazing, existing access roads, the power line corridor along MLA10375 and the King Creek substation.

2. Physical Description of the Proposed Project Site

2.1 Topography

The topography of the local area is generally undulating plains with some scattered areas of high relief. The proposed pipeline route generally follows the lower parts of the landscape, avoiding steep slopes and high relief areas. From the Burdekin River to the site of the King Creek Substation, the landscape is general comprised of broad and relatively flat plains. From the substation to the mine site the terrain undulates with the pipeline route passing through some small rises, but avoiding the steep slopes of the surrounding hills.

2.2 Geology

The base unit for the Bowen Basin is the Lizzie Creek Volcanics Formation, stratigraphically below the Bowen Coal Measures, occurring approximately 50km to the south of MCO (AARC, 2010). Minerals present at Silver Hill (underlying MCO) are provided in Table 2.
Table 2: Minerals present at Silver Hill (AARC 2010)

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MINERALS PRESENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle Minerals</td>
<td>enargite (copper arsenic sulfide) constituting &gt;95% of the copper bearing sulphide</td>
</tr>
<tr>
<td></td>
<td>pyrite (iron sulfide)</td>
</tr>
<tr>
<td></td>
<td>chalcopyrite (copper iron sulfide)</td>
</tr>
<tr>
<td></td>
<td>minor sphalerite (zinc sulfide).</td>
</tr>
<tr>
<td>Silver Minerals</td>
<td>tetrahedrite (silver arsenic sulfide), which are arsenopolybasite series</td>
</tr>
<tr>
<td></td>
<td>minerals or enargite equivalents with silver replacing copper.</td>
</tr>
</tbody>
</table>

Silver Hill’s mineralisation is found in a high sulfidation epithermal environment, whereby hot solutions have permeated flat lying volcanic layers and left behind silica and other alteration products including heavy metals and copper. Mineralisation occurs in two formations: flat lying blanket and steep east west trending veins. The gold and silver mineralisation occurs within the siliceous (quartz) veins while copper mineralisation occurs in sulfide rich fracture veins (AARC 2010). Silver Hill mineralisation in context with other mineralisation in the MCO region is provided in Figure 1.

![Figure 1: General setting and mineralisation styles of Silver Hill](image)

Geology mapping for the region of the pipeline corridor was obtained from the Department of Natural Resources and Mines (Map Sheet SF 55-3). Three geology units are shown within the
study area, as shown in Table 11. The relevant landzones as defined in Wilson and Taylor (2012) are also shown.

Table 3: Geology mapping units within the pipeline area (DNRM, 2014, Map Sheet SF 55-3)

<table>
<thead>
<tr>
<th>MAP CODE</th>
<th>LITHOLOGY</th>
<th>ROCK TYPE</th>
<th>LANDZONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plz</td>
<td>Basalt, andesite, agglomerate, lithic and tuffaceous sediments, minor acid volcanics</td>
<td>Igneous</td>
<td>12</td>
</tr>
<tr>
<td>Cug</td>
<td>Adamellite, granite, granodiorite, minor marginal granophyre and porphyry</td>
<td>Igneous</td>
<td>12</td>
</tr>
<tr>
<td>Qa</td>
<td>Alluvium, semi consolidated in places</td>
<td>Quaternary Alluvium</td>
<td>3</td>
</tr>
</tbody>
</table>

2.3 Shallow Groundwater

The route of the proposed pipeline crosses some 20 creeks between the main MCO ML10343 and the Burdekin River. Nine of these creeks are along the already approved pipeline corridor MLA10375 and the other 11 are between the King Creek substation and the Burdekin River. These creeks are mainly ephemeral, though some are known to contain perennial water pools, which are a result of groundwater expression in areas of low relief during the dry season. Each of the creek crossings were surveyed during field surveys conducted for both the Flora and Fauna Technical Report and the Soil and Land Use Technical Report included in the appendices of this guideline response.

There was no groundwater expression noted at or in the vicinity of the areas of the proposed creek crossings alongside the existing access roads along the proposed pipeline corridor, and none of the creek crossings will be constructed in the vicinity of perennial pools.

There were no identified groundwater dependent ecosystems (GDEs) observed in the vicinity of the creek crossings along the route of the pipeline. The proposed project is not expected to have any impact on shallow groundwater in the region.

2.4 Floodplains

The proposed pipeline route intersects a mapped floodplain in the vicinity of King Creek (refer to the mapping appendix included with this report). Interaction with this floodplain is not expected to cause environmental impacts because the construction of the pipeline will take place in the dry season, finishing at the latest in the early wet season before the heavy rainfall events typical of the later wet season in the region. Flooding is not expected to impact the subterranean pipeline once it is in operation. If there is a flood event, the pipeline area will be inspected once flood waters recede to ensure there has been no disturbance to the buried length of pipeline in the vicinity of the floodplain.
## 2.5 Soil Description

Previous soil studies conducted across the MCO ML10343 and the MLA10375 power line corridor resulted in three soil types observed within the leases at MCO – Rogers, Cannon and Septentri soil management units (AARC 2009). A miscellaneous igneous management unit was also noted, but given this occurred only on rocky igneous outcrops on the main mining lease, it will not be used for comparison in this report. The three specific soil types identified have differing topsoil depths and nutrient statuses, as outlined in Table 4.

Table 4: Soil type information within the project site at Mt Carlton (AARC 2009)

<table>
<thead>
<tr>
<th>SOIL TYPE</th>
<th>DESCRIPTION</th>
<th>LOCATION</th>
<th>RECOMMENDED TOPSOIL STRIPPING DEPTH</th>
<th>LAND SUITABILITY CLASS – BEEF CATTLE GRAZING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rogers</td>
<td>Consists of light to medium brown clay, with clay content increasing through the top 100cm of the soil. This soil is the most fertile within the project area however there is a decrease in essential plant nutrients below 20cm. Neutral pH transitioning to slightly alkaline at depth.</td>
<td>Found predominantly in the lower undulating drainage areas of site.</td>
<td>30cm where practical</td>
<td>2 – Suitable with minor limitation which either reduce production or require more than the simple management practices of Class 1 land to maintain economic production</td>
</tr>
<tr>
<td>Cannon</td>
<td>Consists of brown predominantly sandy loam soil continuing throughout the column with very little texture change. The soil is lightly acidic at the surface by increases in pH to slightly alkaline by a depth of 100cm. The soil is nutrient deficient and has poor fertility. The soil has poor structure and shows signs of elevated exchangeable sodium below 10cm. However, the results of the chemical analysis are not consistent enough to classify the soil as sodic. A precautionary approach recommends that it should be recognised that a potential risk of erosion exists if the soil is disturbed below a depth of 10cm.</td>
<td>Found interspersed with the Rogers soil management unit in the lower undulating areas of the site, predominantly on the mid to upper slopes.</td>
<td>10cm where practical</td>
<td>4 – Marginal land with severe limitations which make it doubtful whether the inputs required to achieve and maintain production outweigh the benefits in the long term.</td>
</tr>
</tbody>
</table>
### Soil Types

<table>
<thead>
<tr>
<th>SOIL TYPE</th>
<th>DESCRIPTION</th>
<th>LOCATION</th>
<th>RECOMMENDED TOPSOIL STRIPPING DEPTH</th>
<th>LAND SUITABILITY CLASS – BEEF CATTLE GRAZING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septentri</td>
<td>Consists of brown to grey brown, light to medium clay throughout the profile, with clay content increasing slightly with depth. The soil has a moderate level of nutrients but is still deficient in organic carbon and nitrogen. A defining characteristic of this soil is a significant increase of chlorine at depth and a high percentage of exchangeable sodium. This soil is considered strongly sodic with ESP &gt; 6 in the A horizon increasing to ESP &gt; 15 at a depth of 90cm. The soil is therefore chemically predisposed to erosion below 10cm further increasing with depth. Soil is slightly acidic at the surface increasing markedly to moderately alkaline by the depth of 100cm.</td>
<td>Found on higher, rockier areas of the site alongside igneous rocky outcrops.</td>
<td>&lt;10cm where practical</td>
<td>4 – Marginal land with severe limitations which make it doubtful whether the inputs required to achieve and maintain production outweigh the benefits in the long term.</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Consists of mostly absent soils on rocky igneous outcrops.</td>
<td>Found on very steep hills and peaks</td>
<td>Nil</td>
<td>5 – Unsuitable land with extreme limitations that preclude its use for the proposed purpose</td>
</tr>
</tbody>
</table>

The Septentri and Cannon soil types were the predominant types along the power line corridor. Septentri soil is considered strongly sodic with ESP > 6 in the A horizon increasing to ESP > 15 at a depth of 90cm (AARC, 2009). The AARC report classified this soil as chemically predisposed to erosion below 10cm, further increasing with depth, which is consistent with the findings of this current survey.

The Cannon soil type is nutrient deficient and has poor fertility, which is also consistent with findings of the current survey along the pipeline corridor. The AARC (2009) report also identifies the ratio of calcium to magnesium in Cannon soil indicates soil that may become sticky when wet and very hard when dry, which is consistent with analysis of existing survey sample results.
2.6 Soil Health and Function

Two soil test pits were assessed along the proposed pipeline pathway, SS04 and SS11. The physical and chemical characteristics of these soils allow an indication of the soil variation, health, and an assessment of the soils potential to pose any management issues to construction.

Field assessment and laboratory analysis show that sodicity is the primary characteristic of soil samples SS04 and SS11. This sodicity is shown to increase with depth in both soil sample locations. Sodic soils pose potential problems as their clay fraction rapidly disperses on contact with water, making soils unstable and erosion prone. Due to the sodic characteristics of SS04 and SS11, each soil sample contains a low permeability and a moderate water holding capacity.

Soils within the proposed pipeline region contain relatively neutral pH conditions ranging from 6.8 - 7.3 (Table 5). Within the subsurface (B Horizon) the pH tends towards increased alkalinity ranging from 8.1 - 8.8. There are no extremely acidic soils present, therefore, the pH should not pose any management issues for development of the pipeline.

Table 5: Soil Fertility and Nutrient Status

<table>
<thead>
<tr>
<th>TEST PIT</th>
<th>SOIL HORIZON</th>
<th>PH</th>
<th>CEC</th>
<th>EXCHANGEABLE CATIONS (MEQ/100G)</th>
<th>TOC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ca</td>
<td>Mg</td>
</tr>
<tr>
<td>SS04</td>
<td>Surface</td>
<td>7.3</td>
<td>4.9</td>
<td>2.3</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Subsoil</td>
<td>8.1</td>
<td>11</td>
<td>4.6</td>
<td>3.5</td>
</tr>
<tr>
<td>SS11</td>
<td>Surface</td>
<td>6.8</td>
<td>13</td>
<td>8.1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Subsoil</td>
<td>8.8</td>
<td>38</td>
<td>21</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Soil fertility is examined in terms of pH, CEC, exchangeable potassium, exchangeable calcium and organic carbon.

Nutrient availability, in regards to exchangeable Ca, Mg, K and Na, is quite high in both soil samples (SS04 and SS11; Table 5). Potassium, however, contains lower values than the other exchangeable cations, which may cause potassium deficiency in future plant growth if the content continues to decrease to <0.2meq/L. The total organic carbon % is lower in SS04 (0.47%) than SS11 (3%).

2.7 Distinct or Unique Features

The land underlying the proposed pipeline corridor is previously cleared land that can be classified as moderately to highly disturbed based on the impacts of grazing activities and the presence of the power line corridor and the King Creek substation. There are no distinct or unique features associated with the landscape or soil in the region.
3. Bioregion and Regional Ecosystems

3.1 Mapped Remnant Vegetation

The RE mapping for the study area included in the Flora and Fauna Technical Report shows that almost the entire area is comprised of remnant vegetation. Table 6 provides a summary of all the REs mapped throughout the study area.

Table 6: Regional ecosystem status and description for mapped remnant vegetation within the study area

<table>
<thead>
<tr>
<th>RE CODE</th>
<th>VMA STATUS</th>
<th>BIODIVERSITY STATUS</th>
<th>REGIONAL ECOSYSTEM DATABASE SHORT DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.3.4</td>
<td>Of Concern</td>
<td>Of Concern</td>
<td>Eucalyptus tereticornis and/or Eucalyptus spp. woodland on alluvial plains</td>
</tr>
<tr>
<td>11.3.7</td>
<td>Least Concern</td>
<td>Of Concern</td>
<td>Corymbia spp. woodland on alluvial plains</td>
</tr>
<tr>
<td>11.3.9</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td>Eucalyptus platyphylla, Corymbia spp. woodland on alluvial plains</td>
</tr>
<tr>
<td>11.3.25</td>
<td>Least Concern</td>
<td>Of Concern</td>
<td>Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines</td>
</tr>
<tr>
<td>11.3.27</td>
<td>Least Concern</td>
<td>Of Concern</td>
<td>Freshwater wetlands. Vegetation is variable including open water with or without aquatic species and fringing sedgelands and eucalypt woodlands.</td>
</tr>
<tr>
<td>11.3.31</td>
<td>Least Concern</td>
<td>Of Concern</td>
<td>Ophiuros exaltatus, Dichanthium spp. grassland on alluvial plains</td>
</tr>
<tr>
<td>11.12.1</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td>Eucalyptus crebra woodland on igneous rocks</td>
</tr>
<tr>
<td>11.12.2</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td>Eucalyptus melanophloia woodland on igneous rocks</td>
</tr>
<tr>
<td>11.12.7</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td>Eucalyptus crebra woodland with patches of semi-evergreen vine thicket on igneous rocks (boulder-strewn hillsides)</td>
</tr>
<tr>
<td>11.12.9</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td>Eucalyptus platyphylla woodland on igneous rocks</td>
</tr>
<tr>
<td>11.12.10</td>
<td>Of Concern</td>
<td>Of Concern</td>
<td>Corymbia clarksoniana woodland on igneous rocks</td>
</tr>
</tbody>
</table>

3.2 Ground-truthed Remnant Vegetation

Ground-truthing of the remnant vegetation within the study area revealed that there are six remnant REs present. The floristic composition and structure of these communities and their
extent within the study area are presented in Table 7. A map of remnant vegetation within the study area conducted by NRC is presented in the mapping appendix of this document.
### Table 7: Floristic composition and structure of Regional Ecosystems and non-remnant vegetation within the study area (reproduced from the Flora and Fauna Technical Report (NRC 2014) included as an appendix of this guideline response)

<table>
<thead>
<tr>
<th>DESCRIPTION AND STATUS</th>
<th>FLORISTIC COMPOSITION AND STRUCTURE</th>
<th>LOCATION AND NOTES</th>
<th>REPRESENTATIVE PHOTOGRAPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE 11.3.9</td>
<td><strong>T1</strong>: Sparse. 14 - 18m Eucalyptus platyphylla (D), Corymbia clarksoniana (SD) and C. dallachiana (SD). <strong>G</strong>: <em>Bothriochloa pertusa</em> (D), <em>Heteropogon contortus</em> (SD), <em>Stylosanthes scabra</em> (A), <em>Sida cordifolia</em> (A), <em>Hyptis suaveolens</em> (A), <em>Macroptilium atropurpureum</em> (A), and <em>Stachytarpheta cayennensis</em> (A).</td>
<td>Western portion of the pipeline corridor in a low-lying area near the Burdekin River</td>
<td><img src="image1" alt="Representative Photograph" /></td>
</tr>
<tr>
<td></td>
<td><strong>T1</strong>: Sparse. 14 - 18m Eucalyptus platyphylla (D), Corymbia clarksoniana (SD) and C. dallachiana (SD). <strong>G</strong>: <em>Bothriochloa pertusa</em> (D), <em>Heteropogon contortus</em> (SD), <em>Stylosanthes scabra</em> (A), <em>Sida cordifolia</em> (A), <em>Hyptis suaveolens</em> (A), <em>Macroptilium atropurpureum</em> (A), and <em>Stachytarpheta cayennensis</em> (A).</td>
<td>Western portion of the pipeline corridor in a low-lying area near the Burdekin River</td>
<td><img src="image2" alt="Representative Photograph" /></td>
</tr>
<tr>
<td></td>
<td><strong>T1</strong>: Sparse. 10 - 18m Melaleuca fluviatilis (D), Corymbia tessellaris (SD), Pleiogyne timorensis (A) C. clarksoniana (A). <strong>T2</strong>: Sparse to mid-dense 5 – 8m Lophostemon grandiflorus (D), Melaleuca bracteata (A-SD)</td>
<td>Along the margins of most major watercourses within the study area (≥ stream order 2). The Burdekin River section of this community is extremely highly disturbed with numerous declared pest plant species (see further description in the Pest Species section of this report). The canopy on the upper banks of this section is dominated by Eucalyptus tereticornis.</td>
<td><img src="image3" alt="Representative Photograph" /></td>
</tr>
</tbody>
</table>
### DESCRIPTION AND STATUS

| RE 11.3.25a | Canopy is dominated by *Eucalyptus raveretiana*.  
*Cryptostegia grandiflora* and other exotic species are abundant throughout.  
VMA Status: Least Concern  
Biodiversity Status: Of Concern |
| --- | --- |

<table>
<thead>
<tr>
<th>FLORISTIC COMPOSITION AND STRUCTURE</th>
<th>LOCATION AND NOTES</th>
</tr>
</thead>
</table>
| **T1:** Sparse. 15 - 25m  
*Eucalyptus raveretiana* (D), *Melaleuca fluviatilis* (SD), *Casuarina cunninghamiana* (SD)  
**T2:** Very Sparse. 10 – 14m  
*Lophostemon grandiflorus* (CD), *Melaleuca fluviatilis* (CD), *Casuarina cunninghamiana* (CD), *Ficus racemosa* (A)  
**T3:** Very Sparse. 3 – 8m *Ficus opposita* (CD), *Pleiochyne timorensis* (A), *Melaleuca viminalis* (A)  
**S:** *Cryptostegia grandiflora* (D), *Lanatana camara* (A)  
**G:** *Bothriochloa pertusa* (CD), *Parthenium hysterophorus* (CD), *Hyptis capitata* (CD), *Sida cordifolia* (A), *Urochloa mosambicensis* (A) |
| Present as a very narrow fringing community along the margin of King Creek and nearby tributaries within the study area.  
There is a very dense infestation of *Cryptostegia grandiflora* that is present throughout all strata, but particularly the shrub layer. Other exotic species are also common in the ground layer. |

| RE 11.3.35 | Canopy is dominated by *Eucalyptus raveretiana*.  
*Cryptostegia grandiflora* and other exotic species are abundant throughout.  
VMA Status: Least Concern  
Biodiversity Status: No Concern at Present |
| --- | --- |

<table>
<thead>
<tr>
<th>FLORISTIC COMPOSITION AND STRUCTURE</th>
<th>LOCATION AND NOTES</th>
</tr>
</thead>
</table>
| **T1/E:** Sparse. 14m  
*Eucalyptus platyphylla* (CD) and *Corymbia clarksoniana* (CD)  
**T2:** Sparse. 3 - 8m *Melaleuca nervosa* (CD), *M. viridiflora* (CD), *Petalostigma pubescens* (CD)  
**S:** *Sida cordifolia* (CD), *Hyptis capitata* (CD), *Stylosanthes scabra* (CD)  
**G:** *Stylosanthes hamata* (D), *Aristida sp.* (SD), *Setaria surgens* (SD), *Chamaecrista rotundifolia* (SD), *Perotis rara* (A) |
| Present on a section of very sandy soil within the western portion of the pipeline corridor.  
Generally a sparse to very-sparse community with significant disturbance from cattle grazing and introduced pasture species. |
<table>
<thead>
<tr>
<th>DESCRIPTION AND STATUS</th>
<th>FLORISTIC COMPOSITION AND STRUCTURE</th>
<th>LOCATION AND NOTES</th>
<th>REPRESENTATIVE PHOTOGRAPH</th>
</tr>
</thead>
</table>
| RE 11.12.1             | **Eucalyptus crebra** woodland with a grassy understory. *Corymbia erythrophloia* is co-dominant or dominant in some areas  | **T1**: Sparse. 12 - 17m *Eucalyptus crebra* (D), *Corymbia erythrophloia* (SD-D).  
**S**: Very sparse (usually absent) <1m Recruitment of canopy species, *Sida cordifolia*, and in some areas *Atalaya hemiglauca*  
**G**: *Bothriochloa pertusa* (D), *Heteropogon contortus* (A), *Stylosanthes scabra* (A), *Stylosanthes hamata* (A), *Chamaecrista rotundifolia* (A)  | This is the dominant RE for the study area and occurs throughout much of the pipeline corridor.  
The shrub layer is usually absent. The ground layer is dominated (almost exclusively) by *Bothriochloa pertusa.*  |
|                        |                                    |                    |                           |
| RE 11.12.9             | **Eucalyptus platyphylla** woodland with a grassy understory. *Corymbia dallachiana* is co-dominant or dominant in some areas  | **T1**: Sparse. 10 - 16m *Eucalyptus platyphylla* (D), *Corymbia dallachiana* (SD-D).  
**S**: Very sparse (usually absent) Recruitment of canopy species  
Ground layer typically dominated by a variety of exotic pasture species.  |
<table>
<thead>
<tr>
<th>DESCRIPTION AND STATUS</th>
<th>FLORISTIC COMPOSITION AND STRUCTURE</th>
<th>LOCATION AND NOTES</th>
<th>REPRESENTATIVE PHOTOGRAPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-remnant vegetation surrounded by RE 11.12.1 25 to 30 metre wide corridor devoid of remnant vegetation with a grassy ground layer and minimal regrowth.</td>
<td>The groundcover throughout the majority of the corridor (and surrounding areas) is dominated by <em>Bothriochloa pertusa</em>. The native species <em>Heteropogon contortus</em> is occasionally sub-dominant in some areas. Regrowth of RE 11.12.1 species (mostly <em>Eucalyptus crebra</em> and <em>Corymbia erythrophloia</em>) is very sparsely scattered along the corridor. <em>Acacia</em> spp. and <em>Breynia oblongifolia</em> are present in some areas and <em>Cryptostegia grandiflora</em> is common at watercourse crossings.</td>
<td>This existing corridor occurs between the current mining operation and the King Creek substation. The use of this existing corridor will avoid disturbance to remnant vegetation for this entire section of the proposed pipeline.</td>
<td><img src="image1.png" alt="Representative Photograph" /></td>
</tr>
<tr>
<td>Non-remnant vegetation surrounded by RE 11.12.1 50 to 60 metre wide corridor devoid of remnant vegetation with a grassy ground layer and minimal regrowth. An access track is present along the centre of the corridor, which the proposed pipeline is to be constructed alongside.</td>
<td>The groundcover throughout the majority of the corridor (and surrounding areas) is dominated by <em>Bothriochloa pertusa</em>, occasionally with <em>Urochloa mosambicensis</em>. There is no shrub layer or any regrowth present within this section.</td>
<td>This existing corridor occurs between the King Creek substation and the access road to Strathalbyn homestead. The use of this existing corridor will reduce disturbance to remnant vegetation for this entire section of the proposed pipeline.</td>
<td><img src="image2.png" alt="Representative Photograph" /></td>
</tr>
</tbody>
</table>
4. Interaction with Land and Other Ecosystems

4.1 Ecosystem Interaction

The site of the proposed pipeline corridor runs alongside existing access roads and tracks. The pipeline along MLA10375 is already approved; the stretch from the King Creek substation at the end of MLA10375 to the Burdekin River will be buried within an 8m wide ML corridor, the edge of which will meet the edge of the access roads the pipeline is planned to run alongside.

This places the pipeline corridor, for the most part, in pre-cleared roadside verges vegetated with introduced pasture grass species, the exception being areas where the pipeline will be elevated and suspended from wire rope to allow it to cross creeks. The excavation will have minimal impact to the soil and pasture grasses, and the trench will be backfilled promptly, allowing the cleared width of the pipeline corridor to revegetate with the same pasture grass species from within the soil’s existing seed bank.

Where the pipeline crosses creeks, a system of concrete plinths with wire rope anchored between them will be used. The concrete plinths will be set back from the tops of the creek banks, clear of the riparian zones.

4.2 Surface Water Interaction

There are 11 creek crossings over the 24km of pipeline that is the subject of this application to amend the EA. Most of the creeks in this region are ephemeral, with King Creek the only one of the creeks in flow during either of the flora and fauna field surveys or the soils field survey conducted for this application.

4.3 Groundwater Interaction

As previously referenced in the section on Shallow Groundwater in this document, some of the ephemeral creeks in the area are known to contain perennial water pools, which are a result of groundwater expression in areas of low relief during the dry season. During field surveys conducted for both the Flora and Fauna Technical Report and the Soil and Land Use Technical Report included in the appendices of this guideline response, there was no groundwater expression noted at or in the vicinity of the areas of the proposed creek crossings alongside the existing access roads along the proposed pipeline corridor, and none of the creek crossings will be constructed in the vicinity of perennial pools.

There were no identified groundwater dependent ecosystems (GDEs) observed in the vicinity of the creek crossings along the route of the pipeline. The proposed project is not expected to have any impact on shallow groundwater in the region.
4.4 Wetland Interaction

There are several referable wetlands mapped in the vicinity of the proposed pipeline corridor near the Burdekin River. These wetlands are, however, at least 1.5km from the nearest section of the proposed pipeline and all construction works will be significantly outside the 200m protection zone buffer that is typically applied to such wetlands. It is therefore unlikely that the values of these referable wetlands will be affected in any way by the proposed pipeline.

There are several areas mapped as wetlands on the vegetation management wetlands map near the Burdekin River in close proximity to the proposed pipeline. These areas are mapped as remnant vegetation of RE 11.3.27. Ground-truthing surveys revealed that these areas are highly disturbed and modified with existing impacts from:

- An access road and power line corridor,
- Vegetation clearing,
- Cattle grazing,
- Invasion by numerous exotic plant species included several declared class two pest species,
- Modified hydrology from the construction of a small dam and other earthworks.

Full details of wetland surveys are included in the Flora and Fauna Technical Report that accompanies this guideline response.

5. Flora

5.1 Species Noted During Field Surveys

A total of 89 flora species from 35 families were recorded from the vegetation transects within the study area of the proposed pipeline. The majority of flora species observed throughout the study area are common and widespread throughout the region in Eucalypt woodland communities. The floristic composition is generally consistent throughout the study area, with low species richness, and disturbance from cattle grazing and exotic species invasion is evident throughout. A full list of flora identified during the flora surveys is included in the appendices of the Flora and Fauna Technical Report, in the appendices of this guideline response.

5.2 Threatened Flora Species

Black Ironbox is present along the margins of King Creek and its tributaries where they intersect with the proposed pipeline corridor. This species is listed as vulnerable under the Nature Conservation Act 1992 (NC Act) and the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act). As per the Flora Survey Guidelines – Protected Plants used to inform the survey effort of the flora and fauna surveys, quantification surveys were conducted to determine the abundance of this species where it occurs within 100m of the proposed...
pipeline corridor. Full details of the surveys are provided in the *Flora and Fauna Technical Report* in the appendices of this guideline response. Seven quantification plots were established, six of which were located on the banks where mature trees are present and one was located in the stream bed where there was a dense area of juvenile trees. The outcomes of these quantification surveys are summarised in Table 7 of this guideline response.

On average, mature Black Ironbox trees are present in densities of seven trees per 100m of stream bank where the proposed pipeline corridor occurs within 100m of Black Ironbox habitat. In these same areas, recruitment of Black Ironbox on the stream banks is, on average, 12 plants per 100m of stream bank.

Vegetation cover within the stream bed is typically absent, with large areas of bare sand, or is dominated by semi-aquatic species such as sedges. Recruitment of Black Ironbox is occasionally present in small dense patches on small sandbars within the stream bed. Quantification plot surveys revealed that these patches occur in densities up to 240 plants per 0.05ha. The location of these plants within the stream bed is such that few, if any, are likely to survive the following wet season.

No other threatened or near threatened flora species (as listed under the EPBC Act or NC Act) were identified during the vegetation surveys, despite targeted surveys in suitable habitat. Full details of the potential for threatened flora species identified in desktop analysis to occur within the study area is addressed in the *Flora and Fauna Technical Report* and its appendices.

### 5.3 Pest Species

Pest plant species were common throughout the study area, including a number of species declared under the *Land Protection (Pest and Stock Route Management) Act*. The following species are considered the most noteworthy pest plant species observed:

- **Rubber Vine** (*Cryptostegia grandiflora*) is a declared Class 2 plant that is present (and in most cases extremely abundant) along the margins of most watercourses and drainage lines throughout the study area.

- **Parthenium** (*Parthenium hysterophorus*) is a declared Class 2 plant that is scattered along the study area as isolated patches that are generally small to moderate in size.

- **Bellyache Bush** (*Jatropha gossypiifolia*) is a declared Class 2 plant that is abundant in the vicinity of the Burdekin River within the pipeline corridor.

- **Common Pest Pear** (*Opuntia stricta*) is a declared Class 2 plant that is scattered as isolated individuals throughout the study area.

- **Lantana** (*Lantana camara*) is a declared Class 3 plant that occurs in dense patches throughout the study area, particularly along watercourses.

Implications regarding the presence of these pest species and recommended management practices are discussed in the *Flora and Fauna Technical Report* in the appendices of this guideline response.
6. Fauna

6.1 Detailed Studies

Detailed fauna studies were conducted for this pipeline project, and the full details of those studies and their findings are presented in the *Flora and Fauna Technical Report* that accompanies this guideline response as an appendix. Finds are synopsised here.

6.2 Habitat

Habitat features vary across the study area, and are influenced by the extent of existing disturbance from clearing and topography. Overall, habitat values for most faunal groups are low within the proposed corridor (due to existing clearing) and moderate in the surrounding area.

There is a low to moderate number of hollow-bearing trees in the local area, and these appear to be generally limited by the small size of mature trees. Consequently other microhabitat features generated by the presence of mature trees (such as fallen logs and branches) are also limited. The limited availability of habitat hollows reduces roosting and breeding locations for arboreal mammals, birds and microbats.

No rocky outcrops or crevices are present within the proposed corridor, but there are some rocky areas adjacent to the corridor. The proposed corridor intersects the side of Mt Pollux (near the King Creek substation), and there are some areas of rocky habitat at higher altitudes adjacent to the corridor.

There are multiple ephemeral watercourses and drainage lines within the study area that could provide seasonal habitat for amphibians. The seasonal availability of water would also attract other species to these areas, at least temporarily. Habitat within these watercourses is limited, with riparian vegetation rarely extending beyond the high banks of the watercourses.

Apart from the Burdekin River, the most significant watercourse within the study area is King Creek. This was the only watercourse within the study area that was flowing at the time of the fauna surveys. King Creek also has the most dense and mature riparian habitat of all the watercourses within the study area.

6.3 Fauna Present – Species Noted During Field Surveys

Mammals

Eight species of terrestrial or arboreal mammals were observed within the study area over the survey period, including three introduced species. Macropods were commonly observed throughout the study area, and the grassy woodlands of the area provide good quality habitat for these species.

Bats showed the greatest diversity of all mammal groups observed, with 12 species positively identified from the call data collected. A further seven species may also occur within the study area, but the call data collected for these species is inconclusive.
Full details of the mammals surveyed are included in the Flora and Fauna Technical Report included as an appendix to this guideline response.

Reptiles

Ten species of reptiles from four different families were observed within the study area. All of these species are common and widespread throughout the region. Indeed, most of these species are distributed over a large expanse of coastal and sub-coastal Queensland.

Other reptile species such as Frilled Lizard (*Chlamydosaurus kingii*), CommonTree Snake (*Dendrelaphis punctulata*) and Eastern Brown Snake (*Pseudonaja textilis*) have been commonly observed in the mining lease other parts of the local area by environment staff of MCO. These species are also common and widespread throughout the region and are highly likely to occur within the study area.

Full details of the reptiles surveyed are included in the Flora and Fauna Technical Report included as an appendix to this guideline response.

Amphibians

Seven amphibian species were recorded within the study area, all of which are common, widespread and relatively tolerant of disturbance. The majority of native amphibian observations were restricted to the targeted survey area along King Creek. A single Desert Tree Frog (*Litoria rubella*) was observed in an area of Narrow-leaved Ironbark woodland during the surveys. In addition to the King Creek site, the Eastern Dwarf Tree Frog was observed around pools in smaller watercourses near the existing mining operations.

When considering the lack of water in most of the streams during the survey period, it is likely that these species would also be present (or in the case of burrowing frogs, more readily observed) in other streams when sufficient water is present.

No amphibians listed as near threatened or threatened were identified during the dry season surveys.

Full details of the amphibians surveyed are included in the Flora and Fauna Technical Report included as an appendix to this guideline response.

Birds

A total of 67 species of birds were observed within the study area over the dry season and wet season surveys. This species assemblage includes a number of sedentary, nomadic, and migratory species. The majority of species observed are common in eucalypt woodland habitat throughout the region. Species of conservation significance and those listed under state and Commonwealth legislation are discussed in the following sections.

The only threatened bird species observed during the fauna surveys was the southern subspecies of Squatter Pigeon (*Geophaps scripta scripta*). This subspecies is listed as Vulnerable under the NC Act and the EPBC Act due to population declines.

The Rainbow Bee-eater (*Merops ornatus*) was observed frequently throughout the study area, particularly during the dry season surveys. The Rainbow Bee-eater is listed as migratory under
Environmental Values of the Site

the EPBC Act. This species occurs in a variety of habitats over a broad distribution comprising much of mainland Australia.

Full details of the birds surveyed are included in the Flora and Fauna Technical Report included as an appendix to this guideline response.

6.4 Pest Species

Evidence (or in most cases direct observation) of four pest species was detected during the fauna surveys, all of which commonly occur in disturbed habitats throughout Queensland. The following species were observed within the study area:

- Cane Toad (Rhinella marinus)
- European Rabbit (Oryctolagus cuniculus)
- Dog (Canus lupus)
- Pig (Sus scrofa)

7. Environmentally Sensitive Areas

Three categories of ESA exist under the Environmental Protection Regulation (1998):

- Category A: areas that have significant ecological values including national parks, marine parks, conservation parks, forest reserves, the Wet Tropics World Heritage Area and the Great Barrier Reef region.

- Category B: areas that include REs with an Endangered biodiversity status, Ramsar wetlands (as per the Ramsar Convention on wetlands of international importance, especially as waterfowl habitat), state forest parks, wilderness areas, areas seaward of the highest astronomical tide, fish habitat areas and areas containing marine plants.

- Category C: areas that include REs with an Of Concern biodiversity status, essential habitat, referable wetlands, nature refuges, state forests, timber reserves, declared water catchment areas, Koala habitat areas and resource reserves.

Environmentally Sensitive Areas mapping (EHP 2014) identified no sensitive areas (Category A, B or C) within the proposed pipeline boundary; however, endangered regional ecosystems occur approximately 2.5km to the south of the main MCO ML10343. These endangered regional ecosystems are located on the southern side of the Mount Carlton range and will not be impacted by activities pertaining to the Burdekin River pipeline project.

Groundtruthing surveys confirmed the absence of any ESAs in the vicinity of the proposed pipeline corridor.
8. Areas of High Ecological Significance

8.1 Wetlands

As discussed in the Flora and Fauna Technical Report, there are several referable wetlands mapped in the vicinity of the proposed pipeline corridor near the Burdekin River. These wetlands are, however, at least 1.5km from the nearest section of the proposed pipeline and all construction works will be significantly outside the 200m protection zone buffer that is typically applied to such wetlands. It is therefore unlikely that the values of these referable wetlands will be affected in any way by the proposed pipeline.

There are several areas mapped as wetlands on the vegetation management wetlands map near the Burdekin River in close proximity to the proposed pipeline. These areas are mapped as remnant vegetation of RE 11.3.27. Ground-truthing surveys revealed that these areas are highly disturbed and modified with existing impacts from:

- An access road and power line corridor,
- Vegetation clearing,
- Cattle grazing,
- Invasion by numerous exotic plant species included several declared class two pest species,
- Modified hydrology from the construction of a small dam and other earthworks.

In some areas, the existing disturbance is so significant that the vegetation present is not considered to be of remnant status. This is particularly the case for the existing powerline corridor and access road, which are collocated where the mapped vegetation management wetlands occur. There is no canopy present at this location and exotic grasses and pasture weeds dominate the ground layer. The vegetation is not characteristic of native wetland vegetation and is not representative of RE 11.3.27. The proposed pipeline will follow the route of the existing linear infrastructure corridor at this location, utilising the areas of existing disturbance. The construction and operation of the proposed pipeline is highly unlikely to have any further impact on the ecological function of any area mapped as a vegetation management wetland.

8.2 Threatened Ecological Communities

The EPBC Protected Matters search conducted for the Flora and Fauna Technical Report identified the Brigalow (Acacia harpophylla dominant and co-dominant) Threatened Ecological Community (TEC) as ‘known to occur’ within 25km of the study area.

The Brigalow ecological community is characterised by the presence of Brigalow (Acacia harpophylla) as one of the most abundant tree species. Brigalow is either dominant in the tree layer, or co-dominant with other species – notably Belah (Casuarina cristata), other species of Acacia, or species of Eucalyptus.
Detailed vegetation surveys revealed that there is no vegetation characteristic of this community within the study area. The study area is characterised by eucalypt woodland that lacks the relevant floristic composition and structure of the TEC. The species that form the ecologically dominant layer of this community were not identified anywhere within the study area.

The Commonwealth Listing Advice for the Brigalow TEC lists Queensland REs units that are equivalent to the TEC. Interrogation of the DNRM RE mapping data revealed one of these REs (RE 11.3.1) is mapped as a sub-dominant component (10%) of a polygon, the nearest point of which is approximately 4.5km south of the study area. Given the substantial distance from the proposed pipeline, and the small scale of the impacts associated with construction, it is unlikely that there will be any impacts to this community resulting from the construction and operation of the pipeline.

8.3 Large Tracts of Remnant Vegetation and Connectivity Corridors

As detailed in the Flora and Fauna Technical Report, almost the entire study area and surrounding landscape is comprised of remnant vegetation and consequently, habitat connectivity is high, with large continuous areas of eucalypt woodland. There are existing areas of disturbance from power line corridors, access roads, weed invasion, and vegetation thinning and clearing. However, the scale of these disturbances compared to the vast areas of remnant vegetation indicates that such disturbance is unlikely to have had any impact on the value of connectivity for most fauna species.

Some of the riparian vegetation is partially fragmented due to disturbance from cattle grazing and weed infestation. The existing corridors and roads dissect areas of remnant vegetation, but the given the open nature of the surrounding habitat, it is unlikely that these corridors have a significant impact on the value of connectivity. Much of the pipeline will be constructed within existing clearings for other linear infrastructure. Movement of fauna and other factors affecting biodiversity (such as genetic flow) in the area are unlikely to be any further impacted by the small loss of habitat associated with the proposed pipeline.

It is unlikely that the function of this value will be compromised at any scale, and as such, environmental offsets for this value are not required under the QEOP.

8.4 Special Biodiversity Areas

Black Ironbox is present along the margins of King Creek and its tributaries where they intersect with the proposed pipeline corridor. This species is listed as vulnerable under the NC Act and the EPBC Act. Management practices designed to prevent impacts to this species during construction of the pipeline are described in detail in the Proposed Management Practices section of this guideline response, and in the Flora and Fauna Technical Report accompanying this guideline response.

9. State Significant Biodiversity Values

State significant biodiversity was formerly defined under the now superseded Queensland Biodiversity Offset Policy 2011. Matters of State Environmental Significance (MSES) are now
defined under the *Queensland Environmental Offsets Regulation 2014*. These MSES are addressed in detail in the *Flora and Fauna Technical Report* included in the appendices of this guideline response.

10. Potential Land Uses

10.1 Primary Industry and Agriculture

The proposed pipeline corridor will run alongside existing access roads and tracks for the length of the existing ML10375 power line corridor between the main MCO operations ML10343 and the King Creek substation. The proposed ML from King Creek to the Burdekin River will be 8m wide and continue to run alongside existing access roads, in a previously cleared verge where the ground layer is predominantly exotic grasses and pasture weeds.

The pipeline will be buried for its entire length from ML10343 to the Burdekin River, which will mitigate any potential impacts it may have on agricultural activities or primary industry.

10.2 Recreational or Aesthetic Purposes

The route of the proposed pipeline across Strathalbyn Station crosses private land. As such, there are no publicly accessible routes for bushwalking or bird watching and the ephemeral waterways in the vicinity of the project are not used for recreational activities. The pipeline will be buried from the MCO ML10343 and the Burdekin River, other than where it crosses creeks, and as such there will be no impacts to the aesthetic value of the region. The creek crossings are on private land which is not used for recreational activity, and the route of the pipeline is alongside an existing access road and quite a distance from each of the nearby sensitive receptors.

10.3 Industrial Purposes

The route of the proposed pipeline travels approximately 15km along the existing power line corridor. As already indicated in this report, in some areas of the proposed pipeline corridor, the existing disturbance is so significant that the vegetation present is not considered to be of remnant status. This is particularly the case for the existing power line corridor and access road. There is no canopy present at this location and exotic grasses and pasture weeds dominate the ground layer. As such this land is appropriate for the industrial purpose of accommodating a power line and for construction and operation of the pipeline.

The route across Strathalbyn Station is in similar condition in places. The pipeline corridor runs along the previously cleared grass verge of the station access roads, which is again dominated by exotic grasses and pasture weeds in the ground layer for the most part. Given that the proposed pipeline will be buried it will cause minimal disturbance. There is no intended industrial use earmarked for the pipeline corridor across the privately-held Strathalbyn Station, so there will be no impacts to potential future industrial use of that land.
10.4 Cultural and Spiritual Value

The Native Title Claimants for the land underlying the project and associated power line corridor are the Birri People (Claimant Number QUD6244/98). The Birri people have been in negotiations regarding the MCO mining project since the exploration phase (2004; Bird 2009).

Comprehensive field surveys were completed throughout ML10343 and surrounding areas likely to be impacted by the proposed mining activities. A total of 93 Aboriginal cultural heritage sites and values were recorded during Phase 1 of the surveys. Phase 2 of the surveys focussed on the power line corridor from King Creek Substation to the MCO mine site. Three culturally significant sites were found during these surveys. The proposed pipeline will not impact these sites. No additional impacts cultural heritage values are likely as part of this EA amendment.

The stretch of the pipeline from the King Creek substation to the Burdekin River travels alongside the existing access roads in an 8m wide ML corridor that starts at the edge of the road. This proximity to the road mitigates the potential for the ML to impact any areas of cultural or spiritual value for the length of the pipeline.

10.5 Qualities Conducive to Human Health and Well Being

The proposed pipeline corridor crosses privately held agricultural land used for beef cattle grazing. The area is sparsely populated and is not used for recreational activities. The proposed pipeline will have no impacts to qualities of the land that are conducive to human health and well-being.

10.6 Qualities Conducive to the Protection of the Aesthetics of the Environment

The proposed pipeline will be buried for the 39km length from the MCO ML10343 to the Burdekin River, other than where it crosses creek lines. The creek crossings will be in close proximity to the access roads, thereby concentrating disturbance in already disturbed areas and on previously cleared roadside verges where most of the ground layer is exotic grass species and pasture weeds. The concrete plinths used to anchor the wire rope from which the pipeline will be suspended will be set back from the riparian zones in the creeks. This is privately held land in a sparsely populated area, so it is reasonable to consider the proposed pipeline will have little or no impact to the aesthetics of the environment.

11. Wild Rivers

The Wild Rivers Act 2005 Qld was developed to preserve the natural values of a number of major rivers in Queensland by regulating further development within a declared wild river catchment area.

A wild river map is provided in the appendix of this document. This map shows the wild river catchments closest to the MCO mining lease and proposed mining lease. MCO is located within the Burdekin River catchment area. This catchment is not currently declared or nominated for declaration under the Wild Rivers Act 2005. Hence, the proposed pipeline construction and operation is not likely to impact on any wild rivers.
12. Acid Sulfate Soils

Acid Sulfate Soils (ASS) are a particular risk in areas that:

- Are coastal and at or below 5mAHD
- Are coastal and the environmentally relevant activity (ERA) will result in drainage, disturbance or excavation of soils to a depth at or below 5mAHD
- Exhibit geomorphic or site indicators (field 5< pH >4, presence of corroded shell, jarostitic horizons or substantial iron oxide mottling in surface encrustations, sulphurous smell; Appendix 2: A2.1 Soil and Water Field Indicators, DLGP and DNRM 2002)
- Are of higher elevation than has previously been found to have ASS present due to geomorphology.

The proposed linear pipeline area has an elevation ranging from 56-205mAHD and is located approximately 70km from the coast of Queensland. Soils within the proposed pipeline region contain relatively neutral pH conditions ranging from 6.8 - 7.3 (Table 5). Within the subsurface (B Horizon) the pH tends towards increased alkalinity ranging from 8.1 - 8.8. There are no extremely acidic soils present, therefore, ASS will not be a risk associated with this project.
Possible Impacts to Identified Environmental Values

1. Diagram of the Proposed Project Site

The proposed pipeline corridor is 39km in total from the MSWD on ML10343 to the Burdekin River. Maps of the proposed pipeline are provided in the appendices of this report. The area of the proposed ML is 19.2ha, and the pipeline will be buried to a depth of 300mm. The pipeline trench will be progressively rehabilitated as construction progresses. The disturbance area that will persist during operation of the pipeline will be limited to crossing points over 11 creeks along the 24km length of the proposed ML between King Creek substation and the Burdekin River, where the pipeline will be suspended across the creeks using a system of concrete plinths and suspended wire rope.

2. Land Disturbance

The maximum surficial disturbance size of the proposed mining lease is 39km in length and 8m wide. Approximately 15km of the pipeline is already approved and included in MCO’s EA EPML00982113. The remaining 24km will have a disturbance footprint of approximately 19.2 hectares.

The pipeline corridor will run alongside the existing access roads and tracks that run from the King Creek substation across Strathalbyn Station to the Burdekin River, with the edge of the proposed ML aligning with the edge of the roads. The disturbance involved with laying the pipeline will take the form of a trench which will be excavated and backfilled promptly after the pipeline has been laid. For most of the pipeline length, disturbance will be within already cleared verges vegetated with introduced pasture grasses common to the area.

The pipeline will be laid at a depth of 300mm. Excavated soil will be piled alongside the pipeline trench while the pipeline is being laid.

The Flora and Fauna Technical Report presented as an appendix to this guideline response addresses the vegetation types in detail.

3. Proposed and Potential Releases

The proposed pipeline corridor will be used for water supply only; there are no mining related activities proposed on this lease. As a result, no proposed releases of contaminants are likely as
4. Environmental Risk Assessment

The following risk assessment follows Evolution Mining’s own corporate risk assessment methodology applied across all sites. The pipeline construction and operation project is a relatively low risk activity in terms of potential impacts to the receiving environment. However, there are elements involved in the construction of the pipeline and the design of the creek crossings that merit a clear mitigation strategy to ensure the project progresses without incident.

Operationally, the risk of environmental impact from the operation of the pumping station infrastructure and the pipeline itself is very low. The pipeline is designed to transfer raw water from the Burdekin River to the MSWD at MCO ML10343, and even in the event of an integrity failure in the pipeline and pumping infrastructure, the water released will be raw river water and therefore will not pose a risk of environmental harm through release of contaminants.

The risk assessment matrix used to define different risk consequences is presented in Table 8. The risk assessment tools used in devising this risk register are presented in Table 9. Risks posed by the proposed pipeline project are addressed in Table 10.

Table 8: Risk assessment matrix as applied to Environmental Risk (Evolution Mining 2014)

<table>
<thead>
<tr>
<th>RISK ASSESSMENT MATRIX</th>
<th>ENVIRONMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td><strong>Catastrophic</strong></td>
</tr>
<tr>
<td></td>
<td>Significant and permanent environment damage or effect</td>
</tr>
<tr>
<td></td>
<td>&gt; 10,000 L Hydrocarbon</td>
</tr>
<tr>
<td></td>
<td>&gt;50,000 L Mine Water, Slurry, Tailings etc.</td>
</tr>
<tr>
<td></td>
<td>Suspension of operations</td>
</tr>
<tr>
<td>4</td>
<td><strong>Major</strong></td>
</tr>
<tr>
<td></td>
<td>Widespread and long-term (&gt;3 year) environmental damage or effect</td>
</tr>
<tr>
<td></td>
<td>1,000-10,000L Hydrocarbon</td>
</tr>
<tr>
<td></td>
<td>10,000-50,000L Mine Water, Slurry, Tailings etc.</td>
</tr>
<tr>
<td></td>
<td>Fine by statutory authorities</td>
</tr>
<tr>
<td>3</td>
<td><strong>Moderate</strong></td>
</tr>
<tr>
<td></td>
<td>Medium-term (&lt;3 year) environment damage or effect to a small area</td>
</tr>
<tr>
<td></td>
<td>250-1,000 L Hydrocarbon</td>
</tr>
<tr>
<td></td>
<td>5,000 - 10,000 L Mine Water, Slurry, Tailings etc.</td>
</tr>
<tr>
<td></td>
<td>Reportable</td>
</tr>
</tbody>
</table>
### RISK ASSESSMENT MATRIX

<table>
<thead>
<tr>
<th>RISK ASSESSMENT</th>
<th>ENVIRONMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2</strong> Minor</td>
<td>Short-term (&lt;1 year) environment damage or effect to a small area</td>
</tr>
<tr>
<td></td>
<td>20-250 L Hydrocarbon</td>
</tr>
<tr>
<td></td>
<td>100-5,000 L Mine Water, Slurry, Tailings etc.</td>
</tr>
<tr>
<td></td>
<td>Non-reportable</td>
</tr>
<tr>
<td><strong>1</strong> Very Minor</td>
<td>No lasting environment damage of effect</td>
</tr>
<tr>
<td></td>
<td>0-20 L Hydrocarbon</td>
</tr>
<tr>
<td></td>
<td>0-100 L Mine Water, Slurry, Tailings etc.</td>
</tr>
<tr>
<td></td>
<td>Non-reportable</td>
</tr>
</tbody>
</table>
Table 9: Risk assessment parameters used in establishing the environmental risk register (Evolution Mining, 2014).

<table>
<thead>
<tr>
<th>RISK ASSESSMENT TOOLS</th>
<th>LIKELIHOOD / PROBABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Highly Improbable</td>
<td>16 (High)</td>
</tr>
<tr>
<td>Unlikely / Improbable</td>
<td>9 (Moderate)</td>
</tr>
<tr>
<td>Possible</td>
<td>5 (Low)</td>
</tr>
<tr>
<td>Likely / Probable</td>
<td>3 (Low)</td>
</tr>
<tr>
<td>Highly Probable</td>
<td>1 (Low)</td>
</tr>
</tbody>
</table>
## Table 10: Environmental risk register: risks with potential impacts to land for construction and operation of the Burdekin River pipeline project

<table>
<thead>
<tr>
<th>Task / Activity / Aspect</th>
<th>What could go wrong?</th>
<th>Why could it happen?</th>
<th>Likelihood</th>
<th>Consequence</th>
<th>Priority</th>
<th>Controls</th>
<th>Residual Likelihood</th>
<th>Residual Consequence</th>
<th>Residual Priority</th>
<th>Additional Action / Control Required</th>
<th>Responsibility</th>
<th>Due By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline Construction</td>
<td>Dust</td>
<td>Excavation generates dust</td>
<td>Possible</td>
<td>Minor</td>
<td>Moderate</td>
<td>Use dust suppression techniques e.g. water cart.</td>
<td>Unlikely / Improbable</td>
<td>Very Minor</td>
<td>Low</td>
<td>Ensure water cart availability if required.</td>
<td>Project Manager / Construction Supervisor</td>
<td>During construction</td>
</tr>
<tr>
<td>Pipeline Construction</td>
<td>Erosion</td>
<td>Erosion of stockpiled soil, causing sediment runoff into waterways</td>
<td>Possible</td>
<td>Minor</td>
<td>Moderate</td>
<td>Promptly backfill and grade construction trench.</td>
<td>Highly Improbable</td>
<td>Very Minor</td>
<td>Low</td>
<td>Establish a pre-construction weather check and ensure vehicles have access to sandbags in case of inclement weather.</td>
<td>Project Manager / Construction Supervisor</td>
<td>During construction</td>
</tr>
<tr>
<td>Pipeline Construction</td>
<td>Rehabilitation</td>
<td>Revegetation from within the existing seed bank does not establish</td>
<td>Possible</td>
<td>Minor</td>
<td>Moderate</td>
<td>Monitor the pipeline corridor for revegetation success.</td>
<td>Highly Improbable</td>
<td>Very Minor</td>
<td>Low</td>
<td>Conduct routine pipeline route inspections post construction to monitor revegetation progress.</td>
<td>Senior Environmental Advisor</td>
<td>After construction and before end of wet season</td>
</tr>
<tr>
<td>Pipeline Construction</td>
<td>General Earthworks</td>
<td>Impact to vulnerable species Black Ironbox in the vicinity of King Creek</td>
<td>Possible</td>
<td>Moderate</td>
<td>High</td>
<td>Adhere to the management approach outlined in the Flora and Fauna Technical Report (NRC 2014).</td>
<td>Unlikely / Improbable</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Supervisor to monitor clearing in the region of the identified Black Ironbox species to ensure adherence to the management approach in the Flora and Fauna Technical Report (NRC 2014).</td>
<td>Construction Supervisor / Senior Environmental Advisor</td>
<td>During construction</td>
</tr>
<tr>
<td>ESTABLISH CONTEXT</td>
<td>IDENTIFY HAZARDS</td>
<td>ASSESS THE RISK</td>
<td>IDENTIFY EXISTING CONTROLS</td>
<td>EVALUATE THE RISKS</td>
<td>TREAT THE RISK</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Task / Activity / Aspect</td>
<td>What could go wrong?</td>
<td>Why could it happen?</td>
<td>Likelihood</td>
<td>Consequence</td>
<td>Priority</td>
<td>Controls</td>
<td>Residual Likelihood</td>
<td>Residual Consequence</td>
<td>Residual Priority</td>
<td>Additional Action / Control Required</td>
<td>Responsibility</td>
</tr>
<tr>
<td>Pipeline Construction</td>
<td>Vehicle Movement</td>
<td>Hydrocarbon release</td>
<td>Risk of fuel or oil spill resulting from blown hose or other machinery malfunction</td>
<td>Possible</td>
<td>Very Minor</td>
<td>Moderate</td>
<td>Conduct vehicle pre-start before commencing work. Ensure vehicles are maintained appropriately. Ensure vehicles are operated in a manner appropriate to the conditions. Ensure vehicles are operated only by a trained operator.</td>
<td>Possible</td>
<td>Very Minor</td>
<td>Moderate</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Pipeline Construction</td>
<td>General Earthworks</td>
<td>Open trenches pose a risk to native fauna through entrapment and exposure</td>
<td>Native fauna can fall into trenches left unfilled overnight / over days</td>
<td>Likely / Probable</td>
<td>Very Minor</td>
<td>High</td>
<td>Adhere to the management approach outlined in the Flora and Fauna Technical Report (NRC 2014).</td>
<td>Unlikely / Improbable</td>
<td>Very Minor</td>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipeline Construction</td>
<td>General Earthworks</td>
<td>Infrastructure positioned outside of locations allowed in the Environmental Authority. Financial assurance not adequate for clearing required</td>
<td>Design changes. Location requirements from EA. not understood. Land clearing process not followed.</td>
<td>Possible</td>
<td>Moderate</td>
<td>High</td>
<td>Survey control ahead of excavation. Appropriate environmental work permits in place before construction commences. Inductions and training of staff in clearing requirements.</td>
<td>Unlikely / Improbable</td>
<td>Minor</td>
<td>Low</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Pipeline Construction and Pipeline Operation</td>
<td>Vehicle Movement</td>
<td>Fauna death – contact / collision with wildlife causing potential harm or death to both vehicle occupant and wildlife</td>
<td>Speed, night time driving, lack of situational awareness</td>
<td>Possible</td>
<td>Very Minor</td>
<td>Moderate</td>
<td>Limit night time driving. Observe speed limits. Drive awareness.</td>
<td>Possible</td>
<td>Very Minor</td>
<td>Moderate</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Pipeline Construction and Pipeline Operation</td>
<td>Vehicle Movement</td>
<td>Avifauna death – contact / collision with vulnerable squatter pigeon subspecies</td>
<td>Interaction with vehicles poses a known threat to this species due to its ground dwelling nature and tendency to squall in cleared areas such as roads</td>
<td>Possible</td>
<td>Very Minor</td>
<td>Moderate</td>
<td>Adhere to the management approach outlined in the Flora and Fauna Technical Report (NRC 2014).</td>
<td>Unlikely / Improbable</td>
<td>Very Minor</td>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company / Business Area / Activity</td>
<td>Task / Activity / Aspect</td>
<td>What could go wrong?</td>
<td>Why could it happen?</td>
<td>Inherent Risk</td>
<td>Controls</td>
<td>Residual Risk</td>
<td>Additional Action / Control Required</td>
<td>Responsibility</td>
<td>Due By</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Pipeline Construction / Pipeline Operation</strong></td>
<td>Pumping</td>
<td>Faulty or inadequate pipeline joints</td>
<td>Improperly fused pipeline joins, Movement and settling of earth after backfilling places stress on pipeline joints, Integrity failure in pipeline at creek crossings.</td>
<td>Possible</td>
<td>Very Minor</td>
<td>Moderate</td>
<td>Use of bedding sand in construction to limit movement of pipeline, Random inspection of pipeline joints during construction for quality assurance, Routine inspection of pipeline length for surface expression of water, Monitoring of pumping infrastructure performance to allow early identification of leaks.</td>
<td>Unlikely / Improbable</td>
<td>Very Minor</td>
<td>Low</td>
<td>Construction supervisor to conduct random quality inspection on pipeline joins. Poorly made joins to be remade.</td>
<td>Construction Supervisor / Mining operations</td>
</tr>
<tr>
<td><strong>Pipeline Operation</strong></td>
<td>Erosion</td>
<td>Erosion or sediment runoff at Burdekin River pumping station</td>
<td>Hose uncoupling at pumping station causes river water to release at</td>
<td>Possible</td>
<td>Minor</td>
<td>Moderate</td>
<td>Monitoring of pumping infrastructure performance to allow early identification of leaks, Cessation of pumping in the event of a suspected pumping station infrastructure failure.</td>
<td>Unlikely / Improbable</td>
<td>Very Minor</td>
<td>Low</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>Pipeline Operation</strong></td>
<td>Environmental</td>
<td>Flooding along the Burdekin River causes damage to the pumping station</td>
<td>A rapid rise in river height / increase in river flow / flood event may cause damage to the riverside pumping infrastructure at the Burdekin River</td>
<td>Possible</td>
<td>Minor</td>
<td>Moderate</td>
<td>Communication with the landholder regarding conditions at the pumping station in the case of an extreme weather event, Monitoring of pumping infrastructure performance to allow early identification of leaks, Cessation of pumping in the event of a suspected pumping station infrastructure failure. Prompt repair of the infrastructure if damaged.</td>
<td>Possible</td>
<td>Minor</td>
<td>Moderate</td>
<td>N/A</td>
<td></td>
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</tbody>
</table>
5. Acid Producing Rock, Overburden, Tailings, Waste Storage

The proposed activity does not involve the disturbance of acid-producing rock, the removal or storage of overburden, generation of tailings, or waste storage, nor is this proposed for the pipeline corridor in the future.

6. Acid Sulfate Soils

Acid sulfate soils are not present at the site as previously discussed in this document. Also limited excavation activities of the soil are proposed to occur and soils analysed at intervals along the existing power line corridor on ML10343 had a neutral to slightly alkaline pH to 100cm depth. Hence, no further investigation into acid sulfate soils is intended as a part of this application.

7. Wild River

The proposed mining lease is not located within a wild river area.

8. Land Disturbance Mitigation

Land on the proposed pipeline corridor has previously been disturbed in areas to accommodate the MCO power line corridor. The excavation for the corridor will be conducted progressively, with rehabilitation on each section of laid pipeline being completed promptly to minimise the duration of time the trench is exposed and the time soil is stockpiled. The trench will be backfilled and graded and revegetation is expected to occur from within the existing seed bank in the disturbed soil. There are no anticipated long-term impacts to the land.
Proposed Management Practices

1. Contaminant Management

1.1 Potential Sources of Contamination

The pipeline construction is a relatively simple project that carries a minimal risk of contamination. The only potential source of contaminants during construction of the pipeline is from fuel or oil through malfunction of construction machinery. In order to minimise the risk of a fuel or oil spill caused by malfunction, the following measures will be taken:

- All construction machinery will be appropriately maintained as per the manufacturer’s recommendations.
- Vehicle pre-start checks will be carried out before construction begins each day.
- Vehicles will be operated appropriately to the environment in which they are working.
- Vehicles will only be operated by suitably trained operators.

1.2 Spill Kits, Containment Systems and Contingency Plans

During construction of the pipeline, appropriate spill kits will be carried in the construction vehicles to allow rapid response to potential fuel or oil spills from machinery malfunction.

No containment systems are required for the pipeline construction activity. During operations, if there is a leak along the pipeline, raw river water will be released. This does not pose a risk of environmental harm through contamination. The HDPE pipeline lengths will be butt welded or electro-fused. Bedding sand will be used in sections of the pipeline to stabilise the pipeline in the soil and reduce the risk of stress on joins.

Leaks will be identified through monitoring of the performance of the pumping infrastructure and measurement of the water uptake of the pumps versus the water output into the MSWD at MCO. There will be routine inspections of the pipeline corridor length which will help identify any expression of leaking water at the surface. In the event of a major integrity failure of the pipeline infrastructure, pumping will cease until the failure has been rectified.
2. Management of Environmentally Sensitive Areas

As previously identified within this guideline response, there are no ESAs in the vicinity of the pipeline project. A management strategy for ESAs is not required for this project.

3. Dredge Spoil

There are no dredging activities associated with the project, and no dredge spoil will be generated by the project.

4. State Significant Biodiversity

4.1 Matters of State Environmental Significance

As already identified in this guideline response, state significant biodiversity was formerly defined under the now superseded Queensland Biodiversity Offset Policy 2011. Matters of State Environmental Significance (MSES) are now defined under the Queensland Environmental Offsets Regulation 2014.

4.2 Black Ironbox

Black Ironbox (Eucalyptus raveretiana) is listed as vulnerable under the EPBC Act and the NC Act. As discussed previously it is present in varying densities along the banks of King Creek where the proposed pipeline crossing is located, as well as along the banks of some smaller tributaries at that location.

Full details of the prevalence of the species and the survey conducted is presented in the Flora and Fauna Technical Report that accompanies this guideline response.

The proposed method for constructing the pipeline across the watercourse at this location is to embed concrete plinths on either side of the waterway and suspend the pipeline across the watercourse using a wire rope suspension system anchored in the concrete plinths. The concrete plinths will be located outside the top of bank on each side of the watercourse. Therefore, there will be no disturbance to the ground between the top of banks of the watercourse.

The proposed mining lease for the pipeline corridor is 8m wide from the edge of the existing access road. At the King Creek crossing the pipeline will be constructed as close as possible to the road, which will leave a small but sufficient buffer from the nearest Black Ironbox trees. The suspended pipeline crossing the watercourse should be at least 4m from any part of a Black Ironbox tree, and given that there will not be any disturbance to the ground between the top of banks, all disturbance to the root zone of any Black Ironbox will be avoided.

In order to maintain the structural integrity of the suspended pipeline, any large trees (of any species) that develop in close proximity will need to be trimmed or otherwise controlled. Whilst this may represent a small loss in the amount of available habitat for Black Ironbox, it is mostly within a cleared area that is already maintained as part of the existing road crossing.
Furthermore, there is no recruitment of Black Ironbox in this area and the extremely minor loss of potential habitat is insignificant compared to the habitat available along the length of this and other watercourses at the locality.

There are two mature Black Ironbox trees in close proximity to the proposed pipeline corridor, 19 metres and 24 metres from the edge of the existing road. The precise location of these individual trees is noted in the Flora and Fauna Technical Report. There is sufficient distance on the western side of the road to accommodate the pipeline mining lease without disturbance to individual Black Ironbox trees or Black Ironbox habitat. All other Black Ironbox trees or potential Black Ironbox habitat areas are at least 25 metres from the existing road, and therefore there is sufficient area available to accommodate the proposed eight metre mining lease without disturbance to these trees or potential habitat.

Overall, disturbance to all Black Ironbox trees can be avoided and impacts to Black Ironbox habitat will be extremely minimal. It is unlikely that there will be a significant impact on this species because the proposed development will not:

- Lead to a long term decrease in the size of the population,
- Reduce the area of occupancy of the species,
- Cause further fragmentation to the existing population,
- Reduce gene flow among populations or disrupt the reproductive output,
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Although all Black Ironbox trees can be avoided by design, there are some management strategies that should be implemented in order to ensure that direct impacts are avoided:

- The pipeline mining lease and authorised disturbance areas should be clearly marked to ensure disturbance is restricted to these areas only.
- All Black Ironbox trees within 20 metres of the mining lease should be clearly marked with flagging tape to identify their presence and ensure they are not disturbed.
- Project inductions and toolbox meetings should include:
  - Information on the significance of this species, including its protection under State and Commonwealth legislation,
  - Details of where it is known to occur within the project area,
  - Measures that have been undertaken to signify its presence within the project area (e.g. flagging tape).

Under the current vegetation management framework in Queensland a clearing permit is required for clearing that will occur within 100m of endangered, vulnerable or near threatened (EVNT) plants (such as Black Ironbox). The application for a clearing permit will need to include
details of how the presence of EVNT plants has been confirmed (including details of survey methods outlined in this document), and how impacts to Black Ironbox will be avoided, in the form of an impact management plan.

4.3 Squatter Pigeon

The southern subspecies of the Squatter Pigeon (*Geophaps scripta scripta*) is listed as vulnerable under the EPBC Act and the NC Act. It occurs over a reasonable broad distribution from the Burdekin-Lynd divide in the north to the Border Rivers region of NSW in the south, and from the east coast to Hughenden, Longreach and Charleville.

The Squatter Pigeon (southern) was observed at four locations along the proposed corridor, including multiple occasions at a monitoring transect where there is a stock watering point. In all cases, individuals were observed on the ground either by the side of the access road amongst pasture grasses or beside the dam.

Given the reasonably small scale and temporary nature of the disturbance, and the fact that existing areas of disturbance will be utilised for most of the proposed pipeline route, it is unlikely that this minimal disturbance to potentially suitable habitat will have a significant impact on the Squatter Pigeon (southern). Indeed, there are vast areas of similar habitat present in the surrounding area.

The greatest threat to the Squatter Pigeon as a result of the proposed development is interaction with vehicles due to increased traffic volumes along the access roads during construction. The following controls will be implemented to minimise the likelihood of death or injury from vehicle strike:

- Site inductions or toolbox meetings will include information about sensitive aspects of the environment in which personnel are working, including the risk of injury or death to Squatter Pigeons from vehicles.

- Due to the ground dwelling nature of the species, all vehicles will remain on existing access tracks and roads wherever possible.

- Clearing works will be carried out in a sequential manner that allows fauna to escape to natural areas away from construction works.

- Speed limits will be implemented as appropriate for the condition of the roads and access tracks on site. A limit of 50km/hr is recommended for well-developed access roads and a limit of 20km/hr is recommended within 200m of the dam where Squatter Pigeons have been regularly observed.

With the aforementioned controls in place to minimise the threat from interaction with vehicles, it is considered unlikely that there will be a significant impact to the Squatter Pigeon (southern) as a result of the proposed project. Impacts to the species habitat will be of a relatively small scale and temporary nature and it is unlikely that the project will result in a long term decrease in the size of the population or reduce the area of occupancy for the species.
5. **All Other Biodiversity**

The potential for the pipeline project to impact other biodiversity matters is minimal. These impacts are assessed in detail in the Flora and Fauna Technical Report that accompanies this guideline response. There are no further management practices identified as required to protect other biodiversity in the *Flora and Fauna Technical Report*.

6. **Land Release Management**

This application does not involve the release of waste water to land. The pipeline will only transport raw water from the Burdekin River. In the event of an unplanned release through a failure in integrity of the pumping infrastructure, water released will be raw river water and will not pose a risk of environmental harm through transport of contaminants. Potential leaks will be identified through monitoring of the performance of the pumping infrastructure and routine inspections of the pipeline corridor to identify any surface expression of river water.

7. **Acid Mine Drainage, Overburden and Tailings Management**

There are no activities in the proposed project which would generate acid mine drainage, overburden or tailings and subsequently no requirement to manage same for this project.

8. **Acid Sulfate Soil**

As already identified in this guideline response, there is no ASS in the vicinity of the pipeline corridor, and subsequently there is no requirement to manage same for this project.

9. **Subsidence**

While the intention is to bury the pipeline along the 39km from the MSWD at MCO to the Burdekin River, the excavation will be limited to that required to facilitate burying it to a depth of 300mm.

Where the pipeline crosses creeks, concrete plinths will be set back from the riparian zones at the top of the creek banks, allowing some clearance and mitigating the risk of erosion and stream widening through disturbance to creek banks. There are no other subsidence risks posed by this project.

10. **Unsurfaced Areas**

The pipeline corridor will be promptly backfilled and graded progressively during construction, reducing the duration of exposure of an unsurfaced area to erosional forces such as wind and rainfall.
The pumping infrastructure at the Burdekin River will be set on concrete slabs, mitigating the risk of contamination from dust. This will also mitigate the risk of erosion of an unsurfaced area, and ensure there is no sediment runoff from the pumping infrastructure area into the Burdekin River.
Rehabilitation

1. Rehabilitation

1.1 Rehabilitation During Construction

The pipeline corridor will be progressively rehabilitated during construction, through a system of prompt backfilling of the pipeline trench and grading of the backfilled soil. The refilled trench is expected to revegetate from the existing seed bank within the disturbed soil. Revegetation progress will be noted during routine pipeline inspections. If bare patches persist nearing the end of the wet season after construction, assuming there has been sufficient rainfall to facilitate revegetation in areas of the pipeline, the bare patches will be reseeded with suitable species and fertiliser may be applied if appropriate.

1.2 Rehabilitation After Operation Ceases

After the cessation of operations, the pumping infrastructure will be offered to the landholder in the first instance. If the landholder requests removal of the infrastructure, the pumping station will be decommissioned and the area of the pumping station will be graded and reseeded. If the landholder requests removal of the pipeline, the course of the pipeline will be excavated, the pipeline will be removed, the trench will be backfilled and graded and again, revegetation should occur from within the existing seed bank.
References


Bird (2009).


## Appendix summary

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</tr>
<tr>
<td></td>
<td>(NRC 2014)</td>
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<td>Appendix C</td>
<td>Flora and Fauna Technical Report</td>
</tr>
<tr>
<td></td>
<td>(NRC 2014)</td>
</tr>
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</table>
Appendix A

Maps
MOUNT CARLTON OPERATIONS
BURDEKIN WATER PIPELINE EA AMENDMENT
GROUND TRUTHED REMNANT VEGETATION WITH FAUNA SITES

Map 3 of 11

Legend
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse
- Groundtruthed Remnant Vegetation
  Least Concern
  Of concern (dom)
  Of Concern (sub-dom)
- Regional Ecosystem (VMA)
  Least Concern
- Non Remnant
- Fauna Survey Sites
  Systematic

Notes:
- Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
- Regional Ecosystem from Vegetation management regional ecosystem and remnant map - version 8.0 coastal © State of Queensland (Department of Natural Resources and Mines) 2014

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 1/07/2014
Scale: 1:15,000 at A3
Map 5 of 11

Legend
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse

Groundtruthed Remnant Vegetation
- Least Concern
- Non-rem

Regional Ecosystem (VMA)
- Least Concern

Notes:
Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
Regional Ecosystem from Vegetation management regional ecosystem and remnant map - version 8.0 coastal © State of Queensland (Department of Natural Resources and Mines) 2014.
Map 7 of 11

Legend
- Mt Carlton ML 10343
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse

Groundtruthed Remnant Vegetation
- Least Concern
- Non-rem
- RE Assessment Sites

Regional Ecosystem (VMA)
- Least Concern

Fauna Survey Sites
- Targeted
- Squatter pigeon observation

Notes:
- Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
- Regional Ecosystem from Vegetation management regional ecosystem and remnant map - version 8.0 coastal © State of Queensland (Department of Natural Resources and Mines) 2014.
Limitations of this Report

Client: Mt Carlton Operations

Prepared by Northern Resource Consultants (NRC)

This disclaimer brings the limitations of the investigations to the attention of the reader.

The information in this report is for the exclusive use of Mt Carlton Operations. Mt Carlton Operations is the only intended beneficiary of our work.

We cannot be held liable for third party reliance on this document. The information within this report could be different if the information upon which it is based is determined to be inaccurate or incomplete.

The results of work carried out by others may have been used in the preparation of this report. These results have been used in good faith, and we are not responsible for their accuracy.

This report has been formulated in the context of published guidelines, field observations, discussions with site personnel, and results of laboratory analyses.

NRC’s opinions in this document are subject to modification if additional information is obtained through further investigation, observations or analysis. They relate solely and exclusively to environmental management matters, and are based on the technical and practical experience of environmental scientists.

They are not presented as legal advice, nor do they represent decisions from the regulatory agencies charged with the administration of the relevant Acts.

Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current as of the date of this document.
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A soil assessment has been prepared by Northern Resource Consultants (NRC) for the proposed construction of a water pipeline at Mt Carlton Operations (MCO) to supply water from the Burdekin River to the operations. This water pipeline will be approximately 39km in length and will supply onsite water for processing during times of limited rainfall.

This report presents the results of a current soil survey within 24km of the pipeline length and an existing soil survey conducted within the other 15km which overlaps with the MCO power line corridor.

The current survey incorporated 13 soil sample sites in which ground observations were undertaken, four test pits within representative soil types (outlined by the Atlas of Australian Soils) and soil samples analysed in the laboratory from two of these test pits which were most representative of the soil types present along the pipeline length. Test pits and soil sample collection was undertaken to determine soil types present, delineate the boundaries of soil types in the soil profile and analyse samples for various physical and chemical soil parameters.

As part of this application to amend an Environmental Authority (EA), MCO must evaluate pre-disturbance land suitability and the condition of the proposed disturbance site. This technical report will be used as supporting evidence in response to EHP’s Guideline EM961 outlining application requirements for activities with impacts to land. In addition, this report will document information on land values and resources, with particular reference to the physical and chemical properties of soil materials and the accompanying erosion and stormwater runoff potential posed by activities associated with the project.

This soil and land use assessment provides:

- A description of the soil variation and distribution along the water pipeline corridor,
- An assessment of the soil for land suitability under the *Regional Planning Interests Act 2014* (Qld), and the *State Planning Policy 2013* (Qld), which in turn replaced existing policies listed in the EHP guideline (EM961) such as SPP2/02 Planning and Managing Development Involving Acid Sulfate Soils, SPP1/92 Guidelines for the Identification of Good Quality Agricultural Land and SPP1/12 Protection of Strategic Cropping Land,
- A description of the physical and chemical properties of the soils present,
- An assessment of the soil’s potential to pose any management issues to construction, development and/or rehabilitation activities,
- An assessment of the soil for use as topdressing material and development of an inventory suitable for rehabilitation,
- Comments on options for erosion and sediment control during the construction and operation phases of the project.
Desktop, field and laboratory assessments were conducted across the pipeline corridor to provide a thorough assessment of the soil characteristics present and combined with existing soils data from along the length of the pipeline which overlaps with the MCO power line corridor. The desktop assessment comprised: reviews of relevant soil literature (including the Queensland State Planning Policy), mapping of regional soil types across the landscape, and an extensive literature review on soil information previously documented in the local area.

Overall, results of the desktop study, field assessment and laboratory analysis, and the existing soil sample results show that sodicity is the main management issue. This sodicity is shown to increase with depth in both soil sample locations. Both soil samples also demonstrate the effects of magnesium enhanced sodicity and as a result have the potential for increased soil dispersion. In addition, the salinity of each soil sample also increases with depth to very saline values (>770 µS/cm).

The fertility status of the soil samples is moderate, containing suitable nutrient concentrations; however, one sample contains slightly lower fertility status as potassium availability is low and the organic carbon content is considered small. Due to the sodic characteristics of the soil samples, each sample also contains a low permeability and a moderate water holding capacity.

These findings will influence management and handling of soil material during the construction of the pipeline. The lower soil fertility demonstrated by one of the soil samples may indicate the potential for low soil fertility to exist along the proposed area for pipeline construction.

The potential for erosion as a result of the sodicity of the soil will be controlled through the use of a strict construction approach that aims to have the pipeline trench promptly backfilled and graded after the pipeline is laid, to minimise environmental disturbance and negate the risk of further environmental impacts from leaving the trench exposed and the soil stockpiled at length before backfilling.
Introduction

1. Project Description

The Mt Carlton Operation (MCO) is a gold, silver and copper mining project in North Queensland. The mine has been in operation since early 2013. Water used in processing at the site is sourced from pit dewatering bores and from rainfall across the lease that is collected in the main site water dam (MSWD).

As part of MCO’s ongoing water supply strategy, a 400 ML raw water allocation has been secured from an adjoining landholder of the project. Through negotiations with the landholder of Strathalbyn Station, which lies due west of ML10343 and underlies MLA10375, MCO have arranged to utilise the landholder’s existing water allocation from the Burdekin River up to 400ML annually.

This EA Amendment application is for the construction and operation of a 225mm subterranean HDPE pipeline and associated pumping infrastructure, to carry river water from the Burdekin River to the MSWD at MCO for processing. The proposed pipeline will be approximately 39km long. Approximately 15km of that pipeline will follow the existing pipeline corridor along MLA10375, which hosts the King Creek substation power line and under which the raw water pipeline is also approved as an external water pipeline infrastructure corridor as per Schedule A of the site’s EA EPML00982113. The remaining 24km of pipeline that is the subject of this application for a mining lease will branch off from Johnny Cake Road and then follow the Strathalbyn Station Access Driveway across Strathalbyn Station to the Burdekin River.

The proposed mining lease will be 8m wide along the remaining 24km, comprising an additional 19.2ha of disturbance under the site’s EA. Utilisation of pumping infrastructure already in place at the Burdekin River is included in the agreement between MCO and the landholder, though MCO intend to upgrade some of the pumping equipment to ensure most effective performance and monitoring of water uptake.

The excavation of the pipeline corridor, laying of the piping and rehabilitation of the excavation trench is expected to take 18 weeks in total and will be carried out in stages to minimise the risk of environmental harm. The proposed activity is considered to have a relatively low risk of environmental harm given the linear nature of the disturbance, the decision to bury the pipeline to a depth of approximately 300mm and the intent to rehabilitate the pipeline trench progressively.

A map illustrating the location of MCO in north Queensland and the route of the proposed pipeline corridor is included in the mapping appendix of this technical report.

2. Objectives of this Report

The main objectives of this soil study within the proposed pipeline corridor are to:
- Conduct a soil survey of the area that is likely to be affected by the proposed development in accordance with Section 6.1 Compilation of Land Resources Inventory (LRI) – Pre Mining Studies, of the Land Suitability Assessment Techniques in the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME 1995),

- Undertake soil tests and laboratory analyses of representative samples in the soil profile, with particular reference to physical and chemical properties of the soil that will influence erosion potential, storm water runoff quality, rehabilitation and agricultural productivity of the land,

- Describe and map soil types and profiles according to the Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain, 2009), Guidelines for Survey Soil and Land Resources (McKenzie et al, 2nd Edition, 2008) and Australian Soil Classification (Isbell, 2002),

- Assess the potential implications of mapped Strategic Cropping Land (SCL) under the recently introduced Regional Planning Interests Act 2014.

The main objective of this report is to provide:

- A description and mapping of the soil variation and distribution across the study area, including:
  - Identification of soil types within the study area,
  - Collection of baseline physical and chemical characteristics of the soils,
  - An assessment of the soil for topdressing material suitability,
  - Describe management and rehabilitation options based on soil test pit results.

The scope of this soil and land use assessment pertains to the construction and operation of the MCO pipeline. The study area covers the 39 linear kilometres of the pipeline with a buffer zone of up to 10m. While the ML under application is only 8m in width, a buffer of 10m was considered to provide the most realistic measure of potential environmental impacts to the receiving environment.

3. Site Description

3.1 Topography and Landscape

The topography of the MCO region includes hills raised up to 350m in height. South of the operational region contains steeper sloping hills (500m elevation); whilst north of the operations, lower relief with small, gradually sloping, undulating hills are present. Steeper sloping hills with relatively smaller relief than directly south of the operation are also present SW of MCO, where
maximum elevation is located further than 4km from the course of the proposed pipeline. A topographic map of the region is included in the mapping appendix of this technical report.

3.2 Land Use

Regional Land Use

MCO is a relatively isolated mining project. The closest townships are:

- Dalbeg – approximately 25km to the west
- Collinsville – approximately 45km to the southeast
- Gumlu – approximately 45km to the north northeast
- Bowen – approximately 80km to the northeast.

The land surrounding the existing and proposed mining lease is used as low intensity cattle grazing land for beef cattle. There are a number of large beef cattle properties surrounding the lease, including Strathalbyn station, which is the underlying property of the proposed mining lease. Other stations surrounding the proposed lease include King Creek Station, Desmond Station, Johnny Cake Station, Mt Wickham Station, Spring Creek Station, Strathmore Station and Table Top Station. Water catchments within the receiving environment, especially the King Creek catchment, are typically used for stock drinking purposes.

Agricultural Land Use

Agricultural mapping of MCO and the pipeline pathway shows ‘limited crop land’ underlying approximately one third of the proposed pipeline course (see the mapping appendix of this document). Limited crop-land (Class B) is defined in DPI and DHLGP (1993) as marginal for current and potential crops due to severe limitations, yet is suitable for pastures. Suitable crop-land (Class A1) underlies approximately one quarter of the proposed pipeline course, however, given the pipeline will run alongside the existing disturbance areas such as access roads, this crop land will not be impacted by the proposed project.

There is potential SCL mapped along a short stretch of the pipeline (see the mapping appendix of this document). While the proposed pipeline project underlies this SCL polygon, the project is considered exempt from assessment for SCL under Division 2, Section 22 of the RPI Act 2014. This is addressed in detail in the Project Description (NRC, 2014a) accompanying this EA Amendment application.

Local Land Use

Current land use along the linear pipeline corridor is low intensity cattle grazing. Two pastoral stations occupy the underlying land. These pastoral stations are:

- Strathbogie Station – also underlies the MCO mining lease
- Strathalbyn Station

The lot on plan numbers for these stations are provided in Table 1. The pipeline will track alongside access roads, including that from MCO to the King Creek power station, Johnny Cake Road and the Strathalbyn Station access road. A cadastre map of the pipeline route is included in the mapping appendix of this report.

Table 1: Lot on Plan for the underlying pastoral stations

<table>
<thead>
<tr>
<th>STATION</th>
<th>LOT ON PLAN</th>
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<tbody>
<tr>
<td>Strathbogie Station</td>
<td>4899 SB7665</td>
</tr>
<tr>
<td>Strathalbyn Station</td>
<td>7 SB730 and 507 SP17655</td>
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3.3 Climate

A full description of the climate in the region of MCO is included in the *Response to Guideline EM961, Application Requirements for Activities with Impacts to Land* that accompanies this EA Amendment (NRC, 2014b). The temperature and rainfall records for the region is particularly pertinent to this soils technical report.

Temperature and Rainfall

Temperatures surrounding MCO range from 11°C in winter (June) to 44°C in summer (January; Figure 1). The Mt Carlton region receives on average 712.7mm of rain per year, with the majority of this rain falling during wet season months, November to April (Figure 1).

High intensity rainfall often occurs during wet season months due to the presence of rain troughs and cyclonic depressions, which form off the northeast coast of Queensland and progress inland (Bureau of Meteorology, 2014).
Figure 1: Monthly minimum and maximum temperatures for the MCO region (BoM, 2014)

Figure 2: Average monthly rainfall with 95% Confidence Intervals for the Mt Carlton region (BoM), comparative to 2012/2013 rainfall data (Jan - Feb 2014, Mar – Dec 2013)

Inter-annual rainfall is highly variable with a maximum annual rainfall of 1583.6mm in 1956 and minimum annual rainfall of 282.8mm in 1969 (Figure 3). Rainfall above 1184.4mm falls in the
95th percentile and below 394.6mm falls in the 5th percentile. It is important to note that the maximum annual rainfall is more than double the average annual rainfall, indicating that extreme isolated events occur in some years. These extreme events are likely the product of depressions, cyclonic events or other extreme meteorological conditions.

**Figure 3**: Annual rainfall records from wet and dry seasons in the MCO region (BOM, 2014)

### Rainfall Intensity

Rainfall Intensity-Frequency-Duration (IFD) statistics obtained from the Bureau of Meteorology for the MCO region are displayed below in Figure 4 (BoM, 2014). This information describes the likelihood of a rainfall event occurring at a given level of intensity and duration. For example, a one in one hundred year rainfall event (0.01 AEP), would result in approximately 386.6mm of rain (mean of 32.2mm/hr for 24 hours). To date there have been no recorded 24 hour rainfall events greater than 386.6mm at MCO.
Figure 4: Return period of different rainfall events including 24-hour, 48-hour and 72-hour rainfall events for the MCO region (BOM, 2014)
Methodology

1. Desktop Analysis

1.1 Objective

The purpose of the desktop assessment was to construct a baseline conceptual site model of the soil and landscape characteristics of the site and identify the preliminary mapping units (PMUs) that would require site observations and sampling during fieldwork. The desktop analysis involved:

- Assessing historic climate data for the MCO region, sourced from BoM,
- Reviewing satellite imagery, topographic imagery and regional geological and soil data, sourced through Queensland Globe, Google Maps and GIS data,
- Reviewing data available from the Australian Soil Resource Information System (CSIRO), Atlas of Australian Soils and the Regional Ecosystem Classification Database (EHP),
- Reviewing the State Planning Policy,
- Assessing land suitability for high value agricultural land including review of trigger mapping,
- Assessing Strategic Cropping Land presence,
- Review of aerial imagery to ascertain where soil profiles vary, and to plan soil test pit location (to be confirmed in the field analysis by ground truthing),
- Literature review of the localised and regional area’s background information on soil types present.

1.2 Development of Preliminary Mapping Units

The development of preliminary mapping units (PMUs) for the study area was based upon a review of existing information and using GIS to overlay mapping of soils, geology, topography, land zones and vegetation communities.

The PMUs were developed to identify tracts of land that are expected to share similar attributes (e.g., soil, geology, vegetation and landform), which can be separated from neighbouring tracts of land with a different pattern of attribute values. These PMUs would then be used to excavate soil test pits and take soil samples for further laboratory analysis.

This survey would focus on soil and land capability survey and sampling along the pipeline corridor from the Burdekin River to the Kings Creek Substation, approximately 24km in length.
The desktop PMUs were modified slightly during fieldwork following ground truthing, with more test pits excavated where soil types were observed to differ.

The existing mining lease and associated power line corridor has been extensively sampled for soils during previous government approvals. These data are deemed suitable for use in outlining the soil types over the existing mining lease and associated power line corridor. A soil and land suitability assessment was conducted over the existing mine lease area, including out to the Kings Creek substation by Austral Asian Resource Consultants in 2009. Survey sites were distributed evenly over the length of the pipeline to account for varying soil types, vegetation communities and geology (refer to the Soils Survey Locations map contained in the appendix of this report).

1.3 Density of Soil Sampling

Density of soil test pits described in Australian Soil and Land Survey Handbook (Gunn et al. 1988) shows ground observations for a 1:5 000 soil survey as outlined in Table 2 and the recommended sites per hectare outlined in Table 3.

The length of the pipeline being surveyed is approximately 24km (from the Burdekin River to Kings Creek Substation), creating a survey footprint of 48 hectares (24km with a 10m buffer). Hence, the total number of survey sites required to meet the best practice survey effort outlined in Gunn et al. (1988) is between 12 and 48 survey sites. Thirteen soil sample sites were chosen to undertake general land capability observations. Of these thirteen sites, four test pits were excavated, again following the best practice survey effort outlined in Gunn et al. (1988). Soil samples from each depth horizon from two of the test pits selected in major soil units within the study area were sent away for laboratory testing.

Table 2: Ground observation densities for 1:50 000 soil survey per 100 hectare

<table>
<thead>
<tr>
<th>TOTAL AREA OF PROPOSED PROJECT</th>
<th>MAPPING SCALE</th>
<th>DENSITY (HA PER OBSERVATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 – 100 ha</td>
<td>1:5,000</td>
<td>1.0 – 4.0 ha</td>
</tr>
</tbody>
</table>

Table 3: Recommended sites/ha for proposed pipeline

<table>
<thead>
<tr>
<th>DISTURBANCE AREA</th>
<th>MAPPING SCALE</th>
<th>HIGH</th>
<th>LOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>48 ha</td>
<td>1:5,000</td>
<td>48</td>
<td>11.75</td>
</tr>
</tbody>
</table>
2. Field Analysis

2.1 Methodology

A field survey was undertaken on 4 June 2014 with a total of 13 soil survey sites. Excavation of four test pits were made along the proposed pipeline corridor, in order to provide a representative section of soil stratigraphy to accompany the soil description information from the 13 soil sites. Samples were collected at both the surface and sub-surface horizons encountered within the test pits. Field screening was conducted on all test pits, while laboratory analysis was conducted on two test pits providing sediment samples from each of the soil horizons within the soils profile.

Observational assessments of landscape, local geomorphology and soil salinity indicators including landform and vegetation were undertaken, assisting in the delineation of the soil type boundaries across the sites and the preliminary assessment of soil quality. This information provides a non-intrusive method of characterising the landscape and determines how subsoils interact with vegetation, hydrology and climate to influence the geomorphology of the site. Photographs from each test pit location can be found in the appendices to this report.

Three types of ground observations were utilised to describe soils within each observation area:

- General Land Capability Observation including landform assessment, vegetation and land surface (refer to the appendices of this report).

- Detailed soil profile descriptions. A dingo excavator with auger attachment was used to excavate test pits to a depth of approximately one metre below ground level and the soil profile (A, B and C horizons) described in detail (refer to the appendices of this report).

- Sampling of soil horizons. Collected from within each soil horizon present and analysed for physical and chemical properties relative to fertility, sodicity and particle sizing.

Of the 13 survey sites, general land capability observations were taken at 13 sites, four detailed soil profile descriptions and sampling at two sites. Field data collected from these ground observations included geographic location, landscape attributes (landform, vegetation, land degradation, erosion, scalds etc.) and micro-relief. Detailed soil profile descriptions provide a full morphological description, including soil horizon depths, designation, boundary distinction, field texture and field pH tests.

Soil samples were collected from each soil horizon (both A and B). Sample depths were selected to ensure that significant horizon boundaries were not crossed in the sample e.g., A2/B1 boundary. When collecting the samples, the following best practices were used:

- Samples did not span significant horizon boundaries,
- Samples were not bulked between sites,
- Samples were collected from a detailed profile site,
- Samples for chemical analyses were placed into sealed bags. Approximately 500 grams was required to ensure adequate analysis of each sample.

### 2.2 Reporting Soil Classification

The technical standard adopted to classify soil profiles identified at test pits is the Australian Soil Classification (ASC) system (Isbell, 2002). Soil profiles are classified and named on the basis of their characteristics and attributes:

- Number of horizons in the profile,
- Colour of various horizons,
- Texture, texture contrast and structure,
- Relative arrangement and geochemistry,
- Geological origin of the soil material (i.e. alluvial, colluvial, residual etc.),
- Depth of horizons.

### 3. Laboratory Analysis

Soil samples were collected from the soil profiles of major soil units within the study area. Representative samples were selected for subsequent laboratory analysis. Two samples were selected based on the following factors:

- The presence of an A horizon in the soil profile.
- Surface indications of soil dispersivity and assessment of sodicity in the A and B horizons.
- Surface indications of soil dispersivity and salinity and assessment of indicators across the soil profile.
- Assessment of soil fertility (particularly A horizon soil fertility) across the study area.

This analysis enabled characterisation of the chemical and physical properties of the soils present, classification of soil types (orders and sub-orders) and delineation of the suitability of certain soil types for varying end land use. Test pits were excavated to the effective rooting depth, to a maximum depth of one metre. In the field, a soil scientist logged the stratigraphy of each test pit and completed the specific field sheets (adapted from Gunn et al. 1998). Testing for pH was conducted in the field for each test pit.

The following laboratory analysis was conducted on the samples:

- Electrical conductivity (EC).
- Moisture content.
- Particle size.
- Exchangeable cations: calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), cation exchange capacity (CEC).
- Total metals: arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), nickel (Ni), vanadium (V), zinc (Zn).
- Total recoverable mercury (Hg).
- Ammonia as N.
- Organic nitrogen as N.
- Total Kjeldahl Nitrogen as N (TKN).
- Total phosphorus as P (P).
- Total organic carbon (TOC).

4. Desktop Research

4.1 Guidelines and Policies

This technical report will be used as supporting documentation in response to EHP’s Guideline EM961 Application requirements for activities with impacts to land. Environment impacts to land associated with environmentally relevant activities in Queensland are regulated under the EPA1994 and subordinate legislation including the Environmental Protection Regulation 2008. Impacts to land may also occur through notifiable activities, if occurring on the proposed land. No notifiable activities, as outlined in Schedule 3 of the EPA 1994, will be occurring on the proposed mining lease.

The following legislation will also be used to generate this report:

- Environmental Protection Act 1994
- State Planning Policy, December 2013
- Regional Planning Interests Act, 2014
- Wild Rivers Code (EHP 2007)

In December 2013, the Department of State Development, Infrastructure and Planning (DSDIP) released a single State Planning Policy to replace the multiple policies previously in existence. This replaced existing policies listed in the DEHP Guideline (EM961), such as SPP2/02 Planning and Managing Development Involving Acid Sulfate Soils, SPP1/92 Guidelines for the
Identification of Good Quality Agricultural Land and SPP1/12 Protection of Strategic Cropping Land. In July 2014, the *Regional Planning Interests Act* replaced the *Strategic Cropping Land Act 2011* and matters relating to Strategic Cropping Land are now assessed by DSDIP.

Other literature referred to in undertaking this study include:

- *Australian Soil and Land Survey: Guidelines for Survey Soil and Land Resources* (McKenzie et al., 2008)
- *Australian Soil Survey and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009)
- *Australian Soil Classification* (Isbell, 2002)
- *Land Suitability Assessment Techniques* (Department of Mines and Energy, 1995)
- *Interpreting Soil Test Results: What do all the numbers mean?* (Hazelton & Murphy, 2007).

### 4.2 Literature Review

**AARC 2009 EMP Soil and Land Suitability Assessment**

AARC was commissioned by Conquest Mining Limited to undertake the soil and land suitability assessment for the MCO project. This baseline survey was conducted over four field trips from 2006 – 2008, including two wet and two dry season surveys. In total 182 survey sites were assessed throughout the MCO mining lease, heavy vehicle access road, light vehicle access road, and power line corridor.

This assessment determined three soil types within the area: Rogers, Cannon and Septentri Soil, and one predominantly rocky management unit classified as the Miscellaneous Igneous Management Unit (AARC 2009). Information regarding these three soil types is provided in Table 4.

AARC (2009) also determined the land suitability class for the land use (beef cattle grazing) of each soil type present based on a number of soil characterisation factors including water availability, nutrient efficiency, soil physical factors, salinity, pH, exchangeable sodium percent (ESP), erosion potential and flooding. The determined land suitability classes are also provided in Table 4.

Chemical analysis was undertaken on all soil samples taken by AARC (2009). These chemical analyses were used to determine topsoil fertility and land suitability for cattle grazing. Where appropriate these results will be used to describe the soil types underlying the pipeline in the vicinity of the power line corridor.
Table 4: Soil type information within the project site at Mt Carlton (AARC 2009)

<table>
<thead>
<tr>
<th>SOIL TYPE</th>
<th>DESCRIPTION</th>
<th>LOCATION</th>
<th>RECOMMENDED TOPSOIL STRIPPING DEPTH</th>
<th>LAND SUITABILITY CLASS – BEEF CATTLE GRAZING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rogers</td>
<td>Consists of light to medium brown clay, with clay content increasing through the top 100cm of the soil. This soil is the most fertile within the project area however there is a decrease in essential plant nutrients below 20cm. Neutral pH transitioning to slightly alkaline at depth.</td>
<td>Found predominantly in the lower undulating drainage areas of site.</td>
<td>30cm where practical</td>
<td>2 – Suitable with minor limitation which either reduce production or require more than the simple management practices of Class 1 land to maintain economic production</td>
</tr>
<tr>
<td>Cannon</td>
<td>Consists of brown predominantly sandy loam soil continuing throughout the column with very little texture change. The soil is lightly acidic at the surface but increases in pH to slightly alkaline by a depth of 100cm. The soil is nutrient deficient and has poor fertility. The soil has poor structure and shows signs of elevated exchangeable sodium below 10cm. However, the results of the chemical analysis are not consistent enough to classify the soil as sodic. A precautionary approach recommends that it should be recognised that a potential risk of erosion exists if the soil is disturbed below a depth of 10cm.</td>
<td>Found interspersed with the Rogers soil management unit in the lower undulating areas of the site, predominantly on the mid to upper slopes.</td>
<td>10cm where practical</td>
<td>4 – Marginal land with severe limitations which make it doubtful whether the inputs required to achieve and maintain production outweigh the benefits in the long term.</td>
</tr>
</tbody>
</table>
### Septentri

**Description**: Consists of brown to grey brown, light to medium clay throughout the profile, with clay content increasing slightly with depth. The soil has a moderate level of nutrients but is still deficient in organic carbon and nitrogen. A defining characteristic of this soil is a significant increase of chlorine at depth and a high percentage of exchangeable sodium. This soil is considered strongly sodic with ESP > 6 within 10 cm of the surface increasing to ESP > 15 by a depth of 90 cm. The soil is therefore chemically predisposed to erosion below 10 cm further increasing with depth. Soil is slightly acidic at the surface increasing markedly to moderately alkaline by the depth of 100 cm.

**Location**: Found on higher, rockier areas of the site alongside igneous rocky outcrops.

**Recommended Topsoil Stripping Depth**: <10 cm where practical

**Land Suitability Class – Beef Cattle Grazing**: 4 – Marginal land with severe limitations which make it doubtful whether the inputs required to achieve and maintain production outweigh the benefits in the long term.

### Miscellaneous

**Igneous**

**Description**: Consists of mostly absent soils on rocky igneous outcrops.

**Location**: Found on very steep hills and peaks

**Recommended Topsoil Stripping Depth**: Nil

**Land Suitability Class**: 5 – Unsuitable land with extreme limitations that preclude its use for the proposed purpose

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**NRC 2012 Baseline Soils Report**

In October 2012, NRC documented the baseline soil results at MCO prior to operations starting. Soil samples were taken from the top 20 cm and analysed in the laboratory for a number of trace metals, including arsenic, cadmium, copper, lead, mercury, nickel and zinc.

Trace metals were recorded in small amounts in the 2012 study, most likely caused by the natural weathering of rocks (NRC 2012). All metal concentrations remained below the Department of Environment (DoE 1998) health based investigation levels, with one sample taken along the haul road exceeding the DoE environmental investigation limits for arsenic and copper. This sample was taken from the surface, along the haul road and may have been contaminated by road disturbance.
Results

1. Results from the 24km Pipeline Survey

1.1 Field Observations

The field survey involved observations of the 13 soil survey sites. The observations and photographs are included in Table 10 and Table 11 in Appendix B and Appendix C of this report.

In general, field observations reveal the proposed pipeline corridor to traverse land that is mostly moderately to highly disturbed from grazing activities and the existing power line corridor. The proposed route alongside existing access roads lies predominantly in a pre-cleared verge with dense dry grass cover, which will help to mitigate risks of erosion during construction. There is likely to be a healthy pre-existing seed bank within the soil, which will facilitate revegetation of the backfilled and graded pipeline trench.

1.2 Criteria for Potential Management Issues

Soil samples were taken from two sites (SS04 and SS11), with a sample taken from both the surface soils (A Horizon) and sub-soils (B Horizon). Results of the laboratory analyses are displayed in Table 5. Coordinates and photographs of these test pit locations and remaining tests pits that were not sampled for laboratory testing are provided in the appendices of this document.

Soil samples can be assessed using the criteria outlined in McKenzie et al. (2004) to determine potential management issues for construction, future operations and rehabilitation activities. Assessment of the soil results against the criteria has been conducted and the analysis provided in the Soil Health section below.

Table 5: Soil sample results measuring criteria used to assess potential management issues

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS04 – Surface</td>
</tr>
<tr>
<td>pH</td>
<td>7.3</td>
</tr>
<tr>
<td>CEC (meq/100g)</td>
<td>4.9</td>
</tr>
<tr>
<td>Exchangeable K (meq/100g)</td>
<td>0.25</td>
</tr>
<tr>
<td>Exchangeable Ca (meq/100g)</td>
<td>2.3</td>
</tr>
</tbody>
</table>
### Table 6: Criteria used to assess soils for potential management issues (McKenzie et al. 2004)

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>ISSUE</th>
<th>MEASURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Acidity (fertility)</td>
<td>pH 1-3: Extreme pH for acid peats</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pH 5-7: Range in pH common for mineral soils in humid regions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pH 7-9: Range in pH common for mineral soils in arid regions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pH 10-14: Attained only by soils with alkali minerals</td>
</tr>
<tr>
<td>CEC</td>
<td>Nutrient status (fertility)</td>
<td>Nutrient status low when &lt;5meq%, high when &gt;15meq/100g</td>
</tr>
<tr>
<td>Exchangeable K</td>
<td>Nutrient status (fertility)</td>
<td>K availability can be an issue when &lt;0.2 meq/100g</td>
</tr>
<tr>
<td>Exchangeable Ca</td>
<td>Nutrient status (fertility)</td>
<td>Ca availability can be an issue when &lt;1 meq/100g</td>
</tr>
<tr>
<td>Organic Carbon</td>
<td>Nutrient status (fertility)</td>
<td>Considered small &lt;1%, moderate 1-2% and large &gt;2%</td>
</tr>
<tr>
<td>ESP</td>
<td>Sodicity (fine sediment export, erosion, physical fertility)</td>
<td>ESP 0&lt; non-sodic ≤ 6 &lt; sodic ≤ 15 &lt; strongly sodic</td>
</tr>
<tr>
<td>Silt + Fine Sand</td>
<td>Physical Erosion Potential</td>
<td>&gt; 65% high risk</td>
</tr>
</tbody>
</table>

### 1.3 Soil Health and Function

#### Soil pH and Soil Fertility

Soils within the proposed pipeline region contain relatively neutral pH conditions ranging from 6.8 - 7.3 (Table 7). Within the subsurface (B Horizon) the pH tends towards increased alkalinity ranging from 8.1 - 8.8. There are no extremely acidic soils present, therefore, the pH should not pose any management issues for development of the pipeline.

Soil fertility is examined in terms of pH, CEC, exchangeable potassium, exchangeable calcium and organic carbon.
Nutrient availability, in regards to exchangeable Ca, Mg, K and Na, is quite high in both soil samples (SS04 and SS11; Table 7). Potassium, however, contains lower values than the other exchangeable cations, which may cause potassium deficiency in future plant growth if the content continues to decrease to <0.2meq/L. The total organic carbon % is lower in SS04 (0.47%) than SS11 (3%).

Table 7: Soil fertility indicator results from test pits along the Burdekin River pipeline corridor

<table>
<thead>
<tr>
<th>TEST PIT</th>
<th>SOIL HORIZON</th>
<th>pH</th>
<th>CEC</th>
<th>EXCHANGEABLE CATIONS (MEQ/100G)</th>
<th>TOC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ca</td>
<td>Mg</td>
</tr>
<tr>
<td>SS04</td>
<td>Surface</td>
<td>7.3</td>
<td>4.9</td>
<td>2.3</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Subsoil</td>
<td>8.1</td>
<td>11</td>
<td>4.6</td>
<td>3.5</td>
</tr>
<tr>
<td>SS11</td>
<td>Surface</td>
<td>6.8</td>
<td>13</td>
<td>8.1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Subsoil</td>
<td>8.8</td>
<td>38</td>
<td>21</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Sodicity

The ASC identify the dominant soils as sodosols and vertosols across the survey area. For soil material to be classed as sodic, the exchangeable sodium percentage (ESP) of the fine earth soil material has to be 6% or greater. A map of Queensland dominant soils is included in the mapping appendix of this technical report, as is a map showing the Australian Soils Atlas soil types mapped across the pipeline.

Excessive concentrations of exchangeable sodium causes deflocculation, where soil aggregates disperse into their basic individual soil particles, creating a dispersed soil condition (poor soil structure), saturated with sodium. Macroporosity and water infiltration is reduced and drainage in the soil is poor, with soils becoming hard on drying. Seedling germination and plant growth in these soils are problematic. Additionally, sodic soils with few stabilising agents such as humus, clay or sesquioxides, in the topsoil will be susceptible to erosion, especially when high in silt and clay content. Soil sodicity leads to reduced air and water permeability and poor soil drainage. Depending on clay percentage within the soil, soil dispersion problems can occur at a higher or lower value than 6%.

Sodicity is identified by calculating the Exchangeable Sodium Percentage (ESP) from the CEC, and exchangeable sodium values. Soils with an ESP > 6 is considered sodic while > 15 is strongly sodic (McKenzie et. al., 2004). ESP is calculated as follows:

\[
ESP (%) = \frac{\text{Exchangeable (Na)}}{\text{CEC}} \times 100
\]

where the units of concentration are in meq/100g

The following scale describes soils as ‘non-sodic’ to ‘very strongly sodic’ depending on the ESP value:

- <6% non-sodic;
- 6-10 sodic;
- 10-15 moderately sodic;
- 15-25 strongly sodic;
- 25 very strongly sodic.

All of the samples taken along the survey area were classified as sodic with an ESP above 6% (Table 5). Surface sodicity was classified as strongly sodic and sodic for samples SS04 and SS11 respectively. Sodicity increased with depth with values changing from 19.0% and 8% to 24.2% and 20.5%, for SS04 and SS11 respectively. These B Horizon values are categorised as strongly sodic. Sodic soils pose potential problems as their clay fraction rapidly disperses on contact with water, making soils unstable and erosion prone with poorer water quality due to the dispersion of fine sediment (McKenzie et al. 2004). Sodic soils also tend to set hard on drying, making them impermeable to water and plant roots.

**Magnesium Enhanced Sodicity**

Sodicity can be enhanced in soil with very high exchangeable magnesium concentrations. In this case the soil undergoes increased dispersion from exchangeable sodium when:

- Exchangeable Mg > 30% CEC
- Ca:Mg < 1
- ESP > 4%, and/or
- Exchangeable Mg / 10 + ESP > 6

Magnesium is a divalent cation that can undergo cation exchange with Na+ when found in excess levels. This results in soil degradation as the process impacts the soil’s physical properties (Karimov, 2009). In addition soils with exchangeable magnesium and sodium develop lower hydraulic conductivity. As a result of this Mg2+ Na+ exchange, clay surfaces preferentially absorb water, which results in the weakening of forces that govern the soil particle integrity (Qadir and Schuber, 2002).

It is evident that the Ca:Mg ratio decreases with depth from 1.64 and 1.31 in the A horizon, to 2.7 and 2.41 in the B horizon. A contrasting trend is demonstrated by the ESP% and the Ex Mg/10+ESP value, which increases with depth from the A to B horizon. A larger increase is experienced by sample SS11 between horizon A and B than SS04, in regards to increasing ESP and Ex Mg/10+ESP values. Hence, the sodicity of the soil is not enhanced by the magnesium concentrations present within the soils.

Table 8: Magnesium enhanced sodicity from test pits along the Burdekin River pipeline corridor
Soil Erosion Potential

Erosion potential can be interpreted from particle size distribution (PSD), in particular the presence of silt and fine sand (McKenzie et al. 2004; Table 5). A high erosion potential is indicated by a combined silt and fine sand content of >65% (McKenzie et al. 2004; Table 5).

SS11 and SS04 both contain a value of silt + fine sand below 65%, however, SS11 comprises of 58% silt + fine sand in the A horizon (surface). This value is quite close to the >65% measure and it can therefore be inferred that this soil may contain the potential for physical erosion during the development of the pipeline.

1.4 Other Potential Management Issues

Soil Salinity

The salinity results of the two soil samples (SS04, SS11) indicate that the salinity of the soil increases with depth, with the B horizon (sub soil) of each sample containing a higher salinity than the surface samples (A horizon). SS04 contains very low salinity (<90 µS/cm) on the surface, although the salinity increased with depth it still remains overall low. SS11 contains low salinity on the surface, yet increases to very high (760-1210µS/cm) salinity in the sub-surface

Table 9: Electrical conductivity results from pits SS04 and SS11

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SS04 – Surface</th>
<th>SS04 – Sub-soil</th>
<th>SS11 – Surface</th>
<th>SS11 - Sub-soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC (µS/cm)</td>
<td>84</td>
<td>230</td>
<td>170</td>
<td>770</td>
</tr>
</tbody>
</table>

Water Permeability

The permeability of soils is a measure of the ease of fluid movement through the material. A soil’s permeability and water storage capacity are fundamental factors controlling the soil-water regime. These factors can indirectly control ecosystem process and the suitability of land for a range of purposes (McKenzie et al. 2004).

ESP% directly affects the soil permeability as an increase in sodicity causes a blockage of water-conducting soil pores with dispersed clay particles, ultimately reducing water and air
movement (Menneer et al, 2001). The ESP in both soil samples (SS04 and SS11) indicates the high sodic characteristic, however SS04 demonstrates a value of sodicity (19) that is believed to be very strong (>15). Therefore SS04 will contain lower water permeability than SS11.

Water Holding Capacity

A soil’s capacity to supply air and water is determined by its porosity and ability to retain water (McKenzie et. al., 2004). The sodic characteristic of both soil samples (SS04 and SS11) indicates that moderate water holding capacities will be experienced. Sodic clays undergo swelling and dispersion that destroy soil pore structure and the ability of the soil to hold water (Goncalves et al, 2010). Therefore, SS11 contains a lower ESP than SS04 and therefore, potentially has a higher water holding capacity.

2. Pre-existing Results Pertaining to the 15km Power Line Corridor

Previous soil studies conducted across the MCO ML10343 and the MLA10375 power line corridor resulted in three soil types observed within the leases at MCO – Rogers, Cannon and Septentri soil management units (AARC 2009). A miscellaneous igneous management unit was also noted, but given this occurred only on rocky igneous outcrops on the main mining lease, it will not be used for comparison in this report. The three specific soil types identified have differing topsoil depths and nutrient statuses, as outlined in Table 4 in the literature review section in this report.

The Septentri and Cannon soil types were the predominant types along the power line corridor. Septentri soil is considered strongly sodic with ESP >6 in the A horizon increasing to ESP >15 at a depth of 90cm (AARC, 2009). The AARC report classified this soil as chemically predisposed to erosion below 10cm, further increasing with depth, which is consistent with the findings of this current survey.

The Cannon soil type is nutrient deficient and has poor fertility, which is also consistent with findings of the current survey along the pipeline corridor. The AARC (2009) report also identifies the ratio of calcium to magnesium in Cannon soil indicates soil that may become sticky when wet and very hard when dry, which is consistent with analysis of existing survey sample results.
1. Potential Management Issues Relating to Soil Health Characteristics

1.1 Soil pH

Depending on the soil type and climate, pH values vary in soils. pH can exert strong control on the soils chemical environment and most importantly it determines the nature of weathering and the availability of nutrients to plants (McKenzie et. al., 2004). The pH of a soil can directly influence the growth of plants by affecting the amount of nutrients available. These nutrients are found in both acidic and alkaline conditions, yet most are available under neutral pH conditions (Zhao, 2011). The pH also affects the concentration of dissolved metals, and which specific metals will become dissolved when exposed to precipitation. A low pH can cause aluminium toxicity, calcium deficiency and low levels of phosphorus. Alkaline soils however, contain low levels of zinc, copper and other vital plant nutrients. A correct balance of these trace elements creates optimal conditions for plant growth and is usually obtained during neutral pH conditions (Fernandez-Calvino, 2011).

The pH also contains implications for microbial activity. As soils reach the extremes of becoming acidic or alkaline, microbial activity becomes less effective or may become inactive, preventing microbial activity and their effect on plant growth/survival (Anderson, 2001). Microbial activity is essential for plant growth as it plays a vital role in nitrogen and carbon fixing (Gazy and Andrew, 2012).

Given the pH of the soils in the pipeline corridor is neutral, and there is no presence of acidic soil along the pipeline, the pH of soils poses no environmental risk for construction of the pipeline and there is no specific management activity required for soil based on its pH.

1.2 Soil Fertility

Soil fertility is initially influenced by the parent material from which it was developed and the original vegetation. Ideally, these nutrients are held within the soil and contain cations and anions that are electrically charged. As plant roots come in contact with these electrically charged ions, the plants readily takes up the nutrients. The amount of nutrients available however is dependents on the pH, the organic matter, the amount of pore water, and the biota. A loss of these nutrients may occur form soil erosion, leaching, or runoff, resulting in the depletion of the soil’s nutrients (Foth and Ellis, 1997).

Organic colloids within soil are composed on decomposed plant and animal remains, they are composed of carbon, oxygen, hydrogen and other accompanying elements such as nitrogen and phosphorous. The charge of these colloids determines the ability of the soil to retain nutrients. The Cation Exchange Capacity (CEC) refers to the negative charge on the soil, a high CEC accompanies high nutrients, and a greater fertility.
In regards to high nutrient soil, potassium plays a large role in the growth of plants and the associated root system. Exchangeable potassium is one of the main ions associated with CEC, therefore the concentrations of potassium within the soil play a large role in the overall fertility. Calcium is also an important exchangeable ion associated with the CEC of a soil. Calcium is involved in cell growth within the plant and roots (Lucas and Davis, 1961).

Organic carbon is an important compound required for micro-organism behaviour. As mentioned earlier, these micro-organisms play a large role in the nitrogen and carbon fixation cycle essential for plant growth (Jardine and McCarthy, 1989).

Nutrient availability is quite high in both soil samples; however, potassium was lower than the other exchangeable cations, which may cause potassium deficiency in future plant growth if the content decreased below 0.2meq/L. An application of fertiliser could increase the availability of potassium in the soil if required. The deficiency of TOC% in one sample has the potential to cause a management issue, as a lack of energy will be available for microbial activity and nutrient mineralisation in the soil.

After the pipeline trench has been backfilled and graded, routine inspections will be conducted to note the progress of revegetation along the pipeline corridor. The pipeline is due to be completed before the onset of the wet season. If bare patches are noted toward the end of the wet season, assuming sufficient rainfall to accommodate regrowth has been received, the proponent will investigate the application of a fertiliser and potential reseeding in bare patches to encourage regrowth.

1.3 Sodicity

The results from test pits indicate strongly sodic soils in the surface and subsurface, with sodicity increasing with depth at both test pit locations. This indicates a high potential for physical erosion to result when surface soils and subsoils are disturbed within the proposed pipeline area. Sodic soils pose potential problems as their clay fraction rapidly disperses on contact with water, making soils unstable and erosion prone with poorer water quality due to the dispersion of fine sediment (McKenzie et. al., 2004). Sodic soils also tend to set hard on drying, making them impermeable to water and plant roots.

The construction of the pipeline is intended to take place entirely during the dry season, thereby reducing the chance of a rainfall event causing erosion and mobilisation of sediment from stockpiled soil. In addition the construction activity will involve the prompt backfilling of the pipeline trench, minimising the exposure of disturbed soil and the risk of environmental impacts from erosion and dispersion of disturbed soil.

The backfilled trench will be graded and the existing seed bank within the soil is considered sufficient to allow germination and revegetation along the pipeline corridor. Routine surveys will be conducted to ensure weeds are not overwhelming the disturbed area, and spraying will be carried out where necessary to ensure weeds are controlled. Reliance on the existing seed bank also ensures species already suited to the sodic soil in the region have a chance to establish.
1.4 Soil Erosion Potential

Erosion of soils causes land degradation. It also has the potential to impact construction and cause damage to infrastructure. The degree and length of the slope, and the water infiltration characteristics of the surface soils make soils prone to water erosion, particularly when vegetation cover is <30%. Where soils are located of gentler relief, the poor water infiltration and sodic subsoils increases the risk of waterlogging (McKenzie et al. 2004).

It was inferred from the soil sample results that the soil may contain the potential for physical erosion during the development of the pipeline. Hence, erosion controls should be put in place during the construction of the pipeline. These controls are outlined in the next section.

1.5 Other Potential Management Issues

Soil Salinity

Excessive salinity in soils can have detrimental effects on plants, stunting growth and in the extreme causing plant death. Salinity is also detrimental to water quality as it is highly soluble and can be transported by water movement. Salinity is indicated in soils by measuring the electrical conductivity (EC) of the soil/water solution (typically a ratio of 1:5).

While the salinity of both soil samples increases with depth, with the B horizon containing higher salinity than the A horizon, it is unlikely that the excavation activity involved in construction of the pipeline will cause sufficient disturbance to pose a risk of environmental harm from exposure of saline soils. The depth of excavation is intended to be 300mm to facilitate the pipeline. For the most part along the pipeline, the A horizons are approximately 10cm in depth. Excavation will disturb only the top 200mm of the B horizon. The disturbed soil will be promptly backfilled into the trench and graded, reducing exposure time.

Samples from test pit SS11 contain very high saline soil in the sub-surface that could be potentially exposed during construction within the region. The A horizon at this sample site has a depth of 10cm, with the B horizon stretching from 10cm to 60cm. Again the excavation will only disturb the top 200mm of the B horizon, and the trench will be backfilled promptly to reduce the risk of environmental harm.

The excavation is due to take place in dry season months, minimising the risk of rainfall that would facilitate transport of salinity from disturbed, stockpiled soil to waterways in the receiving environment.

Soil Permeability

Soil permeability plays a large role in regards to water availability for plants, and the solutes through the soil (Rawls et al, 1982). Soils with low permeability become saturated quickly during a rainfall event, resulting in most water lost as runoff, rather than infiltration into the groundwater system. For the soil to demonstrate ultimate capture and storage of soil moisture it must characteristically allow water to move through the soil profile, resulting in a higher soil permeability (Batey, 2009).
Results of the soil samples and ESP% reveals that some soils over the pipeline area are more permeable than others. Increased water permeability however has minimal impact on the construction of the pipeline as it will occur in the dry season.

**Water Holding Capacity**

A high porosity results in maximum infiltration and increasing available water within the soil profile. The porosity of soils is influenced by the size of the pores available to retain water, an extremely high porosity will allow water to drain and air to substitute, whilst extremely low porosity results in water storage that is not available to root systems. (Batey, 2009; Lipiec et al, 2006).

Soils along the pipeline were considered to be of moderate water holding capacity. The light textured surface soils characteristic of sodosols typically have moderate water holding capacities. The availability of this water to plants is therefore only moderate due to poor soil structure and typical chemical conditions (salinity), reducing the depth to which plant roots will grow.

### 2. Soil Management During and after Construction

Given the nature of the soil along the Burdekin River pipeline corridor, the best management approach during construction will be to adhere to the intended construction schedule and approach, namely:

- Construction of the pipeline in sections, to allow progressive rehabilitation,
- Minimal soil stockpiling for as short a time as practical,
- Prompt backfilling and grading of the trench,
- Completion of construction work during the dry season,
- Suspension of construction work in the event of a sustained rainfall event that is considered to pose an erosion risk to stockpiled soil,
- Post-construction routine inspections to review the progress of revegetation,
- Weed control where required,
- Potential application of fertiliser and reseeding of bare patches if required.

### 3. Erosion and Sediment Control Measures

#### 3.1 Watercourse Erosion

Watercourse erosion commonly occurs when changes are implemented in the drainage catchment or directly to the stream itself. The proposed area for the pipeline to be constructed is
alongside existing access roads. As a result, the pipeline will be laid in a previously disturbed area and no further clearing of land/vegetation will occur; causing no major changes in the catchment hydrology.

Where the pipeline is expected to traverse a waterway or drainage channel, concrete plinths will be bedded in on either side of the waterway and the pipeline will be suspended across the waterway using a wire rope suspension system anchored in the concrete stump. This methodology will minimise any changes to the stream, its associated banks, and the natural drainage pathways.

### 3.2 Land Based Erosion

The results of the soil samples tested indicate the sodic characteristics pose erosional risks when disturbance occurs. Methodology has been proposed in order to minimise the erosion risk of the soil during the construction of the pipeline. Initially, construction work is planned to take place in the dry season over approximately 18 weeks, to minimise the potential for erosion to occur as a result of precipitation. If work were to continue beyond this time period, it would expand into the early wet season when minimal rainfall is likely to occur.

In order to minimise the time that the excavated soil trench is exposed to erosional forces, the pipeline constructional will occur in intervals so that complete methodology can be completed on one length of the pipe at a single time. This allows the excavated trench to be promptly backfilled, and graded immediately after the pipe is laid. Prompt backfilling also mitigates the risk of erosion of stockpiled topsoil.
Conclusion

In conclusion, desktop, field and laboratory assessments were conducted across the proposed pipeline area to provide a thorough assessment of the soil characteristics present. Thirteen ground observation sites and four soil test pits were assessed along the proposed pipeline pathway, with soil samples taken in two of the representative test pits, SS04 and SS11.

Overall, results of the desktop study, field assessment and laboratory analysis show that sodicity is the primary characteristic of soil samples SS04 and SS11. This sodicity is shown to increase with depth in both soil sample locations. Sodic soils pose potential problems as their clay fraction rapidly disperses on contact with water, making soils unstable and erosion prone. Due to the sodic characteristic of SS04 and SS11, each soil sample contains a low permeability and a moderate water holding capacity.

The results of the existing survey effort are consistent with past soil surveys conducted in the power line corridor and across the main MCO ML10343. Samples display similar characteristics to those noted by AARC in their 2009 Soil and Land Suitability Assessment conducted for MCO.

In addition, the salinity of each soil sample also increases with depth to very saline values (>770µS/cm) seen in soil sample SS11. The fertility status of both soil samples is moderate with SS04 and SS11 containing suitable nutrient concentrations; however, SS04 contains slightly lower fertility status as potassium availability is low and the organic carbon content is considered small. These findings will influence management and handling of soil material during the construction of the pipeline, as discussed in the discussion section of this report.

The lower soil fertility demonstrated by SS04 may indicate the potential for low soil fertility regions to exist along the proposed area for pipeline construction. As a result, appropriate soil conservation methods will be implemented if needed (e.g. short-term stockpiling and post rehabilitation monitoring for revegetation progress, with weed control steps to be taken, and the potential for fertiliser application and reseeding to be considered in the event of bare patches persisting at the end of the wet season).

The potential for erosion, as a result of the sodicity and additional soil characteristics, will be controlled by promptly backfilling and grading after the pipe is laid to minimise environmental disturbance. This methodology limits the soil’s exposure to erosional forces by completing the pipeline construction in intervals, which allow the full completion of a length of the pipeline at a single time before constructing the next length.

Watercourse erosion is also limited by constructing the pipeline along existing access roads, negating any requirement for extensive land/vegetation clearance. Where the pipeline is expected to traverse a waterway or drainage channel, concrete plinths will be bedded in on either side of the waterway and the pipeline will be suspended across the waterway, ensuring there will be no direct changes to the stream course.

In conclusion, the desktop and field analysis shows that the sodic characteristic of the soil present in the proposed pipeline area poses a potential erosion management issue during construction, which can be mitigated using the approach described in this report. The methodology planned for the construction of the pipeline, in addition to associated soil...
conservation methods outlined, will minimise this potential for direct and watercourse erosion to occur.
References


DME 1995 Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland


Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME 1995),(National Committee on Soil and Terrain, 2009), state planning policy

Appendix summary

Appendix A  Maps
Appendix B  Land Capability – Field Observations
Appendix C  Detailed Soil Profile Observations
Appendix A

Maps

Maps included in this appendix:

- Site Location of Mt Carlton Operation and the proposed pipeline route
- Land Tenure and Cadastre
- Topography and Hydrology
- Agricultural Land Audit
- Strategic Cropping Land
- Queensland Dominant Soils
- Atlas of Australian Soils
- Soil Survey Locations
Notes:
Land Tenure and Cadastre from IQQLD_CADASTRETENURE_DCDB_CUR <Whitsunday Regional Council, 2014>
Trigger Map for Strategic Cropping Land from QLD_SCL_Mapping.shp
State of Queensland 24-06-2014
Aerial imagery from ArcGIS basemaps.

Legend
- SCL mapped inside pipeline buffer
- Pipeline with a 50m buffer
- Trigger Map Strategic Cropping Land
- Cadastre

Total area of mapped potential SCL: 10.5 ha
Narrowest band of SCL: < 25 m
Area of mapped SCL intersected by pipeline and buffer: 2.34 ha
SOIL SURVEY LOCATIONS

Legend
- Soil Survey Sites
- Proposed Pipeline
- Mine Lease

QLD Dominant Soil
- CHROMOSOLS
- SODOSOLS
- VERTOSOLS

Notes:
Imagery sourced through ArcGIS Basemaps.
MRO Site boundary extracted from ml.shp, from IRTMI © State of Queensland 2012.
QLD Dominant Soils © State of Queensland 2012.

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 7/07/2014

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Appendix B

Land Capability – Field Observations
Table 10: General field observations from survey sites along the Burdekin River pipeline corridor

<table>
<thead>
<tr>
<th>SURVEY SITE</th>
<th>COORDINATES (GDA94 55K)</th>
<th>LANDFORM ASSESSMENT</th>
<th>VEGETATION</th>
<th>LAND SURFACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS01</td>
<td>532 876 E 775 8059 S</td>
<td>Slope: Level</td>
<td>Growth form: Woodland (Gum and red blood).</td>
<td>Highly disturbed through power corridor, road and grazing activities. Low erosion risk due to landform and grass cover.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morphological type: Flat</td>
<td>Height: 8m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landform: Floodplain</td>
<td>Foliage cover: 40%</td>
<td></td>
</tr>
<tr>
<td>SS02</td>
<td>534 372 E 775 8772 S</td>
<td>Slope: Gently inclined</td>
<td>Growth form: Open woodland (Gum and red blood)</td>
<td>Moderately disturbed with road access and grazing activities. Moderate erosion risk due to landform and cleared road surface.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morphological type: Upper-slope</td>
<td>Height: 6-10m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landform: Hillslope</td>
<td>Foliage cover: 20%</td>
<td></td>
</tr>
<tr>
<td>SS03</td>
<td>535 424 E 775 7656 S</td>
<td>Slope: Very gently inclined</td>
<td>Growth form: Open woodland (Ghost, poplar gum and red blood)</td>
<td>Moderately disturbed from grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morphological type: Mid-slope</td>
<td>Height: 8m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landform: Hillslope</td>
<td>Foliage: 20%</td>
<td></td>
</tr>
<tr>
<td>SS04</td>
<td>536 041 E 775 7419 S</td>
<td>Slope: Level</td>
<td>Growth form: Woodland (Poplar, red blood and beefwood)</td>
<td>Low disturbance from grazing activities. Low erosion risk due to landform and grass cover.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morphological type: Flat</td>
<td>Height: 6m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landform: Hillcrest</td>
<td>Foliage cover: 30%</td>
<td></td>
</tr>
<tr>
<td>SS05</td>
<td>537 057 E 775 6832 S</td>
<td>Slope: Very gently inclined</td>
<td>Growth form: Woodland (Iron bark and red blood)</td>
<td>Moderately disturbed from grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morphological type: Mid-slope</td>
<td>Height: 6 – 10m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landform: Hillslope</td>
<td>Foliage: 40%</td>
<td></td>
</tr>
<tr>
<td>SS06</td>
<td>540 071 E 775 6852 S</td>
<td>Slope: Very gently inclined</td>
<td>Growth form: Woodland (Box, iron bark and gum)</td>
<td>Moderately disturbed from grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morphological type: Mid-slope</td>
<td>Height: 6 - 8m</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Landform: Hillslope</td>
<td>Foliage: 30%</td>
<td></td>
</tr>
<tr>
<td>SURVEY SITE</td>
<td>COORDINATES (GDA94 55K)</td>
<td>LANDFORM ASSESSMENT</td>
<td>VEGETATION</td>
<td>LAND SURFACE</td>
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<tr>
<td>-------------</td>
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</tr>
<tr>
<td>SS07</td>
<td>541 129 E 775 7242 S</td>
<td>Slope: Very gently inclined Morphological type: Upper-slope Landform: Hillslope</td>
<td>Growth form: Open woodland (Iron bark) Height: 10 - 12m Foliage: 20%</td>
<td>Moderately disturbed from grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td>SS08</td>
<td>542 558 E 775 5978 S</td>
<td>Slope: Level Morphological type: Flat Landform: Plain</td>
<td>Growth form: Open woodland (Gum) Height: 10 – 15m Foliage: 20%</td>
<td>Moderately disturbed from grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td>SS09</td>
<td>544 065 E 775 4779 S</td>
<td>Slope: Gently inclined Morphological type: Mid-slope Landform: Hillslope</td>
<td>Growth form: Open woodland (Iron bark and red blood) Height: 4 - 20m Foliage: 20%</td>
<td>Moderately disturbed from grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td>SS10</td>
<td>545 290 E 775 4817 S</td>
<td>Slope: Level Morphological type: Flat Landform: Plain</td>
<td>Growth form: Open woodland (Gum and red blood) Height: 6 - 25m Foliage: 20%</td>
<td>Moderately disturbed from grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td>SS11</td>
<td>546 347 E 775 3698 S</td>
<td>Slope: Level Morphological type: Flat Landform: Plain</td>
<td>Growth form: Open woodland (Gum and red blood) Height: 6 - 10m Foliage: 20%</td>
<td>Highly disturbed from power corridor, road access and grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td>SS12</td>
<td>547 299 E 775 1920 S</td>
<td>slope: Very gently inclined Morphological type: Mid-slope Landform: Hillslope</td>
<td>Growth form: Open woodland Height: 5m Foliage: 10%</td>
<td>Highly disturbed from power corridor, road access and grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
<tr>
<td>SS13</td>
<td>548 607 E 774 9927 S</td>
<td>Slope: Level Morphological type: Flat Landform: Plain</td>
<td>Growth form: Open woodland (Gum and red blood) Height: 6 - 20m Foliage: 20%</td>
<td>Highly disturbed from power corridor, road access and grazing activities. Low erosion risk due to landform and dense grass cover.</td>
</tr>
</tbody>
</table>
Appendix C

Detailed Soil Profile Observations
Table 11: Detailed soil profile observations from sites along the Burdekin River pipeline corridor

<table>
<thead>
<tr>
<th>SURVEY SITE</th>
<th>HORIZON</th>
<th>PROFILE DEPTHS</th>
<th>DESCRIPTION</th>
<th>FIELD TEXTURE</th>
<th>FIELD pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS01</td>
<td>A</td>
<td>0-10cm</td>
<td>Light brown colour, dense roots and accumulated humified organic matter.</td>
<td>Silty clay</td>
<td>- -</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>10-60cm</td>
<td>Brown colour with an orange mottle. Apedal massive soil. Gradual boundaries.</td>
<td>Silty clay</td>
<td>7</td>
</tr>
<tr>
<td>SS04</td>
<td>A</td>
<td>0-10cm</td>
<td>Light brown colour, dense roots. Small granite fragments.</td>
<td>Sandy clay</td>
<td>- -</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>10-70cm</td>
<td>Brown colour. Apedal massive soil. Gradual boundaries.</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>SURVEY SITE</td>
<td>HORIZON</td>
<td>PROFILE DEPTHS</td>
<td>DESCRIPTION</td>
<td>FIELD TEXTURE</td>
<td>FIELD pH</td>
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<td>----------</td>
</tr>
<tr>
<td>SS08</td>
<td>A</td>
<td>0-10cm</td>
<td>Light brown colour, dense roots.</td>
<td>- -</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>10-60cm</td>
<td>Brown to black colour. Weakly pedal soils with sub-angular to polyhedral peds. Gradual boundaries.</td>
<td>Silty clay loam</td>
<td>7</td>
</tr>
<tr>
<td>SS11</td>
<td>A</td>
<td>0-10cm</td>
<td>Light brown colour, dense roots.</td>
<td>Silty clay</td>
<td>- -</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>10-60cm</td>
<td>Brown colour. Weakly pedal soils with granular peds (2-5mm). Gradual boundaries.</td>
<td>Sandy clay loam</td>
<td>8.5</td>
</tr>
<tr>
<td>SURVEY SITE</td>
<td>HORIZON</td>
<td>PROFILE DEPTHS</td>
<td>DESCRIPTION</td>
<td>FIELD TEXTURE</td>
<td>FIELD pH</td>
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Appendix C

Flora and Fauna Technical Report (NRC 2014)
Burdekin River Pipeline EA Amendment

Flora and Fauna Technical Report

July 2014

prepared on behalf of Mt Carlton Operations
Limitations of this Report

Client: Mt Carlton Operations

Prepared by Northern Resource Consultants (NRC)

This disclaimer brings the limitations of the investigations to the attention of the reader.

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Any advice, opinions or recommendations contained in this document should be read and relied upon only in the context of the document as a whole and are considered current as of the date of this document.
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Introduction

1. Background

The Mt Carlton Operation (MCO) is a gold, silver and copper mining project in North Queensland. The mine has been in operation since early 2013. Water used in processing at the site is sourced from pit dewatering bores and from rainfall across the lease that is collected in the main site water dam (MSWD).

As part of MCO’s ongoing water supply strategy, a 400 ML raw water allocation has been secured from an adjoining landholder of the project. Through negotiations with the landholder of Strathalbyn Station, which lies due west of ML10343 and underlies MLA10375, MCO have arranged to utilise the landholder’s existing water allocation from the Burdekin River up to 400ML annually.

This EA Amendment application is for the construction and operation of a 225mm subterranean HDPE pipeline and associated pumping infrastructure, to carry river water from the Burdekin River to the MSWD at MCO for processing. The proposed pipeline will be approximately 39km long. Approximately 15km of that pipeline will follow the existing pipeline corridor along MLA10375, which hosts the King Creek substation power line and under which the raw water pipeline is also approved as an external water pipeline infrastructure corridor as per Schedule A of the site’s EA EPML00982113. The remaining 24km of pipeline that is the subject of this application for a mining lease will branch off along Johnny Cake Road and then follow the Strathalbyn Station Access Driveway across Strathalbyn Station to the Burdekin River.

The proposed mining lease will be 8m wide along the remaining 24km, comprising an additional 19.2ha of disturbance under the site’s EA. Utilisation of pumping infrastructure already in place at the Burdekin River is included in the agreement between MCO and the landholder, though MCO intend to upgrade some of the pumping equipment to ensure most effective performance and monitoring of water uptake.

The excavation of the pipeline corridor, laying of the piping and rehabilitation of the excavation trench is expected to take 18 weeks in total and will be carried out in stages to minimise the risk of environmental harm. The proposed activity is considered to have a relatively low risk of environmental harm given the linear nature of the disturbance, the decision to bury the pipeline to a depth of approximately 300mm and the intent to rehabilitate the pipeline trench progressively.

2. Purpose

This report details the following aspects of a flora and fauna assessment of the proposed pipeline corridor:

- Methodologies employed for assessing the terrestrial flora and fauna within the study area.
- The presence and status of species and communities within the local area.
- Potential ecological impacts of the project and recommendations for mitigating impacts, with a focus on species of conservation concern, such as those listed under State and Commonwealth legislation.

3. Study Area

The study area for this report includes the full length of the proposed pipeline corridor, with a buffer of at least 50m on either side of the corridor (see the map series in Appendix A).

The proposed pipeline corridor covers approximately 39 linear kilometres as it tracks from the MSWD at MCO to the Burdekin River pumping station at Strathalbyn. Along this distance the corridor traverses two pastoral holdings: Strathbogie Station, which also underlies the MCO mining lease, and Strathalbyn Station. The lot on plan numbers for these stations are provided in Table 1.

Table 1: Lot on plan for the underlying pastoral stations along the pipeline

<table>
<thead>
<tr>
<th>STATION</th>
<th>LOT ON PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strathbogie Station</td>
<td>4899 SB7665</td>
</tr>
<tr>
<td>Strathalbyn Station</td>
<td>7 SB730 507 SP17655</td>
</tr>
</tbody>
</table>

There are a number of existing disturbances along the pipeline route including land clearing, cattle grazing, pasture improvement and weed invasion. Furthermore, the entire length of the pipeline route utilises previously cleared areas for existing linear infrastructure such as power line corridors, service roads, and access tracks. The majority of the pipeline route is therefore characterised by previously cleared areas with a low diversity of pasture species and some regrowth of eucalypt woodland species. The surrounding areas are mostly comprised of remnant vegetation, with some cleared areas and regrowth vegetation.

4. Regulatory Framework

4.1 Commonwealth Legislation

Environmental Protection and Biodiversity Conservation Act 1999

The Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) is administered by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of national environmental significance (MNES). The MNES listed in the EPBC act that are relevant to this report are:
- nationally threatened species and ecological communities,
- migratory species.

Database searches and field assessments should be conducted as part of any flora and fauna impact assessment. The results of these assessments can be used to determine the presence or likelihood of the presence of any MNES within a proposed development area. If any species or communities listed under the EPBC Act are present or likely to be present, an assessment of significance is required. If the proposed action may have a significant impact on a MNES, it must be referred to SEWPaC for assessment. If SEWPaC determines that the proposed action is likely to have significant impacts, the project will be considered as a Controlled Action and will require formal assessment and approval. If the proposed action is not likely to be significant, approval is not required if the action is taken in accordance with the referral. Consequently, the action can proceed, subject to any state or local government requirements.

4.2 State Legislation

Vegetation Management Act 1999

The Vegetation Management Act 1999 (VMA) is administered by the Queensland Department of Natural Resources and Mines (DNRM) and protects Queensland’s biodiversity by conserving native vegetation and addressing land degradation issues.

Queensland’s vegetation management framework regulates the clearing of certain native vegetation. The framework includes legislation, a state vegetation management code, a regrowth vegetation code and an offsets policy.

The VMA incorporates the regional ecosystem (RE) classification scheme to regulate the clearing of native vegetation. REs are remnant vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. Remnant vegetation is defined under the VMA as vegetation where the dominant canopy layer has greater than 70% of the height and greater than 50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.

The Queensland Herbarium has mapped the remnant extent of regional ecosystems for much of the state using a combination of satellite imagery, aerial photography and on-ground studies (ground-truthing). Regional ecosystem maps published by DNRM describe the extent and conservation status of remnant vegetation as REs. REs are classified in the following vegetation management class and biodiversity status categories:

- Endangered,
- Of Concern,
- Least Concern/Not of Concern.

The VMA does not apply to most environmentally relevant activities conducted on mining leases, but the classification of REs is relevant to potential offsetting requirements and determining environmentally sensitive areas (ESAs), which are discussed further in the proceeding sections.
Environmental Protection Act 1994

The Environmental Protection Act 1994 (EP Act) is intended “to protect Queensland’s environment while allowing for development that improves total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development)”. The EP Act regulates environmentally relevant activities (ERAs), which includes mining activities and EHP assesses applications to undertake ERAs, and issues environmental authorities (EAs) that identify environmental conditions to be met to ensure the prevention or minimisation of environmental harm caused by authorised ERAs. An assessment of environmental impacts to identified environmental values is required as part of the EA application.

When making an application to EHP for EAs for mining activities, the applicants are required under the Environmental Protection Regulation 1998 to identify ESAs within or adjacent to the proposed mining tenement. An ESA is defined as a location that:

- has environmental values that contribute to maintaining biological diversity and integrity,
- has intrinsic or attributed scientific, historical or cultural heritage value,
- is important to providing amenity, harmony or sense of community.

Three categories of ESA exist:

- Category A: areas that have significant ecological values including national parks, marine parks, conservation parks, the Wet Tropics World Heritage Area and the Great Barrier Reef Marine Park Region.
- Category B: areas that include REs with an Endangered biodiversity status, Ramsar wetlands (as per the Ramsar Convention on wetlands of international importance, especially as waterfowl habitat), forest reserves, wilderness areas, areas seaward of the highest astronomical tide, fish habitat areas and areas containing marine plants.
- Category C: areas that include nature refuges, state forests, timber reserves, declared catchment areas, river improvement areas, and resource reserves.

Nature Conservation Act 1992

The Nature Conservation Act 1992 (NC Act) is administered by EHP and provides the framework for the declaration and management of protected areas, and protection of wildlife listed under the Nature Conservation (Wildlife) Regulation 2006 (NC Regulation). The purpose of the NC Regulation is to prescribe wildlife as one of the following classes of wildlife:

- extinct in the wild
- endangered
- vulnerable
- near threatened
- least concern
Threatened wildlife under the NC Act is wildlife that is prescribed under the Act as extinct in the wild, endangered or vulnerable. All native flora and fauna species are protected under the act and permits to ‘take’ protected wildlife are required from EHP.

EHP provides the Wildlife Online database, which can be searched to generate a list of all species recorded within a specified area. This tool is useful for determining the presence or likelihood of occurrence of threatened species in an area.

Land Protection (Pest and Stock Route Management) Act 2002

The Land Protection (Pest and Stock Route Management) Act 2002 (LP Act) provides a framework for the management of weeds, pest animals and the stock route network. It governs actions with respect to the control and management of declared plants and animals in the state and provides local governments with a legal instrument to enforce the management of high-priority weeds and pest animals.

There are three classes of declared pests under the LP Act and the species within these classes have been targeted for control because they have, or could have, serious economic, environmental or social impacts. There are legal obligations associated with the control, supply, sale, keeping and transport of declared plants in Queensland. Declaration under state legislation imposes various legal responsibilities for control by landowners on land under their management, including all landowning state agencies.

The three categories of declared plants in Queensland are:

Class 1: A pest that has the potential to become a very serious pest in Queensland in the future. All landholders are required by law to keep their land free of Class 1 pests.

Class 2: A pest that has already spread over substantial areas of Queensland, but its impact is so serious that control is required to avoid further spread. By law, all landholders must try to keep their land free of Class 2 pests and it is an offence to possess, sell or release these pests without a permit.

Class 3: A pest that is commonly established in parts of Queensland but its control by landowners is not enforceable unless the pest is impacting, or has the potential to impact, on an adjacent ‘environmentally significant area’ (e.g. a national park).

Queensland Environmental Offsets Framework

On 1 July 2014, a new environmental offsets framework was introduced in Queensland. The framework includes an Act, a regulation and a single policy, which replaces the five previous single-issue policies.

The Environmental Offsets Regulation 2014 provides details of the prescribed activities regulated under legislation and the prescribed environmental matters (known as Matters of State Environmental Significance) to which the framework applies. Examples of Matters of State Environmental Significance (MSES) include:

- Endangered and vulnerable wildlife under the Nature Conservation Act
- Wetlands and watercourses
- Endangered and Of Concern REs
– Connectivity areas
– Protected wildlife habitat

For any new development, all impacts to MSES must be avoided or minimised where possible. Where there is a significant residual impact to MSES, an environmental offset may be required in accordance with the Queensland Environmental Offsets Policy (QEOP).
Flora and Fauna Assessment Methodology

1. Overall Assessment Methodology

NRC employed a joint approach of desktop analysis and field surveys in this study. The study team utilised best practice recommendations from sources such as:

Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre et al. 2012)
Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Neldner et al. 2012)
Flora Survey Guidelines – Protected Plants (EHP 2014a)

The following steps were undertaken as part of the methodology for this report:

- Scoping
  - Project planning and definition of objectives
  - Assignment of highly qualified ecologists
  - Detailed desktop studies
  - Review of previous studies
  - Collation of existing records
  - Literature review of species and potential threats and impacts

- Field Surveys
  - Targeted and incidental flora surveys
  - Vegetation community mapping and assessments
  - Targeted and incidental fauna surveys on site

- Analysis of Findings
  - Group review of field data, photographs and samples
  - Commissioning expert analysis for identification of recorded bat calls
NRC is a registered scientific user with ethics approval to conduct fauna studies from the Department of Agriculture, Fisheries and Forestry (DAFF) Animal Ethics Committee (AEC). The survey work involved in this report was conducted under Scientific Purposes Permit number WISP14046014.

A reconnaissance visit was not conducted specifically for the pipeline corridor field surveys due to the existing knowledge of the site held by the NRC ecologists and the adequacy of desktop components such as aerial imagery. However, the initial component of the field survey included site familiarisation to confirm assumptions made during desktop assessment and ensure generic trapping sites covered an appropriate variety of habitat types within the study area.

2. Desktop Analysis

2.1 Literature review and previous studies

Previous flora and fauna studies of the local area were reviewed and relevant findings were evaluated with respect the proposed pipeline corridor. A previous report completed for flora and fauna surveys conducted prior to the commencement of the MCO is one of the only known documented studies in the area. This report by AustralAsian Resource Consultants (2008) details the outcomes of a terrestrial fauna and flora assessment in the area occupied by the current mining lease. The outcomes of this report have some bearing on the design of this field study and the potential impacts of the proposed pipeline corridor, and these are discussed in the proceeding sections of this report.

NRC has previously conducted a number of environmental surveys for MRO, including aquatic ecology surveys. The existing knowledge of the site and local flora and fauna was beneficial in determining the appropriate design for this study.

Field guides and scientific publications were reviewed prior to field surveys to determine species likely to be present within the study area and preferred habitat. Focus was given to threatened species identified as having the potential to occur within the study area.

2.2 Database Searches

The EPBC protected matters search tool and the Queensland Government Wildlife Online database were utilised to determine species, communities and areas of conservation significance of potential relevance to the proposed development. Both searches included a 25 km buffer around a central co-ordinate along the pipeline route (20.3109° S, 147.4416° E), which includes the entire corridor as well as a considerable buffer.

The results of the database searches and their relevance to the proposed development are discussed in the results section of this report. Threatened species and communities recorded from the desktop searches (and field surveys) were ranked in terms of their likelihood of occurring within the study area. Factors used to determine the likelihood of occurrence included species records, known distributions, climatic requirements, preferred habitat and resource requirements for different stages of their life cycle (e.g. breeding). The potential impacts to threatened species considered to possibly occur within the study area are discussed in the Impacts Assessment section of this report.
2.3 Mapping

The following mapping sources were reviewed as part of the desktop analysis:

- Regulated Vegetation Management Map (DNRM 2014)
- Geoscience Australia Bowen SF 55-3 1:250000 Mapsheet (1971)
- Environmentally Sensitive Areas Map (EHP 2014b)

3. Nomenclature and Taxonomy

With the exception of technical descriptions for vegetation communities, all flora and fauna species are referred to by their common names throughout this report, with their scientific names given in brackets after the first reference. After the first reference, species are referred to by their common name only. Where no common name is provided in reference texts, a search was conducted for other accepted common names. An asterisk is used to denote species that are not native to Australia.

The use of scientific and common names for fauna species is in accordance with the following:

- Birds: Pizzey and Knight (2012),
- Amphibians: Vanderduys (2012),
- Reptiles: Wilson (2005),
- Mammals (except bats): Van Dyck and Strahan (2008),

4. Flora Survey Methodology

4.1 Overall methodology

An adaptation of Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Neldner et al. 2012) was used to collect sufficient data during the field vegetation assessments to verify the RE codes of the remnant and regrowth vegetation in the assessment area. The adapted methodology allowed for more rapid assessments to be conducted without compromising the suitability of the data for use in the classification of vegetation communities. The key features recorded in the field that are relevant to this report are:

- Vegetation structure including height of each stratum and cover density,
- Key species within each stratum,
- Geology, landform and other landzone characteristics.

The species composition and structure for each community were compared to the descriptions provided in the Regional Ecosystem Description Database (Queensland Herbarium 2014). The landzone characteristics of each site were compared to the descriptions provided in Wilson and Taylor (2012). This information provided the basis for determining the appropriate RE code for each community. The information in these documents was also used in conjunction with site observations to determine appropriate values for the factors relating to remnant status.

Vegetation surveys were conducted over two survey periods, one during the late wet season 2014 and one during the early dry season 2014. The wet season survey was conducted between 9 and 12 April 2014. The purpose of the wet season survey was to:

- Determine the appropriate RE code, extent, and remnant status of vegetation communities throughout the study area,
- Perform targeted searches for threatened flora species identified during desktop analyses,
- Compile a flora species inventory for the study area.

The dry season surveys were conducted between 4 and 5 June 2014. The purpose of the dry season surveys was to quantify and map the extent of threatened species identified during the previous field survey and to validate vegetation community mapping performed during the previous survey.

4.2 Vegetation Assessment Sites

Site Selection

Ground-truthing of the remnant and regulated regrowth vegetation mapping involved detailed assessments of vegetation characteristics along multiple transects within the assessment area. Assessment sites were selected where they would provide representative data for the vegetation type that was the subject of the assessment. The location of the assessment sites and the survey techniques employed were selected to achieve the following:

- validation of the state published RE and regrowth mapping,
- accurately determine of the extent of each vegetation type,
- resolve heterogeneous polygons,
- determine the remnant status of vegetation,
- target threatened flora species identified during desktop assessments and their habitat,
- compile a species inventory for each vegetation community and the entire study area.
A total of 22 assessments were conducted over the two survey periods, with the majority of sites concentrated within areas of mapped remnant vegetation (see map series in Appendix A). Areas of non-remnant vegetation were also assessed to ensure a comprehensive coverage of the vegetation types and species present within the study area.

Survey Techniques

A 50m x 10m vegetation assessment transect was established at each of the assessment sites within the study area. Within these transects a combination of quantitative and qualitative techniques was employed. The vegetation survey techniques employed and attributes recorded during the assessments are detailed in Table 2.

Quantitative measurements such as basal area (using the Bitterlich stick methodology, Grosenbaugh 1952, Loetsch et al. 1973) and canopy height and cover were used to describe the structural form of each community based on the structural formation classes. These attributes were also used to determine the remnant status of the vegetation.

For each assessment site, particular focus was given to the dominant species, crown cover and median height of the ecologically dominant layer, which is used to define each community and determine the appropriate RE code.

Table 2: Vegetation attributes measured in survey transects

<table>
<thead>
<tr>
<th>SURVEY METHOD</th>
<th>ATTRIBUTES MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey Plot</td>
<td>Key species of each stratum</td>
</tr>
<tr>
<td>50m x 10m</td>
<td>Median height of each stratum</td>
</tr>
<tr>
<td></td>
<td>Weed species and cover</td>
</tr>
<tr>
<td></td>
<td>Complete species list</td>
</tr>
<tr>
<td></td>
<td>Central coordinate</td>
</tr>
<tr>
<td>Transect</td>
<td>Percentage cover of each stratum</td>
</tr>
<tr>
<td>50m</td>
<td></td>
</tr>
<tr>
<td>Quadrats (x5)</td>
<td>Ground cover species and percentage of cover</td>
</tr>
<tr>
<td>1m x 1m</td>
<td></td>
</tr>
<tr>
<td>Greater area encompassing the present vegetation community</td>
<td>Tree basal area</td>
</tr>
<tr>
<td></td>
<td>Incidental species observed</td>
</tr>
<tr>
<td></td>
<td>Additional relevant notes</td>
</tr>
</tbody>
</table>

4.3 Vegetation Mapping

Mapping of vegetation communities was performed using a combination of vegetation traverses and aerial imagery. Using the information gained at each of the vegetation assessment sites, and observations made when traversing the proposed corridor, the boundaries of vegetation communities were recorded using a handheld GPS device. Some vegetation mapping was also refined using current, high-resolution aerial images.
4.4 Random Meander Technique

Various parts of the study area were traversed using the Random Meander technique documented by Cropper (1993) and recommended as the preferred approach in the Flora Survey Guidelines – Protected Plants (EHP 2014a). This technique was applied to supplement other survey techniques and to achieve the following:

- locate and record any flora species not identified in the vegetation assessment transects
- target threatened flora species
- validate vegetation community mapping
- determine the presence and extent of pest species

4.5 Threatened Species Quantification

Quantification surveys of threatened species was conducted in accordance with the Queensland Flora Survey Guidelines – Protected Plants (EHP 2014a). The plot survey technique was employed, whereby a 50m by 10m plot was established and the number of individuals of threatened species was recorded along with notes on the age structure of those plants. A comprehensive survey of the vegetation community in which any threatened species occur was also performed by measuring the attributes listed in Table 2.

5. Fauna Survey Methodology

5.1 Survey Timing and Environmental Conditions

The timing of the fauna survey was conducted in accordance with the recommendations outlined in Eyre et al. (2012). A single survey was conducted during autumn (between 9 and 12 April 2014) as temperatures were decreasing but before the onset of the cold winter nights. Incidental fauna observations were also recorded during the dry season (June 2014) vegetation surveys.

The weather preceding and during the fauna survey period was characterised by warm days and cool to mild nights (Table 3). Overall the weather conditions were considered suitable for detecting most vertebrate fauna groups. However, the survey period was terminated earlier than planned due to the onset of Tropical Cyclone Ita. The trapping program was aborted after three nights (four days) due to the heavy falls that were anticipated as a result of the cyclone (see rainfall data for the two days following the trapping period in Table 3). The program was cut short as the amount of rainfall was expected to restrict access to trapping sites and pose a significant risk to animal welfare.
Table 3: Weather conditions at MCO during the dry season fauna survey period and surrounding period

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>DATE</th>
<th>RAINFALL (MM)</th>
<th>MIN TEMP. (°C)</th>
<th>MAX TEMP. (°C)</th>
<th>HUMIDITY</th>
</tr>
</thead>
<tbody>
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<td>Pre-survey</td>
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<td>31</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>03/04/2014</td>
<td>0.0</td>
<td>22</td>
<td>33</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>04/04/2014</td>
<td>0.2</td>
<td>22</td>
<td>30</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>05/04/2014</td>
<td>0.0</td>
<td>21</td>
<td>32</td>
<td>77</td>
</tr>
<tr>
<td></td>
<td>06/04/2014</td>
<td>0.0</td>
<td>22</td>
<td>32</td>
<td>73</td>
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<tr>
<td></td>
<td>07/04/2014</td>
<td>0.0</td>
<td>22</td>
<td>30</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>08/04/2014</td>
<td>0.0</td>
<td>20</td>
<td>32</td>
<td>71</td>
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<tr>
<td>During Survey</td>
<td>09/04/2014</td>
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<td>21</td>
<td>31</td>
<td>72</td>
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<td></td>
<td>10/04/2014</td>
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<td>31</td>
<td>73</td>
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<td>11/04/2014</td>
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<td></td>
<td>12/04/2014</td>
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<td>18</td>
<td>30</td>
<td>83</td>
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<td>Post Survey</td>
<td>13/04/2014</td>
<td>29.0</td>
<td>17</td>
<td>24</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>14/04/2014</td>
<td>48.5</td>
<td>18</td>
<td>24</td>
<td>96</td>
</tr>
</tbody>
</table>

5.2 General Survey Sites

Three systematic survey sites were established where an array of fauna trapping and surveying techniques were employed. The location of the systematic surveys sites were designed to target the different habitat types present, as well as provide an appropriate spatial distribution within the study area. A description of the habitat present at each systematic survey site is provided in Table 4. The location of each systematic trapping site is depicted in the map series in Appendix A.
Table 4: Habitat targeted at each systematic survey site

<table>
<thead>
<tr>
<th>SITE NUMBER AND LOCATION</th>
<th>HABITAT DESCRIPTION</th>
<th>PHOTOGRAPH OF HABITAT AT SITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Central section of pipeline adjacent to major power line corridor</td>
<td>Remnant RE 11.12.1 <em>Eucalyptus crebra</em> woodland with a grassy ground layer dominated by <em>Bothriochloa pertusa</em>. Microhabitat features are generally limited, with some hollow bearing trees, loose bark and coarse woody debris. Actual pipeline corridor is within the adjacent power line corridor comprised of exotic grasses (non-remnant vegetation).</td>
<td><img src="image1.jpg" alt="Image" /></td>
</tr>
<tr>
<td>2. Western section of pipeline adjacent to King Creek crossing</td>
<td>Remnant RE 11.3.25a Narrow fringing riparian community dominated by <em>Eucalyptus raveretiana</em> and a shrubby understory of mostly exotic species such as <em>Lantana camara</em> and <em>Cryptostegia grandiflora</em>. This community is present along the banks of King Creek, which was flowing and contained significant pools of water at the time of the survey. Very few hollow bearing trees were present, but coarse woody debris is present along the watercourse as a result of flooding.</td>
<td><img src="image2.jpg" alt="Image" /></td>
</tr>
<tr>
<td>3. Western section of pipeline adjacent to access road</td>
<td>Remnant RE 11.3.35 <em>Eucalyptus platyphylla</em> and <em>Corymbia clarksoniana</em> woodland with a mid-dense shrub/low-tree layer of <em>Melaleuca</em> spp and <em>Petalostigma pubescens</em>. The ground layer is dominated by a mix of native and exotic grasses and numerous pasture weed species. The soil at this site was very sandy and microhabitat features were limited to a low number of fallen logs.</td>
<td><img src="image3.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>

5.3 Survey Techniques

The survey techniques employed at each generic survey site are detailed in Table 5. Some of these techniques were also utilised at other locations throughout the study area, and these are discussed in the subsequent sections.
Table 5: Fauna survey methods employed at general survey sites

<table>
<thead>
<tr>
<th>SURVEY METHOD</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elliott traps</td>
<td>At least 15 type A Elliott style traps were placed on the ground approximately 10m apart in a straight line for three nights at each of the trapping sites. All traps were baited with a mixture of rolled oats, sesame seeds and honey.</td>
</tr>
<tr>
<td>Pitfall and Funnel traps</td>
<td>Drift fence lines incorporating pitfall and funnel traps were established for three nights at each of the three systematic trapping sites. At each site, three pitfall traps (20 litre buckets) were buried flush to the ground surface with the drift fence intersecting the centre of each bucket. Six funnel traps were located along the drift fencing at each site. A shade cloth covering each funnel trap was deployed to protect trapped species from exposure.</td>
</tr>
<tr>
<td>Cage traps</td>
<td>Four cage traps were placed at each of the three sites and baited with different meats.</td>
</tr>
<tr>
<td>Anabat detectors</td>
<td>An Anabat SD2 detector was deployed for at least one night near each of the main trapping sites, and was also placed opportunistically in likely flyway zones at other targeted fauna surveys sites.</td>
</tr>
<tr>
<td>Active diurnal searches</td>
<td>Active diurnal searches were undertaken within each of the three sites. This technique involved intensive investigation of ground layer habitat features (such as under logs, rocks and leaf litter), low vegetation (under bark and tree stumps) for cryptic fauna, particularly amphibians and reptiles. Searches were focussed during the parts of the day when reptile activity was likely to be at its peak.</td>
</tr>
<tr>
<td>Diurnal bird surveys</td>
<td>Birds were surveyed within each vegetation community for at least one hour at multiple periods throughout the day, but with a particular focus during peak activity in the morning. Incidental observations made whilst conducting other survey techniques were also recorded. Birds were identified from either direct observation or by their calls.</td>
</tr>
<tr>
<td>Nocturnal surveys</td>
<td>High-powered spotlights were used to survey nocturnal mammals (flying, arboreal and terrestrial), birds (active nocturnal species, and roosting diurnal species), reptiles and frogs in each of the main trapping sites, as well as other locations throughout the study area.</td>
</tr>
</tbody>
</table>

5.4 Additional Survey Areas and Techniques

During the fauna survey period the Anabat detector, active diurnal search, diurnal bird survey and nocturnal survey techniques were all performed at additional locations outside the generic survey sites. These locations are depicted in the map series in Appendix A.

In addition to the techniques outlined previously, camera traps (motion-sensing infrared cameras) were utilised at multiple locations within the study area to target fauna that may be too large or ‘shy’ to be detected by other trapping techniques, or utilising areas outside of the main trapping sites. Camera traps were baited with the rolled oat mixture, fruit, nuts and a variety of meats.

Targeted nocturnal searches for arboreal mammals and nocturnal predatory birds were performed in areas considered higher quality habitat for such species. These areas included the mature vegetation along watercourses where they intersect the proposed pipeline corridor.
Spotlighting surveys were also conducted whilst driving slowly over multiple parts of the study area, where it was safe to do so. These surveys mainly targeted reptile and amphibian species, but were also successful in locating some birds and mammals.

Fauna species were continually observed throughout the survey period and records were frequently obtained outside of the systematic methodology of the survey. Any observations, tracks, scats or other signs of fauna were recorded with reference to the vegetation community within which it was found.

5.5 Targeted Techniques

Some of the above survey techniques were concentrated in areas of potentially suitable habitat for threatened species considered to have potential to occur within the study area (based on the results of the desktop analyses – see relevant sections below). Techniques involving targeted effort included spotlighting, active diurnal searches, diurnal bird searches, and camera traps.

5.6 Survey Effort

The survey effort employed for each of the aforementioned techniques is outlined in Table 6, showing the effort employed at each systematic trapping site and the total survey effort over the period. The survey effort was restricted by the onset of Tropical Cyclone Ita, as previously discussed is section 5.1. However, the total effort is considered adequate for the scale of disturbance associated with the project. The level of effort was taken into consideration when assessing the potential impact of the project and the likelihood of occurrence for threatened species.

<table>
<thead>
<tr>
<th>METHOD</th>
<th>EFFORT PER SURVEY SITE</th>
<th>TOTAL SURVEY EFFORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitfall trapping</td>
<td>9 trap nights</td>
<td>27 trap nights</td>
</tr>
<tr>
<td>Funnel trapping</td>
<td>24 trap nights</td>
<td>72 trap nights</td>
</tr>
<tr>
<td>Diurnal active search</td>
<td>2 person hours</td>
<td>18 person hours</td>
</tr>
<tr>
<td>Elliott trapping</td>
<td>45 trap nights</td>
<td>135 trap nights</td>
</tr>
<tr>
<td>Cage trapping</td>
<td>12 trap nights</td>
<td>36 trap nights</td>
</tr>
<tr>
<td>Diurnal bird survey</td>
<td>3 person hours</td>
<td>32 person hours</td>
</tr>
<tr>
<td>Camera Trapping</td>
<td>3 trap nights</td>
<td>9 trap nights</td>
</tr>
<tr>
<td>Spotlight/nocturnal searches</td>
<td>1.5 – 2 person hours</td>
<td>16 person hours</td>
</tr>
<tr>
<td>Echolocation call detection</td>
<td>1 detector night</td>
<td>5 detector nights</td>
</tr>
</tbody>
</table>
1. Literature Review and Previous Studies

1.1 AARC Terrestrial Flora and Fauna Assessment (2008)

Surveys and Reporting

AARC conducted four flora and fauna site surveys at the Mt Carlton mine site between 2006 and 2008, including:

- A survey during the dry season in 2006 for the main project area,
- A survey during the following wet season in 2007 for the main project area,
- A survey in October 2007 for the site access road,
- A survey in April 2008 for the powerline corridor.

The Terrestrial Flora and Fauna Assessment report (AARC 2008) provides the results of those field surveys and associated desktop analyses. Part of the proposed pipeline corridor follows the same route as the powerline corridor surveyed by AARC in 2008. This corridor has since been cleared for the construction of the powerline infrastructure. However, the results of this survey (and others associated with the Mt Carlton mine site) are considered to be highly relevant to this report.

AARC reported that the vegetation throughout the main project site and powerline corridor is mainly comprised of a variety of eucalypt woodland communities. These communities provide habitat to an array of terrestrial vertebrate fauna, the majority of which are common in similar habitat throughout the region.

Conservation Significant Species

No threatened flora species were identified during the field surveys conducted by AARC. However, it was noted that suitable habitat for some locally occurring threatened species was present within the project area.

The Squatter Pigeon (Gheopaps scripta scripta) was the only species listed as threatened under the EPBC Act or the NC Act that was detected during the surveys. This species was observed on all surveys relevant to the AARC report (as listed above), and was mainly observed in the vicinity of livestock watering points.

The Short-beaked Echidna (Tachyglossus aculeatus) was observed on at least one occasion within the project site. This species is listed as a ‘special least concern’ animal under the Nature Conservation (Wildlife) Regulation 2006.
AARC also reported multiple Anabat echolocation recordings from within the project area that were identified as Troughton’s Sheathtail Bat (Taphozous troughtoni). AARC noted the potential conservation significance of this species, as at the time of survey it was listed as endangered under the NC Act. This species is poorly known, but recent studies reveal that this species appears to be far more common than originally thought (Department of the Environment 2014a). The conservation status of this species has been revised and it is not currently listed as near threatened or threatened under any State or Commonwealth legislation.

1.2 Species of Relevance to this Project

Based on the report by AARC (2008) the Squatter Pigeon and the Short-beaked Echidna are considered to have a moderate relevance to the proposed pipeline corridor. This is supported by the data obtained from government database searches, which are discussed in the following section.

2. Database Searches

The EPBC Protected Matters Report and Wildlife Online Database extract are included in Appendix B and Appendix C of this document respectively. The relevance of these results to the proposed pipeline development is discussed in the following sections.

2.1 Threatened Ecological Communities

The EPBC Protected Matters Report identified the Brigalow (Acacia harpophylla dominant and co-dominant) Threatened Ecological Community as ‘known to occur’ within 25km of the study area (SEWPaC 2014).

The Brigalow ecological community is characterised by the presence of Brigalow (Acacia harpophylla) as one of the most abundant tree species (Butler 2007). Brigalow is either, dominant in the tree layer, or co-dominant with other species – notably Belah (Casuarina cristata), other species of Acacia, or species of Eucalyptus.

2.2 Threatened Flora Species

A total of 8 near threatened or threatened flora species were returned in the database searches. The EPBC Protected Matters Report predicted 6 threatened plant species potentially occur within a 25km radius of a central point within the study area (SEWPaC 2014, see Appendix B). The Queensland Government Wildlife Online extract shows records of 5 near threatened or threatened plant species within a 25km radius of a central point within the study area (EHP 2014c, see Appendix C). The results of these searches have been combined in Table 7 to show all near threatened and threatened flora species recorded from the database searches and their status under State and Commonwealth legislation.

Records of Dietrich’s Morning Glory (Bonamia dietrichiana) and Large-podded Trefoil (Desmodium macrocarpum) were listed in the Wildlife Online extract. Within the extract, both species were identified as near-threatened species (Appendix C). However, neither of these
species are currently listed as near-threatened or threatened under the Nature Conservation (Wildlife) Regulation 2006. Consequently, these species have not been listed in the near-threatened and threatened species tables below, nor are they discussed further in this report as species of conservation significance.

The only species that was returned in both searches was Black Ironbox (*Eucalyptus raveretiana*). This species has a fairly wide distribution in coastal and sub-coastal areas from south of Townsville to around Rockhampton. Within this range it usually grows along watercourses, and sometimes on river flats or open woodland (Halford 1997). Population data for Black Ironbox is limited, but it is reported to be locally common along some watercourses (Department of Environment 2014b and references therein). This species is typically co-dominant with other *Eucalyptus* species, as well as Melaleuca species and Moreton Bay Ash (*Corymbia tessellaris*) (e.g. RE 11.3.25a).

The Wildlife Online extract shows two records of Black Ironbox within a 25km radius of a central point within the study area. There are multiple other records of this species in the broader area. Desktop analyses indicated that there is suitable habitat for this species along some of the watercourses in the broader area. Given that the proposed pipeline corridor crosses a number of minor watercourses, as well as the more significant King Creek, this species was considered to be the most likely threatened plant species to occur within the study area.

The only other species identified in the desktop searches that was considered to have potential to occur within the study area was Native Frangipani (*Cerbera dumicola*). This species occurs across a range of habitat in Queensland that are typically dominated by Eucalyptus and/or *Acacia* species, sometimes with semi-evergreen vine thicket species. Little is known of the ecology of this species. The nearest record is in the region of Collinsville and was recorded in acidic soils of a mine rehabilitation area. Given the limited information on the ecology of this species, the presence of potentially suitable habitat, and a record of this species nearby, it is considered that this species could possibly occur within the study area.

The vegetation surveys included targeted searches for these species using the techniques outlined previously in the Methodology section of this report.

The remaining six species were not expected to occur within the study area or its immediate surrounds (Table 7). These species were therefore considered unlikely to be significantly impacted by the proposed development and have been excluded from further discussion in this report. However, see Appendix D for justification on why these species are not considered likely to occur within the study area.

### 2.3 Threatened Fauna Species

A total of 11 fauna species were returned from the database searches for near threatened and threatened species within a 25km radius of a central point the study area. These included 11 from the EPBC Protected Matters Search Tool (SEWPAC 2014, see Appendix B), and one from the Wildlife Online search (EHP 2014c, see Appendix C). The results of these searches have been combined in Table 8. Table 8 also provides an interpretation on the likelihood that each of these species would occur within the study area. This has been determined by consulting a variety of different resources to assess a number of factors for each of these species, including species records, known distributions, climatic requirements, preferred habitat and resource requirements for different stages of their life cycle (e.g. breeding). Those species that are
considered unlikely to occur within the study area have been excluded from further discussion in
this report. Appendix D provides details on why those species are considered unlikely to occur
within the study area.

All species that are considered to have the possibility (or are likely) to occur within the study
area are discussed in further detail in the Impact Assessment section of this report, including
discussion of potential impacts to these species and measures to avoid or reduce those
impacts.

2.4 Migratory Species

The EPBC Protected Matters Search Tool predicted 13 migratory species potentially occur
within 25km of the study area, and there are Wildlife Online records for four of those species in
the local area. The results of this search are included in Table 9 along with interpretation on the
likelihood that each of these species would occur within the study area. As mentioned
previously, this has been determined by consulting a variety of different resources to assess a
number of factors for each of these species, including species records, known distributions,
climatic requirements, preferred habitat and resource requirements for different stages of their
life cycle (e.g. breeding). Those species that are considered unlikely to occur within the study
area have been excluded from further discussion in this report. Appendix D provides details on
why those species are considered unlikely to occur within the study area.
Table 7: Near threatened and threatened flora species identified from database searches

<table>
<thead>
<tr>
<th>STATUS¹</th>
<th>NCA</th>
<th>FAMILY</th>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>SOURCE²</th>
<th>WO RECORDS</th>
<th>LIKELIHOOD OF OCCURRENCE³</th>
</tr>
</thead>
<tbody>
<tr>
<td>NT</td>
<td>-</td>
<td>Apocynaceae</td>
<td><em>Cerbera duminola</em></td>
<td>Native Frangipani</td>
<td>WO</td>
<td>1</td>
<td>Possible</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
<td>Cycadaceae</td>
<td><em>Cycas ophiolitica</em></td>
<td>Marlborough Blue</td>
<td>PM</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
<td>Euphorbiaceae</td>
<td><em>Omphalea celata</em></td>
<td>Tree Omphalea</td>
<td>PM</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
<td>Fabaceae</td>
<td><em>Cajanis mareebensis</em></td>
<td>-</td>
<td>PM</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>LC</td>
<td>E</td>
<td>Moraceae</td>
<td><em>Streblus pendulius</em></td>
<td>Siah’s Backbone</td>
<td>PM</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>V</td>
<td>V</td>
<td>Myrtaceae</td>
<td><em>Eucalyptus raveretiana</em></td>
<td>Black Ironbox</td>
<td>PM, WO</td>
<td>2</td>
<td>Present</td>
</tr>
<tr>
<td>NT</td>
<td>V</td>
<td>Orchidaceae</td>
<td><em>Bulbophyllum globuliforme</em></td>
<td>Miniature Moss-orchid</td>
<td>PM</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td>NT</td>
<td>-</td>
<td>Solanaceae</td>
<td><em>Solanum sporadotrichum</em></td>
<td>-</td>
<td>WO</td>
<td>1</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

1. Status: LC = Least Concern, NT = Near Threatened, V = Vulnerable, E = Endangered, M = Migratory, Ma = Marine
2. WO = Wildlife Online Database, PM = EPBC Protected Matters Report
Table 8: Near threatened and threatened fauna species identified from database searches

<table>
<thead>
<tr>
<th>STATUS¹</th>
<th>FAMILY</th>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>SOURCE²</th>
<th>WO RECORDS</th>
<th>LIKELIHOOD OF OCCURRENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCA</td>
<td>EPBC</td>
<td>FAMILY</td>
<td>SCIENTIFIC NAME</td>
<td>COMMON NAME</td>
<td>SOURCE²</td>
<td>WO RECORDS</td>
</tr>
<tr>
<td>BIRDS</td>
<td></td>
<td></td>
<td>Erythrotriorchis radiatus</td>
<td>Red Goshawk</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Columbidae</td>
<td>Geophas scripta scripta</td>
<td>Squatter Pigeon (southern)</td>
<td>PM, WO</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Estrildidae</td>
<td>Neochmia ruficauda ruficauda</td>
<td>Star Finch (eastern/southern)</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poephila cincta cincta</td>
<td>Black-throated Finch (southern)</td>
<td>PM</td>
<td>0</td>
<td>Unlikely</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rostratulidae</td>
<td>Rostralula australis</td>
<td>Australian Painted Snipe</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tytonidae</td>
<td>Tyto novaehollandiae kimberli</td>
<td>Masked Owl</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>MAMMALS</td>
<td></td>
<td></td>
<td>Dasyurus hallucatus</td>
<td>Northern Quoll</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phascolarctidae</td>
<td>Phascolarctos cinereus</td>
<td>Koala</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>REPTILES</td>
<td></td>
<td></td>
<td>Denisonia maculata</td>
<td>Ornamental Snake</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scincidae</td>
<td>Egernia rugosa</td>
<td>Yakka Skink</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lerista vittata</td>
<td>Mount Cooper Striped Lerista</td>
<td>PM</td>
<td>0</td>
<td>Unlikely</td>
</tr>
</tbody>
</table>

1. Status: LC = Least Concern, NT = Near Threatened, V = Vulnerable, E = Endangered, M = Migratory
2. WO = Wildlife Online Database, PM = EPBC Protected Matters Report
3. The southeast Queensland bioregion population of the Koala is listed as Vulnerable under the NC Act.
4. The combined Koala populations of Queensland, New South Wales and the Australian Capital Territory are listed as Vulnerable under the EPBC Act.
### Table 9: EPBC Act listed migratory species from the Protected Matters Search Tool results

<table>
<thead>
<tr>
<th>STATUS¹</th>
<th>FAMILY</th>
<th>SCIENTIFIC NAME</th>
<th>COMMON NAME</th>
<th>SOURCE²</th>
<th>WO RECORDS</th>
<th>LIKELIHOOD OF OCCURRENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCA</td>
<td>EPBC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>REPTILES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>M</td>
<td>Crocodylidae</td>
<td><em>Crocodylus porosus</em></td>
<td>Estuarine Crocodile</td>
<td>PM</td>
<td>-</td>
</tr>
<tr>
<td><strong>BIRDS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Accipitridae</td>
<td><em>Haliaeetus leucogaster</em></td>
<td>White-bellied Sea-Eagle</td>
<td>PM, WO</td>
<td>2</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Apodidae</td>
<td><em>Apus pacificus</em></td>
<td>Fork-tailed Swift</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Hirundinidae</td>
<td><em>Hirundo rustica</em></td>
<td>Barn Swallow</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Meropidae</td>
<td><em>Merops ornatus</em></td>
<td>Rainbow Bee-eater</td>
<td>PM, WO</td>
<td>2</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Monarchidae</td>
<td><em>Monarchia melanopsis</em></td>
<td>Black-faced Monarch</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Monarchidae</td>
<td><em>Monarchis trivirgatus</em></td>
<td>Spectacled Monarch</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Monarchidae</td>
<td><em>Myiagra cyanoleuca</em></td>
<td>Satin Flycatcher</td>
<td>PM, WO</td>
<td>1</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Rhipiduridae</td>
<td><em>Rhipidura rufifrons</em></td>
<td>Rufous Fantail</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Ardeidae</td>
<td><em>Ardea alba</em></td>
<td>Great Egret</td>
<td>PM, WO</td>
<td>1</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Ardeidae</td>
<td><em>Ardea ibis</em></td>
<td>Cattle Egret</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Scolopacidae</td>
<td><em>Gallinago hardwickii</em></td>
<td>Latham’s Snipe</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td>V</td>
<td>E, M</td>
<td>Rostratulidae</td>
<td><em>Rostratula australis</em></td>
<td>Australian Painted Snipe</td>
<td>PM</td>
<td>0</td>
</tr>
</tbody>
</table>

1. Status: LC = Least Concern, NT = Near Threatened, V = Vulnerable, E = Endangered, M = Migratory, Ma = Marine
2. WO = Wildlife Online Database, PM = EPBC Protected Matters Report
3. Regional Ecosystem Mapping

The RE mapping for the study area shows that almost the entire area is comprised of remnant vegetation (DNRM 2014). Table 10 provides a summary of all the REs mapped throughout the study area.

Table 10: Regional ecosystem status and description for mapped remnant vegetation within study area

<table>
<thead>
<tr>
<th>RE CODE</th>
<th>VMA STATUS</th>
<th>BIODIVERSITY STATUS</th>
<th>REGIONAL ECOSYSTEM DATABASE SHORT DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.3.4</td>
<td>Of Concern</td>
<td>Of Concern</td>
<td><em>Eucalyptus tereticornis</em> and/or <em>Eucalyptus</em> spp. woodland on alluvial plains</td>
</tr>
<tr>
<td>11.3.7</td>
<td>Least Concern</td>
<td>Of Concern</td>
<td><em>Corymbia</em> spp. woodland on alluvial plains</td>
</tr>
<tr>
<td>11.3.9</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td><em>Eucalyptus platyphylla</em>, <em>Corymbia</em> spp. woodland on alluvial plains</td>
</tr>
<tr>
<td>11.3.25</td>
<td>Least Concern</td>
<td>Of Concern</td>
<td><em>Eucalyptus tereticornis</em> or <em>E. camaldulensis</em> woodland fringing drainage lines</td>
</tr>
<tr>
<td>11.3.27</td>
<td>Least Concern</td>
<td>Of Concern</td>
<td>Freshwater wetlands. Vegetation is variable including open water with or without aquatic species and fringing sedgelands and eucalypt woodlands.</td>
</tr>
<tr>
<td>11.3.31</td>
<td>Least Concern</td>
<td>Of Concern</td>
<td><em>Ophiuros exaltatus</em>, <em>Dichanthium</em> spp. grassland on alluvial plains</td>
</tr>
<tr>
<td>11.12.1</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td><em>Eucalyptus crebra</em> woodland on igneous rocks</td>
</tr>
<tr>
<td>11.12.2</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td><em>Eucalyptus melanophloia</em> woodland on igneous rocks</td>
</tr>
<tr>
<td>11.12.7</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td><em>Eucalyptus crebra</em> woodland with patches of semi-evergreen vine thicket on igneous rocks (boulder-strewn hillsides)</td>
</tr>
<tr>
<td>11.12.9</td>
<td>Least Concern</td>
<td>No Concern at Present</td>
<td><em>Eucalyptus platyphylla</em> woodland on igneous rocks</td>
</tr>
<tr>
<td>11.12.10</td>
<td>Of Concern</td>
<td>Of Concern</td>
<td><em>Corymbia Clarksoniana</em> woodland on igneous rocks</td>
</tr>
</tbody>
</table>

4. Geology Mapping

Geology mapping for the region was obtained from the Department of Natural Resources and Mines (Map Sheet SF 55-3). Three geology units are shown within the study area, as shown in Table 11. The relevant landzones as defined in Wilson and Taylor (2012) are also shown.
Table 11: Geology mapping units within the assessment area

<table>
<thead>
<tr>
<th>MAP CODE</th>
<th>LITHOLOGY</th>
<th>ROCK TYPE</th>
<th>LANDZONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plz</td>
<td>Basalt, andesite, agglomerate, lithic and tuffaceous sediments, minor acid volcanics</td>
<td>Igneous</td>
<td>12</td>
</tr>
<tr>
<td>Cug</td>
<td>Adamellite, granite, granodiorite, minor marginal granophyre and porphyry</td>
<td>Igneous</td>
<td>12</td>
</tr>
<tr>
<td>Qa</td>
<td>Alluvium, semi consolidated in places</td>
<td>Quaternary Alluvium</td>
<td>3</td>
</tr>
</tbody>
</table>
Flora Survey Results

1. Vegetation Communities

1.1 EPBC Act Threatened Ecological Communities

The EPBC Act Protected Matters Report identifies that the Brigalow Threatened Ecological Community (TEC) is known to occur within 25km of the study area. Detailed vegetation surveys revealed that there is no vegetation characteristic of this community within the study area. The study area is characterised by eucalypt woodland that lacks the relevant floristic composition and structure of the TEC (which is dominated by *Acacia harpophylla* and *Casuarina cristata*). The species that form the ecologically dominant layer of this community were not identified anywhere within the study area.

The Commonwealth Listing Advice for the Brigalow TEC lists Queensland REs units that are equivalent to the TEC (TSSC, 2001). Interrogation of the DNRM RE mapping data revealed one of these REs (RE 11.3.1) is mapped as a sub-dominant component (10 per cent) of a polygon, the nearest point of which is approximately 4.5km south of the study area. Given the substantial distance from the proposed pipeline, and the small scale of the impacts associated with construction, it is unlikely that there will be any impacts to this community resulting from the construction and operation of the pipeline.

1.2 VMA Regional Ecosystems

Ground-truthing of the remnant vegetation within the study area revealed that there are six remnant REs present. The floristic composition and structure of these communities and their extent within the study area are presented in Table 12. The mapping of remnant vegetation within the study area conducted by NRC is presented in the map series in Appendix A.

1.3 Non-remnant Vegetation

Given that the location of the pipeline corridor has been designed to utilise areas of existing disturbance, there are areas of non-remnant vegetation along much of the corridor. These areas of non-remnant vegetation are the result of previous clearing performed to create powerline corridors and access roads. The areas of non-remnant vegetation are now almost entirely dominated by Indian Bluegrass (*Bothriochloa pertusa*), with very sparsely scattered regrowth of *Eucalyptus* species in some areas.

The proposed pipeline route follows the areas of disturbance along its entire length and very little remnant vegetation will need to be cleared during construction. Whilst the majority of works will be within these areas of non-remnant vegetation, the vegetation surveys included a buffer around the proposed pipeline to give an indication of the vegetation communities in the surrounding area and to determine any potential impacts to these communities.
Table 12: Floristic composition and structure of Regional Ecosystems and non-remnant vegetation within the study area

<table>
<thead>
<tr>
<th>DESCRIPTION AND STATUS</th>
<th>FLORISTIC COMPOSITION AND STRUCTURE</th>
<th>LOCATION AND NOTES</th>
<th>REPRESENTATIVE PHOTOGRAPH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RE 11.3.9</strong></td>
<td><strong>T1:</strong> Sparse. 14 - 18m Eucalyptus platyphylla (D), Corymbia clarksoniana (SD) and C. dallachiana (SD). <strong>G:</strong> <em>Bothriochloa pertusa</em> (D), <em>Heteropogon contortus</em> (SD), <em>Stylosanthes scabra</em> (A), <em>Sida cordifolia</em> (A), <em>Hyptis suaveolens</em> (A), <em>Macroptilium atropurpureum</em> (A), and <em>Stachytarpheta cayennensis</em> (A).</td>
<td>Western portion of the pipeline corridor in a low-lying area near the Burdekin River</td>
<td></td>
</tr>
<tr>
<td><strong>Eucalyptus platyphylla woodland to open woodland with Corymbia clarksoniana sub-dominant in some areas</strong></td>
<td>Grassy ground layer, dominated by <em>Bothriochloa pertusa</em> and other exotic species</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VMA Status:</strong> Least Concern</td>
<td><strong>Biodiversity Status:</strong> No Concern at Present</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RE 11.3.25</strong></td>
<td><strong>T1:</strong> Sparse. 10 - 18m Melaleuca fluviatilis (D), Corymbia tessellaris (SD), Pleiogyonium timorense (A) C. clarksoniana (A). <strong>T2:</strong> Sparse to mid-dense 5 – 8m Lophostemon grandiflorus (D), Melaleuca bracteata (A-SD) <strong>S:</strong> <em>Cryptostegia grandiflora</em> (D), <em>Melaleuca viminalis</em> (A-SD), <em>Crotophala palida</em> (A), <em>Leucaena leucocephala</em> (A), <em>Grewia retusifolia</em> (A). <strong>G:</strong> <em>Bothriochloa pertusa</em> (D), <em>Sida rhombifolia</em> (A), <em>S. cordifolia</em> (A), Cyperus spp. (A) <strong>Typha domingensis</strong> is present (and dominant) in wetter areas within some creek beds</td>
<td>Along the margins of most major watercourses within the study area (≥ stream order 2). The Burdekin River section of this community is extremely highly disturbed with numerous declared pest plant species (see further description in the Pest Species section of this report). The canopy on the upper banks of this section is dominated by Eucalyptus tereticornis.</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION AND STATUS</td>
<td>FLORISTIC COMPOSITION AND STRUCTURE</td>
<td>LOCATION AND NOTES</td>
<td>REPRESENTATIVE PHOTOGRAPH</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------</td>
<td>--------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>RE 11.3.25a</strong></td>
<td><strong>T1</strong>: Sparse. 15 - 25m Eucalyptus raveretiana (D), Melaleuca fluviatilis (SD), Casuarina cunninghamiana (SD)</td>
<td>Present as a very narrow fringing community along the margin of King Creek and nearby tributaries within the study area.</td>
<td><img src="image1.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Canopy dominated by <em>Eucalyptus raveretiana</em>. <em>Cryptostegia grandiflora</em> and other exotic species are abundant throughout. <strong>VMA Status</strong>: Least Concern <strong>Biodiversity Status</strong>: Of Concern</td>
<td><strong>T2</strong>: Very Sparse. 10 – 14m Lophostemon grandiflorus (CD), Melaleuca fluviatilis (CD), Casuarina cunninghamiana (CD), Ficus racemosa (A).</td>
<td>There is a very dense infestation of <em>Cryptostegia grandiflora</em> that is present throughout all strata, but particularly the shrub layer. Other exotic species are also common in the ground layer.</td>
<td><img src="image2.jpg" alt="Image" /></td>
</tr>
<tr>
<td><strong>T3</strong>: Very Sparse. 3 – 8m Ficus opposita (CD), Pleiogynium timorense (A), Melaleuca viminalis (A).</td>
<td><strong>S</strong>: <em>Cryptostegia grandiflora</em> (D), <em>Lanatana camara</em> (SD), Ficus opposita (A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>G</strong>: <em>Bothriochloa pertusa</em> (CD), <em>Parthenium hysterophorus</em> (CD), <em>Hyptis capitata</em> (CD), <em>Sida cordifolia</em> (A), <em>Urochloa mosambicensis</em> (A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RE 11.3.35</strong></td>
<td><strong>T1/E</strong>: Sparse. 14m Eucalyptus platypylla (CD) and Corymbia clarksoniana (CD)</td>
<td>Present on a section of very sandy soil within the western portion of the pipeline corridor.</td>
<td><img src="image3.jpg" alt="Image" /></td>
</tr>
<tr>
<td>Canopy dominated by <em>Eucalyptus raveretiana</em>. <em>Cryptostegia grandiflora</em> and other exotic species are abundant throughout. <strong>VMA Status</strong>: Least Concern <strong>Biodiversity Status</strong>: No Concern at Present</td>
<td><strong>T2</strong>: Sparse. 3 - 8m Melaleuca nervosa (CD), <em>M. viridiflora</em> (CD), Petalostigma pubescens (CD).</td>
<td>Generally a sparse to very-sparse community with significant disturbance from cattle grazing and introduced pasture species.</td>
<td><img src="image4.jpg" alt="Image" /></td>
</tr>
<tr>
<td><strong>S</strong>: <em>Sida cordifolia</em> (CD), <em>Hyptis capitata</em> (CD), <em>Stylosanthes scabra</em> (CD)</td>
<td><strong>G</strong>: <em>Stylosanthes hamata</em> (D), Aristida sp. (SD), Setaria surgens (SD), <em>Chamaecrista rotundifolia</em> (SD), Perotis rara (A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION AND STATUS</td>
<td>FLORISTIC COMPOSITION AND STRUCTURE</td>
<td>LOCATION AND NOTES</td>
<td>REPRESENTATIVE PHOTOGRAPH</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------</td>
<td>--------------------</td>
<td>---------------------------</td>
</tr>
</tbody>
</table>
| **RE 11.12.1**
*Eucalyptus crebra* woodland with a grassy understory. *Corymbia erythrophloia* is co-dominant or dominant in some areas

**VMA Status:**
Least Concern

**Biodiversity Status:**
No Concern at Present

| T1: Sparse. 12 - 17m *Eucalyptus crebra* (D), *Corymbia erythrophloia* (SD-D),
S: Very sparse (usually absent) <1m Recruitment of canopy species, *Sida cordifolia*, and in some areas *Atalaya hemiglauca*
| This is the dominant RE for the study area and occurs throughout much of the pipeline corridor. The shrub layer is usually absent. The ground layer is dominated (almost exclusively) by *Bothriochloa pertusa.* |
| ![Image](image1.jpg) |
| **RE 11.12.9**
*Eucalyptus platyphylla* woodland with a grassy understory. *Corymbia dallachiana* is co-dominant or dominant in some areas

**VMA Status:**
Least Concern

**Biodiversity Status:**
No Concern at Present

| T1: Sparse. 10 - 16m *Eucalyptus platyphylla* (D), *Corymbia dallachiana* (SD-D),
S: Very sparse (usually absent) Recruitment of canopy species
| Numerous areas scattered along the pipeline corridor, usually alternating with RE 11.12.1. Ground layer typically dominated by a variety of exotic pasture species. |
| ![Image](image2.jpg) |
**DESCRIPTION AND STATUS** | **FLORISTIC COMPOSITION AND STRUCTURE** | **LOCATION AND NOTES** | **REPRESENTATIVE PHOTOGRAPH**
---|---|---|---
Non-remnant vegetation surrounded by RE 11.12.1 25 to 30 metre wide corridor devoid of remnant vegetation with a grassy ground layer and minimal regrowth. | The groundcover throughout the majority of the corridor (and surrounding areas) is dominated by *Bothriochloa pertusa*. The native species *Heteropogon contortus* is occasionally sub-dominant in some areas. Regrowth of RE 11.12.1 species (mostly *Eucalyptus crebra* and *Corymbia erythrophloia*) is very sparsely scattered along the corridor. *Acacia* spp. and *Breynia oblongifolia* are present in some areas and *Cryptostegia grandiflora* is common at watercourse crossings. | This existing corridor occurs between the current mining operation and the King Creek substation. The use of this existing corridor will avoid disturbance to remnant vegetation for this entire section of the proposed pipeline. | ![Non-remnant vegetation surrounded by RE 11.12.1](image1.png) |
Non-remnant vegetation surrounded by RE 11.12.1 50 to 60 metre wide corridor devoid of remnant vegetation with a grassy ground layer and minimal regrowth. An access track is present along the centre of the corridor, which the proposed pipeline is to be constructed alongside. | The groundcover throughout the majority of the corridor (and surrounding areas) is dominated by *Bothriochloa pertusa*, occasionally with *Urochloa mosambicensis*. There is no shrub layer or any regrowth present within this section. | This existing corridor occurs between the King Creek substation and the access road to Strathalbyn homestead. The use of this existing corridor will reduce disturbance to remnant vegetation for this entire section of the proposed pipeline. | ![Non-remnant vegetation surrounded by RE 11.12.1](image2.png) |
2. Flora Species

A total of 89 flora species from 35 families were recorded from the vegetation transects within the study area. The majority of flora species observed throughout the study area are common and widespread throughout the region in Eucalypt woodland communities. The floristic composition is generally consistent throughout the study area, with low species richness, and disturbance from cattle grazing and exotic species invasion is evident throughout. A full list of flora identified during the flora surveys is included in Appendix E.

2.1 Threatened Flora Species

Black Ironbox is present along the margins of King Creek and its tributaries where they intersect with the proposed pipeline corridor. This species is listed as vulnerable under the NC Act and the EPBC Act. As per the Flora Survey Guidelines – Protected Plants, quantification surveys were conducted to determine the abundance of this species where it occurs within 100m of the proposed pipeline corridor. Seven quantification plots were established, six of which were located on the banks where mature trees are present and one was located in the stream bed where there was a dense area of juvenile trees. The outcomes of these quantification surveys are summarised in Table 13.

On average, mature Black Ironbox trees are present in densities of 7 trees per 100m of stream bank where the proposed pipeline corridor occurs within 100m of Black Ironbox habitat. In these same areas, recruitment of Black Ironbox on the stream banks is, on average, 12 plants per 100m of stream bank.

Vegetation cover within the stream bed is typically absent, with large areas of bare sand, or areas dominated by semi-aquatic species such as sedges. Recruitment of Black Ironbox is occasionally present in small dense patches on small sandbars within the stream bed. Quantification plot surveys revealed that these patches occur in densities up to 240 plants per 0.05ha. The location of these plants within the stream bed is such that few, if any, are likely to survive the following wet season.

No other threatened or near threatened flora species (as listed under the EPBC Act or NC Act) were identified during the vegetation surveys, despite targeted surveys in suitable habitat. The potential for threatened flora species identified in the desktop analysis to occur within the study area is addressed in Appendix D.
<table>
<thead>
<tr>
<th>PLOT</th>
<th>AGE/HEIGHT STRUCTURE</th>
<th>QUANTITY (PER 500M²)</th>
<th>PHOTOGRAPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Mature (20 - 25m)</td>
<td>6</td>
<td><img src="Q1.jpg" alt="Photo" /></td>
</tr>
<tr>
<td>Q2</td>
<td>Juvenile (0.1 - 0.5m)</td>
<td>240</td>
<td><img src="Q2.jpg" alt="Photo" /></td>
</tr>
<tr>
<td>Q3</td>
<td>Mature (~25m)</td>
<td>5</td>
<td><img src="Q3.jpg" alt="Photo" /></td>
</tr>
<tr>
<td>Q4</td>
<td>Mature (16 - 24m)</td>
<td>9</td>
<td><img src="Q4.jpg" alt="Photo" /></td>
</tr>
<tr>
<td></td>
<td>Juvenile (0.3 - 2m)</td>
<td>3</td>
<td><img src="Q4.jpg" alt="Photo" /></td>
</tr>
</tbody>
</table>
2.2 Pest Species

Pest plant species were common throughout the study area, including a number of species declared under the Land Protection (Pest and Stock Route Management) Act 2002. The following species are considered the most noteworthy pest plant species observed:

- Rubber Vine (*Cryptostegia grandiflora*) is a declared Class 2 plant that is present (and in most cases extremely abundant) along the margins of most watercourses and drainage lines throughout the study area.
- Parthenium (*Parthenium hysterophorus*) is a declared Class 2 plant that is scattered along the study area as isolated patches that are generally small to moderate in size.
- Bellyache Bush (*Jatropha gossypifolia*) is a declared Class 2 plant that is abundant in the vicinity of the Burdekin River within the pipeline corridor.
– Common Pest Pear (*Opuntia stricta*) is a declared Class 2 plant that is scattered as isolated individuals throughout the study area.

– Lantana (*Lantana camara*) is a declared Class 3 plant that occurs in dense patches throughout the study area, particularly along watercourses.

The locations where these declared pest plants were observed within close proximity to the proposed pipeline corridor are shown in map series titled Flora Survey Weed Species located in Appendix A. Implications regarding the presence of these pest species and recommended management practices are discussed in the following sections of this report.
Fauna Survey Results

1. Fauna Habitat

1.1 Vegetation

The vegetation throughout the study area is primarily eucalypt woodland, with narrow fringing riparian communities along the margins of some watercourses. In general, the canopy vegetation remains largely undisturbed in remnant areas, but the ground and shrub layer are often dominated by exotic species. The ground layer is usually dominated by a dense cover of grasses, which provides abundant habitat for grazing species.

The majority of the proposed pipeline corridor is aligned with existing disturbance from other previously constructed linear infrastructure. Consequently the proposed corridor is primarily within areas that have been previously cleared and are now mostly devoid of mature vegetation. Vegetative habitat features (such as tree hollows, logs, and nesting sites) are virtually absent within the corridor, and those features present within the surrounding landscape will be retained.

The presence of highly mobile fauna species is likely to be influenced by seasonal characteristics such as rainfall, with these species (such as birds and bats) foraging when suitable trees are flowering or fruiting. Species diversity is limited in most areas (particularly those dominated by acacia regrowth), which reduces the suitability of these areas as foraging habitat for sedentary species.

1.2 Habitat Features

Habitat features vary across the study area, and are influenced by the extent of existing disturbance from clearing and topography. Overall, habitat values for most faunal groups are low within the proposed corridor (due to existing clearing) and moderate in the surrounding area.

There is a low to moderate number of hollow-bearing trees in the local area, and these appear to be generally limited by the small size of mature trees. Consequently other microhabitat features generated by the presence of mature trees (such as fallen logs and branches) are also limited. The limited availability of habitat hollows reduces roosting and breeding locations for arboreal mammals, birds and microbats.

No rocky outcrops or crevices are present within the proposed corridor, but there are some rocky areas adjacent to the corridor. The proposed corridor intersects the side of Mt Pollux (near the King Creek substation), and there are some areas of rocky habitat at higher altitudes adjacent to the corridor.
1.3 Watercourse and Wetland Habitat

There are multiple ephemeral watercourses and drainage lines within the study area that could provide seasonal habitat for amphibians. The seasonal availability of water would also attract other species to these areas, at least temporarily. Habitat within these watercourses is limited, with riparian vegetation rarely extending beyond the high banks of the watercourses.

The Burdekin River is one of the largest river systems in Queensland, but the flow can be extremely erratic. This system provides an abundance of habitat to a vast array of fauna. It is likely that some species utilising this system as foraging or breeding habitat would also occur in other parts of the study area.

Apart from the Burdekin River, the most significant watercourse within the study area is King Creek. This was the only watercourse within the study area that was flowing at the time of the fauna surveys. King Creek also has the most dense and mature riparian habitat of all the watercourses within the study area. Consequently, this was one of the areas in which fauna survey effort was concentrated. The diversity of fauna observed at this site is discussed in the following sections of this report.

There are several referable wetlands mapped in the vicinity of the proposed pipeline corridor near the Burdekin River. These wetlands are, however, at least 1.5km from the nearest section of the proposed pipeline and all construction works will be significantly outside the 200m protection zone buffer that is typically applied to such wetlands. It is therefore unlikely that the values of these referable wetlands will be affected in any way by the proposed pipeline.

There are several areas mapped as wetlands on the vegetation management wetlands map near the Burdekin River in close proximity to the proposed pipeline. These areas are mapped as remnant vegetation of RE 11.3.27. Ground-truthing surveys revealed that these areas are highly disturbed and modified with existing impacts from:

- An access road and powerline corridor,
- Vegetation clearing,
- Cattle grazing,
- Invasion by numerous exotic plant species included several declared class two pest species,
- Modified hydrology from the construction of a small dam and other earthworks.

In some areas, the existing disturbance is so significant that the vegetation present is not considered to be of remnant status. This is particularly the case for the existing powerline corridor and access road, which are collocated where the mapped vegetation management wetlands occur. There is no canopy present at this location and exotic grasses and pasture weeds dominate the ground layer. The vegetation is not characteristic of native wetland vegetation and is not representative of RE 11.3.27. The proposed pipeline will follow the route of the existing linear infrastructure corridor at this location, utilising the areas of existing disturbance. The construction and operation of the proposed pipeline is highly unlikely to have
any further impact on the ecological function of any area mapped as a vegetation management wetland.

1.4 Connectivity

Almost the entire study area and surrounding landscape is comprised of remnant vegetation and consequently, habitat connectivity is high. There are existing areas of disturbance from powerline corridors, access roads, weed invasion, and vegetation thinning and clearing. However, the scale of these disturbances compared to the vast areas of remnant vegetation indicates that such disturbance is unlikely to have had any impact on the value of connectivity for most fauna species.

1.5 Disturbance

The entire length of the proposed pipeline follows existing disturbance areas associated with existing linear infrastructure. Consequently, much of the study area is devoid of remnant vegetation and dominated by ground cover species with sparse regrowth of the surrounding eucalypt woodland species. The use of these existing areas of disturbance is a key aspect of the corridor design, which is aimed at minimising impacts to local flora and fauna.

There are several other areas surrounding the corridor that contain limited woody vegetation and are dominated by the introduced Indian Bluegrass. Some of these areas may have been cleared in the past as part of pasture management by local landholders, or alternatively they were formerly native grasslands that have been invaded by non-native species. Given the dominance of the non-native grass species (and the absence of woody vegetation), these areas cannot be considered as remnant vegetation.

Cattle grazing occurs throughout most of the study area, and impacts from this are most evident where surface water is available. The banks of watercourses are frequently eroded, with significant disturbance to lower vegetation strata from trampling.

Disturbance from invasive plant species is prevalent throughout the study area and represents one of the greatest threats to local biodiversity. The ground cover for almost the entire length of the corridor is dominated by the introduced species Indian Bluegrass. This species is particularly abundant within the previously cleared corridors and within the more open areas of woodland surrounding these corridors. The spread of this species throughout the study area has greatly reduced the diversity of the ground cover flora. This reduction in flora diversity may have flow-on effects to the fauna present in this area. Indeed, cattle appeared to prefer these areas that are more open and dominated by dense grass cover. Macropod species were also frequently observed in these areas.

Many different weeds are present in high abundance within the riparian zone of the watercourses within the study area. Most riparian zones contain an abundance of plants declared as class 2 pests under the *Land Protection (Pest and Stock Route Management) Act 2002* and listed as weeds of national significance (WONS). Rubber Vine is prevalent along almost all watercourses and drainage lines, often in densities that pose a significant threat to the biodiversity of these areas. Parthenium and Bellyache Bush are also prevalent within some of the riparian communities, particularly along the bank of the Burdekin River within the study area.
These areas will require careful management to avoid the spread of these weed species. Recommended management practices are discussed in the latter sections of this report.

2. Fauna Species

An array of fauna was identified within the study area over the two survey seasons using a variety of different observation and trapping techniques. A combined list of all species identified during the both survey periods is included in Appendix F. The following sections provide a brief discussion of the species observed for each taxonomic group. Potential impacts to fauna are discussed in the latter sections of this report, with a focus on conservation significant species.

2.1 Mammals

Eight species of terrestrial or arboreal mammals were observed within the study area over the survey period, including three introduced species. Macropods were commonly observed throughout the study area, and the grassy woodlands of the area provide good quality habitat for these species.

Bats showed the greatest diversity of all mammal groups observed, with 12 species positively identified from the call data collected. A further seven species may also occur within the study area, but the call data collected for these species is inconclusive. The Microbat Call Interpretation Report from the Anabat data collected during the fauna survey is included in Appendix G.

Possible call data from the Little Pied Bat (Chalinolobus picatus) was identified from Anabat data analysis. These calls could not be clearly distinguished from other species, such as the Little Broad-nosed Bat (Scotorepens greyii) and the Hoary Wattled Bat (Chalinolobus nigrogriseus) due to similarities in call frequencies. These calls were recorded at multiple locations within the proposed corridor. This species is listed as near threatened under the NC Act and potential impacts to this species are discussed in the Impact Assessment section of this report.

2.2 Reptiles

Ten species of reptiles from four different families were observed within the study area (see Appendix F). All of these species are common and widespread throughout the region. Indeed, most of these species are distributed over a large expanse of coastal and sub-coastal Queensland.

Other reptile species such as Frilled Lizard (Chlamydosaurus kingii), CommonTree Snake (Dendrelaphis punctulata) and Eastern Brown Snake (Pseudonaja textilis) have been commonly observed in the mining lease other parts of the local area by environment staff of MCO. These species are also common and widespread throughout the region and are highly likely to occur within the study area.

There are no habitat features relevant to any species observed that are unique to the study area. There are vast areas of similar habitat immediately adjacent to the proposed development
sites and the loss of habitat from within the study area is considered unlikely to have an impact on any of these species.

No evidence of any reptiles listed as near threatened or threatened was observed within the study area.

2.3 Amphibians

Seven amphibian species were recorded within the study area, all of which are common, widespread and relatively tolerant of disturbance. The majority of native amphibian observations were restricted to the targeted survey area along King Creek. A single Desert Tree Frog ($Litoria rubella$) was observed in an area of Narrow-leaved Ironbark woodland at systematic trapping site 1. In addition to the King Creek site, the Eastern Dwarf Tree Frog was observed around pools in smaller watercourses near the existing mining operations.

When considering the lack of water in most of the streams during the survey period, it is likely that these species would also be present (or in the case of burrowing frogs, more readily observed) in other streams when sufficient water is present.

No amphibians listed as near threatened or threatened were observed within the study area.

The introduced Cane Toad ($Rhinella marina$) is very abundant throughout the study area, particularly near watercourses and drainage lines. This species was observed in high numbers at most systematic trapping sites and targeted search sites, particularly during spotlight surveys.

2.4 Birds

Species Assemblage

A total of 67 species of birds were observed within the study area over the two survey periods. This species assemblage includes a number of sedentary, nomadic, and migratory species. The majority of species observed are common in eucalypt woodland habitat throughout the region. Species of conservation significance and those listed under state and Commonwealth legislation are discussed in the following sections.

Near Threatened and Threatened Species

The only threatened bird species observed during the fauna surveys was the southern subspecies of Squatter Pigeon ($Geophaps scripta scripta$). This subspecies is listed as Vulnerable under the NC Act and the EPBC Act due and the likelihood of impacts to this species is discussed in the Impact Assessment section of this report.

Migratory Species

The Rainbow Bee-eater ($Merops ornatus$) was observed frequently throughout the study area, particularly during the dry season surveys. The Rainbow Bee-eater is listed as migratory under the EPBC Act. This species occurs in a variety of habitats over a broad distribution comprising
much of mainland Australia. The likelihood of impacts to this species and other EPBC listed migratory species are discussed in the Impacts Assessment section of this report.

2.5 Pest Species

Evidence (or in most cases direct observation) of four pest species was detected during the fauna surveys, all of which commonly occur in disturbed habitats throughout Queensland. The following species were observed within the study area:

– Cane Toad (*Rhinella marinus*)
– European Rabbit (*Oryctolagus cuniculus*)
– Dog (*Canus lupus*)
– Pig (*Sus scrofa*)
Impact Assessment

1. Matters of State Environmental Significance

1.1 Connectivity

The habitat connectivity of the area is generally high, with large continuous areas of eucalypt woodland. Some of the riparian vegetation is partially fragmented due to disturbance from cattle grazing and weed infestation.

The existing corridors and roads dissect areas of remnant vegetation, but the given the open nature of the surrounding habitat, it is unlikely that these corridors have a significant impact on the value of connectivity. Much of the pipeline will be constructed within existing clearings for other linear infrastructure. Movement of fauna and other factors affecting biodiversity (such as genetic flow) in the area are unlikely to be any further impacted by the small loss of habitat associated with the proposed pipeline.

It is unlikely that the function of this value will be compromised at any scale, and as such, environmental offsets for this value are not required under the QEOP.

1.2 Essential Habitat

The nearest area of Essential Habitat mapped under the VMA is approximately 15km southeast of the study area. This area of essential habitat is associated with a record of the Squatter Pigeon (southern). Potential impacts to this species are discussed in the following section of this report. Given the substantial distance (>15km) from all mapped areas of essential habitat, the proposed pipeline corridor is unlikely to have any impact on these areas. Further detail of potential impacts to the Squatter Pigeon are discussed below.

1.3 Vegetation Communities

Wherever possible the pipeline corridor has been located in areas where the vegetation communities present have already been cleared for existing linear infrastructure. Any disturbance to remnant vegetation will involve very minimal clearing on the edge of existing corridors.

All remnant vegetation communities observed within the study area have a least concern status and are common in the local area and throughout the region. Vegetation assessments included a 50m buffer surrounding the proposed pipeline corridor to ensure that all communities within close proximity to the proposed pipeline were considered. No REs with a higher conservation status were present within this buffer area.

The RE code and status of the communities observed does not equate to an ESA or MSES, and therefore no environmental offsets are required under the QEOP for disturbance to these communities.
1.4 Watercourse Habitat and Riparian Vegetation

Remnant vegetation associated with a watercourse identified on the vegetation management watercourse map is classified as a MSES under the Environmental Offsets Regulation 2014. The proposed pipeline corridor crosses a number of first and second order streams along the proposed route, as well as the more significant King Creek, which is a fourth order stream. As discussed previously, the proposed route utilises areas of existing disturbance from other linear infrastructure and at the location of all crossing there are previously cleared areas that can be utilised to minimise disturbance to remnant riparian vegetation.

Given the prevalence of low stream order watercourses in the area, it is not possible to avoid intersecting these watercourses. However, the use of previously disturbed areas will significantly reduce impacts to remnant riparian vegetation. Where any additional clearing is required, it will be restricted to less than 10 metres width. On the basis of this approach, significant impacts to remnant riparian vegetation will be avoided. The construction and operation of the proposed pipeline route will not result in increased fragmentation of any regional ecosystems, and it will not cause a substantial change in the species composition or ecological function of any regional ecosystems.

One of the most significant threats to biodiversity in the riparian zones is the existing prevalence of invasive pest plant species, including several declared class 2 species. To reduce the further spread of these species, careful pest plant control measures will need to be implemented particularly during, and shortly after, the construction phase for the proposed pipeline. Further details of pest plant management strategies are provided in the Recommendations section of this report.

1.5 Wetlands

There are no mapped referrable wetlands in close proximity to the proposed pipeline corridor, with the nearest of these occurring over 1.5 kilometres north of the proposed route. There is one area mapped as a vegetation management wetland containing RE 11.3.27 near where the pipeline meets the Burdekin River. At this location the proposed pipeline follows an existing powerline and access road route, where there is existing disturbance to this RE. Vegetation clearing, exotic plant species invasion and construction of the road and a small dam have significantly modified the vegetation composition and hydrology of the area. Consequently, the area within the existing corridor is considered as non-remnant vegetation with very low, if any, wetland values. The construction of the pipeline within this existing corridor will not cause a significant modification to any wetland area or the hydrological regime of any wetland. The habitat and lifecycle of native species that may be dependent on any wetlands in the surrounding area will not be affected. Given the existing prevalence of invasive plant species, careful pest plant control measure should be implemented to reduce impacts to biodiversity. Details of pest plant management strategies are provided in the Recommendations section of this report.
2. Pest Species

As discussed in several of the previous sections of this report, pest plant species are prevalent along the route of the proposed pipeline, particularly in riparian areas. Several species that are common along the route are declared class 2 species under the *Land Protection (Pest and Stock Route Management) Act 2002* and are listed as Weeds of National Significance. The prevalence of these weeds in some riparian zones, such as along the Burdekin River and King Creek, represents a significant threat to local biodiversity. Whilst the disturbance width of the proposed pipeline corridor will be reasonable narrow, careful management will be required to avoid spreading these invasive species to other locations along the route. Details of proposed pest plant management strategies are provided in the recommendations section of this report.

The use of existing linear infrastructure corridors will significantly reduce any additional fragmentation of the landscape. The construction and operation of the proposed pipeline is not expected to significantly modify the landscape in any way that would increase the occurrence of pest animal species or the threat they represent to local biodiversity values.

3. Conservation Significant Flora Species

3.1 Black Ironbox (*Eucalyptus raveretiana*)

Black Ironbox (*Eucalyptus raveretiana*) is listed as vulnerable under the EPBC Act and the NC Act. As discussed previously it is present in varying densities along the banks of King Creek where the proposed pipeline crossing is located, as well as along the banks of some smaller tributaries at that location.

The prevalence of this species on the banks of King Creek is indicated in the *Eucalyptus raveretiana* Map in Appendix A, where all individual trees within at least 100m either side of the King Creek crossing location are shown. It is important to note that Black Ironbox continues to occur along the banks of this watercourse in both directions, and that the individuals shown on this map are to provide an indication of the distribution of this species at the proposed creek crossing location. Six other individual trees in close proximity to the proposed pipeline route are also shown in the *Eucalyptus raveretiana* Map in Appendix A, and these are shown to facilitate design considerations and avoidance measures.

It is clear from the *Eucalyptus raveretiana* Map in Appendix A that Black Ironbox is prevalent along King Creek and following the course of the existing disturbance presented by the access road provides the best opportunity to avoid impacts to this species. All Black Ironbox individuals at this location are mature trees that occur between the top of banks of the watercourse, mostly along the margins of the stream bed. The nearest Black Ironbox on the western side of the existing road is approximately 12 metres from the edge of the road, and the nearest on the eastern side is 15 metres from the edge of the road.

The proposed method for constructing the pipeline across the watercourse at this location is to embed concrete stumps on either side of the waterway and suspend the pipeline across the watercourse using a wire rope suspension system anchored in the concrete stumps. The concrete stumps will be located outside the top of bank on each side of the watercourse.
Therefore, there will be no disturbance to the ground between the top of banks of the watercourse.

The proposed mining lease for the pipeline corridor is eight metres wide from the edge of the existing access road. At the King Creek crossing the pipeline will be constructed as close as possible to the road, which will leave a small but sufficient buffer from the nearest Black Ironbox trees. The suspended pipeline crossing the watercourse should be at least four metres from any part of a Black Ironbox tree, and given that there will not be any disturbance to the ground between the top of banks, all disturbance to the root zone of any Black Ironbox will be avoided.

In order to maintain the structural integrity of the suspended pipeline, any large trees (of any species) that develop in close proximity will need to be trimmed or otherwise controlled. Whilst this may represent a small loss in the amount of available habitat for Black Ironbox, it is mostly within a cleared area that is already maintained as part of the existing road crossing. Furthermore, there is no recruitment of Black Ironbox in this area and the extremely minor loss of potential habitat is insignificant compared to the habitat available along the length of this and other watercourses at the locality.

There are two mature Black Ironbox trees in close proximity to the proposed pipeline corridor near the location of quadrat 6 (as shown in the *Eucalyptus raveratiana* Map in Appendix A). These trees are 19 metres and 24 metres from the edge of the existing road and therefore there is sufficient distance on the western side of the road to accommodate the pipeline mining lease without disturbance to individual Black Ironbox trees or Black Ironbox habitat. All other Black Ironbox trees or potential Black Ironbox habitat areas are at least 25 metres from the existing road, and therefore there is sufficient area available to accommodate the proposed eight metre mining lease without disturbance to these trees or potential habitat.

All Black Ironbox trees can be avoided at the watercourse crossing of the King Creek tributary (where quadrat 7 is marked on the *Eucalyptus raveratiana* Map in Appendix A). Whilst this area also represents potential habitat for Black Ironbox, it is dominated by invasive species and is degraded to a point that it is unlikely that recruitment of Black Ironbox trees would occur at this location.

Overall, disturbance to all Black Ironbox trees can be avoided and impacts to Black Ironbox habitat will be extremely minimal. It is unlikely that there will be a significant impact on this species because the proposed development will not:

- Lead to a long term decrease in the size of the population,
- Reduce the area of occupancy of the species,
- Cause further fragmentation to the existing population,
- Reduce gene flow among populations or disrupt the reproductive output,
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Although all Black Ironbox trees can be avoided by design, there are some management strategies that should be implemented in order to ensure that direct impacts are avoided:
- The pipeline mining lease and authorised disturbance areas should be clearly marked to ensure disturbance is restricted to these areas only.

- All Black Ironbox trees within 20 metres of the mining lease should be clearly marked with flagging tape to identify their presence and ensure they are not disturbed.

- Project inductions and toolbox meetings should include:
  - Information on the significance of this species, including its protection under State and commonwealth legislation,
  - Details of where it is know to occur within the project area,
  - Measures that have been undertaken to signify its presence within the project area (e.g. flagging tape).

Under the current vegetation management framework in Queensland a clearing permit is required for clearing that will occur within 100m of endangered, vulnerable or near threatened (EVNT) plants (such as Black Ironbox). The application for a clearing permit will need to include details of how the presence of EVNT plants has been confirmed (including details of survey methods outlined in this document), and how impacts to Black Ironbox will be avoided, in the form of an impact management plan.

3.2 Native Frangipani (*Cerbera damicola*)

This species is fairly poorly known, with most of the habitat information described here obtained from species label information from herbarium records. Local records for this species tend to be from within Lancewood (*Acacia shirleyii*) forest in sandstone country, where this species occurs as a shrub or low tree. There are also some records from within semi-evergreen vine thicket habitat. Based on this habitat information, it is likely that the habitat within the study area is not suitable for this species.

Native Frangipani is a distinctive species and would be readily detectable in the open woodland habitat that dominates the study area. This species was not detected during the flora surveys despite targeted effort. Given the apparent lack of suitable habitat, and that this species was not detected during the surveys, it is unlikely that this species would occur within the study area. Nonetheless, any impacts that may occur are minimised by the use of existing corridors along the route.

4. Conservation Significant Fauna Species

4.1 Little Pied Bat

The Little Pied Bat (*Chalinolobus picatus*) is listed as near threatened under the NC Act and occurs from near the central Queensland coast through western New South Wales and into eastern South Australia. It lives in dry forest and woodland, and despite its broad distribution and habitat preferences it is relatively uncommon (Ford *et al.* 2008). This species was originally
considered a cave dweller, but more recent records suggest that it mainly roosts in tree hollows, with an apparent preference for dead trees (Pennay & Freeman 2005, Schulz et al. 1994). However, they have also been observed roosting in houses, sheds, caves and mines (Churchill 2008). It often occurs in areas of ephemeral surface water, but has been recorded travelling 14-34 kilometres between roost sites and pools of water, where they were active throughout the night (Ford et al. 2008).

Possible echolocation call data from this species were recorded in the study area during the dry season surveys. However, those call recordings could not be distinguished reliably from that of other species.

The use of previously cleared corridors for construction of the pipeline will result in minimal clearing of vegetation. The extent of clearing is therefore considered unlikely to have any impact on the suitability of the habitat for foraging for the Little Pied Bat. Furthermore, the surrounding area provides vast areas of similar habitat, and therefore this highly mobile species is unlikely to be impacted by the proposed development.

4.2 Northern Quoll

The Northern Quoll (Dasyurus hallucatus) is listed as endangered under the EPBC Act. There are no records of this species within the study site or surrounding local area. Recent surveys and reports (e.g. Burnett 2008) suggest that this species is persistent in the broader Townsville-Bowen region, but is generally restricted to more coastal areas (Cape Cleveland and Cape Upstart) and the Mt Elliot massif.

This species was formerly distributed across much of northern Australia, but its distribution has contracted significantly since European settlement to several disjunct populations (Oakwood 1997). Poisoning from eating the introduced Cane Toad is a major mechanism for the decline of this species (Oakwood 1997).

A recent report by Woinarski et al. (2008) suggests the following factors are important for the persistence of Northern Quoll in parts of Queensland:

- steep slopes
- shallow soils
- abundant rocky habitat (particularly large rocks, boulders and outcrops)
- minimal disturbance from fires.

Based on these habitat attributes, the study area represents poor habitat for this species. The site does not contain steep slopes, and generally there are no significant features such as large rocks, boulders or outcrops. The topography is general flat with open vegetation and a grassy ground layer.

There are a number of steep hills and rocky outcrops to the east of the study area (e.g. Mt Herbert). These areas provide substantially more suitable habitat for Northern Quoll, and despite a lack of records it is possible that Northern Quoll populations are present there.
The proposed pipeline does not impact on any areas of suitable habitat for the Northern Quoll. It is possible (although unlikely) that this species may traverse the habitat within the study area, either during foraging or in search of other areas of suitable habitat. However, the proposed pipeline is not likely to cause any significant impact to the movement of this species throughout the local area.

4.3 Koala

The combined Queensland, N.S.W and A.C.T populations of the Koala (*Phascolarctos cinereus*) are listed as vulnerable under the EPBC Act. The listed population of this species extends from north-eastern Queensland through to the Victorian border. Koala habitat can be broadly defined as any forest of woodland containing species that are known food trees (Department of Environment 2014c). The diet of the Koala is mainly restricted to foliage of *Eucalyptus* spp; however, it may also consume foliage of related genera, including *Corymbia* spp., *Angophora* spp. and *Lophostemon* spp. The dominant species throughout the study area are Narrow-leaved Ironbark (*Eucalyptus crebra*) and Variable-barked Bloodwood (*Corymbia erythrophloia*), both of which represent potentially suitable food trees for Koala.

No evidence of Koalas was observed anywhere within the study during either of the survey periods. Interrogation of the Queensland Government Wildlife Online database, the Atlas of Living Australia and the Australian Koala Foundation Koalamap tool revealed that there are no records of Koalas within at least a 25km buffer of the study area.

On 17 May 2014 one individual Koala was observed near the access road to the mine site by mine site contactors. The animal appeared to be sick and was collected and taken to a veterinary clinic in Townsville. Whilst this individual was collected over 20km from the study area, its occurrence suggests that it is possible that Koalas may occur within the study area.

The use of existing linear infrastructure corridors for the entire length of the proposed pipeline route significantly minimises the potential impacts to Koala habitat. Much of these areas have been cleared previously and therefore clearing of Koala food trees can be largely avoided.

Due to the reasonable small scale, temporary nature of the project and the use of existing corridors, it is unlikely that the construction and operation of the proposed pipeline will:

- Lead to a long term decrease in the size of the population of the species,
- Reduce the area of occupancy of the population,
- Fragment any population into multiple populations,
- Adversely affect habitat critical to the survival of the species,
- Disrupt the breeding cycle of an important population,
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline,
- Result in invasive species that are harmful to Koalas becoming established in Koala habitat
- Introduce disease that may cause the species to decline,
-Interfere substantially with the recovery of the species.

It is therefore considered unlikely that there will be any significant impacts to the listed population of the Koala.

### 4.4 Red Goshawk

The Red Goshawk is listed as endangered under the Queensland NC Act and vulnerable under the Commonwealth EPBC Act. No evidence of this species was detected during the field surveys. The home range for this species is very large, with reports and between 50 and 220km² (Debus & Czechura 1988). Whilst this species may fly over the study area, or use the area as part of a much larger home range, the minor loss of habitat is not likely to significantly impact the species.

### 4.5 Squatter Pigeon

The southern subspecies of the Squatter Pigeon (*Geophaps scripta scripta*) is listed as vulnerable under the EPBC Act and the NC Act. It occurs over a reasonable broad distribution from the Burdekin-Lynd divide in the north to the Border Rivers region of NSW in the south, and from the east coast to Hughendon, Longreach and Charleville (Department of Environment 2014d and references therein).

The southern boundary of the known distribution of the Squatter Pigeon (southern) is contracting northwards, and subpopulations occurring south of the Carnarvon Ranges are considered to be important populations (Squatter Pigeon Workshop 2011). However, Garnett & Crowley (2000) determined that the subspecies remains locally abundant at sites at the northern limits of its distribution. The study area occurs in the northern part of the distribution and the Squatter Pigeon (southern) appears to be reasonable common in this area.

The Squatter Pigeon (southern) was observed at four locations along the proposed corridor, including multiple occasions at site T1 where there is a stock watering point (see map series in Appendix A). In all cases, individuals were observed on the ground either by the side of the access road amongst pasture grasses or beside the dam at site T1. Natural foraging habitat for the Squatter Pigeon (southern) includes area of open forest to open woodland dominated by *Eucalyptus, Corymbia, Acacia or Callitris* species within three kilometres of a suitable water body (Squatter Pigeon Workshop 2011). Suitable foraging habitat is therefore abundant in the study area and throughout the broader area.

The Squatter Pigeon (southern) is known to visit water bodies to drink on a daily basis and prefers locations where there is a gentle slope and bare ground to approach the waters edge (Squatter Pigeon Workshop 2011). The dam at site T1 is consistent with this description and given that the subspecies was observed there on multiple occasions it likely represents an important habitat feature for Squatter Pigeons in the local area, where permanent water is otherwise fairly scarce.

Given the reasonably small scale and temporary nature of the disturbance, and the fact that existing areas of disturbance will be utilised for most of the proposed pipeline route, it is unlikely
that this minimal disturbance to potentially suitable habitat will have a significant impact on the Squatter Pigeon (southern). Indeed, there are vast areas of similar habitat present in the surrounding area.

The greatest threat to the Squatter Pigeon as a result of the proposed development is interaction with vehicles due to increased traffic volumes along the access roads during construction. The following controls will be implemented to minimise the likelihood of death or injury from vehicle strike:

- Site inductions or toolbox meetings will include information about sensitive aspects of the environment in which personnel are working, including the risk of injury or death to Squatter Pigeons from vehicles.
- Due to the ground dwelling nature of the species, all vehicles will remain on existing access tracks and roads wherever possible.
- Clearing works will be carried out in a sequential manner that allows fauna to escape to natural areas away from construction works.
- Speed limits will be implemented as appropriate for the condition of the roads and access tracks on site. A limit of 50km/hr is recommended for well developed access roads and a limit of 20km/hr is recommended within 200m of the dam where Squatter Pigeons have been regularly observed.

With the aforementioned controls in place to minimise the threat from interaction with vehicles, it is considered unlikely that there will be a significant impact to the Squatter Pigeon (southern) as a result of the proposed project. Impacts to the species habitat will be of a relatively small scale and temporary nature and it is unlikely that the project will result in a long term decrease in the size of the population or reduce the area of occupancy for the species.

4.6 Masked Owl

In Queensland, this subspecies occurs along the southern rim of the Gulf of Carpentaria, Cape York Peninsula and south at least as far as the Atherton Tablelands (Garnett et al. 2011, and references therein). There is some uncertainty about the southern limit of this subspecies in Queensland (Department of the Environment 2014e). It has been recorded in a variety of habitats including riverside forests, rainforest, open forest and paperbark swamps (Garnett et al. 2011). This subspecies is known to occupy home-ranges of over 1000ha in the non-breeding season (Higgins 1999; Kavanagh & Murray 1996). Given the uncertainty regarding the southern limit of the distribution of this species, and the large home range that would encompass a variety of habitats, it is considered possible that this subspecies may occur within the study area. However, the proposed development will not cause a significant decline in the availability and quality of the habitat for this species and the proposed development is unlikely to lead to a decline in the size of the population or the area of occupancy of this species.
4.7 Estuarine Crocodile

The Estuarine Crocodile is listed as Vulnerable under the NC Act and is listed as a migratory species under the EPBC Act. Its distribution extends from around Gladstone, north to areas throughout Cape York and through to the Queensland - Northern Territory border.

On the east coast of Queensland this species is generally restricted to coastal waterways. The Department of Environment Species Profile and Threats (SPRAT) database includes details of a study conducted by Read et al. (2004) where 6 non-hatchling Estuarine Crocodiles were observed over 57.3 km surveyed in the Burdekin River catchment. This species was not observed during the fauna surveys, but there is at least one record from the Burdekin River in reasonable close proximity to the study area.

The proposed pipeline terminates at the Burdekin river and apart from some relatively minor infrastructure being constructed on the southern bank, there will be no disturbance to habitat relevant to the Estuarine Crocodile in the Burdekin River. The proposed pipeline will not result in the disturbance or modification of any habitat relevant to the Estuarine Crocodile and will not restrict the movement of this species at any scale. It is therefore considered unlikely that there will be any significant impacts to this species as a result of the proposed development.

5. Migratory Species

The Rainbow Bee-eater (Merops ornatus) is listed as migratory under the EPBC Act and was observed within the study area at multiple locations.

Other listed migratory bird species are also considered to have potential to occur in the local area include:

- White-bellied Sea-Eagle (Haliaeetus leucogaster)
- Fork-tailed Swift (Apus pacificus)
- Barn Swallow (Hirundo rustica)
- Satin Flycatcher (Myiagra cyanoleuca)
- Rufous Fantail (Rhipidura rufifrons)
- Great Egret (Ardea alba)
- Cattle Egret (Ardea ibis)

All of these listed migratory bird species (observed and predicted) are common and widespread throughout coastal and sub-coastal Queensland. These species also occur in a broad range of habitats and the study area does not exhibit any unique habitat features for any of these species. Similar habitat is abundant in the local area and throughout the region.

The highly mobile nature, large distribution and broad habitat requirements of these migratory bird species indicate that the construction of the proposed pipeline is unlikely to have a significant impact on individuals or populations of these species.
As discussed previously, the Estuarine Crocodile is also listed as a migratory species under the EPBC Act and has potential to occur in the Burdekin River adjacent to the study area. The proposed pipeline will not restrict the movement of this species in the local area or have any significant impacts on areas of important habitat for this species.
Recommendations

1. Clearing and Vegetation Management

During construction activities, the following measures should be implemented to minimise disturbance impacts and potential harm to habitat values, flora and fauna present within the area:

- The boundary of areas to be cleared should be clearly marked, to ensure that the disturbance footprint is minimised.

- Clearing should occur in a sequential manner to allow any fauna present in the area to escape to areas away from construction activities.

The following measures should be undertaken to ensure that impacts to the State and Commonwealth listed vulnerable species Black Ironbox:

- All Black Ironbox trees within 20 metres of construction areas should be clearly marked with flagging tape to identify their presence and ensure they are not disturbed.

- Project inductions and toolbox meetings should include:
  - Information on the significance of this species, including its protection under State and Commonwealth legislation,
  - Details of where it is known to occur within the project area,
  - Measures that have been undertaken to signify its presence within the project area e.g. flagging tape).

Vegetation stockpiles will provide habitat for small ground dwelling mammals and reptiles during the construction phase. It is important to locate these stockpiles away from high traffic areas, and ensure that they are not isolated from contiguous vegetation at the edge of the site, to reduce the likelihood of fauna travelling across the site.

Cleared vegetation should be managed according to the following best practice principles:

- Where possible, logs and large branches with hollows should be reserved, and stockpiled separately (at the edge of the site) for rehabilitation purposes.

- Any mulching should occur as near as possible to the time of clearing to prevent the establishment of stockpiles as fauna habitat.

- Stockpiles should provide for fauna passage by leaving a gap between stockpiles.
2. Weed Management

Soil disturbance is a major contributor to weed establishment and invasion. A number of weed species with serious potential to cause habitat degradation have been identified within the site. Areas where declared class 2 weeds have been observed are shown in the map series in Appendix A. The following recommendations are relevant to the construction phase as well as ongoing monitoring and management post-construction:

- Wherever possible construction activities should work from areas with fewer weed species and smaller infestations towards areas where there is a greater abundance of weeds.

- Vehicles and machinery brought on site should be clean and free of weeds, dirt and other material that may contain weed seeds and cause exotic species to become established within the works areas.

- Weed spread could be minimised by implementing some control measures within the proposed works areas prior to construction, particularly in riparian zones.

- Regular observation of disturbance sites and stockpiles for incidence of weed species, particularly those declared as class 2 pests under the Land Protection (Pest and Stock route) Act 2007.

- Where any weed establishment is identified, appropriate control measures should be implemented to minimise the impacts of weeds on native habitat.

3. Fauna Management

Open trenches can pose a risk to native fauna through entrapment and exposure. Open trenches should be checked regularly for trapped fauna, with inspection occurring at least twice daily. Trenches should be check early in the morning for fauna that has become trapped overnight, and again in the late afternoon for fauna that has become trapped over the course of the day.

Safe egress points should be included regularly along trenches to allow fauna to escape of their own accord. Any fauna that cannot escape of its own accord should be removed in a manner that is safe for both the animal and the person handling the animal. Dangerous fauna species such as snakes should only be handled by a suitably qualified and experienced person.

The State and Commonwealth listed vulnerable subspecies of the Squatter Pigeon (southern) is known to occur within the study area. The greatest threat to this species from the proposed development is interaction with vehicles. The following controls must be implemented to minimise the likelihood of death or injury to Squatter Pigeons from vehicle strike:

- Site inductions or toolbox meetings will include information about sensitive aspects of the environment in which personnel are working, including the risk of injury or death to Squatter Pigeons from vehicles.
- Due to the ground dwelling nature of the species, all vehicles will remain on existing access tracks and roads wherever possible.

- Clearing works will be carried out in a sequential manner that allows fauna to escape to natural areas away from construction works.

- Speed limits will be implemented as appropriate for the condition of the roads and access tracks on site. A limit of 50km/hr is recommended for well developed access roads and a limit of 20km/hr is recommended within 200m of the dam where Squatter Pigeons have been regularly observed.
References


EHP. (2014a). Flora Survey Guidelines – Protected Plants. Published by the State of Queensland


References


Wilson, P.R. and Taylor, P.M. (2012) *Land Zones of Queensland*. Queensland Herbarium, Queensland Department of Science, Information Technology, Innovation and the Arts, Brisbane. 79 pp

Appendix summary

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<tr>
<td>Appendix A</td>
<td>Mapping</td>
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<td>Appendix B</td>
<td>EPBC Act Protected Matters Report</td>
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<td>Appendix C</td>
<td>Wildlife Online Database Extract</td>
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<td>Appendix D</td>
<td>Potential Occurrence of EVNT Species</td>
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<td>Appendix E</td>
<td>Flora Species List</td>
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<td>Appendix F</td>
<td>Fauna Species List</td>
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<td>Appendix G</td>
<td>Microbat Call Interpretation Report</td>
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Appendix A

Mapping
MOUNT CARLTON OPERATIONS
BURDEKIN WATER PIPELINE EA AMENDMENT
GROUND TRUTHED REMNANT VEGETATION WITH FAUNA SITES

Map 5 of 11

Legend
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse

Groundtruthed Remnant Vegetation
- Least Concern
- Non-rem

Regional Ecosystem (VMA)
- Least Concern

Notes:
Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
Regional Ecosystem from Vegetation management regional ecosystem and remnant map - version 8.0 coastal © State of Queensland (Department of Natural Resources and Mines) 2014.
MOUNT CARLTON OPERATIONS
BURDEKIN WATER PIPELINE EA AMENDMENT
GROUND TRUTHED REMNANT VEGETATION WITH FAUNA SITES

Legend
- Mt Carlton ML 10343
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse

Groundtruthed Remnant Vegetation
- Least Concern
- Non-rem
- RE Assessment Sites

Regional Ecosystem (VMA)
- Least Concern
- Non Remnant

Notes:
- Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
- Regional Ecosystem from Vegetation management regional ecosystem and remnant map - version 8.0 coastal © State of Queensland (Department of Natural Resources and Mines) 2014.

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 1/07/2014

Map 10 of 11

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
FLORA SURVEY
WEED SPECIES

Legend

- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse

Weed Species
- Bellyache
- Parthenium
- Rubber Vine

Notes:
- Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
- Aerial Imagery from Google Earth and Qld Globe.

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 1/07/2014
Scale: 1:15,000 at A3
Map 3 of 11

Legend
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse

Weed Species
- Parthenium
- Rubber Vine

Notes:
- Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
- Aerial Imagery from Google Earth and Qld Globe.

Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 1/07/2014
Scale: 1:15,000 at A3
Flora Survey
Weed Species

Notes:
MOUNT CARLTON OPERATIONS
BURDEKIN WATER PIPELINE EA AMENDMENT

FLORA SURVEY WEED SPECIES

Legend
- Mt Carlton ML 10343
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse

Weed Species
- Parthenium
- Rubber Vine

Notes:
Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
Hydrology from: IQ_VM_WATERCOURSE_MAP_100K_250K.shp © State of Queensland.
Aerial Imagery from Google Earth and Qld Globe.

Scale: 1:15,000 at A3
Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 1/07/2014

Map 7
Map 8
Map 9
Map 10
Map 11
Map 1 of 11
Coordinate System: GDA 1994 MGA Zone 55
Projection: Transverse Mercator
Datum: GDA 1994
Date: 1/07/2014

Notes:
Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
Hydrology from: IQ_VM_WATERCOURSE_MAP_100K_250K.shp © State of Queensland.
Aerial Imagery from Google Earth and Qld Globe.

Legend
- Mt Carlton ML 10343
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse
- Weed Species
  - Rubber Vine

Map 7 of 11

Scale: 1:15,000 at A3
MOUNT CARLTON OPERATIONS
BURDEKIN WATER PIPELINE EA AMENDMENT

FLORA SURVEY WEED SPECIES

Map 8 of 11

Legend
- Mt Carlton ML 10343
- MCO Pipeline
- MCO Pipeline 50m buffer
- Watercourse

Weed Species
- Rubber Vine

Notes:
- Mining Lease boundary extracted from ml.shp, from IRTM© State of Queensland 2012.
- Aerial Imagery from Google Earth and Qld Globe.

Scale: 1:15,000 at A3

Coordinate System: GDA 1994 MGA Zone 55
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Datum: GDA, 1994
Date: 1/07/2014
Notes:
"Watercourses from: IQ_VM_WATERCOURSE_MAP_100K_250K.shp. State of Queensland." Quantification quadrat and eucalyptus raveretiana observations from field studies.
Appendix B

EPBC Act Protected Matters Report
EPBC Act Protected Matters Report

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 is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 25/03/14 12:41:46

Summary
Details
  Matters of NES
  Other Matters Protected by the EPBC Act
  Extra Information
Caveat
Acknowledgements

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010
Coordinates
Buffer: 25.0Km
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.

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<td>Listed Migratory Species</td>
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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.

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.

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.

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<td>Geophaps scripta  scripta</td>
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<td>Species or species habitat likely to occur within area</td>
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### Listed Threatened Ecological Communities

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.

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### Extra Information

- **Place on the RNE:** None
- **State and Territory Reserves:** None
- **Regional Forest Agreements:** None
- **Invasive Species:** 23
- **Nationally Important Wetlands:** 1
- **Key Ecological Features (Marine):** None
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</tr>
<tr>
<td>Rainbow Bee-eater [670]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Threatened</td>
<td>Type of Presence</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Black-faced Monarch [609]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Spectacled Monarch [610]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Satin Flycatcher [612]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Osprey [952]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Rufous Fantail [592]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Painted Snipe [889]</td>
<td>Endangered*</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Salt-water Crocodile, Estuarine Crocodile [1774]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
</tbody>
</table>

**Extra Information**

**Invasive Species**

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 Resources Audit, 2001.
<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cane Toad</strong> [83218]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Rhinella marina</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Canis lupus familiaris</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Domestic Dog</strong> [82654]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Equus caballus</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Horse</strong> [5]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Felis catus</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Cat, House Cat, Domestic Cat</strong> [19]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Feral deer</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Feral deer species in Australia</strong> [85733]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Lepus capensis</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Brown Hare</strong> [127]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Mus musculus</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>House Mouse</strong> [120]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Oryctolagus cuniculus</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Rabbit, European Rabbit</strong> [128]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Sus scrofa</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Pig</strong> [6]</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Vulpes vulpes</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Plants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prickly Acacia</strong> [6196]</td>
<td></td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><strong>Acacia nilotica subsp. indica</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Hymenachne amplexicaulis</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Jatropha gossypifolia</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Lantana camara</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Parthenium hysterophorus</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td><strong>Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]</strong></td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Name</td>
<td>Status</td>
<td>Type of Presence</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Salvinia molesta</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vachellia nilotica</td>
<td></td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nationally Important Wetlands

<table>
<thead>
<tr>
<th>Name</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdekin-Bowen Junction and Blue Valley Weir Aggregation</td>
<td>QLD</td>
</tr>
</tbody>
</table>
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.
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 the 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
- Geoscience Australia
- CSIRO
- 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.
Appendix C

Wildlife Online Database Extract
Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: Rare and threatened species
Records: All
Date: All
Latitude: 20.3109
Longitude: 147.4416
Distance: 25
Email: davehall@northres.com.au
Date submitted: Tuesday 25 Mar 2014 11:39:57
Date extracted: Tuesday 25 Mar 2014 11:50:19

The number of records retrieved = 6

Disclaimer

As the DSITIA 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.
<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Class</th>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>I</th>
<th>Q</th>
<th>A</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>animals</td>
<td>birds</td>
<td>Columbidae</td>
<td><em>Geopha scripta scripta</em></td>
<td>squatter pigeon (southern subspecies)</td>
<td>V</td>
<td>V</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>plants</td>
<td>higher dicots</td>
<td>Apocynaceae</td>
<td><em>Cerbera duminica</em></td>
<td>V</td>
<td>V</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plants</td>
<td>higher dicots</td>
<td>Convolvulaceae</td>
<td><em>Bonamia dietrichiana</em></td>
<td>V</td>
<td>V</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plants</td>
<td>higher dicots</td>
<td>Fabaceae</td>
<td><em>Desmodium macrocarpum</em></td>
<td>V</td>
<td>V</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plants</td>
<td>higher dicots</td>
<td>Myrtaceae</td>
<td><em>Eucalyptus raveretiana</em></td>
<td>V</td>
<td>V</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plants</td>
<td>higher dicots</td>
<td>Solanaceae</td>
<td><em>Solanum sporadotrichum</em></td>
<td>NT</td>
<td>V</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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 D

Potential Occurrence of EVNT Species
Table D1: Potential of Near threatened and Threatened Flora identified in PMST and Wildlife Online database searches to occur within the study area.

<table>
<thead>
<tr>
<th>Status&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Source&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Potential to occur within the study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCA</td>
<td>Apocynaceae</td>
<td><em>Cerbera dumincola</em></td>
<td>Native Frangipani</td>
<td>WO</td>
<td>Possible – This species occurs across a range of habitat in Queensland that are typically dominated by Eucalyptus and/or Acacia species, sometimes with semi evergreen vine thicket species. Little is known of the ecology of this species. The nearest record is in the region of Collinsville and was recorded in acidic soils of a mine rehabilitation area. Given the limited information on the ecology of this species, the presence of potentially suitable habitat, and a record of this species nearby, it is considered that this species could possibly occur within the study area.</td>
</tr>
<tr>
<td>EPBC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Cycadaceae</td>
<td><em>Cycas ophiolitica</em></td>
<td>Marlborough Blue</td>
<td>PM</td>
<td>Unlikely – This species is known only from a relatively small area in the vicinity of Rockhampton and Marlborough. Many of the species that <em>C. ophiolitica</em> is typically associated with are present within the study area. However, given that the site is well outside this species known range, with the nearest records over 300km away, it is considered unlikely that it would occur within the study area.</td>
</tr>
<tr>
<td>V</td>
<td>Euphorbiaceae</td>
<td><em>Omphalea celata</em></td>
<td>Tree Omphalea</td>
<td>PM</td>
<td>Unlikely – This species is known from three sites in central Queensland near Eungella and Bowen. Locations include Hazlewood Gorge, near Eungella; Gloucester Island, near Bowen; and Cooper Creek in the Homevale Station area, north-west of Nebo. Details from species records (viewed on Atlas of Living Australia) show that this species has been recorded in different habitat types usually associated with watercourses and gullies. Vegetation types include semi-evergreen vine forest, Araucaria microphyll forest and Eucalyptus raveretiana/E. tereticornis riparian woodland. The latter vegetation type is present along the margins of Kings Creek, but there are few (if any) other areas of suitable habitat for this species within the study area. A large survey effort was conducted within the riparian vegetation at Kings Creek due to the presence of the</td>
</tr>
</tbody>
</table>

<sup>1</sup> Status: NCA = National Critical, EPBC = Environment Protection and Biodiversity Conservation Act, NT = Near Threatened.

<sup>2</sup> Source: WO = Wildlife Online, PM = PMST.
threatened species *E. raveretiana*. Given that *O. celata* was not detected despite substantial survey effort in the only area of suitable habitat, and there are no records in the local area, it is unlikely that this species would occur within the study area.

<table>
<thead>
<tr>
<th>Family</th>
<th>Genus</th>
<th>Species Name</th>
<th>Threat Status</th>
<th>Habitat Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabaceae</td>
<td><em>Cajanus</em></td>
<td><em>mareebensis</em></td>
<td>PM</td>
<td>Unlikely – This species was originally only known from two locations in the vicinity of Mareeba, but recently it has been located at sites in the Irvinebank to Petford area, and another site west of Mt Garnet. It has been recorded from grassy woodlands of <em>Melaleuca-Acacia</em>, <em>Eucalyptus-Callitris</em> and <em>Eucalyptus-Corymbia</em> on sandy soils derived from granite (TSSC 2008). Whilst similar habitat types are present within the study area, the lack of local records (within 350km) indicates that this species is unlikely to occur within the study area.</td>
</tr>
<tr>
<td>LC</td>
<td>Moraceae</td>
<td><em>Streblus</em></td>
<td>PM</td>
<td>Unlikely – This species occurs throughout much of coastal eastern Australia as well as on Norfolk Island. The Norfolk Island population was originally considered as a separate species, but it is now considered synonymous with the mainland population due to recent taxonomic revision (Department of the Environment 2014a). On the Australian mainland, this species typically occurs in warmer rainforests, particularly along watercourses (ATRP 2010). There a few records in the northern Brigalow belt bioregion and none within 25km of the study area. Given the lack of suitable habitat and local records, this species is considered unlikely to occur within the study area.</td>
</tr>
<tr>
<td>V</td>
<td>Myrtaceae</td>
<td><em>Eucalyptus</em></td>
<td>WO, PM</td>
<td>Present – This species was recorded in the riparian areas around King Creek within regional ecosystem 11.3.25a. Details of its occurrence including quantification survey results are provided in the <em>Flora and Fauna Technical Report</em>.</td>
</tr>
<tr>
<td>NT</td>
<td>Orchidaceae</td>
<td><em>Bulbophyllum</em></td>
<td>PM</td>
<td>Unlikely – This orchid is a host-specific species, only growing on the Hoop Pine, where it colonises the upper branches of mature trees (Jones 2006). The Hoop Pine is a distinct tree that does not occur anywhere within the study area. <em>B. globuliforme</em> is therefore considered unlikely to occur within the study area due to the absence of suitable habitat.</td>
</tr>
<tr>
<td>NT</td>
<td>Solanaceae</td>
<td><em>Solanum</em></td>
<td>WO</td>
<td>Unlikely – All local records of this species have been recorded from semi-evergreen vine thicket and dry rainforest habitat. No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family</th>
<th>Genus</th>
<th>Species Name</th>
<th>Threat Status</th>
<th>Habitat Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fabaceae</td>
<td><em>Cajanus</em></td>
<td><em>mareebensis</em></td>
<td>PM</td>
<td>Unlikely – This species was originally only known from two locations in the vicinity of Mareeba, but recently it has been located at sites in the Irvinebank to Petford area, and another site west of Mt Garnet. It has been recorded from grassy woodlands of <em>Melaleuca-Acacia</em>, <em>Eucalyptus-Callitris</em> and <em>Eucalyptus-Corymbia</em> on sandy soils derived from granite (TSSC 2008). Whilst similar habitat types are present within the study area, the lack of local records (within 350km) indicates that this species is unlikely to occur within the study area.</td>
</tr>
<tr>
<td>LC</td>
<td>Moraceae</td>
<td><em>Streblus</em></td>
<td>PM</td>
<td>Unlikely – This species occurs throughout much of coastal eastern Australia as well as on Norfolk Island. The Norfolk Island population was originally considered as a separate species, but it is now considered synonymous with the mainland population due to recent taxonomic revision (Department of the Environment 2014a). On the Australian mainland, this species typically occurs in warmer rainforests, particularly along watercourses (ATRP 2010). There a few records in the northern Brigalow belt bioregion and none within 25km of the study area. Given the lack of suitable habitat and local records, this species is considered unlikely to occur within the study area.</td>
</tr>
<tr>
<td>V</td>
<td>Myrtaceae</td>
<td><em>Eucalyptus</em></td>
<td>WO, PM</td>
<td>Present – This species was recorded in the riparian areas around King Creek within regional ecosystem 11.3.25a. Details of its occurrence including quantification survey results are provided in the <em>Flora and Fauna Technical Report</em>.</td>
</tr>
<tr>
<td>NT</td>
<td>Orchidaceae</td>
<td><em>Bulbophyllum</em></td>
<td>PM</td>
<td>Unlikely – This orchid is a host-specific species, only growing on the Hoop Pine, where it colonises the upper branches of mature trees (Jones 2006). The Hoop Pine is a distinct tree that does not occur anywhere within the study area. <em>B. globuliforme</em> is therefore considered unlikely to occur within the study area due to the absence of suitable habitat.</td>
</tr>
<tr>
<td>NT</td>
<td>Solanaceae</td>
<td><em>Solanum</em></td>
<td>WO</td>
<td>Unlikely – All local records of this species have been recorded from semi-evergreen vine thicket and dry rainforest habitat. No</td>
</tr>
</tbody>
</table>
suitable habitat for this species occurs within the study area and therefore it is considered unlikely to occur.

2. WO = Wildlife Online Database, PM = EPBC Protected Matters Report
Table D2: Potential of Near threatened and Threatened Fauna identified in PMST and Wildlife Online database searches to occur within the study area.

<table>
<thead>
<tr>
<th>Status</th>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Source¹</th>
<th>WO Records</th>
<th>Potential to occur within the study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BIRDS</td>
</tr>
<tr>
<td>E</td>
<td>Accipitridae</td>
<td><em>Erythrotriorchis radiatus</em></td>
<td>Red Goshawk</td>
<td>PM</td>
<td>0</td>
<td>Possible – There are no records of Red Goshawk in the local area. The nearest records on the Atlas of Living Australia and The Atlas of Australian Birds are in the region of Townsville, which is over 100km from the study area. This species prefers forest and woodland with a mosaic of vegetation types, particularly near riverine systems and permanent water, where there is an abundance of prey species (Department of the Environment 2013b, and references therein). The home range in northern Australia has been reported as up to 200km², with indications it may be even larger (Aumann &amp; Baker-Gabb 1991). Given the lack of local records, this species is considered unlikely to occur within the study area. However, it is possible that this species may fly over the study site or even on occasion use the site as part of a much larger home range or foraging area.</td>
</tr>
<tr>
<td>V</td>
<td>Columbidae</td>
<td><em>Geophaps scripta scripta</em></td>
<td>Squatter Pigeon (southern)</td>
<td>PM, WO</td>
<td>1</td>
<td>Present - This species was observed at multiple locations and appears to be reasonable common within the study area. Squatter Pigeon were typically observed in <em>Eucalyptus</em> or <em>Corymbia</em> woodland near stock watering points. This species has been observed regularly on other fauna surveys and environmental monitoring surveys.</td>
</tr>
<tr>
<td>E</td>
<td>Estrildidae</td>
<td><em>Neochmia ruficauda ruficauda</em></td>
<td>Star Finch (eastern/southern)</td>
<td>PM</td>
<td>0</td>
<td>Unlikely - There are very few accepted records for this subspecies, and recent records indicate that this species is now restricted to central Queensland (Department of the Environment, 2014c). Given the lack of recent records anywhere near the study area (&gt;100km), it is considered extremely unlikely that this subspecies would occur within the study area.</td>
</tr>
<tr>
<td>E</td>
<td>Estrildidae</td>
<td><em>Poephila cincta cincta</em></td>
<td>Black-throated Finch (southern)</td>
<td>PM</td>
<td>0</td>
<td>Unlikely – The southern subspecies of the Black-throated Finch is now considered to be extinct at most sites south of the Burdekin River, and is confined to a very few remaining ‘pockets’ of suitable habitat (Department of the Environment, 2014d). The nearest</td>
</tr>
</tbody>
</table>
recent records for this species are in the region surrounding the Ross River Dam, where it is still regularly observed. Given the currently accepted distribution of this species, and the lack of recent records in the locality, it is considered unlikely that it would occur within the study area.

<table>
<thead>
<tr>
<th>V</th>
<th>E</th>
<th>Rostratulidae</th>
<th>Rostratula australis</th>
<th>Australian Painted Snipe</th>
<th>PM</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>V</td>
<td>Tytonidae</td>
<td>Tyto novaehollandiae k</td>
<td>Masked Owl</td>
<td>PM</td>
<td>0</td>
</tr>
</tbody>
</table>

Unlikely - This species has been recorded at wetland sites throughout much of Australia, but is most common in the eastern States. The Australian Painted Snipe is a distinct species, but its cryptic and crepuscular behaviour can make it difficult to detect. This species typically occurs in shallow freshwater wetlands and other permanently or temporarily inundated areas, particularly where rank tussocks of grasses, sedges, rushes or reeds are present (Department of the Environment, 2014e). Some parts along the margins of the Burdekin River likely contain suitable habitat for this species. However, the only habitat that is potentially suitable within the study area is a along the margins of Kings Creek, but much of this habitat is disturbed by cattle and only flows for a short period of time during the wet season. It is considered that this species is unlikely to occur within the study area due to the limited availability of suitable habitat. In any case, the proposed pipeline will not cause any significant disturbance to suitable habitat for this species.

Possible – In Queensland, this subspecies occurs along the southern rim of the Gulf of Carpentaria, Cape York Peninsula and south at least as far as the Atherton Tablelands (Garnett et al. 2011, and references therein). There is some uncertainty about the southern limit of this subspecies in Queensland (Department of the Environment 2014f). It has been recorded in a variety of habitats including riverside forests, rainforest, open forest and paperbark swamps (Garnett et al. 2011). This subspecies is known to occupy home-ranges of over 1000ha in the non-breeding season (Higgins 1999; Kavanagh & Murray 1996). Given the uncertainty regarding the southern limit of the distribution of this species, and the large home range that would encompass a variety of habitats, it is considered possible that this subspecies may occur within the study area.
### Mammals

<table>
<thead>
<tr>
<th>LC</th>
<th>E</th>
<th>Family</th>
<th>Species</th>
<th>Habitat Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>Dayuridae</td>
<td><em>Dasyurus hallucatus</em></td>
<td>Northern Quoll utilises a wide variety of habitats. However, in Queensland, it is believed that the species is more likely to be present in high relief areas with shallower soils, greater boulder cover, and low fire frequency; close to permanent water (Department of the Environment 2014g). There are no known records of this species occurring in the vicinity of the study site (review of species records included Wildlife Online search and Atlas of Living Australia). The study area itself does not represent preferred habitat for the Northern Quoll, as it lacks high relief, boulder cover and permanent water. No evidence of this species was observed during the current NRC flora and fauna surveys, or any of the previous surveys targeting this species in the area. Given that there is potentially suitable habitat for this species in the broader area, and the site occurs within the known distribution, it is considered possible that this species will occur within the study area.</td>
</tr>
</tbody>
</table>

| V  | V | Phascolarctidae | *Phascolarctos cinereus*   | Koala range includes the eastern half of Queensland. While being widespread, suitable feed species and leaf moisture are the primary determinants of habitat suitability (Department of the Environment 2014h). Suitable habitat is present within the study area and the surrounding landscape. There are no records within 70 km of the study area (source: Wildlife Online, KoalaMap and Atlas of Living Australia), and no evidence of Koala was observed during the fauna survey. However, given the presence of potential suitable habitat, it is considered possible that this species may occur within the study area. |

### Reptiles

<table>
<thead>
<tr>
<th>V</th>
<th>V</th>
<th>Family</th>
<th>Species</th>
<th>Habitat Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>Elapidae</td>
<td><em>Denisonia maculata</em></td>
<td>Ornamental Snake features, particularly with respect to soil type. It prefers woodlands and open forests associated with moist areas,</td>
</tr>
</tbody>
</table>

Possible – The study site falls within the species known range. Across its entire range, the Northern Quoll utilises a wide variety of habitats. However, in Queensland, it is believed that the species is more likely to be present in high relief areas with shallower soils, greater boulder cover, and low fire frequency; close to permanent water (Department of the Environment 2014g). There are no known records of this species occurring in the vicinity of the study site (review of species records included Wildlife Online search and Atlas of Living Australia). The study area itself does not represent preferred habitat for the Northern Quoll, as it lacks high relief, boulder cover and permanent water. No evidence of this species was observed during the current NRC flora and fauna surveys, or any of the previous surveys targeting this species in the area. Given that there is potentially suitable habitat for this species in the broader area, and the site occurs within the known distribution, it is considered possible that this species will occur within the study area.
1. Status: LC = Least Concern, NT = Near Threatened, V = Vulnerable, E = Endangered, M = Migratory
2. WO = Wildlife Online Database Extract, PM = EPBC Protected Matters Report
3. The southeast Queensland bioregion population of the Koala is listed as Vulnerable under the NCA
4. The combined Koala populations of Queensland, New South Wales and the Australian Capital Territory are listed as Vulnerable under the EPBC Act.

<table>
<thead>
<tr>
<th>Status</th>
<th>Superfamily</th>
<th>Genus</th>
<th>Species</th>
<th>Common Name</th>
<th>Habitat</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Scincidae</td>
<td>Egeria</td>
<td>rugosa</td>
<td>Yakka Skink</td>
<td>Open dry sclerophyll forest, woodland and scrub, usually associated with the southern brigalow belt bioregion. There are no records of this species in the local area, and only a single record within over 300km of the study area (at Mount Cooper Station, approximately 60km west of the study area). The species is not highly mobile, living in aggregations or colonies; individuals are limited in their capacity to disperse from a colony site (Department of the Environment 2014i). The absence of records within the region and the lack of suitable microhabitat features throughout the majority of the study area indicates that this species is unlikely to occur.</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Scincidae</td>
<td>Lerista</td>
<td>vittata</td>
<td>Mount Cooper Striped Lerista</td>
<td>Open dry sclerophyll forest, woodland and scrub, usually associated with the southern brigalow belt bioregion. There are no records of this species in the local area, and only a single record within over 300km of the study area (at Mount Cooper Station, approximately 60km west of the study area). The species is not highly mobile, living in aggregations or colonies; individuals are limited in their capacity to disperse from a colony site (Department of the Environment 2014i). The absence of records within the region and the lack of suitable microhabitat features throughout the majority of the study area indicates that this species is unlikely to occur.</td>
<td></td>
</tr>
</tbody>
</table>
Table D3: Potential of Migratory fauna identified in the PMST database search to occur within the study area.

<table>
<thead>
<tr>
<th>Status</th>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Source</th>
<th>WO Records</th>
<th>PM</th>
<th>Likelihood of Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCA</td>
<td>EPBC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>REPTILES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>M</td>
<td>Crocodylidae</td>
<td>Crocodylus porosus</td>
<td>PM</td>
<td>0</td>
<td></td>
<td>Possible – The Burdekin River adjacent to the proposed pipeline corridor provides suitable habitat for this species. This species is known from the Burdekin River catchment and there is a nearby record downstream of the proposed pump station location.</td>
</tr>
<tr>
<td></td>
<td>BIRDS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Accipitridae</td>
<td>Haliaeetus leucogaster</td>
<td>PM, WO</td>
<td>2</td>
<td></td>
<td>Likely – This species’ range covers a vast area across Asia and Oceana, and is found within several hundred kilometres inland from the Australian coastline, right around the country. Preferred habitats of this species are characterised by the presence of large areas of open water (Marchant &amp; Higgins 1993). There are records of this species in the local area, and it is likely that this species would fly over the study area whilst foraging in the broader area – particularly around the Burdekin River.</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Apodidae</td>
<td>Apus pacificus</td>
<td>PM</td>
<td>0</td>
<td></td>
<td>Possible – This species has been observed over a number of different habitat types including dry, open woodland and riparian woodland (Higgins 1999). The study site occurs within the species known range, and whilst there are no known local records, it is considered possible that this species could occur within the study area.</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Hirundinidae</td>
<td>Hirundo rustica</td>
<td>PM</td>
<td>0</td>
<td></td>
<td>Possible – In Australia this species has been recorded in open country in coastal lowlands, often near water (Department of the Environment 2014k). The study site occurs within the species known range, and whilst there are no known local records, it is considered possible that this species could occur within the study area.</td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Meropidae</td>
<td>Merops ornatus</td>
<td>PM, WO</td>
<td>2</td>
<td></td>
<td>Present – This is a woodland species that occurs across</td>
</tr>
</tbody>
</table>
Suitable habitat occurs throughout the study area. This species was commonly observed at multiple locations within the study area.

<table>
<thead>
<tr>
<th>LC</th>
<th>M</th>
<th>Order</th>
<th>Family</th>
<th>Species</th>
<th>Habitat Type</th>
<th>PM, WO</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC</td>
<td>M</td>
<td>Monarchidae</td>
<td>Monarchidae</td>
<td>Monarch melanopsis</td>
<td>Black-faced Monarch</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unlikely – this species is most commonly found in rainforest and other wet forest habitats. There is no preferred habitat within the study area. The lack of local records and suitable habitat suggests that this species is unlikely to occur within the study area.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Monarchidae</td>
<td>Monarchidae</td>
<td>Monarchis trirgatus</td>
<td>Spectacled Monarch</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Unlikely – preferred habitat includes thick understory in rainforests, wet gullies and waterside vegetation (Birdlife Australia 2014). The lack of local records and suitable habitat suggests that this species is unlikely to occur within the study area.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Monarchidae</td>
<td>Myiagra cyanoleuca</td>
<td>Satin Flycatcher</td>
<td>PM, WO</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Possible – Satin flycatchers prefer eucalypt forests near wetland and watercourses, often occurring in gullies. The site occurs within this species’ range, and some locations within the study area contain this species’ preferred habitat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Rhipiduridae</td>
<td>Rhipiduridae</td>
<td>Rhipidura rufifrons</td>
<td>Rufous Fantail</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Possible - In north and north-east Australia, this species often occurs in tropical rainforest and monsoon rainforests. These habitat types occur in the broader area around the study site but not within the study site. The site occurs within this species’ range, and some locations in the broader area contain this species’ preferred habitat. It is possible that this species would at least fly over the study area in search of more suitable habitat in the broader area.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Ardeidae</td>
<td>Ardeidae</td>
<td>Ardea alba</td>
<td>Great Egret</td>
<td>PM, WO</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Likely – The Great Egret occurs across Australia, with breeding colonies occurring in coastal areas. This species may occur within the study site, using watercourses (when flowing) and stock watering points as a temporary roosting and foraging sites.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LC</td>
<td>M</td>
<td>Ardeidae</td>
<td>Ardeidae</td>
<td>Ardea ibis</td>
<td>Cattle Egret</td>
<td>PM</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Likely – This species has a broad range across Australia, inhabiting woodlands and grassland areas with tall grasses. Frequently occurs within and near agricultural areas, and shallow wetlands. Is likely to occur with the study area, as suitable habitat is present in some areas.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**LC** | **M** | **Scolopacidae** | **Gallinago hardwickii** | **Latham’s Snipe** | **PM** | **0** | Unlikely – This species occurs in permanent and ephemeral freshwater wetlands, with low dense vegetation. Foraging areas are characterised by areas of mud, associated with low dense vegetation. It is unlikely that this species will occur within the study site, as there are no areas of suitable habitat.

| **V** | **E, M** | **Rostratulidae** | **Rostratula australis** | **Australian Painted Snipe** | **PM** | **0** | Unlikely – See description in Table D2 |

1. Status: **LC** = Least Concern, **NT** = Near Threatened, **V** = Vulnerable, **E** = Endangered, **M** = Migratory
2. **WO** = Wildlife Online Database, **PM** = EPBC Protected Matters Report
References for Appendix D


Burdekin River Pipeline EA Amendment
Flora and Fauna Technical Report
July 2014


Appendix E

Flora Species List
## Table E1: Flora species recorded within the study area

<table>
<thead>
<tr>
<th>Family</th>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amaranthaceae</td>
<td>Alternanthera ficoidea</td>
<td>Joyweed</td>
<td>*</td>
</tr>
<tr>
<td>Anacardiaceae</td>
<td>Pleiogynium timorense</td>
<td>Burdekin Plum</td>
<td>LC</td>
</tr>
<tr>
<td>Anacardiaceae</td>
<td>Mangifera indica</td>
<td>Mango</td>
<td>LC</td>
</tr>
<tr>
<td>Apocynaceae</td>
<td>Wrightia saliva</td>
<td>Coolaroo</td>
<td>LC</td>
</tr>
<tr>
<td>Asclepiadaceae</td>
<td>Cryptostegia grandiflora</td>
<td>Rubber Vine</td>
<td>*</td>
</tr>
<tr>
<td>Asparagaceae</td>
<td>Lomandra hystrix</td>
<td>Spiny-head Matrush</td>
<td>LC</td>
</tr>
<tr>
<td>Asteraceae</td>
<td>Bidens pilosa</td>
<td>Cobbler's Pegs</td>
<td>*</td>
</tr>
<tr>
<td>Asteraceae</td>
<td>Cyanthillium cinereum</td>
<td>Ironweed</td>
<td>*</td>
</tr>
<tr>
<td>Asteraceae</td>
<td>Parthenium hysterophorus</td>
<td>Parthenium Weed</td>
<td>★</td>
</tr>
<tr>
<td>Asteraceae</td>
<td>Tridax procumbens</td>
<td>Tridax daisy</td>
<td>★</td>
</tr>
<tr>
<td>Asteraceae</td>
<td>Xanthium pungens</td>
<td>Noogoora Burr</td>
<td>LC</td>
</tr>
<tr>
<td>Cactaceae</td>
<td>Opuntia stricta</td>
<td>Common Pest Pear</td>
<td>*</td>
</tr>
<tr>
<td>Caesalpiniaeae</td>
<td>Lysiphyllum hookeri</td>
<td>White Bauhinia</td>
<td>LC</td>
</tr>
<tr>
<td>Casuarinaceae</td>
<td>Casuarina cunninghamiana</td>
<td>River Oak</td>
<td>LC</td>
</tr>
<tr>
<td>Commelinaceae</td>
<td>Commelina diffusa</td>
<td>Spreading Dayflower</td>
<td>LC</td>
</tr>
<tr>
<td>Cyperaceae</td>
<td>Cyperus exaltatus</td>
<td>Giant Sedge</td>
<td>LC</td>
</tr>
<tr>
<td>Cyperaceae</td>
<td>Eleocharis philippinensis</td>
<td>Spike Rush</td>
<td>LC</td>
</tr>
<tr>
<td>Euphorbiaceae</td>
<td>Jatropha gossypifolia</td>
<td>Bellyache Bush</td>
<td>★</td>
</tr>
<tr>
<td>Euphorbiaceae</td>
<td>Mallotus philippinensis</td>
<td>Red Kamala</td>
<td>LC</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Chamaecrista rotundifolia</td>
<td>Wynn Cassia</td>
<td>*</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Indigofera linifolia</td>
<td>Narrow-leaved Indigo</td>
<td>LC</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Indigofera linnaei</td>
<td>Birdsville Indigo</td>
<td>LC</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Macroptilium atropurpureum</td>
<td>Siratro</td>
<td>*</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Stylosanthes hamata</td>
<td>Caribbean Stylo</td>
<td>*</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Stylosanthes scabra</td>
<td>Shrubby Stylo</td>
<td>*</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Crotolaria pallida</td>
<td>Strekaed Rattlepod</td>
<td>*</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Leucaena leucocephala</td>
<td>Leucaena</td>
<td>*</td>
</tr>
<tr>
<td>Fabaceae</td>
<td>Erythrina vespertilio</td>
<td>Bat's Wing Coral Tree</td>
<td>LC</td>
</tr>
<tr>
<td>Juncaceae</td>
<td>Juncus usitatus</td>
<td>Common Rush</td>
<td>LC</td>
</tr>
<tr>
<td>Lamiaceae</td>
<td>Clerodendrum floribundum</td>
<td>Lolly Bush</td>
<td>LC</td>
</tr>
<tr>
<td>Lamiaceae</td>
<td>Hyptis capitata</td>
<td>Knobweed</td>
<td>*</td>
</tr>
<tr>
<td>Lamiaceae</td>
<td>Hyptis suaveolens</td>
<td>Horehound</td>
<td>*</td>
</tr>
<tr>
<td>Lecythidaceae</td>
<td>Planchonia careya</td>
<td>Cocky Apple</td>
<td>LC</td>
</tr>
<tr>
<td>Malvaceae</td>
<td>Sida cordifolia</td>
<td>Flannel Weed</td>
<td>*</td>
</tr>
<tr>
<td>Malvaceae</td>
<td>Sida rhombifolia</td>
<td>Paddy's Lucerne</td>
<td>*</td>
</tr>
<tr>
<td>Malvaceae</td>
<td>Urena lobata</td>
<td>Caesarweed</td>
<td>*</td>
</tr>
<tr>
<td>Family</td>
<td>Scientific Name</td>
<td>Common Name</td>
<td>Status</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------</td>
<td>---------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Malvaceae</td>
<td>Grewia retusifolia</td>
<td>Dog's Balls</td>
<td>LC</td>
</tr>
<tr>
<td>Malvaceae</td>
<td>Hibiscus meraukensis</td>
<td>Bush Hibiscus</td>
<td>LC</td>
</tr>
<tr>
<td>Malvaceae</td>
<td>Brachychiton australis</td>
<td>Broad-leaved Bottle Tree</td>
<td>LC</td>
</tr>
<tr>
<td>Mimosaceae</td>
<td>Acacia bidwillii</td>
<td>Corkwood Wattle</td>
<td>LC</td>
</tr>
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¹Status relates to listing under the Queensland *Nature Conservation Act 1992* and the Commonwealth EPBC Act: LC = Least concern under the NCA, V = Vulnerable under the NCA and the EPBC Act

*Species is not native to Australia

*Species is a Declared Class 2 pest species under the *Land Protection (Pest and Stock Route Management) Act 2002*
Appendix F

Fauna Species List
### Table F1: Fauna species recorded within the study area

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</table>

1. Status: LC = Least Concern, NT = Near Threatened, V = Vulnerable, E = Endangered, M = Migratory, * = Species not native to Australia
Appendix G

Microbat Call Interpretation Report
Microbat Call Interpretation Report

<table>
<thead>
<tr>
<th>Prepared for (“Client”):</th>
<th>Northern Resource Consultants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey location/project name:</td>
<td>Bowen-Collinsville area</td>
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<tr>
<td>Survey dates:</td>
<td>9-12 April 2014</td>
</tr>
<tr>
<td>Client project reference:</td>
<td></td>
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<tr>
<td>Job no.:</td>
<td>NRC-1402</td>
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<td>Report date:</td>
<td>11 May 2014</td>
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Methods

Data receipt and processing

Bat calls were recorded using two Anabat detectors (Titley Scientific, Brisbane). Call data were downloaded and submitted for analysis by Faunalink on behalf of Northern Resource Consultants. Some 5879 Anabat sequence files (zero-crossing format) were received, representing surveys over three nights at sites between Bowen and Collinsville, north-central Queensland.

Zero-crossing analysis

All Anabat sequence files were viewed using AnalookW (Corben 2013) and a subset of files containing representative samples of all observed call types were selected for further analysis. A high proportion of the recorded calls were attributable to just 2-3 species, so the number of files selected for identification (364 files) was relatively low in comparison to the total number of files submitted. Calls with fewer than four clear pulses were excluded from the analysis.

Species identification was achieved manually by viewing sonograms of the selected calls and comparing them with those of reference calls from central and southern Queensland and/or with published call descriptions (Reinhold et al 2001).

Determination of species' identity was refined by considering probability of occurrence based on distributional information presented in Churchill (2008) and van Dyck et al. (2013).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows van Dyck et al. (2013).

Results & Discussion

Table 1 presents a summary of species recorded on each night by the two detectors. At least twelve and possibly as many as nineteen microbat species were recorded overall.

Several species listed in Table 1 were not reliably identified due to similarities in call characteristics with other species and/or poor call quality in the few relevant calls recorded. These species are discussed in more detail below.
Table 1. Microbat species recorded in Bowen-Collinsville area, 9-12 April 2014.

<table>
<thead>
<tr>
<th>Detector:</th>
<th>AB2</th>
<th>AB3</th>
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<tbody>
<tr>
<td>Night:</td>
<td>9-Apr</td>
<td>10-Apr</td>
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<tr>
<td>Total number of sequence files:</td>
<td>239</td>
<td>2010</td>
</tr>
<tr>
<td>Number of calls identified:</td>
<td>7</td>
<td>226</td>
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</tbody>
</table>

- **Chalinolobus gouldii**: 1
- **Chalinolobus morio**: 2
- **Chalinolobus nigrogriseus**: 2
- **Chalinolobus picatus**: 2
- **Nyctophilus species**: 1
- **Scotorepens balstoni**: 2
- **Scotorepens greyii / S. sanborni**: 2
- **Vespadelus baverstocki**: 1
- **Vespadelus troughtoni**: 2
- **Miniopterus australis**: 1
- **Miniopterus orianae oceanensis**: 2
- **Chaerephon jobensis**: 1
- **Mormopterus beccarii**: 1
- **Mormopterus ridei**: 1
- **Saccolaimus flaviventris**: 1
- **Taphozous troughtoni**: 2

Species/calls not reliably identified

**Chalinolobus morio and Vespadelus troughtoni**

With steep FM-qCF pulses at characteristic frequency (Fc) or 48-53 kHz, these two species are often difficult to differentiate. The few calls recorded here were too brief to consistently display any of the features needed for reliable identification; however, it is possible that both were present.

**Chalinolobus nigrogriseus, C. picatus and Scotorepens greyii / S. sanborni**

These species all share many common call features and their Fc overlaps substantially: S. greyii/S. sanborni Fc=35-41 kHz; C. nigrogriseus Fc=36-40 kHz; and C. picatus Fc=39-43 kHz.
Numerous calls were positively attributed to *S. greyii/S. sanborni* based on their short-duration hooked pulses at uniform frequency around 38-40 kHz; and a few calls had longer pulse duration and flatter pulse bodies, indicative of *C. nigrogriseus*. Many calls in the relevant frequency range had variable pulse characteristics and could have been from any of these three species; however, despite some calls having weak evidence of the alternating pulse frequencies typical of *C. picatus*, this species’ presence could not be confirmed.

**Nyctophilus species**

Long-eared bats cannot be differentiated on call characteristics. Three species potentially occur in the study area (eastern *N. bifax*, lesser *N. geoffroyi* and Gould’s *N. gouldi*); any of which may have been responsible for the few calls attributed to this group.

*Myotis macropus* calls have very similar characteristics and can be difficult to separate from *Nyctophilus* spp. The likelihood of calls belonging to this species would be relatively high if any of the recording sessions were conducted over or near water bodies; however, it is considered more likely that the few calls in this data set were from *Nyctophilus* spp.

**Vespadelus baverstocki and Miniopterus oriana oceanensis**

Both of these species have steep FM-qCF pulses with Fc around 42-46 kHz. *V. baverstocki* was positively identified in many calls due to the distinctive short-duration, hooked pulse-bodies; and a number of calls with flat or diagonal pulse bodies of relatively longer duration were reliably attributable to *M. o. oceanensis*. Many calls had intermediate features and could have been from either species.

**Taphozousroughtoni**

A few brief, low-quality calls with flattish (qCF) pulses at Fc=23-25 kHz possibly represented this species. *Mormopterus beccarii* occupies a similar frequency range and was positively identified from calls with steeper (FM-qCF) pulses; however, it also generates flatter pulse shapes so these calls could have been from either species.

**References**


Appendix  Representative call sequences from Bowen-Collinsville area, 9-12 April 2014. 
(Scale: 10msec per tick; time between pulses removed)

<table>
<thead>
<tr>
<th>Species</th>
<th>Likelihood</th>
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<tr>
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<td>Probably</td>
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<tr>
<td>Chalinolobus morio</td>
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</tr>
<tr>
<td>Chalinolobus nigrogriseus</td>
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</tr>
<tr>
<td>Probably Chalinolobus picatus</td>
<td></td>
</tr>
<tr>
<td>Nyctophilus sp</td>
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</tr>
<tr>
<td>Scotorepens balstoni</td>
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</tr>
<tr>
<td>Scotorepens greyii/S. sanborni</td>
<td></td>
</tr>
<tr>
<td>Vespadelus baverstocki</td>
<td>Possibly</td>
</tr>
<tr>
<td>Possibly Vespadelus troughtoni</td>
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Miniopterus australis
Miniopterus orianae oceanensis
Chaerephon jobensis
Mormopterus beccarii
Mormopterus ridei
Saccolaimus flaviventris
Possibly Taphozous troughtoni