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6.1 INTRODUCTION

This Chapter provides a summary of the environmental values, potential impacts and mitigation measures for terrestrial ecology within the proposed mine site footprint.

Desktop and field studies were used to identify, describe and assess key flora and fauna values of the study area and potential impacts associated with both the construction and operation of the mine.

The project's environmental objective for terrestrial ecology is to undertake activities that minimise impacts on terrestrial flora, fauna and ecological communities. The technical report is provided in Volume 5, Appendix 11.

6.2 ASSESSMENT METHODS

6.2.1 DESKTOP ASSESSMENT

The impacts on fauna and flora have been assessed after reviewing publically available databases, previously published information and studies and detailed field surveys including, but not limited to:

- Queensland Herbarium Regional Ecosystem mapping (Version 6.0, 2009) to identify significant vegetation communities mapped;
- Queensland Herbarium HERBRECS data and DERM Wildlife Online databases to identify all flora and fauna species of conservation significance known to occur within the wider study area;
- DSEWPC Protected Matters Search Tool to identify all Matters of National Environmental Significance (MNES) known or potentially occurring within, or close to, the study area including Ramsar-listed wetlands, critical habitat areas, Threatened Ecological Communities (TEC), flora and fauna species and other matters including conservation areas (including National Parks and Conservation Parks) in accordance with EPBC Act;
- Review of records held by the QLD Museum;
- Review of Wildnet Database;
- Review of Birds Australia records;
- Queensland Herbarium Regrowth mapping to identify areas of high-value regrowth vegetation as listed under the *Queensland Vegetation Management Act 1999* (VM Act);
- DERM Queensland Essential Habitat Area (EHA) mapping to identify essential habitat areas for Threatened listed flora species;
- DERM Desert Uplands Biodiversity Planning Assessment (BPA) to identify areas of ecological significance at the state, regional and local level;
- DERM Environmentally Sensitive Areas (ESA) online mapping to identify key ecologically sensitive areas including, wetlands, Endangered regional ecosystems (REs) (Biodiversity Status) and nature refuges;
- Directory of Important Wetlands (Blackman *et al.*, 1999) database;
- DERM Queensland Wetlands mapping (Wetland Info);
- satellite imagery to gain an appreciation of the project's proximity to sensitive areas, assess vegetation patterns and identify target areas for field investigations;
- review of the Desert Uplands Flora, Fauna and Landscape Expert Panel Report (EPA, 2005), Conservation of Biodiversity in the Desert Uplands Report (Morgan *et al.*, 2002) and the CSIRO Rare or Threatened Plants (ROTAP) (Briggs and Leigh, 1995) to identify regionally significant flora species;
- a recently completed rapid flora and fauna assessment of the Bimblebox Nature Refuge (BNR) undertaken by WorleyParsons (2009); and
- discussion with relevant research authorities including Dr Rod Fensham from the Queensland Herbarium and Eric Vanderduys from CSIRO Sustainable Ecosystems.

6.2.2 FIELD SURVEYS

- investigation of the area and ground-truthing by flora and fauna ecologists (a total of 31 flora sites and eight fauna sites over a total of 20 days from October 2009 to April 2010) that included the use of pitfall traps, Elliott traps, funnel traps, bat traps and ultrasonic recording, spotlighting and bird transects;
- Additional work including 14 survey-person days as part as part of an on-going site survey and habitat assessment program for black-throated finch (southern) (*Poephila cincta cincta*).

Detailed field survey methodologies are outlined in Appendix 10 and 10 A.

6.3 EXISTING ENVIRONMENT

The project is located within the Desert Uplands bioregion. The bioregion is one of 85 bioregions recognised in Australia and one of 13 located in Queensland. This bioregion encompasses an area of about 70,300 km^2 and straddles the Great Dividing Range between Blackall and Pentland in central northern Queensland. The bioregion partly lies within the Galilee and Eromanga Basins. These basins consist of Mesozoic to Tertiary (less than 251 million years ago) sediments including major coal and gas deposits (ANRA, 2009).

The climate of the bioregion is semi-arid with variable summer-dominant rainfalls that decline from east to west. Average annual rainfall in the region ranges from 400 mm to 800 mm, declining from east to west. Mean temperature ranges from 23 – 35.8ºC in summer to 7.7 – 22.50C in winter **(see Volume 2, Chapter 2)**.

The bioregion straddles the low hills of the Great Dividing Range and is dominated by sandstone ranges and sand plains. It lies on the eastern margins of the GAB and encompasses two major internal drainage basins, Lake Galilee and Lake Buchanan. The main waterways draining the Desert Uplands are the Belyando, Cape, Campaspe, Barcoo and Alice Rivers and Aramac and Torrens Creeks.

The soil of the bioregion is generally very well drained but structurally poor and of low fertility (Ahern et al., 1994). Uniform clay soils occur in association with old lakebed deposits and as extensions of the western plains into the Desert Uplands bioregion. The soils in general are very low in essential mineral and trace elements, particularly phosphorus. The biodiversity of the soil-vegetation association is regarded as being high with approximately 80 % of the bioregion remaining uncleared (EPA, 2005) **(see Volume 2, Chapter 3)**.

The vegetation of the bioregion consists predominantly of eucalypt and acacia woodlands (often with an open spinifex understorey) and acacia woodlands. The bioregion includes 29 vulnerable and 14 endangered REs that support habitat for 21 threatened species. There are five nationally important wetlands and another 45 wetlands of regional significance present in the bioregion. The Galilee and Buchannan Lakes, in addition to numerous other smaller lakes are the dominant landscape features within the bioregion.

Most of the bioregion is under leasehold tenure and is used for cattle grazing and some sheep grazing in the west (DNRW, 2006). Recent work by McCosker *et al.* (2009) suggests that there is some degree of compatibility between grazing management and biodiversity within this bioregion.

The dominant land use across the proposed mine site is cattle grazing. A significant portion of the site is cleared of standing timber for cattle pastures. These areas are dominated by buffel grass (*Pennisetum ciliare*), an introduced invasive pasture species which is well established on rough, blade ploughed terrain on low, undulating hills (e.g. Sites BB28 and BB29). Broad habitat types across the project area are shown in **Figure 1**.

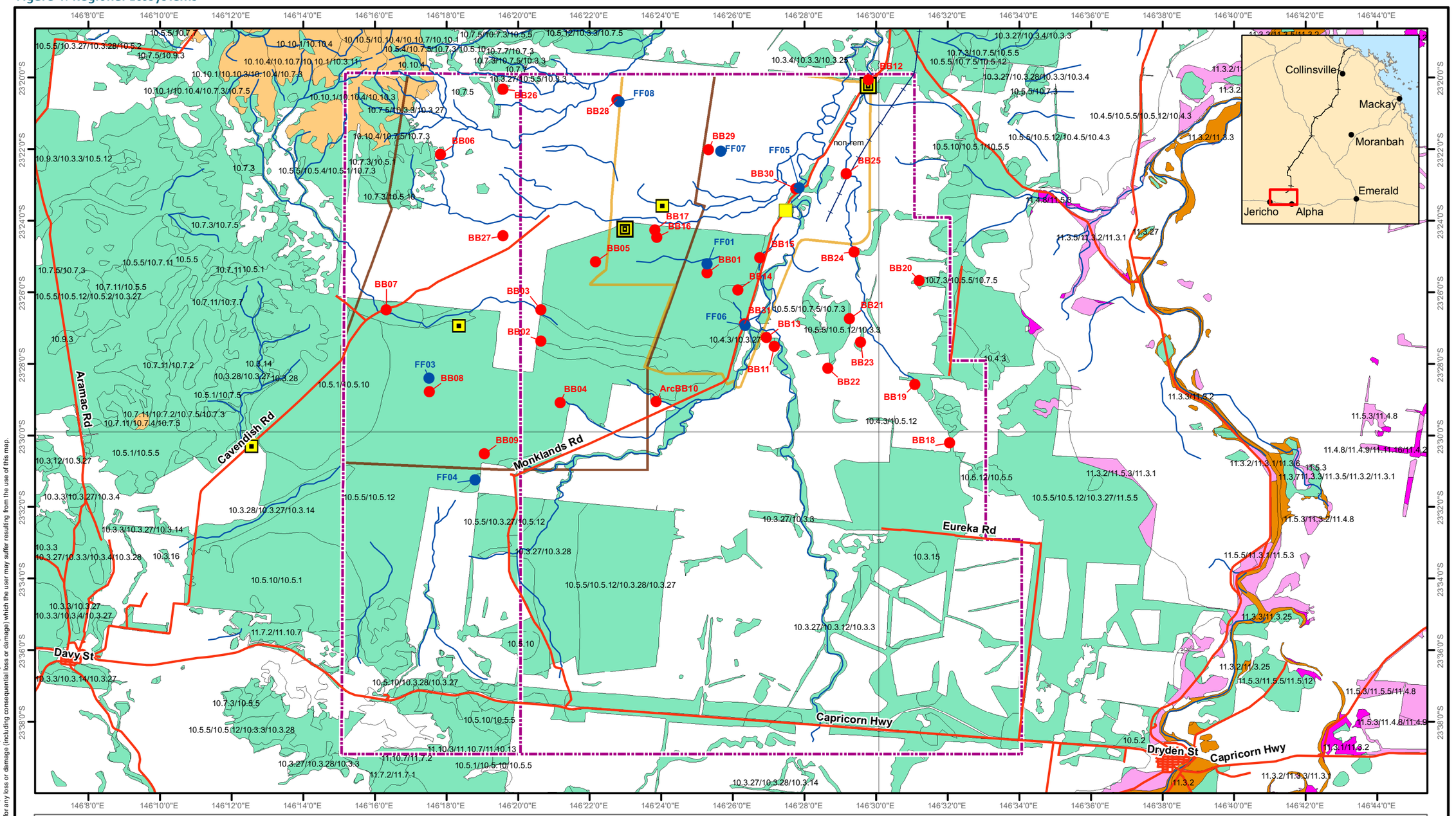
Part of the mine surface clearance footprint occurs in the north and eastern parts of the Bimblebox Nature Refuge (BNR), a protected area gazetted under the *Nature Conservation (Protected Areas) Regulation 1994*. The vegetation within this area consists predominantly of poplar box (*Eucalyptus populnea*) and silver-leaved ironbark (*Eucalyptus melanophloia*) open woodland (REs 10.5.12, 10.5.5). The BNR is identified as containing 'Special biodiversity values' and is of value as a 'Wildlife refugia'. It is mapped as being of State Significance within the Desert Uplands Biodiversity Planning Assessment (EPA, 2005).

Immediately to the south-west of the BNR the study area encompasses a woodland area with similar vegetation to that of the BNR. Dominant tree species include silver-leaved ironbark, poplar box and lancewood (*Acacia shirleyi*). This area is identified as containing Of Concern RE (Biodiversity status), 'Wildlife refugia', 'Disjunct populations', 'Taxa at limit of geographic range', 'Areas of high species richness' and 'Hollow-bearing trees' and is mapped as being of part State and part Regional Significance (EPA, 2005).

Partially cleared sandstone escarpments with some areas supporting Lancewood dominated woodlands are present to the north-west within the study area.

To the east the mine surface clearance footprint transects a riverine habitat comprising several ephemeral watercourses including Lagoon Creek. The vegetation within this area is dominated by poplar box open woodland and also contains patches of river red gum (*Eucalyptus camaldulensis*) and brigalow (*Acacia harpophylla*). This area is mapped as being of Regional Significance (EPA, 2005).

Figure 1. Regional Ecosystems



Regional Ecosystem Mapping and Location of Flora and Fauna Survey Sites

Data Source
Regional Ecosystem Data © State of Queensland (Department of Environment and Resource Management) 2010

Job: WACL_2535
Date: 21/06/2011

Legend

- Fauna Survey Sites
- Flora Survey Sites
- Bat Harp Trap Site
- Bat Ultrasonic Recording Site
- Bat Ultrasonic Recording Site & Bat Mistnet Site
- Rail Alignment (Option 1)
- Roads
- Watercourse
- Mine Study Area
- Surface Clearance Footprint
- Underground Mine Area

Regional Ecosystems

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Not Of Concern
- Non-remnant / regrowth

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UNIDEL INFRASTRUCTURE ENERGY RESULTS

6.3.1 FLORA

6.3.1.1 Terrestrial Flora Field Assessment

Flora desktop studies and field surveys:

- ground-truthed Herbarium regional ecosystem mapping within mine study area. All ground-truthed sites were assessed to 'Tertiary' level in accordance with methodology outlined by Queensland Herbarium and data collected is compatible with Queensland Herbariums COVREG database;
- investigated the presence / absence or likely presence / absence of the Threatened and Near Threatened flora species and Significant Ecological Communities. This included vehicle and foot based random meander surveys focused within and adjoining the mine surface clearance footprint and in the vicinity of all tertiary survey sites as well as vehicle based surveys along all access tracks to and between the tertiary sites;
- observed the wider environment surrounding the study area so that potential impacts could be considered in the local, regional and state contexts; and,
- observed the general distributions of declared pest plants.

Detailed field survey methodologies are outlined in **Volume 5, Appendix 10 and 10 A**.

6.3.1.2 Floral Environment

The project is located within the Desert Uplands bioregion. The vegetation of the bioregion consists predominantly of eucalypt and acacia woodlands (often with an open spinifex understorey) and acacia woodlands.

The dominant land use across the study area is cattle grazing. A significant portion of the area is cleared of standing timber for cattle pastures. These areas are dominated by buffel grass, which is well established on rough, blade ploughed terrain on low, undulating hills and plains.

No VM Act Endangered or Of Concern REs are required to be cleared or will be impacted by the mine surface clearance footprint. Most remnant vegetation within the study area and all within the mine surface clearance footprint are listed as Least Concern and these communities do not form part of any TEC identified under the EPBC Act.

6.3.1.3 Environmentally Sensitive Areas (ESAs) and Bimblebox Nature Refuge (BNR)

ESAs

The *Environmental Protection Regulation 1998* classifies environmentally sensitive areas according to the level of significance of each. Endangered regional ecosystems (DERM Biodiversity Status) are classified as Category B environmentally sensitive areas. Two such REs (RE 10.3.25 and RE 10.4.3) occur as small patches in close proximity to the margins of the mine surface clearance footprint. The presence of Category B environmentally sensitive areas within the project area triggers the need for an environmental authority under the *Environmental Protection Act 1994* for those areas only. The balance of the site is exempt from this particular requirement.

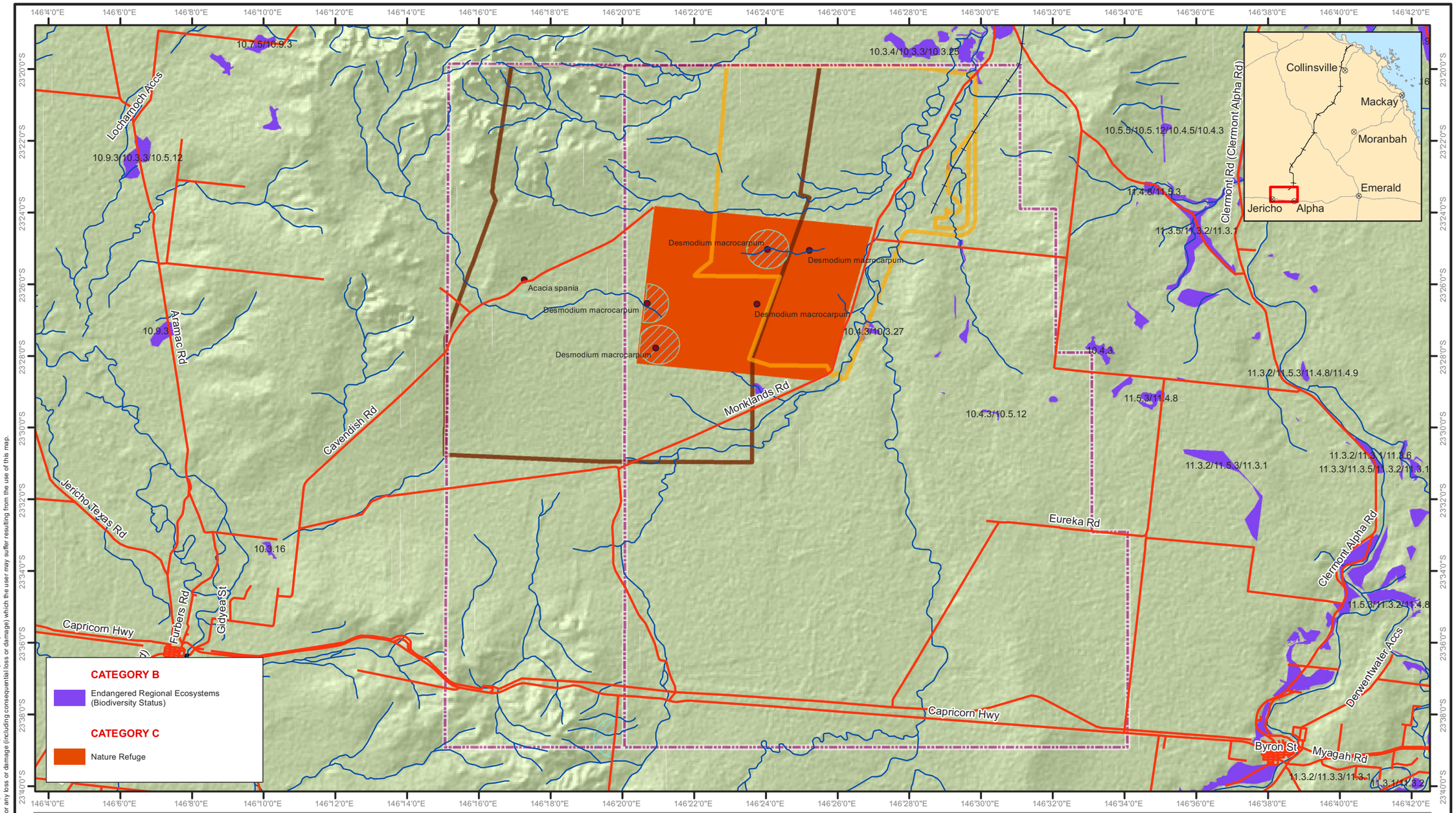
BNR

Part of the mine surface clearance footprint occurs in the north and eastern parts of the BNR, which, as a nature reserve, is categorized by DERM as a Category C ESA. Underground mining will also occur under a large part of BNR. The BNR comprises approximately 8,000 ha of remnant semi-arid woodlands dominated by poplar box and silver-leaved ironbark. There are no National Parks, State Forests or other ESA's mapped by DERM as occurring within the study area. The BNR is known to contain the Near Threatened flora species, large-podded tick-trefoil (*Desmodium macrocarpum*). The BNR also contains habitat for fauna species of conservation significance under the EPBC A

EPA (2004) described the BNR as having high biodiversity values supporting a wide variety of native grass and fauna species. The vegetation in this area was found to range from average to very good condition with evidence of grazing, clearing for tracks, buffel grass invasion and patches of dieback present to varying degrees.

As a Nature Refuge is classed as a Category C Environmentally Sensitive Area in the DERM Codes of Environmental Compliance, DERM may use the Codes to apply extra conditions to activities in the BNR. DERM has in the past successfully conditioned exploration on a number of nature refuges. Waratah Coal have outlined measures to provide appropriate protection of the environmental values above the underground mined sections of the BNR as well as rehabilitation requirements and have also formulated a draft off-set strategy to address the unavoidable impacts to the BNR from the open cut mining that cannot be mitigated .

Figure 2. DERM Environmentally Sensitive Areas



DERM Environmentally Sensitive Areas and Threatened and Near Threatened Flora Species

Data Source
ESA Data © State of Queensland (Department of Environment and Resource Management) 2010

Job: WACL_2535
Date: 21/06/2011

Legend

- Threatened and Near Threatened Flora Species
- Rail Alignment (Option 1)
- Roads
- Watercourse
- Mine Study Area
- Surface Clearance Footprint
- Underground Mine Area
- DERM Essential Habitat

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UNIDEL INFRASTRUCTURE ENERGY RESULTS

The Cudmore National Park and Cudmore Resource Reserve are located approximately 40 km north-west of the mine site. The project will not have any direct impact on these areas.

6.3.1.4 Ecological Communities / Regional Ecosystems

DERM RE mapping at Figure 2 identified 21 REs as occurring within the study area, two of which are Of Concern under the VM Act (RE 10.3.4 and RE 10.10.7). Of Concern REs are those in which the remnant vegetation is 10 – 30 % of the pre-clearing extent or, more than 30 % remains, but the total remaining is less than 10,000 ha. Two others, listed as Least Concern under the VM Act, are classified as Endangered under the DERM biodiversity status (RE 10.3.25 and RE 10.4.3). REs can be listed as endangered, regardless of their RE status, using a combination of area and the level of degradation or loss of biodiversity values. The two REs listed as Endangered (DERM biodiversity status) in the study area do not affect any exemptions or consent requirements under the VM Act for the project. The field survey found the DERM RE mapping to be generally accurate. Tertiary flora and fauna survey sites are shown in Figure 2.

A total of 10 Least Concern REs, equating to approximately 4,594.68 ha, is required to be cleared or will be impacted by the mine surface clearance footprint. This represents 6.89 % of the RE extent within a 10 km buffer and 0.30 % of the RE extent within the bioregion. The underground mine component of the project extends beneath roughly equal areas of buffel grass pasture habitat and open woodland, including most of the balance of the BNR and a large portion of the Cavendish area **(Figure 1)**.

While no REs mapped by DERM were analagous with any TECs listed under the EPBC Act, the EPBC Act Protected Matters Search Tool identified three TECs potentially occurring within the broader study area. These are:

- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin; and
- Weeping Myall Woodlands.

The field survey confirmed that no EPBC Act listed TECs occur within the study area. Minor occurrences of Brigalow dominant and co-dominant REs were found to be present (i.e. RE 10.3.3 and RE 10.4.3) but these REs are not included within the EPBC Act definition of the TEC Brigalow (*Acacia harpophylla* dominant and co-dominant).

Furthermore, no VM Act Endangered REs occur in the project footprint. The majority of RE on the study site is Least Concern, with some small areas of Of Concern Subdominant RE occurring close to the edge of the underground mine area **(see Figure 1)**. The mine surface clearance footprint does not contain any areas mapped as high-value regrowth under the VM Act.

6.3.1.5 Threatened and Near Threatened Flora Species

Three flora species listed under the NC Act were identified during the assessment. Table 1 provides the summary details.

Environmentally Sensitive Areas are shown at Figure 3. The Queensland Essential Habitat mapping identified one essential habitat area for large-podded tick-trefoil occurring within the study area. This is shown at Figure 3. This essential habitat mapping is used to determine the habitat and/or biodiversity status of the broader vegetation areas when assessing applications for clearing.

Western rosewood (*Acacia spania*) is a Near Threatened species which HERBRECS indicates is growing at the Cavendish Homestead on a small lense of red sand amongst cleared silver-leaf ironbark (-23.4313, 146.2877 GDA decimal degrees). The location of this record is approximately 7 km west of the mine surface clearance footprint but is located above the underground mining footprint **(Figure 3)**. The Queensland Herbarium also has a record of the species 21.5 km southeast of Jericho.

The WorleyParsons (2009) survey of the BNR recorded large-podded tick-trefoil plants at five locations (plotted separately to the essential habitat described above in Figure 3), one of which had been previously recorded by the Queensland Herbarium (in 2003). The October 2009 and April 2010 surveys were unable to confirm the potential extent of large-podded tick-trefoil beyond these five locations.

Table 1. Threatened and Near Threatened flora species recorded as occurring within or having ranges that overlap the study area

COMMON NAME	SCIENTIFIC NAME	STATUS		PREFERRED HABITAT	SOURCE
		NC ACT[1]	EPBC ACT[2]		
western rosewood	*Acacia spania*	NT	–	Shallow sandstone-derived soils in open eucalypt woodlands or acacia shrub-lands. Known within study area but no preferred habitat within mine surface clearance footprint.	1,2
large-podded tick-trefoil	*Desmodium macrocarpum*	NT	–	Open forests and woodlands and semi-evergreen vine thickets in red earths, rarely sandy clay soils throughout the coastal ranges of eastern QLD as far west as Longreach and at altitudes to 884 m (DNR, 1999). Known within study area and mine surface clearance footprint.	1,2,3
round-leaved myrtle	*Micromyrtus rotundifolia*	V	–	Acacia shrublands and in eucalypt-acacia woodlands on breakaways associated with the Great Dividing Range in shallow and sandy red soils in central west QLD. Known north east of the study area but no preferred habitat within mine surface clearance footprint.	1,2

Status: [1] State (NC Act) listed: E = Endangered; V = Vulnerable; NT = Near Threatened

[2] Commonwealth (EPBC) listed: E = Endangered; V = Vulnerable

Source: 1 = QEPA WildNet record; 2 = Herbrecs; 3 = BNR Rapid Assessment Worley Parsons Field Survey May 2009

Note: Western rosewood and large-podded tick-trefoil were listed as Rare under the NC Act until early 2010. However, the Rare category has been phased out and replaced by the category Near Threatened (DERM, 2010). All previously listed Rare species are being progressively reviewed by DERM. In the mean time the transfer of Rare species to the Near Threatened category does not change the management requirements for these species (DERM, 2010).

Conditions for detection of large-podded tick-trefoil individuals and groups were problematic during both these periods. Indeed, in October 2009 weather conditions were very dry (specimens were desiccated, and in April 2010 the ground layer had become dominated by tall dense grasses (particularly buffel grass). Due to the challenges of surveying for this species it is considered likely that additional individuals and groups occur within the study area.

The WorleyParsons (2009) survey identified between 33 and 53 individual large-podded tick-trefoil plants. The majority of these occur at two sites while the other three sites recorded less than five individuals at each site. The numbers of individuals recorded at each site are represented in Table 2 and illustrated in Figure 3.

Table 2. Numbers of Large-podded Tick-trefoil individuals previously recorded

SITE	COORDINATES (GDA DECIMAL DEGREES)	NUMBERS OF INDIVIDUALS
1	- 23.46154962540 - 146.34912210200	< 5
2	-23.41767020590 - 146.42038691800	1
3	-23.41713550330 - 146.40076463900	20-30
4	-23.44261624300 - 146.39600947200	2
5	-23.44231098760 - 146.34495789600	10-15

Source: WorleyParsons, 2009

Based on the WorleyParsons (2009) survey results, between 33 and 53 individuals large-podded tick-trefoil occur within the study area. At least 21-33 individuals occur within the mine surface clearance footprint, which equates to over half of the populations within the study area.

Large-podded tick-trefoil is an herbaceous perennial scrambler to 0.5 m that is known to be self-pollinating (Hacker, 1990 as cited in DNR, 1999). It normally occurs in open eucalypt woodlands and open eucalypt forest communities predominantly on red earths (rarely on sandy clay soils) and has been recorded to 884 m elevation (Queensland Herbarium, 1996 as cited in DNR, 1999). Populations have been recorded from north of Townsville to near Mundubbera and as far west as Longreach. The closest known populations occur 50 km and 70 km northwest and 120 km east of the study area.

Round-leaved myrtle (*Micromyrtus rotundifolia*) has been recorded by the Queensland Herbarium in association with hilly terrain to the northwest of the study area. The mine surface clearance footprint does not contain suitable habitat for this species.

No other NC Act Threatened or Near Threatened flora species were identified during the assessment and no flora species listed under the EPBC Act were identified by either the desktop review or the field surveys.

Although it is not possible to rule out the potential occurrence of any EPBC Act listed flora species (or any NC Act Threatened or Near Threatened flora species in addition to the species detailed above), the likelihood of occurrence of additional species within the mine surface clearance footprint or above the underground mining areas is considered to be low. Vegetation communities across the study site are dominated by buffel grass pasture and open woodland similar to that in the BNR.

6.3.1.6 Regionally Significant Flora Species

Three Regionally Significant flora species were identified in a search of the DERM Biodiversity Assessment and Mapping Methodology (BAMM) database from the wider study area.

- Sandstone wattle (*Acacia gnidium*);
- Broad-leaved sandstone myrtle (*Homoranthus thomasii*); and,
- Desert heather (*Calytrix microcoma*).

These species are representative of assessed portions of the Desert Uplands bioregion which are considered to be of special biodiversity value. There is potential for these species to occur in the northwestern corner of the study area above the underground mining activities, but they are not within or adjacent to the mine surface clearance footprint. No Regionally Significant species were observed within the study area during the field survey.

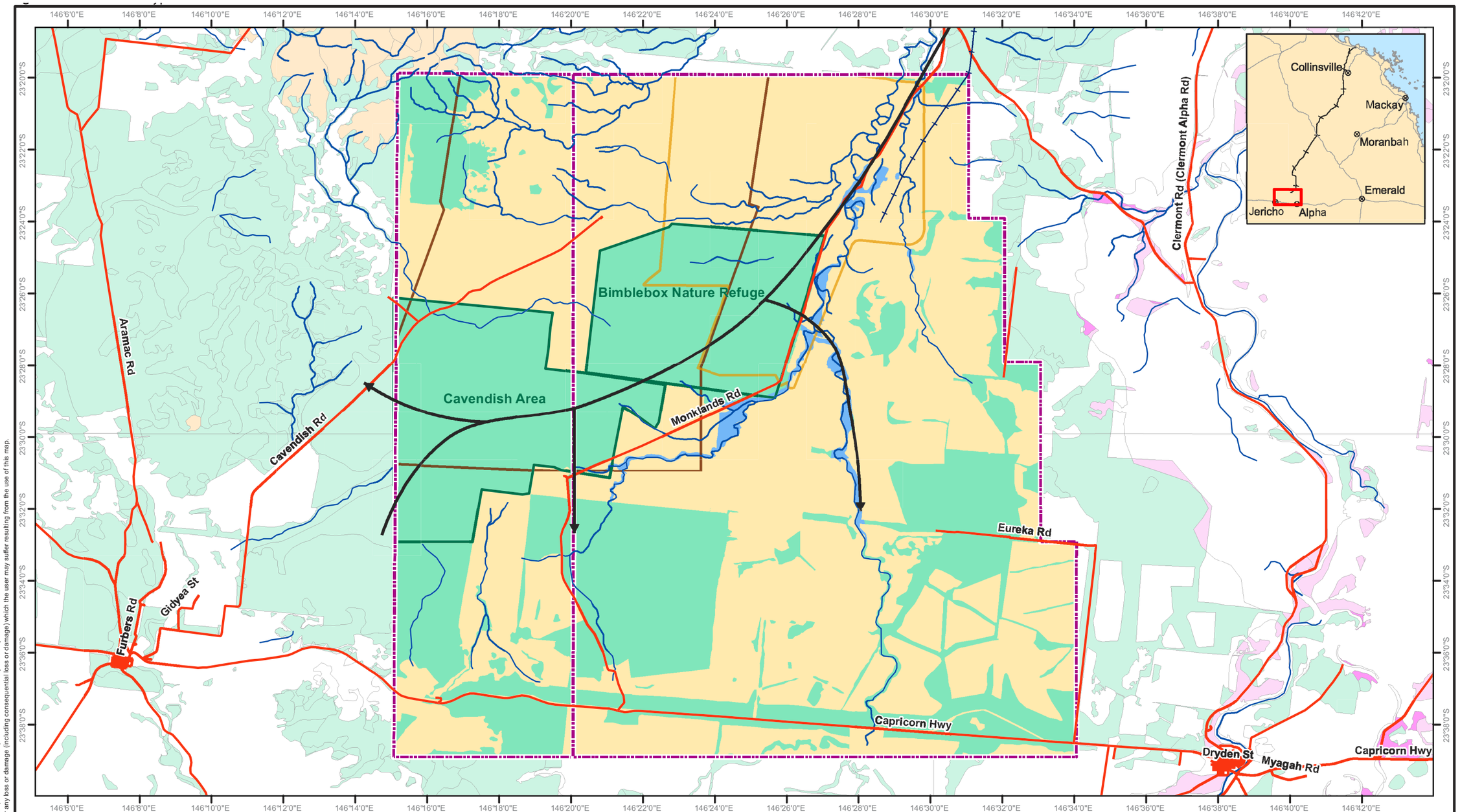
6.3.1.7 Significant Weed Species

The study area is generally dominated by blade ploughed and pulled paddocks that contain a high density (> 95 %) of pasture grass (primarily buffel grass). This environmental weed is also present in open woodland areas but in lower densities (generally less than 5% cover).

Table 3. List of non-native flora species recorded during field surveys

COMMON NAME	SCIENTIFIC NAME	STATUS
Rubber vine	*Cryptostegia grandiflora*	WONS & Class 2
Prickly pear	*Opuntia tomentosa*	Class 2
Arsenic weed	*Senna obtusifolia*	Class 2
Buffel grass	*Pennisetum ciliare*	NA
Natal grass	*Melinis repens*	NA
Durban grass	*Dactyloctenium australe*	NA
Shrubby scabra	*Stylosanthes scabra*	NA
Olive hymenachne	*Hymenachne amplexicaulis*	NA

Figure 3. Fauna Habitat Types



Fauna Habitat Types and Linkages

Data Source
ESA Data © State of Queensland (Department of Environment and Resource Management) 2010

Job: WACL_2535
Date: 21/06/2011

Legend

- Rail Alignment (Option 1)
- Fauna Movement Linkages
- Roads
- Watercourse
- Mine Study Area
- Surface Clearance Footprint
- Underground Mine Area
- Habitat Areas

Habitat Type

- Buffel Grass Pasture Habitat
- Open Woodland Habitat
- Riverine Habitat

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UNIDEL INFRASTRUCTURE ENERGY RESULTS

6.3.2 FAUNA

6.3.2.1 Terrestrial Fauna Field Assessment

Fauna desktop studies and field surveys:

- gathered an inventory of fauna for the area and detailed overall distributions and habitat preferences as well as in the broader environment in order for potential impacts associated with activities in a local, regional and state context;
- identified the presence / absence or likely presence / absence of Threatened and Near Threatened fauna species identified in Commonwealth and State legislation; and
- observed the general distributions of declared feral species.

Detailed field survey methodologies are outlined in Appendix 10 and 10 A.

6.3.2.2 Fauna Habitats

Biological values in the improved pasture sections of the study area were found to be low, due to the highly disturbed and degraded nature of the habitats observed (i.e. a large proportion of the area consists of blade-ploughed buffel grass pasture). However, the open woodland areas have higher fauna habitat values. The fauna values of the study site are discussed below.

Three broad fauna habitat types were identified as being present within the study area:

1. open woodland,
2. riverine; and
3. buffel grass pasture.

6.3.2.3 Open Woodland Habitats

The majority of open woodland habitats are eucalypt woodlands but also include some acacia woodlands.

Open woodland habitats occupy approximately 30 % of the study area (and approximately 18 % of the mine surface clearance footprint) and are distributed across the majority of the study area (with the exception of the north eastern portions). Relatively large areas of open woodland habitats adjoin the study area on all sides (Figure 3).

The open woodland habitats can be broken down as follows:

- BNR;
- Cavendish area; and
- Sandstone escarpment.

BNR

The BNR is managed for conservation and beef production purposes as part of the cattle grazing enterprise conducted by Glen Innes Station. The vegetation in this area was found to range from average to very good condition with evidence of grazing, clearing for tracks, buffel grass invasion and patches of dieback present in varying degrees.

The BNR is mostly dominated by silver-leafed ironbark open woodland on sandplains (RE 10.5.5) which is identified by Morgan *et al.* (2002) as an area of species biodiversity with habitat values for a variety of fauna, and particularly for woodland birds. The mature woodlands in the BNR include individual large habitat trees with hollows suitable for use by arboreal mammals, bats and birds. The trees provide bark habitats as well as contributing fallen logs and branches to the ground layer. However, the fallen timber is very sparsely distributed which may limit the habitat value for mammals and reptiles which are dependent on woody debris.

Generally, the BNR has a sparse shrublayer to one metre tall although it is dense in some areas where it provides good habitat for small insectivorous birds.

The ground layer generally has limited buffel grass content (mostly <5 %) and supports a relatively intact, dense understorey of native grasses which provides habitat niches for a number of reptile and mammal species.

Current research being conducted in the BNR includes rangeland assessment and monitoring by CSIRO Sustainable Ecosystems. The Queensland Herbarium has a number of permanent monitoring sites in the refuge for the purpose of studying the effects of buffel grass invasion into natural systems and also ecological processes including fire dynamics (E. Vanderduys pers. comm. and R. Fensham pers. comm.).

Cavendish Area

Woodlands in the Cavendish property to the west of the BNR also have relatively high conservation values with generally similar plant species and fauna habitats to those found to occur in the BNR although buffel grass may be more widespread in this area than in the BNR.

This habitat is generally in very good condition and is composed mostly of lancewood, silver-leaved ironbark, and poplar box open woodland. The understorey is made up of shrubs and grasses. Logs are present and tree hollows are in relatively high abundance.

Sandstone Escarpment

This area consists mostly of Eucalypt open woodlands (e.g. yellowjacket (*E. similis*), slender-leaved ironbark (*E. exilipes*), poplar box and Thozet's box (*E. thozetiana*)) with patches of lancewood woodland and occurs in the north west of the study area. The two sites assessed in nearest proximity to the mine surface clearance footprint (i.e. BB06 and BB26) were found to be in average condition.Riverine Habitat (Lagoon Creek)

The riverine habitats in the eastern edge of the study area, although heavily grazed and with an understory dominated by buffel grass, were found to have habitat value for mobile species such as bats and some birds, and also species closely associated with the larger riverine trees, such as brushtail possums (*Trichosurus vulpecula*) and hollow nesting birds.

Lagoon Creek in particular, supports tracts of remnant vegetation (RE 10.4.3 / 11.3.27) including extensive linear strips of mature river red gums that fringe ephemeral and semi-permanent waterholes. This habitat contains a high proportion of large tree-hollows. The aquatic habitat values associated with this site are described in **Volume 2, Chapter 7**.

6.3.2.4 Buffel Grass Pasture Habitat

The majority of the study area and mine surface clearance footprint consists of cleared, grazing lands that support a monoculture of buffel grass. Occasional shrubs and trees occur along fence lines and in some drainage depressions. The areas are mapped by DERM as non-remnant.

Night spotlight surveys in the buffel grass pasture habitat north of the BNR identified spectacled hare-wallabies (*Lagorchestes conspicillatus*) and rufous bettongs (*Aepyprymnus rufescens*) feeding in this area, which are two Regionally Significant species. The Australian bustard (*Ardeotis australis*), also of conservation significance, was recorded in this area. Other than these records, the buffel grass pasture habitat was found to support several common bird species. No native reptiles, frogs or other small mammals were recorded.

6.3.2.5 Connectivity

The largest tract of intact native vegetation in the study area is the joint Cavendish area / BNR. Overall, connectivity values of these woodlands to areas to the west and south west are considered to be high. However due to lack of adjoining native vegetation in all other directions, connectivity to the north, east and south east is considered low. Lagoon Creek to the east provides some limited connectivity value for relatively mobile species including birds, bats and larger mammals.

6.3.2.6 Threatened and Near Threatened Fauna Species

The review of information available revealed a total of 10 Threatened and Near Threatened fauna species as potentially occurring across the study area (under the NC Act or the EPBC Act). An additional 15 species, that are not listed as Threatened or Near Threatened but which are listed under the EPBC Act as Marine and / or Migratory fauna species, were also identified as potentially occurring across the study area. The species have been recorded from, or may potentially utilise habitat, within the broader area. They comprise three reptiles, six birds and one mammal.

The Endangered (NC Act listed species) Troughton's sheathtail-bat (*Taphozous troughtoni*) was tentatively recorded (ultrasonic recording) within the BNR by WorleyParsons (2009) on the basis of echolocation call analysis. The calls of this species are very similar to those of a free-tail bat (*Mormopterus* sp.3.) and since there are no cave formations within the local region (roosting habitat for *Taphozous*), it is most likely that all echolocation call records are attributable to this latter species which is not listed as threatened under any legislation. Further, preliminary genetic investigations suggest that the name *T. troughtoni* is synonymous with the common and widespread common sheathtail bat (*Taphozous georgianus*) in Queensland (Hall, 2008). For these reasons, the species has been excluded from this report.

Table 4. Assessment of general habitat values for threatened species and connectivity between habitat areas

HABITAT	QUALITY OF EXISTING HABITAT	LIKELY EVNT SPECIES OCCURRENCES	CONNECTIVITY
Bimblebox Nature Refuge (BNR) dominated by silver-leafed ironbark open woodland on sandplains (RE 10.5.5)	Very high	All EVNT species mapped in this southern part of the project footprint may possibly occur in this area – those species likely to occur are listed in Table 5. * Refer to list below	Joins to Cavendish in the south west and Lagoon Creek in the east.
Cavendish Area Woodlands - mostly lancewood, silver-leaved ironbark, and poplar box open woodland. The understorey is made up of shrubs and grasses - buffel grass may be more widespread than in BNR.	Very high	All EVNT species mapped in this southern part of the project footprint may possibly occur in this area. Logs are present and tree hollows are in relatively high abundance – those species likely to occur are listed in Table 5. * Refer to list below.	Joins extensive areas of remnant to the west.
Sandstone Escarpment Occurs in the north west of the study area - eucalypt open woodlands (e.g. yellowjacket (*E. similis*), slender-leaved ironbark (*E. exilipes*), poplar box and Thozet's Box (*E. thozetiana*)) with patches of Lancewood woodland.	Low	The two sites assessed in nearest proximity to the mine footprint (i.e. BB06 and BB26) were found to be in average condition. Unlikely occurrence of eastern long-eared bat, northern quoll, squatter pigeon, brigalow scaly-foot, yakka skink.	Joins extensive areas of remnant to the west.
Riverine Habitat (Lagoon Creek) On eastern edge of the study area. Is heavily grazed with an understory dominated by buffel grass. Lagoon Creek in particular, supports tracts of remnant vegetation (RE 10.4.3 / 11.3.27) including extensive linear strips of mature river red gums that fringe ephemeral and semi-permanent waterholes.	High	Riverine, aquatic and species associated with large trees (blossom feeding and hollow-nesting); migratory water birds. Likely to provide habitat value for mobile species such as bats and some birds, and also species closely associated with the larger riverine trees, such as brushtail possums (Trichosurus vulpecula) and hollow nesting birds. This habitat contains a high proportion of large tree-hollows.	Joins BNR to the west and in itself, forms a linear riparian corridor of many km in length.
Buffel Grass Pasture Habitat Dominates the mine footprint. Consists of cleared, grazing lands dominated by buffel grass. Occasional shrubs and trees occur along fence lines and in some drainage depressions.	Very Low	Some foraging by regionally significant species. Surveys to the north of the BNR identified spectacled hare-wallabies (*Lagorchestes conspicillatus*) and rufous bettongs (*Aepyprymnus rufescens*), two regionally significant species. The Australian bustard (*Ardeotis australis*), also of conservation significance, was recorded in this area. Apart from several common bird species, no native reptile, frog or other small mammal species were recorded. May provide habitat for Migratory inland waterbirds after rain.	Non-remnant

* Endangered, Vulnerable and Near Threatened (EVNT) species: common death adder, yakka skink, Brigalow scaly-foot, fork-tailed swift, great egret, cattle egret, sharp-tailed sandpiper, black-necked stork, horsfield's bronze-cuckoo, Latham's snipe, squatter pigeon (southern), sarus crane, white-throated needletail, square-tailed kite, black-chinned honeyeater, rainbow bee-eater, southern boobook, little curlew, black-throated finch (southern), sacred kingfisher, Australian painted snipe, common greenshank, marsh sandpiper, channel-billed cuckoo, eastern long-eared bat

An unconfirmed sighting of squatter pigeon (*Geophaps scripta scripta*) was made in the BNR. This Vulnerable (NC Act and EPBC Act listed) species is likely to occur within the study area and has been reported to occur in the area (E. Vanderduys pers. comm.).

Additional work as part of an on-going site survey and habitat assessment program for black-throated finch (southern) (*Poephila cincta cincta*) has revealed a putative record of black throated finch from the BNR. SEWPaC have advised Waratah Coal that they have been in contact with an ornithologist who claims to have recorded black-throated finch on the Bimblebox Nature Refuge, and with Birds Australia. Based on conversations with Birds Australia SEWPaC have advised Waratah Coal that they have high confidence in the record of this species, but have not yet received written confirmation that the record has been accepted by Birds Australia.

Waratah Coal have also independently sought confirmation and record details, but at the time of preparing this EIS, no further information on that record has been made available. No black-throated finches were observed during either the Unidel (2010) assessment or the additional 14 survey-person day field assessment (Austecology, 2011). A full account of the black-throated finch surveys and habitat assessments is provided in Appendix 10A.

No other Threatened or Near Threatened fauna species were recorded during the field surveys.

Table 5 presents a list of Threatened, Near Threatened and Migratory fauna species that have been identified as occurring or potentially occurring across the study area. It also presents a description of preferred habitat for each species and an assessment of whether this habitat occurs within or adjoining the mine surface clearance footprint.

Additional information in the form of potential habitat maps for brigalow scaly-foot, yakka skink, Australian painted snipe and black-throated finch at the mine site can be found at Figure 5, Figure 6, Figure 7 and Figure 8 (respectively) of the MNES standalone report in Chapter 26 of Volume 5.

Table 5. Threatened, Near Threatened and Migratory fauna species potentially present within the study area

COMMON NAME	SCIENTIFIC NAME	STATUS		PREFERRED HABITAT	LIKELIHOOD OF OCCURRENCE WITHIN STUDY CORRIDOR	BASIS FOR MAPPED LIKELIHOOD OF OCCURRENCE
		NC ACT[1]	EPBC ACT[2]			
Reptiles						
Common Death Adder	*Acanthophis antarcticus*	NT	–	Wet and dry eucalypt forests, woodlands and coastal heaths.	Likely	All remnant vegetation except Landzones 1, 2.
Yakka Skink	*Egernia rugosa*	V	V	Poplar box, ironbark, brigalow, white cypress pine, mulga, bendee and lancewood woodlands, open forests. Substrates include rock, sand, clay and loamy red earth.	Likely	All remnant vegetation in project area except Landzones 1 & 2.
Brigalow Scaly-foot	*Paradelma orientalis*	V	V	Sandstone ridges in woodlands and vine thickets, and in open forests and woodlands, especially ironbark, cypress pine, Brigalow, bull oak, spotted gum and vine scrubs.	Possible	Remnant vegetation in Landzones 3,4,5,7,8,9 &10 South of latitude -21.70.
Birds						
Fork-tailed Swift	*Apus pacificus*	–	Mi	Aerial forager of insects. Often seen flying before storm fronts. Not known to land on the Australian continent.	Likely	Throughout study area
Great Egret	*Ardea alba*	–	Mi	Widespread species – common.	Likely	Throughout Study area, Landzones 1,3,4,5,9
Cattle Egret	*Ardea ibis*	–	Mi	Widespread species – common.	Likely	Throughout Study area, Landzones 1,3,4,5,9
Sharp-tailed Sandpiper	*Calidris acuminata*		Mi	Fresh or saltwater wetlands, edges of lagoons, swamps, lakes and similar habitats.	Likely	Landzone 1,3
Black-necked Stork	*Ephippiorhynchus asiaticus*	NT	–	Permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands.	Likely	Landzone 1,3
Horsfield's Bronze-cuckoo	*Chalcites basalis*		Mi	Found in many wooded habitats (such as open and dry woodland and forest) with a range of understoreys from grasses to shrubs or heath.	Likely	Throughout the study area in remnant vegetation areas

COMMON NAME	SCIENTIFIC NAME	STATUS		PREFERRED HABITAT	LIKELIHOOD OF OCCURRENCE WITHIN STUDY CORRIDOR	BASIS FOR MAPPED LIKELIHOOD OF OCCURRENCE
		NC ACT[1]	EPBC ACT[2]			
Latham's Snipe	*Gallinago hardwickii*	–	Mi	Marshes and swamps in tall grass.	Likely	Throughout Study area in Landzones 1,3
Squatter Pigeon (southern)	*Geophaps scripta scripta*	V	V	Patchy distribution in dry eucalypt forest, often near water. Recorded from Abbot Point area. Locally extinct in former southerly parts of its range.	Likely	Throughout study area
Sarus Crane	*Grus antigone*	–	Mi	Swamps, grasslands and coastal mudflats.	Likely	Throughout Study area in Landzones 1,3
White-throated Needletail	*Hirundapus caudacutus*	–	Mi	Migrant, occasionally found in airspace over project area only.	Likely	Throughout the study area
Square-tailed Kite	*Lophoictinia isura*	NT	–	Variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	Likely	Remnant vegetation throughout study area in Landzones 3, 8-12
Black-chinned Honeyeater	*Melithreptus gularis*	NT	–	Upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (Eucalyptus sideroxylon), White Box (*Eucalyptus albens*), Grey Box (*Eucalyptus microcarpa*), Yellow Box (*Eucalyptus melliodora*) and Forest Red Gum (*Eucalyptus tereticornis*).	Likely	All remnant vegetation south of Latitude-20.02 and north of Latitude -22.21
Rainbow Bee-eater	*Merops ornatus*	–	Mi	Variety of habitats. May breed in sand banks of creeks and rivers. Seasonal visitor.	Likely	Throughout study area
Southern Boobook	*Ninox novaeseelandiae*		Mi	Southern Boobooks are seen in a variety of habitats from dense forest to open desert.	Likely	Throughout study area
Little Curlew	*Numenius minutus*	–	Mi	Coastal and inland grasslands and black soil plains in northern Australia, near swamps and flooded areas.	Likely	Throughout Study area in Landzones 1,3, 4,5,8

COMMON NAME	SCIENTIFIC NAME	STATUS		PREFERRED HABITAT	LIKELIHOOD OF OCCURRENCE WITHIN STUDY CORRIDOR	BASIS FOR MAPPED LIKELIHOOD OF OCCURRENCE
		NC ACT[1]	EPBC ACT[2]			
Black-throated Finch (southern)	*Poephila cincta cincta*	E	E	Eucalypt woodland and riverside vegetation, including paperbark and Acacia shrublands and dense riverine grass and reed areas with scattered trees.	Likely	17 REs in which this subspecies was recorded between 1994 and 2007 (Black-throated Finch Recovery Team *et al.* 2007)
Sacred Kingfisher	*Todiramphus sanctus*		Mi	Shallow inland wetlands, either freshwater or brackish, and seasonally or ephemerally inundated pastures and grasslands.	Likely	Throughout Study area in Landzones 1,3,4,5,8
Australian Painted Snipe	*Rostratula australis*	V	V/Mi	The Sacred Kingfisher inhabits woodlands, mangroves and paperbark forests, tall open eucalypt forest and melaleuca forest.	Likely	Throughout the study area
Common Greenshank	*Tringa nebularia*	–	Mi	On the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops.	Likely	Throughout Study area in Landzones 1,3,4,5,8
Marsh Sandpiper	*Tringa stagnatilis*	–	Mi	Fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps.	Likely	Throughout Study area in Landzones 1,3,4,5,8
Channel-billed Cuckoo	*Scythrops novaehollandiae*		Mi	Summer breeding migrant to the tall open forests in northern and eastern Australia. Widespread in suitable habitat where it parasitises currawongs, crows and magpies.	Likely	Remnant vegetation throughout the study area
Mammals						
Eastern Long-eared Bat*	*Nyctophilus timoriensis*	V	V	Mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities. Roosts in tree hollows, crevices, and under loose bark.	Unlikely	All remnant veg south of Latitude -21.69

Status: [1] State (NC Act) listed: E = Endangered; V = Vulnerable; NT = Near Threatened

[2] Commonwealth (EPBC) listed: E = Endangered; V = Vulnerable

Source: EPBC Protected Matters Search; QEPA WildNet record; Queensland Museum (QM) record; Bird data online; WorleyParsons (2009); Mackay Conservation Council (2009).
EPBC = Listed status under the EPBC Act: Mi = Migratory Species.

* Taxonomic debate about whether this is a separate species to the widespread and common sheathtail-bat (Hall, 2008). Tentative identification only.

6.3.2.7 Regionally Significant Fauna Species

According to database searches, 46 Priority Species listed under BAMM for the Desert Uplands (Criteria H) (EPA, 2005) may potentially occur within or in the broad vicinity of the study area.

Eleven Regionally Significant fauna species were observed within the study area during the Unidel field survey (2010) (see Table 6).

Table 6. Regionally Significant fauna species recorded in the study area

COMMON NAME	SCIENTIFIC NAME	NUMBER OF RECORDS
	Frog	
Great Brown Broodfrog	*Pseudophryne major*	1
	Birds	
Australian Bustard	*Ardeotis australis*	4
Bush Stone-curlew	*Burhinus grallarius*	1
Brown Treecreeper	*Climacteris picumnus*	2
Hooded Robin	*Melanodryas cucullata*	2
Grey-crowned Babbler	*Pomatostomus temporalis*	3
	Mammals	
Rufous Bettong	*Aepyprymnus rufescens*	8
Spectacled Hare-wallaby	*Lagorchestes conspicillatus*	2
Desert Mouse	*Pseudomys desertor*	4
Common Brushtail Possum	*Trichosurus vulpecula*	3
Swamp Wallaby	*Wallabia bicolor*	1

6.3.2.8 Vertebrate Fauna Recorded During Field Survey

A total of 130 vertebrate species were recorded during the Unidel (2010) field survey. This includes 5 amphibians, 15 reptiles, 88 birds and 22 mammals. In addition, a total of nine bat taxa were identified.

With the exception of one amphibian species cane toad (*Rhinella marinus*), three mammal species cat (*Felis catus*); rabbit (*Oryctolagus cuniculus*) and cattle (*Bos taurus*), all of the species recorded are native species currently listed as 'Least Concern' wildlife under the NC Act.

Table 7 summarises the number of vertebrate records and species per habitat area.

Overall, both the number of vertebrate records and number of species recorded were higher in the open woodland than in the riparian or buffel grass pasture.

The number of vertebrate records and number of species recorded was highest in the BNR than in the Cavendish area but this variation is likely to be due, at least partially, to the extra sampling effort which occurred in the BNR (which was sampled in both the dry and wet seasons whereas other surveys outside the Refuge only occurred in the wet season).

Table 7. Number of vertebrate records and species per habitat type and area

HABITAT TYPE AND AREA	OPEN WOODLAND		RIVERINE (LAGOON CREEK)	BUFFEL GRASS PASTURE	GRAND TOTAL
	(BNR)	(CAVENDISH AREA)			
TOTAL NUMBER OF VERTEBRATE RECORDS	158	52	81	86	377
TOTAL NUMBER OF VERTEBRATE SPECIES	93	63	54	40	130

The species diversity in the Cavendish area was also relatively high, considering the much lower number of total records obtained from this area. Some records were for multiple species.

The riverine habitat recorded a number of species that are associated with eucalypt forest environments, such as brushtail possums and lorikeets. These species were not recorded elsewhere. Records along the riverine habitat also included many aquatic birds such as ducks and herons.

The buffel grass pasture habitats recorded the lowest number of species and many of these were ubiquitous and resilient species that adapt readily to altered environments, such as Torresian crows (*Corvus orru*), Zebra finch (*Taeniopygia guttata*) and other species often associated with open grasslands such as the Australian bustard, red and eastern grey kangaroos (*Macropus rufus* and *M. giganteus*), masked lapwings (*Vanellus miles*) and emus (*Dromaius novaehollandiae*). Pitfall and funnel traps set in this environment only recorded frogs (e.g. desert tree frog (*Litoria rubella*), ornate burrowing frog (*Limnodynastes ornatus*) and green tree frog (*L. aurea*).

6.3.2.9 Introduced Fauna

Four common introduced species were recorded from the study area (i.e. cane toad, cat, cattle and rabbit). These species occur widely within the local district and two of them (rabbit and cat) are declared animals listed under the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act).

6.3.3 WETLANDS

There is no Nationally Important Wetland or Wetlands of International Importance (Ramsar sites) within and / or in the vicinity of the study area.

The DERM Queensland Wetland Mapping identifies several freshwater palustrine and lacustrine wetlands within the study area. These wetlands are identified as being watercourses that are fringed with RE 10.3.14 and RE 10.3.15. These watercourses are commonly ephemeral creeks and several sections of Lagoon Creek contain temporary / semi-permanent waterholes, which are fringed with mature red gums. These riparian waterholes are not suitable for hosting breeding or significant congregations of migratory or nomadic birds.

A detailed assessment of the aquatic values associated with these watercourses is provided in the Aquatic Ecology technical report at Volume 5, Chapter 7.

6.4 POTENTIAL IMPACTS DURING CONSTRUCTION

The construction and operation of the mine has the potential to impact the terrestrial ecology of the area. The following section discusses these potential impacts and identifies the likelihood of occurrence and the potential consequence of these impacts.

6.4.1 SIGNIFICANCE OF CONSTRUCTION OF THE MINE IN A STATE, BIOREGIONAL AND LOCAL CONTEXT

In order to ascertain the clearing related impacts that may occur within the project area and to place this in a bioregional perspective, the following has been analysed:

- the total mapped area of EPBC-listed ecological communities within the project area and the extent and percentage of the area that may be impacted;
- the total mapped area of VM Act Endangered, Of Concern and Least Concern REs within the project area and the extent and percentage of the area that they may occur; and
- the overall extent of these RE categories within the bioregion.

6.4.1.1 Open cut mine

Clearance areas and figures refer to the area within the surface mine clearance footprint or the open cut portion of the site. Accordingly, the estimates provided in Table 8 relate to the surface mine clearance only. These are worst case scenario as actual loss is likely to be less when mitigation measures are implemented such as environmental offsets.

Within the Desert Uplands bioregional context, the mine clearance footprint would require the unavoidable removal of approximately 4,595 ha of Least Concern remnant vegetation, which represents approximately 0.3 % of the remnant vegetation in the Bioregion. This includes clearance of approximately 1.65 % of RE 10.3.27 which is classified as Of Concern under its DERM Biodiversity Status.

The surface mine clearance footprint includes 52 % of the BNR (an area identified by DERM as a Category C Environmentally Sensitive Area). At the local scale the direct impact of clearing in the BNR has been determined to be High, for Threatened and Near Threatened, Migratory and most Regionally Significant fauna species, this proposed clearance represents a proportionally minor reduction in spatial extent of suitable habitats that are extensively represented in the local area and other parts of the bioregion.

The mine will require diversion of Lagoon Creek and clearing of the associated riparian habitats. Removal of these habitats, and the limited level of fauna movement connectivity that they currently provide, has been determined to be a Medium impact in the local context. Approximately 77 ha of RE 10.3.12 is proposed to be cleared, which equates to 44 % of the amount of that remnant estimated to occur within a 10 km buffer. This potential impact has been determined to be High for this RE in the local context. However, the latest information provided by DERM shows that this RE is widely distributed across the bioregion. In 2006 the remnant extent was >10,000 ha and >30 % of the pre-clearing area remained.

6.4.1.2 Underground mine

The total area to be affected by subsidence is expected to be in the order of 25,161 ha. This area contains both improved pasture and Least Concern remnant vegetation (see Figure 1) and includes a large part of the BNR (Figure 2). This figure is based upon an expectation of subsidence in the areas directly above the underground mine, as well as an additional 'buffer' area of 350 m directly adjacent to the actual mined areas. It should be noted that this 350 m buffer is a very conservative estimate as the level of extension of subsidence outside of the limits of extraction is usually assumed to be half the depth of cover (to the coal) in the Queensland coalfields. The level of cover for the project is between 80 m and 350 m. See Section 1.3.6 of Volume 2, Chapter 2 for a more detailed description of the subsidence expected as a result of the project.

The surface above the underground mine area will not be cleared of vegetation. Given the level of subsidence above the open woodland areas (i.e. expected to range between 1.3 m to 1.61 m) and the sandy nature of the soils in this area, there is not expected to be any substantial cracking within the open woodland areas. However, despite this expectation, it is reasonable to assume that there will be some level of indirect impact from the subsidence associated with the underground mining areas on the overlying habitat. For example, it is acknowledged that there may be depressions resulting from this degree of subsidence. This could affect surface drainage patterns and possibly create long-term impacts to the surface vegetation communities such as alteration of species habitats and the ecological function of communities. Species and ecological communities dependent upon aquatic and semi-aquatic habitats are particularly susceptible to the impacts of subsidence. Effects could be temporary or long-term. Given the uncertainties described, more work will need to be undertaken to quantify the type and magnitude of the impacts of subsidence on the habitat above the underground mining activities.

A Subsidence Management Plan will be prepared prior to the commencement of underground mining operations. The plan will be risk based, flexible, responsive and capable of dealing with unexpected changes or uncertainties. The plan will consider and include if necessary the mitigation measures outlined above to re-establish drainage patterns and included the ripping, ploughing and reseeding of surface cracks and earthworks to redirect drainage and address erosion. In addition, Waratah Coal will provide compensation for unavoidable impacts of subsidence within the Bimblebox Nature Refuge.

6.4.2 POTENTIAL IMPACTS OF CONSTRUCTION ON FLORA IN GENERAL

The majority (69 %) of the mine surface clearance footprint encompasses areas of cleared non-remnant vegetation (i.e. pasture land). However, the southern and eastern portions of this footprint are located within VM Act Least Concern eucalypt woodlands as well as riparian vegetation associated with Lagoon Creek. No EPBC Act or VM Act listed ecological communities / REs are required to be cleared.

In all, approximately 4,595 ha of remnant vegetation is proposed to be cleared. This represents approximately 7 % of the entire vegetation extent within a 10 km buffer and 0.3% of that which occurs in the Desert Uplands bioregion.

Potential direct and indirect impacts to flora associated with the proposed clearing include:

- direct spatial reduction in remnant vegetation due to clearing (detailed below);

- increased edge effects within the BNR (through reducing the edge to area ratio and moving the edge) including the potential to increase the abundance of buffel grass and other weeds;
- potential for increased fire intensity if buffel grass densities within the BNR are increased;
- potential for changes to vegetation above underground mining areas;
- potential for dust to reduce the health of retained vegetation in the vicinity of the clearance footprint;
- potential for temporary facilities, materials and equipment to damage areas outside the construction footprint;
- potential to alter the hydrological characteristics for areas above the underground mining areas and areas adjoining and downstream of the mine; and,
- potential for accidental and inappropriate release of pollutants.

6.4.3 POTENTIAL IMPACTS OF CONSTRUCTION ON ECOLOGICAL COMMUNITIES

6.4.3.1 EPBC Threatened Ecological Communities (TECs)

There are no vegetation communities within the study area that are listed as TECs under the EPBC Act. As such, there are no impacts on this MNES.

6.4.3.2 Endangered REs

No VM Act Endangered REs are required to be cleared or will be impacted by the mine surface clearance footprint.

Two REs classified as Endangered under the DERM Biodiversity Status classification occur within the footprint. The estimated clearing extent is 13.4 ha of RE 10.4.3 and 0.08 ha of RE 10.3.25. The proportion of these REs that this clearing would represent is 0.19 % (RE 10.4.3) and <0.01 % (RE 10.3.25) of that which occurs in the Bioregion. This clearing is unavoidable and will have a minor consequence for these REs within a bioregional context. As such, it represents a Medium impact on these REs as after mitigation measures are implemented, the impact will be reduced.

6.4.3.3 Of Concern REs

No VM Act Of Concern REs is required to be cleared or will be impacted by the mine surface clearance footprint.

Two REs classified as Of Concern under the DERM Biodiversity Status classification occur within the mine surface clearance footprint. The estimated clearing extent is 1,172 ha of RE 10.3.27 and 11.3 ha of RE 10.3.4. The proportion of these REs that this clearing would represent is 1.65 % (RE 10.3.27) and 0.07 % (RE 10.3.4) of that which occurs in the Bioregion and 14 % and 0.58 % within 10 km. This unavoidable clearing will have a moderate consequence for (RE 10.3.27) and minor for

Table 8. Estimated clearing requirements within Least Concern REs

RES	CLEARING EXTENTS (HA)*	EXTENT WITHIN 10 KM BUFFER	% WITHIN 10 KM BUFFER	CLEARING EXTENT WITHIN BIOREGION	% WITHIN BIOREGION
10.3.12a	77.09	175.48	43.93	32,853.64	0.23
10.3.25	0.08	113.88	0.07	11,199.77	<0.01
10.3.27a	1,172.29	8,533.12	13.74	71,031.29	1.65
10.3.28a	128.30	2,130.14	6.02	273,761.32	0.05
10.3.3	40.01	957.41	4.18	31,640.90	0.13
10.3.4b	11.26	1,927.30	0.58	16,810.99	0.07
10.4.3	13.54	185.44	7.30	7,109.01	0.19
10.5.12	315.28	7,319.61	4.31	138,918.13	0.23
10.5.5a	2,836.78	44,441.47	6.38	937,744.75	0.30
11.5.5	0.06	927.93	0.01	927.93	0.01
TOTAL	4,594.68	66,711.78	6.89	1,521,997.73	0.30

(RE 10.3.4) and represents High and Medium impacts respectively for these REs at the local level. However, after mitigation measures are implemented, the impact will be reduced.

6.4.3.4 Least Concern REs

The estimated mine surface clearing footprint within each of the affected Least Concern REs is shown in Table 8.

For the majority of these Least Concern REs the extent of clearing is relatively small in comparison to their local (<10 %) and bioregional (<0.1 %) occurrence. As such the unavoidable impact of the clearing on these REs is of minor consequence and has been determined to be Medium at both local and regional levels. However after mitigation measures are implemented, the impact will be reduced. Mitigation measures are discussed in Section 6.6.1 of this chapter and include measures such as seed collection, use of threatened species propagules in rehabilitation, protection of areas adjacent the mine surface clearing footprint and preparation of a species management plan where appropriate.

Exceptions where a more significant portion of the local and bioregional occurrence is proposed to be cleared are RE 10.3.12 and RE 10.2.27a. The proposed clearing of 1,172 ha of RE10.3.27a represents approximately 14% of that which occurs within the 10 km buffer and approximately 1.65 % of that occurring in the bioregion. Approximately 77 ha of RE 10.3.12 is proposed to be cleared, which equates to 44 % of the amount of that remnant estimated to occur within a 10 km buffer. Localised impacts have been determined to be High for these REs. However, after mitigation measures are implemented the impact will be reduced.

6.4.4 POTENTIAL IMPACTS OF CONSTRUCTION ON THREATENED AND NEAR THREATENED FLORA SPECIES

Five populations of large-podded tick-trefoil are known to occur within the study area.

Potential direct and indirect impacts associated with construction of the mine on this Near Threatened flora species include:

- direct loss of individuals through clearing activities. Approximately 21-33 individuals will be removed. This represents over half of the known plants (33 to 53 individuals (WorleyParsons, 2009)) in the vicinity;
- reduction in the long term viability of the local population by removing approximately over half of the known individual plants. Although there is no known study on the long term viability of the large-podded tick-trefoil, population reduction and increased spatial isolation of plant populations generally result in decreasing genetic variation (Young et al 1996);
- direct loss of mapped Essential Habitat. While a comparatively small area of essential habitat has been mapped, approximately 3,926 ha of potential habitat is proposed to be removed. This figure equates to approximately 52 % of the BNRs existing remnant vegetation extent (7,526 ha) and approximately 0.4 % of amount of the affected REs which occur in the bioregion; and,
- potential to affect health and viability of plants outside the clearance footprint through:
  - increased edge effects and associated potential to increasing the abundance of buffel grass and fire intensity;
  - potential for dust to reduce the health of plants and associated vegetation retained outside the construction footprint; and
  - potential for temporary facilities, materials and equipment to damage plants and associated vegetation outside the construction footprint.

The unavoidable direct impacts of removing over half of the known individual plants in the local population are of moderate consequence and unmitigated the indirect impacts could potentially be major (threatening the locally known occurrence of the species). As such, the potential impact on large-podded tick-trefoil is High. Mitigation measures to help minimise the impacts upon large-podded tick-trefoil are provided in Section 6.6.1.

No other Threatened or Near Threatened flora species were located during the assessment. It is possible but unlikely that any other Threatened or Near Threatened flora species occur within or adjoining the footprint in significant numbers. Therefore no significant impacts are anticipated for any Threatened or Near Threatened flora species with the exception of large-podded tick-trefoil.

6.4.5 POTENTIAL IMPACTS OF CONSTRUCTION ON ENVIRONMENTALLY SENSITIVE AREAS

The mine site is remote from and unlikely to have any detrimental impact upon any Category A ESA. Category A ESAs include national parks, the great Barrier Reef Marine area and other areas of high significance.

No VM Act Endangered REs are required to be cleared or will be impacted by the mine.

Two REs classified as Endangered under the DERM Biodiversity Status classification occur within the mine clearance footprint. The estimated clearing extent is 13.4 ha of RE 10.4.3 and 0.08 ha of RE 10.3.25. The proportion of these REs that this clearing would represent is 0.19% (RE 10.4.3) and <0.01% (RE 10.3.25) of that which occurs in the Bioregion. The need to clear these patches is still to be finalised; however, it is likely that at least some portions will be unavoidable. The consequence is Minor and the impact has been determined to be Medium for these REs in a regional context.

The mine surface clearance footprint overlaps with the BNR, which is classified as a Category C ESA.

The potential impacts on the BNR associated with the construction of the Mine include:

- direct spatial reduction in extent. It is estimated that approximately 3,926 ha of remnant vegetation will be cleared within the BNR as a result of the project construction. This figure equates to approximately 52 % of the Refuge's existing remnant vegetation extent (7,526 ha) and would represent an approximate 0.4 % of amount of the affected REs which occur within the bioregion;
- increased edge effects within the BNR (through reducing the edge to area ratio and moving the edge) including the potential to increase the abundance of buffel grass (and other weeds) and the associated potential for increased fire intensity;
- the underground mining area takes up the remaining 48 % and has the potential to cause subsidence and other impacts on the soil profile, hydrology etc. which may then negatively impact on the vegetation;
- potential for dust to reduce the health of retained vegetation in the vicinity of the clearance footprint; and
- potential for temporary facilities, materials and equipment to damage areas outside the construction footprint.

The unavoidable direct impacts associated with the clearing represent a Major consequence for the BNR and has been determined to be a High impact. Mitigation measures to help minimise the indirect impacts are provided in Section 6.6.1.

6.4.6 POTENTIAL IMPACTS ASSOCIATED WITH DECLARED AND OTHER WEEDS

The construction of the mine has the potential to spread existing declared, environmental and other weeds and introduce new weed species to the area.

Of the three declared weeds that are known to occur in the study area (rubber vine, prickly pear and arsenic weed), there is potential for the mine activities to spread these into currently clean areas through earthworks, movement of vehicles, machinery, equipment, materials and fill. All three species have the potential to cause agricultural and environmental degradation, particularly in alluvial soil areas (Land Zone 3).

The mine activities also have the potential to spread environmental weeds into the adjoining woodlands and riparian areas where they do not currently occur. There is potential for the density and prevalence of buffel grass within the BNR to be increased through edge effects and increased traffic. This species is an introduced and highly valued pasture grass in many areas; however, it has the potential to out-compete native groundcover species. It has the potential to cause an increase in biomass which biases fire regimes towards much more intense and frequent fire events which could degrade the adjoining eucalypt woodlands. The grass itself also provides very little nutritive or forage value for wildlife and therefore areas dominated by the buffel grass can become less biodiverse.

Potential impacts associated with introduction and spread of weeds is possible and could have moderate ecological consequences for adjoining remnant vegetation areas. As such, these potential impacts have been determined to be Medium. Mitigation measures aimed at controlling the introduction and spread of weed species are provided in Section 6.3.6.2.

6.4.7 POTENTIAL IMPACTS OF CONSTRUCTION ON FAUNA IN GENERAL

Potential direct and indirect impacts on fauna are likely to include the following:

- loss of habitat such as mature vegetation, hollow-bearing trees and fallen logs, and therefore loss of nesting, refuge and foraging resources;
- mortality;
- habitat fragmentation and loss of connectivity (disturbance to fauna movement corridors);
- barrier effects; and
- edge effects.

6.4.7.1 Loss of habitat

Clearing of remnant vegetation inevitably results in habitat loss for wildlife fauna species.

An important potential impact on fauna is the loss of hollow-bearing trees. Within the study area large habitat trees (e.g. mature river gums) were observed, in particular, along Lagoon Creek.

Additionally, fallen logs and dead timber on the ground and understorey vegetation provide shelter (either underneath timber or within hollow logs) and food resources for a broad range of small ground-dwelling fauna. Fallen logs and dead timber mostly occur in the riverine habitat (Site FF05, FF06) and in lesser quantity in both the Cavendish woodland and BNR. The loss of remnant vegetation to the open cut areas, particularly the loss of intact native understorey components, including spinifex, will result in a direct loss of high value habitat for species that are dependent upon relatively undisturbed habitats. This includes the desert mouse, various woodland bird species and possibly some reptiles.

The underground mining has the potential to cause subsidence and other impacts on the soil profile and hydrology which may then affect the habitat values in the overlying open woodland habitats.

6.4.7.2 Mortality

Fauna injury or death has the greatest potential to occur during the start-up phase of construction when vegetation and habitats are being cleared. While some mobile species, such as birds, may be able to move away from the path of clearing, other species that are less mobile, or those that are nocturnal, restricted to tree hollows and / or burrowing species, could find it difficult to escape direct impacts.

6.4.7.3 Habitat Fragmentation and Loss of Connectivity

The areas proposed to be cleared do not currently provide strong connectivity because they are principally joined on one side only by remnant vegetation (Cavendish area). Weaker connectivity may occur along Lagoon Creek riverine environments, which are intensively grazed and fragmented through partial clearing. Connectivity of the southern parts of the BNR with adjoining remnant vegetation areas to the south west will remain unaffected.

Loss of vegetation and habitat within the BNR and adjacent Threatened species habitats in the surface mine footprint will be compensated for through environmental offsets. The location of offsets will be aimed at enhancing connectivity and the protection and management of offset areas will support the conservation of those Threatened species habitats and ecosystems impacted by the project.

Further detail on the projects offset requirements is outlined in the Galilee Coal Biodiversity Offset Strategy.

6.4.7.4 Barrier Effects

The mine area could potentially form a barrier for fauna movements to the north of the BNR, but since most of this area is already degraded habitat (cleared and dominated by buffel grass), it is unlikely that impacts will be significant. The primary north-south fauna corridor in the study area is that provided by the riverine environments of Lagoon Creek, which is currently fragmented through partial clearing. Construction of the mine will require diversion of Lagoon Creek and further reduce the connectivity at this location.

6.4.7.5 Edge effects

Edge effects refer to disturbance associated with an edge or boundary between retained vegetated habitats and cleared areas such as mining areas or infrastructure. While the existing vegetated habitats are already affected by edge effects resulting from previous clearing, grazing and roads, new edges would be created during the construction phase of the project.

Edge effects may potentially reduce soil moisture, increased wind, dust, noise and light impacts. Such changes have the potential to alter species composition and abundance in the vicinity of the mine, increase predation and competition, and particularly increase weed invasion. This is most likely to occur along the margin between the remaining BNR and the mine, and along the remaining Lagoon Creek riverine environments and the mine.

6.4.8 POTENTIAL IMPACTS OF CONSTRUCTION ON THREATENED AND NEAR THREATENED FAUNA SPECIES

No Threatened or Near Threatened species under the NC Act were observed during the field survey. All species identified in Table 5 as potentially occurring within the vicinity of the mine surface clearance are considered in terms of the loss of potential habitat. Table 9 lists these species and the comparative areas of habitat available within the mine surface clearance and within a 10 km radius. The potential area of habitat to be cleared is expressed as a percentage of the 10 km radius. For the purposes of this study, these species are considered to be present in the area and are thus treated accordingly and included in the development of the mitigation measures presented. Note that these areas are potential habitat areas and as such, are likely to be overestimates of the amount of habitat to be impacted. It should further be noted that not all of these species may actually occur on site.

It is assumed there will be loss of vegetation within the BNR which is proposed to be cleared by approximately 50 % for surface mining. The remaining area of BNR, and additional open woodland outside the BNR is above an area of underground mining. Volume 2 Chapter 3 of the EIS relating to subsidence indicates that the area expected to be worst affected by subsidence will be located in the north western corner of the mine footprint. In those areas subsidence is predicted to reach a depth of approximately 3.27 m. Across the balance of the site subsidence depths are expected to range from 1.3 m to 1.6 m. Given the level of subsidence above the open woodland areas (i.e. expected to range between 1.3 m to 1.61 m) and the sandy nature of the soils in this area, there is not expected to be any substantial cracking within the open woodland areas. However, it is acknowledged that there may be depressions resulting from this degree of subsidence. This could affect surface drainage patterns and possibly create long-term impacts to the surface vegetation communities such as alteration of species habitats and the ecological function of communities. Species and ecological communities dependent upon aquatic and semi-aquatic habitats are particularly susceptible to the impacts of subsidence. Effects could be temporary or long-term.

Table 10 examines the potential impacts likely to affect each species having the potential to occur and rates them according to the degree of impact. The likelihood (L) of the impact occurring is ranked on a scale of 1 – 5. The consequence (C) of the impact on the particular species is also given a score between 1 – 5. These are added to determine the overall risk (R) to the species. The likelihood (L) relates to the potential for an impact to occur, not the potential for the species to occur which is indicated in Table 5.

Of the species rated as having a medium significance of impacts (R score of 5 of higher), only one of these is considered to require additional consideration. The black-throated finch (*Poephila cincta cincta*) was the subject of an additional targeted field survey which identified potential breeding habitat on site.

Table 9. Area of potential habitat clearing within the mine surface clearance footprint and surrounding area

COMMON NAME	SCIENTIFIC NAME	STATUS		POTENTIAL HABITAT WITHIN MINE SURFACE CLEARANCE FOOTPRINT	POTENTIAL HABITAT WITHIN 10 KM OF PROJECT AREA	PREFERRED HABITAT TO BE CLEARED AS A PERCENTAGE OF THAT WHICH OCCURS WITHIN 10 KM
		NC ACT	EPBC ACT			
Common Death Adder	*Acanthophis antarcticus*	NT	–	4587	39598	11.59
Ornamental Snake	*Denisonia maculata*	V	V	1435	8296	17.30
Yakka Skink	*Egernia rugosa*	V	V	4587	39598	11.59
Brigalow Scaly-foot	*Paradelma orientalis*	V	V	Nil	2687	Nil
Fork-tailed Swift	*Apus pacificus*	–	Mi	All potential	All potential	
Great Egret	*Ardea alba*	–	Mi	4587	36912	12.43
Cattle Egret	*Ardea ibis*	–	Mi	4587	36912	12.43
Sharp-tailed Sandpiper	*Calidris acuminata*		Mi	1414	8002	17.67
Black-necked Stork	*Ephippiorhynchus asiaticus*	NT	–	1414	8002	17.67
Horsfield's Bronze-cuckoo	*Chalcites basalis*		Mi	All potential	All potential	
Latham's Snipe	*Gallinago hardwickii*	–	Mi	1414	8002	17.67
Squatter Pigeon (southern)	*Geophaps scripta scripta*	V	V	All potential	All potential	
Sarus Crane	*Grus antigone*	–	Mi	1414	8002	17.67
White-throated Needletail	*Hirundapus caudacutus*	–	Mi	All potential	All potential	
Square-tailed Kite	*Lophoictinia isura*	NT	–	1414	8002	17.67
Rainbow Bee-eater	*Merops ornatus*	–	Mi	All potential	All potential	
Black-chinned Honeyeater	*Melithreptus gularis*	NT	–	All potential	All potential	

COMMON NAME	SCIENTIFIC NAME	STATUS		POTENTIAL HABITAT WITHIN MINE SURFACE CLEARANCE FOOTPRINT	POTENTIAL HABITAT WITHIN 10 KM OF PROJECT AREA	PREFERRED HABITAT TO BE CLEARED AS A PERCENTAGE OF THAT WHICH OCCURS WITHIN 10 KM
		NC ACT	EPBC ACT			
Southern Boobook	*Ninox novaeseelandiae*	–	Mi	All potential	All potential	
Little Curlew	*Numenius minutus*	–	Mi	4587	36912	12.43
Black-throated Finch (southern)	*Poephila cincta cincta*	E	E	4587	36912	12.43
Sacred Kingfisher	*Todiramphus sanctus*	–	Mi	1414	8002	17.670582
Australian Painted Snipe	*Rostratula australis*	V	V/Mi	4587	36912	12.43
Common Greenshank	*Tringa nebularia*	–	Mi	4587	36912	12.43
Marsh Sandpiper	*Tringa stagnatilis*	–	Mi	4587	36912	12.43
Channel-billed Cuckoo	*Scythrops novaehollandiae*		Mi	All potential	All potential	
Eastern Long-eared Bat	*Nyctophilus timoriensis*	V	V	4587	39598	11.59

Table 10. Potential impacts and significance of impacts on Threatened, Near Threatened and Migratory fauna species potentially present within the study area.

SPECIES	STATUS		PREFERRED HABITAT	OCCURRENCE OF PREFERRED HABITAT WITHIN MINE SURFACE CLEARANCE FOOTPRINT	POTENTIAL IMPACTS	SIGNIFICANCE OF IMPACTS		
	NC	EPBC				L	C	R
Common Death Adder *Acanthophis antarcticus*	NT	–	Wet and dry eucalypt forests, woodlands and coastal heaths.	All treed areas.	Likely to result in removal of suitable habitat.	3	2	(5) Medium
Yakka Skink *Egernia rugosa*	V	V	Poplar box, ironbark, brigalow, white cypress pine, mulga, bendee and lancewood woodlands, open forests. Substrates include rock, sand, clay and loamy red earth.	All treed areas, although preference for dense ground cover.	Unlikely as dense ground cover generally absent from footprint area and minor consequence from loss of marginal habitat.	2	2	(4) Low
Brigalow Scaly-foot *Paradelma orientalis*	V	V	Sandstone ridges in woodlands and vine thickets, and in open forests and woodlands, especially ironbark, cypress pine, Brigalow, bull oak, spotted gum and vine scrubs.	All treed areas, although preference for dense leaf litter and fallen material	Likely to result removal of suitable habitat	2	2	(4) Low
Fork-tailed Swift *Apus pacificus*	–	Mi	Aerial forager of insects. Often seen flying before storm fronts. Not known to land on the Australian continent.	All areas of site	Negligible consequence as highly mobile species tolerant of disturbance and able to use a wide range of habitats.	1	1	(2) Low
Great Egret *Ardea alba*	–	Mi	Widespread species – common.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low
Cattle Egret *Ardea ibis*	–	Mi	Widespread species – common.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low
Sharp-tailed Sandpiper *Calidris acuminata*		Mi	Fresh or saltwater wetlands, edges of lagoons, swamps, lakes and similar habitats.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low
Black-necked Stork *Ephippiorhynchus asiaticus*	NT	–	Permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low

SPECIES	STATUS		PREFERRED HABITAT	OCCURRENCE OF PREFERRED HABITAT WITHIN MINE SURFACE CLEARANCE FOOTPRINT	POTENTIAL IMPACTS	SIGNIFICANCE OF IMPACTS		
	NC	EPBC				L	C	R
Horsfield's Bronze-cuckoo *Chalcites basalis*		Mi	Found in many wooded habitats (such as open and dry woodland and forest) with a range of understoreys from grasses to shrubs or heath.	All treed areas.	Likely to result in removal of suitable habitat but negligible consequence as highly mobile species tolerant of disturbance and able to use a wide range of habitats.	4	1	(5)Medium
Latham's Snipe *Gallinago hardwickii*	–	Mi	Marshes and swamps in tall grass.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low
Squatter Pigeon (southern) *Geophaps scripta scripta*	V	V	Patchy distribution in dry eucalypt forest, often near water. Recorded from Abbot Point area. Locally extinct in former southerly parts of its range.	All treed areas.	Likely to result in removal of suitable habitat but negligible consequence as highly mobile species tolerant of disturbance and able to use a wide range of habitats.	4	1	(5)Medium
Sarus Crane *Grus antigone*	–	Mi	Swamps, grasslands and coastal mudflats.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low
White-throated Needletail *Hirundapus caudacutus*	–	Mi	Migrant, occasionally found in airspace over project area only.	All areas of site.	Negligible consequence as highly mobile species tolerant of disturbance and able to use a wide range of habitats.	1	1	(2) Low
Square-tailed Kite *Lophoictinia isura*	NT	–	Variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.	All areas of site.	Negligible consequence as highly mobile species tolerant of disturbance and able to use a wide range of habitats.	1	1	(2) Low
Black-chinned Honeyeater *Melithreptus gularis*	NT	–	Upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (Eucalyptus sideroxylon), White Box (Eucalyptus albens), Grey Box (Eucalyptus microcarpa), Yellow Box (Eucalyptus melliodora) and Forest Red Gum (Eucalyptus tereticornis).	All treed areas.	Possible occurrence. Moderate consequence if breeding, minor consequence if not breeding. Highly mobile species able to use adjacent habitats.	3	3	(6)Medium

SPECIES	STATUS		PREFERRED HABITAT	OCCURRENCE OF PREFERRED HABITAT WITHIN MINE SURFACE CLEARANCE FOOTPRINT	POTENTIAL IMPACTS	SIGNIFICANCE OF IMPACTS		
	NC	EPBC				L	C	R
Rainbow Bee-eater *Merops ornatus*	–	Mi	Variety of habitats. May breed in sand banks of creeks and rivers. Seasonal visitor.	All areas of site.	Negligible consequence as highly mobile species tolerant of disturbance and able to use a wide range of habitats.	1	1	(2) Low
Southern Boobook *Ninox novaeseelandiae*		Mi	Southern Boobooks are seen in a variety of habitats from dense forest to open desert.	All treed areas.	Negligible consequence as highly mobile species tolerant of disturbance and able to use a wide range of habitats.	1	1	(2) Low
Little Curlew *Numenius minutus*	–	Mi	Coastal and inland grasslands and black soil plains in northern Australia, near swamps and flooded areas.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low
Black-throated Finch (southern) *Poephila cincta cincta*	E	E	Eucalypt woodland and riverside vegetation, including paperbark and Acacia shrublands and dense riverine grass and reed areas with scattered trees.	All treed areas.	Possible occurrence. Moderate consequence if breeding, minor consequence if not breeding..	4	3	(7)Medium
Sacred Kingfisher *Todiramphus sanctus*		Mi	Shallow inland wetlands, either freshwater or brackish, and seasonally or ephemerally inundated pastures and grasslands.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low
Australian Painted Snipe *Rostratula australis*	V	V/Mi	The Sacred Kingfisher inhabits woodlands, mangroves and paperbark forests, tall open eucalypt forest and melaleuca forest.	Riverine habitat.	Possible visitor but negligible consequence as unlikely to roost within the study area due to ephemeral nature of watercourses.	3	1	(4) Low
Common Greenshank *Tringa nebularia*	–	Mi	On the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low

SPECIES	STATUS		PREFERRED HABITAT	OCCURRENCE OF PREFERRED HABITAT WITHIN MINE SURFACE CLEARANCE FOOTPRINT	POTENTIAL IMPACTS	SIGNIFICANCE OF IMPACTS		
	NC	EPBC				L	C	R
Marsh Sandpiper *Tringa stagnatilis*	–	Mi	Fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps.	Limited to areas of inundation – seasonally available.	Likely to result in removal of limited foraging habitat but negligible consequence as highly mobile species tolerant of disturbance.	1	1	(2) Low
Channel-billed Cuckoo Scythrops *novaehollandiae*		Mi	Summer breeding migrant to the tall open forests in northern and eastern Australia. Widespread in suitable habitat where it parasitises currawongs, crows and magpies.	All treed areas.	Possible occurrence. Moderate consequence if breeding, minor consequence if not breeding. Highly mobile species able to use adjacent habitats	4	3	(7)Medium
Eastern Long-eared Bat *Nyctophilus timoriensis*	V	V	Mallee, bulloke Allocasuarina leuhmanni and box eucalypt dominated communities. Roosts in tree hollows, crevices, and under loose bark.	All treed areas.	Possible occurrence. Moderate consequence if breeding, minor consequence if not breeding. Highly mobile species able to use adjacent habitats	4	3	(7)Medium

6.4.9 POTENTIAL IMPACTS OF CONSTRUCTION ON EPBC ACT LISTED MIGRATORY SPECIES

Migratory species are all highly mobile species which may visit the study area periodically. Fifteen species were identified as potentially utilising the site however, the footprint and adjoining areas do not include significant or locally uncommon habitat values and the site would not constitute a critical resource to any migratory species given the availability of similar habitat within the local area. As such, the impacts from the construction of the mine on all of these species have negligible consequence and have been determined to be Low. Nonetheless, mitigation measures to help minimise these impacts are provided in Section 6.3.6.

6.4.10 POTENTIAL IMPACTS OF CONSTRUCTION ON REGIONALLY SIGNIFICANT FAUNA SPECIES

Regionally significant fauna, including the 11 species recorded on the site, will be affected by the direct loss of habitat and other potential indirect impacts. The direct habitat loss and some edge effect impacts are unavoidable. The consequences of these impacts will be minor for most of these species which are generally either mobile (bush stone-curlew (*Burhinus grallarius*), grey-crowned babbler, brown treecreeper (*Climacteris picumnus*)), able to utilise adjoining habitats (e.g. great brown broodfrog (*Pseudophryne major*), Australian bustard, rufus bettong (*Aepyprymnus rufescens*), hooded robin (*Melanodryas cucullata*)) and / or relatively tolerant of disturbance (common brushtail possum, swamp wallaby (*Wallabia bicolor*) and spectacled hare-wallaby (*Pseudomys desertor*)). As such the impacts on these species have been determined to be Medium. However, for the desert mouse (*Pseudomys desertor*), the consequence is potentially moderate as this species is known to be dependent on perennial native groundcovers (Kutt *et al.*, 2004) which are well represented in the footprint area and generally less abundant in surrounding areas. Desert mouse is known to be sensitive to grazing and fire (Kutt *et al.*, 2004; Kutt and Woinarski, 2007). As such the impact on this species is classified as being potentially High.

6.4.11 POTENTIAL IMPACTS ASSOCIATED WITH PEST FAUNA SPECIES

Four species of introduced animals were recorded in the study area. Amongst these were two declared pest species listed under the LP Act (i.e. cat and rabbit). These pest species are listed under Class 2, which are pests that are established in Queensland and have, or could have, a substantial adverse economic, environmental or social impact. Management of these pests requires coordination and they are subject to programs led by local government, community or landowners. Under the LP Act landowners must take reasonable steps to keep land free of Class 2 pests.

It is possible that the construction of the mine will favour pest fauna species and the consequence on adjoining remnant vegetation areas could potentially be Moderate. After mitigation measures are implemented, the potential impacts associated with enhancing the environment for pest fauna species is Low.

6.4.12 POTENTIAL IMPACTS OF CONSTRUCTION TO WETLANDS

The mine will require diversion of the Lagoon Creek and some of its tributaries. These are identified by the DERM Queensland Wetland Mapping as watercourses that are fringed with RE 10.3.14 and RE1 0.3.15. Lagoon Creek contains a number of small temporary / semi-permanent waterholes which are fringed by mature red gums. The mine will require clearing and removal of these wetlands. The potential impacts on the aquatic values associated with these wetlands are detailed in the Aquatic Ecology technical report at Volume 5, Appendix 14.

6.4.13 IMPACTS ASSOCIATED WITH CONSTRUCTION ACTIVITIES

While the detailed assessment of potential impacts associated with construction is provided in the previous sections, Table 11 provides a summary of these impacts based on primary changes affecting the terrestrial ecology of the area. It also provides a summary assessment of the risks before and after mitigation measures.

Table 11. Risk ratings for construction phase impacts before and after mitigations

ACTIVITY	IMPACT	RISK ASSESSMENT (L, C) SCORE	MITIGATION MEASURES	RESIDUAL RISK AFTER MITIGATION MEASURES IMPLEMENTED
Loss of remnant vegetation	Loss of habitat and resources Approx. 4,595 ha of native vegetation will be cleared within the mine surface clearing footprint.	Unavoidable (5) Minor (2) Medium (7)	Infrastructure should be located away from remnant vegetation areas whenever possible. Ensure only mine footprint is cleared. Offset vegetation clearing associated with the BNR and Threatened species habitat.	Unavoidable (5) Minor (2) Medium (7)
	Loss of Near Threatened species Approximately 21-33 Large-podded Tick-trefoil (over half of known plants within the study area) will be cleared.	Unavoidable (5) Major (4) High (9)	Develop Significant Species Management Plan. Offset Essential Habitat for the species.	Unavoidable (5) Moderate (3) High (8)
	Loss of Environmentally Sensitive Area Approx. 3,926 ha (52%) of BNR will be cleared.	Unavoidable (5) Major (4) High (9)	Offset the biodiversity values of 100% of the BNR (approx. 8,000ha)	Unavoidable (5) Major (4) High (9)
	Direct mortality of wildlife Low mobility, nocturnal, tree hollows-dependant and / or burrowing species have the potential to be injured or killed during clearing activities.	Possible (3) Moderate (3) Medium (6)	Employ a fauna handler to check all vegetation prior to clearing. Develop Significant Species Management Plan. Enforce construction-zone speed limits. Educate personnel about environmental responsibilities.	Possible (3) Minor (2) Medium (5)

ACTIVITY	IMPACT	RISK ASSESSMENT (L, C) SCORE	MITIGATION MEASURES	RESIDUAL RISK AFTER MITIGATION MEASURES IMPLEMENTED
	Restricted fauna movement Clearing of vegetation will result in increased barrier effect, edge effect and loss of connectivity, in particular for species with low mobility.	Possible (3) Minor (2) Medium (5)	Offsets will enhance connectivity and wildlife movement in other areas.	Possible (3) Minor (2) Medium (5)
Potential to introduce pests and weeds	Weeds and feral pests are typically associated with increased human activity. The mine activities could spread environmental weeds in the adjoining woodlands and riparian areas and could also favour pest species.	Possible (3) Moderate (3) Medium (6)	Develop a Weed and Pest Management Plan. Wash down vehicle. Control movement of machinery and trucks onsite.	Unlikely (2) Minor (2) Low (4)
Increase in light, noise and dust	The mine activities will cause a localised increase in noise, light and dust. This has the potential to disrupt local wildlife behaviour.	Likely (4) Minor (2) Medium (6)	Monitor dust emission regularly. Fit lights with guards to allow for directional lighting. Maintain all construction machinery to limit noise level.	Likely (4) Negligible (1) Medium (5)

6.5 POTENTIAL IMPACTS DURING OPERATION

Mine operations include on-going underground excavations (both vertically and horizontally), resource extraction, loading, site maintenance and rehabilitation of disturbed areas. Without appropriate mitigation measures, potential impacts of these operational activities can include generation of dust, noise and light, introduction of weed species, changed fire regime through accidental fires, wildlife mortality through collisions with vehicles, accidental release of pollutants and inadvertent clearing for temporary facilities or lay down areas storage. The following section discusses these potential impacts on particular environmental elements and identifies the likelihood of occurrence and the potential consequence of these impacts.

6.5.1 SIGNIFICANCE OF OPERATION OF THE MINE IN A STATE, BIOREGIONAL AND LOCAL CONTEXT

It is not anticipated that the operation of the mine will result in any State significant impacts.

The operation of the mine has the potential to result in both regional and localised impacts. The following section discusses the potential impacts that may be caused by the mine operation including potential impacts upon regionally significant fauna species.

The proposed clearing of 4,595 ha of Least Concern RE represents approximately 7 % of that which occurs within the 10 km buffer and approximately 0.3% of that occurring in the bioregion. Within the Desert Uplands bioregional context, the mine has the potential to have a Medium impact upon the BNR and its flora and fauna through direct and indirect impacts associated with the operation of the mine. However, it is considered that with adequate implementation of mitigation measures and the provision of an offset above and beyond the normal offset requirements to compensate for the impacts to the BNR these impacts can be largely avoided at the bioregional scale.

6.5.2 POTENTIAL IMPACTS OF MINE OPERATION ON FLORA IN GENERAL

The main potential impacts to flora associated with the operation of the mine are:

- potential for dust to reduce the health of retained vegetation in the vicinity of the clearance footprint;
- potential for accidental fires to alter the biodiversity of the adjoining areas;
- potential for temporary facilities, materials and equipment to damage areas outside the construction footprint;
- potential to alter the surface and near surface water characteristics for areas adjoining and downstream of the mine (noting that watercourse diversions will be developed to help ensure that significant alterations to surface and near surface water levels are avoided); and
- potential for accidental and inappropriate release of pollutants which could contaminate local soils and waterways, reducing the health of riparian and other flora.

The potential to alter surface and near surface water characteristics will be managed through the establishment of appropriate watercourse diversions and appropriate management of mine wastes and other potential pollutants. All of the above listed potential impacts are unlikely to eventuate, assuming that widely accepted standards of environmental practise are implemented. Their consequences could potentially be moderate so the impacts associated with these indirect impacts have been determined to be Medium. Mitigation measures to help minimise these impacts are provided in Section 6.6.1.

6.5.3 POTENTIAL IMPACTS OF MINE OPERATION ON THREATENED ECOLOGICAL COMMUNITIES

There are no vegetation communities within the study area that are listed under the EPBC Act. As such, no impacts are expected to EPBC TECs from the operation of the mine.

6.5.4 POTENTIAL IMPACTS OF MINE OPERATION ON THREATENED AND NEAR THREATENED FLORA SPECIES

Five populations of large-podded tick-trefoil and their Essential Habitat are known to occur within the vicinity of the mine surface clearance footprint and additional potential habitat occurs immediately adjacent to this area.

Potential impacts associated with operation of the mine on this species include:

- potential impacts on the health and viability of plants outside the clearance footprint through:
  - potential for dust to reduce the health of plants and associated vegetation retained outside the construction footprint;
  - potential for temporary facilities, materials and equipment to damage plants and associated vegetation outside the construction footprint; and
  - potential for accidental and inappropriate release of pollutants which could contaminate soil and water, reducing the health of riparian and water dependant vegetation.

These impacts are unlikely, assuming widely accepted standards of environmental practise. Their consequences could potentially be major so the impacts associated with these indirect impacts have been determined to be Medium. Mitigation measures to help minimise these impacts are provided Section 6.6.1.

No significant impacts are anticipated from the operation of the mine for any Threatened or Near Threatened flora species with the exception of large-podded tick-trefoil. Offsets are proposed to compensate for the surface mine impacts on the mapped Essential Habitat for the species.

6.5.5 POTENTIAL IMPACTS OF MINE OPERATION ON ENVIRONMENTALLY SENSITIVE AREAS

The potential impacts on the BNR associated with the operation of the mine include:

- increased edge effects (through potential increase in the amount of dust, noise and light entering the woodland);
- changes in soil profile and hydrology which may affect habitat values;
- increased fire frequency through accidental fires;
- potential for dust to reduce the health of retained vegetation in the vicinity of the clearance footprint;
- potential for noise and light (at night) to reduce the value of the BNR for some fauna species (no particularly sensitive fauna species have been identified and this is likely to be a negligible to minor impact); and
- potential for temporary facilities, materials and equipment to damage areas outside the construction footprint.

Assuming widely accepted standards of environmental practice, these indirect impacts are unlikely to occur. Their consequences could potentially be moderate so the impacts associated with these indirect impacts have been determined to be Medium.

A compensation package for unavoidable impacts on the biodiversity values of the BNR are proposed that will result in a net conservation gain and will also compensate for impacts to the local terrestrial flora and fauna species that occur within the BNR.

Potential Impacts of Mine Operation Associated with Declared and Other Weeds

The operation of the mine has the potential to spread existing declared, environmental and other weeds and introduce new weed species to the area through earthworks, movement of vehicles, machinery, equipment, materials and fill.

These impacts are unlikely, assuming widely accepted standards of environmental practice are implemented. The consequences for terrestrial ecology could potentially be moderate so the impacts associated with these indirect impacts have been determined to be Medium. Recommendations aimed at controlling the introduction and spread of weed species are provided in Section 6.6.1.

6.5.6 POTENTIAL IMPACTS OF MINE OPERATION ON FAUNA IN GENERAL

Potential impacts on fauna are likely to include the following:

- potential reduction in habitat values and general health and viability through edge effects such as potential increase in dust, noise and light pollution and changed moisture availability;
- mortality through potential collisions with vehicles; and
- barrier effects (associated with the open cut mine).

These impacts are possible and could potentially be of moderate consequence for some species. As such, they have been determined to be Medium. Mitigation measures are proposed in Section 6.3.6 and are aimed at reducing these impacts.

6.5.8 POTENTIAL IMPACTS OF MINE OPERATION ON THREATENED AND NEAR THREATENED FAUNA SPECIES

The potential impacts on Threatened and Near Threatened fauna species associated with the operation of the mine are as described for fauna in general in Section 6.5.7 . The likely impacts on vegetation communities overlaying the underground mine is discussed in Section 6.4.3 and were not considered likely to be significant. Where the operation involves predominantly underground disturbance it is unlikely that any of the potential impacts listed in Section 6.5.7 will be of more than minor consequence for any Threatened or Near Threatened fauna species. Operational impacts resulting from the open cut or surface mine will be reduced by the mitigating measures presented in Section 6.6.2.

6.5.9 POTENTIAL IMPACTS OF MINE OPERATION ON EPBC ACT LISTED MIGRATORY SPECIES

Listed migratory species are all highly mobile species which may visit the study area periodically. The mine clearance footprint and adjoining areas do not include locally uncommon habitat and the mine site is not considered to constitute a critical resource to any migratory species given the availability of similar habitat within the local area. As such, the operation of the mine is unlikely to be of more than minor consequence for any of these species and the impacts are therefore identified as Low.

6.5.10 POTENTIAL IMPACTS OF MINE OPERATION ON REGIONALLY SIGNIFICANT FAUNA SPECIES

The potential impacts for regionally significant species, with the exception of the desert mouse, are unlikely to be of more than minor consequence for any of these species. As such, the impacts have been determined to be Low.

For the desert mouse, the operation of the mine could possibly cause a reduction in habitat values in the areas adjacent to the mine footprint through edge effects such as potential increase in dust, noise and light pollution. The consequence could potentially be moderate and therefore the impact has been determined to be potentially Medium.

With the implementation of appropriate mitigation measures, potential impacts would be reduced to Low.

6.5.11 POTENTIAL IMPACTS OF MINE OPERATION ASSOCIATED WITH PEST FAUNA SPECIES

It is possible that the operation of the mine will attract pest fauna species due to factors such as the introduction of permanent water sources increased food availability and human and vehicular movement. As such, the potential impacts associated with enhancing the environment for pest fauna species is Medium.

6.5.12 SUMMARY OF IMPACTS ASSESSMENT DURING OPERATION

Table 12 summarises the impacts of operation activities on the terrestrial ecology of the area. It also provides an assessment of the risks before and after mitigation measures.

Table 12. Risk ratings for operation phase impacts before and after mitigations

ACTIVITY	RISK ASSESSMENT (L, C) SCORE	MITIGATION MEASURES	RESIDUAL RISK AFTER MITIGATION MEASURES IMPLEMENTED
Increase in light, noise and dust. The mine activities will cause a localised increase in noise, light and dust. This has the potential to reduce the health of retained vegetation (including Large-podded Tick-trefoil) and disrupt local wildlife behaviour.	Unlikely (2) Moderate (3) Medium (5)	Monitor dust emission regularly. Fit lights with guards to allow for directional lighting. Maintain all construction machinery to limit noise level. Implement Significant Species Management Plan.	Unlikely (2) Minor (2) Low (4)
Accidental or inappropriate release of pollutants. Potential for accidental and inappropriate release of pollutants which could contaminate local soils and waterways, reducing the health of riparian and other flora.	Unlikely (2) Moderate (3) Medium (5)	Install Gross Pollutant Traps(GTPs), detention tanks and filters to capture oil / hydrocarbons, fines and heavy metals. Regular machinery and vehicle maintenance.	Unlikely (2) Minor (2) Low (4)
Potential to alter the hydrological characteristics for adjoining and downstream areas.	Possible (3) Severe (5) High (8)	Establishment of appropriate watercourse diversions and appropriate management of mine wastes and other potential pollutants. Monitor adjoining wetland areas for water quality and hydrology impacts	Possible (3) Moderate (3) Medium (6)
Animal death and / or injury due to collision with vehicles.	Possible (3) Moderate (3) Medium (6)	Enforce construction-zone speed limits. Educate personnel about environmental responsibilities.	Possible (3) Minor (2) Medium (5)
Weeds and feral pests are typically associated with increased human activity. The mine activities could spread environmental weeds in the adjoining woodlands and riparian areas and could also favour pest species.	Unlikely (2) Moderate (3) Medium (5)	Develop a Weed and Pest Management Plan. Wash down vehicle. Control movement of machinery and trucks onsite.	Unlikely (2) Minor (2) Low (4)

6.6 MITIGATION AND MANAGEMENT

6.6.1 MITIGATION AND MANAGEMENT COMMITMENTS FOR FLORA

6.6.1.1 Construction

The following mitigation measures will be implemented to ensure that significant impacts to flora are avoided where possible and otherwise minimised:

- infrastructure will be located away from remnant vegetation areas whenever possible to avoid the potential to inadvertently cause or create additional edge effects;
- all vegetation clearing boundaries will be clearly identified in the field to avoid inadvertent clearing of vegetation;
- fire fuel loads will be monitored and vehicle activities should be restricted to roads, access tracks and hardened surfaces to reduce the possibility of wildfire. Vehicles will be fitted with spark arrestors and firefighting equipment should be available at construction sites;
- a Bushfire Management Plan (BMP) will be developed and implemented in order to minimise the risk of bushfire associated with on-site infrastructure;
- a detailed Weed Management Plan (WMP) that addresses the construction, rehabilitation and operation phases of the project should will be prepared prior to construction. This Plan will include hygiene protocols to minimise the likelihood of introduction and spread of environmental, agricultural and declared weeds, including:
  - the implementation of sediment control mechanisms to reduce the potential for the spread of weed species into sensitive areas;
  - vehicle wash down procedures; and
  - monitoring and weed inspections (monitoring across disturbed areas on a monthly basis is recommended during construction);
- all construction personnel will be educated through inductions to ensure compliance with environmental requirements;
- watercourse diversion activities will be undertaken during the dry season and utilise best practice methods to minimise risk of impact upon terrestrial and aquatic flora and fauna associated with these watercourses;
- detailed Erosion and Sedimentation Control Plan (ESCP) will be developed prior to construction to minimise sediment runoff. The plan will include a requirement to rehabilitate disturbed areas as soon as possible after disturbance;
- dust monitoring will be undertaken and dust reduction measures should be implemented where necessary to avoid harm to flora and fauna species. These measures could include:
  - the regular maintenance and wetting down of tracks to minimise dust generation;
  - the implementation and enforcement of a site speed limit to minimise dust generation; and
  - cleared areas to be rehabilitated as soon as practicable.
- a detailed Mine Rehabilitation and Closure Plan will be developed that includes the identification of the intended final landforms and land use. The mine rehabilitation and closure plan should include a detailed rehabilitation monitoring and evaluation plan including monitoring schedule (e.g. quarterly monitoring of areas under rehabilitation). Depending on the final land use objectives suitable completion criteria and indicators to measure the progress of rehabilitation may include 70 % of cover of native and introduced species within each stratum as occurring on adjoining reference sites of the same land use type. At least two reference sites within the same sub-catchment will be established within each land use (possibly including each RE depending on final land use objectives) to provide benchmarking of rehabilitation progress and completion; and
- a Significant Species Management Plan (SSMP) will be developed for large-podded tick-trefoil in accordance with DERM requirements. This plan would include:
  - proposed management measures including those identified for construction and operation of the mine;
  - seed collection and propogation that may be required and can then be used in rehabilitation activities;
  - a monitoring and evaluation program for the species; and
  - offset commitments relating to the species.
- In addition to the above mitigation measures a Biodiversity Offset Strategy which compensates for unavoidable impacts to particular biodiversity values

of significance, will be finalised and implemented (refer to Section 6.6.1.) to meet the requirements of the EPBC Act and the Queensland Government's Environmental Offsets Policy (QGEOP).

6.6.1.2 Operation

- the WMP will be implemented and the regular monitoring of the prevalence of weed species in disturbed and adjacent areas should be undertaken;
- fire fuel loads will be monitored and vehicle activities should be restricted to roads, access tracks and hardened surfaces to reduce the possibility of wildfire. Vehicles should be fitted with spark arrestors and firefighting equipment should be available at construction sites;
- all personnel will be educated through inductions to ensure compliance with environmental requirements;
- remnant vegetation areas adjacent to the mine footprint will be monitored using the Queensland Government Biocondition Assessment methodology with the purpose of identifying the presence of edge effect impacts from the mine (e.g. dust, weeds) on these areas;
- the Rehabilitation and Mine Closure Plan will be implemented including the identified rehabilitation monitoring and evaluation program;
- detention tanks and filters will also be installed to capture oil / hydrocarbons, fines and heavy metals to avoid the potential release of harmful pollutants;
- monitor adjoining wetland areas for water quality and hydrology impacts to ensure baseline conditions are maintained;
- any future infrastructure should, wherever practicable, be located within previously cleared areas; and
- the SSMP for large-podded tick-trefoil, including the monitoring and evaluation program will be implemented.

6.6.2 MITIGATION AND MANAGEMENT COMMITMENTS FOR FAUNA

The following mitigation measures will be implemented to ensure that significant impacts to fauna are avoided where possible and otherwise minimised.

6.6.2.1 Construction

- construction areas that pose a risk to fauna will be fenced off where practicable to avoid the potential to inadvertently cause or create additional edge effects;
- to help minimise impacts on fauna, fauna handlers will be present to survey for, and if necessary relocate wildlife immediately prior to and during clearing activities;
- field survey will be undertaken to confirm absence / detect presence of black-throated finch immediately prior to construction activities. If nesting birds are present, clearing will be rescheduled to avoid disruption;
- removal of vegetation in a staggered sequence to allow fauna species to relocate off site;
- relevant permits will be obtained to allow for surface water channels and drainage patterns to be altered, and consideration will be given to water retention for use by local fauna;
- appropriate strategies will be developed and implemented to minimise the risk of road kill including (reduced speed zones, minimise vehicle movement during times of high fauna activity, for example dawn, dusk and at night);
- lighting will be limited to construction areas and lights in close proximity to adjoining woodlands and riparian areas will be fitted with guards to allow for directional lighting away from these areas of remnant vegetation;
- all construction machinery will be well maintained to ensure it is operating at the lowest possible noise level to avoid the impacts of noise and vibration upon wildlife;
- the Mine Rehabilitation and Closure Plan will include final land use objectives for fauna and suitable completion criteria and indicators to measure the progress of rehabilitation. This will include 70% of habitat features on adjoining reference sites of the same land use / fauna habitat types. At least two reference sites within the same sub-catchment should be established within each land use / habitat type (possibly including each RE depending on final land use objectives) to provide benchmarking of rehabilitation progress and completion from a fauna habitat perspective; and

- a SSMP will be developed for the desert mouse in accordance with DERM requirements. This plan will include:
  - proposed management measures including those identified for construction and operation of the mine; and
  - a monitoring and evaluation program for the species.
- In addition to the above mitigation measures a Biodiversity Offset Strategy which compensates for unavoidable impacts to particular biodiversity values of significance, will be finalised and implemented (refer to Section 6.6.1.) to meet the requirements of the EPBC Act and the Queensland Government's Environmental Offsets Policy (QGEOP).

6.6.2.2 Operation

- will not allow domestic animals on-site to reduce the risk to wildlife;
- implementation of the Mine Rehabilitation and Closure Plan which includes the specified land use / fauna habitat objectives and progress and completion criteria;
- detention tanks and filters will be installed to capture oil / hydrocarbons, fines and heavy metals to avoid the potential release of harmful pollutants;
- monitor adjoining watercourses for water quality and hydrology characteristics to ensure baseline conditions are known and any changes as a result of operation of the mine detected; and
- a SSMP for desert mouse, including the monitoring and evaluation, will be implemented.

6.6.3 BNR AND ENVIRONMENTAL OFFSETS

Due to constraints associated with the location of the coal resource and extraction requirements, impacts to remnant vegetation within the mine footprint, including within the BNR, cannot be avoided. As such, it is proposed that offsets be established to compensate for unavoidable impacts to particular significant biodiversity values as required under existing offset policies at the State and Commonwealth level (such as EREs, OCREs, TECs and EVR flora). Waratah Coal also commit to compensating for impacts to the Bimblebox Nature Refuge (both to the open cut and underground mining areas) in addition to the normal offset requirements, with the aim of achieving a net conservation gain and expanding Queensland's protected area estate.

Both the Commonwealth and Queensland Governments' offsets policies, including the 'Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999' and the Queensland Government's Environmental Offsets Policy (QGEOP) (EPA 2008) require that unavoidable impacts to Threatened flora, fauna and ecological communities be compensated for through the provision of offsets.

The estimated biodiversity offset requirements of the project, including the mine area, and Waratah Coal's proposed approach to offset delivery is detailed in the Galilee Coal Biodiversity Offset Strategy (Unidel, 2011).

The key offset principles adopted for the project are as follows:

- offsets will only be proposed after all attempts have been made to avoid, minimise and mitigate the environmental impacts;
- the offset should directly relate to the environmental values being impacted, often referred to as the "like for like" principle;
- offset values will be co-located to the greatest extent possible and strategically located adjacent to existing protected areas or within biodiversity corridors to maximise biodiversity outcomes and long-term viability of the offset;
- the offset should be either direct and/or indirect actions. A direct action usually requires the on-ground maintenance and / or improvement of the protected matter. An indirect action, however, includes a wide range of actions that improve the knowledge and understanding of a protected matter in order to facilitate its conservation;
- the implementation of the offset should be timed to minimise the time lag between the impact and the delivery of the offset;
- where possible the offset will be located in the vicinity of the impact and the same bioregion;
- the offset should be legally secured; and
- mechanisms will be put in place to ensure that the offset is enforceable, monitored and audited.

The main offset requirements associated with the mine component of the project include:

- Bimblebox Nature Refuge;
- Threatened fauna species habitat under the EPBC Act including the squatter pigeon, black-throated finch and yakka skink; and
- Essential Habitat for the Threatened flora species *Desmodium macrocarpum* (large-podded tick- trefoil).

Based on results of the offset analysis, spatial analysis has been undertaken to determine the potential availability of suitable offsets. This included a desktop exercise to identify potential offset sites that contain as many of the offset values as possible, will deliver strategic conservation outcomes such as expanding existing protected areas or enhancing biodiversity corridors, and also deliver real benefit to those species and ecological communities at greatest risk. Large areas of potential offsets have been identified within 100 km of the mine. A focus for the Bimblebox Nature Refuge is to identify another parcel of land within the same bioregion (Desert Uplands) that is of 'ecological equivalence' to the BNR. Offset criteria will include an area that contains a mix of the same REs and the same or higher biodiversity values. To assist in determining 'ecological equivalence' DERM's biocondition methodology and BPA mapping will be used. It is currently estimated the BNR offset may be twice the total area (approx. 16,000 ha) and the intent is it will become a future protected area. The next phase is to prioritise offset areas, commence landholder engagement and undertake preliminary site inspections to verify the biodiversity values on the ground. In consultation with the CG, DERM and DSEWPaC an Offset Package will then be prepared that details the proposed offset sites, mechanisms to secure the areas and management requirements.

Further detail on the offset requirements, spatial analysis, offset availability and future steps is provided within the Galilee Coal Biodiversity Strategy at Appendix 27.

6.7 CONCLUSIONS

6.7.1 ASSESSMENT OUTCOMES

The majority of the mine will be underground and may not significantly impact on terrestrial flora and fauna. Further work to quantify the impacts of the underground mining on surface ecological values is ongoing. The open cut and clearance footprint of the mine will be approximately 14,600 ha, of which 69 % is located upon buffel grass pasture of low terrestrial ecological value.

No EPBC Act listed TECs or VM Act Endangered or Of Concern communities will be impacted by the mine.

The footprint requires unavoidable clearing of approximately 4,595 ha of Least Concern remnant vegetation. This clearing will potentially have High impacts upon:

- RE 10.3.27, listed as Of Concern under the DERM Biodiversity Status;
- RE 10.3.12, listed as Least Concern under both the DERM Biodiversity Status mapping and the VM Act;
- Large-podded tick-trefoil;
- the BNR; and
- Desert mouse.

The clearing will also potential have a Medium impact upon:

- riparian / wetland REs associated with Lagoon Creek and some of its tributaries;
- Two REs listed as Endangered under the DERM Biodiversity Status;
- RE 10.3.4, listed as Of Concern under the DERM Biodiversity Status;
- common death adder
- Horsfield's bronze cuckoo
- Black-chinned honeyeater (if breeding at time of clearing);
- Squatter pigeon (although this is of negligible consequence for the species);
- Black-throated finch (if breeding at time of clearing);
- Channel-billed cuckoo;
- Long eared bat; and
- Regionally Significant and Least Concern fauna in general.

Operation of the mine also has potential to have indirect impacts upon terrestrial flora and fauna including High impacts on large-podded tick-trefoil, BNR and desert mouse, although these impacts will be reduced through implementation of appropriate mitigation measures and delivery of offsets.

6.7.2 COMMITMENTS

To avoid and reduce potential impacts on terrestrial ecology associated with the construction, operation and decommissioning of the mine, Waratah Coal will:

- develop a Biodiversity Offset Strategy that compensates for unavoidable clearing and impacts to the BNR in consultation with DERM and DSEWPC;
- develop a Subsidence Management Plan in consultation with DERM;
- develop a Fire Management Plan, working with BRC and the Rural Fire Service;
- develop Weed and Pest Management Plan in consultation with BRC and Biosecurity Queensland;
- develop an Erosion and Sediment Management Plan incorporating existing State Planning Policy and local management plans;
- develop and implement a Mine recovery, Remediation Rehabilitation and Monitoring plan;
- develop a Vegetation Management Plan for the remaining vegetation overlying the underground mine area if monitoring determines it is viable in the long term;
- Develop a Significant Species Management Plan specifically for large-podded tick-trefoil; and
- Develop a Significant Species Management Plan specifically for the desert mouse in accordance with DERM requirements, the Back on Track Prioritisation Framework and other relevant management and recovery plans.