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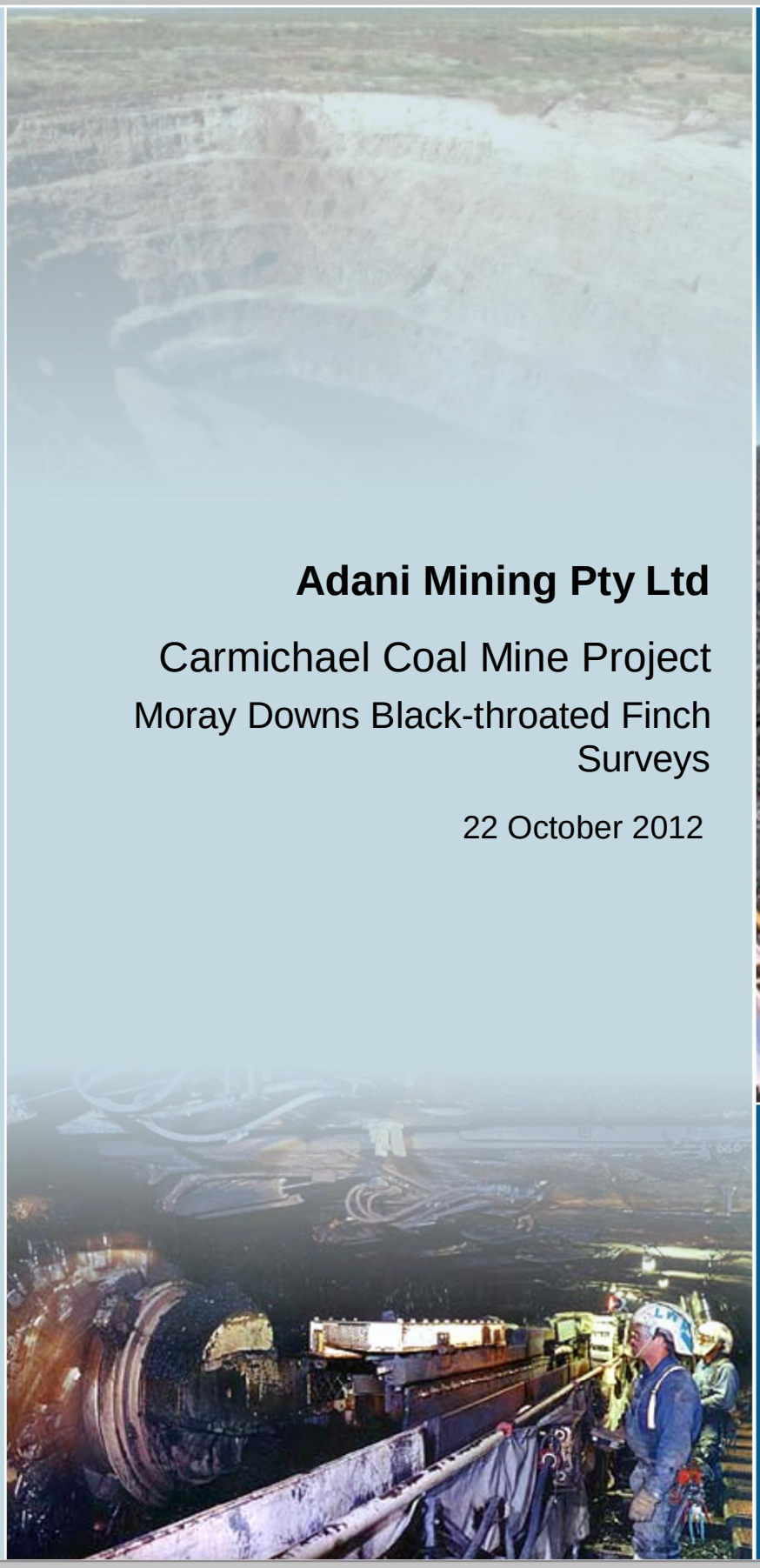

Adani Mining Pty Ltd

Carmichael Coal Mine Project

Moray Downs Black-throated Finch Surveys

22 October 2012

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Abbreviations and Glossary

Project Specific Terminology	
Abbreviation	**Term**
the Proponent	Adani Mining Pty Ltd
the Project	Carmichael Coal Mine Project
Generic Terminology	
Abbreviation	**Term**
BOM	Australian Government Bureau of Meteorology
DEHP	Department of Environment and Heritage Protection (Qld) (formerly DERM)
DERM	Former Department of Environment and Resource management (Qld) (now DEHP)
DEWHA	Former Department of Environment, Water, Heritage and the Arts (Cwlth) (now SEWPAC)
EP Act	*Environmental Protection Act 1994* (Qld)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EPC	Exploration Permit for Coal under the MR Act
GHD	GHD Pty. Ltd
GIS	Geographic Information System
GPS	Global Positioning System
MNES	Matters of national environmental significance under the EPBC Act
Moray Downs	Lot 662 on PH1491
MR Act	*Mineral Resources Act 1989* (Qld)
NC Act	*Nature Conservation Act 1992* (Qld)
Project (Mine)	the area of EPC 1690 and EPC 1080 over which it is proposed that the Carmichael Coal Mine will be developed by Adani Mining Pty Ltd
RE	Regional Ecosystem
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities (Cwlth) (formerly DEWHA)
Study Area	Areas within Moray Down Property but outside the Project (Mine)
VAST	Vegetation Assets, States and Transitions

Executive Summary

The Black-throated Finch (southern) (*Poephila cincta cincta*) was identified as present in two previous terrestrial ecological surveys (Volume 4, Appendix N1 Mine Terrestrial Ecology Report) within both Exploration Permit for Coal (EPC) 1690 and the portion of EPC 1080 the subject of the Project (Mine). The previous surveys also opportunistically identified the presence of the Black-throated Finch within the Study Area (which encompasses the majority of the Moray Downs property and is owned by Adani Mining Pty Ltd, outside of the EPC areas of the proposed Carmichael Coal Mine).

These surveys also identified the potential distribution of Black-throated Finch (southern) habitat within the Project (Mine) and across the broader Study Area outside of the Project (Mine) (Volume 4, Appendix N1 Mine Terrestrial Ecology Report). This included the identification of 'important areas' as defined by the Department of Sustainability, Environment, Water, Populations and Communities (SEWPAC) Significant Impact Guidelines (DEWHA 2009b).

The purpose of this survey and report was to expand on the existing survey work, and to survey for populations of Black-throated Finch (southern) in the Study Area outside the EPCs which have been proposed as a potential offset habitat. In particular this report aims to investigate the presence of populations of Black-throated Finch (southern) using bird survey and habitat assessment methods as recommended in the Significant Impact Guidelines for the Black-throated Finch (southern) *Poephila cincta cincta* (DEWHA 2009a,b) and undertake an assessment of the distribution and condition of the habitat for the species. This includes recommendations for future management and monitoring work.

The surveys undertaken for this report were undertaken over the period 21-26 May 2012, which falls into the recommended wet season survey period for the Black-throated Finch in areas north of latitude 23° (DEWHA 2009a). A combination of three survey methods were employed based on the recommended methods within the Significant Impact Guidelines for the Black-throated Finch (southern) *Poephila cincta cincta* (DEWHA 2009a, b). These methods comprised water source watches, two hectare counts and remote fauna cameras.

In total, 105 species of birds were observed across 37 survey sites, as well as incidental observations within the Study Area, and comprised of over 2,118 bird records. The Black-throated finches were observed at nine sites during this survey in flocks of up to 30 individuals, and one incidental observation within the mine lease (of two individuals). Survey sites were aimed to focus on suitable foraging habitat within 1-3 km of water source areas (DEWHA 2009a) most of the Study Area was considered suitable. Survey sites were mostly within one kilometre of an access track to allow more sites to be surveyed. Most survey sites were chosen at random at regular distance intervals to avoid anthropomorphising the suitability of the habitat.

The extent of important and potential habitat within Study Area and the EPCs for the Black-throated Finch is presented. Important habitat for Black-throated Finch (southern) covers 61% of the EPCs and Study Area (53,755 ha), and excluding the EPC areas, 52.6% of the Study Area. Combined with potential habitat category, Black-throated Finch (southern) habitat encompasses almost 64.9% of the Study Area.

The number of Black-throated Finch (southern) observations made during this survey suggests that the species occurs in large numbers in the area and that the habitat is in good condition and suitable for the species. The sub-population of Black-throated Finch (southern) in the landscape that encompasses the

Study Area, EPC 1080 and EPC1690 and the neighbouring properties to the north and west, is seemingly large and potentially significant in context of the existing known populations (i.e. Townsville).

Examination of the bird assemblages pattern, the variation in the bird species recorded in the survey sites, and the composition and condition of the vegetation and grass species in sites where the Black-throated Finch was recorded and where it was absent, suggests that the Black-throated Finch (southern) uses the entire Study Area and EPCs, and beyond, where the REs are appropriate. The over storey vegetation and RE types (nesting sites), the diversity and condition of the ground cover (including a high diversity of grass species known to be key food resources for the species), the intact (uncleared) and lightly grazed nature of the landscapes and the presence of artificial (dams and troughs) and natural waterbodies (springs, permanent and ephemeral drainage lines), all combine to create highly suitable habitat for the species.

The assessment of terrestrial ecology impacts associated with the proposed Carmichael Coal Mine indicates the potential for an effect, both directly and indirectly, on Black-throated Finch (southern) populations in the EPC area. With respect to Black-throated Finches (southern) the Project's Land Management (Flora and Fauna), Vegetation Management, Species Specific Management, Fire Management, Subsidence Management and Weed Management Plans will be most relevant (Volume 4, Appendix N1 Mine Terrestrial Ecology Report). A specific Black-throated Finch (southern) Management Plan will also be developed which will develop a research, habitat management and monitoring program, in line with the National Recovery Plan for the species (Volume 1, Chapter 8 Offsets). The implementation of a Project Offsets Strategy will mitigate residual impacts of habitat loss as a result of the staged development of the mine. This current survey identifies that while there are large areas of Important and Potential habitat on the Mine area, the adjacent habitat in the Study Area also support populations of the Black-throated Finch (southern) and Important and Potential habitat. Black-throated Finch (southern) are also present on adjacent properties to the north, west and south of the Study Area, and potential habitat for the species is widespread in the region.

The following recommendations are provided with respect to the proposed management plans and offsets strategy:

- Development and implementation of a long term monitoring program
- Conduct a survey to identify the location and number of breeding sites within the Study Area and broader landscape
- Development and implementation of species specific Black-throated Finch (southern) Management Plan
- Examination of the context of the Study Area habitat and population within the broader landscape and regional population via regional and/or bioregional survey and habitat assessments as per the significant impact guidelines for the Black-throated Finch (southern) (DEWHA 2009a)
- Preparation of a Project Offset Strategy which will be based on securing "like for like" habitat
- Preparation of a Project Offset Strategy that will integrate offset Black-throated Finch habitat and form part of a network of landscape linkages across the eastern Desert Uplands region and to other known locations for Black-throated Finch (southern) populations and habitat.

1. Introduction

The Project is located in the northern part of the Galilee Basin, Central Queensland. It is proposed that the Carmichael Coal Mine will be developed over EPC 1690 (incorporating Mining Lease Application (MLA) 70441) and part of EPC 1080. The mine will also be located in part on the Moray Downs cattle station approximately 160 km north-west of the town of Clermont. The nearest regional centre is Moranbah, 200 km east (Volume 4, Appendix N1 Mine Terrestrial Ecology Report). Current proposed access to the Carmichael Coal Mine is via Moray Carmichael Road, which runs off the Gregory Developmental Road (located approximately 70 km to the east of the proposed Carmichael Coal Mine).

The Black-throated Finch (southern) is listed as endangered under the *Environment Protection Biodiversity and Conservation Act 1999* (Cwlth) (EPBC Act) and as endangered under the *Nature Conservation Act 1992* (Qld) (NC Act). Listed threatened species and ecological communities are 'matters of national environmental significance' (MNES) under the EPBC Act. Under the EPBC Act an action requires approval from the federal environment minister if the action has, will have, or is likely to have, a 'significant impact' on a MNES. A description of the biology and ecology of the species and reasons for its current threatened status is provided in (Volume 4, Appendix N1 Mine Terrestrial Ecology Report).

1.1 Previous Work

Baseline terrestrial ecological values were assessed by GHD Pty Ltd within the Project (Mine), including EPC 1690 and the adjacent eastern portion of EPC 1080 as part of the Project's Environmental Impact Assessment process. This included desktop and seasonal field assessments and identification of potential impacts and mitigations for the construction and operation of the mine (Volume 4, Appendix N1 Mine Terrestrial Ecology Report).

Seasonal field surveys were undertaken over three survey periods. A spring field survey was undertaken in November 2010 and an autumn field survey was undertaken in April/May 2011 at (and to the immediate east of) EPC 1690. A spring survey of the eastern part of EPC 1080 was undertaken in November 2011. A summary of the results of this work can be found in (Volume 4, Appendix N1 Mine Terrestrial Ecology Report).

The two previous terrestrial ecological surveys (Volume 4, Appendix N1 Mine Terrestrial Ecology Report) identified the presence of the Black-throated Finch (southern) (*Poephila cincta cincta*) within the Project (Mine) and opportunistically within the Study Area outside of the EPC areas. These reports also identified the potential distribution of Black-throated Finch (southern) habitat within the Project (Mine) and across the broader Study Area outside of the Project (Mine) (Volume 4, Appendix N1). This included the identification of 'important areas' as defined by the Department of Sustainability, Environment, Water, Populations and Communities (SEWPAC) Significant Impact Guidelines (DEWHA 2009b).

1.2 Purpose

The purpose of this survey and report was to expand on the existing survey work through survey for populations of Black-throated Finch (southern) on areas of the Moray Downs property but outside the EPCs which have been proposed as a potential offset habitat. In particular this report aims to investigate the presence and populations of Black-throated Finch (southern) using bird survey and habitat assessment methods as recommended in the Significant Impact Guidelines for the Black-throated Finch (southern) *Poephila cincta cincta* (DEWHA 2009a,b) and undertake an assessment of the distribution and condition of the habitat for the species. This includes recommendations for future management and monitoring work.

2. Study Area

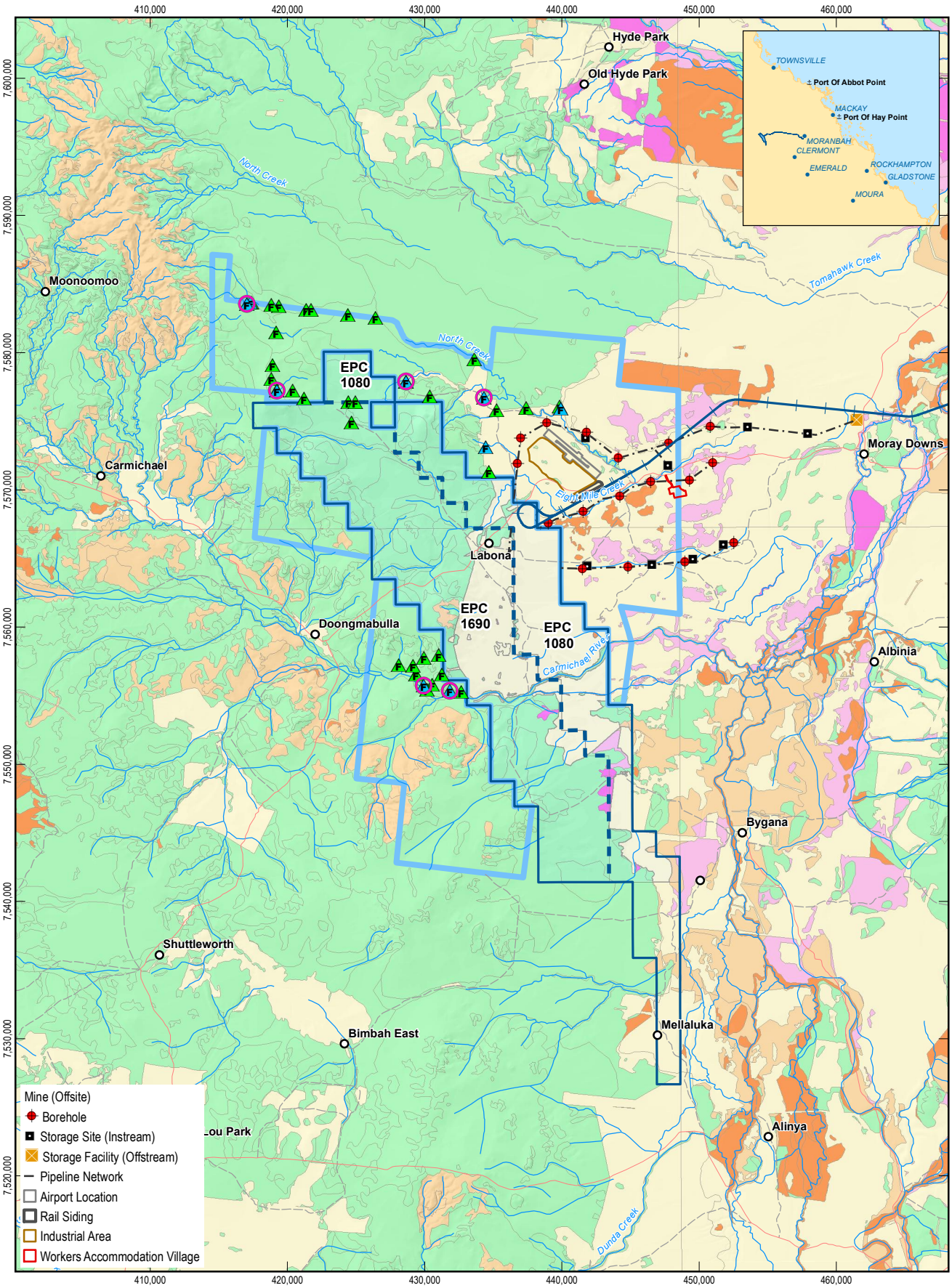
The previous survey work undertaken (as described at 1.1 above) focused on the 44,700 ha area that comprises EPC 1690 (26,000 ha) and EPC 1080 (18,700 ha) (Volume 4, Appendix N1 Mine Terrestrial Ecology Report).

In contrast, this report and the current Study Area examine the broader Moray Downs property area outside of the EPC leases which have been proposed as potential offset habitat. While some surveys were carried out within the Project (Mine) these were triggered by incidental observations of Black-throated Finches and the main focus of the study was outside of the Project (Mine).

Adani owns the Moray Downs cattle station (approx. 88,000 ha). The station is typically farmland, predominately livestock (cattle) and is held in leasehold tenure. There are some improvements existing as part of the cattle property including paddocks, watering bores, homestead, access tracks and small amounts of native vegetation clearing. However on the whole there has been limited vegetation clearing on the property within the Project (Mine).

The broader Moray Downs property contains a mosaic of vegetation communities and habitat types including Gidgee and Brigalow woodlands, ironbark-box grassy woodland, low open woodlands, open forests and woodland fringing streams, tall mixed shrublands, Yellowjacket-rough leaved Bloodwood open woodland, open cleared land and natural and artificial water-bodies.

The Study Area is approximately 55,000 ha (i.e. Moray Downs station excluding an eastern portion and excluding the area of the Project (Mine)). Figure 1 displays the REs within the Moray Downs area, the EPCs and the surrounding region. REs displayed are based on the DERM certified REs Version 6.0b in areas outside the Project (Mine) and are field verified REs within the Project (Mine).



LEGEND

- Homestead
- Survey Site May 2012
  - 2ha
  - Waterbody
- Remote Fauna Camera
- Local Road
- Track
- Watercourse
- Study Area
- Mine (Onsite)
- Rail (West)
- Regional Ecosystems
  - Endangered - Dominant
  - Endangered - Sub-dominant
  - Of Concern - Dominant
  - Of Concern - Sub-dominant
  - Not of Concern
  - Non-remnant

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Grid: Map Grid of Australia 1994, Zone 55

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Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project

Black-throated Finch (southern) survey locations

Job Number 41-25215
Revision B
Date 15-10-2012

Figure: 1

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Level 4, 201 Charlotte St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

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Data Source: GHD: Fauna Survey Sites (2012), Field Verified Regional Ecosystems (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Road, Homestead, Watercourse (2007);
DME: EPC 1690 (2010)/EPC 1080 (2011); DERM: Regional Ecosystems v6.1 (2011); Adani: Mine Layout / Infrastructure, Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: AL, MS

3. Methods

3.1 Field Assessment

The surveys undertaken for this report were undertaken over the period 21-26 May 2012, and this falls into the recommended wet season survey period for the Black-throated Finch in areas north of latitude 23° (DEWHA 2009a). Six personnel were split into survey teams of two people each, consisting of one botanist (vegetation and habitat assessment) and one zoologist (bird surveys).

A combination of three survey methods was employed based on the recommended methods within the Significant Impact Guidelines for the Black-throated Finch (southern) *Poephila cincta cincta* (DEWHA 2009a, b): water source watches; two hectare counts; and remote fauna cameras.

- The Study Area was stratified into three general areas north west, north east and south west according to regional ecosystem type, infrastructure, access and water points. Each area comprised potential habitat suitable for finches (water sources, troughs, known vegetation types preferred by the species). Logistically, this was also the most efficient way to cover the most ground, reducing the amount of travel time and crossover of teams by sending one of each of the three teams to one of the general areas. Copies of the pro forma sheets used to record data during water source watches and 2 ha surveys are provided in Appendix A and Appendix B. Survey sites are presented in Figure 1.

3.1.1 Water Source Watches

The Study Area has permanent and ephemeral water sources including the Carmichael River, low order ephemeral streams and a number of dams and troughs with permanent water. As recommended in the Background paper to the EPBC Act policy statement 3.13 (DEWHA 2009a) some of these locations were targeted for timed watches, including targeted searches in woodlands and grasslands surrounding the water sources.

Watches were conducted by two people and included at least one person watching for the full duration of the watch and one person surveying the surrounding habitat (600 m radius of water source; as per DEWHA 2009a); once complete both people would continue the watch. Each selected water source was watched for a minimum of 90 person minutes (Table 1). It was intended that each water source would be watched a minimum of three times each (up to 6 person hours over a variety of times of the day); however unexpected inclement weather and associated closure of access tracks prevented this target watch effort to be achieved. Table 1 outlines the actual number of visits and duration of watches that occurred during the survey.

Water source watches were conducted at nine different water sources for almost 28 person hours Figure 1 and Table 1). Location data of water source watches is provided in Appendix C. A habitat assessment (Section 3.1.4) was completed at each of the nine water sources and 2 ha search sites.

Table 1 Duration of Water Source Watches

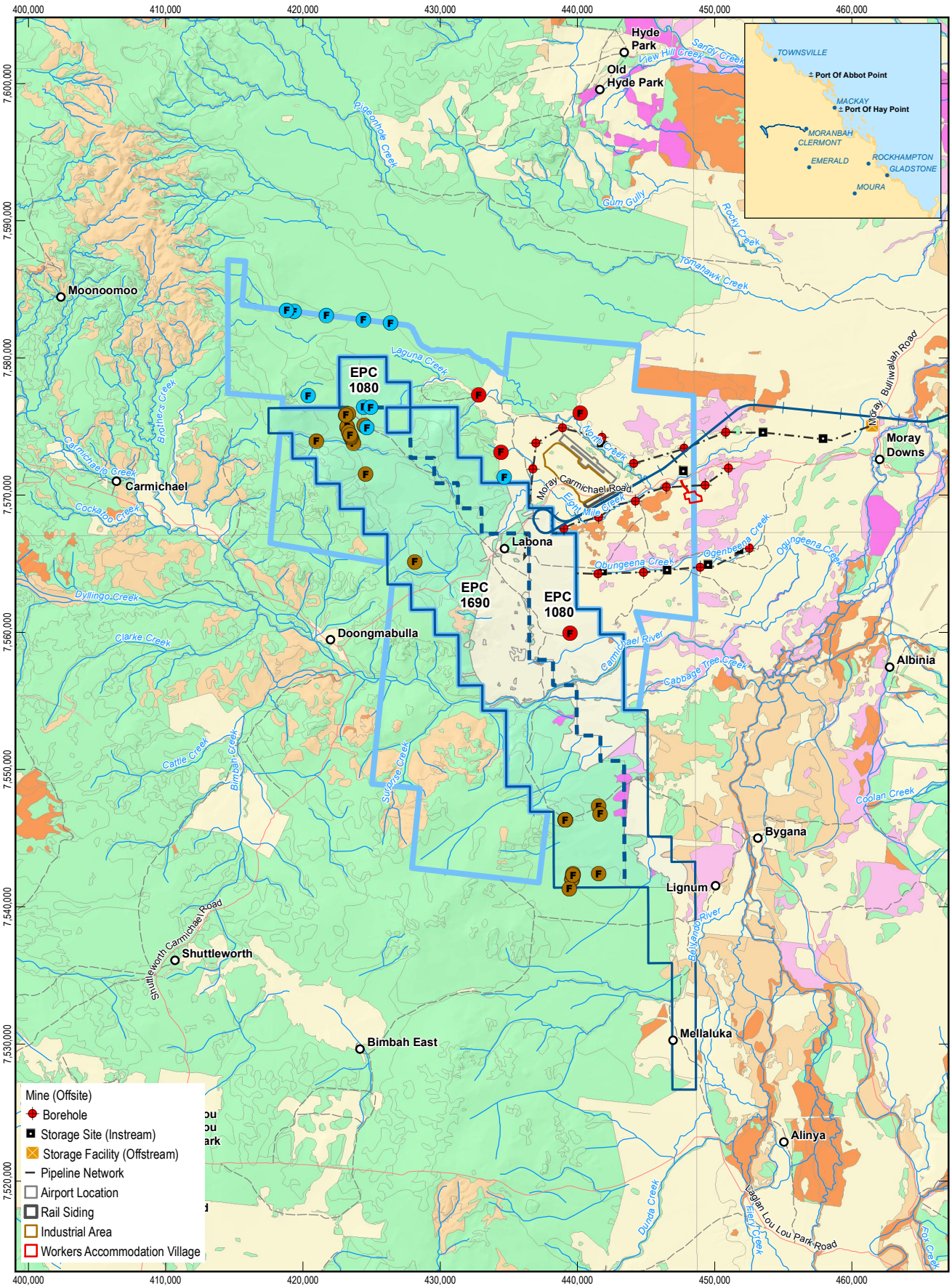
Site Name	Water Source Type	Visits (2012)	Duration
C1S5	Billabong	23 May afternoon	180 person mins
		24 May afternoon	120 person mins
C1S6	Billabong	24 May morning	180 person mins
C2S1	Creek with pools	22 May afternoon	90 person mins
C2S4	Dam	23 May midday	160 person mins
		24 May morning	128 person mins
C2S7	Dam	23 May afternoon	120 person mins
C2S11	Wetland and dam	24 May afternoon	150 person mins
C3S3	Dam	23 May morning	120 person mins
C3S6	Creek	23 May afternoon	120 person mins
C3S7	Creek	23 May afternoon	120 person mins
		24 May morning	180 person mins

3.1.2 Two Hectare Searches

Standardised bird surveys were undertaken at each assessment site using the methods recommended for surveys by Birds Australia. This involved a timed 20 minute (minimum) survey of a two hectare search area (2 ha) by one ecologist, recording the number of birds seen or heard calling, and the presence and composition of any mixed flocks. Bird surveys were undertaken throughout the day. A total of 31 searches with a total of 21 person hours were dedicated to bird surveys within the Study Area. These surveys were implemented to compliment the water watch surveys.

These surveys aimed to focus on all areas of suitable foraging habitat within 1-3 km of water source areas (DEWHA 2009a). As water was abundant in the Study Area due to the presence of dams, stock troughs, springs and ephemeral drainage lines (many of which still contained water) most of the Study Area was considered suitable for conducting 2-ha searches. Surveys also included searches for signs of Black-throated finches (southern) such as nest sites (DEWHA 2009a).

Surveys were conducted at thirty-one locations across the Study Area (Figure 1). Survey sites were mostly within one kilometre of an access track to allow more sites to be surveyed. Sites were chosen at random at regular distance intervals to avoid anthropomorphising the suitability of the habitat. A full species list of birds identified at each site is provided in Appendix D. Locations of each of the sites are provided in Appendix C. A habitat assessment (section 3.1.4) was completed at each of the thirty-one 2-ha survey sites. For both the water source counts and the 2-ha searches, if Black-throated Finches (southern) were observed the following observation data was collected as per the recommendations of DEWHA (2009 a, b); the number observed, the number of adults and juveniles, observations on feeding, drinking, perching, preening, begging by young, flighting, nesting and mating.



LEGEND

- Homestead

Records

- May 2012 Survey
- Spring 2011 EPC 1080 Survey
- Spring 2010/Autumn 2011 EPC 1690 Survey

- Local Road
- Track
- Watercourse

- Mine (Onsite)
- Study Area
- Rail (West)

Regional Ecosystems

- Endangered - Dominant
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- Not of Concern
- Non-remnant

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

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Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Black-throated Finch (southern) records

Job Number 41-25215
Revision B
Date 15-10-2012

Figure: 2

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3.1.3 Remote Fauna Cameras

Remote fauna surveillance camera surveys involved the use of un-manned motion-sensing cameras that were set up and left in situ to detect fauna over an extended period. Cameras are weatherproof and have an infrared sensor to detect movement and/or heat in front of the lens, and an infrared flash which allows night photography, but avoids startling or blinding fauna and revealing the camera's location.

Nine cameras were installed at six different water sources where water source watches were also performed. Locations of each of the cameras are provided in Appendix C and Figure 1. Each camera was left out for at least one day. Weather and associated degradation of access tracks spurred the removal of four cameras after only one day to avoid flooding whilst the remaining cameras were left on site until roads reopened the following month (Table 2).

Table 2 Duration of Remote Camera Surveillance

Site	No. of Cameras	Camera Installed	Camera Removed
C1S05	2	23 May	3 June
C1S6	2	23 May	3 June
C2S01	1	22 May	24 May
C2S04	1	23 May	24 May
C3S03	1	23 May	3 June
C3S07	2	23 May	24 May

Cameras were installed at water sources where easy access to watering points was available for Black-throated Finches, (e.g. banks flat and with sparse vegetation and shallow water). Vegetation was removed from in front of the lens, to avoid the system being triggered by vegetation in the wind. After collection, cameras where brought back and the images were downloaded for viewing.

For each location where a camera was installed, the following details were documented:

- Camera SD card identification number
- Accurate location, using a GPS
- Date and time (at start and end)

When the photos from each of the surveillance cameras were being analysed, the following details were documented for each photo that contains a fauna species:

- Species recorded (Appendix D)
- Location of camera

The surveillance cameras aimed to complement the water source watches.

3.1.4 Habitat Assessment

At water source and 2 ha survey sites vegetation and habitat data was collected. Vegetation data was collected using a modified Queensland Herbarium Quaternary site survey data sheet (based on the Nelder et al. 2005 survey and mapping methods). Quaternary site forms are provided in Appendix B.

Data collected included:

- Site location
- Vegetation structure
- Cover of dominant plant species, relative dominance and strata
- Site disturbance and condition
- General notes on land forms, structural formation, soil and geology and condition
- Ground cover estimates (native and non-native grass and forb cover, litter, rock and bare ground cover)

This data includes information on grassland quality and density, and characteristics of potential nest trees as recommended by DEWHA (2009a).

If Black-throated Finches (southern) were observed the following additional information was collected as recommended by (DEWHA 2009a):

- Current land use and site history (e.g. grazing, cropping)
- Number of water sources within 5 km
- Types of available water sources on site (natural vs. artificial) and the distance from nesting trees and foraging habitat (which may be offsite)
- Number, location and characteristics of known nesting trees (tree species, tree structure)
- Number, location and characteristics of potential nesting trees (tree species, tree structure)
- Connectivity of the site to other areas of Black-throated Finch (southern) habitat

3.1.5 Incidental Observations

In the event that Black-throated Finches were observed in the Study Area during the survey period in an area that wasn't already a designated water source watch site or a 2-ha survey site, then a 2-ha site was conducted at that point. All information was collected as per standard 2-ha survey sites (including a habitat assessment). In the event that Black-throated Finches were observed in the Project (Mine), site detail forms were not completed (to enable greater time surveying the broader Study Area) but locality information was collected (Figure 2, Appendix C).

3.2 Habitat Mapping

Revised habitat mapping was undertaken after the completion of the field survey of the Study Area to incorporate any new records of Black-throated Finch (southern) and to estimate the extent of important and potential habitat in the Study Area in context of the EPCs and the wider region. As Volume 4, Appendix N1, habitat was categorised into four different categories (Figure 3):

- **Important**: All RE polygons with a confirmed record of a Black-throated Finch (southern) that intersect with a five km buffer around the Black-throated Finch record, including non-remnant vegetation. A 5 km buffer is considered likely to cover habitat critical to the survival of the species necessary for activities such as foraging, breeding roosting or dispersal (DEWHA 2009c)
- **Potential**: All the RE polygons which do not contain Black-throated Finch (southern) records but which are the same RE that correspond to all Black-throated Finch records in the above **Important** category, and all REs that are considered potentially suitable habitat for the subspecies (i.e. records in north Queensland since 1994) as presented in the National Recovery Plan for the Black-throated Finch Southern Subspecies (BTF Recovery Team 2007). These REs are 10.5.5, 10.3.6, 10.3.28, 10.7.7, (from this survey), and REs 10.3.9, 10.3.13, 10.4.8, 10.5.1, 10.7.11., 11.3.12, 11.3.25, 11.3.27, 11.3.30, 11.3.35 and 11.11.9 from the BTF Recovery Plan (2007). All RE polygons containing these REs, even if they are part of a complex polygon, are included. For example if a Black-throated Finch was recorded within RE 10.5.5 then all polygons of, or including, 10.5.5 are considered Potential habitat. This includes all RE polygons sub-units (e.g. 10.5.5 a, b, c, etc) alone or in a complex. Potential habitat includes REs within the Study Area and REs beyond the Study Area in the presented map extent;
- **Other**: All remnant vegetation not included in the above categories
- **Non remnant:** all non-remnant vegetation excluding those within the 5 km buffer for the Black-throated Finch records in the **Important** habitat category above

It should be noted that the 5 km buffer for the **Important** habitat category is defined as one of convenience and is recommended by DEWHA (2009c); for mobile species such as birds that are highly dispersive across the landscape and seasonal in their movement patterns and resource use, it is likely that polygons of continuous suitable habitat within and beyond the buffer boundary are likely to be used and may constitute important habitat.

3.3 Limitations of Survey Method

The hand-held GPS units used to record site information are typically accurate to within 10 m. Maps presenting site information and species records should not be relied on for detailed design during construction of the mine.

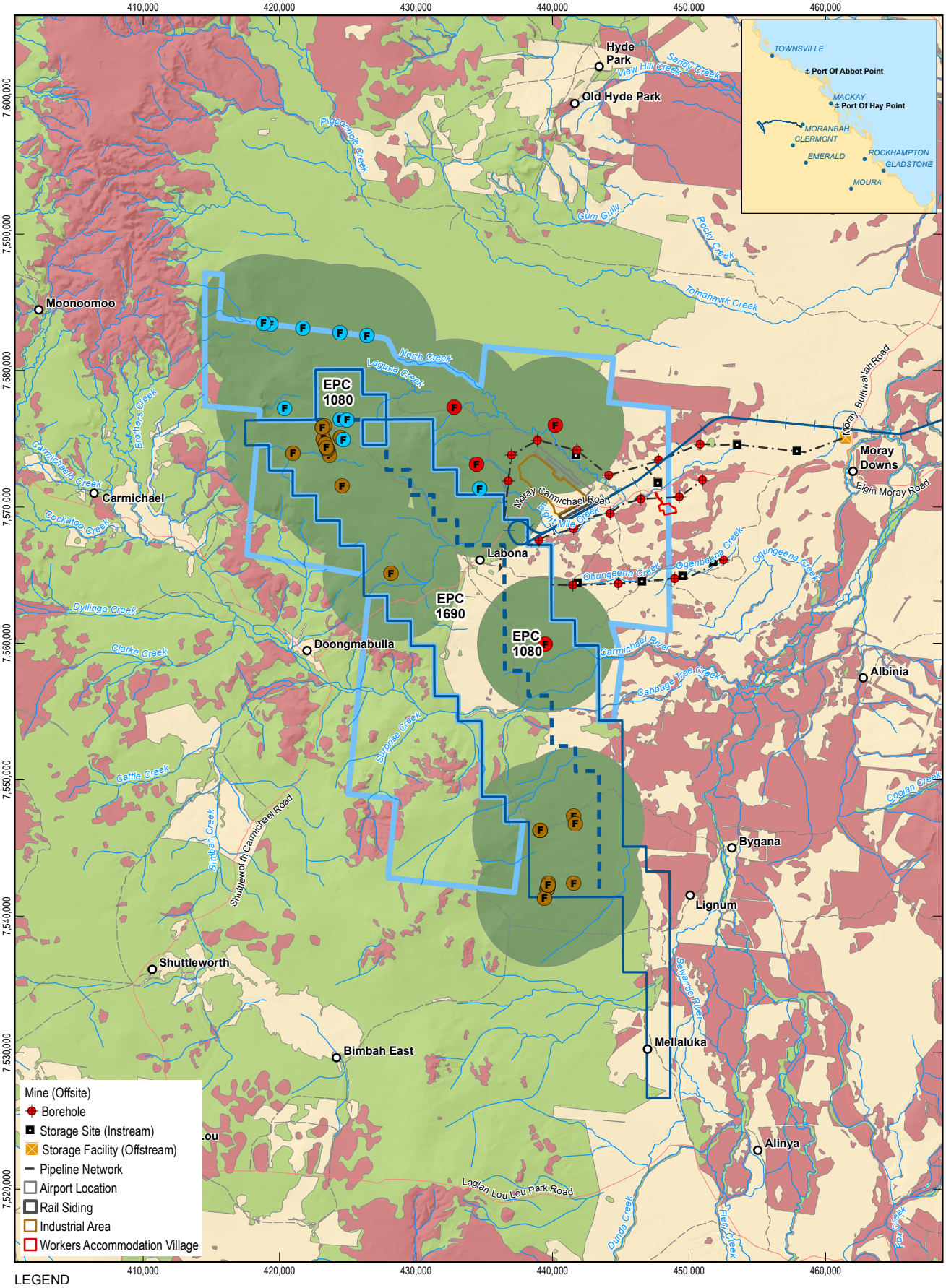
The daily average maximum temperature during the survey period was 23.0 ˚C (range 20.2 ˚C to 25.1 ˚C) with an overnight average minimum of 14.0 ˚C (range 9.1 ˚C to 17.4 ˚C) (Clermont Airport Weather Station; Bureau of Meteorology 2012a). Wind strength and direction were variable. Rainfall for the period March 2011 through to the start of the survey (22 May), 2012 was approximately average (total 114.5 mm).

The exact breeding period for the populations occurring within the Study Area is unknown however it is possible, based on knowledge from other Queensland populations (Townsville), that the survey was conducted during the breeding season (February to May). During this period it is documented that the subspecies makes only small daily movements (DEWHA 2009a). It is possible that the species remained undetected in some areas of the Study Area as not all water sources were surveyed. Water sources (both natural and artificial) are abundant across the Study Area and given the short survey period (shortened by weather conditions) it was not feasible to survey all water sources (see Section 3.1.1).

A small amount of rain (0.2 mm) fell on the 24 May 2012 but during that evening and the following day 44.4 mm fell. The heavy overnight rain caused the deterioration of the access tracks and restricted access to all but arrivals/departures and emergencies. This lead to a complete stop works for the project resulting in shortened (two and a half day) survey effort. Due to the predicted rain several of the surveillance cameras were collected to prevent being lost to rising waters; however a number remained in the field until early June when the roads reopened and could be collected.

As with all fauna surveys in tropical savanna environments especially of mobile species reliant on a range of seasonal seeding, nesting and water resources, the presence and abundance of species can be highly variable in the landscape on a monthly and annual basis. However this and previous surveys at the site (Volume 4, Appendix N1 Mine Terrestrial Ecology Report), including unpublished data from Birdlife International (2012), and more recent surveys on Moray Downs (Ecology and Heritage Partners, unpublished, 2012) provide excellent baseline data on the presence and broad distribution of the species across the EPCs, Moray Downs and adjacent areas. All surveys were conducted using the recommended methods within the Significant Impact Guidelines for the Black-throated Finch (southern) *Poephila cincta cincta* (DEWHA 2009a, b).

Each of the limitations presented are at least partially overcome by supplementing the survey results with those of previous assessments (Volume 4, Appendix N1 Mine Terrestrial Ecology Report) and the use of multiple survey techniques to cover more area in the survey time (water source watches, 2 ha counts, surveillance cameras, and incidental observations).



LEGEND

Homestead

Records

- May 2012 Survey
- Spring 2011 EPC 1080 Survey
- Spring 2010/Autumn 2011 EPC 1690 Survey

- Local Road
- Track
- Watercourse
- Mine (Onsite)
- Rail (West)

- Study Area
- Black-throated finch (southern) Important Habitat
- Black-throated finch (southern) Potential Habitat
- Other Remnant Vegetation
- Non-Remnant Vegetation

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:400,000 (at A4)

0 2 4 6 8 10

Kilometres

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

N

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project

Black-throated Finch (southern) Important Areas

Job Number 41-25215
Revision B
Date 15-10-2012

Figure: 3

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Data Source: DERM: Elevation (2011); GHD: BTF Habitat (2012), Airstrip, Village, Access Road (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Road, Homestead, Watercourse (2007); DME: EPC 1690 (2010)/EPC 1080 (2011); Adani: Mine Layout / Infrastructure, Alignment Opt9 Rev3 (2012); Gassman/Hyder: Mine (Offsite) (2012). Created by: AL, MS

4. Results

4.1 Bird Species Abundance and Frequency

In total, 105 species of birds were observed across 37 survey sites, as well as incidental observations within the Study Area, and comprised of over 2,118 bird records. Appendix D provides a summary of results.

The most abundant species recorded included Little Black Cormorant (200 sightings), Double-barred Finch (189 sightings), Rainbow Lorikeet (168 sightings), Black-throated Finch (southern) (95 sightings), and Red-backed Fairy-wren (93 sightings). Although these were among the most abundant bird species recorded during the survey, these observations tended to be of larger groups (i.e. all 200 Little Black Cormorants in one group, 17 observations of Double-barred Finch groups of up to 40 individuals, and ten observations of Rainbow Lorikeet groups of up to 40 individuals). The most frequently recorded bird species included Rufous Whistler (recorded at 27 sites), Grey Fantail (23 sites), Willie Wagtail (northern) (21 sites), and Pale-headed Rosella (20 sites).

The Black-throated Finches were observed at nine sites during this survey in flocks of up to 30 individuals, and one incidental observation within the Project (Mine) (of two individuals).

4.2 Mixed Flocks

Birds operating in mixed flocks were observed at 11 sites during surveys (Appendix E). Mixed flocks of foraging birds are believed to be advantageous for predator detection, and increased feeding efficiency. Mixed flocks may function to overwhelm territorial defences, increase the likelihood that a rich feeding patch will be located, provide commensal feeding, as well as providing less competition than a flock of conspecifics (Sridar et al 2009; Ehrlich et al. 1980).

Black-throated Finches (southern) were identified moving or foraging in mixed-flocks on 33% of occasions they were recorded in the Study Area. These mixed flocks commonly included Black-faced Woodswallow (present in 75% of Black-throated Finch (southern) mixed flocks), Double-barred Finch, Crested Bellbird, Restless Flycatcher, and Jacky Winter (all 50%). Other species found to be commonly operating in mixed flocks included Double-barred Finches (41% of observations were in mixed flocks), Restless Flycatcher (33% of observations were in mixed flocks), and Grey Fantail (26% of observations were in mixed flocks). Mixed flocks identified during surveys were predominately foraging. The composition of these mixed flocks including the association between Black-throated Finches (southern) and Woodswallows, is typical of mixed flock composition in the tropical savannas of northern and north-eastern Queensland (Vanderduys et al. 2012).

4.3 Vegetation at Survey Sites

As discussed in Section 3, 37 sites were surveyed in the Study Area (see Figure 1). Figure 1 displays the REs where survey sites were located. REs used are based on the DERM certified REs Version 6.0b in areas outside the Project (Mine) and are field verified REs within the Project (Mine). Eight different RE and RE mosaics were surveyed, representing a range of potential habitat for bird species, in particular, Black-throated Finch (southern). Surveys were also undertaken in non-remnant vegetation, which also yielded Black-throated Finch (southern) observations.

Table 3 Survey Sites and Mapped Regional Ecosystems (RE)

Mapped RE	RE splits (%)	No. survey sites	BTF present (#)
10.3.13a	100	3	N
10.3.28a/10.3.6a	60/40	6	N
10.3.6a/10.3.28a	60/40	2	N
10.4.5/10.3.6a/10.4.3a/10.4.3b	40/40/10/10	1	N
10.5.5/10.3.6/10.3.28/10.7.7	70/15/10/5	2	Y (*21*)
10.5.5a/10.3.12a	80/20	2	N
10.5.5a/10.3.6a/10.3.28a	80/10/10	12	Y (*71*)
10.7.11a/10.5.5a/10.3.6a/10.7.12a	50/20/20/10	3	N
Non-remnant	100	6	Y (*3*)

Based on field verified REs within the Project (Mine) and DERM certified Regional Ecosystems Version 6.0b outside the Project (Mine)

Condition of the sites was assessed during the rapid vegetation assessments. Condition was based on the Vegetation Assets, States and Transitions (VAST) system (Thackway and Lesslie 2005). Seven of the nine sites recording Black-throated finches (southern) were of Type I condition (on a scale of 0, least vegetation modification to VI, greatest vegetation modification). Only one Type III (and one Type II) rated sites were recorded, indicating a transformed site (characteristic of structure, composition and regenerative capacity) significantly altered by land use/land management practices. These observations are likely to indicate the preference for higher quality, intact habitat by the subspecies. Further site characteristics of survey locations are presented in Table 5.

4.4 Black-throated Finch (Southern) Habitat

The 95 Black-throated Finch (southern) records were from nine survey sites. The vegetation mapped (by DERM) at these sites is detailed in Appendix C and Table 6. The extent of important and potential habitat within the Study Area and the EPCs for the Black-throated Finch is presented in Table 4. The extent of habitat for the species is presented in Figure 3.

4.4.1 Important Habitat

Areas considered 'Important habitat' for the Black-throated Finch (southern), as discussed in Section 3.2, were identified within the following REs:

- Twelve sites (six with Black-throated Finch (southern) records) contained vegetation dominated by 10.5.5a (80%) in mosaic with 10.3.6a (10%), and 10.3.28a (10%) (As discussed in Section 3, 37 sites were surveyed in the Study Area (see Figure 1). Figure 1 displays the REs where survey sites were located. REs used are based on the DERM certified REs Version 6.0b in areas outside the Project (Mine) and are field verified REs within the Project (Mine). Eight different RE and RE mosaics were surveyed, representing a range of potential habitat for bird species, in particular, Black-throated Finch (southern). Surveys were also undertaken in non-remnant vegetation, which also yielded Black-throated Finch (southern) observations.

- *Eucalyptus melanophloia* open-woodland (10.5.5a) represents the dominant ecosystem (80%) where 71 Black-throated Finch (southern) were recorded. Characteristics of this regional ecosystem include Eucalyptus *melanophloia* dominating the very sparse canopy, with *Corymbia plena* and *C. dallachiana* occasionally co-dominant in the canopy. Very sparse to sparse shrub layer is present, with *Triodia pungens* often dominant in the very sparse to mid-dense ground layer, occasionally with other dominant or co-dominant graminoids such as (but not limited to) *Aristida* spp. and *Bothriochloa ewartiana* (DERM 2012) . This DERM description is generally consistent with vegetation recorded during current field surveys; however groundcover diversity varied between sites.

  The mosaic mapped for this site also includes *Eucalyptus brownii* open woodland to woodland (10.3.6a); *Eucalyptus melanophloia* woodland, with occasional *Corymbia dallachiana*, on sandy alluvial plains (10.3.28a) (DERM 2012).

- Two sites (with 21 Black-throated Finch (southern) records) contained vegetation dominated by 10.5.5 (70%) in mosaic with 10.3.6 (15%), 10.3.28 (10%), and 10.7.7 (5%) (As discussed in Section3, 37 sites were surveyed in the Study Area lease (see Figure 1). Figure 1 displays the REs where survey sites were located. REs used are based on the DERM certified REs Version 6.0b in areas outside the Project (Mine) and are field verified REs within the Project (Mine). Eight different RE and RE mosaics were surveyed, representing a range of potential habitat for bird species, in particular, Black-throated Finch (southern). Surveys were also undertaken in non-remnant vegetation, which also yielded Black-throated Finch (southern) observations.

- One of six survey sites in non-remnant vegetation in the Study Area contained Black-throated Finch (southern) (s discussed in Section 3, 37 sites were surveyed in the Study Area lease (see Figure 1). Figure 1 displays the REs where survey sites were located. REs used are based on the DERM certified REs Version 6.0b in areas outside the Project (Mine) and are field verified REs within the Project (Mine). Eight different RE and RE mosaics were surveyed, representing a range of potential habitat for bird species, in particular, Black-throated Finch (southern). Surveys were also undertaken in non-remnant vegetation, which also yielded Black-throated Finch (southern) observations.

- The non-remnant vegetation on site has been cleared of overstorey vegetation in the past, and has been (and in many cases, still is), grazed by livestock.

  N.B. *Remnant vegetation is vegetation that meets the following criteria: 50% of the predominant canopy cover that would exist if the vegetation community were undisturbed; 70% of the height of the predominant canopy that would exist if the vegetation community were undisturbed; and composed of the same floristic species that would exist if the vegetation community were undisturbed.* (DERM 2011).

Table 4 identifies the total areas of each habitat mapping category; Important and Potential within Moray Downs and the EPCs. Important habitat for Black-throated Finch (southern) covers 61% of Study Area (53,755 ha), and excluding the EPC areas, 52.6% of the Study Area. Combined with potential habitat category, Black-throated Finch (southern) habitat encompasses almost 64.9% of Study Area.

Table 4 Extent of Important and Potential Black-throated Finch (Southern) Habitat

Locality	Important		Potential		Other		Total Area	
	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)	Area (ha)	Percent (%)
Moray Downs	53,755	61.0	15,775	17.9	4,505	5.1	74,035	84.0
Study Area (excluding mine area)	28,690	52.6	12,680	12.3	4,140	7.6	45,510	83.5
EPC 1080	12,470	66.6	1,270	6.8	855	4.6	14,595	78.0
EPC 1690	19,600	75.4	2,905	11.2	245	0.9	22,755	87.5

4.4.2 Bird Composition and Species Variation at Black-Throated Finch (Southern) Sites

At each survey site the bird and vegetation species composition was recorded in a standardised manner (Appendix A and Appendix B) in order to provide information on site condition, and to investigate if there was any variation in the plant species and bird species (if and where Black-throated Finch (southern) were recorded either as present or absent). Information on the variation or heterogeneity of the site can provide some guidance on whether there are key areas for the species in the area, or whether the resources required by the species are widespread across the site.

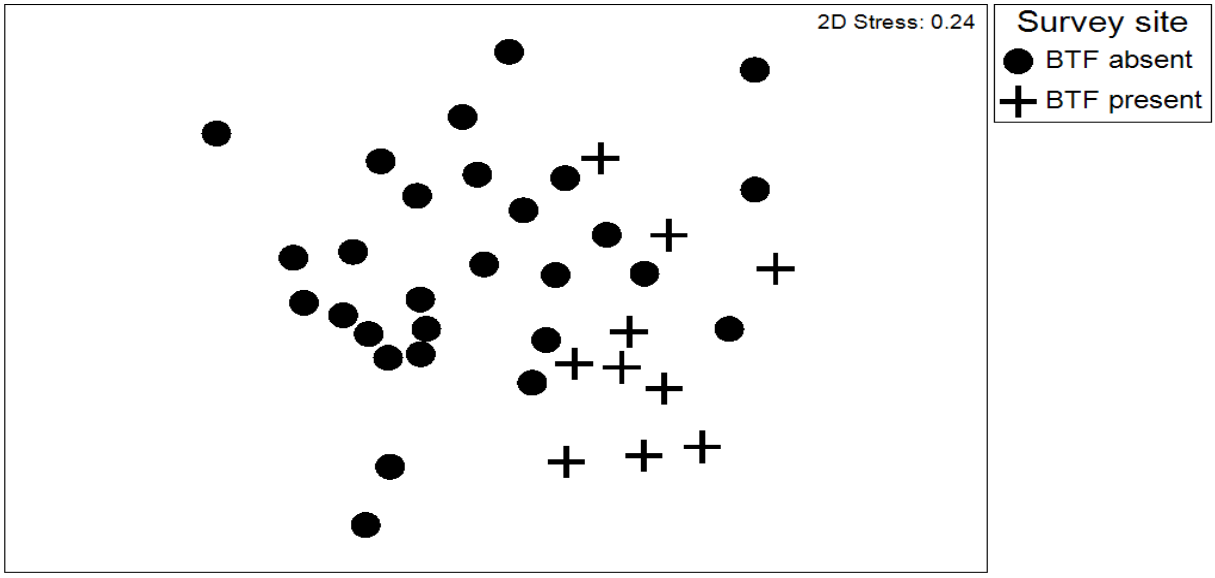
The relationship between the composition of the bird assemblage recorded at sites where the Black-throated Finch (southern) was recorded as present or absent, was examined via ordination using multi-dimensional scaling in the Primer package (Clarke and Gorley, 2006). The site by species abundance array was square-root transformed and a Bray Curtis dissimilarity matrix was derived to identify the relative similarity and differences in bird community at each site. The sites within subsequent ordination was labelled as Black-throated Finch (southern) present or absent (Figure 4).

The intent of this exercise was to investigate whether there were any particular differences in the bird community where the Black-throated Finches were recorded, or whether they are a typical component of the wider bird community and therefore likely to be distributed widely across the survey area. The variation in the bird composition from site to site was not significant or particularly separated (Figure 4) though there is some suggestion that the bird community with Black-throated Finch (southern) present have some degree of composition difference from those without. Table 5 indicates which species were more abundant with Black-throated Finch (southern) present, and these species drive the compositional differences. These species are all also typical components of mixed flocks in which Black-throated Finch (southern) commonly occur. The woodland bird community recorded across all sites and different RE types was typical of savannas of northern Queensland, and in this region Black-throated Finch (southern) form a moderately common component of the bird fauna.

To further examine whether there was any particular difference in the bird assemblages where Black-throated Finch (southern) were recorded, an examination was carried out as to whether there was any significant difference in individual species abundances across the sites where the Black-throated Finch was recorded (as either present or absent). Non-parametric Mann-Whitney-U tests were used, and of the 105 species recorded, only 10 species were recorded in greater abundances in either Black-throated Finch (southern) present or absent sites. Species such as Brown Honeyeater, Little Friarbird and

Rainbow Lorikeet were more abundant where the Black-Throated Finches were absent and these are typically aggressive and territorial species that often exclude other bird species from feeding areas (Kutt et al. 2012). Conversely Black-Faced Woodswallow and Crested Bellbird were more abundant where the Black-Throated Finches were present and these species are typical members of mixed feeding flock that include Black-throated Finches (Vanderduys et al. 2012). However on the whole the lack of variation in bird assemblage and abundance across the survey sites suggest that the bird community composition is relatively uniform across the Study Area and typical of tropical savanna woodlands. In this area the endangered Black-throated Finch (southern) is an abundant and typical component of the bird community, unlike other areas throughout its southern range; in northern Queensland the Black-throated Finch (northern) is common and often observed. One determinant of Black-throated Finch (both species) presence in both cases is good condition, intact tropical savanna woodlands with a species diverse native grass cover.

Figure 4 Two Dimensional Ordination of Bird Species Composition



Note: Two dimensional ordination of bird species composition at each of the water source and 2 ha bird count sites, labelled with Black-throated Finch (southern) present and absent sites.

4.4.3 Plant Composition and Species Present at Black-throated Finch (Southern) Sites

As with the bird assemblages recorded, we examined the relationship between plant species recorded at sites where the Black-throated Finch (southern) was recorded at present or absent, via ordination using multi-dimensional scaling in the Primer package (Clarke and Gorley, 2006). The site by species abundance array was square-root transformed and a Bray Curtis dissimilarity matrix was derived to identify the relative similarity and differences in plant community at each site. The sites within subsequent ordination was labelled as Black-throated Finch (southern) present or absent (Figure 5). The intent again was to investigate whether the sites where the finches were recorded had a particular or different vegetation composition compared to sites where they were absent, or whether all the sites that were sampled across the study area were suitable for Black-throated Finch (southern). The pattern in the vegetation indicated that there was little difference in the vegetation composition across the Black-throated Finch present and absent sites, suggesting most of the areas sampled were probably suitable habitat for the species. This is further supported by the important and highly likely habitat mapping that

indicated the Study Area (whilst comprised of mixed vegetation) is predominantly suitable Black-throated Finch (southern) habitat.

As Black-throated Finch (southern) are granivorous (seed eating) species, we also investigated whether there was a significant difference in grass species recorded in the sites where the Black-throated Finch was present or absent. Again we used non-parametric Mann-Whitney-U tests and of 63 grass species (Poaceae) recorded in all the surveys, only four were recorded with significantly different cover abundance between the Black-throated Finch present and absent sites, and in all cases, the cover was higher in Black-throated Finch (southern) present sites (Figure 5). These four species *Digitaria divaricatissima Paspalidium rarum Schizachyrium fragile* and *Themeda triandra* are all recorded as food resources for the species, suggesting some association between the Black-throated Finch presence and the grass species cover abundance. However other species recorded as typical Black-throated Finch (southern) food sources (Table 5) did not vary between finches present and absent sites, even though 12 food species were present. This suggests that again though some sites were favoured at the time of our survey, most of the sites sampled contained habitat and resources required and used by Black-throated Finch (southern).

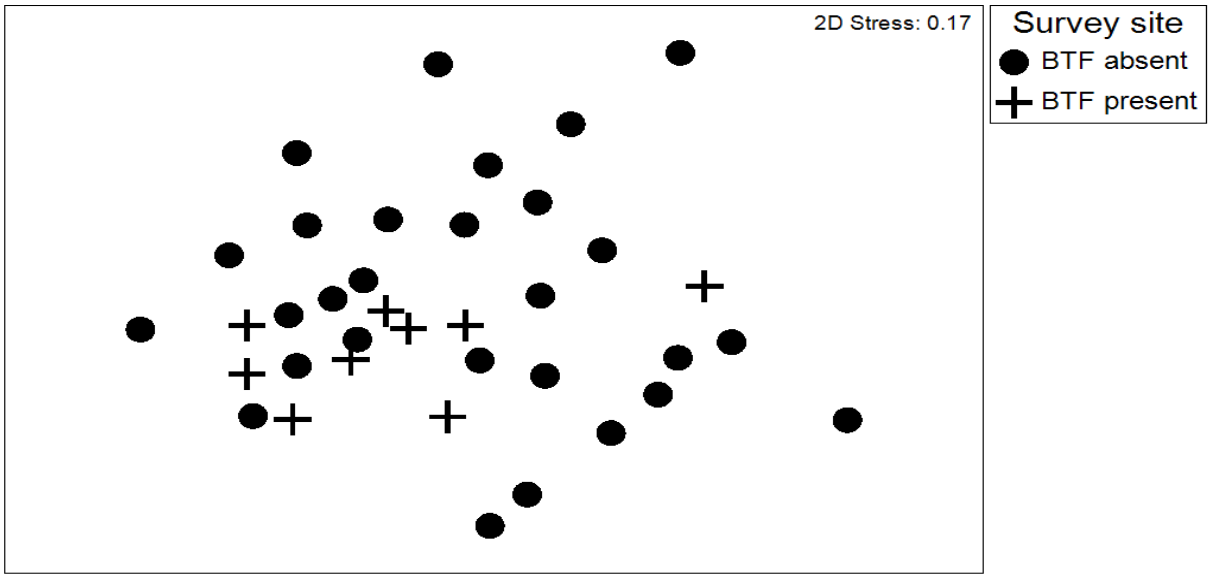
During the field surveys one direct observation of Black-throated Finches (southern) feeding was obtained and the species was recorded as feeding on *Enteropogon ramosus*, *Paspalidium rara*, *Schizachyrium fragile* and possibly *Digitaria brownii* and *Panicum effusum* seed. *Enteropogon*, *Paspalidium* and *Schizachyrium* are all grass genera previously recorded as food sources for Black-throated Finch (southern) (Mitchell 1996; NRA 2005 in DSEWPC 2012).

Plant species most commonly recorded at sites containing Black-throated Finch (southern) included:

- Upper strata: *Eucalyptus melanophloia* (89% of Black-throated Finch (southern) sites), *Corymbia dallachiana* (78%)
- Mid-strata: *Carissa ovata* (56%), *Maytenus cunninghamii* (44%), *Indigofera linifolia* (44%), *Stylosanthes* sp (44%), *Acacia coriacea* subsp. *sericophylla* (44%)
- Ground strata: *Heteropogon contortus* (100%), *Themeda triandra* (67%), *Triodia pungens* (56%), *Cymbopogon bombycinus* (44%), *Schizachyrium fragile* (44%)

A full plant species array is present in Appendix F.

Figure 5 Two Dimensional Ordination of Plant Species Composition



Note: Two dimensional ordination of plant species composition at each of the water source and 2 ha bird count sites, labelled with Black-throated Finch (southern) present and absent sites.

4.4.4 Habitat Characteristics at Black-throated Finch (Southern) Sites

Habitat characteristics of sites containing Black-throated Finch were recorded to determine the context of the site within the broader landscape; this is displayed in Table 6. Commonalities in the results of the habitat assessment included: all sites contained foraging habitat and connectivity to sites of other known Black-throated Finch populations, while the all but one site contained potential nest trees. The distance to the nearest water source varied, and considering the presence of artificial water sources (e.g. for stock watering) throughout the area, this was difficult to confirm.

Further potential habitat is likely to be present throughout the congruous and continuous habitat surrounding these sites, and would not be confined to the area immediately surrounding the survey sites, as represented in Figure 3.

Table 5 Significant Variation in Bird Abundance and Grass Cover Abundance Between Black-throated Finch (Southern) Present and Absent Sites.

Family	Scientific name	Common name	BTF present	BTF absent	Z	*P*
Birds						
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	0 (0)	6.0 (2.1)	2.1	0.034
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	0.2 (0.1)	0 (0)	-2.3	0.018
Climacteridae	*Climacteris picumnus*	Brown Treecreeper	1.7 (0.6)	0.5 (0.2)	-2.6	0.008
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	0 (0)	1.9 (0.6)	1.9	0.047
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater	0 (0)	1.3 (0.5)	2.2	0.023
Meliphagidae	*Philemon citreogularis*	Little Friarbird	0 (0)	1.5 (0.5)	1.9	0.047
Pachycephalidae	*Oreoica gutturalis*	Crested Bellbird	0.8 (0.3)	0.2 (0.1)	-2.6	0.009
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	0.5 (0.3)	1.9 (0.4)	2.3	0.019
Artamidae	*Artamus cinereus*	Black-faced Woodswallow	2.1 (0.8)	0.4 (0.4)	-3.4	0.000
Megaluridae	*Cincloramphus mathewsi*	Rufous Songlark	1.0 (0.6)	0 (0)	-3.4	0.000
Grass cover						
Total grass cover			*70.7 (6.7)*	*74.0 (4.5)*		
Total grass richness			*7.8 (0.8)*	*8.0 (0.6)*		
Poaceae	*Alloteropsis cimicina*		0.1 (0.1)	0.1 (0.6)		ns
Poaceae	*Dichanthium sericeum*		1.6 (1.3)	1.0 (0.7)		ns
Poaceae	*Digitaria divaricatissima*		0.6 (0.3)	0.1 (0.0)	-1.7	0.072
Poaceae	*Enteropogon acicularis*		0.1 (0.1)	0.6 (0.3)		ns
Poaceae	*Enteropogon ramosus*		0 (0)	0.4 (0.4)		ns

Family	Scientific name	Common name	BTF present	BTF absent	Z	*P*
Poaceae	*Eragrostis sororia*		0 (0)	0.1 (0.1)		ns
Poaceae	*Panicum decompositum*		0.6 (0.3)	0.7 (0.3)		ns
Poaceae	*Panicum effusum*		0.7 (0.4)	0.4 (0.2)		ns
Poaceae	*Paspalidium rarum*		0.1 (0.1)	0 (0)	-1.7	0.088
Poaceae	*Schizachyrium fragile*		2.4 (1.0)	0.6 (0.3)	-1.8	0.059
Poaceae	*Sarga plumosum*		1.5 (1.0)	3.6 (1.7)	0.0	ns
Poaceae	*Themeda triandra*		23.7 (8.6)	4.9 (1.8)	-2.1	0.037

Note: Significant variation tested by non-parametric Mann-Whitney-U tests. Data presented are mean abundance (and standard error) for birds, and mean cover (and standard error) for vegetation (except for richness measures). Z is the test statistic for Mann-Whitney U analysis and P is the significance level

Table 6 Site Observations at Black-throated Finch (southern) Recorded Locations

Black-throated Finch (southern) feature / Survey sites	C2S02	C2S03	C2S12	C3S02	C3S05	C3S10	C3S12	C3S13	C3S14
Current land use	Grazing intensity low	Grazing intensity low	Grazing intensity moderate	Grazing intensity low	Grazing intensity low	Grazing intensity low	Grazing intensity low	Grazing intensity low	Grazing intensity low
Site history	Grazing, no improvement	grazing, no improvement	grazing, no improvement	grazing, no improvement	grazing, no improvement	grazing, no improvement	grazing, no improvement	grazing, no improvement	grazing, no improvement
Distance to closest waterbody (GIS aerial interpretation)	715 m	1212 m	1558 m	3567 m	7836 m	8257 m	5773 m	3744 m	2864 m
Types of avail water at site (natural, artificial, type)	none	none	none	none	none	none	none	none	none
Distance from nearest water and type as identified in the field	0.7km, dam	1km, dam	1.5km, stock dam	Unknown	Unknown	<1 km, ephemeral water source	3-5km	Unknown	Unknown
Distance from nearest known nest tree	Unknown, none observed	Unknown, none observed	Unknown, none observed	Unknown, none observed,	Unknown, none observed	Unknown, none observed	Unknown, none observed,	Unknown, none observed	Unknown, none observed
Distance from nearest potential nest tree	Unknown, >1km	On site	On site	On site	On site	None	On site	On site	On site
Distance from foraging site	On site	On site	On site	On site	On site	On site	On site	On site	On site
Known nest tree (height, spp, structure, nest height location)	Unknown, none observed	Unknown, none observed	Unknown, none observed	Unknown, none observed	Unknown, none observed	Unknown, none observed	Unknown, none observed	Unknown, none observed	Unknown, none observed,

Black-throated Finch (southern) feature / Survey sites	C2S02	C2S03	C2S12	C3S02	C3S05	C3S10	C3S12	C3S13	C3S14
Potential nest trees (spp.)	On Site. Mix of Eucalyptus and Corymbia.	On Site. Mix of Eucalyptus and Corymbia	None	On Site. Melaleuca nervosa approx. 8 m	On Site. Mix of Eucalyptus and Corymbia	On Site. Mix of Eucalyptus and Corymbia	On Site. Mix of Eucalyptus and Corymbia	On Site. Mix of Eucalyptus and Corymbia	On Site. Mix of Eucalyptus and Corymbia
Connectivity to sites of other known Black-throated Finch populations	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous

5. Discussion

During this survey 105 bird species were observed from across 37 sites and incidental observations (Appendix D). During the survey 2,118 bird observations were made. Of these records, 95 individual Black-throated Finches (southern) were recorded from 10 sites; seven of these observations were made in the broader Study Area (Figure 2). All of these sites were 2 ha searches (nine sites) or incidental observations (one instance). No individuals were detected during either the water source watches or captured by the surveillance cameras.

The number of Black-throated Finch (southern) observations made during this survey suggests that the species occurs in large numbers in the area (compared with other recorded Black-throated Finch locations in the Desert Uplands and Northern Brigalow Belt, post 1995 records - Black-throated Finch Recovery Team 2007) and that the habitat is suitable for the species. The habitat here is also seemingly in good condition due to the high diversity of the ground layer (grass species), the intact nature of the tree strata and the low evidence of degradation from threatening processes (ie. grazing, exotic pasture invasion and clearing). Garnett et al. (2011) indicates that that largest known population of the species is in Townsville and consists of no more than 600 birds and that poorly known sub-populations of the species in central Queensland are likely to consist of no more than 400 mature individuals. Ninety-five sightings were made during this survey in 3 days – a substantial number. Unpublished recent survey records by BirdLife International (2012) suggest that the complex of properties (Moray Downs, Carmichael, Moonoomoo, Yarrowmere, Hyde Park, Doongmabulla, etc.) contain a number of recent records of Black-throated Finch (southern). Given the intact nature of the habitat and REs in the region, the spatial extent of the area and the good condition of the landscapes, this sub-population Black-throated Finch (southern) in the area that encompasses the Study Area and the Project (Mine), is potentially significant. The other large, well established population of this species occurs in the urban and peri-urban area of the Townsville, and is subject to a variety of threatening processes namely habitat loss and degradation due to an expanding population (Black-throated Finch Recovery Team 2007).

Black-throated Finches (southern) were observed in two different mapped RE mosaics and within non-remnant vegetation (As discussed in Section 3, 37 sites were surveyed in the Study Area (see Figure 1). Figure 1 displays the REs where survey sites were located. REs used are based on the DERM certified REs Version 6.0b in areas outside the Project (Mine) and are field verified REs within the Project (Mine). Eight different RE and RE mosaics were surveyed, representing a range of potential habitat for bird species, in particular, Black-throated Finch (southern). Surveys were also undertaken in non-remnant vegetation, which also yielded Black-throated Finch (southern) observations.

Notably, Black-throated Finches (southern) were not observed from six of the eight REs or RE mosaics including some REs where Black-throated Finches (southern) have been recorded in recent years (e.g. 10.3.13, 10.3.38 and 10.7.11, Black-throated Finch Recovery Team 2007), and this may be a reflection of the reduced survey period due to the unexpected inclement weather. Certainly the vegetation types and composition is all suitable for the species based on the presence of REs which constitute potential habitat.

Some Black-throated Finches (southern) were recorded in non-remnant vegetation (C2S12) which lacked over storey vegetation. It is likely that the species will utilise non-remnant vegetation where there is available water sources or appropriate ground cover (i.e. seeding grasses). The distribution of Black – throated Finch records (Figure 1, Figure 2, Figure 3) in the Study Area indicates that almost all the records are from remnant vegetation and the non-remnant records are from sites directly adjacent to remnant vegetation.

Heteropogon contortus was the most commonly recorded plant species and was recorded at all sites, this was followed by *Themeda triandra* (67%) which is a perennial grass thought to be one of the plant species which dominates Black-throated Finches (southern) diet (DEWHA 2009a). However all remnant vegetation surveyed sites contained suitable over story and ground strata species (food species) typically used and required by the finches. Differences in the relative cover abundance of certain grass species seemed to determine the presence or absence of Black-throated Finch (southern) during the survey, though which species and the locations where the finch feeds changes annually as grasses seed, flourish or die, and the amount of fallen seed on the ground. The most commonly recorded upper strata species were *Eucalyptus melanophloia and Corymbia dallachiana*. It is thought however that Black-throated Finch (southern) nest site selection is more closely related to tree location than structure (DEWHA 2009a). Available tree species is unlikely to be a key determinant of overall distribution as the availability of suitable tree species is not a limiting factor. Proximity of water and foraging resources is thought to be the most important factor in the location of nesting sites, but again across the entire survey area, this does not seem to be a limiting factor for the Study Area as the canopy and sub-canopy vegetation in the REs across the Study Arae, contain mature, healthy and abundant populations of the tree species that are typically used by the Black-throated Finch for nesting.

The biology of the Black-throated Finch (southern) is dependent on the availability of water, the species drinks at least daily (DEWHA 2009a). Water troughs and dams are abundant across the Study Area and adjacent properties; as such regular water sources, an important habitat component for the Black-throated Finch, might not be a limiting factor in the landscape. Spatial analysis indicated that each observation of the species during this survey ranged from 700 m to 8,300 m of a natural water source. However the distance to closest water source calculated by GIS (Table 6) is unlikely to be a true representative of the actual distribution of water across the landscape as there are abundant artificial watering points in the region due to the grazing land use history, and that there are also a large number of small ephemeral soaks and springs across this landscape that would provide very significant seasonal watering points for the species, particularly during and towards the end of the wet season. The availability of permanent water may result in the species dispersing widely and/or utilising a broader area of the landscape beyond the Study Area, in order to access different feeding areas (i.e. areas of different grass production over the year). In this case the variation and condition of the vegetation might be more influential in the seasonal habitat use and seasonal movement patterns. These factors will influence detection of the species across the landscape, and within any site, abundance may vary monthly, seasonally and annually. Though water source counts are a recommended survey method (DEWHA 2009a, b) the use of 2 ha surveys to supplement this increases the rate of detection as it is difficult to identify accurately where all water sources occur across the landscape and therefore which ones are important. In this survey almost all the Black-throated Finch (southern) records were derived from the random 2 ha area counts.

The presence of mixed bird feeding flocks was observed at 11 sites during surveys (Appendix E). Mixed flocks of foraging birds are believed to be advantageous for predator detection, and increased feeding efficiency. Mixed flocks may function to overwhelm territorial defences, increase the likelihood that a rich feeding patch will be located, provide commensal feeding, as well as providing less competition than a flock of conspecifics (Sridar et al 2009; Ehrlich et al. 1980). Black-throated Finches were identified moving or foraging in mixed-flocks on 33% of occasions they were recorded during the 2012 surveys, and are a common component of mixed feeding flocks in the tropical savannah bird communities of northern and central Queensland (Vanderduys et al. 2012). The ecological and functional importance of these mixed feeding flocks is uncertain, but for ground foraging species they confer distinct advantage in predator vigilance and avoidance (Vanderduys et al. 2012). When land management and landscape configuration change

occurs this can disrupt these feeding associations, which in turn can increase the threats to populations of endangered species (e.g. Golden-shouldered Parrots and wood swallows, Crowley and Garnett, 1998). It is likely, though speculative to a degree that land management changes and habitat clearing which effects typical bird community associations such as mixed flocks, can have ramifications for the persistence of species in disturbed landscapes – and this might be one additional reason for the decline of Black-throated Finch (southern) across its former range. The intact and functioning nature of the bird assemblage recorded in the Study Area further highlights the importance of this population.

The current survey focused on areas outside the Project (Mine) and expanded on previous surveys. The new location records provided better refinement of the distribution of important and potential habitat for the species across the study area (Figure 3). Habitat was categorised into two main categories – Important and Potential – using previous methods used in the Terrestrial Ecology surveys (Volume 4, Appendix N1 Mine Terrestrial Ecology Report). Both the Study Area and the Project (Mine) are mapped as predominantly Important and Potential habitat for the species (Figure 3), and a majority of the adjacent region to the west beyond the Study Area is Potential habitat (Figure 3).

Examination of the bird assemblages' records, the variation in the bird species recorded in the survey sites, and the variation and condition of the vegetation and grass species in sites where the Black-throated Finch was recorded and where it was absent, suggests that the Black-throated Finch (southern) uses the entire Study Area where the REs are appropriate. The over storey vegetation and RE types (nesting sites), the diversity and condition of the ground cover (including a high diversity of grass species known to be key food resources for the species), the intact (uncleared) and lightly grazed nature of the landscapes and the presence of artificial (dams and troughs) and natural (springs, permanent and ephemeral drainage lines) waterbodies, all combine to create suitable habitat for the species.

6. Recommendations

The assessment of terrestrial ecology impacts associated with the proposed Carmichael Coal Mine indicates the potential for impacts both directly and indirectly to Black-throated Finch populations on the Project (Mine). As a result of the assessment (Volume 4, Appendix N1 Mine Terrestrial Ecology Report) a framework was proposed to mitigate operational phase impacts as well as enhance the biodiversity values of adjoining areas of habitat at both a local and regional scale. With respect to Black-throated Finches (southern) the Project's Land Management (Flora and Fauna), Vegetation Management, Species Specific Management, Fire Management and Weed Management Plans will be most relevant to (Volume 4, Appendix N1 Mine Terrestrial Ecology Report), and a specific Black-throated Finch (southern) Management Plan will also be developed which will develop a research, habitat management and monitoring program, in line with the Nation Recovery Plan for the species. The development of a Project Offsets Strategy will mitigate any long term effects of habitat loss as a result of the staged development of the mine. This current survey identifies that while there are large areas of Important and Potential habitat on the Mine area, the adjacent habitat in the Study Area also supports populations of the Black-throated Finch (southern) and Important and Potential habitat. Black-throated Finch (southern) are also present on adjacent properties to the north, west and south of the Study Area, and potential habitat for the species is widespread in the region.

As a result of the current survey, the following recommendations are made to enhance and contribute to the development and implementation of the proposed management plans and offsets strategy;

- Development and implementation of a long term monitoring program to gain a better understanding of the population size, seasonal movements and key habitat areas used by the Black-throated Finch (southern). The monitoring program and surveys will be developed and conducted by a combination of on-site environmental officers, consultants and research organisations. Monitoring should include surveys and data from surrounding properties and landscapes, and detailed information on water sources, vegetation composition and seasonal variation in habitat use. This can then refine the habitat mapping and models using more sophisticated and detailed spatial analysis methods. Such mapping would help refine the proposed Project Offset Strategy to ensure the best possible habitat is protected and maintained for the species.
- Conduct further survey to identify the location and number of breeding sites within the Study Area and broader landscape, as these will be the most important components of the Black-throated Finch (southern) biology that will result in the persistence and conservation of the species in any proposed offset areas. Whilst no nests have been found to date it is considered likely that nesting occurs in the Study Area; these may consist of small pockets of suitable ephemeral wet season habitat such as sandy drainage lines and/or *Eucalyptus camaldulensis* / *Melaleuca* spp. Complexes found embedded within REs 10.5.5, 10.3.6 and 10.5.1.
- Development and implementation of species specific Black-throated Finch (southern) Management Plan which clearly incorporates the concepts of adaptive management. Adaptive management is a process of decision making that deals with uncertainty and incomplete knowledge that evolves over time using systematic monitoring data to reduce uncertainty and improve future management objectives. Such a process incorporates learning from new data and improved management outcomes, and also involves the development of strategic ecological and political consensus for contested management objectives (Holling 1973).

- Determine the context of the Study Area habitat and population within the broader landscape and regional population through survey and habitat assessments as per the significant impact guidelines for the Black-throated Finch (southern) (DEWHA 2009a). It is expected that the population is larger than currently identified and spread across the surrounding landscape to the north, west and south. A strategic assessment, i.e. Bioregional Plan, and/or a conservation plan for the Galilee Basin region would help achieve this, and though this is a responsibility for Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), such an exercise could be facilitated by Adani and other groups with adjacent mineral interests in the Galilee Basin.
- The Project Offset Strategy will be based on securing "like for like" habitat The Project Offset Strategy will include enhancement of habitat, and mitigation of any habitat loss via the careful conservation management of offset areas (i.e. reduced or no grazing, control of exotic pasture grass species, control of feral predators such as cats and foxes via innovative means such as reduced of dingo control, raised watering troughs). This would be integrated with proposed research program, where the most effective means to rehabilitate or enhance Black-throated Finch habitat are tested and used in on-going management.
- The Project Offset Strategy will integrate at a landscape scale and form part of a network of landscape linkages across the eastern Desert Uplands region and to other known locations for Black-throated Finch (southern) populations and habitat. Project Offsets will be of secure conservation land tenure, and should include programs for long term management and monitoring. Innovative options will be considered such as possible management partnerships of offset land through public and/or private partnership arrangements with well-established conservation organisations such as BirdLife Australia, Australian Wildlife Conservancy or Bush Heritage.

As there is proposed to be staged disturbance over the life of the Mine, the framework is based on an adaptive management strategy across a number of key elements that require mitigation. The framework will be underpinned by proposed monitoring programs, on-going research and management actions. A detailed implementation schedule is proposed to be prepared, outlining the timing and location of the applicable management actions, to reflect the staged development of the Project (Mine).

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Appendix A

Field Data Sheets – Bird Count Form

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Appendix A. Bird Count Pro Forma
Bird counts 100 x 200 (2 ha) / dam (see notes on page 2 for explanation)
PAGE 1 (front)

Site (unique#):							
Date:							
Observers:							
Map RE:							
Time start:							
Time finish:							
Water or 2ha:							
Water type:							
Water size							
Lat (dec):							
Long (dec):							
Mixed flock?							
Species:							

Site (from p 1)						
BTF PRESENT						
Number (max)						
No. adult						
No. juvenile						
Feeding?						
Drinking?						
Perching?						
Preening?						
Begging young?						
Fighting?						
Nesting?						
Mating?						

NOTES:

Site (unique#):	Chose a unique site ID, esp important to dams with repeat visits – use the same unique ID for each visit to same site, and cross ref with lat/long. Suggest Car1-4, with Site 1 to infinity, so for e.g. C1S1, C1S2, C2,S24. Data sheets will remain in car, even if we mix personnel
Date:	Obvious
Observers:	Initials
Map RE	RE from the printed veg maps available
Time start:	24 hr clock, e.g. 0600, 1430,
Time finish:	As above
Water or 2ha	Indicate which
Water type	Trough, turkey nest, perm water, ephemeral, size
Water size:	Area, depth
Lat (dec):	Always list, even if repeat observation at dam, as a cross check/ref to an incorrect site number
Long (dec):	As above
Mixed Flock?:	Yes or No, and then circle the total numbers against spp within the mixed flock
Species:	List spp as code or name. If not confident use a ? after name, and we can revisit later.
e.g. AUSTMAGP	Total numbers seen and heard over course of count / observation period for example 1S, 2H

Appendix B

Field Data Sheets - Quaternary Site Form

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Appendix B. Vegetation Site Pro Forma

Quaternary Site Form + BTF site details

Location

Site:		**Recorder:**		**Day/Date:**	
Project:					
Locality:					
Coordinates:	Zone	E	N	**Datum:**	

Vegetation structure

Median height of EDL is to be measured
Cover density is to be estimated
D = touching-overlap <0; M = touching-slight separation 0-0.25; S = clearly separated 0.25-1; V = well separated 1-20

Stratum	Median height	Height interval	Est. cover (D,M,S,V + %cover)
E		-	
T1		-	
T2		-	
T3		-	
S1		-	
S2		-	
G		-	

Structural formation (including height):

Ecologically dominant layer:

Land form element# (40 m radius):

Land form pattern# (300 m radius):

Soil and geology (+landzone):

Slope and aspect:

Condition (VAST – see definition table):

Plant species

Record relative (numerical) dominance for each stratum;
***d* – dominant; *c* – codominant; *s* – subdominant; *a* – associated**
*** = exotic; [2] = class 2 declared weed; [3] = class 3 declared weed**

Str.	% cover	Rel. dom.	Scientific Name

Wildfire **(0=<1yr, 1=1-5yr, 2=>5yr):**	Str.	% cover	Rel. dom.	Scientific Name
Grazing **(0=none to 3=severe):**				
0=none, 1=small amount from few plants, 2=small to moderate amount from many plants, 3=moderate to large amount from many plants				
Erosion **(0=none to 3=severe):**				
Erosion definition: **0=stable, 1=slight disturbance (ie cattle tracks), 2 = moderate (pedestalling, sheet, rill), 3 = severe (pedestals, scalds, sand blown, exposure),**				

Ground cover (estimate from 100 m line transect or 10 x 50 m area)	%
Native perennial grass TUSSOCK	
Native perennial grass HUMMOCK	
Native perennial herbs/forbs (non-grass)	
Native annual grass, herbs and forbs	
Non-native grass	
Non-native herbs and shrubs	
Litter (leaf, twigs, branches <10cm diam, dead ann grass, forbs, etc)	
Litter (logs > 10cm diam)	
Rock	
Bare ground	

BFT features (only record if BTF are recorded at site!)	
Current land use	
Site history (post hoc?)	
No. water courses in 5 km (post hoc GIS)	
Types of avail water at site (natural, artificial, type)	
Dist from nearest water and type	
Dist from nearest known nest tree	
Dist from nearest potential nest tree	
Dist from foraging site	
Known nest trees (height, spp, structure, nest height location)	
Potential nest trees (height, spp, structure, nest height location)	
Connectivity to sites of other known finch populations (post hoc GIS)	

Appendix C

Site Locations

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Appendix C. Site locations

Site	Type	Easting	Northing	Mapped RE	RE mosaic split (%)	Distance to closest waterbody (GIS estimate) (m)	Number of mapped waterbodies within a 5km Buffer	No. BTF recorded	Mixed flock?
C1S01	2ha	431260	7556554	10.3.28a/10.3.6a	60/40	2162.86	3	0	Y
C1S02	2ha	430536	7555812	10.3.28a/10.3.6a	60/40	2485.75	2	0	Y
C1S03	2ha	430175	7555436	10.3.13a	100	2295.63	2	0	Y
C1S04	2ha	432663	7555274	10.5.5a/10.3.12a	80/20	703.86	4	0	
C1S05	Water, Camera	431828	7555354	10.5.5a/10.3.12a	80/20	891.15	3	0	Y
C1S06	Water, Camera	429938	7555730	10.3.13a	100	2166.12	2	0	
C1S07	2ha	429359	7556554	10.3.28a/10.3.6a	60/40	3354.80	2	0	
C1S08	2ha	429155	7557215	10.3.28a/10.3.6a	60/40	3902.11	1	0	
C1S09	2ha	428102	7557251	10.3.13a	100	4849.79	2	0	
C1S10	2ha	429957	7557757	10.3.28a/10.3.6a	60/40	3791.76	2	0	
C1S11	2ha	431024	7557953	10.3.28a/10.3.6a	60/40	3489.60	2	0	
C2S01	Water, Camera	434320	7576739	10.3.6a/10.3.28a	60/40	2207.72	5	0	
C2S02	2ha	424440	7576434	10.5.5/10.3.6/10.3.28/10.7.7	70/15/10/5	714.96	1	1	
C2S03	2ha	424947	7576401	10.5.5/10.3.6/10.3.28/10.7.7	70/15/10/5	1212.13	1	20	
C2S04	2 Ha, Water, Camera	428653	7577909	10.4.5/10.3.6a/10.4.3a/10.4.3b	40/40/10/10	5143.55	0	0	
C2S05	2ha	430373	7576816	10.5.5a/10.3.6a/10.3.28a	80/10/10	4746.59	1	0	
C2S06	2ha	433631	7579520	10.3.6a/10.3.28a	60/40	4647.74	2	0	
C2S07	Water	434448	7573151	non-rem	100	11.59	2	0	
C2S08	2ha	435238	7575802	non-rem	100	1080.58	6	0	
C2S09	2ha	437395	7575966	non-rem	100	875.88	6	0	
C2S10	2ha	439838	7576082	non-rem	100	1565.26	5	0	Y
C2S11	Water	439926	7575930	non-rem	100	1826.54	5	0	Y
C2S12	2ha	434677	7571329	non-rem	100	1558.45	5	3	Y
C3S01	2ha	421205	7576684	10.5.5a/10.3.6a/10.3.28a	80/10/10	2516.94	1	0	Y
C3S02	2ha	420384	7577251	10.5.5a/10.3.6a/10.3.28a	80/10/10	3568.60	1	3	Y
C3S03	2 Ha, Water, Camera	419234	7577239	10.5.5a/10.3.6a/10.3.28a	80/10/10	4624.93	2	0	Y
C3S04	2ha	418825	7578094	10.5.5a/10.3.6a/10.3.28a	80/10/10	5083.91	0	0	
C3S05	2ha	419366	7583408	10.5.5a/10.3.6a/10.3.28a	80/10/10	7835.58	0	30	
C3S06	Water	417294	7583664	10.7.11a/10.5.5a/10.3.6a/10.7.12a	50/20/20/10	8853.62	0	0	
C3S06	2ha	417396	7583640	10.7.11a/10.5.5a/10.3.6a/10.7.12a	50/20/20/10	8891.08	0	0	
C3S07	Water, Camera	417038	7583567	10.7.11a/10.5.5a/10.3.6a/10.7.12a	50/20/20/10	8689.55	0	0	
C3S08	2ha	419178	7581494	10.7.11a/10.5.5a/10.3.6a/10.7.12a	50/20/20/10	7043.57	0	0	
C3S09	2ha	418901	7579124	10.5.5a/10.3.6a/10.3.28a	80/10/10	5658.44	0	0	
C3S10	2ha	418831	7583476	10.5.5a/10.3.6a/10.3.28a	80/10/10	8256.97	0	10	
C3S11	2ha	421364	7583164	10.5.5a/10.3.6a/10.3.28a	80/10/10	6117.62	0	0	
C3S12	2ha	421715	7583119	10.5.5a/10.3.6a/10.3.28a	80/10/10	5772.70	0	13	Y
C3S13	2ha	424420	7582789	10.5.5a/10.3.6a/10.3.28a	80/10/10	3744.62	3	10	
C3S14	2ha	426403	7582545	10.5.5a/10.3.6a/10.3.28a	80/10/10	2863.67	3	5	

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Appendix D

Bird Species Array

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Appendix D. Bird species composition across each site

Scientific name	Common name	C1S01	C1S02	C1S03	C1S04	C1S05	C1S06	C1S07	C1S08	C1S09	C1S10	C1S11	C2S01	C2S02	C2S03	C2S04	C2S05	C2S06	C2S07	C2S08	C2S09	C2S10	C2S11	C2S12	C3INC01	C3S01	C3S02	C3S03	C3S04	C3S05	C3S06	C3S07	C3S08	C3S09	C3S10	C3S11	C3S12	C3S13	C3S14
Dromaius novaehollandiae	emu					2																										1							
Coturnix ypsilophora	brown quail		1																																				
Dendrocygna eytoni	plumed whistling-duck															43																							
Chenonetta jubata	Australian wood duck															6																							
Nettapus coromandelianus	cotton pygmy-goose															4																							
Anas superciliosa	Pacific black duck			6		11						1							20				5																
Anas gracilis	grey teal																						30																
Tachybaptus novaehollandiae	Australasian grebe																						5																
Anhinga novaehollandiae	Australasian darter			1	1											1		1																					
Microcarbo melanoleucos	little pied cormorant																						2																
Phalacrocorax sulcirostris	little black cormorant																						200																
Pelecanus conspicillatus	Australian pelican								9																														
Egretta novaehollandiae	white-faced heron																		1				1																
Egretta garzetta	little egret																						2																
Ardea pacifica	white-necked heron																			1		1	1																
Threskiornis spinicollis	straw-necked ibis																						8																
Elanus axillaris	black-shouldered kite																																		1				
Milvus migrans	black kite																					1	1																
Haliastur sphenurus	whistling kite						1									1						1	3																
Aquila audax	wedge-tailed eagle			1																								1										
Hieraaetus morphnoides	little eagle																			2																			
Falco berigora	brown falcon					1																										1						
Falco peregrinus	peregrine falcon																			1																			
Falco cenchroides	nankeen kestrel																			1																			
Grus rubicunda	brolga																							2															
Gallinula tenebrosa	dusky moorhen																						1																
Ardeotis australis	Australian bustard																					1															2		
Vanellus miles miles	masked lapwing (northern)																		1	1																			
Chlidonias hybrida	whiskered tern															2																							
Ocyphaps lophotes	crested pigeon															1				6								3			1								
Geophaps scripta scripta	squatter pigeon (southern)					2	3																																
Geopelia striata	peaceful dove	1	1				2		1							28													3										
Geopelia humeralis	bar-shouldered dove						1																																
Eolophus roseicapillus	galah		5																2	6																			
Cacatua galerita	sulphur-crested cockatoo								1																			1											
Nymphicus hollandicus	cockatiel																																		2				
Trichoglossus haematodus haematodus	rainbow lorikeet	3	1	40	24	22	30	15	15	10									8																				
Trichoglossus chlorolepidotus	scaly-breasted lorikeet													10																									
Aprosmictus erythropterus	red-winged parrot		3			4	1												2													3			2		2		
Platycercus adscitus adscitus	pale-headed rosella (northern)		4	7	4	9	1	6		2	4				5	2			2	2		3	2			1	2				2			2			2	2
Melopsittacus undulatus	budgerigar		10																							12		8				3			20			15	
Centropus phasianinus	pheasant coucal			1																	1						1											
Chalcites basalis	Horsfield's bronze-cuckoo	1																																		1			
Aegotheles cristatus	Australian owlet-nightjar													1																							1		
Dacelo novaeguineae	laughing kookaburra					3			2		1										1	2																
Dacelo leachii	blue-winged kookaburra			1		3																																
Todiramphus macleayii	forest kingfisher																					1																
Todiramphus pyrrhopygius	red-backed kingfisher																					2														1		
Todiramphus sanctus	sacred kingfisher																						1															
Merops ornatus	rainbow bee-eater																																					1
Climacteris picumnus picumnus	brown treecreeper					2	6	3		2				3	3						1						6			1				1	1		1	2
Malurus lamberti	variegated fairy-wren	8			5	5	1		6			5					4	4				15																
Malurus melanocephalus	red-backed fairy-wren					11												4		1	1	20	10	6		6	6		6	12		7						3
Malurus sp																1														1				1	1	3		1
Pardalotus rubricatus	red-browed pardalote																										1				2		1		1	2	1	

Scientific name	Common name	C1S01	C1S02	C1S03	C1S04	C1S05	C1S06	C1S07	C1S08	C1S09	C1S10	C1S11	C2S01	C2S02	C2S03	C2S04	C2S05	C2S06	C2S07	C2S08	C2S09	C2S10	C2S11	C2S12	C3INC01	C3S01	C3S02	C3S03	C3S04	C3S05	C3S06	C3S07	C3S08	C3S09	C3S10	C3S11	C3S12	C3S13	C3S14
Pardalotus striatus	striated pardalote	1	3	3	4	10	5	2	5	2	4				1		1						3				1	7	3		1								1
Smicrornis brevirostris	weebill		3	1		6	4	3	1	1										1							3	1	3			2							
Gerygone albogularis	white-throated gerygone		1	1		4		3													1			1			3	1	2		1					1	2		
Acanthiza reguloides	buff-rumped thornbill		4						2																														
Acanthiza chrysorrhoa	yellow-rumped thornbill					3			4	3																	4	6											
Acanthiza nana	yellow thornbill																						6																
Acanthiza sp				2																																			
Lichenostomus virescens	singing honeyeater	6	4		1											2								3	1	2	1	2				4			1		1		
Lichenostomus plumulus	grey-fronted honeyeater			3	6	2	1																		1				1				2	2					
Lichenostomus fuscus	fuscous honeyeater								1			1																											
Manorina melanocephala	noisy miner															1			2																				
Manorina flavigula	yellow-throated miner															1										3							2	1					2
Manorina sp																		2																				
Lichmera indistincta	brown honeyeater	10	10	4	1		1		2	2	3	1									1							1										
Melithreptus albogularis	white-throated honeyeater		4	1																															1			1
Entomyzon cyanotis	blue-faced honeyeater		2																																			
Philemon corniculatus	noisy friarbird	4	4	4		6	15	4		7																												
Philemon citreogularis	little friarbird			6	4	7	4	10	5	3																		1			1							
Microeca fascinans	jacky winter													1		3				1	1						3	1	3			1	2		2		2	1	
Melanodryas cucullata picata	hooded robin (northern inland)																											1	1			2				2		1
Eopsaltria australis	eastern yellow robin																											1										
Pomatostomus temporalis temporalis	grey-crowned babbler (eastern)	3	5					2													2	15						1						3				
Daphoenositta chrysoptera leucocephala	varied sittella (east - mid-east)																									6		2										
Pachycephala rufiventris	rufous whistler	6	1			2	4	3	4	1	3	2	3	2	2	2		1		1	1	1				1	1	1	1			3	1		1	2	1	1
Colluricincla harmonica	grey shrike-thrush																																				1	
Oreoica gutturalis	crested bellbird																								1	2	1			1		2	1			1	3	1	1
Myiagra rubecula	leaden flycatcher							1																														
Myiagra inquieta	restless flycatcher						2									5				1		1	1			1	1	1	1	1		2			1		2	1	
Grallina cyanoleuca	magpie-lark					3										3			2			1																
Rhipidura albiscapa	grey fantail	4	4	1	1	6	2	4	6	5	3	3				4				1	1	1	2	3				1			1	2			1	1		1
Rhipidura leucophrys picata	willie wagtail (northern)			1		3	4	2		1				1		7			3	1		2	2					2	1	2	1	3			3	1	2	1	2
Coracina novaehollandiae	black-faced cuckoo-shrike		1			4										1					1							1			1			2		2	1	
Coracina papuensis	white-bellied cuckoo-shrike				1	3								1		1											1											
Lalage sueurii	white-winged triller																									1	2											
Oriolus sagittatus	olive-backed oriole					2																																
Artamus superciliosus	white-browed woodswallow													1																								
Artamus cinereus albiventris	black-faced woodswallow (east-central)															1									4		6							5		5	1	
Cracticus torquatus	grey butcherbird			3				1		1	2	2					1	1										1				1						1
Cracticus nigrogularis	pied butcherbird		3			1												1		1													1		2	1	1	1	1
Cracticus tibicen	Australian magpie	1												2		1					1	2				1	1	1			1	4	1	1		1			
Strepera graculina graculina	pied currawong (eastern)		2				2																															
Corvus coronoides	Australian raven	1					1		1							2						2		1				2					1	1				
Corvus orru	Torresian crow			2		1					1	1				2	1	1													2				2		1	1
Struthidea cinerea	apostlebird															20						12																
Ptilonorhynchus maculatus	spotted bowerbird					2																																
Taeniopygia guttata	zebra finch												10													1												
Taeniopygia bichenovii	double-barred finch	15	4	2		6		4				6	10	5		130		3		10		20	10	40	4			4			10					10		
Poephila cincta cincta	black-throated finch (white-rumped)													1	20									3	2		3		25					10		13	10	5
Dicaeum hirundinaceum	mistletoebird	1				1																									1	1						
Petrochelidon nigricans	tree martin																		15															1					
Megalurus timoriensis	tawny grassbird																																			1			
Cincloramphus mathewsi	rufous songlark																										6							1			2	1
Cisticola exilis	golden-headed cisticola													2		1			2	1	1	10		2	2	1												

Appendix E

Mixed flock – Bird Species Array

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Appendix E. Species composition of mixed flocks that were observed. Refer to Appendix C for site locations.

Family	Scientific name	Common name	Mixed Flock Number											
			1	2	3	4	5	6	7	8	9	10	11	12
Psittacidae	*Trichoglossus haematodus haematodus*	rainbow lorikeet			40									
Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		3										
Psittacidae	*Platycercus adscitus adscitus*	pale-headed rosella (northern form)		4	7									
Maluridae	*Malurus lamberti*	variegated fairy-wren	8			5	15							
Maluridae	*Malurus melanocephalus*	red-backed fairy-wren					20	10			6	6		
Pardalotidae	*Pardalotus striatus*	striated pardalote	1	3	3	5						1		
Acanthizidae	*Smicrornis brevirostris*	weebill		3		1								
Acanthizidae	*Gerygone albogularis*	white-throated gerygone										3	1	
Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill											4	
Meliphagidae	*Lichenostomus virescens*	singing honeyeater	6	4						1				
Meliphagidae	*Lichenostomus plumulus*	grey-fronted honeyeater								1				
Meliphagidae	*Lichmera indistincta*	brown honeyeater	10	10	4								1	
Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		4										
Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		2										
Meliphagidae	*Philemon corniculatus*	noisy friarbird	4	4	4	2								
Petroicidae	*Microeca fascinans*	jacky winter										3		2
Petroicidae	*Melanodryas cucullata picata*	hooded robin (northern inland)											1	2
Petroicidae	*Eopsaltria australis*	eastern yellow robin											1	
Neosittidae	*Daphoenositta chrysoptera leucocephala*	varied sittella (east - mid-east Qld race)									6		2	
Pachycephalidae	*Pachycephala rufiventris*	rufous whistler	6			2								
Pachycephalidae	*Oreoica gutturalis*	crested bellbird								1				3
Monarchidae	*Myiagra rubecula*	leaden flycatcher												
Monarchidae	*Myiagra inquieta*	restless flycatcher					1	1			1	1		2
Monarchidae	*Grallina cyanoleuca*	magpie-lark												
Rhipiduridae	*Rhipidura albiscapa*	grey fantail	4	4	1	2	1	2					1	
Artamidae	*Artamus cinereus albiventris*	black-faced woodswallow (east-central Queensland)								4		6		5
Estrildidae	*Taeniopygia guttata*	zebra finch									1			
Estrildidae	*Taeniopygia bichenovii*	double-barred finch	15	4	2		20	10	40	4			4	
Estrildidae	*Poephila cincta cincta*	black-throated finch (white-rumped subspecies)							3	2		3		13
Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird	1			1								
Megaluridae	*Cincloramphus mathewsi*	rufous songlark										6		
Sylviidae	*Cisticola exilis*	golden-headed cisticola								2				

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Appendix F

Plant Species Array

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Appendix E. Vegetation species composition per site.

Family	Species	C1S01	C1S02	C1S03	C1S04	C1S05	C1S06	C1S07	C1S08	C1S09	C1S10	C1S11	C2S01	C2S02	C2S03	C2S04	C2S05	C2S06	C2S07	C2S08	C2S09	C2S10	C2S11	C2S12	C3S01	C3S02	C3S03	C3S04	C3S05	C3S06	C3S07	C3S08	C3S09	C3S10	C3S11	C3S12	C3S13	C3S14
Amaranthaceae	*Alternanthera dentata*																						x															
Amaranthaceae	*Alternanthera nodiflora*																					x																
Anacardiaceae	*Pleiogynium timorense*		x																																			
Apocynaceae	*Carissa lanceolata*											x	x					x	x		x			x														
Apocynaceae	*Carissa ovata*			x	x		x							x	x	x	x			x				x	x									x		x	x
Apocynaceae	*unidentified Carissa*																		x																			
Arecaceae	*Livistona lanuginosa*			x			x	x																														
Asteraceae	*Bidens pilosa*					x		x		x																												
Asteraceae	*Camptacra barbata*																														x	x			x			
Asteraceae	*Centipeda minima*																					x																
Asteraceae	*Chrysocephalum apiculatum*								x		x																												
Asteraceae	*Parthenium sp.*			x						x			x			x				x		x		x														
Asteraceae	*Pterocaulon serrulatum var. velutinum*																	x																				
Asteraceae	*Xanthium occidentale*			x		x		x														x																
Caesalpiniaceae	*Cassia brewsteri*																			x																		
Caesalpiniaceae	*Chamaecrista absus var. absus*																																			x		
Caesalpiniaceae	*Lysiphyllum carronii*																			x	x	x	x	x														
Caesalpiniaceae	*Lysiphyllum hookeri*				x																																	
Caesalpiniaceae	*unidentified Senna*										x	x																											
Campanulaceae	*unidentified Wahlenbergia*														x																	x						
Capparaceae	*Capparis lasiantha*				x												x	x																				
Capparaceae	*Capparis mitchellii*																				x	x	x															
Casuarinaceae	*Casuarina cristata*																						x															
Celastraceae	*Maytenus cunninghamii*																	x		x								x	x	x			x	x			x	x
Chenopodiaceae	*Einadia nutans*															x																						
Chenopodiaceae	*Enchylaena tomentosa*																		x					x														
Chenopodiaceae	*Salsola tragus*															x			x																			
Chenopodiaceae	*unidentified Sclerolaena*															x			x					x														
Combretaceae	*Terminalia oblongata*												x									x	x															
Convolvulaceae	*Bonamia media*																																					x
Convolvulaceae	*Evolvulus alsinoides*														x			x			x	x			x							x						x
Cyperaceae	*Cyperus concinnus*																						x															
Cyperaceae	*unidentified Cyperus*															x			x			x																
Cyperaceae	*unidentified Fimbristylis*																									x												
Erythroxylaceae	*Erythroxylum australe*		x								x											x									x						
Euphorbiaceae	*Flueggea leucopyrus*																x																				
Euphorbiaceae	*Petalostigma banksii*	x	x	x		x		x			x																	x	x		x			x		x	
Euphorbiaceae	*Petalostigma pubescens*							x	x	x		x									x				x	x											
Euphorbiaceae	*Phyllanthus virgatus*															x		x		x		x															
Fabaceae	*Erythrina vespertilio*																			x																	
Fabaceae	*Gastrolobium grandiflorum*																								x												
Fabaceae	*Glycine tomentella*																											x			x			x	x	x	
Fabaceae	*Indigastrum parviflorum*													x	x						x																
Fabaceae	*Indigofera colutea*																																		x			
Fabaceae	*Indigofera linifolia*													x	x					x					x											x		x
Fabaceae	*Indigofera linnaei*																																x					
Fabaceae	*Indigofera pratensis*																																	x				x
Fabaceae	*Rhynchosia minima*											x		x	x		x										x	x					x				
Fabaceae	*Sesbania cannabina*															x						x		x													
Fabaceae	*Stylosanthes humilis*																																x					
Fabaceae	*Stylosanthes scabra*	x																									x	x						x			
Fabaceae	*unidentified Erythrina*																												x								

Family	Species	C1S01	C1S02	C1S03	C1S04	C1S05	C1S06	C1S07	C1S08	C1S09	C1S10	C1S11	C2S01	C2S02	C2S03	C2S04	C2S05	C2S06	C2S07	C2S08	C2S09	C2S10	C2S11	C2S12	C3S01	C3S02	C3S03	C3S04	C3S05	C3S06	C3S07	C3S08	C3S09	C3S10	C3S11	C3S12	C3S13	C3S14
Fabaceae	*unidentified Glycine*														x						x	x																
Fabaceae	*unidentified Stylosanthes*		x	x	x			x	x			x	x	x	x		x	x	x	x		x		x						x							x
Fabaceae	*unidentified Zornia*														x																							
Fabaceae	*Zornia adenophora*																	x																				
Goodeniaceae	*unidentified Goodenia*																																	x		x	x
Juncaceae	*unidentified Juncus*															x																					
Laxmanniaceae	*Lomandra leucocephala subsp. leucocephala*								x																													
Laxmanniaceae	*Lomandra longifolia*			x																																	
Loranthaceae	*Lysiana exocarpi*																				x																
Malvaceae	*Sida cordifolia*					x		x	x	x		x																									
Malvaceae	*unidentified Sida*					x				x											x			x													
Marsileaceae	*Marsilea drummondii*																					x	x														
Marsileaceae	*unidentified Marsilea*															x																					
Meliaceae	*Owenia acidula*			x												x																					
Mimosaceae	*Acacia bidwillii*																				x									x		x				x	
Mimosaceae	*Acacia calyculata*											x																									
Mimosaceae	*Acacia cambagei*																							x													
Mimosaceae	*Acacia coriacea subsp. sericophylla*												x												x			x	x		x		x	x	x	x	x
Mimosaceae	*Acacia elachantha*		x								x																										
Mimosaceae	*Acacia excelsa*				x								x					x			x	x				x										
Mimosaceae	*Acacia falcata*																									x											
Mimosaceae	*Acacia falciformis*																									x											
Mimosaceae	*Acacia harpophylla*												x			x						x	x	x													
Mimosaceae	*Acacia holosericea*		x	x		x	x		x	x	x																				x	x		x	x	x	x
Mimosaceae	*Acacia julifera*																																			x	x	
Mimosaceae	*Acacia laccata*		x								x	x		x			x					x															
Mimosaceae	*Acacia latifolia*											x																										
Mimosaceae	*Acacia leptostachya*	x	x								x																											
Mimosaceae	*Acacia melleodora*																																			x	
Mimosaceae	*Acacia salicina*			x	x		x	x	x	x		x		x		x			x	x		x	x								x						
Mimosaceae	*Acacia sericophylla*													x	x		x	x		x											□							
Mimosaceae	*Acacia shirleyi*		x																																			
Mimosaceae	*Acacia tenuissima*											x	x																					x				
Mimosaceae	*Archidendropsis basaltica*																	x				x															
Mimosaceae	*unidentified Acacia*																																					x
Myoporaceae	*Eremophila mitchellii*				x	x		x				x												x					x								
Myoporaceae	*Myoporum montanum*																		x					x													
Myrtaceae	*Corymbia brachycarpa*	x	x					x		x																					x		x			x	x	
Myrtaceae	*Corymbia clarksoniana*					x			x		x															x	x	x				x					
Myrtaceae	*Corymbia dallachiana*		x			x	x	x	x		x			x	x						x				x			x		x	x	x	x	x	x	x	x
Myrtaceae	*Corymbia erythrophloia*																								x												
Myrtaceae	*Corymbia setosa*	x																							x					x				x		x	x	
Myrtaceae	*Corymbia sp.*																	x																			
Myrtaceae	*Corymbia tessellaris*			x																																	
Myrtaceae	*Eucalyptus brownii*				x	x						x	x			x		x		x	x	x	x														
Myrtaceae	*Eucalyptus camaldulensis*			x		x	x	x		x																					x		x				
Myrtaceae	*Eucalyptus cambageana*																		x																		
Myrtaceae	*Eucalyptus coolabah*			x			x	x																													
Myrtaceae	*Eucalyptus crebra*										x																x		x	x	x		x				x
Myrtaceae	*Eucalyptus drepanophylla*										x	x																										
Myrtaceae	*Eucalyptus melanophloia*		x								x	x	x	x	x		x	x		x					x	x	x	x	x	x	x	x	x	x	x	x	x
Myrtaceae	*Eucalyptus persistens*		x																									x									
Myrtaceae	*Eucalyptus similis*	x	x						x		x										x					x	x	x							x		
Myrtaceae	*Eucalyptus tereticornis*							x																													
Myrtaceae	*Melaleuca*			x			x																														

Family	Species	C1S01	C1S02	C1S03	C1S04	C1S05	C1S06	C1S07	C1S08	C1S09	C1S10	C1S11	C2S01	C2S02	C2S03	C2S04	C2S05	C2S06	C2S07	C2S08	C2S09	C2S10	C2S11	C2S12	C3S01	C3S02	C3S03	C3S04	C3S05	C3S06	C3S07	C3S08	C3S09	C3S10	C3S11	C3S12	C3S13	C3S14
	fluviatilis																																					
Myrtaceae	*Melaleuca leucadendra*			x																																	
Myrtaceae	*Melaleuca nervosa*					x		x	x	x															x	x							x				
Myrtaceae	*Melaleuca tamariscina*										x																											
Myrtaceae	*unidentified Corymbia*																	x																				
Oxalidaceae	*Oxalis perennans*																					x																
Pittosporaceae	*Bursaria incana*		x																		x							x	x	x	x				x		
Poaceae	*Alloteropsis cimicina*																								x		x				x				x		
Poaceae	*Aristida calycina var. calycina*	x	x		x	x		x	x	x	x																x		x				x				x
Poaceae	*Aristida contorta*																																x					
Poaceae	*Aristida holathera*																																x					
Poaceae	*Aristida hygrometrica*																								x													
Poaceae	*Aristida ingrata*																								x	x				x		x	x		x	x	x	
Poaceae	*Aristida jerichoensis*												x													x												
Poaceae	*Aristida latifolia*	x	x			x			x	x	x						x	x						x						x							x
Poaceae	*Aristida pruinosa*											x																										
Poaceae	*Arundinella nepalensis*			x																																		
Poaceae	*Bothriochloa bladhii*																															x						
Poaceae	*Bothriochloa decipiens*					x	x																															
Poaceae	*Bothriochloa ewartiana*																												x	x	x			x				
Poaceae	*Bothriochloa pertusa*			x									x							x				x														
Poaceae	*Capillipedium parviflorum*																																x					
Poaceae	*Cenchrus ciliaris*				x	x		x	x	x			x		x	x			x	x	x	x		x							x					x	
Poaceae	*Chloris inflata*			x			x	x																														
Poaceae	*Chloris virgata*												x																									
Poaceae	*Chrysopogon fallax*		x	x	x	x	x	x		x		x		x								x			x					x	x		x		x	x		
Poaceae	*Cymbopogon bombycinus*		x								x														x	x	x	x		x		x	x		x	x	x	x
Poaceae	*Cymbopogon obtectus*												x					x	x																			
Poaceae	*Cynodon dactylon*			x			x									x							x														
Poaceae	*Dichanthium fecundum*																																x					
Poaceae	*Dichanthium sericeum*			x			x									x				x				x				x		x			x				
Poaceae	*Digitaria brownii*					x																			x					x					x		x
Poaceae	*Digitaria ciliaris*					x	x						x																								
Poaceae	*Digitaria divaricatissima*																													x		x	x	x			x	x
Poaceae	*Enteropogon acicularis*	x	x		x																						x			x		x			x		
Poaceae	*Enteropogon ramosus*				x																																
Poaceae	*Eragrostis sororia*																										x										
Poaceae	*Eragrostis speciosa*					x	x																														
Poaceae	*Eriachne aristidea*	x																																			
Poaceae	*Eriachne mucronata*											x																									
Poaceae	*Eriachne obtusa*																x																				
Poaceae	*Eulalia aurea*			x		x																															
Poaceae	*Heteropogon contortus*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x
Poaceae	*Ischaemum fragile*														x		x			x																	
Poaceae	*Leptochloa digitata*																						x														
Poaceae	*Melinis repens*	x				x																															
Poaceae	*Panicum decompositum*						x					x												x				x	x	x	x	x		x				
Poaceae	*Panicum effusum*	x																							x	x	x						x			x	x	
Poaceae	*Paspalidium jubiflorum*																						x														
Poaceae	*Paspalidium rarum*																																				x	
Poaceae	*Pennisetum ciliare*																										x	x		x							
Poaceae	*Schizachyrium fragile*																								x	x	x					x	x		x	x	x	x
Poaceae	*Sehima nervosum*																												x	x			x	x	x			
Poaceae	*Setaria*	x			x	x			x	x	x																											

Family	Species	C1S01	C1S02	C1S03	C1S04	C1S05	C1S06	C1S07	C1S08	C1S09	C1S10	C1S11	C2S01	C2S02	C2S03	C2S04	C2S05	C2S06	C2S07	C2S08	C2S09	C2S10	C2S11	C2S12	C3S01	C3S02	C3S03	C3S04	C3S05	C3S06	C3S07	C3S08	C3S09	C3S10	C3S11	C3S12	C3S13	C3S14
	surgens																																					
Poaceae	*Sorghum plumosum*																									x	x	x						x				
Poaceae	*Sporobolus caroli*			x			x																x							x				x				
Poaceae	*Themeda avenacea*																												x	x			x	x				
Poaceae	*Themeda triandra*		x			x						x	x	x	x		x			x					x		x	x	x	x	x		x		x			x
Poaceae	*Triodia pungens*	x	x						x		x	x			x			x							x	x	x				x	x	x		x	x	x	x
Poaceae	*unidentified Aristida*									x					x		x	x	x		x																	
Poaceae	*unidentified Bothriochloa*																		x	x																		
Poaceae	*unidentified Dichanthium*																									x							x					
Poaceae	*unidentified Digitaria*			x		x		x			x	x						x				x													x			
Poaceae	*unidentified Enneapogon*							x	x			x						x					x															
Poaceae	*unidentified Eragrostis*			x			x	x												x		x								x							
Poaceae	*unidentified Eriochloa*																			x			x															
Poaceae	*unidentified Panicum*										x									x																		
Poaceae	*unidentified Paspalidium*			x																																		
Poaceae	*unidentified Perotis*																				x																	
Poaceae	*unidentified Sporobolus*															x			x																			
Polygonaceae	*unidentified Persicaria*																		x																			
Proteaceae	*Grevillea parallela*									x																x							x					
Proteaceae	*Grevillea pteridifolia*																	x			x															x	x	
Proteaceae	*Grevillea striata*				x	x				x	x							x			x					x	x			x							
Proteaceae	*Hakea chordophylla*																								x						x							
Proteaceae	*Hakea lorea subsp. lorea*		x												x																							
Rhamnaceae	*Alphitonia excelsa*	x		x		x		x	x	x	x																											
Rhamnaceae	*Ventilago viminalis*								x						x					x		x																
Rutaceae	*Geijera salicifolia*																x				x																	
Sapindaceae	*Alectryon diversifolius*																						x															
Sapindaceae	*Alectryon oleifolius*																						x															
Sapindaceae	*Atalaya hemiglauca*				x			x				x				x			x			x	x	x														
Sterculiaceae	*Keraudrenia collina*	x																																				
Sterculiaceae	*Melhania oblongifolia*															x																						
Tiliaceae	*Grewia retusifolia*													x			x					x							x	x		x					x
Typhaceae	*Typha sp.*															x			x																		
Verbenaceae	*unidentified Stachytarpheta*									x																												

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