Chinova Cloncurry Pty Ltd

Mt Dore Heap Leach Project

Carpentarian Antechinus (*Pseudantechinus mimulus*)
Management Plan

RBC Environmental

9 March 2017
# Quality Information

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Date: 9 March 2017

Prepared by: Andrew Holzheimer and Rod Coe

Reviewed by: Richard Webb

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<tr>
<th>Document Version</th>
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<td>Andrew Holzheimer and Rod Coe</td>
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<td>Andrew Holzheimer and Rod Coe</td>
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1. Introduction

The Carpentarian Antechinus (\textit{Pseudantechinus mimulus}) has been found to occur within the Selwyn Range, and there is potential for the species to be impacted by proposed activities associated with the Mt Dore Heap Leach Copper Project. This Carpentarian Antechinus Management Plan (hereafter referred to as 'the Plan') provides a detailed analysis of the species in the context of the Mt Dore Heap Leach Copper Project and outlines the management strategies that will be implemented to provide for its ongoing protection. The structure and content of the Plan is consistent with the Department of the Environment’s (DoE) \textit{Environmental Management Plan Guidelines 2014}.

There are recognised gaps in our current understanding of the species’ ecology and distribution. Expert input has been used in the preparation of this Plan to address this issue. The information used is the best available, and the interpretation of relevant impacts and identification of suitable mitigation strategies is informed by extensive field experience.

The primary purpose of the Plan is for use by Chinova personnel responsible for its implementation. The Plan has also been developed as part of a package of information to support an EPBC Act referral for the Mt Dore Heap Leach Copper Project. In this way, the Plan has a broader audience and purpose, which is to provide regulators and the public with:

- an understanding of the values of the Mt Dore Heap Leach Copper Project mine tenements to the local population of Carpentarian Antechinus;
- an understanding of the relevant impacts associated with mining and the range of measures that will be implemented to manage them; and
- confidence in Chinova’s commitment to managing the species as part of mining operations and in the outcomes, that will be delivered.

1.1 Objectives of the Plan

The objective of the Plan is to ensure construction, operation and rehabilitation activities of the Mt Dore Heap Leach Copper Project are undertaken with sufficient controls and management strategies to ensure protection of the local Carpentarian Antechinus population.

To achieve this objective the Plan provides:
• background to the Carpentarian Antechinus and detailed information regarding the baseline values of the Mt Dore Heap Leach Copper Project mine tenements for the local population;
• an assessment of potential impacts to the Carpentarian Antechinus because of the proposed project;
• identification of environmental management measures and performance targets required to mitigate relevant impacts and provide for ongoing protection of the local population;
• a residual risk assessment to identify and understand key areas of risk to the species from project activities; and
• outline the relevant systems for environmental management, reporting, monitoring, review and audit.

2. Project Description

The Cloncurry Project Operations are owned by Chinova Resources Limited (Chinova) a mineral exploration and mining development company (formerly known as Ivanhoe Australia Limited) focussed on mining and exploration tenements in north-west Queensland. Chinova through its wholly owned subsidiary, Chinova Resources Cloncurry Mines Pty Limited (CRCM), owns 100% of the Cloncurry Project Operations which was acquired in 2003. Chinova also acquired the Osborne Project Operations on 30 September 2010 by taking control of Barrick (Osborne) Pty Limited, a subsidiary of Barrick Gold Corporation. Chinova currently operates an open pit copper/gold mining operation and copper flotation processing plant at Osborne approximately 195 kilometres (km) south-east of Mt Isa and 54 kilometres south of the proposed Mt Dore Heap Leach Copper Project. The Osborne operation is scheduled for completion by mid-2018, with Chinova committed to rehabilitating and managing this site while continuing to progress other projects in the region.

The CRCM Mt Dore Heap Leach Copper Project is part of the Cloncurry Project mining leases and will involve a five-year development and operational phase of the Mt Dore Copper Oxide ore body as well as the establishment of a Heap Leach and associated Solvent Extraction Electro-Winning (SXEW) processing circuit. Water will be provided from the Mt Dore aquifer for this period of operation with any excess water being disposed into the Southern Tailings Dam. Diesel generators (4-5MW capacity) will provide initial power for the Mt Dore Camp and early construction and production activities with the establishment of a powerline from Osborne along the existing 56 kilometre mining lease corridor after the initial operating period. The existing Mt Dore Camp and Osborne Village will be used to accommodate a proposed workforce of 150 during construction, reducing to 100 for operations. Note
a proposed powerline from Osborne is considered a separate standalone project to provide power to other future projects that Chinova is studying in the area as well as the Mt Dore Heap Leach Copper Project. The powerline project does not trigger any matters of national environmental significance and is not considered further in this document.

An Environmental Authority amendment application (MIM100894709) has been lodged with the Queensland Department of Environment and Heritage Protection (DEHP) to allow for the establishment of a 2Mtpa Heap Leach Copper Project. The proposed mining operation will include simultaneous extraction from two open pits to maximise efficiencies for both the drill and blast and earth-moving fleet. Mining will proceed at a maximum rate of 2Mtpa of ore extracted with the following proposed operations.

- 2 open pits
- 3 non-acid forming (NAF) waste rock dumps
- 8.5 Mt of copper ore at 0.85% Cu
The proposed disturbance areas are detailed in Table 1 below and the disturbance area initially proposed in the referral application is shown in
Figure 1. It should be noted that both the open pits will remain open at the completion of this proposed phase of operation. Both pits will offer future potential underground access to the underlying Merlin molybdenum/rhenium deposit.

The Environmental Authority amendment has been determined by DEHP to be a major amendment with no EIS requirement.

Table 1: Proposed disturbance areas

<table>
<thead>
<tr>
<th>Disturbance</th>
<th>Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Pit</td>
<td>6.9</td>
</tr>
<tr>
<td>South Pit</td>
<td>28.7</td>
</tr>
<tr>
<td>North Waste Rock Dump</td>
<td>23.3</td>
</tr>
<tr>
<td>South Waste Rock Dump</td>
<td>29.8</td>
</tr>
<tr>
<td>Heap Leach Pad</td>
<td>28.7</td>
</tr>
<tr>
<td>Process Plant</td>
<td>1.1</td>
</tr>
<tr>
<td>Process Ponds</td>
<td>5.9</td>
</tr>
<tr>
<td>ROM / Agglomerator / Crusher</td>
<td>12.9</td>
</tr>
<tr>
<td>ROM Dam</td>
<td>1.0</td>
</tr>
<tr>
<td>Dams</td>
<td>1.5</td>
</tr>
<tr>
<td>Equipment Parking</td>
<td>3.8</td>
</tr>
<tr>
<td>Haul Roads</td>
<td>8.1</td>
</tr>
<tr>
<td>ROM / Process/ Heap Leach Surrounds</td>
<td>23.8</td>
</tr>
<tr>
<td>Topsoil Stockpiles</td>
<td>11.6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>187.1</strong></td>
</tr>
</tbody>
</table>
Figure 1: Proposed infrastructure components within the project area.
2.1 Location

The Cloncurry Project is located 140km south-east of Mt Isa in the south west corner of the Selwyn Ranges in north-western Queensland (Figure 2). The Selwyn Range is a key environmental feature within the Cloncurry Project tenements and runs in a general north-south direction, with prominent features being rocky outcrops that provide suitable habitat for the EPBC Act listed Carpentarian Antechinus (*Pseudantechinus mimulus*). Latitudes and longitudes for the Project area are given in Table 2.

### Table 2: Latitudes and longitudes for project area.

<table>
<thead>
<tr>
<th>Location</th>
<th>Latitude</th>
<th>Longitude</th>
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<tr>
<td>North eastern corner</td>
<td>-21.645</td>
<td>140.508</td>
</tr>
<tr>
<td>North western corner</td>
<td>-21.645</td>
<td>140.479</td>
</tr>
<tr>
<td>South western corner</td>
<td>-21.677</td>
<td>140.479</td>
</tr>
<tr>
<td>South eastern corner</td>
<td>-21.678</td>
<td>140.508</td>
</tr>
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</table>

CRCM holds 23 mining leases totalling 4,990.18ha. The tenements of the projects are listed in Table 3, which also includes the expiry date, area and background tenure information. Mining lease numbers 90215 and 90217 were granted over a 100m wide access corridor to Osborne Mine in 2012. The mining leases allow for the development of a power-line, gas pipe-line and water pipe-line in addition to the already constructed haul-road access.

CRCM has 35 granted Exploration Permits for Minerals (EPMs) with a total area of 4,083 km² including joint ventures and two EPM applications with a total area of 130 km². The granted EPMs include 25 that are 100% owned by Chinova subsidiaries Chinova Resources Cloncurry Mines Pty Ltd (CRCM) and Chinova Resources Osborne Pty Ltd (CRO), five EPMs in the CRCM / Exco JV (181 km²) and five EPMs in the Red Metal / CRO JV (60 km²) where Chinova are the operators.
Figure 2: Project location.
Table 3: Cloncurry Project mining tenures.

<table>
<thead>
<tr>
<th>Ming Lease</th>
<th>Name</th>
<th>Expiry Date</th>
<th>Area (ha)</th>
<th>Real Property Description</th>
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<td>2454</td>
<td>Reward Claim</td>
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<td>3.966</td>
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<tr>
<td>2566</td>
<td>Marilyn 1</td>
<td>31-May-29</td>
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<tr>
<td>2688</td>
<td>Mt Dore Extended No 1</td>
<td>30-Jun-20</td>
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<td>2689</td>
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<tr>
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<td>2732</td>
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<td>2733</td>
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<tr>
<td>2738</td>
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<td>2745</td>
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<td>2746</td>
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<td>90043</td>
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<tr>
<td>90061</td>
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<td>28-Feb-25</td>
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<td>90217</td>
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<tr>
<td>90215</td>
<td>Access North</td>
<td>31-Jul-30</td>
<td>83.56</td>
<td>Lot 13 on SP223510</td>
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</tbody>
</table>

(Mt Dore Project MLs in bold).

2.2 Project activities

This Plan considers potential impacts to Carpentarian Antechinus because of construction, operation and rehabilitation phases of the mine development. The project involves construction, operation and decommissioning of the following four components:

- Mt Dore open pits and waste rock dumps;
- Three stage crushing and agglomeration;
- Heap leach; and
- Solvent extraction – Electro-Winning.
The locations of these project components are given in Figure 1. A summary of the activities to be undertaken for construction, operation and decommissioning of each of these components is given below.

2.3 Mt Dore open pits and waste rock dumps

The proposed mining operation will include simultaneous extraction from two open pits to maximise efficiencies for both the drill and blast and earth-moving fleet. Mining will proceed at a maximum rate of 2Mtpa of ore extracted with the following proposed operation.

- 2 open pits
  - North 450 x 220 x 90m depth;
  - South 530 x 515 x 150m depth;
- 2 non-acid forming (NAF) waste rock dumps
  - North – 2,460,000 bcm
  - South – 6,102,335 bcm
- 8.5 Mt of copper ore at 0.85% Cu
- 15,375m³ of potentially acid forming waste (PAF >0.5% S)

It should be noted that both the open pits will remain open at the completion of this proposed operation. Both pits will offer future potential underground access to the underlying Merlin molybdenum/rhenium deposit. Any identified PAF material will be disposed into the existing Starra 257 open pit. Ores and waste will be blasted for removal by a typical open cut heavy earthmoving equipment and hauled along posed roads on a 24 hour 7 day a week basis.

A list of mining machinery and supporting equipment proposed to be used at the Mt Dore Heap Leach Copper Project includes but is not limited to the following:

- Sandvik DP1100 drill
- Emulsion truck
- 2 x D10 bulldozers
- PC2500 excavator
- PC1700 excavator
- 6 x 785 Cat dump trucks
- 8 x 777 Cat dump trucks
- Service truck
- Water Cart
2.4 Three stage crushing and agglomeration

The crushing and agglomeration activity will occur on the ROM pad along with the stockpiling of ore. Three stages of crushing are employed to produce a final product with a P100 of 12.5 mm. The selection of this product size is based on test work for Mt Dore copper leaching kinetics, indicating that the copper leach kinetics were significantly increased when crushed to 12.5mm compared to 25mm. A Belt Feeder transfers the ore from the Agglomerator Feed Bin to the Agglomerator Feed Conveyor. Process water and sulphuric acid are added to the Agglomeration Drum at controlled rates via pipe manifolds and spray nozzles.

The agglomeration process involves the fine particles adhering to the coarser material, which is promoted by the tumbling action of the agglomeration drum to produce rounded ball shape lumps or agglomerates. The main objective of the agglomeration process is to firstly produce agglomerates that can be transported and stacked without breaking down and secondly the agglomerates must maintain integrity when the heap is irrigated with an acidic solution.

The agglomerated ore is directly conveyed to the leach pad. The overland conveyor would be equipped with a tripper car chute for variable position offloading. This would be followed by a series of conveyors including a portable ramp conveyor, several portable conveyors and a horizontal conveyor. The stacking of the agglomerated ore on the heap would be performed by a radial stacker and stinger conveyor.

2.5 Heap leach

The process utilises biologically assisted heap leaching to facilitate the solubilisation of secondary sulphide minerals contained in the ore. Iron oxidising bacteria are introduced to the ore surface during agglomeration and they in turn provide a mechanism to solubilise secondary sulphide minerals, notably chalcocite, and improve copper leach kinetics. Once stacked, the agglomerated material is subjected to rest and curing in the leach pad area. During this period the irrigation net is installed. The irrigation system consists of a main pipe, a system of distribution pipes of decreasing diameter and drop emitters, all constituting a net type arrangement. The emitters or drippers distribute the solution on the heap and are positioned to ensure efficient wetting of the agglomerate bed. The overall leach cycle comprises heap establishment, stacking, curing, primary leaching and secondary leaching.

Primary leaching would be carried out on freshly cured agglomerates using a stream of intermediate leach solution (ILS) combined with sulphuric acid in a static mixer. This part of the cycle produces the
pregnant leach solution (PLS), which contains dissolved copper and some impurities. Secondary leaching would be carried out on the partially leached agglomerates after the primary leaching. The secondary leachate is a combined stream of raffinate (barren liquor) and water make-up. The residual acid contained in this combined solution results in the recycling of acid and assists in reducing the overall acid consumption.

Air would be required to achieve bacterial oxidation of both primary and secondary copper mineralisation. To assist in this process, air is injected into the heap using a set of low-pressure high volume blowers via headers and perforated pipe networks installed through the base of the heap. The heaps will be under irrigation for a period of 365 days with a corresponding predicted recovery of 80% of total copper over this period.

The leach heaps are built on an impermeable base consisting of a high-density polyethylene liner with a compacted clay layer beneath and a finely crushed rock layer above. This permits collection of the leached copper and prevents solution penetration into the underlying environment. The base of the pad is sloped to direct copper rich solution to a collection basin which drains by gravity to the process pond.

2.6 Solvent extraction – Electro-Winning

Solvent Extraction:

Acidic copper sulphate solution produced in the heap leach circuit is collected in the PLS pond before being pumped to two extraction mixer settlers in series. PLS is mixed with organic in the primary and secondary mixer and copper is extracted from the PLS solution and selectively transferred to the organic phase. Organic exits E1 settler and flows by gravity to the Loaded Organic Tank before being pumped to the strip settler (S1). The raffinate solution exiting the extraction stages will be returned under gravity to the raffinate pond.

The loaded organic will be pumped from the Loaded Organic Tank to the strip stage S1 where it is contacted with spent electrolyte returned from the electrowinning plant. Copper is transferred from the organic into the spent electrolyte to create strong electrolyte (Advance Electrolyte).

Advance electrolyte reports to the filter feed tank and is pumped to the electrolyte multi-media filter to remove the entrained organic. Filtered electrolyte flows to the filtered electrolyte tank. From here it is pumped to the electrowinning plant. A filtered electrolyte tank is required to smooth surges and
maintain a reservoir for whenever the single electrolyte filter is backwashed. On a regular cycle, some of the filtered electrolyte is used to backwash the multi-media filter. The electrolyte filter is controlled by PLC and is automatically backwashed with spent electrolyte. Filter backwash is returned to SX circuit from the backwash collection tank.

Crud from various areas within the SX plant is pumped to the Crud Collection Tank prior to treatment. Crud treatment involves firstly decanting aqueous from the Crud Collection Tank prior to pumping the remaining mixture of organic and crud through a centrifuge. Crud is periodically removed by the centrifuge which splits the crud into its three constituent phases, i.e.: aqueous, organic and solids. Both the aqueous and organic phases are returned to the SX circuit. Contaminated solids are collected in a Crud Skip and transferred to the heap leach pad for disposal at a rate of approximately 50kg/day.

Cleaned organic can also be transferred to the crud/clay treatment tank for further treatment with activated clay. During clay treatment, activated bentonite clay is added to the organic in the organic clay treatment tank and the slurry is transferred to the centrifuge for separation. The function of the activated bentonite is to absorb unwanted oxidation products from the organic that affect the extraction and separation performance.

**Electrowinning:**

Advance electrolyte that has been filtered by the electrolyte filter will be pumped into the tankhouse. The advance electrolyte will exchange heat in the electrolyte inter-exchanger with the spent electrolyte returning to the solvent extraction plant. A trimming heat exchanger will be used to maintain the temperature of the advance electrolyte at a constant temperature to maintain the electrolyte at optimum temperature for copper deposition and to aid reaching this set point during the operation start-up.

Advance electrolyte will flow into the polishing cells for final capture of any organic. Overflow from the polishing cells will be collected and flow into the electrolyte circulation tank where it will mix with spent electrolyte, from the remainder of the EW. The electrolyte circulation pump will circulate electrolyte to the commercial cells. Commercial cell overflow (spent electrolyte) will report to the spent electrolyte tank. Spent electrolyte more than that sent back to SX will flow into the circulation electrolyte tank. When required, concentrated acid is added to the polishing cell overflow return to the circulating electrolyte tank. The number of polishing cells to commercial cells is approximately 20% of total.
Cobalt sulphate and salt solution will be added to the electrolyte to maintain set cobalt and chloride concentrations. Cobalt protects the anodes from severe corrosion; while chloride is a crystal growth modifier that improves the cathode quality. A smoothing agent or Guar will also be added to the electrolyte to improve the deposit quality. Potable water will be added to the spent electrolyte tank to make up for process, evaporation and chemistry losses. A DC current will be applied to the electrolytic cells that contain lead anodes and stainless steel cathode plates. Oxygen will be liberated at the anodes and copper will be deposited at the cathodes in accordance with the current density, targeted to an industry standard 300A/m².

**Stripping and Packaging:**

The cathode plates will be removed and transported by overhead crane to the semi-automatic cathode stripping machine where adherent electrolyte is washed from the copper deposit with hot water. The cathode plates will then be delivered one at a time to a flexing-stripping station where the sheets of copper deposit will be removed from both sides. Copper will be harvested on a seven-day growth cycle from the electrowinning cells by an overhead crane that transports the cathode plates to the cathode stripping machine. Harvesting will be conducted on a nominal three day/week (every second or third day) to ensure good copper growth morphology and simple harvesting management. This allows newly stripped cathodes in the cell for two days to grow copper before stressing them (electrically) by harvesting the ones next to them.

The cathode stripping machine will be semi-automatic and contain a flexing stripping and knifing station. Cathode plates will be delivered to the feed-in conveyor of the machine and indexed automatically through the wash station where adherent copper sulphate electrolyte will be washed off. The stripping machine operator will pick up a single electrode from the wash station using the stripping machine hoist and deliver it to the flexing/stripping station. The flexing stripping station operation will be initiated by the operator and the cathode deposit will be automatically removed from the plate and delivered to a bundling station on either side of the stripping machine. While, the freshly stripped cathode plate will be delivered to the feed-out conveyor and automatically spaced for return to the cells. The copper sheets (deposits) will be sampled, bundled, weighed, marked and strapped ready for shipment to export customers. Shipment will be by truck to an export terminal.

### 2.7 Schedule of activities

The following is the proposed schedule of activities for the Mt Dore Heap Leach Copper Project:

- Land clearing and site preparation – August 2017
- Open pit mining commences – November 2017
• Crusher, Heap Leach and Plant construction – February 2018
• First ore delivery – March 2018
• Heap Leach irrigation commences – April 2018
• First copper cathode production – May 2018
• Project completion – December 2022
• Rehabilitation commences January 2023

2.8 Decommissioning

Decommissioning of the project and rehabilitation will be undertaken in accordance with the commitments within this document, the associated Cloncurry Project Closure Plan and the Project Environmental Authority. Work will commence immediately following project completion while equipment and manpower is still available on site with rehabilitation activities completed within 6 months. Rehabilitation monitoring will be ongoing until the relevant completion criteria and regulatory conditions have been met.

3. Environmental Management Roles and Responsibilities

3.1 Site Manager

The Site Senior Executive maintains the overall responsibility for the management of health, safety and environmental risks on site including the proposed avoidance, safeguards and mitigation measures proposed in this plan.

3.2 Health Safety and Environment Superintendent

The HSEC Superintendent is responsible for the maintenance of this plan and monitoring compliance with this plan.

3.3 Site Personnel

All site personnel will be required to adhere to this plan and the associated procedures and standard work instructions.
4. Reporting

All records required to be kept by this Plan will be made publicly available on the Chinova Resources website www.chinovaresources.com. A report summarising the achievement of outcomes and monitoring of the performance measures will be produced annually commencing in July 2018, along with a review of this Plan. The report and Plan update will be also made publicly available on the Chinova Resources website.

5. Training

All personnel seeking to access or conduct work at Mt Dore Mine are required to complete the site induction. The induction outlines the roles and responsibilities of individuals in the management of environmental risk associated with site activities including the protection of the Carpentarian Antechinus. The site induction further includes procedures for incident notification and consequences for non-compliance with site procedures.

Records of all training conducted are maintained and include:

- the person receiving the training;
- the date the training was received; and
- the name of the person conducting the training.

Secondary methods for communication of general awareness of environmental matters are via pre-start meetings and site bulletins.

6. Emergency Procedures

Chinova Resources has an established Crisis and Emergency Management Procedure designed to respond to and recover from significant events of consequence that threaten people, environment, asset, or reputation. The plan contains emergency related processes, organisation structures, duty cards, support tools, and resources that will support an effective site-wide response to significant events of consequence.
7. Carpentarian Antechinus (*Pseudantechinus mimulus*)

7.1 Conservation Status

The Carpentarian Antechinus is currently listed as vulnerable under the EPBC Act 1999 and least concern under the Nature Conservation Act 1992.

7.2 Ecology of the species

The ecology of the Carpentarian Antechinus is poorly understood. It is closely related to and superficially like other antechinus species that typically occupy rocky areas in northern and central Australia, but is slightly smaller than these species (Woinarski, 2004). All five species have a somewhat flattened head and pointed muzzle, large ears, and are generally brown above and pale below. The Carpentarian Antechinus is nocturnal and has a distinguishing patch of reddish fur around the ears and feeds primarily on a variety of invertebrates (particularly termites), but may also prey on small vertebrates such as skinks (Johnson, et al., 2008; Ward, 2012; Burnett, et al., 2014; Woinarski, et al., 2014).

Carpentarian Antechinus are monoestrous and have a single breeding season each year. The species has a type II dasyurid life strategy. After the breeding season, most breeding-age adults die with only limited numbers surviving to breed in a second year (Lee, et al., 1982). Breeding is thought to occur in winter. Pouch young are typically detected in July and August, and females with enlarged teats (indicative of post-breeding) detected during October (Johnson, et al., 2008; Woolley, 2011; Woinarski, et al., 2014). One individual has been recorded with six pouch young (Woolley, 2011). This life-cycle results in a temporary reduction in the population each year and may explain why the species is less likely to be detected after August (Burnett, et al., 2014).

Home range and movement patterns are unknown. *Pseudantechinus macdonnellensis*, a slightly larger sister species which inhabits a similar ecological space has home ranges averaging between 0.76 and 1.14 ha, with males having larger home ranges than females (Pavey, et al., 2003).

7.3 Habitat requirements

The habitat requirements and biology of the Carpentarian Antechinus are also poorly understood. In 2013 Chinova engaged Dr Scott Burnett Lecturer in Animal Ecology, School of Science and Engineering, University of the Sunshine Coast as a relevant species expert to study the species, with a focus on optimising the detectability of the species and associated habitat requirements. The study found more individuals in Queensland than previously detected, and an increased likelihood of the species...
occurring in habitat that includes massive rock features (boulders, outcrops, rubble, and scarps) (Burnett, et al., 2014).

It clearly identifies that the Carpentarian Antechinus is confined to rocky habitats in the study area and has been associated with 15 different Regional Ecosystem (RE) types. This is consistent with the findings of other studies. Despite this dependence on rock habitat, the presence/absence of Carpentarian Antechinus at a site is not predicted by any of the rock variables; lithology (metamorphic, sedimentary or igneous), landform (boulder, scarp, ridge etc.), % rock ground cover, or an index of cavity size and number (Burnett, et al., 2014). Burnett et al., (2014) also found that those rocky sites supporting low woodland to open forest of *Acacia shirleyi* (Lancewood) are significantly more likely to be occupied by Carpentarian Antechinus. Table 4 includes RE descriptions and images of some of the sites where the Carpentarian Antechinus have been identified within CRCM tenements.

Table 4: Regional ecosystem descriptions and images of Carpentarian Antechinus sites.

<table>
<thead>
<tr>
<th>Regional ecosystem description</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Eucalyptus leucophloia</em> low open woodland on granites</td>
<td><img src="image1.jpg" alt="Image" /> <img src="image2.jpg" alt="Image" /></td>
</tr>
<tr>
<td><em>Eucalyptus leucophloia</em> low open woodland on granites</td>
<td><img src="image3.jpg" alt="Image" /> <img src="image4.jpg" alt="Image" /></td>
</tr>
<tr>
<td><em>Eucalyptus leucophloia</em> low open woodland/<em>Corymbia terminalis</em> low open</td>
<td><img src="image5.jpg" alt="Image" /> <img src="image6.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>
### Regional ecosystem description

<table>
<thead>
<tr>
<th>Ecosystem Description</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodland on basic metamorphics</td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td><em>Eucalyptus leucophloia</em> low open woodland/Corymbia terminalis low open woodland on basic metamorphics</td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
</tbody>
</table>

### 7.4 Distribution and population trends

Carpentarian Antechinus have been recorded in the north-eastern Northern Territory and western Queensland. Observations from the Northern Territory were first made at Alexandria Station in 1906. The species has not since been recorded in the area. Recent observations were recorded on the Northern, South-West, Centre and Vanderlin Islands of the Sir Edward Pellow group and the adjacent mainland in an Australian Wildlife conservancy reserve (Kitchener, 1991; Johnson, et al., 2008; Woolley, 2011; Woinarski & Ward, 2012). These records suggest the species may be more widespread in the Northern Territory than previously thought.

Recent recordings have been made in Queensland near Mount Isa and across CRCM sites in the Selwyn Range which is the current southern known extent of the species. The species was recorded near the Mt Colin mine in 2013 and Dugald River mine in May 2015 (AARC, 2013; Open Lines Environmental Consulting, 2015). Subsequent studies found four individuals in the Knapdale Range (within proximity to the Dugald River mine and approximately 22km north-west of Quamby) and a fifth individual in a rock outcrop approximately 1.5km north-west of Quamby (Open Lines Environmental Consulting, 2015). These records represent the north-eastern limit of the species known range. The current Extent of Occurrence and known records within the Mt Isa region are shown in Figure 3.

If the Queensland and Northern Territory populations are contiguous, the species has an estimated occurrence of 124,800 km² 12,480,000 ha. If the two populations are disjoint, the estimated occurrence of Carpentarian Antechinus is 2,100 km² 210,000 ha in the Northern Territory and 16,900 km² 1,690,000 ha in Queensland. These estimates do not account for regions of unsuitable habitat within the mapped areas of occupancy and the species is unlikely to occur uniformly throughout these regions. Studies have found no evidence of deep genetic breaks between the scattered, disjoint populations of Carpentarian Antechinus in north-west Queensland and north-east...
Further evidence is required to determine the species’ distribution and genetic structure.

### 7.5 Abundance and population trends

There is no available population estimate for the Carpentarian Antechinus. Capture rates of the species are low, typically <1% in the Northern Territory (Woinarski, et al., 2011), and lower in Queensland (e.g., 0.3% (Lloyd, et al., 2013); 0.5-4% (EcoSmart Ecology, 2015). Trap rates are low in known areas of occupied habitat and appears to be more readily detected by camera trap surveys than standard live-trapping (Woinarski & Ward, 2012; Burnett, et al., 2014; EcoSmart Ecology, 2015).

It is not clear whether the low trap rates represent low numbers of individuals or whether the species is wary of traps.

Repeated survey data in known populations of Carpentarian Antechinus is limited. Repeated surveys from the Sir Edward Pellew islands have no established population trends except for a possible decline on North Island (Woinarski et al. 2011, 2014). The number of records of the species in Queensland within the last four years has increased substantially, as has the known range of the species within the state. This increase is likely due to improved survey methodology (i.e. camera traps) and increased survey effort.
Figure 3: Extent of occurrence and known records within the Mt Isa region.
7.6 Threats

Documented threats to Carpentarian Antechinus are provided in Table 5, which extends on and uses criteria published in Woinarski, et al., (2014).

Table 5: Documented threats to the Carpentarian Antechinus*.  

<table>
<thead>
<tr>
<th>Threat</th>
<th>Consequence rating</th>
<th>Extent over which the threat may occur</th>
<th>Evidence base</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inappropriate fire regimes</td>
<td>Severe</td>
<td>Large</td>
<td>Not demonstrated, but plausible. Impacts of severe fires demonstrated for the similar Sandstone Antechinus (Begg, et al., 1981)</td>
</tr>
<tr>
<td>Predation by feral cats</td>
<td>Moderate</td>
<td>Large</td>
<td>Not demonstrated, but plausible.</td>
</tr>
<tr>
<td>Habitat change associated with invasive weeds (particularly Buffel Grass <em>Cenchrus ciliaris</em>)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Noted as a threat (mostly through driving increased fire impacts) for parts of the range (White &amp; Mason, 2011; Lloyd, et al., 2013).</td>
</tr>
<tr>
<td>Poisoning by cane toads</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Not demonstrated, but plausible; however, many records post-date the introduction of cane toads.</td>
</tr>
<tr>
<td>Pollution (lead and other deposits)</td>
<td>Minor</td>
<td>Minor</td>
<td>Reasonable correlative evidence from structured sampling across a pollution gradient around Mt Isa (Baker &amp; Griffiths, 2005).</td>
</tr>
<tr>
<td>Mining</td>
<td>Severe</td>
<td>Localised</td>
<td>Several mining related activities have located species within proposed areas of impact (Wilson &amp; Mittermeier, 2015).</td>
</tr>
<tr>
<td>Grazing</td>
<td>Minor</td>
<td>Large</td>
<td>Not demonstrated, but plausible.</td>
</tr>
</tbody>
</table>

* Modified from Woinarski, et al., 2014.

7.7 Carpentarian Antechinus within the Mt Dore Heap Leach project area

The records of Carpentarian Antechinus within CRCM tenements the southernmost records for the species. During the 2013 study, it was recorded at 44 sites (Figure 4) and approximately quadrupled the number of sites from which the species was known at the time and revealed new information regarding its preferred habitats (Burnett, et al., 2014). There is a significant amount of suitable habitat for the species throughout the Selwyn Range and it is likely to occur further to the east and north. Further to the north-west (approximately 65km) the species has been recorded at Trekelano, which is approximately 10km to the south of Duchess. It is expected the species would also occur in suitable rocky habitat throughout the range to the north of Duchess.
7.8 Habitat mapping for Carpentarian Antechinus within the Mt Dore project area

Following targeted field survey for the species, mapping for the Carpentarian Antechinus was undertaken by CRCM to identify the extent and location of potential habitat areas across the proposed project area.

Previous records and recent studies (Burnett, et al., 2014) demonstrate that the species is absent from areas that have little or no rocks. As such, these areas have been identified as unsuitable habitat. Broad identification of potential habitat across the whole of the Mt Dore project mining leases has been conducted by CRCM using two categories: ‘little/no rock’, which represent areas of no habitat for the species; and ‘rock’, which represent areas of potential habitat for the species. Rocky habitats can be readily distinguished from non-rocky habitats based on aerial interpretation and topography. It should be noted that the maps produced through this work represent potential habitat. They have been produced at a desktop level using previous field experience, aerial imagery and topographical data. They provide a high level of confidence that the areas identified are potentially suitable or unsuitable habitat.

Importantly, the habitat mapping is considered adequate for this assessment in providing a baseline understanding of habitat values across the project area where potential impacts can be analysed. The areas that have been mapped as potentially suitable for the Carpentarian Antechinus broadly occur throughout the Selwyn Ranges which traverse the mining tenements running in north to south direction and covers an area of approximately 1.7 million ha (Open Lines Environmental Consulting, 2015). Suitable mapped areas are associated with steep slopes, gullies, outcrops and ridges. The core mine processing and operating areas are situated on the flat plains that do not contain the necessary rocky features to support the species.
Figure 4: Carpentarian Antechinus survey locations.
The area of high quality rocky habitat within the project area that was originally proposed to be disturbed was 5.5ha (Referral Application, September 2016). Importantly CRCM have undertaken a review of their activities and have reduced the proposed disturbance area by 1.9ha by redesigning the Northern waste rock dump and relocating the Southern waste rock dump. It should also be noted that there have been changes made to the South Pit and associated haul road footprint because of a geotechnical review and risk assessment. The currently proposed disturbance represents <2% of 251 ha of the mapped habitat on the Cloncurry Project mining leases.

The elements of the proposed action that remain within areas of potential habitat include the north and south pits and these areas have been ground checked. Proposed amendments have been made to both the northern and southern waste rock dumps to avoid mapped rocky habitat areas. Figure 5 and Figure 6 show the proposed disturbance areas and mapped habitat within the proposed project area.

7.9 Importance of the Mt Dore project area to the Carpentarian Antechinus

The population of Carpentarian Antechinus within the southern section of the Selwyn Range (CRCM tenements) is likely to be considered an important population of the species under the EPBC Act for the following reasons:

- the population may be important for maintaining genetic diversity of the species;
- it may be a key source population of Carpentarian Antechinus for either breeding or dispersal;
- the population extends this species range in Queensland by 50 km.

Suitable habitat for the species is associated with rocky areas, particularly massive boulders or rock features. Within the mine tenements, these habitats are typically found within the Selwyn Range, which run north-south through the middle of the tenements. Outside of the Selwyn Range to the east the landscape is dominated by black soil plains and is unlikely to support Carpentarian Antechinus. This is also likely for the Mitchell Grass Plains that separate the Selwyn Range and the range to the west where Trekelano is located.
Figure 5: Proposed disturbance areas
Figure 6: Proposed disturbance to Carpentarian Antechinus habitat
8. Potential Environmental Impacts and Management Measures

8.1 Background and approach

Chinova resources has previously undertaken mining and development in the Mt Dore area. Development of the Merlin Decline commenced in October 2011 to access a small high grade molybdenum rhenium deposit that underlies the Mt Dore Copper Oxide orebody. The decline intersected the upper part of the orebody and the project is currently on care and maintenance due to the depressed molybdenum price. Underground development of the Starra 276 mine by Chinova Resources, commenced early in February 2012 with a total of 856,280t of ore produced and hauled to Osborne for processing. The Mine was closed on 21st August 2014 with underground services removed and much of rehabilitation completed. Up to 150 workers were accommodated at the Mt Dore Camp during this period.

As such, it is currently conditioned to operate under a range of measures to manage potential environmental impacts. These measures address issues relating to erosion and sedimentation, weeds, fire, feral animals, noise and vibration, land contamination and changes to ground and surface water. This section of the Plan considers the potential impacts of the proposed Mt Dore Heap Leach Copper Project on the Carpentarian Antechinus within the context of these existing controls. Additional management measures are defined here where they are considered necessary or sensible for the protection of the local population.

There are recognised gaps in our current understanding of the species’ ecology and distribution. Expert input has been used in the preparation of this Plan to address this issue. The information used is the best available, and the interpretation of relevant impacts and identification of suitable mitigation strategies is informed by extensive field experience.

Section 8.2 describes several general measures intended to improve understanding of the species’ habitat and presence in the CRCM tenements. These measures include monitoring and refining habitat mapping that will better inform the implementation of specific management measures for the potential impacts of mining activities outlined in Section 8.3.

8.2 General measures

There is a lack of targeted survey data for the species from Queensland and the Northern Territory. It is not clear whether current gaps in the known occurrence of the species are accurate or reflect an absence of appropriate surveys. Chinova has committed to continuing joint research projects with
Sunshine Coast University and MMG to support a defined project for two monthly monitoring for one year of Carpentarian Antechinus at known habitat locations in the Selwyn Ranges. The project aims to gain an understanding of variations in detectability and life cycle of the species. In addition, the Sunshine Coast University will be contracted to complete the trapping and removal of individuals from the proposed disturbance areas and to determine the statistical effectiveness of this approach. Chinova Resources has committed a budget of $42,000 to complete this work.

The proposed research will also conduct surveys across potential rocky habitats in the Southern Gulf, Desert Uplands, Einsleigh Uplands, Brigalow Belt, and Mitchell Grass Downs bioregions in Queensland, and adjacent areas in the Northern Territory. Surveys will use baited trail cameras to improve distribution data and assist in the development of a habitat model for the species. The results of this will be available at the completion of the project in the final report. It is expected that this will improve the level of knowledge of the Carpentarian Antechinus lifecycle and help inform future management plans.

8.3 Potential impacts and management measures

The Multispecies Recovery Plan for the Carpentarian Antechinus, Butler’s Dunnart and the Northern Hopping-mouse (Woinarski, 2004) and the Carpentarian Antechinus Conservation Advice have been reviewed in developing the following assessments.

The proposed project has the potential to impact the Carpentarian Antechinus and includes a combination of direct and indirect impacts including:

- mortality of individuals
- habitat loss
- loss of habitat connectivity
- noise and vibration
- human disturbance and artificial lighting
- spread of feral predators
- introduction and spread of weeds
- contamination, and
- changes to fire regime.

The sections below provide an analysis of the relevance, extent and proposed mitigation measures.
8.3.1 Mortality from Land Clearing

Mortality of individuals will occur during land clearing and the species is unlikely to be able to outpace clearing activities or rapidly relocate to other suitable habitat adjacent to the proposed disturbance area. Mortality of individuals within disturbance areas is therefore considered to be an unavoidable impact. It is not possible to quantify the number of individuals which may be lost from the population because of the proposed disturbance. However, the area of habitat loss will not exceed 4ha or 1.6% of habitat available within the project mining leases, suggesting that only a relatively small proportion of the local population will be potentially impacted. In relation to the total project mining lease area of 4,990.18ha, 251ha (5%) has been mapped as potential habitat.

Proposed Mitigation Measures

Trapping and relocation will be undertaken immediately prior to disturbance of suitable habitat where the Carpentarian Antechinus has been identified and known to occur. Individuals that are captured will provide an opportunity to gain a better understanding of their spatial ecology and translocation success. Relocation work will be undertaken by the Sunshine Coast University over a 14 day period using a minimum of 1,000 trap nights (expected success rate ~1%) during the currently known period of higher activity between May and July (Burnett, et al., 2014) Trapping effort will be dependent on the results of the camera trapping prior to disturbance and adjusted accordingly if required. Captured individuals will be relocated a minimum distance of 500 metres.

Camera trapping will also be undertaken in the removal area after trapping is completed to determine the success of the relocation program. The success of the program will be evaluated using an occupancy modelling power analysis approach. This will be an adaptive approach in that we will utilise camera trap data from the pre-removal phase of the animal translocation to determine the amount of trapping effort required to be 80% certain that lack of detections on trail cameras reflects that there are no individuals remaining at the site. Given the near impossibility of capturing every individual of any species, let alone a sparse and difficult to trap species such the Carpentarian Antechinus, it is unreasonable to expect that every individual will be trapped and removed.

8.3.2 Habitat Loss

Loss of habitat because of the originally proposed project would occur through direct clearing of vegetation and land modification during construction of the north and south pits and associated northern and southern waste rock dumps. An area of 3.7ha of potential habitat loss has been calculated based on this basis.
Proposed Mitigation Measures

Adjustment of the position of both the northern and southern waste rock dumps has been approved by CRCM effectively reducing habitat loss by 1.8 ha. The north and south pit disturbance areas cannot be relocated due to the position of the orebody and therefore this disturbance is unavoidable. The total area of habitat loss is <2% of suitable available habitat on the Cloncurry Project mining leases.

The area of all disturbance including mapped Carpentarian Antechinus habitat will be monitored and reported through CRCM’s Permit to Disturb system.

Rehabilitation of waste rock dumps will include:

- Establishment of rocky outer batters for erosion resistance and habitat development for the Carpentarian Antechinus and Purple Necked Rock Wallaby.
- Placement of rock areas across a minimum of 20% of the waste rock dump upper surface by way of rock infiltration basins and regularly placed low shaped coarse rock dumps.
- Cleared vegetation will also be stockpiled for replacement during rehabilitation to provide habitat for invertebrate species.
- *Acacia shirleyi* (Lancewood) will be used in the seeding mix applied to the rehabilitated site.
- The existing Cloncurry Project Closure Plan includes revegetation criteria with the aim to:
  - establish a vegetation systems that contains species tolerant to drought and fire conditions;
  - has demonstrated resilience and recovery to drought and/or fire conditions;
  - has demonstrated secondary recruitment and progression towards the analogue condition;
  - has a foliage projective cover >50% of the analogue sites;
  - has a species diversity >50% of the analogue sites.
- Camera trapping of the new habitat will be undertaken to demonstrate usage by the Carpentarian Antechinus.

It is estimated that the rehabilitated waste rock dumps will provide 10.6ha of potential new rocky habitat suitable for the species. Rehabilitation monitoring is likely to extend at least 5 years beyond the completion of rehabilitation to achieve all relevant completion criteria.

8.3.3 Loss of Habitat Connectivity

Connectivity of suitable habitat is not expected to be impacted by the proposed project. The habitat within the north pit footprint lies a small valley that has connectivity to suitable habitat further to the
north and east. The habitat within the south pit footprint is adjacent to habitat further to the north east. The closest habitat in relation to the north pit where the species has also been found is approximately 400m to the east. The habitat in between these two locations is open woodland and this suggests that the species may move through less rocky habitat up to at least this distance. The presence of the species in isolated rock outcrops surrounded by non-habitat suggests that the species can disperse through non-optimal habitat (Burnett, et al., 2014). It is speculated that when conditions are favourable, population growth and competition forces individuals into less suitable habitat areas that have lower occupancy. Likewise, when conditions are unfavourable populations may retract to higher quality habitat.

There will be no physical barriers (i.e. pipelines) and the proposed Haul Road is not expected to significantly disrupt the movement of the species. Burnett, et al., (2014) indicates that the Carpentarian Antechinus has been encountered in at least two waste rock dumps indicating that the species is either using or moving through these disturbed area.

**Proposed Mitigation Measures:**

No mitigation measures proposed.

### 8.3.4 Noise and Vibration

Several activities will produce noise and vibration including:

- blasting
- light and heavy vehicles on the project site and accessing the project site
- hauling and dumping operations
- generators, and
- ore processing.

It would be expected that the Carpentarian Antechinus would express a temporary change in behaviour because of increased noise/vibration, despite no published studies to confirm this. The levels expected will be high compared to background and most noise and vibration will be generated by blasting and heavy vehicle operations. Blasting will be intermittent events that only last for a short period (<10 seconds), whereas hauling and dumping operations will be more persistent (24/7). However, hauling and dumping operations will be expected to create less noise and vibration than blasting despite operations occurring closer to suitable habitat. Much of the noise and vibration generated from the proposed project will not be located adjacent to suitable habitat, except for the south pit and the northern waste rock dump.
It is expected that noise and vibration will not cause a significant impact on the species as there has been extensive blasting and hauling operations conducted historically along the Starra ridgeline and the species is still present in this location. More recently similar mining operations (eg. Exco Resources, Mt Colin and MMG, Dugald River) have been conducted within proximity to other populations which are known to persist. It is also expected that noise/vibrations generated during the initial clearing phase may cause individuals within proximity to the proposed project to relocate. Impacts from light vehicles is expected to be negligible as they will not be accessing suitable habitat and the noise/vibrations they create are substantially less than heavy vehicles.

Generators will operate while the power line corridor to Osborne is under construction and as a backup after the power lines are operational. Noise from generators will occur throughout the night, but noise levels will be low and continuous and likely to be tolerated by the species. Previously generators have been used to power the Mt Dore camp, dewatering pumps at Mt Dore and the Starra 276 mine with the species recorded around these locations.

**Proposed Mitigation Measures**

No mitigation measures proposed.

**8.3.5 Human Disturbance and Artificial Lighting**

Because the Carpentarian Antechinus is a nocturnal species which inhabits rocky outcrops, human disturbance to the species is likely negligible as there expected to be no human activity near rocky outcrops outside of daylight hours. The only potential for human disturbance is by undertaking monitoring of the species, which, will occur during daylight hours when the species is expected to reside down deep rock crevices and are unlikely to respond to minor surface activity (such as that from human movement). Therefore, human activities during daylight hours are not expected to impact on the species.

Most operations for the proposed project will be restricted to areas which do not contain suitable habitat. Therefore, lighting sources in these areas will be of no consequence to the species. The only expected lighting sources that are in proximity to suitable habitat could include those associated with south pit and north waste rock dump. The effect of lighting on the behaviour and ecology of the Carpentarian Antechinus is unknown. However, given that the species if often active during daylight hours in the cooler months (Burnett, et al., 2014), it is unlikely that artificial light will impact on the species.
It would be expected that the Carpentarian Antechinus would express a temporary change in behaviour because of increased lighting in near proximity to habitat, despite no published studies to confirm this. It is expected that lighting will not cause a significant impact on the species as there has been extensive mining operations conducted historically along the Starra ridgeline and the species still persists in this location. More recently similar mining operations (eg. Exco Resources, Mt Colin and MMG, Dugald River) have been conducted within proximity to other populations which are known to persist.

**Proposed Mitigation Measures**

No mitigation measures proposed.

**8.3.6 Proliferation of Feral Predators**

Several exotic pest species are known to occur within and surrounding the Selwyn Range including feral pigs, dingo/wild dog, and feral cats. CRCM has had existing feral animal monitoring and control procedures for pest species during the operation of Starra 276 and the development of Merlin, which, included appropriate waste management practises and actively trapping feral cats. These measures, which are inherent to CRCM mining activity, will reduce the risk of feral animal proliferation in these locations and may confer a net benefit to small vertebrates inhabiting the area.

**Feral Pigs**

Feral Pigs are predominantly restricted to the waterways, plains and stock watering locations throughout the Selwyn Range they can cause considerable damage to vegetation and habitat while foraging and in these areas. However, the Selwyn Range has hard skeletal soils with abundant rock and these features inhibit pig foraging. As such, they are highly unlikely to occur with any frequency in suitable rocky habitat. Feral pigs are therefore unlikely to be a threat to the Carpentarian Antechinus and no additional control or monitoring of this species is required.

**Dingo/Wild Dogs**

Dingos/wild dogs have been recorded in a variety of habitats throughout the Selwyn Range. While dingos/wild dogs prey on a wide variety of native fauna, they are unlikely to prey on elusive species such as the Carpentarian Antechinus and may in fact benefit the species by limiting feral cat numbers through direct predation and competition (Johnson, et al., 2007; Wang & Fisher, 2011; Kennedy, et al., 2012). As such, dingos/wild dogs are unlikely to have a significant negative effect on Carpentarian Antechinus populations.

**Feral Cats**

Feral cats are a major predator of small native mammals and are a listed threatening process. High numbers of feral cats are likely to increase predatory pressure on small mammals of the Selwyn Range,
including the Carpentarian Antechinus. The severity of this threat will vary, influenced by feral cat and alternative prey abundance (e.g., Common Rock-rats, small lizards, birds etc) and associated environmental factors such as rainfall. Feral cats can also benefit from human activity, most notably through an increase in prey or food associated with inappropriate disposal of food waste. Mine sites also provide shelter and hiding areas and can lead to an increase in feral cat numbers.

**Proposed Mitigation Measures**

CRCM has existing waste management practises (dump cages) to ensure food waste is disposed of appropriately, and as such it is not anticipated that feral cat abundance will substantially increase because of the proposed project. CRCM will undertake monitoring and control of feral cats to ensure any potential impacts are avoided or minimised near operations.

8.3.7 **Introduction and Spread of Weeds**

Declared weed species are not prolific in the dry skeletal soils associated with the Mount Isa/Cloncurry region, and the risk of declared weeds being accidentally introduced from mining related activities into Carpentarian Antechinus habitat is extremely low. There are currently no known declared weed species, within the proposed project area.

**Buffel Grass** (*Cenchrus ciliaris*) is a non-native grass species which is considered an environmental weed and favoured by pastoralists. It has however, been demonstrated to negatively influence biodiversity and potentially lead to altered fire regimes (Smyth, et al., 2009; Marshall, et al., 2012). The impact of Buffel grass on arid ecosystem function is significant. Anecdotal evidence indicates that Buffel grass thrives along creek lines in dry environments (Miller, 2003) effectively promoting and spreading fire along what would previously have been considered a barrier to fire. Where it occurs, Buffel grass is also filling in much of the usual bare-ground spacing between native grasses, shrubs and trees. This bare-ground spacing is a feature of most arid and semi-arid Australian ecosystems, in most years, and helps to stop most wildfires from becoming too extensive and from occurring too often. Buffel grass is significantly altering this ecosystem feature and enabling more catastrophic fires to occur.

Buffel Grass is currently present within the project mining leases where it is typically associated with creek lines and plains with a deeper soil profile and (probably) higher moisture content. It is generally not present within rocky habitats, and while there remains a minor risk that some plants may become established where soil disturbance occurs it is unlikely that Buffel grass will become established within Carpentarian Antechinus habitat. Buffel Grass may however provide paths for wildfire to be introduced. Once established there is no single control method available for the successful management of Buffel
Grass over extensive areas (Tu, 2002). The impacts of Buffel Grass on the Carpentarian Antechinus are therefore best managed by management of bushfires.

Despite the low risk of impacts from weeds on suitable rocky habitats within the proposed project area, weeds are broadly recognised as a relevant threat to the environment and will be managed by an existing Weed Washdown Procedure.

**Proposed Mitigation Measures**

General weed introduction will be managed by the existing Weed Washdown Procedure. Buffel grass will not be used in the rehabilitation program and will be actively managed to ensure it does not provide paths for wildfire to areas of Carpentarian Antechinus habitat in the project disturbance area.

**8.3.8 Land Contamination**

The potential for land contamination to have localised impacts on Carpentarian Antechinus habitat is extremely low. The risk of contamination impacts is from the heap leach pad and associated process ponds, processing area, fuel and chemical storage areas. These areas are located on the flats well away from suitable rocky habitat. The risk of any substantive impacts from contamination is therefore considered extremely low and well mitigated.

Potentially acid forming waste rock is a relatively minor issue for this proposed operation and is managed by selective handling and disposal into existing open pits away from suitable rocky habitat, in accordance with a Waste Rock Management Plan.

**Proposed Mitigation Measures**

Managed by a Waste Rock Management Plan and Environmental Authority conditions required by the State Government approvals.

**8.3.9 Changes to the Fire Regime**

Inappropriate fire regimes are listed as a severe threat to the species (Woinarski, et al., 2014). There are currently no fire regimes for the proposed project area and bushfires are common throughout the summer with several occurring in the region since 2011. The 2013 study found the Carpentarian Antechinus at 44% and 33% of sites that had been burnt 6 months and approximately two years respectively, prior to the survey. These results provide some evidence that the species can tolerate infrequent fire regimes. The fuel load associated with the Carpentarian Antechinus habitat in the
proposed project area is low which reduces the likelihood of severe fires. CRCM will develop a Bushfire Management Plan for the project. Key elements of the plan will include:

- actively managing increased fire risk to known habitat from dispersal of buffel grass in disturbance areas;
- use of fire breaks;
- identification of ignition sources;
- identification of fire risk areas; and
- training.

**Proposed Mitigation Measures**

Implementation of the Bushfire Management Plan is considered adequate to manage this potential risk to the species.

### 8.4 Avoidance, Safeguards and Mitigation Measures

The Mt Dore Mine is a proposed mine which will incorporate the existing health, safety and environmental management system currently in use 48 kilometres south at the Osborne Project. The Mt Dore Heap Leach Copper Project will be conditioned to operate under a range of measures to manage potential environmental impacts. These measures address issues relating to weed, fire, feral animals, land contamination, land clearing, rehabilitation and changes to ground and surface water. This section of the Plan considers the avoidance, safeguards and mitigation measures for the significant impacting activities identified within the context of these existing controls. Additional management measures are defined where they are considered necessary or prudent for the protection of the local Carpentarian Antechinus population.

#### 8.4.1 Mortality from Land Clearing

- Land disturbance activities will be managed by the existing Permit to Disturb process with avoidable disturbance to mapped habitat not permitted.
- Land disturbance will be tracked in the existing Land Disturbance Register and mapped by satellite imagery in MapInfo.
- The area of habitat to be disturbed will be minimised by adjustment of the location of infrastructure such as haul-roads and waste rock dumps to avoid known mapped habitat.
- Land clearing activities that have not been conducted in accordance with the issued Permit to Disturb will trigger an incident report and internal investigation process.
- The area of mapped habitat to be disturbed will be intensively trapped with the effort based on results of the camera trapping prior to disturbance and all encountered species
including Carpentarian Antechinus will be relocated to mapped high quality habitat, a minimum distance of 500 metres distant from the proposed disturbance.

- Trapping will be undertaken in the period May to July when the species is known to be most detectable.
- Camera trapping will be undertaken after individuals have been removed to determine the effectiveness of this management strategy.
- The trapped area will be cleared immediately following the trapping program to reduce the potential for recolonization.

8.4.2 Habitat Loss

- Habitat loss will be managed by the existing Permit to Disturb process with avoidable disturbance to mapped habitat not permitted.
- Land disturbance will be tracked in the existing Land Disturbance Register and mapped by satellite imagery in MapInfo.
- The area of habitat to be disturbed will be minimised by adjustment of the location of infrastructure such as haul-roads and waste rock dumps to avoid mapped habitat.
- Habitat loss will be recorded and reported.
- Land clearing activities that have not been conducted in accordance with the issued Permit to Disturb will trigger an incident report and internal investigation process.
- Waste rock dump rehabilitation will include creating rocky environments and associated micro-habitat with the aim of establishing suitable habitat favoured by the Carpentarian Antechinus. At the completion of rehabilitation efforts, it is expected that there will be a net gain in potential habitat of 6.6 ha.
- Cleared vegetation and soil will also be stockpiled for replacement during rehabilitation to provide initial habitat for invertebrate species.
- *Acacia shirleyi* (Lancewood) will be used in the seeding mix applied to the rehabilitated site.
- The existing Cloncurry Project Closure Plan includes revegetation criteria with the aim to:
  o establish a vegetation systems that contains species tolerant to drought and fire conditions;
  o has demonstrated resilience and recovery to drought and/or fire conditions;
  o has demonstrated secondary recruitment and progression towards the analogue condition;
  o has a foliage projective cover >50% of the analogue sites;
  o has a species diversity >50% of the analogue sites.
- Camera trapping of the new habitat will be undertaken to demonstrate usage by the Carpentarian Antechinus.
• It is considered that there will be no significant residual impacts to mapped habitat that will require a conservation offset.

8.4.3 Proliferation of Feral Predators

• Feral cats will be actively trapped and removed from the area during development and operational phases.
• The general waste disposal facility will be protected by an existing dump cage to prevent access by feral and native animals.
• Feral cat activity will be recorded and noted on camera traps.
• CRCM staff will be prevented from feeding feral or native animals.

8.4.4 Changes to the Fire Regime

• A Bushfire Management Plan will be developed primarily for asset protection in the project area. This plan will be applicable to the increased risk of fire to the Carpentarian Antechinus by:
  o Actively managing increased fire risk to known habitat from dispersal of buffel grass in disturbance areas;
  o Use of fire breaks;
  o Identification and management of excessive fuel loads by regular low intensity burns;
  o General fire risk identification; and
  o Emergency response training.
• Maintaining a map of fire affected areas in relation to Carpentarian Antechinus habitat.
• Camera trapping in bushfire affected Carpentarian Antechinus habitat to determine any impacts to resident populations.

9. Risk Assessment

Risks have been assessed per the framework set out in the Department of Environment’s Environmental Management Plan Guidelines. Risks are categorised by qualitative measures of likelihood and the severity of their consequences. These qualitative measures are used to assign a risk rating to each risk before and after mitigation. Each environmental risk is given a rating in terms of likelihood and consequence using the criteria in Table 6 and Table 7 below. These ratings are then combined using Table 8 to generate a risk rating of low, medium, high or severe. The risk rating generated using Table 8 will be used as a guide to the amount of time and resources that will be required to manage each risk. Risks with ‘medium’, ‘high’ and ‘severe’ risks will require mitigation measures (Table 9).
Table 6: Qualitative measures of likelihood.

<table>
<thead>
<tr>
<th>Qualitative measure of likelihood (how likely is it that this event/issue will occur after control strategies have been put in place)</th>
<th>Highly likely</th>
<th>Likely</th>
<th>Possible</th>
<th>Unlikely</th>
<th>Rare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is expected to occur in most circumstances</td>
<td>Will probably occur during the life of the project</td>
<td>Might occur during the life of the project</td>
<td>Could occur but considered unlikely or doubtful</td>
<td>May occur in exceptional circumstances</td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Qualitative measures of consequence.

<table>
<thead>
<tr>
<th>Qualitative measure of consequences (what will be the consequence/result if this issue does occur rating)</th>
<th>Minor</th>
<th>Moderate</th>
<th>High</th>
<th>Major</th>
<th>Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor incident of environmental damage that can be reversed</td>
<td>Isolated but substantial instances of environmental damage that could be reversed with intensive efforts</td>
<td>Substantial instances of environmental damage that could be reversed with intensive efforts</td>
<td>Major loss of environmental amenity and real danger of continuing</td>
<td>Severe widespread loss of environmental amenity and irrecoverable environmental damage</td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Risk ratings

<table>
<thead>
<tr>
<th>Highly Likely</th>
<th>Minor</th>
<th>Moderate</th>
<th>High</th>
<th>Major</th>
<th>Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Severe</td>
<td>Severe</td>
<td></td>
</tr>
<tr>
<td>Likely</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Severe</td>
</tr>
<tr>
<td>Possible</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
<td>Severe</td>
</tr>
<tr>
<td>Unlikely</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Rare</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

9.1 Risk assessment results

The likelihood categories assigned in the initial risk ratings in Table 9 reflect the risks to the Carpentarian Antechinus from the construction and operation of a mine which is already implementing a range of environmental management measures. The effects of these existing
measures have been included in this assessment of initial risk. Residual risk likelihoods consider these initial risks after the introduction of the new mitigation measures set out in Section 8.

The key residual risk identified in this assessment is habitat loss (Table 9). Without mitigation, this presents a high risk to the species in the CRCM tenements. Mitigation measures will be important for ensuring the minimisation of this potential impact.

### 9.2 Outcome Based Conditions

Identifying the outcome for the protected matter is the first step to determine how an action will affect the protected matter and the conditions that should apply to the approval in order to avoid and mitigate its impacts, including consistency with the objectives of a relevant Recovery Plan (Outcome-based conditions guidance, March 2016).

#### 9.2.1 Proposed Outcomes and Performance Measures

The following outcomes and associated performance measures are proposed to manage the impact to the Carpentarian Antechinus in relation to the highlighted significant risks:

**Outcome 1:**

Direct impact to identified Carpentarian Antechinus habitat will be limited to less than 1.6% or 4ha of the available mapped habitat measured within the Cloncurry Project mining lease areas.

**Performance Measures:**

- Measured mapped Carpentarian Antechinus habitat within mining lease numbers 2454, 2566, 2688, 2689, 2690, 2691, 2692, 2693, 2694, 2732, 2733, 2734, 2736, 2737, 2738, 2745, 2746, 90043, 90061, 90215 & 90217.

- Measured disturbance to mapped Carpentarian Antechinus habitat within mining lease numbers 2454, 2566, 2688, 2689, 2690, 2691, 2692, 2693, 2694, 2732, 2733, 2734, 2736, 2737, 2738, 2745, 2746, 90043, 90061, 90215 & 90217.

**Purpose of Condition:**

- To ensure that the loss of identified Carpentarian Antechinus habitat will be effectively limited in relation to the proposed action.
<table>
<thead>
<tr>
<th>Potential Impact</th>
<th>Description</th>
<th>Initial Risk</th>
<th>Proposed Control Measures</th>
<th>Residual Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td>Direct loss of individuals through clearing of known habitat during construction</td>
<td>Moderate x Likely = Medium</td>
<td>Undertake a relocation program. Realign northern and southern waste rock dumps.</td>
<td>Minor x Possible = Low</td>
</tr>
<tr>
<td>Habitat Loss</td>
<td>Direct loss of habitat</td>
<td>Highly Likely x Moderate = High</td>
<td>Relocate northern and southern waste rock dumps. Control and report disturbance through a permit system. Provide replacement habitat through the rehabilitation activities.</td>
<td>Highly Likely x Minor = Medium</td>
</tr>
<tr>
<td>Habitat Connectivity</td>
<td>Loss of connecting habitat.</td>
<td>Minor x Unlikely = Low</td>
<td>No mitigation proposed.</td>
<td></td>
</tr>
<tr>
<td>Noise and Vibration</td>
<td>Noise and vibration from mining activity.</td>
<td>Minor x Unlikely = Low</td>
<td>No mitigation proposed.</td>
<td></td>
</tr>
<tr>
<td>Activity and Lighting</td>
<td>Lighting and activity from night operations.</td>
<td>Minor x Unlikely = Low</td>
<td>No mitigation proposed.</td>
<td></td>
</tr>
<tr>
<td>Feral Animals</td>
<td>Feral cat activity increasing as a result of project activity.</td>
<td>Moderate x Likely = Medium</td>
<td>Dump cages to restrict feral animals. Active trapping program to remove feral cats.</td>
<td>Minor x Possible = Low</td>
</tr>
<tr>
<td>Weeds</td>
<td>Potential for weed incursions as a result of the project activity.</td>
<td>Minor x Unlikely = Low</td>
<td>CRCM has a Weed Washdown Procedure in place. Buffel grass will not be used in rehabilitation programs and will be actively removed from mine related disturbance areas.</td>
<td></td>
</tr>
<tr>
<td>Land Contamination</td>
<td>Potential for impact on habitat by ore processing, fuel and chemical storage.</td>
<td>Minor x Unlikely = Low</td>
<td>A Waste Rock Management Plan will manage potentially acid producing waste rock for disposal away from habitat areas.</td>
<td></td>
</tr>
<tr>
<td>Bushfires</td>
<td>Impacts from uncontrolled bushfires.</td>
<td>Moderate x Possible = Medium</td>
<td>Establish a Bushfire Management Plan</td>
<td>Minor x Unlikely = Low</td>
</tr>
</tbody>
</table>
**Outcome 2:**

Direct impact to individuals of Carpentarian Antechinus will be limited to the minimum extent practicable by active trapping and removal of individuals from areas to be disturbed.

**Performance Measures:**

- A minimum trapping effort of 1,000 Elliott Trap nights will be expected to capture ~10 individuals.
- Trapping effort will be guided by camera trapping results conducted immediately prior to disturbance.
- Camera trapping after removal will be used to identify any remaining individuals and to determine effectiveness of the removal campaign.
- Maintain records of the number of individuals trapped and removed.
- Records of capture (number) and release (location) to be maintained.

**Purpose of Condition:**

- To ensure all practicable efforts are made to effectively translocate affected individuals and to monitor their capture to improve the understanding of the effectiveness of current removal options.

**Outcome 3:**

Actively trap and remove feral cats from the project area during development and operational phases.

**Performance Measures:**

- Maintain records of traps numbers, locations and success.
- Maintain record of feral cats identified in camera trapping locations.

**Purpose of Condition:**

- To effectively reduce the pressures of predation by feral cats in the project area.

**Outcome 4:**

A Bushfire Management Plan will be established before project activities commence to limit the impact of uncontrolled end of dry season fires on Carpentarian Antechinus habitat in the project area.
**Performance Measures:**

- Bushfire Management Plan developed and in place before development activity commences.
- Maintain records of bushfires, any burnt areas and dates of the fires within the project area.
- Maintain records of any controlled burns, the areas burnt and date within the Cloncurry Project mining lease areas.
- Where fire interacts with Carpentarian Antechinus habitat carry out camera trapping surveys and record individual survivals.

**Purpose of Condition:**

- To effectively reduce the frequency and intensity of uncontrolled end of dry season fires which may cause stress to existing populations of the Carpentarian Antechinus and to identify impacts of fire on individuals in known habitat.

**Surrogate Outcomes:**

A surrogate outcomes-based condition is one that specifies an outcome (or a level of performance to be achieved) for something which directly supports the protected matter.

**Surrogate Outcome 1:**

Create rocky environments and associated micro-habitat with the aim of establishing suitable habitat for Carpentarian Antechinus on all waste dump slopes to encourage use of the area for foraging and shelter.

**Performance Measures:**

- A minimum of 20% or 10.6 ha of the waste rock dump surface area will be covered with clean rocky material with a nominal size range of 0.25-1.0 metres to a minimum 2 metres depth.
- Cleared vegetation and soil will also be stockpiled for replacement during rehabilitation to provide initial habitat for invertebrate species.
- *Acacia shirleyi* (Lancewood) will be used in the seeding mix applied to the rehabilitated site.
- The revegetation criteria will be to:
  - establish a vegetation systems that contains species tolerant to drought and fire conditions;
  - has demonstrated resilience and recovery to drought and/or fire conditions;
  - has demonstrated secondary recruitment and progression towards the analogue condition;
• has a foliage projective cover >50% of the analogue sites;
• has a species diversity >50% of the analogue sites.
• Camera trapping will identify Carpentarian Antechinus usage of the area.

Purpose of Condition:
• To effectively provide a net increase in potential habitat area for Carpentarian Antechinus as a beneficial outcome of the project.

**Surrogate Outcome 2:**

Support a defined project for two monthly monitoring for one year of Carpentarian Antechinus at known habitat locations in the Selwyn Ranges to gain an understanding of variations in detectability and life cycle (joint project with Sunshine Coast University and MMG).

Performance Measures:
• Records of two monthly monitoring.
• Report on the findings.

Purpose of Condition:
• To improve detection surveys and the level of knowledge of the Carpentarian Antechinus lifecycle to inform future management plans.

10. Audit and Review

10.1 Auditing

An independent audit of outcomes and monitoring of the performance measures will be conducted every two years from project commencement (July 2017) with the reports made publicly available on the Chinova Resources website (July 2019 & 2021).
10.2 Review

An adaptive management system is key to achieving recognised best practice for achieving continual improvement. This Plan and associated actions will be reviewed on an annual basis commencing July 2018 and updated accordingly to adjust for any identified issues.
11. References


