CHINOVA RESOURCES CLONCURRY MINES PTY LTD

ENVIRONMENTAL AUTHORITY
MIN100894709

Mount Dore Heap Leach Project

ENVIRONMENTAL MANAGEMENT PLAN

CLONCURRY PROJECT
TABLE OF CONTENTS

1 INTRODUCTION ................................................................................................................. 8

2 ENVIRONMENTAL IMPACT ASSESSMENT CRITERIA .................................................. 10

3 TENURES........................................................................................................................... 13

3.1 Previous Mining Activities ........................................................................................... 16

4 STAKEHOLDER CONSULTATION ...................................................................................... 18

4.1 Department of Environment and Heritage Protection (DEHP) .................................. 18

4.2 Commonwealth Department of Environment .............................................................. 18

4.3 Department of Natural Resources and Mines (DNRM) .............................................. 18

4.4 Department of State Development (DSD) .................................................................. 18

4.5 Cloncurry Shire Council (CSC) .................................................................................. 18

4.6 Aboriginal Groups ........................................................................................................ 19

4.7 Land Owner .................................................................................................................. 19

4.8 Local Community .......................................................................................................... 19

5 ENVIRONMENTAL VALUES............................................................................................... 19

5.1 Meteorology .................................................................................................................. 19

5.1.1 Rainfall and Evaporation ......................................................................................... 19

5.1.2 Temperature ............................................................................................................ 21

5.1.3 Wind Speed and Direction ....................................................................................... 21

5.2 Topography and Drainage ............................................................................................ 22

5.3 Regional Geology ......................................................................................................... 24

5.3.1 Mt Dore Geological Setting ..................................................................................... 26

5.3.2 Mineralisation .......................................................................................................... 29

5.3.3 Resource Drilling ..................................................................................................... 31

5.4 Landforms and Soils ..................................................................................................... 33

5.4.1 Landforms .............................................................................................................. 33

5.4.2 Soils ......................................................................................................................... 33

5.5 Flora and Fauna ............................................................................................................. 36

5.5.1 Flora and Species of Conservation Significance ..................................................... 36

5.5.2 Weeds ...................................................................................................................... 37

5.5.3 Regional Ecosystems ............................................................................................... 37

5.5.4 Groundwater Dependent Ecosystems ................................................................... 41
7.4 Solvent Extraction – Electro-Winning

7.4.1 Proposed Activities

7.4.2 Environmental Values Likely to be Affected

7.4.3 Emissions or Releases Likely to be Generated

7.4.4 Risk and Likely Magnitude of Impacts

7.4.5 Proposed Management Practices

7.4.6 Proposed Rehabilitation

7.5 Mt Dore Village

7.5.1 Proposed Activities

7.5.2 Environmental Values Likely to be Affected

7.5.3 Emissions or Releases Likely to be Generated

7.5.4 Risk and Likely Magnitude of Impacts

7.5.5 Proposed Management Practices

7.5.6 Proposed Rehabilitation

8 OTHER PROPOSED AMENDMENTS

8.1 Approval of general waste disposal to open pits

8.1.1 Proposed Amendment

8.1.2 Environmental Values Likely to be Affected

8.1.3 Emissions or Releases Likely to be Generated

8.1.4 Risk and Likely Magnitude of Impacts

8.1.5 Proposed Management Practices

8.1.6 Proposed Rehabilitation

8.2 Add Mort River as a Receiving Water Reference Site

8.2.1 Proposed Amendment

8.2.2 Environmental Values Likely to be Affected

8.2.3 Emissions or Releases Likely to be Generated

8.2.4 Risk and Likely Magnitude of Impacts

8.2.5 Proposed Management Practices

8.2.6 Proposed Rehabilitation

8.3 Removal of RSS14 (Compliance Site) and BS06 (Reference Site) – Mt Cobalt

8.3.1 Proposed Amendment

8.3.2 Environmental Values Likely to be Affected

8.3.3 Emissions or Releases Likely to be Generated

8.3.4 Risk and Likely Magnitude of Impacts

8.3.5 Proposed Management Practices

8.3.6 Proposed Rehabilitation

8.4 Remove monitoring bore MLM01 from the EA

8.4.1 Proposed Amendment

8.4.2 Environmental Values Likely to be Affected

8.4.3 Emissions or Releases Likely to be Generated

8.4.4 Risk and Likely Magnitude of Impacts

8.4.5 Proposed Management Practices

8.4.6 Proposed Rehabilitation

8.5 Amend Water Schedule Elements and Levels

8.5.1 Proposed Amendment

8.5.2 Environmental Values Likely to be Affected

8.5.3 Emissions or Releases Likely to be Generated
• Place Mt Dore Ecological Assessment 2012 ........................................................................................................... 129
• FRC Baseline Aquatic Ecology Survey 2012 ........................................................................................................... 129
• Pseudantechinus mimulus Report 2014 .................................................................................................................... 129
• Mt Dore Pseudantechinus mimulus Camera Trapping Report 2016 ................................................................. 129

14 APPENDIX B – HYDROLOGY REPORTS ........................................................................................................ 130
• Rockwater Mt Dore Aquifer Report 2011 ................................................................................................................ 130
• Lait Report on Merlin Dewatering License 2015 ................................................................................................. 130
• Lait Report on Mt Dore Open Pit Inflow Modelling 2016 ....................................................................................... 130

15 APPENDIX C – WASTE CHARACTERISATION REPORTS .................................................................... 131
• RGS Mt Dore Geochemical Report 2013 ................................................................................................................ 131
• RGS Mt Dore Residue Geochemistry 2016 ............................................................................................................. 131

16 APPENDIX D – HIGH LEVEL RISK ASSESSMENT ............................................................................... 132

FIGURES
Figure 1 – Project Location
Figure 2 – Mt Isa Daily Temperatures
Figure 3 – Mt Dore Weather Station Wind Rose
Figure 4 – Oblique View of Project
Figure 5 – Regional Geology
Figure 6 – Mt Dore Geology
Figure 7 – Mt Dore Lithologies
Figure 8 – Mt Dore Copper Minerals
Figure 9 – Mt Dore Resource Drilling
Figure 10 – Mt Dore Mapped REs
Figure 11 – Proposed Disturbance RE 1.3.7
Figure 12 – Regional Extent RE 1.3.7
Figure 13 – Pseudantechinus mimulus survey sites Mt Dore
Figure 14 – Petrogale purpureicollis sightings and mapped habitat
Figure 15 - Total taxonomic richness in bed habitat at sites in the 2012 - 2
Figure 16 - Total taxonomic richness in edge habitat
Figure 17 – Schematic cross section Mt Dore Aquifer
Figure 18 – Mt Dore Aquifer Boundary
Figure 19 – Mt Dore Soil and Stream Sediment Copper
Figure 20 – Mt Dore Soil and Stream Sediment Lead
Figure 21 – Mt Dore Soil and Stream Sediment Zinc
Figure 22– Project Geological Domains
Figure 23 – Mt Dore Heap Leach Project Disturbance
Figure 24 – Mt Cobalt Historical Mining
Figure 25 – Current MLs over Mt Cobalt
Figure 26 – Rock Cover Revegetation
TABLES
Table 1 – Mining and Background Tenure
Table 2 – Rainfall and Evaporation
Table 3 – Intensity Frequency Duration Storms for Mt Dore
Table 4 – Project Soils
Table 5 – EI AS Surface Water Quality
Table 6 – Mineralised Background Surface Water Quality
Table 7 – Reference Site Groundwater Results
Table 8 – Sediment Quality Analyses
Table 9 – Proposed disturbance areas
Table 10 – Mining Consumables
Table 11 – Operational Risk Summary
Table 12 – Mining Risk Summary
Table 13 – Crushing and Agglomeration Risk Summary
Table 14 – Heap Leach Risk Summary
Table 15 – Summary of Process Reagent Requirements
Table 16 – SXEW Risk Summary
Table 17 – Proposed Environmentally Relevant Activities
Table 18 – Main Waste Types
Table 19 – Sewerage and Water Treatment
Table 20 – Water Quality Criteria
Table 21 - Receiving Water Contaminant Trigger Levels
Table 22 – Vegetation Criteria
1 INTRODUCTION

This Environmental Management Plan (EM Plan) has been prepared to accompany an amendment application to the existing Environmental Authority MIM100894709 to allow for establishment of a 2Mtpa Heap Leach Copper Project including the following:

- 2 open pits
  - North 450 x 220 x 90m depth
  - South 530 x 515 x 150m depth;
- 3 non-acid forming (NAF) waste rock dumps
  - North – 3,730,224 bcm
  - West – 1,778,403 bcm
  - South – 2,561,406 bcm
- 8.5 Mt of copper ore at an average grade of 0.85%;
- Run-of mine (ROM) pad;
- 3 stage crushing circuit;
- Agglomeration;
- Heap Leach Pad;
- Solvent extraction and electrowinning processing area; and
- Removal and processing of copper oxide stockpiles from a number of legacy sites including Lady Ella, Victoria, Starra 222, 244 & 257.

The Chinova Resources Cloncurry Mines Mt Dore Heap Leach Project will involve the initial 5 year development 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 Tailing 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.

Environmental Protection Act 1994

The following section includes the information requirements for an EA amendment application in accordance with Section 226. The content of this EM Plan is intended to provide this information summarised in Section 7.

(k) include an assessment of the likely impact of the proposed amendment on the environmental values, including—

(i) a description of the environmental values likely to be affected by the proposed amendment;
(ii) details of any emissions or releases likely to be generated by the proposed amendment;
(iii) a description of the risk and likely magnitude of impacts on the environmental values;
(iv) details of the management practices proposed to be implemented to prevent or minimise adverse impacts;
(v) details of how the land the subject of the application will be rehabilitated after each relevant activity ceases; and
(l) include a description of the proposed measures for minimising and managing waste generated by any amendments to the relevant activity.

Chinova Resources Cloncurry Mines Pty Ltd (CRCM) recognises the existence of a number of environmental risks associated with the legacy sites of the Cloncurry Project. Development and implementation of acceptable solutions that fully address these risks will require significant input of both capital and resources. The challenge is to find that balanced pathway of addressing environmental issues on legacy sites, whilst also responsibly developing the mineral resources of the area. It should also be noted that some existing legacy sites are located coincident with mineral resources that are currently subject to assessments for future development potential. In these locations active management of liabilities will aim to achieve compliance with the Environmental Authority. Significant rehabilitation and management activities have been undertaken to date including:

- Sonic coring of the existing waste rock dumps and assessments for acid mine drainage in 2010.
- Southern Tailings Dam – increase in spillway elevation; establishment of supporting buttresses on the existing walls; establishment of monitoring bores in 2011.
- Mt Elliott – removal of the ROM pad and placement onto the WRD; establishment of a catch dam and pump-back system to the UG; removal of the dewatering tank and other rubbish and buildings from 2011 - 2014.
- Eastern Tailings Dam – cleanout of the Duck-pond seepage collection system; clay-lined the existing ponds and established a pump back system; establishment of new monitoring bores in 2012.
- Starra 276 – establishment of an environment dam below the existing ore stockpile in 2012.
- Selwyn Mill-site – removal of the scats stockpile and other ore grade sulphide material; removal of the ball-mill and associated foundations and mineralised material; clean-up of the existing sediment dams; battering of the remaining material from 2013 - 2015.
- 251 open pit – backfilled with waste from the mill-site and covered with benign cover material from 2013 - 2014.
- Lady Ella – establishment of a downstream catch dam and pump back system to the open pit in 2014.
- Battering of NAF waste rock dumps at Victoria, Starra 222, 244, 251 and 257 from 2014 - 2015.
• Removal of mineralised and potentially acid forming (PAF) material, processing plant foundations and associated contamination from the former Selwyn Millsite and backfilling into the Starra 251 and 257 open pits in 2015.
• Removal of the ROM and PAF waste rock from the Starra 276 and backfilling into the 257 open pit in 2015.

Key to managing the remaining legacy issues will be the establishment of the ongoing mining projects to achieve a positive cash-flow that can be directed to undertaking rehabilitation activities and any required monitoring and maintenance activities.

It should be noted that the original approvals dating back to 1987, authorised open cut and underground mining and the associated milling and treatment of ore via flotation concentration and heap leaching operations at a level of 0.5Mtpa, in accordance with an Environmental Impact Assessment Study, 1987. A subsequent EMOS was completed in 2001 stating a maximum production level would not exceed 2Mtpa. Review of the Selwyn Concentrator Schedule for the 2002/2003 financial year indicates that 2.34Mt of ore was mined and 2.27Mt of ore was processed in this period. The Starra 276 underground operation was approved in 2012 for an annual production of 0.7 Mtpa and operated from 2012-2014. The Merlin mining operation, paste-fill plant and the associated concentrator was approved in 2014 with a proposed production rate of 0.5Mtpa from underground operations. The Merlin operation remains on care and maintenance due to the low molybdenum/rhenium prices with maintenance pumping to maintain the underground water level below key infrastructure.

2 ENVIRONMENTAL IMPACT ASSESSMENT CRITERIA

The Department of Environment and Heritage Protection has developed a guideline identifying the Environmental Impact Statement (EIS) triggers (10th February 2014) for mining and petroleum activities which are considered in the following section.

Only site-specific applications for new resource activities (“greenfield” sites) or the amendment of existing EAs (“brownfield” sites) require a decision to be made whether an EIS is required under the EP Act. Large-scale impacts associated with resource projects commonly require site-specific applications that trigger assessment by EIS. The scale (i.e. relative magnitude) of an impact is determined by its intensity, duration, irreversibility and the risk of environmental harm, as well as social and economic impacts. Section 143 of the EP Act describe the circumstances under which a resource activity must or may be assessed by EIS. In deciding whether an EIS is required for an application, the administering authority must also consider the standard criteria.

Appendix A of the EIS guideline provides the following triggers for a major amendment application. Each of these triggers is addressed in bold italics:
• For existing mines extracting between 2–10 million tonnes/year (t/y) ROM ore or coal, an increase in annual extraction of more than 100% or 5 megatonnes/y (Mt/y) (whichever is the lesser).

The proposed operation is for a maximum of 2Mtpa which is consistent with historic approvals for open cut and underground mining to a maximum of 2Mtpa (Selwyn Project EMOS 2001).

• For existing mines extracting over 10 million t/y ROM ore or coal, an increase in annual extraction of more than 50% or 10 Mt/year (whichever is the lesser).

Not applicable.

• For existing mines extracting more than 20 million t/y ROM ore or coal extraction, an increase in annual extraction greater than 25%.

Not applicable.

• Proposed activities in a Category A or B environmentally sensitive area, unless previously authorised under Queensland legislation.

There are no Category A environmentally sensitive areas and the only Category B area is Endangered Regional Ecosystem 1.3.7 (Red gum woodland with bare sand or tussock grass on streambeds) which has been mapped in detail in an Ecological Assessment (Place 2012). This section of the ERE is located in a 3rd order stream just south of the proposed South Pit. Haul road access has been re-routed to the western edge to gain access to the proposed ROM pad and waste rock dump. Disturbance to RE 1.3.7 will be avoided.

• A substantial change in mining operations, e.g. from underground to open cut, or (for underground mining), or a change from minor subsidence to potentially substantial subsidence.

Open cut mining will be undertaken which is consistent with previous approvals.

• The introduction of a novel or unproven resource extraction process, technology or activity.

Standard mining and processing (SXEW) techniques will be used.

However, a decision may be made to require an EIS application, even if no EIS criteria are triggered, if DEHP or the Minister for Environment and Heritage Protection determines that the project applied for would involve a significant environmental impact, or a high level of uncertainty about potential impacts, or involve a high level of public interest. The following information responds to these additional criteria.

• It is considered that the impacts will not be significant and widespread with the two small open pits being the only proposed long term impact (refer section 7.1).

This EM Plan provides a high level of assessment and certainty in regards to the potential impacts.

The proposed operation is located fully within Starcross Holding (110,000ha - Lot 5364 on PH1891) owned by the Environmental Authority holder. The
The project area is 105kms south of the nearest populated centre of Cloncurry. Specific consultation has been undertaken with the following affected parties:

- MDH Pty Ltd (McDonald Family) as sub-lessee of Starcross Holding and owners of two out of three surrounding properties (Chatsworth and Farley Stations).
- Yulluna People as the registered Native Title holder.
- Cloncurry Shire in regards to potential impact to road infrastructure.

- The application for Major EA amendment will require advertising to consider any additional issues of public interest that may be raised.

The Standard Criteria (EP Act definitions) must also be assessed to determine if an EIS is required. The criteria includes following highlighted commentary in relation to the relevant aspects of the project:

a) The following principles of environmental policy as set out in the Intergovernmental Agreement on the Environment—

   i. the precautionary principle;

   The level of assessment provides certainty in relation to the intensity and duration of the proposed impacts with relevant contingency built into the operational management system.

   ii. intergenerational equity;

   The project demonstrates reasonable responsibility in relation to the preservation of the natural and cultural environment for the current and future generations.

   iii. conservation of biological diversity and ecological integrity; and

   The proposed project has undertaken a high level of ecological investigation and has taken steps to minimise impacts to matters of national and state environmental significance. Where disturbance to significant habitat is to be undertaken it has been initially proposed to limit the disturbance and environmental offsets have been identified where appropriate.

b) any Commonwealth or State government plans, standards, agreements or requirements about environmental protection or ecologically sustainable development; and

The relevant government plans, standards, agreements and requirements have been assessed and met by the proposal.

c) any relevant environmental impact study, assessment or report; and

This document includes reference to the initial EIAS for the Selwyn Project and subsequent studies, assessments and reports to identify and characterise the impacts and establish effective controls.

d) the character, resilience and values of the receiving environment; and

This document adequately assesses the character, resilience and values of the receiving environment.
e) all submissions made by the applicant and submitters; and

This document summarises all of the relevant submissions made by the applicant. The public advertising process for a major environmental authority amendment allows for relevant public notification and additional submissions.

f) the best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows— (i) an environmental authority; (ii) a transitional environmental program; (iii) an environmental protection order; (iv) a disposal permit; (v) a development approval; and

This document proposes environmental management practices for an environmental authority that represent best practice.

g) the financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument; and

The proposed project provides the opportunity for ongoing employment particularly for indigenous people and extends the ability for the applicant to maintain a presence in the region to carry out rehabilitation and associated monitoring and management. The lodgement of an appropriate Financial Assurance will serve to reduce the financial risk to the State.

h) the public interest; and

The document includes consultation with relevant parties. The public advertising process for a major amendment will allow for any submissions in regards to public interest.

i) any relevant site management plan; and

All relevant site management plans and objectives have been provided with this document. A subsequent Plan of Operations will provide further detail on operational matters.

j) any relevant integrated environmental management system or proposed integrated environmental management system; and

This document represents an integrated assessment of impacts and their proposed controls.

k) any other matter prescribed under a regulation.

All relevant prescribed matters have been assessed.

3 TENURES

The Cloncurry project is located 140km south-east of Mt Isa in the south west corner of the Selwyn Ranges in the state of Queensland (see Figure 1).

CRCM holds 23 mining leases totalling 4,990.18ha. The tenements of the projects are listed in Table 1, 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 km$^2$ including joint ventures and two EPM applications with a total area of 130 km$^2$. 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 km$^2$) and five EPMs in the Red Metal / CRO JV (60 km$^2$) where Chinova are the operators.
Figure 1 – Project Location
<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>2566</td>
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</table>

### 3.1 Previous Mining Activities

Historic copper mining was undertaken at Mount Elliott between 1905 and 1914 with copper smelted on site between 1908 and 1919. Historical records suggest that total production from the Elliott Smelter during this period was 24,862 tonnes of copper and 34,000 oz of gold bullion from about 268,000 tonnes of ore. Some of the ore was sourced from the Hampden Consols Mine at Kuridala and other mines in the area. Incomplete historical records suggest that ore mined from the Upper Zone at Mount Elliott totaled about 160,000 tonnes at 11.85% Cu and 6.43g/t Au.

Intensive exploration of the Western Ironstones (Starra Line) in the late 1970s by a consortium of companies resulted in a feasibility study in mid-1987.

Cyprus Minerals Australia initially developed the Cloncurry Project Environment Impact Assessment Study (EIAS) in 1987 to support a 500Kt/annum gold/copper
project on the Selwyn Hematites (Starra Line) over a proposed 9-year mine life, including underground and open cut mining operations. It was proposed that future operations would include Mt Elliott and Mt Cobalt.

The ore was to be processed at a central mill site involving both floatation for sulphide ores and carbon-in-pulp process for oxide gold ore. A tailings dam was necessary for the storing the flotation and leached tailings.

Monitoring of the watercourses in the area commenced pre-disturbance in the 1985-86 season and ‘significant quantities of metals were detected during the first season’ (EIAS, 1987 Summary). This will be discussed further within this regional water quality section (Section 5.11).

Production commenced in 1988 and a total of four open pits (222, 244, 251 & 257) and 5 underground operations (222, 244, 251, 257 and 276) were developed along a 5.4km long strike length of the Starra Line.

Exploration at the historical Mount Elliott copper mine, some 18km north of Starra, resulted in the delineation of additional ore-grade mineralisation in and around the historically mined Upper Zone and defined a new, high grade copper-gold orebody, (the Lower Zone). Mining commenced in 1994 and ore from the Starra series of mines, Mount Elliott and, for a very short period, from two small open pits at Victoria, was treated through a mill located adjacent to the Starra mines.

Production from both Mount Elliott and Starra was temporarily suspended in February 1999 and the Project was purchased by Selwyn Mines Limited in 2000. Mining and treatment of Starra and Mount Elliott ore recommenced in 2000 and a small open pit was also developed and mined at Lady Ella. Operations ceased in 2003 and Ivanhoe Australia (now Chinova Resources) purchased the assets of the project and assumed management of the sites as Ivanhoe Cloncurry Mines Pty Ltd. Subsequently the mill and much of the associated infrastructure was sold and removed from site. No mining was undertaken at Mt Cobalt.

Metal produced since start-up in 1987 to closure in 2003 totaled approximately 217,700 tonnes of copper and 1.02 million ounces of gold. At the time of closure in 2003, ore reserves remained at both Starra and Mount Elliott.

Subsidence of the Mt Elliott historic workings was first recorded in 1920 following the earlier mining campaigns. More recent subsidence has occurred to the western side of the historic workings. These areas have been fenced with warning signs erected.

The mines at Starra and Mount Elliott are currently closed and the entrances sealed for safety.
Underground development of the Starra 276 mine by Chinova Resources, commenced early in February 2012 with a total of 856,280 t of ore produced and hauled to Osborne for processing. The Mine was closed on 21st August 2014 with underground services removed and the majority of rehabilitation completed. Up to 150 workers were accommodated at the Mt Dore Camp during this period.

4 STAKEHOLDER CONSULTATION

The Osborne site has an annual Local’s Day on Melbourne Cup day each year. This day is used to inform locals and other stakeholders of mining and exploration activity in the coming year. Local’s Day will be held at Osborne on 1st November 2016 and the proposed Mt Dore Heap Leach operation will be discussed along with mining progress at Osborne and ongoing exploration activity.

4.1 Department of Environment and Heritage Protection (DEHP)

DEHP has been consulted on a regular basis in regards to the general operations and also new projects. A meeting was held with DEHP in Cairns on 6th June 2016 to seek advice as to the most appropriate approach to the amendment of the EA such that the development of the Heap Leach Project could proceed.

4.2 Commonwealth Department of Environment

A meeting was held with Elizabeth McMillan (Assistant Director – Queensland Major Projects) from the Department of Environment on Friday 24th June 2016 to discuss potential referrals under the EPBC Act. A presentation was given to outline the proposed Mt Dore Heap Leach Project and the research findings from *Pseudantechinus mimulus* project.

4.3 Department of Natural Resources and Mines (DNRM)

DNRM has been consulted about and involved in recent mining lease applications for the haul road and services corridor and other tenure related dealings. DNRM Mines Inspectors are regular visitors to site.

4.4 Department of State Development (DSD)

DSD in Mt Isa was briefed in June 2016 about the Project and the potential benefits to the region of North West Queensland.

4.5 Cloncurry Shire Council (CSC)

Project infrastructure is all located within the CSC. Chinova Resources is in constant contact with CSC and is providing support for road projects in the area by way of joint submissions to state and federal government. Consultation will be required for Notifiable Road Use in relation to the proposed Heap Leach Project.
4.6 Aboriginal Groups

The Project mining and exploration tenements cover land associated with three native title claimant groups (the Kalkadoon, Mitakoodi, and Yulluna groups). CRCM has an ongoing commitment to consult with these groups on both native title and cultural heritage matters. Land Access Agreements are negotiated with the respective native title claimant groups under the *Native Title Act, 1993*. Yulluna People have been granted Native Title over the proposed project area in a Federal Court hearing that was held at Osborne mine site on 28th March 2014. The management of all sites and items of Aboriginal cultural heritage significance is facilitated by a separate Cultural Heritage Management Agreement with the Yulluna People. Local indigenous people will be targeted for employment and training opportunities in relation to the Heap Leach project effectively transferring the existing employees from the current Osborne Open Pit project.

4.7 Land Owner

The project area is located entirely within Starcross Holding held by CRCM. A sub-lease agreement has been established with MDH Pty Limited (Bob McDonald).

4.8 Local Community

As previously mentioned, Local’s Day at Osborne is used to inform local stakeholders of current and future operations. These days are well considered by the local community and will continue to inform on mine developments and exploration activities. In addition there is regular informal contact throughout the year with local landholders during exploration and mine associated activities.

5 ENVIRONMENTAL VALUES

5.1 Meteorology

5.1.1 Rainfall and Evaporation

The nearest BOM meteorological station to the Mt Dore Operation is approximately 37 kms south west at Chatsworth Station (Station 37013) with more than a hundred years of record. The Cloncurry McIlwraith Street (Station 29008) is located 105 kms north of Mt Dore and has been included for comparison. The semi-arid to arid Mount Isa area is described as having a tropical continental climate (Bureau of Meteorology, Australia - Köppen Australian climate classification scheme). Refer Table 2. Average annual rainfall at Chatsworth is 321.8mm with evaporation of 3,110mm (Mt Isa).
Table 2 – Rainfall and Evaporation

<table>
<thead>
<tr>
<th>Month</th>
<th>Cloncurry</th>
<th>Chatsworth</th>
<th>Monthly Evaporation (mm)</th>
<th>Daily evaporation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>122.5</td>
<td>69.9</td>
<td>303.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Feb</td>
<td>114.8</td>
<td>69.9</td>
<td>252.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Mar</td>
<td>66.7</td>
<td>37.5</td>
<td>279.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Apr</td>
<td>18.3</td>
<td>15.8</td>
<td>252.0</td>
<td>8.4</td>
</tr>
<tr>
<td>May</td>
<td>13.5</td>
<td>13.9</td>
<td>201.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Jun</td>
<td>12.0</td>
<td>9.8</td>
<td>162.0</td>
<td>5.4</td>
</tr>
<tr>
<td>Jul</td>
<td>7.3</td>
<td>9.8</td>
<td>170.5</td>
<td>5.5</td>
</tr>
<tr>
<td>Aug</td>
<td>3.8</td>
<td>3.8</td>
<td>213.9</td>
<td>6.9</td>
</tr>
<tr>
<td>Sep</td>
<td>7.0</td>
<td>5.8</td>
<td>270.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Oct</td>
<td>16.5</td>
<td>14.8</td>
<td>325.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Nov</td>
<td>30.1</td>
<td>21.2</td>
<td>345.0</td>
<td>11.5</td>
</tr>
<tr>
<td>Dec</td>
<td>69.0</td>
<td>48.6</td>
<td>334.8</td>
<td>10.8</td>
</tr>
<tr>
<td>Annual</td>
<td>480.5</td>
<td>321.8</td>
<td>3110.0</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: BOM Climate Data (2016)

Rainfall events exceeding the average condition will need to be assessed to determine the design criteria for water management structures. Table 3 presents the relevant intensity – frequency – duration characteristics for recurrence intervals from 1 – 100 years and durations from 5 minutes to 72 hours.

Table 3 – Intensity Frequency Duration for Mt Dore (21° 40'; 140° 30’)

<table>
<thead>
<tr>
<th>DURATION</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 mins</td>
<td>64.4</td>
<td>84.8</td>
<td>116.</td>
<td>135.</td>
<td>159.</td>
<td>191.</td>
<td>217.</td>
</tr>
<tr>
<td>6 mins</td>
<td>60.1</td>
<td>79.2</td>
<td>108.</td>
<td>126.</td>
<td>149.</td>
<td>179.</td>
<td>203.</td>
</tr>
<tr>
<td>10 mins</td>
<td>50.3</td>
<td>66.2</td>
<td>90.2</td>
<td>105.</td>
<td>124.</td>
<td>149.</td>
<td>169.</td>
</tr>
<tr>
<td>20 mins</td>
<td>38.9</td>
<td>50.9</td>
<td>68.8</td>
<td>79.8</td>
<td>93.7</td>
<td>112.</td>
<td>127.</td>
</tr>
<tr>
<td>30 mins</td>
<td>32.4</td>
<td>42.4</td>
<td>57.1</td>
<td>66.1</td>
<td>77.6</td>
<td>93.0</td>
<td>105.</td>
</tr>
<tr>
<td>1 hour</td>
<td>22.1</td>
<td>29.0</td>
<td>39.2</td>
<td>45.5</td>
<td>53.5</td>
<td>64.2</td>
<td>72.5</td>
</tr>
<tr>
<td>2 hours</td>
<td>14.0</td>
<td>18.4</td>
<td>25.3</td>
<td>29.5</td>
<td>35.0</td>
<td>42.2</td>
<td>47.9</td>
</tr>
<tr>
<td>3 hours</td>
<td>10.4</td>
<td>13.8</td>
<td>19.2</td>
<td>22.6</td>
<td>26.8</td>
<td>32.6</td>
<td>37.2</td>
</tr>
<tr>
<td>6 hours</td>
<td>6.22</td>
<td>8.31</td>
<td>11.8</td>
<td>14.1</td>
<td>16.9</td>
<td>20.8</td>
<td>23.9</td>
</tr>
<tr>
<td>12 hours</td>
<td>3.73</td>
<td>5.03</td>
<td>7.33</td>
<td>8.83</td>
<td>10.7</td>
<td>13.3</td>
<td>15.4</td>
</tr>
<tr>
<td>24 hours</td>
<td>2.28</td>
<td>3.10</td>
<td>4.61</td>
<td>5.61</td>
<td>6.87</td>
<td>8.62</td>
<td>10.0</td>
</tr>
<tr>
<td>48 hours</td>
<td>1.37</td>
<td>1.87</td>
<td>2.84</td>
<td>3.50</td>
<td>4.32</td>
<td>5.47</td>
<td>6.41</td>
</tr>
<tr>
<td>72 hours</td>
<td>0.977</td>
<td>1.34</td>
<td>2.06</td>
<td>2.55</td>
<td>3.17</td>
<td>4.04</td>
<td>4.76</td>
</tr>
</tbody>
</table>


The data from July – June for Chatsworth Station were used to determine the annual 2 month totals on a daily basis. A Log Pearson fit was applied to the maximums using a method described in Australian Rainfall and Runoff: Volume 1, 3rd Edition (Institute
of Engineers Australia, 1999). For ARI 100 years, the equivalent AEP is 1% (0.01 AEP) and the Log Pearson Trend is 561.2mm.

5.1.2 Temperature

The highest average daily temperature for Cloncurry is 38.0°C in December with the lowest average minimum of 10.3°C in July. Temperatures in excess of 53°C have been recorded at Cloncurry. Figure 2 below shows the average monthly temperatures and extremes for Mt Isa.

![Figure 2 – Mt Isa Daily Temperatures](image)

5.1.3 Wind Speed and Direction

Figure 3 shows a wind-rose created from the Mt Dore weather station using records from December 2009 to August 2014. The data correlates closely with Bureau of meteorology data from Cloncurry Airport.

The predominant wind direction over the year is south south-east with average wind speeds of 5-7km/hr.
5.2 Topography and Drainage

The Cloncurry Project is characterized by two sub-parallel (eastern and western ironstones), more or less continuous ridges, of low to moderate relief, that extend above a flat plain. These ridges are formed by more resistant lithologies of the main geological formations of the area the Kuridala and Staveley Formations, with the Starra line located to the west and Merlin located on the eastern ridgeline.

The main water courses traverse the peneplain that has developed between the two main ridges. Most of these watercourses are shallowly incised and ephemeral – flowing for only short durations during and immediately after the wet season.

The watercourses are incised into the laminated near-surface rocks and there is little alluvial development associated with them.

Figure 4 is an oblique view of the topographic setting of the proposed.
Figure 4 – Oblique View of Project
5.3 Regional Geology

The geology of the Chinova Resources leases consists of Proterozoic formations of the Staveley Formation and Kuridala Group. The primary geological formations that comprise the area are the Kuridala Group and the Staveley Formation. These formations express at the surface as thinly laminated and quite steeply dipping siltstone, slate, and phyllite, with subsidiary quartzite and ironstone layers that often form steep remnant ridges.

Granitic sequences intrude the Kuridala and Staveley Formations in places. To the east and the south of the project, Mesozoic cover associated with the Carpentaria Basin onlaps the Proterozoic sequence.

ERA Maptec, 1994 provide the following summary of the Starra and Merlin areas.

The Selwyn deposits are located in a corridor of Staveley Formation rocks bounded by two ironstone ridges, the western (Starra Line) and eastern ironstones (Merlin Line). The Kuridala Formation lies to the east of the eastern ironstones. To the west of the western ironstones lie very strained schists, assumed by some previous workers to be equivalent of the Answer Slate, but mapped as an early ductile shear of uncertain affinity by others. The ironstones are sub parallel with gold copper mineralisation hosted in the western ironstones only. The main difference is that the western ironstone is magnetic and the eastern ironstone is not. The ‘hinge zone’ consists of a series of ironstone lenses, between the eastern and the western ironstones and is intermediate in magnetic character. The copper gold mineralisation consists of:

- quartz-magnetite-chalcopyrite-gold ironstone grading to
- quartz-feldspar-chlorite-hematite-magnetite-chalcopyrite-gold schists being part of a wider alteration halo of
- quartzo feldspathic footwall rocks (albite-quartz-hematite) and scapolitic and carbonaceous hanging wall rocks.

The area lies in a north south trending corridor of concentrated deformation between two granites. The area is structurally complex with the following events generally recognised:

1. Creation of major shears zones at the boundary of the principal units:
   a. The Starra Shear between the Staveley Formation and the Answer Slate and Gin Creek Granite.
   b. The Selwyn Shear at the boundary at the boundary between the Staveley and Kuridala Formations.
2. Ductile sinistral shearing producing steeply plunging folds at various scales. This is accompanied by the formation of a pervasive foliation. This is the most obvious macroscopic event but could be preceded by an earlier event which created large scale upright, tight to isoclinals folds, with doubly plunging axes and an axial planar slaty cleavage.
3. In the south - open to tight folds overprint an earlier foliation.
4. NE ductile to brittle faulting, coeval with regional kinking of the Starra structural corridor.

Figure 5 shows a geological map of the area with mining lease boundaries and prospect names. This large scale mapping is useful for highlighting major structures and for understanding the relationships of the geological units.
Figure 5 – Regional Geology
5.3.1 Mt Dore Geological Setting

Copper (Cu) and molybdenum-rhenium (Mo-Re) mineralisation at Mount Dore is hosted within a tectonised sequence of metashale, metasiltstone, schist and phyllite belonging to the Proterozoic Kuridala Group in the Eastern Fold Belt of the Mount Isa Inlier. This stratigraphic package lies to the west of the over-thrust Mount Dore Granite and extends north-south along strike for several kilometres and dips eastward underneath the granite, see Figure 6. A massive, easterly-dipping, intensely-silicified quartzite ridge on the western side of the area forms the footwall to the deposits.
Figure 6 – Mt Dore Geology
Cu and Mo-Re mineralisation is hosted within variable proportions of inter-fingered black carbonaceous and grey micaceous metasiltstone and grey metashales with thicker beds of phyllite and schist. These metasedimentary units exhibit recrystallisation textures but retain relict sedimentary features such as bedding. Brief descriptions of these units, which appear to have a spatial correlation with mineralisation, are included below and can be related to the example core photographs in Figure 7.

**Hanging wall Granite.** The Mount Dore Granite, dominating the eastern section of the project area, is part of the extensive Williams-Narak Batholith. This intrusion forms the unmineralised hanging wall to the Cu and Mo mineralisation and conceals the greater part of the Cu and Mo deposit.

**Metasiltstone.** The metasiltstone consists of recrystallised quartz grains with a micro-mosaic texture with occasional incipient K-feldspar grains of hydrothermal origin. Another variety of the metasiltstone appears to have a slightly silky sheen due to fine
muscovite (sericite) and is probably derived from clayey or muddy protolith. The metasiltstone is the predominant unit in the metamorphic sequence.

**Black Shale.** The carbonaceous metashales consist of extremely fine-grained oriented muscovite (sericite) and the dark colour is attributed to the presence of abundant ultrafine graphite along laminations (generally <5% of rock). The black shale unit occurs predominantly within the hanging wall to the Merlin mineralization and the footwall of the Mount Dore Granite. However, it is also observed as a mineralization host rock, as well as in a footwall position. This unit branches into at least three discrete lithological units above the mineralization to the north, and is interpreted to be offset by vertical structures down dip.

**Phyllite.** The phyllite occurs predominantly as a single unit, which broadly follows the geometry of the bounding granite and quartzite. Mineralization can be contained within the phyllite, but also sits in a footwall position from 7 505 600 mN moving south. This unit has been modelled with the view to using it as a geological marker unit throughout the deposit.

**Quartzite.** The footwall unit to the Kuridala Formation forms a narrow linear and north-south trending ridge west of the project area. This massive, intensely silicified quartzite ridge, with little internal texture, dips east and is less than 40 m in true thickness. This zone may define the Mount Dore Fault and may serve as the boundary between the host metasedimentary package of the Kuridala Formation and underlying siltstone and shale units of the Staveley Formation.

### 5.3.2 Mineralisation

Mount Dore is a collection of polymetallic deposits containing copper, zinc, silver, gold, lead, cobalt and molybdenite with rhenium. High grade molybdenum is concentrated in the Merlin deposit. All significant copper mineralisation occurs within the Kuridala Group.

The near surface mineralisation has been extensively oxidised such that the copper rich zones outcrop as copper oxides above a thick zone of chalcocite mineralisation. The primary zone includes chalcopyrite, sphalerite, galena and molybdenite as the visible ore minerals.

Mineralisation dips to the east beneath the Mount Dore granite body in a zone of about 180 m true thickness and mineralisation is considered to be open to the north where diamond drill holes have discovered primary copper sulphide ores, with potential zinc silver, gold and molybdenum.

Mineralisation at Mount Dore is largely restricted to the Kuridala Group and internal and bounding structures. These dip at approximately 50° to the east and can be as steep as 70° or as shallow as 30°. For the copper mineralisation, the higher grades
form planar zones around 4 m to 10 m in width. These are included within the lower grade envelope used for mineral resource domaining and estimation. The domains are between 5 m and 30 m in width at Mount Dore North and are more amorphous in shape at Mount Dore South where they are between 30 m and 150 m in true width.

**Copper Mineralisation.** The bulk of the currently known Cu mineralisation in the project area consists of secondary Cu oxides and carbonates (chrysocolla, cuprite, chalcotrichite, pseudomalachite, minor to trace azurite and malachite) and native Cu after chalcocite. This oxide zone is underlain by a transition zone dominated by chalcocite (replacing pyrite, chalcopyrite, and sphalerite) and trace covellite (Lazo and Pal, 2009). The oxides and native Cu penetrate deeper into the transition zone within major shears and fault zones. Primary Cu mineralisation was emplaced in breccias and fractures that were best developed in the metasiltstones and black shales and are only weakly developed in the schists and phyllites.

Two major episodes of Cu mineralisation have been recognised: an earlier chalcopyrite-pyrite-sphalerite-bornite assemblage emplaced into brecciated metasiltstone and black shale with associated K-feldspar ± quartz, and a later dolomite-hosted breccia with chalcopyrite-pyrite sphalerite. Trace to minor galena, cobaltite, arsenopyrite and molybdenite are noted in the primary sulphide zone. Both types of primary Cu sulphide became the source for the secondary enrichment zones for Cu by weathering, after the unroofing of the granite cover by erosion. Very little gossan is developed over the deposits.

Surface oxidation of the primary sulphides produced overlapping zones of copper rich minerals dominated by a suite of secondary copper sulphide and copper oxide minerals, as well as native (metallic) copper.

The supergene process at Mount Dore involves the conversion of the primary copper and other sulphides to predominately chalcocite followed by further oxidation to produce chrysocolla, native copper, cuprite and pseudomalachite.
**Molybdenum – Rhenium Mineralisation.** The underlying Merlin Mo-Re deposit consists of fracture-controlled and breccia-matrix molybdenite mineralisation. Minor molybdenite anomalies also occur in the upper Mount Dore Cu zones but these are not economically significant.

**Polymetallic Mineralisation.** Significant zinc accumulations occur in Mount Dore North, both within the copper zone and surrounding it. Zinc displays some evidence for depletion towards the surface though this could also be related to primary emplacement.

The occurrence of significant Cu in some Mo zones and Zn in many Cu zones (in Mount Dore North) indicate polymetallic zoning. For modelling the primary economic minerals, Mo and Cu are used to define principal domaining. Outside this, the potential for Zn and other potentially economic elements such as Pb, Au, Ag, Co and low grade Mo-Re have been used to define an outer polymetallic domain suitable to constrain these estimates without trying to over domain the resource by considering each separately. The recovery of Zn and Pb is currently uncertain and is not considered a material aspect of the current mineral resource estimate.

### 5.3.3 Resource Drilling

Mineralisation typically dips at approximately 50° to the east and has been intersected acutely by the easterly inclined drilling creating longer intersections than true width. This scenario increases with depth as the drilling tends to steepen as it steps outwards. All resource estimation was undertaken using 3D modelling methods that account for the drill intercepts in true space and the different intersection lengths achieved by the drill orientation. The drill orientation approach undertaken by Ivanhoe Australia is the most practical given the terrain and target depth.

Drilling is only described for the area relevant to the resource estimate at Mount Dore and Merlin within the area modelled for the mineral resource estimate. This area is subdivided into three distinct mineralised zones, including:

- Mount Dore South (south of 28 100N) represents a deeply weathered copper dominated zone which has historically been targeted for exploration for near surface copper oxide material suitable for leach extraction;
- Mount Dore North (north of 28 100N) is less deeply weathered but overlain by a depleted zone; hence the copper does not outcrop at surface and has only been defined by more recent extension drilling. Polymetallic mineralisation with notable Zn mineralisation occurs in the primary zone.
- Merlin and lower Mount Dore North (lower sequence north of 28 100N). This lower copper and polymetallic (mainly Zn) mineralisation contains some lower grade and some very high grade Mo-Re veins referred to as Merlin.

A map of the drill hole collar locations is shown on the geology plan in Figure 9. This figure also indicates the areas used for reference and the extent of the mineralisation.
Figure 9 - Resource Drilling - Mount Dore
A total of 583 drill-holes with a total length of 137,047 metres have been used for determination of the Mt Dore Copper Oxide resource and associated waste characterisation studies.

5.4 Landforms and Soils

5.4.1 Landforms

Cloncurry Project Mining Leases are situated within two land systems (Perry et al. 1962). They are:
- Mt Elliott, which is comprised of immaturely dissected plateau and high plains of pre-mid Mesozoic age; and
- Kuridala, comprised of maturely dissected hill country with dissected pre-mid Mesozoic surface, with some early to mid-Tertiary elements and narrow late Tertiary to Quaternary plains.

The dominant topographical features on these leases is the Starra ridge which attains heights of RL440m, the very broken topography where the two tailings dams and the Merlin deposit are located, with ridges in the order of 410m. The area to the west of the Starra ridge has more gentle sloping topography but with peaks attaining heights of 390m.

The Mt Elliott Mining Leases are situated within two land systems. They are:
- Torwood, comprised of immaturely dissected plateau and high plains of early to mid-Tertiary age; and
- Kuridala, previously described above.

5.4.2 Soils

The soils of the project area were described within the original EIAS, 1987. There are four main soil types in the area:
- Skeletal soils;
- Brown soils of light texture;
- Coarse textured red earths; and
- Fine textured red earths.

Samples were taken from the surface 200mm and 200-400mm intervals for chemical analyses from 56 locations and were bulked according to the mapping units described.

The soil types were then broken into seven classes summarised in Table 4 below with their relative locations and occurrence.
<table>
<thead>
<tr>
<th>Major Group</th>
<th>Class</th>
<th>Descriptor</th>
<th>Description</th>
<th>Location and Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform texture</td>
<td>Skeletal</td>
<td>Skeletal</td>
<td>Shallow (&lt;400mm), coarse textured red or brown soils dominated by rock fragments. Textures are sandy, sandy loams or clay loams.</td>
<td>Ridge tops, steep slopes and exposed rock 410ha Starra 48ha Mt Elliott 71ha Cobalt 17% total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cockatoo</td>
<td>Brown soil of light texture</td>
<td>&lt;400mm deep, dark reddish brown to brown sandy loam; up to 40% surface gravel; massive; slightly acid soil reaction.</td>
<td>Ridge tops extending to gently sloping valley floors. 874ha Starra 6ha Cobalt 34% total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manbulloo</td>
<td>Brown soil of light texture</td>
<td>Shallow (200-500mm), dark reddish brown sands; approximately 30% gravel; massive; predominantly slightly acid pH.</td>
<td>Ridge slopes extending to gently sloping valley floors. 643ha Starra 189ha Mt Elliott 43ha Cobalt 25% total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sturgeon</td>
<td>Red earth</td>
<td>&gt;400mm, dark reddish brown, sand clay loams; low pedality; soft consistence; approximately 30% gravel; neutral surface pH increasing to moderately alkaline with depth.</td>
<td>Undulating slopes 178ha Starra 6% total</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lang</td>
<td>Krasnozen</td>
<td>&gt;400mm deep, red to dark reddish brown loam; uniformly fine textured clays with some soils having a medium textured surface grading to clay; soft surface consistence grading to hard with depth; acid soil reaction in general but mildly alkaline sub-soils.</td>
<td>Undulating and low slopes 149ha Starra</td>
</tr>
<tr>
<td>Gradational texture profile</td>
<td>Forsayth</td>
<td>Red earth</td>
<td>&gt;400mm deep, red to dark reddish brown; predominantly uniformly textured clay loams with some soils of sand or sandy loam texture grading to sandy loam; clay loam or clay; variable consistence; predominantly acid pH but neutral and alkaline lower horizons occur.</td>
<td>Undulating slopes and valley floors</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------</td>
<td>-----------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>334 ha Starra</td>
<td>24 ha Mt Elliott</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12% total</td>
<td></td>
</tr>
<tr>
<td>Elliott</td>
<td>Red earth</td>
<td>&gt;400mm deep, reddish brown to brown sandy loam grading to sandy clay; clay loam; low pedality; soft consistence; alkaline soil reaction.</td>
<td>Undulating slopes and valley floors</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26ha Starra</td>
<td>&lt;1% total</td>
</tr>
</tbody>
</table>
In general the soils are slightly acid, the exceptions being some Munbulloo profiles which were strongly acid and Forsayth and Elliott classes which were mildly and moderately alkaline respectively. The pH either remained unchanged or increased with depth, the greatest change being in Forsayth, for which the subsurface material was strongly alkaline. The pH range detected in this survey was not sufficient to restrict the soils use for rehabilitation.

High salinity levels were detected throughout the profile of the Elliott soil class. The subsoil profiles of the Manbulloo were sodic and both the surface and sub-surface of the Forsayth and Elliott classes were strongly sodic. Phosphorus and nitrogen levels were low in all soils except for the skeletal soils where 17ppm phosphorus was recorded.

5.5 Flora and Fauna

In February 2012, CRCM engaged PLACE Design Group (PDG) to undertake an ecological assessment for the development of the Mt Dore Project.

PDG had previously completed desktop assessments and undertaken detailed vegetation community, flora, fauna and fauna habitat assessments (including fauna trapping) of the 10ha Merlin Decline and Waste Dump Development. A similar detailed assessment of the vegetation communities, flora and fauna habitats, specifically concentrating on Species of Concern (SOCs), was carried out along the proposed 15 km Access Road between Lucky Luke and Cloncurry Project in 2010.

Further to this, PDG undertook an assessment of vegetation communities and fauna habitats within all of the CRCMs mining lease areas. These assessments were focused on the potential occurrence of Species of Conservation Significance and Of Concern / Endangered RE’s.

The surveys were conducted during the mid-late dry season, wet-season, and post-wet season to capture the seasonal variation of both flora and fauna communities. The 2012 assessment complements the results of previous surveys. All conservation listings have been checked against current legislation and updated where required with the current status as of June 2016.

5.5.1 Flora and Species of Conservation Significance

A total of 170 species were recorded during the 2012 post-wet survey, comprising 105 genera from 40 families. None of the flora species recorded during the field survey are listed under the Nature Conservation Act (Qld) 1992 or the Environment Protection and Biodiversity Conservation Act (C’wlth) 1999. From the analysis undertaken to date, it is determined unlikely that Species of Conservation Significance occur either within the proposed disturbance area.
5.5.2 Weeds

Of the recorded flora species, 13 species are exotic species, with nine species being classed as naturalized in Queensland. None of these species are declared under the schedules of the *Land Protection (Pest and Stockroute) Management Act (Qld)* 2002.

5.5.3 Regional Ecosystems

*Eucalyptus leucophloia* (snappy gum) woodland is the dominant vegetation association over most of the area. It is often found in association with *Corymbia terminalis* (western bloodwood) and / or *Eucalyptus leucophylla* (Cloncurry box) which may become locally dominant. A shrub layer of topography-dependent density is dominated by species of the genera *Acacia*, with the seasonally depauperate ground layer is dominated by *Triodia* spp. (pincushion spinifex) apart from the Cainozoic plains which are dominated by *Aristida* spp.

Thirteen Regional Ecosystems were identified within the proposed disturbance area with RE1.11.2a, RE1.5.6, RE1.11.2e and RE1.12.1xa being the dominant ecosystems (PDG 2012). All thirteen have a management status under the *Vegetation Management Act (Qld)* 1999 of Least Concern, the lowest conservation significance levels (greater than 30% of the pre-settlement RE remains). Within the proposed disturbance area, RE1.11.2 is represented by an additional four major vegetation communities recognised by the Queensland Herbarium (2009); RE1.11.2a, RE1.11.2e, 1.11.2x2 and RE1.11.2x6. This is also the case for RE1.12.1 with an additional four major vegetation communities; RE1.12.1x4, RE1.12.1x4a, RE1.12.1xb and RE1.12.1xc.
Riparian areas present throughout the proposed disturbance area are aligned with RE 1.3.7 “River red gum (Eucalyptus camaldulensis) woodland on channels and levees (south)”. This RE coincides with the main riparian feature, starting in the north-western corner of the proposed disturbance area and traversing in a south-easterly direction to exit just south of the airstrip (PDG 2012). This RE has a biodiversity status of *Endangered*. Disturbance to this RE will be avoided. This
section of the ERE is located in a 3rd order stream just south of the proposed South Pit. Haul road access will be required along the western side of this area to the proposed ROM pad and waste rock dump.

Figure 11 – Proposed disturbance beside RE 1.3.7
RE 1.3.6x1a has been mapped as two tributaries to the main riparian corridor as well as along a channel in the southern portion of the proposed disturbance area. This RE has a biodiversity status of **Concern**. All remaining REs have a biodiversity status of **No Concern at Present** which is the lowest significance level (greater than 30% of the pre-settlement RE remains). None of these are considered threatened ecological communities at a national level under the *Environment Protection and Biodiversity Conservation Act (C’wlth) 1999*.

RE1.3.7 is considered **Endangered** under DEHPs biodiversity assessment on account of regional degradation of this RE by high total grazing pressure. Direct impacts are associated with trampling, and secondary impacts associated with exotic pasture species introductions principally *Pennisetum ciliare* (buffel grass), and tertiary impacts associated with altered fire regimes arising from buffel grass which carries a greater biomass than undisturbed systems and habitat alteration. They also afford significant nesting and denning (live in a den) habitat for hollow dependent species, habitat for migratory waterbirds, and local and regional habitat connectivity opportunities. These areas are therefore considered to have the highest ecological value in the proposed disturbance area and will not be impacted by the current proposed project.

Natural examples of these systems do burn patchily due to low flammability and small fuel loads, however they should not be targeted for prescribed burning. This is particularly pertinent for waterways containing *Pennisetum ciliare* (buffel grass) which significantly contributes to the fuel load and exacerbates the vulnerability of these areas to fire.
5.5.4 Groundwater Dependent Ecosystems

It is worthwhile to note that while there are no groundwater dependent ecosystems mapped within the proposed disturbance area, *Eucalyptus camaldulensis* (RE1.3.7) is a species that is indicative of terrestrial vegetation being dependent on groundwater to some extent (DSITIA 2012). However, where RE1.3.7 has been mapped closest to
the proposed disturbance area, the groundwater associated with the Mt Dore aquifer has been currently modelled at >50 meters below surface (Lait 2015) and is therefore unlikely to be connected with RE1.3.7. Historically Mackie Martin and Associates (1987) recorded the water level as close as 20-30 meters below surface and in 2010 it was approximately 40 meters below surface (Rockwater 2010).

There have been no visible signs of plant stress to the *E. camaldulensis* that overlie the groundwater of the Mt Dore aquifer since dewatering activities commenced in 1987. For this reason it is reasonably considered that there are no groundwater dependent species that will be impacted by the dewatering of the Mt Dore Aquifer.

5.5.5 Flora Species of Conservation Significance

One Species of Conservation Significance was identified in the field in 2012, *Brachychiton collinus*, and it was then listed as Type A plant under the *Nature Conservation Act (Qld)* 1992. This plant was associated with the mapped RE1.12.1x4. Its location information is shown on Figure 10. However, this species has been downgraded and is currently listed as Least Concern, as is the associated RE. There is currently no proposed disturbance that would impact the species or the associated RE.

5.5.6 Terrestrial Fauna

A total of 76 species of terrestrial vertebrate fauna were recorded throughout the proposed disturbance area. A high proportion of these, 46 species (20 families) are derived from the avifauna group which dominates the landscape. The remaining fauna consisted of 18 species (seven families) of mammals, seven species (six families) of reptiles and five species (three families) of amphibian (PDG 2012). None of these are listed as Threatened under the *Nature Conservation Act (Qld)* 1992 or the *Environmental Protection and Biodiversity Conservation Act (C’wlth)* 1999. Three of the bird species are listed as migrant marine or terrestrial species under the EPBC Act including *Falco cenchroides* Nankeen kestrel, *Merops ornatus* Rainbow bee-eater, and *Coracina novaehollandiae* Black-faced cuckoo-shrike. (PDG 2012).

5.5.7 Terrestrial Fauna Species of Conservation Significance

The surveys have identified two species of conservation significance which are listed under the *Nature Conservation Act (Qld)* 1992 and have been identified on-site. These species included *Petrogale purpureicollis* (purple-necked rock wallaby) and *Falco hypoleucos* (grey falcon).

The mammal (purple-necked rock wallaby) has specific roosting, shelter and foraging habitat requirements met by the site. The bird of prey (grey falcon) is nomadic and occupy a large home range of several hundred square kilometres.

A number of other species not recorded by the survey but which have been recorded previously on the site or in the region, and/or may have habitat requirements met within the proposed disturbance area include:

- *Grantiella picta* (painted honeyeater)
- *Pezoporus occidentalis* (night parrot)
- *Rostratula australis* (Australian Painted Snipe)
- *Merops ornatus* (Rainbow bee-eater)
- *Pseudeutechinus mimulus* (Carpentarian antechinus).
- *Macrotis lagotis* (Greater bilby)
- *Acanthophis antarcticus* (common death adder).

*Petrogale purpureicollis* (purple-necked rock wallaby) readily inhabits the area and is listed as *Vulnerable* under the *Nature Conservation Act (Qld)*. This species is dependent on rocky ridges and cave habitats (particularly eastern facing caves for basking purposes), which are common. Sub populations of this species have been observed within areas of high disturbance, most notably areas where large rock dumps have settled and created a network of caves and tunnels. These habitats are close to semi-permanent to permanent water sources and large areas of good forage habitat.

*Falco hypoleucos* (grey falcon) is a diurnal raptor species with nomadic habits and extensive home ranges, respectively. This species has been previously noted foraging in the project area. *Falco hypoleucos* is currently listed as *Vulnerable* under the *Nature Conservation Act (Qld) 1992*. It is unlikely this species will be impacted due to its nomadic habits and extensive range.

The *Grantiella picta* (painted honeyeater) is endemic to mainland Australia and inhabits mistletoes in eucalypt forests/woodlands and riparian woodlands of river red gum, acacia-dominated woodlands, paperbarks and casuarinas (Garnett et al., 2011). It is currently listed as *Vulnerable* under both the *Nature Conservation Act (Qld)* and *Environment Protection and Biodiversity Conservation Act (C’wth) 1999*. It is not likely that this species will be impacted by any proposed activities given the amount of habitat present within the surrounding region.

The *Endangered* nomadic Cloncurry Night Parrot (*Pezoporus occidentalis*) *Environment Protection and Biodiversity Conservation Act (C’wth) 1999* has been identified by database searches as potentially occurring in the area as an arid specialist species. This species prefers dense lowland vegetation, primarily consisting of *Triodia spp.* (spinifex). The closest known record of the *Pezoporus occidentalis* (night parrot) is approximately 200 km south-east of the Investigation Area. Given previous impacts from cattle grazing and trampling suitable habitat coupled with the scarcity of confirmed records, it is considered unlikely that this species occurs within the proposed disturbance area (PDG 2012). During the 2012 survey nocturnal fauna searches were conducted at four sites for one hour per night for a total of six nights.

*Rostratula australis* (Australian Painted Snipe) is currently listed as *Vulnerable* under the *Nature Conservation Act (Qld)* and *Endangered* under the *Environment Protection and Biodiversity Conservation Act (C’wth) 1999*. It is a stocky wading bird and has been recorded at wetlands throughout Australia. Due to the lack of wetland habitat within the proposed disturbance area it is unlikely this species will be impacted.
Merops ornatus (Rainbow bee-eater) is distributed across much of mainland Australia. It occurs in open woodlands and shrublands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands (Gibson 1986; Jones 1986; Leach 1988) and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Badman 1989; Gibson 1986). It is not likely that this species will be impacted by any proposed activities given the amount of available habitat present within the surrounding region.

Pseudantechinus mimulus (Carpentarian false antechinus) was highlighted in the 2012 PDG report as potentially occurring within the proposed disturbance area and is currently listed as Vulnerable under the Environmental Protection and Biodiversity Conservation Act (C’wlth) 1999. CRCM subsequently engaged the University of the Sunshine Coast in 2013 to determine the occurrence and habitat usage by P. mimulus in the region including exploration and mining interests. The study also compared the use of Elliot trapping versus camera trapping to detect the presence/absence of P. mimulus. Results indicate that camera trapping is the preferred method for the detection of the species (Burnett et al. 2014). There is also evidence that P. mimulus is tolerant of fire and may be linked to their food source which includes termites (S. Burnett, pers. Comm., June 2015).

A total of 362 camera stations were deployed at 218 sites for a total of 5,149 camera trap nights. The study has confirmed the widespread occurrence of P. mimulus in the Mt Dore – Mt Elliott area, and has extended the known range of the species in Queensland. The surveys have detected P. mimulus 30km to the South of Mt Dore Camp (near intersection of Link Rd and Haul Rd, 6km East of Houdini), 65km to the North-West (Trekelano), 54km to the North (16km NW of Kuridala) and 10km to the East (along track to Mount Carol). Survey and occupancy analyses demonstrate that P. mimulus occurs in rocky habitats only, in the Selwyn Ranges area. The survey also demonstrates that there is potential for interaction between the project proposed in this EM plan and the demonstrated occurrence of P. mimulus. Subsequent camera trapping by RBC Environmental in July 2016 (Holzheimer, 2016) identified individuals within the proposed disturbance areas of the North Pit and associated Waste Rock Dump. Figure 13 shows detections on known habitat in the project area. Refer to Appendix 1 for the full reports.
Macrotis lagotis (Greater bilby) is currently listed as Endangered under the Nature Conservation Act (Qld) and Vulnerable under the Environment Protection and Biodiversity Conservation Act (C’wth) 1999. The species occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils. It occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and
hummock grassland in plains and alluvial areas. The species has not been identified in the Wildlife Online database search and the proposed disturbance area is situated north-west of the known population making it unlikely that the species would occur in the proposed disturbance area (PDG 2012).

*Acanthopis antarcticus* (common death adder) has been noted in previous surveys within the locality and anecdotally within the Cloncurry Project Mining Camp. This species is listed as *Vulnerable* under the *Nature Conservation Act (Qld) 1992*. Rocky ridgeline habitat throughout the Investigation Area provides a suitable forage and movement habitat for this species. The proposed disturbance will include the identified habitat; however, the amount will be minimal given the amount of suitable habitat present within the surrounding region.

Two migratory bird species were subsequently listed in 2015.

- *Motacilla flava* (Yellow Wagtail) - listed as a Migratory Species in 2015. No records of occurrence in the area from an updated Wildlife On-line search and no record from the Place (2012) fauna survey.

### 5.6 Matters of National Environmental Significance

Under the *Environment Protection and Biodiversity Conservation Act 1999*, actions that have, or are likely to have, a significant impact on a Matter of National Environmental Significance (MNES) require approval from the Australian Government Minister for the Environment (the Minister). A significant impact is an impact which is important, notable, or of consequence, having regard to its context or intensity. As *P. mimulus* is listed under the *Environment Protection and Biodiversity Conservation Act* this is a matter of National Significance. However CRCM have controls in place to mitigate the impacts to *P. mimulus* and it is expected that no significant impact to the species will occur. A meeting with Elizabeth McMillan (Assistant Director – Queensland Major Projects) from the Australian Government Department of Environment on 24th June 2016. The outcomes of this meeting highlighted the following:

- Referrals should be considered from the point of view of impact to the species rather than individuals;
- It is clear from the research that the species is regionally common and has been detected in the proposed disturbance areas for the Mt Dore Heap Leach Project;
- The process for determination of whether a referral should be lodged is effectively a self-assessment process identified in Matters of National Environmental Significance Significant Impact Guidelines 1.1.

The Matters of National Environmental Significance Significant Impact Guidelines 1.1 guideline requires that to make a decision as to whether or not to refer an action to the Minister we have considered the following with commentary highlighted in red:
1. Are there any matters of national environmental significance located in the area of the proposed action (noting that ‘the area of the proposed action’ is broader than the immediate location where the action is undertaken; consider also whether there are any matters of national environmental significance adjacent to or downstream from the immediate location that may potentially be impacted)? **Yes – P. mimulus**

2. Considering the proposed action at its broadest scope (that is, considering all stages and components of the action, and all related activities and infrastructure), is there potential for impacts, including indirect impacts, on matters of national environmental significance? **Yes to individuals.**

3. Are there any proposed measures to avoid or reduce impacts on matters of national environmental significance (and if so, is the effectiveness of these measures certain enough to reduce the level of impact below the ‘significant impact’ threshold)? **Yes – camera trapping has been demonstrated as an effective detection method by a university lead study. Detected individuals can then be targeted for removal by standard trapping methods (Elliott Traps) and removed from any area to be impacted. The species is regionally common. The preferred habitat has been clearly defined.**

4. Are any impacts of the proposed action on matters of national environmental significance likely to be significant impacts (important, notable, or of consequence, having regard to their context or intensity)? **No – the species has been identified as regionally common. There have been detections within the proposed disturbance area in July 2016. Without any further control it is unlikely that the Mt Dore Heap Leach Project would have a significant impact on regional populations of P.mimus.**

Even though the above rationale indicates that the lodgement of a referral for *P.mimus* may be unnecessary, an application (Referral of proposed action) has been lodged with the Australian Government Department of Environment.

*Macroderma gigas* (Ghost bat) was also identified as a MNES in the *Environment Protection and Biodiversity Conservation Act 1999* search. CRCM has previously engaged PDG to undertake several ecological studies throughout the region since 2006. One of these conducted in September 2010 specifically targeted habitat for the species. Another survey was undertaken during January and February/March 2011 targeting micro bats and suitable habitat in several mine declines throughout the area. *M. gigas* was not detected during any of the surveys using a combination of methods including echolocation, harp trapping and physical inspection. The species may potentially utilise the site and surrounding locality for foraging purposes as a part of a broader home range, however it has been recognised that this species has undergone a contraction in its range and is now mostly restricted to tropical north Australia (PDG 2010). Based on the above assessments it is expected that no significant impact to the species will occur.

### 5.7 Environmental Offsets

An offset condition may only be imposed on an authority for a significant residual impact on a prescribed environmental matter. They include:
• a MSES listed in schedule 2 of the Environmental Offset Regulation 2014;
• an accredited MNES, should Queensland receive accreditation in relation to environmental offsets for the purpose of the Environment Protection and Biodiversity Conservation Act 1999 (EPBCA); and
• a MLES, as described in section 10(1)(c) of the Environmental Offset Act 2014.

A significant residual impact as defined in the *Environmental Offsets Act (Qld) 2014* is an adverse impact, whether direct or indirect, of a prescribed activity on all or part of a prescribed environmental matter that—

a) remains, or will or is likely to remain, (whether temporarily or permanently) despite on-site mitigation measures for the prescribed activity; and

b) is, or will or is likely to be, significant.

Matters of State Environmental Significance include:

- **Regulated vegetation**
  1. The prescribed regional ecosystems that are endangered regional ecosystems comprise a matter of State environmental significance. **No endangered regional ecosystems under the Vegetation Management Regulation 2012 will be disturbed** (Note ERE 1.3.7 has a biodiversity status of endangered but is not registered under the Vegetation Management Regulation 2012 as endangered).
  2. The prescribed regional ecosystems that are of concern regional ecosystems comprise a matter of State environmental significance. **No of concern regional ecosystems under the Vegetation Management Regulation 2012 will be disturbed.**
  3. A prescribed regional ecosystem is a matter of State environmental significance if it is—
     a) a regional ecosystem that intersects with an area shown as a wetland on the vegetation management wetlands map (to the extent of the intersection); or
     **Not applicable as there are no wetlands within the proposed project area.**
     b) an area of essential habitat on the essential habitat map for an animal that is endangered wildlife or vulnerable wildlife or a plant that is endangered wildlife or vulnerable wildlife. **Specimens of Petrogale purpureicollis were located in rocky habitat at sites 1 and 2 in the Northern waste rock dump footprint during a detection program for Pseudantechinus mimulus by RBC Environmental (Holzheimer, 2016).** It is therefore considered that the ridgeline rocky habitat in this area is an area of essential habitat, although not currently mapped.
  4. A prescribed regional ecosystem is a matter of State environmental significance to the extent the ecosystem is located within a defined distance from the defining banks of a relevant watercourse. **Not applicable no prescribed regional ecosystems identified.**
  5. In this section—
defined distance, for a regional ecosystem, means a distance identified in the environmental offsets policy as the relevant distance from the defining banks of a relevant watercourse.

endangered regional ecosystem means a regional ecosystem declared to be an endangered regional ecosystem under the Vegetation Management Act 1999, section 22LA.

of concern regional ecosystem means a regional ecosystem declared to be an of concern regional ecosystem under the Vegetation Management Act 1999, section 22LB.

relevant watercourse means a watercourse identified on the vegetation management watercourse and drainage feature map.

vegetation management watercourse and drainage feature map see the Vegetation Management Act 1999, section 20AB.

vegetation management wetlands map see the Vegetation Management Act 1999, section 20AA.

- Connectivity areas
  (1) This section applies to a prescribed regional ecosystem—
      (a) to the extent the ecosystem contains remnant vegetation; and
      (b) if the ecosystem contains an area of land that is required for ecosystem functioning (a connectivity area).

      Not applicable no relevant connectivity areas identified.

  (2) The prescribed regional ecosystem is a matter of State environmental significance if the administering agency is satisfied, having had regard to criteria in the environmental offsets policy about connectivity areas, that—
      (a) the connectivity area is of sufficient size or configured in a way that maintains ecosystem functioning; and
      (b) the prescribed regional ecosystem will remain despite a threatening process within the meaning of the Nature Conservation Act 1992.

      Not applicable.

- Wetlands and watercourses
  (1) Each of the following matters is a matter of State environmental significance—
      (a) a wetland—
          (i) in a wetland protection area; or
          (ii) of high ecological significance shown on the Map of referable wetlands;
      (b) a wetland or watercourse in high ecological value waters.

      Not applicable no wetlands or high ecological value waters identified.

  (2) In this section—
      high ecological value waters see the Environmental Protection (Water) Policy 2009, schedule 2.
Map of referable wetlands see the Environmental Protection Regulation 2008, schedule 12, part 2.

watercourse see the Environmental Protection Regulation 2008, schedule 12, part 1, section 8.

wetland means an area shown as a wetland on the Map of referable wetlands.

wetland protection area means an area shown as a wetland protection area on the Map of referable wetlands.

- Designated precinct in a strategic environmental area
  (1) A designated precinct in a strategic environmental area is a matter of State environmental significance.
  Not applicable.
  (2) In this section—
  designated precinct, in a strategic environmental area, see the Regional Planning Interests Regulation 2014, schedule 2, section 15(3).

- Protected wildlife habitat
  (1) An area that is shown as a high risk area on the flora survey trigger map and that contains plants that are endangered wildlife or vulnerable wildlife is a matter of State environmental significance.
  Not applicable no areas identified on the flora survey trigger map.
  (2) An area that is not shown as a high risk area on the flora survey trigger map, to the extent the area contains plants that are endangered wildlife or vulnerable wildlife, is a matter of State environmental significance.
  Not applicable no endangered or vulnerable plants are within the project area.
  (3) A non-juvenile koala habitat tree located in an area shown as bushland habitat, high value rehabilitation habitat or medium value rehabilitation habitat on the map called ‘Map of Assessable Development Area Koala Habitat Values’ that applies under the South East Queensland Koala Conservation State Planning Regulatory Provisions is a matter of State environmental significance.
  Not applicable as proposed project is outside of the koala distribution.
  (4) A habitat for an animal that is endangered wildlife or vulnerable wildlife or a special least concern animal is a matter of State environmental significance.
  Examples of habitat— an area of land used by an animal for foraging, roosting, nesting or breeding.

Echidnas (Tachyglossus aculeatus) occur in the project area and have the widest distribution of any native Australian mammal. It is distributed throughout the Australian mainland, Tasmania and New Guinea, occupying habitats as diverse as wet rainforests, dry deserts and alpine regions (Queensland Museum 2011). Although the species has disappeared from densely settled regions, it is not endangered. The impact of this proposed mining operation on Echidna habitat is not considered significant as the available habitat resources of the species
are extensive in the region, and will not be significantly diminished by the proposed project.

(5) In this section—

**flora survey trigger map** means the map held by the department under the *Nature Conservation (Wildlife Management) Regulation 2006*, section 247.

**koala habitat tree** means a tree of any of the following genera—

(a) *Angophora*;

(b) *Corymbia*;

(c) *Eucalyptus*;

(d) *Lophostemon*;

(e) *Melaleuca*.

**non-juvenile koala habitat tree** means a koala habitat tree that—

(a) is more than 4m high; or

(b) has a trunk with a circumference of more than 31.5cm at 1.3m above the ground.

**South East Queensland Koala Conservation State Planning Regulatory Provisions** means the document called the ‘South East Queensland Koala Conservation State Planning Regulatory Provisions’, dated May 2010 and published on the website of the department in which the *Sustainable Planning Act 2009* is administered.

**special least concern animal** means the following animals that are least concern wildlife under the *Nature Conservation Act 1992*—

(a) a koala (*Phascolarctos cinereus*);

(b) an echidna (*Tachyglossus aculeatus*);

(c) a platypus (*Ornithorhynchus anatinus*).

- **Protected areas**

  A protected area is a matter of State environmental significance.  
  
  **Note**—

  A coordinated conservation area under the *Nature Conservation Act 1992* is excluded by the Act, definition protected area.

  **Not applicable no protected areas are within the project area.**

- **Highly protected zones of State marine parks**

  (1) A highly protected area of a relevant Queensland marine park is a matter of State environmental significance.

  **Not applicable no highly protected zones are within the project area.**

  (2) In this section—

  **highly protected area** means—

  (a) a zone classified, under the *Marine Parks Act 2004*, as a conservation park zone, marine national park zone or preservation zone; or

  (b) another area prescribed under a regulation or zoning plan, under the *Marine Parks Act 2004*, as a highly protected area.

  **relevant Queensland marine park** means any of the following marine parks declared under the *Marine Parks Act 2004*—
(a) the Great Barrier Reef Coast Marine Park;  
(b) the Moreton Bay Marine Park;  
(c) the Great Sandy Marine Park.  

*zone*, for a marine park, see the *Marine Parks Act 2004*, schedule.

- **Fish habitat areas**
  
  An area declared under the *Fisheries Act 1994* to be a fish habitat area is a matter of State environmental significance.

  **Not applicable no fish habitat areas are within the project area.**

- **Waterway providing for fish passage**
  
  (1) Any part of a waterway providing for passage of fish is a matter of State environmental significance only if the construction, installation or modification of waterway barrier works carried out under an authority will limit the passage of fish along the waterway.

  **Not applicable no waterways providing fish passage are within the project area.**

  (2) In this section—
  
  *fish* means fish regulated under the *Fisheries Act 1994*.  
  *passage*, for fish, means the natural movement patterns of fish species required to maintain the biological integrity of the species.  
  *waterway* includes a river, creek, stream, watercourse or inlet of the sea.  
  *waterway barrier works* means a dam, weir or other barrier across a waterway.

- **Marine plants**
  
  A marine plant within the meaning of the *Fisheries Act 1994* is a matter of State environmental significance.

  **Not applicable no marine plants are within the project area.**

- **Legally secured offset areas**
  
  A legally secured offset area is a matter of State environmental significance.

  **Not applicable no legally secured offsets are within the project area.**

One threatened species *Petrogale purpureicollis* has previously been recorded in the region by PDG and is listed as *Vulnerable* under the *Nature Conservation Act (Qld)*. During the 2012 survey PDG did not record *P. purpureicollis* within the proposed disturbance area (PDG 2012), and mapped habitat for the species is located approximately 2km to the south from the proposed disturbance. Specimens of *Petrogale purpureicollis* were however located on camera traps in rocky habitat at sites 1 and 2 in the northern waste rock dump footprint during a detection program for *Pseudantechinus mimulus* by RBC Environmental (Holzheimer, 2016). It is therefore considered that the ridgeline rocky habitat in this area is an area of essential habitat, although not currently mapped. Figure 14 shows the area of
habitat (1.8ha) likely to be impacted by the placement of the northern waste rock dump.

Matters of Local Environmental Significance (MLES) are under the jurisdiction of the Cloncurry Shire Council and searches have not identified any MLES within the proposed disturbance area.
Figure 14 – Locations of *Petrogale purpureicollis* sightings and habitat area
5.8 Exotic and Declared Pests

A total of ten pest species have been identified within the region and include:

- *Camelus dromedarius* (Camel)
- *Cannis familiaris dingo* (Dingo)
- *Equus caballus* (Horse)
- *Felis catus* (Feral cat)
- *Mus musculus* (House mouse)
- *Oryctolagus cuniculus* (Rabbit)
- *Rattus* (Black rat)
- *Rhinella marina* (Cane toad)
- *Sus scrofa* (Feral pig)
- *Vulpes* (Red fox)

Five of these exotic species are Class 2 declared pests under the schedules of the Land Protection (Pest and Stock Route) Management Act 2002. These are *Cannis familiaris dingo* (Dingo), *Felis catus* (Feral cat), *Oryctolagus cuniculus* (Rabbit), *Sus scrofa* (Feral pig) and *Vulpes* (Red fox). Non-declared pest species include *Camelus dromedarius* (Camel), *Equus caballus* (Horse), *Mus musculus* (House mouse), and *Rhinella marina* (Cane toad).

It is intended that CRCM will resume trapping for feral cats when the proposed project becomes operational. A total of ten feral cats were caught between December 2012 and August 2013 in the Mt Dore area during the previous operational period.

5.9 Aquatic Ecology

In 2012 CRCM engaged FRC Environmental to undertake an aquatic ecology assessment of the Mt Dore area. The major waterways in the survey area include Gin Creek and the Mort River, which flow south to the Georgina River, and form part of the Georgina Catchment (part of the Lake Eyre Basin); and Maggies Creek, which flows north to the Cloncurry River, and forms part of the Flinders Catchment.

Thirteen sites were surveyed in the post-wet season from 29 February to 5 March 2012. Two of the sites (sites 2 and 3) are located downstream of the proposed disturbance area. Sites represented a range of aquatic habitats in the area including natural ephemeral watercourses and artificial impoundments such as dams and pits. There are no natural wetlands in the survey area. Aquatic habitat, flora (macrophytes), macroinvertebrates, fish and turtles were surveyed at each site where practical and where habitat allowed.

Aquatic habitat was generally in moderate condition in the survey area, and was lowest in artificial impoundments. While there was grazing and mining activities within the survey area, the riparian vegetation was generally intact. Channel diversity was low at all sites and was generally limited to pool habitat dominated by
overhanging and trailing bank vegetation, woody debris, deep pools, and exposed tree roots.

The results of in-situ water quality sampling from the survey were consistent with those of other recent surveys in the region. Water quality was characterised by high turbidity and low dissolved oxygen; electrical conductivity was high at two sites in the upper Mort River sub-catchment and one site in the upper Gin Creek sub-catchment.

Macroinvertebrate taxonomic richness in the survey area was consistent with previous studies done in the Georgina and Flinders catchments, and was highest at the higher order streams such as the Mort River and Gin Creek. There was a similar trend for sensitive Plecoptera Ephemeroptera Trichoptera (PET) taxa in bed habitat, which were low in diversity (which is to be expected in ephemeral systems).

Macroinvertebrates are monitored annually as part of CRCMs Receiving Environment Monitoring Program (REMP). Results in subsequent surveys have remained generally consistent, despite some variability. Taxonomic richness in onsite water storages is comparable to that of natural waterways in both bed and edge habitat with the variability likely related to environmental conditions (i.e. rainfall) Figures 15 & 16 show results from annual macro-invertebrate surveys from 2012-2016. Any potential impacts from the proposed disturbance should be evident at downstream sites 2 and 3.

![Figure 15 - Total taxonomic richness in bed habitat](image-url)
Fifteen native fish species have been recorded in the Georgina Catchment and 47 species in the Flinders Catchment. However, of the 53 species recorded in the Georgina and Flinders catchments, only four were caught during the survey. This low taxonomic richness is related to the survey area being in the upper reaches of both the Georgina and Flinders catchments. No other aquatic vertebrates such as turtles and freshwater crocodiles were caught or observed during the survey.

Overall, biological values of aquatic ecosystems within the survey area were consistent with those of the wider catchments. The creeks within the survey area provide ‘upstream’ dispersal habitat for the fish species that were recorded in the survey area (and possibly breeding habitat for some species). Therefore, macroinvertebrate and fish communities found within the survey area are likely to contribute to the success of downstream populations through movement / migration. Despite the lower habitat diversity of the dams and pits in the survey area, these permanent waterbodies generally supported relatively similar aquatic macroinvertebrate and fish communities to the natural watercourses (FRC 2012).

No endangered, vulnerable, or near threatened species of aquatic flora or fauna have been recorded from, or are likely to occur in, the waterways of the survey area. Exotic species of aquatic flora and fish are known from the region, but were not recorded during the 2012 survey.

FRC Environmental also undertook a stygofauna assessment for the Cloncurry and Osborne Projects, as well as the Osborne and Burke River borefields during November 2012. Stygofauna were recorded at one of the four bores surveyed within the Mt Dore area. The stygofauna in bore MDWB12 (Mt Dore) were assessed as non-significant stygofauna and likely to be widespread taxa with a relatively low dependency on groundwater and therefore unlikely to be threatened by any current or future development of groundwater (FRC 2013). The aquifer associated with MDWB12 also forms part of a separate groundwater system (Rockwater, 2011) that has demonstrated no apparent impact from the current Mt Dore Aquifer dewatering activities. No stygofauna were recorded in bores MDWB27, MDWB28 and MDWB32 which are located within the Mt Dore Aquifer.
5.10 Cloncurry Project Hydrogeology

Rob Lait & Associates, 2011 has undertaken a regional hydro-geological review previously provided to DEHP with the following commentary.

Several hundred mineral resource exploration holes have been drilled on the Chinova Resources mining leases. Additionally, dedicated vertical groundwater monitoring bores have been constructed for assessing groundwater occurrence and behaviour.

Groundwater may be encountered in leached areas where dissolution of sulphide minerals has imparted a primary porosity to siltstone and shale, and along fractures (bedding planes, joints and faults). This probably accounts for the water that is known to be present in the disused underground workings. In these zones inter-grain pores formed by leaching provide most of the storage capacity and aquifer capacity is directly proportional to the amount of leaching that has occurred.

Shallow, perched aquifers may also occur. The upper 10-30m of the laminated siltstone, shale and phyllite sequences of the Kuridala and Staveley Formations are less resistant to weathering and delaminate due to stress release, thereby developing open bedding plane fissures.

These laminated upper sequences are often in-filled by secondary deposition of minerals (such as calcite) and clay which can be transported or occur by in-situ weathering, by chemical precipitates such as carbonates, iron and aluminium oxides or sulphides. The net effect of infilling is a reduction in porosity and permeability if the rock is saturated.

Notwithstanding that the upper sequences delaminate, their bulk permeability remains low. Because of the low bulk permeability of the laminated upper sequence groundwater storage may be high but groundwater flow is generally low.

Where not in-filled, the laminated upper sequence forms unconfined or semi-confined aquifers.

Many reports have been undertaken identifying potential water resources in the area and also to determine the impact of aquifers on underground mining operations. Summary information is provided in the regional hydro-geological study.

The aquifer types on the Chinova Resources leases are ranked below in order of their hydro-geological significance, from greatest to least:

1. Fractured rock aquifers at the contact between the Mount Dore Granite and the Kuridala and Staveley Formations at Mount Dore borefield;
2. Perched aquifers that may occur in the laminated upper sequence of the Kuridala and Staveley Formations;
3. Aquifers in open fault zones in fractured and brecciated shear zones deep in the Kuridala and Staveley Formations;
4. **Aquifers formed by dissolution of sulphide minerals** in deep calc-silicate rocks in the mineralized zones.

The Merlin deposit is associated with the adjacent Mt Dore aquifer which is a significant localized fractured rock aquifer bounded on the east by the Mt Dore Granite and the west by the Staveley Formation. Water is generally intersected in water bearing fractures at depths of 80 to 120 metres with groundwater occurring along the contact zone with the granites and at greater depth in the calc silicates. This aquifer is disconnected from any other nearby aquifers.

Other more minor, but still significant aquifers, occur along the Burke River 37 kilometres to the west of the Mount Dore camp and at Gin Creek 21 kilometres to the southwest of the Mount Dore camp. Two aquifer types occur at the Burke River, one being in fractured limestone and shale. Small airlift discharges of the order of 0.5L/s were obtained from this aquifer at this locality. Significant groundwater (2.16L/s) was encountered in the Burke River alluvium in Bore WB33. However, since the Burke River alluvium is so far to the west, this information is only useful for comparison purposes and is not directly relevant to the project area. There are no other reports of groundwater in alluvial sequences. This is not unsurprising as the alluvium across the CRCM leases is discontinuous and occurs as isolated pods. Therefore, for the purposes of this report, there is no further discussion of groundwater in alluvium.

Coffey Partners International Pty Ltd (CPI) investigated groundwater at the Starra 251 mine in 1990. In that report they stated that ‘It is apparent that the ore body is the aquifer, as the surrounding meta-sediments of the Staveley Formation are generally tight and contain little or no groundwater. Only very minor seepages have been intersected in the decline which is constructed in the footwall meta-sediments. It would therefore appear that the aquifer (ore body) is an encapsulated ellipsoid which has minimal hydraulic connection to surface or subsurface recharge…

The ore body is vughy and granular with 3 distinct orthogonal joints making it quite blocky. The most permeable zone is the contact with the meta-sediments. The footwall in particular contains both small and large cavities which have been exposed during mining. The degree of jointing is also noticeably higher in the footwall. These characteristics impart a relatively high permeability to the ore body, in contrast to the generally very tight meta-sediments.’

PPK Consultants Pty Ltd undertook pumping tests at Mount Elliot in the northern section of the Chinova Resources leases in 1994. They reported that groundwater storage that occurred in joints and fractures in the country rock at Mount Elliot was limited, that a locally perched water table existed and that there are varying degrees of hydraulic connection between pumping bores and water level monitoring bores. PPK concluded from their pumping tests that there was limited hydraulic connection between the old underground workings and the joints and fractures in the country rock.
5.10.1 Mt Dore Aquifer

Rockwater Pty Ltd were engaged in 2010 to undertake detailed assessments of the Mt Dore Aquifer in relation to the predicted dewatering requirements for the Merlin underground mine, which underlies the proposed Mt Dore Copper Oxide deposit. The final Rockwater report (2011) is included in Appendix B and summarised below.

The Mount Dore Aquifer is hosted within the Kuridala Formation, shown diagrammatically in cross section (Figure 17), and in plan (Figure 18). The stratigraphic sequence of the Mount Dore area is detailed in section 3.3.1 of this report.

![Schematic cross section Mt Dore Aquifer](image)

Figure 17 - Schematic cross section Mt Dore Aquifer

The basal unit of the Kuridala Formation is referred to locally as the “footwall quartzite” and represents the most permeable unit. The footwall quartzite forms a prominent ridge extending up to 5 km north and 3 km south of the Merlin deposit. The footwall quartzite is interpreted as a silica-altered calcareous sedimentary rock. Silica alteration is prevalent within the Kuridala Formation, resulting in rocks that have fractured in a brittle manner under deformation. Quartzite and silicified rocks within the Kuridala Formation, when fractured, form localised highly permeable zones within the aquifer. The Mount Dore Granite overlies the Kuridala Formation, and there is a polymictic fault breccia several metres thick in some areas along the contact. The breccia has been re-opened by later stage faulting in some areas producing a discontinuous permeable horizon near the contact.

The Mount Dore aquifer is a tabular body striking north and dipping between 45° and 70° to the east. It is bound to the west by the Staveley Formation (aquiclude) and to the east by the Mount Dore Granite. The basal unit of the aquifer is the footwall quartzite (Figures 17 and 18), which is highly permeable near the dewatering...
borefield and reduces in permeability to the north. The Merlin decline is being developed in the Staveley Formation beneath the footwall quartzite and has encountered very low groundwater inflows.

The granite contact is a thrust fault for most of its length with fractured and brecciated zones along strike. The contact is curvi-planar and extends north beyond bore MDWB15 and south beyond 7603000mN. The granite has an extensive surface area and numerous lineaments delineated from satellite images. If the lineaments represent open joints or fractures there could be groundwater flow from them to the aquifer. The granite contact has been assigned as a leaky boundary.
The northern extent of the Mount Dore aquifer is inferred to be at 7606000mN (Fig. 19), 250 metres north of bore MDWB31, based on an observed reduction in fracture density from core logging, and low estimates of hydraulic conductivity. The footwall quartzite is fractured and more permeable than the Kuridala Formation to about 7606400mN. The southern extent of the aquifer is poorly defined due to lack of drilling, although there is significant fracturing (possibly E–W faulting) at 7603700mN. The southern boundary has been arbitrarily assigned at 7603300mN (Fig. 19). The depth of the aquifer base varies from about 100 metres to 500 metres, averaging about 250 metres, depending on the depth of faults and fractured rock units.

Two 48-hour constant-rate pumping tests were performed on bores MDWB29 and MDWB30 in April and May 2011. The bores were pumped consecutively at constant rates of 1,374 m$^3$/day and 1,436 m$^3$/day, respectively. Analysis of pumping test data from bores MDWB29 and MDWB 30 determined storativity values ranging from 0.00000033 to 0.0034, which are typical of confined aquifers.

Hydrographs commonly show no response to rainfall which might suggest that there is no recharge. Alternatively, no response to rainfall could mean that the frequency of groundwater level readings was insufficient and any rise and fall in groundwater levels occurred between readings. This could certainly be the case for the 2009 and 2010 wet seasons, and less so for the 2008 wet season. Historic data show that the aquifer was dewatered to about 210 m AHD in the late 1980’s and had recharged again by 1997. It is considered that recharge occurs at low rates via the fractured granite and where the footwall quartzite and fractured zones within the Kuridala Formation, crop out in tributaries of Camp Creek.

Discharge from the aquifer is expected to occur in the southern part of the area but the mechanism is not understood. There are insufficient bores and drill core south of the Turkeys Nest to determine the aquifer geometry in detail, but it is assumed that discharge occurs via faults crossing the narrow extension of the Mount Dore Granite, near Camp Creek.

Mackie Martin and Associates (1987) show the hydraulic gradient is downwards to the south east, following the flow of Camp Creek and its tributaries. Camp Creek passes through the valley between the granite and the quartzite ridge and joins with another tributary which drains an area west of the quartzite ridge, and then turns toward the east near the camp toward the airstrip (Figure 18). The flow of Camp Creek, south of the Turkey’s Nest, is interpreted to be strongly controlled by faults and lithological contacts as shown in Figure 18. Low discharge rates have been assigned to match inflows from the North.

Pumping at the site has lowered groundwater levels since the 1980’s, when monitoring commenced, therefore pre-pumping test groundwater levels and hydraulic gradients cannot be determined accurately. Mackie Martin and Associates (1987) recorded groundwater levels in excess of 325 m AHD, but the source of these data is not reported. Other site data from the 1980’s reflect groundwater levels
similar to present levels (for those bores close to the Turkey’s Nest and the production bores). Unrecorded pumping was occurring before 1984. The pre-pumping test groundwater levels of around 309 m AHD, from August 2010 show a gently sloping water level gradient toward the south. The gradient may still have been affected by pumping from the camp borefield (at the Turkey’s Nest), which has been almost continuous since about 2002. The levels were adopted as starting levels for the numerical model.

The groundwater levels at bore MDWB12 are several metres above those of the Mount Dore Aquifer, and are therefore assumed to be within another groundwater system, either hosted in the granite or in metasediments east of the granite.

Previous aquifer depletion from the 1980’s reduced the standing water level from around a reported 325m AHD to 210m AHD with recharge to around 309m AHD by 2010. In general the Mt Dore aquifer shows storativity values consistent with a confined aquifer, although slow recharge has been demonstrated from the initial significant dewatering episode (1980’s) and low levels of aquifer discharge potentially occur to the south of the assumed aquifer. Three bores (MDWB4, 5 & 27) showed relatively consistent standing water levels of around 307m AHD (40-50m below surface) in 2010 before the second major phase of dewatering commenced for the Merlin development. The water level measured in MDWB27 in October 2015 was equivalent to 193.58m AHD or 171.88m below surface.

There are no recorded surface springs or soaks in the area that would identify any aquifer discharge to surface waters. MDWB12 just to the south of the assumed Mt Dore Aquifer boundary has been unaffected by the Merlin dewatering with a standing water level of 325.44m AHD (approximately 14 m below surface) being effectively maintained during the second major phase of dewatering. This provides evidence that the drawdown effect is limited in extent and not impacting on bores beyond the limits of the aquifer. Rob Lait in the Report on Merlin Dewatering Licence, 2015 also indicates there have been no ‘wholesale changes groundwater quality within (or outside of) the Merlin Bore-field during the review period (2010-2015).’

5.11 Regional Water Quality

The Cloncurry Project area is highly mineralised and has been explored extensively since the 1970’s. Mining occurred at Mt Elliott in the early 1900’s after discovery of the surface mineralised gossan in the late 1880’s by James Elliott. The extensive mineralisation has an apparent effect on surface and groundwater chemistry, evident when reviewing historical data.

Figures 19-21 show the copper, lead and zinc geochemistry of surface soil and stream sediment pre-1987 for the Mt Dore area. Significant copper, lead and zinc elevations show along the mineralised north south trends associated with prospects that have been mined under the authority of the current mining leases since 1987. No significant mining activity occurred along the Starra or Merlin trends prior to 1987. No recent mining has occurred at Mt Dore although there is evidence of
limited ‘potholing’ for copper from historic activities. It is expected that the outcropping mineralisation will contribute naturally to elevations in total metals in receiving water and stream sediment.

Figure 19 – Mt Dore Soil and Stream Sediment Copper
Figure 20 – Mt Dore Soil and Stream Sediment Lead
Figure 21 – Mt Dore Soil and Stream Sediment Zinc
5.11.1 Surface Water Quality

Almost all the receiving sites are located within first to third order streams which are typically characterised by short duration, highly erosive flows which also contribute to an elevated particulate load in the receiving waters. Surface water flows in the receiving environment are typically the result of isolated rainfall events (storms) that occur during the brief wet season December to February each year. The surface water quality results appear to vary dependent on the intensity and location of storms within a particular catchment.

The immediate catchments associated with the Cloncurry Project are generally highly mineralised and it is expected that local biota will have adapted to these conditions. Historic mining operations at Mt Elliott and Mt Cobalt are likely to have resulted in increased metal loads in surface soils and sediments in the surrounding areas. However in the absence of any pre-mining water quality data this cannot be fully quantified. Surface water sampling was initially undertaken in 1985 and 1986 and reported in the Selwyn Project Environmental Impact Assessment Study (EIAS 1987), prior to the mining operation commencing. This sampling provides a useful insight into surface water quality prior to any significant disturbance. Table 5 below provides a summary of those results.

The reported surface water sampling from the Starra line drainage indicates a slightly acidic pH with significantly elevated cadmium, copper, iron, lead and zinc in surface waters. The Starra line had outcropping ore grade material which contributes to a naturally elevated metal level in stream and soil sediments. These elevations are also represented in pre-mining surface water quality is also supported by recent background water monitoring sites in the existing environmental authority (see Table 6). Monitoring data collected until March 2016 supports the original water quality data showing significant elevations of total arsenic, cadmium, chromium, copper, iron, lead, manganese and nickel. The results clearly indicate mobility of some total metals (As, Cu & Pb) in excess of the results from water sampling in 1985 and 1986. RSS 24 is located in Camp Creek immediately downstream of the proposed Mt Dore operation and exhibits near neutral pH, low salinity and elevated copper levels. These results are an indication of the highly variable background water quality dependent on the location and intensity of any particular storm event. Highly turbid events generally give higher total and ‘dissolved’ metal levels. It must also be recognised that the use of 0.45µm filtration is an imperfect mechanism for determining the boundary between total and dissolved metals. Higher levels of suspended solids or turbiditoy often results in an increase in the apparent ‘dissolved’ metal levels.

A literature search indicates that research undertaken by Ran et al (2000) in the Namoi River identified fine (0.2-0.006µm) and ultrafine (0.006-0.00µm) colloidal material as contributing to the suspended particle material in that environment, with the peak maximum for the particle size at around 0.14µm. The results also indicated a peak copper level in the 0.003-0.006µm fraction with a noted progressive enrichment of Mg, Ca, Na, Cu and Zn with decreasing particle size. The research
concluded that the colloidal Cu and Zn (total) concentrations in rivers may be much higher than previously considered.
### Table 5 – EIAS Surface Water Quality

<table>
<thead>
<tr>
<th>Site</th>
<th>pH</th>
<th>EC (µS/cm)</th>
<th>As (mg/L)</th>
<th>Cd (mg/L)</th>
<th>Cu (mg/L)</th>
<th>Fe (mg/L)</th>
<th>Pb (mg/L)</th>
<th>Zn (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>6.7</td>
<td>84</td>
<td>&lt;0.01</td>
<td>0.018</td>
<td>0.46</td>
<td>30.1</td>
<td>0.17</td>
<td>0.58</td>
</tr>
<tr>
<td>5</td>
<td>6.1</td>
<td>32</td>
<td>&lt;0.01</td>
<td>0.013</td>
<td>0.46</td>
<td>29.3</td>
<td>0.13</td>
<td>0.37</td>
</tr>
<tr>
<td>6</td>
<td>5.8</td>
<td>78</td>
<td>&lt;0.01</td>
<td>&lt;0.004</td>
<td>0.18</td>
<td>2.89</td>
<td>0.14</td>
<td>0.16</td>
</tr>
<tr>
<td>7</td>
<td>6.2</td>
<td>63</td>
<td>&lt;0.01</td>
<td>0.032</td>
<td>2.54</td>
<td>31.8</td>
<td>0.3</td>
<td>0.65</td>
</tr>
</tbody>
</table>

1. Site 4 – was located downstream of the Starra 222 mine and is coincident with a downstream monitoring point 4a in the current EA.
2. Site 5 – was taken from downstream of the Starra 257 pit and upstream from the mill site.
3. Site 6 – coincides with the mill site.
4. Site 7 – coincides with Wychee Dam.

### Table 6 – Mineralised Background Water Quality (total metals data range)

<table>
<thead>
<tr>
<th>Site</th>
<th>pH</th>
<th>EC (µS/cm)</th>
<th>TSS (mg/L)</th>
<th>As (mg/L)</th>
<th>Cd (mg/L)</th>
<th>Cu (mg/L)</th>
<th>Fe (mg/L)</th>
<th>Pb (mg/L)</th>
<th>Zn (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackback</td>
<td>5.7 - 7.0</td>
<td>18.4 - 109.2</td>
<td>50 - 1,512</td>
<td>0.001 - 0.133</td>
<td>0.0001 - 0.0017</td>
<td>0.016 - 3.600</td>
<td>0.18 - 53.00</td>
<td>0.001 - 0.110</td>
<td>0.019 - 0.140</td>
</tr>
<tr>
<td>Central</td>
<td>5.5 - 8.9</td>
<td>35.6 - 228.4</td>
<td>550 - 59,000</td>
<td>0.001 - 0.070</td>
<td>0.0001 - 0.0020</td>
<td>0.040 - 10.000</td>
<td>0.66 - 140.00</td>
<td>0.002 - 0.380</td>
<td>0.024 - 0.390</td>
</tr>
<tr>
<td>RSS24</td>
<td>6.02 - 6.81</td>
<td>17 - 160</td>
<td>370 - 3,000</td>
<td>0.003 - 0.008</td>
<td>0.0001 - 0.0005</td>
<td>0.056 - 1.1</td>
<td>3.1 - 23</td>
<td>0.005 - 0.046</td>
<td>0.042 - 0.18</td>
</tr>
</tbody>
</table>

Sulphate results were not significant.
5.11.2 Stream Sediment Quality

Stream sediment sampling was undertaken in March 2016 from reference sites Blackback, Central and Amethyst as well as from RSS24 (downstream of the proposed Mt Dore Project) with the results presented in Table 6.

<table>
<thead>
<tr>
<th>Sample</th>
<th>As</th>
<th>Co</th>
<th>Fe</th>
<th>Mn</th>
<th>Mo</th>
<th>Cr</th>
<th>Cu</th>
<th>Pb</th>
<th>Ni</th>
<th>Zn</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackback</td>
<td>3.0</td>
<td>8.1</td>
<td>9600</td>
<td>300</td>
<td>1.2</td>
<td>5.6</td>
<td>77</td>
<td>6.9</td>
<td>4.3</td>
<td>13.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Amethyst</td>
<td>3.4</td>
<td>9.6</td>
<td>15000</td>
<td>210</td>
<td>&lt;0.5</td>
<td>20.0</td>
<td>170</td>
<td>4.7</td>
<td>11.0</td>
<td>9.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Central</td>
<td>2.4</td>
<td>39.0</td>
<td>43000</td>
<td>1300</td>
<td>0.6</td>
<td>38.0</td>
<td>160</td>
<td>29.0</td>
<td>14.0</td>
<td>16.0</td>
<td>6.2</td>
</tr>
<tr>
<td>RSS24</td>
<td>2.8</td>
<td>15</td>
<td>8500</td>
<td>810</td>
<td>1.3</td>
<td>6.5</td>
<td>49</td>
<td>6.6</td>
<td>5.3</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>ISQG</td>
<td>20</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>80.0</td>
<td>65</td>
<td>50.0</td>
<td>21.0</td>
<td>200</td>
<td>NA</td>
</tr>
</tbody>
</table>

Total metals in mg/kg

ISQG = ANZECC 2000 Interim Sediment Quality Guideline trigger values

The results indicate elevations of copper at Central and Amethyst and to a lesser extent at Blackback in relation to the ANZECC 2000 Interim Sediment Quality Guideline trigger values. Elevated levels of and iron and manganese also occur throughout the region and cobalt and lead concentrations at reference site Central are also elevated. The sediment results downstream of Mt Dore in March 2016 are within the guideline triggers.

5.11.3 Ground Water Quality

Ground-waters in the region are highly variable and frequently have high levels of metals and sulphate present. Most sites have a high level of reported hardness >181 mg/L as CaCO3. Electrical conductivity and total dissolved solids are also frequently elevated, although this is not atypical for the region. Regionally, monitoring programs have identified the presence of heavy metals, iron, manganese, chloride and fluoride which also has the potential to influence the quality of groundwater within the Chinova leases. Apart from the Mt Dore Aquifer overlying the Merlin deposit, no significant groundwater resources are located within the near vicinity of any of the operational areas. Care however, must be taken to ensure potentially contaminated groundwater does not migrate from the existing facilities or report to surface water.

Mineral content can vary significantly over short distances with concentration of elements expected to vary depending on rock type, alteration and variations in degree and type of mineralisation. The Osborne – Lucky Luke – Mt Elliott sites are located within and along the boundary between the adjoining Kuridala-Selwyn and Marimo Staveley Proterozoic Geological Domains covering an area of ~350kilometres north-south and ~100 kilometres east-west. The southern (including Osborne) and eastern parts of the domain are covered by younger sedimentary rocks (Mesozoic). See Figure 23.
Figure 22 – Project Geological Domains
Within these geological domains Chinova has established several background reference sites including Brolga (non-mineralised) in the south, LLMB1 (mineralised), Mort River (non-mineralised), MDWB10 and MDWB12 (Mt Dore) in the central area and at Mt Elliott MERB1 (mineralised) in the north to characterise the background water quality in both mineralised and non-mineralised areas. MDWB 27 range is included to provide an indication of the Mt Dore Aquifer water quality which has remained relatively stable during the most recent dewatering period (2010 – to date).

It should be noted that only dissolved metal results have been included in Table 8 as it is reasonably considered that this is the parameter of concern in relation to soluble elements moving within the groundwater system. Total metal results vary dependent on the bore water level and associated turbidity. As particulate metals will be confined to the bore casing, it is not considered useful to have trigger and limit values applied to total metals.

This water data demonstrates the high natural variability in salinity, pH and dissolved metal content which is characteristic of the limited poor quality groundwater that exists within the region. The dissolved metals are typically at levels which exceed the default trigger and limit values. The Mt Dore Aquifer (MDWB27) has water with relatively low salinity, neutral pH with elevations of arsenic, copper and molybdenum. Uranium marginally exceeds the default limit value. The current EA requires the percentile value or default value whichever is lower for groundwater compliance. Clearly this is not achievable even for the natural systems and using site specific triggers calculated from the regional reference bores is more relevant.
### Table 7 - Reference site ground water results

<table>
<thead>
<tr>
<th>Site</th>
<th>pH range</th>
<th>EC (µS/cm)</th>
<th>SO₄ (mg/L)</th>
<th>As (mg/L)</th>
<th>Cd (mg/L)</th>
<th>Cu (mg/L)</th>
<th>Cr (mg/L)</th>
<th>Fe (mg/L)</th>
<th>Pb (mg/L)</th>
<th>Mn (mg/L)</th>
<th>Mo (mg/L)</th>
<th>Ni (mg/L)</th>
<th>U (mg/L)</th>
<th>Zn (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERB1 80th percentile</td>
<td>6.01</td>
<td>9870</td>
<td>4700</td>
<td>0.009</td>
<td>0.0005</td>
<td>0.003</td>
<td>0.0322</td>
<td>3.9</td>
<td>0.004</td>
<td>12.00</td>
<td>0.009</td>
<td>0.058</td>
<td>0.44</td>
<td>0.078</td>
</tr>
<tr>
<td>MERB1 95th percentile</td>
<td>6.88</td>
<td>10486</td>
<td>5280</td>
<td>0.015</td>
<td>0.0008</td>
<td>0.010</td>
<td>0.5983</td>
<td>93.0</td>
<td>0.010</td>
<td>14.00</td>
<td>0.010</td>
<td>0.160</td>
<td>0.49</td>
<td>0.835</td>
</tr>
<tr>
<td>LLMB1 80th percentile</td>
<td>4.46</td>
<td>15234</td>
<td>2200</td>
<td>0.015</td>
<td>0.0010</td>
<td>0.005</td>
<td>0.0134</td>
<td>0.1</td>
<td>0.005</td>
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<td>0.025</td>
<td>0.005</td>
<td>0.12</td>
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<tr>
<td>LLMB1 95th percentile</td>
<td>7.49</td>
<td>15730</td>
<td>2300</td>
<td>0.015</td>
<td>0.0017</td>
<td>0.009</td>
<td>0.0413</td>
<td>2.4</td>
<td>0.010</td>
<td>0.53</td>
<td>0.030</td>
<td>0.010</td>
<td>0.14</td>
<td>0.353</td>
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<tr>
<td>Brolga 80th percentile</td>
<td>5.30</td>
<td>24202</td>
<td>1840</td>
<td>0.030</td>
<td>0.0011</td>
<td>0.010</td>
<td>0.0342</td>
<td>0.1</td>
<td>0.010</td>
<td>0.12</td>
<td>0.010</td>
<td>0.010</td>
<td>0.01</td>
<td>0.092</td>
</tr>
<tr>
<td>Brolga 95th percentile</td>
<td>8.50</td>
<td>26120</td>
<td>2119</td>
<td>0.033</td>
<td>0.0030</td>
<td>0.017</td>
<td>0.3112</td>
<td>9.3</td>
<td>0.030</td>
<td>0.40</td>
<td>0.011</td>
<td>0.017</td>
<td>NA</td>
<td>1.334</td>
</tr>
<tr>
<td>MDWB10 80th percentile</td>
<td>5.44</td>
<td>891</td>
<td>120</td>
<td>0.039</td>
<td>0.0002</td>
<td>0.001</td>
<td>0.0070</td>
<td>0.8</td>
<td>0.001</td>
<td>0.39</td>
<td>0.022</td>
<td>0.005</td>
<td>0.01</td>
<td>0.270</td>
</tr>
<tr>
<td>MDWB10 95th percentile</td>
<td>7.80</td>
<td>945</td>
<td>139</td>
<td>0.108</td>
<td>0.0008</td>
<td>0.001</td>
<td>0.0892</td>
<td>3.2</td>
<td>0.123</td>
<td>0.72</td>
<td>NA</td>
<td>0.022</td>
<td>0.03</td>
<td>NA</td>
</tr>
<tr>
<td>MDWB12 80th percentile</td>
<td>6.02</td>
<td>3876</td>
<td>1300</td>
<td>0.003</td>
<td>0.0002</td>
<td>0.001</td>
<td>0.0034</td>
<td>0.4</td>
<td>0.001</td>
<td>0.44</td>
<td>0.014</td>
<td>0.001</td>
<td>0.12</td>
<td>0.028</td>
</tr>
<tr>
<td>MDWB12 95th percentile</td>
<td>7.31</td>
<td>4364</td>
<td>1395</td>
<td>0.004</td>
<td>0.0003</td>
<td>0.001</td>
<td>0.0120</td>
<td>4.3</td>
<td>0.004</td>
<td>0.50</td>
<td>0.018</td>
<td>0.002</td>
<td>0.13</td>
<td>0.047</td>
</tr>
<tr>
<td>MDWB27 Range</td>
<td>5.48 – 7.24</td>
<td>1191 – 1326</td>
<td>216-290</td>
<td>0.005 – 0.059</td>
<td>0.0004 – 0.002</td>
<td>0.001</td>
<td>0.0042 – 0.34</td>
<td>0.005 – 0.05</td>
<td>0.001 – 0.008</td>
<td>0.002 – 0.063</td>
<td>0.11 – 0.3</td>
<td>0.001 – 0.003</td>
<td>0.0005 – 0.23</td>
<td>0.063 – 0.42</td>
</tr>
<tr>
<td>Trigger value</td>
<td>6.0-7.5</td>
<td>435</td>
<td>-</td>
<td>0.013</td>
<td>0.0002</td>
<td>0.001</td>
<td>0.0014</td>
<td>-</td>
<td>0.0034</td>
<td>1.9</td>
<td>-</td>
<td>0.011</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Limit</td>
<td>6.0-8.5</td>
<td>1000</td>
<td>1000*</td>
<td>0.5</td>
<td>0.01</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>0.01</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.2</td>
<td>-</td>
</tr>
</tbody>
</table>

NA insufficient data
5.12 Noise, Dust and Vibration

The magnitude of the potential impact on the existing acoustic, air quality and vibration values of the Cloncurry Project and nearest sensitive receptors is not considered to be significant. CRCM is the land owner of the pastoral lease (Starcross) on which all mining operations will occur. The proposed access route to Osborne is remote from the nearest residence (Chatsworth Station) by a distance of approximately 37 kilometres.

Vibration monitoring in relation to operations at Mt Elliott Heritage Site has been an issue during past operations with monitoring of underground blasts required to meet relevant criteria to reduce the potential impact on the structures. As no mining operations are proposed at Mt Elliott in this plan no impacts will occur.

5.13 Cultural Heritage

5.13.1 European Cultural Heritage

The proposed development activities do not conflict with any known European Cultural Heritage sites, although there are many such identified sites in the surrounding area. Sites on project mining leases include Mt Elliott Mining and Smelting Complex and the Mt Cobalt Mining Complex.

Rehabilitation activities undertaken at Mt Elliott are located outside of the Heritage Site in areas disturbed by the mining activity that commenced in 1994. No activity is proposed at the Mt Cobalt site.

5.13.2 Aboriginal Cultural Heritage

The Yulluna People are the Native Title Claimants for the total area of CRCM mining leases. CRCM has negotiated a Cultural Heritage Management Agreement which was signed off by the Yulluna People in January 2011. This agreement manages the process of cultural heritage surveys and the associated finds, in relation to proposed mining or exploration activity.

CRCM maintains processes for recording and managing cultural heritage finds and sites including a Permit to Disturb Land process and an associated Mapinfo database. The Mapinfo database includes known and registered sites and is updated constantly in relation to completed cultural heritage surveys.

Aboriginal Cultural Heritage abounds in the area including artefacts, knapping areas, quarries, ceremonial sites, grave sites and art sites. CRCM’s policy is to avoid disturbance of Aboriginal Cultural Heritage sites where possible and to consult with the Yulluna People at every step in the cultural heritage management process.
6 RISK ASSESSMENT

A risk assessment of all proposed mining activities and legacy sites in accordance with Environmental Authority (EA) condition A16 was conducted by CRCM staff and provided to DEHP staff for input on the 29th January 2011. This risk assessment was updated on the 13th June 2016 to include the additional Heap Leach Project elements. The full risk assessment is attached as Appendix 2. The Risk Assessment has been integrated into this document to identify management priorities for both proposed operational sites. All proposed operational activities rated as having an elevated risk (M12 or higher) after current controls in accordance with the Risk Assessment are listed in Table 8.

<table>
<thead>
<tr>
<th>Site</th>
<th>Hazard</th>
<th>Unwanted Event</th>
<th>High Risk Rating (No Controls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open pits</td>
<td>Impacts to groundwater</td>
<td>Contamination of groundwater</td>
<td>H8</td>
</tr>
<tr>
<td>Waste Rock Disposal</td>
<td>Acid mine drainage</td>
<td>Contamination of surface or groundwater</td>
<td>H5</td>
</tr>
<tr>
<td>Ore stockpiling/crushing</td>
<td>Acid mine drainage</td>
<td>Contamination of surface or groundwater</td>
<td>H5</td>
</tr>
<tr>
<td></td>
<td>Mineralised dust</td>
<td>Contamination of soils</td>
<td>M12</td>
</tr>
<tr>
<td>Ponds and pipelines</td>
<td>Pipeline failure</td>
<td>Contamination of surface or groundwater</td>
<td>H5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contamination of soils</td>
<td>H8</td>
</tr>
<tr>
<td>Failure to contain</td>
<td></td>
<td>Contamination of surface or groundwater</td>
<td>M9</td>
</tr>
<tr>
<td>Heap Leach Pad</td>
<td>Failure to contain</td>
<td>Contamination of surface or groundwater</td>
<td>H5</td>
</tr>
</tbody>
</table>

7 LIKELY IMPACT OF THE PROPOSED ACTIVITIES

The information requirements for an EA amendment application must be in accordance with Section 226 of the EP Act and:

Include an assessment of the likely impact of the proposed amendment on the environmental values, including—
(i) a description of the environmental values likely to be affected by the proposed amendment;
(ii) details of any emissions or releases likely to be generated by the proposed amendment;
(iii) a description of the risk and likely magnitude of impacts on the environmental values;
(iv) details of the management practices proposed to be implemented to prevent or minimise adverse impacts;
(v) details of how the land the subject of the application will be rehabilitated after each relevant activity ceases; and
(l) include a description of the proposed measures for minimising and managing waste generated by any amendments to the relevant activity.

The following section will describe each element of the proposed disturbance in relation to the above requirements.
Figure 23 – Mt Dore Heap Leach Project Disturbance
Table 9 – Proposed disturbance areas

<table>
<thead>
<tr>
<th>Disturbance</th>
<th>Area (ha)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Pit</td>
<td>8.3</td>
<td></td>
</tr>
<tr>
<td>South Pit</td>
<td>19.7</td>
<td></td>
</tr>
<tr>
<td>North Waste Rock Dump</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>West Waste Rock Dump</td>
<td>13.9</td>
<td></td>
</tr>
<tr>
<td>South Waste Rock Dump</td>
<td>18.2</td>
<td></td>
</tr>
<tr>
<td>Heap Leach Pad</td>
<td>28.6</td>
<td></td>
</tr>
<tr>
<td>Process Plant</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Process Ponds</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td>ROM / Agglomerator /Crusher</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td>ROM Dam</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dams</td>
<td>2.6</td>
<td>For waste rock dumps</td>
</tr>
<tr>
<td>Equipment Parking</td>
<td>4</td>
<td>Waste rock fill - Goline</td>
</tr>
<tr>
<td>Haul Roads</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Laydown</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>ROM / Process/ Heap Leach Surrounded</td>
<td>14.4</td>
<td>General fill placement</td>
</tr>
<tr>
<td>TOTAL</td>
<td>168.4</td>
<td></td>
</tr>
</tbody>
</table>

7.1 Mt Dore Open Pits and Waste Rock Dumps

7.1.1 Proposed Activities

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;
- 3 non-acid forming (NAF) waste rock dumps
  - North – 3,730,224 bcm
  - West – 1,778,403 bcm
  - South – 2,561,406 bcm
- 8.5 Mt of copper ore at 0.85% Cu
- 15,375m³ of PAF (>0.5% S)

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 South Pit also has significant potential for expansion to extract further heap leachable copper resources. Any identified PAF material will be disposed into the existing Starra 257 open pit.

A detailed waste characterisation study was completed by RGS (2013) including the assessment of 433 samples from 55 drill-holes. It should be noted that this study
was completed on a much larger proposed mining operation at that time, which included the development of 32Mt of ore and 198Mt of waste rock. The assessment is still however relevant to the much smaller scale operation proposed in this amendment application. The shallower depth of this proposed operation will result in a significant reduction in the percentage and actual volume of proposed PAF material as well as less interaction with the underlying molybdenum/rhenium and polymetallic zones.

The following is a summary of the RGS main findings:

- **Most of the ore and waste rock materials are likely to be Non-Acid Forming (NAF) and have a low risk of acid generation.** A relatively small amount of identified Potentially Acid Forming (PAF) waste rock materials (0.7 % or 1.4 Mt out of a total of 198 Mt) is closely associated with the mineralised ore zones at the Project.

- **Initial and ongoing surface runoff and seepage from most ore and waste rock materials will be pH neutral to slightly alkaline and have a low level of salinity.**

- **Most total metal/metalloid concentrations in ore are low and below applied NEPC background soil concentrations (NEPC, 1999A), except for cobalt, copper and arsenic.** All metal concentrations in waste rock are within applied NEPC HIL(E) guideline criteria for soils apart for copper in some black shale and calcareous silicate. Hence, it may be advisable to avoid placement of these rock types as cover materials for waste rock storage areas.

- **Some of the ore and waste rock materials are enriched with a number of metal/metalloids compared to median crustal abundance.** However, most of these metals/metalloids are sparingly soluble at the neutral to alkaline pH of leachate from these materials.

- **NAF waste rock materials should be amenable to revegetation as part of rehabilitation activities, although some fertilizer addition may be required to establish and sustain vegetation.**

- **Dissolved metal concentrations in surface runoff and leachate from most mine materials are typically low and should not impact upon the quality of surface and groundwater resources at relevant storage facilities.** Minor exceptions include molybdenum and selenium;

- **Long term exposure of any PAF waste rock materials could lead to acid generation over time and increase the dissolution rate of metals/metalloids into surface runoff and seepage.**

RGS made the following recommendations:

- **CRCM geologists use opportunistic visual assessment for the presence of pyrite and progressive characterisation to identify any potential waste rock material with elevated sulphur content (> 0.5 %) as a practical method to delineate the location any PAF waste rock materials;**
• Identified PAF waste rock materials be selectively handled and undergo in-pit disposal, either to another part of the active open pit, or as a component of backfill for an existing open pit void with a low risk of hydraulic connectivity and potential impact to groundwater resources;

• Operational sampling and geochemical testing waste rock materials should also be used from time to time to verify the veracity of the recommended waste rock management strategy;

• CRCM investigate the potential beneficial re-use of NAF waste rock material at the site;

• Any PAF ore should be managed at the ROM pad by limiting the length of time that it is exposed to oxidising conditions and by controlling and monitoring surface runoff and seepage from any stockpiled ore materials;

• CRCM monitors pH and EC in surface water and seepage downstream of the ROM pad and waste rock dump areas indicated to contain some PAF materials. Should the monitored pH drop below 6.5 and/or the EC increase by more than 100%, a wider range of water quality parameters should be tested including acidity, alkalinity, major soluble cations and anions, and the range of dissolved metals/metalloids described in Table B5 of this report;

• Rehabilitation field trials be completed when the mine is operational and bulk waste rock materials become available; and

• Representative samples of spent heap leach residue be subjected to geochemical tests when these become available.

An assessment of the proposed open pits in relation to the Chinova Block Model provides the following expected volumes of material:

**North Pit**
- 754,375m$^3$ of granite waste rock
- 2,415,500 m$^3$ of phyllite waste rock
- No calc-silicate or black shale
- 7,500m$^3$ of PAF (>0.5% S)
- 482,422m$^3$ of ore
- 59,000m$^3$ of PAF ore (>0.5%S)

**South Pit**
- 5,865,250m$^3$ of granite
- 8,375m$^3$ of calc-silicate
- 337,625m$^3$ of black shale
- 182,500m$^3$ of quartzite
- 6,389,875 m$^3$ of phyllite
- 7,875m$^3$ of PAF (>0.5% S)
- 2,890,313m$^3$ of ore
- 118,500m$^3$ of PAF ore (>0.5%S)
RGS 2013 reported 18 of the 68 composite waste rock samples had copper levels >2000mg/kg. 16 of these samples were located within the black shale and calc-silicate lithologies. These samples showed no enrichment for copper in water extracts or kinetic leach columns, indicating the copper mineralogy is stable. Kinetic leaching of waste rock was also reported with slight elevations of molybdenum in one black shale sample and selenium in two black shale and one granite sample.

It is considered prudent to ensure that any black shale and calc-silicate exposures in waste rock dumps are covered with a minimum of 0.5 metres of non-mineralised material (granite, quartzite or phyllite). Downstream environmental dams will be monitored for a suite of metals including molybdenum and selenium.

Rob Lait, 2016 has undertaken a hydrological assessment of the North Pit to provide an indication of the potential for catchment management to avoid pit discharge to surface waters. It should be noted that the South Pit does not have any significant reporting catchment that requires management. The report indicates the following:
- with all catchment diverted, the north pit will not overflow despite experiencing five 1:200 year events during filling;
- under all scenarios the pit water level will be higher than the surrounding groundwater turning the pit into a source; and
- that the catchment into the pit can be managed to improve contained water quality.

**Mining Fleet:**
A list of mining machinery and supporting equipment proposed to be used at the Mt Dore Project includes 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

**Consumable Use:**
Table 10 summarises the consumables use expected in relation to the proposed open cut mining operation.
Table 10 – Mining Consumables

<table>
<thead>
<tr>
<th>Operations Area</th>
<th>Type of Consumable</th>
<th>Average Annual Use</th>
<th>Main Storage Facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt Dore Mine</td>
<td>Diesel</td>
<td>21,000 kL</td>
<td>4 x 65kL storage capacity.</td>
</tr>
<tr>
<td></td>
<td>Oils and Grease</td>
<td>230 kL</td>
<td>5,000 L storage capacity.</td>
</tr>
<tr>
<td></td>
<td>ANFO</td>
<td>1,000 t</td>
<td>200 t storage capacity at magazine.</td>
</tr>
<tr>
<td></td>
<td>Bulk Emulsion</td>
<td>2,000t</td>
<td>70 t storage capacity at magazine.</td>
</tr>
</tbody>
</table>

7.1.2 Environmental Values Likely to be Affected

The following is a summary of environmental values likely to be affected by the proposed activities:

**Land Impacts:**
- Permanent loss of the habitat areas below the open pits and waste rock dumps.
- Temporary loss of habitat below the haul and access roads.

**Water Impacts:**
- The open pits are located with the defined area of the Mt Dore Aquifer which is the only significant groundwater resource within 21kms (Gin Creek 21kms south west). Water quality is marginal stock-water guidelines and this water has been used in the past for mining and limited stock-watering.
- Continued dewatering of the Mt Dore aquifer will occur as a result of use for the proposed heap leach operation. Previous major dewatering operations have not resulted in any impact on surrounding groundwater systems or significant changes in the Mt Dore water quality.
- Potential water quality changes to the Mt Dore Aquifer may occur from the exposure of mineralised material in the open pits.
- The catchment of the open pits can be managed to ensure no discharge occurs to surface waters.
- Sediment loss is expected from disturbed areas and will be managed by the location of appropriate sediment dams and use of the CRCM Sediment and Erosion Control Manual.
- All clean catchments will be diverted around the disturbed area.
- PAF waste rock will be identified and selectively handled for disposal into the 251 open pit.
- Water quality will be monitored from the waste rock dumps to ensure any impacts are identified and managed.

**Noise Impacts:**
- There is likely to be a moderate amount of noise generated. Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.
Waste Impacts:

- The development of the Mt Dore Open Pits has been designed specifically to **REDUCE** the volume of waste rock produced relative to the volume of ore that can be economically recovered. NAF waste rock will be stored for potential **RE-USE** preferentially for rehabilitation cover over the Heap Leach Pad and for general civil works. The open pits will be maintained for potential future resource **RECOVERY** of ore from the Merlin mine and additional copper resource associated with the South Pit. NAF waste rock excess to these requirements will be **DISPOSED** into two waste rock dumps. PAF waste rock will be disposed to 257 open pit.

- The mining fleet will generate quantities of waste oil, filters, oily rags, reject equipment parts typical of this scale of operation. Regulated waste will be removed from site by a suitably licensed regulated waste transported for **RE-USE, RECOVERY and DISPOSAL**.

7.1.3 Emissions or Releases Likely to be Generated

The following is a summary of the emissions likely to be generated by the activity:

- There will be temporary (5 years) noise and dust emissions during the disposal and subsequent rehabilitation operations that are unlikely to significantly impact the surrounding area. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres to the south west.

- Run-off water quality during the operational phase (5 years) may be impacted by sediment and effective sediment dams or other erosion control methods will be used to minimise the impact.

7.1.4 Risk and Likely Magnitude of Impacts

The most significant risks associated with this activity are summarised in Table 11.

<table>
<thead>
<tr>
<th>Site</th>
<th>Hazard</th>
<th>Unwanted Event</th>
<th>High Risk Rating (No Controls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open pits</td>
<td>Impacts to groundwater</td>
<td>Contamination of groundwater</td>
<td>H8</td>
</tr>
<tr>
<td>Waste Rock Disposal</td>
<td>Acid mine drainage</td>
<td>Contamination of surface or groundwater</td>
<td>H5</td>
</tr>
</tbody>
</table>

- Waste rock has been thoroughly characterised and a detailed block model developed from extensive drilling in the area provides a clear outline on where potentially problematic material will be encountered. The relatively shallow pits will not encounter significant sulphide mineralisation with a
relatively low volume of PAF material expected. Progressive waste characterisation will be used to demonstrate predictions are accurate.

- Black shale and calc-silicate lithologies have potential for elevated copper levels and low levels of molybdenum and selenium mobility. This material will be covered with a minimum of 0.5 m of non-mineralised material within waste rock dumps. Run-off from waste rock dumps will be captured in environment dams and monitored for a suite of metals.
- Two significant dewatering events have occurred in the recent past (1987-1990 & 2010-2015). Monitoring has demonstrated no apparent impacts to surrounding groundwater systems and no apparent change to water quality within the Mt Dore Aquifer. Potential water quality changes to the Mt Dore Aquifer may occur from the exposure of mineralised material in the open pits and evapo-concentration of soluble salts. The catchment of the open pits can be managed to ensure no discharge occurs.
- All other impacts are considered transitory in nature and of a low level of potential impact.

### 7.1.5 Proposed Management Practices

The following is a summary of the proposed management practices relevant to the activity:

- Progressive waste characterisation and the selective handling and placement of problematic waste rock material will reduce potential impacts.
- PAF waste rock will be placed into the Starra 257 open pit.
- Mineralised calc-silicate or black shale exceeding pre-mine metal levels will be covered with a minimum of 0.5 metres of non-mineralised material.
- Run-off from waste rock dumps will be captured in environment dams designed for a 1:10 ARI 30 minute storm (33mm) and monitored for a suite of metals.
- All clean catchments will be diverted around the disturbed area.
- The catchment into the open pits can be excluded to ensure the pits do not discharge or otherwise managed to improve water quality.
- General and regulated waste will be managed in accordance with the Chinova Waste Management Plan.
- Environment dams will be established below each waste rock dump to capture sediment and to monitor water quality.

### 7.1.6 Proposed Rehabilitation

The following is a summary of the proposed rehabilitation relevant to the activity:

- The waste rock dump outer slope will be battered to a 15 – 20° slope;
- Topsoil would be replaced on the dump upper surface;
- The dump upper surface would be ripped and seeded.
- The waste rock dump outer slope will be armoured with competent clean waste rock to minimise erosion and replicate the pre-existing habitat;
• Black shale and calc-silicate lithologies will be covered with a minimum of 0.5 metre of competent clean waste rock or topsoil;
• The waste rock top will include a 1 metre high retention bund to reduce run-off down the dump slopes;
• Open pits catchments will be managed to limit the potential for pit discharge and impacts to the surrounding groundwater;
• A geotechnical review of stability will be undertaken to determine any areas of instability;
• Rock bunds will be constructed of fresh end dumped rock;
• Bunds will be a minimum of 2 metres in height and 4 metres base width;
• Bunds will be located a minimum of 10 metres beyond any areas of instability; and
• Vehicle access into the voids will be gated and locked.

7.2 Three Stage Crushing and Agglomeration

7.2.1 Proposed Activities

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 P_{100} 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 construction heap. 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.

Water Management

The Southern Tailings Dam will be used for storage of excess water from the Mt Dore Heap Leach Project. Pumping from the Mt Dore aquifer has been underway since December 2010 at a rate of up to 30L/sec transferring to the Southern Tailings Dam.
To date the Southern Tailings Dam has reached a maximum RL of approximately 359m in mid-2012, which is less than 20% capacity.

To minimise any potential for discharge Metago, 21st March 2011 carried out a water balance review for the Southern Tailings Dam.

The report considered the following parameters relevant to the storage at that time.

- TSF surface area at RL360m = 498,020 m$^2$;
- Contributing natural catchment area = 625,354 m$^2$;
- Total contributing catchment area = 1,123.374 m$^2$.
- Embankment elevation = RL365m;
- Spillway elevation = RL363.5m;
- Maximum stored volume = 1,690,621 m$^3$;

From the analyses in the report the following conclusions were made:

- At the constructed spillway elevation of RL363.5m the facility would have an AEP of 5% at 76L/s; and
- An AEP of 2.5% at 70L/s;

### 7.2.2 Environmental Values Likely to be Affected

The following is a summary of environmental values likely to be affected by the proposed activities:

**Land Impacts:**
- Temporary loss of habitat below haul the ROM Pad.

**Water Impacts:**
- Sediment loss is expected from disturbed areas and will be managed by the location of appropriate sediment dams and use of the Chinova Sediment and Erosion Control Manual.
- Potential impact from mineralised and PAF ore grade material will be limited by continuous processing of the target grade ore.
- AI non-ore grade PAF material will be disposed directly into 257 open pit and not stockpiled at the ROM pad.
- The primary crusher is a major source of dust, particularly at the ROM bin during loader dumping. Water sprays are located on and around the ROM Bin to suppress the dust generated during the dumping process.
- Dust generated at the transfer points where the Vibrating Grizzly and the Primary Crusher deposit material on the Primary Crusher Sacrificial Conveyor is also suppressed with water sprays at all transfer points.
- Water sprays will also be included at the stockpile and at all transfer points within the secondary and tertiary crusher circuits to control the emission of airborne dust.
• A downstream environment dam will capture any adverse run-off from the ROM area and will be designed to contain a 1:100 ARI 72 hour storm (343mm) with contingency to pump 10L/sec to the Southern Tailings Dam.
• All clean catchments will be diverted around the disturbed area.

Noise Impacts:
• There is likely to be a moderate amount of noise generated. Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.

Waste Impacts:
• The crushing and agglomeration circuit is not expected to generate any waste material.
• PAF material will be disposed directly into the Starra 257 open pit and not stockpiled.

7.2.3 Emissions or Releases Likely to be Generated

The following is a summary of the emissions likely to be generated by the activity:
• There will be temporary (5 years) noise and dust emissions during the ROM crushing and subsequent rehabilitation operations, that are unlikely to significantly impact the surrounding area. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres to the south west.
• Run-off water quality during the operational phase (5 years) may be impacted by mineralised dust and potential acid drainage. The downstream environment dam will capture any adverse run-off from the impacted area.
• The primary crusher is a major source of dust, particularly at the ROM bin during loader dumping. Water sprays are located on and around the ROM Bin to suppress the dust generated during the dumping process.
• Dust generated at the transfer points where the Vibrating Grizzly and the Primary Crusher deposit material on the Primary Crusher Sacrificial Conveyor is also suppressed with water sprays at all transfer points.
• Water sprays will also be included at the stockpile and at all transfer points within the secondary and tertiary crusher circuits to control the emission of airborne dust.

7.2.4 Risk and Likely Magnitude of Impacts

The most significant risks associated with this activity are summarised in Table 12.

Table 12 – Crushing and Agglomeration Risk Summary

<table>
<thead>
<tr>
<th>Site</th>
<th>Hazard</th>
<th>Unwanted Event</th>
<th>High Risk Rating (No Controls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ore stockpiling/crushing</td>
<td>Acid mine drainage</td>
<td>Contamination of surface or groundwater</td>
<td>H5</td>
</tr>
</tbody>
</table>
• Stockpiling of the main ore grade material is not expected to result in any significant acid mine drainage as it will be continually processed and removed.
• PAF material will be disposed directly into the Starra 257 open pit and not stockpiled.
• The downstream environment dam and pumping capacity to the Southern Tailings Dam will capture any adverse run-off from the impacted area.
• All other impacts are considered transitory in nature and of a low level of potential impact.

7.2.5 Proposed Management Practices
The following is a summary of the proposed management practices relevant to the activity:
• Clean catchment will be diverted around the ROM Pad.
• A downstream environment dam will capture any adverse run-off from the ROM area and will be designed to contain a 1:100 ARI 72 hour storm (343mm) with contingency to pump 10L/sec to the Southern Tailings Dam.
• All clean catchments will be diverted around the disturbed area.
• Crushing plant and conveyors will include dust suppression sprays and shrouds to reduce fugitive emissions.
• Water quality will be monitored within the environment dam to assess run-off from the ROM pad.

7.2.6 Proposed Rehabilitation
The following is a summary of the proposed rehabilitation relevant to the activity:
• Crushing plant and conveyors would be removed.
• Any remaining ore material would be removed and placed into the 257 Open Pit.
• Mineralised material would be scraped and removed from the ROM pad surface and placed into 257 open pit.
• Any significant soil contamination from fugitive dust emissions would be scraped and removed from the area surrounding the ROM and placed into 257 open pit.
• The remaining landform would have topsoil replaced and be ripped and seeded.

7.3 Heap Leach

7.3.1 Proposed Activities
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.

The agglomerated ore is deposited directly on to an Overland Conveyor and transported to the Leach Pad Construction Heap. The overland conveyor is equipped with a tripper car chute for variable position off-loading. This is followed by a series of conveyors including a Portable Ramp Conveyor, several Portable Conveyors (grasshopper type) and a Horizontal Conveyor. The stacking of the agglomerated ore on the heap is performed by a radial stacker and stinger conveyor.

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 subsequent to 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 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.
The heap leach process involves a series of solutions of different compositions (PLS, ILS and raffinate) and each type of solution requires a dedicated storage pond/s. The individual pond design allows for 24 hour surge capacity.

Raffinate is the leachate for the secondary leach and is pumped to and irrigated on the Secondary Leach Heap.

The solution percolating from the Secondary leach portion of the heap is stored in an Intermediate Leach Solution (ILS) Pond. The secondary leach liquor together with other solutions flowing to this pond make up the ILS and these include raffinate bleed, process water and storm water. Process water and storm water are added to maintain the required ILS volume. Should the solution balance be such that excess raffinate is produced and cannot be accommodated in the Raffinate Pond or ILS pond, it is bled to a single stormwater pond.

The Primary Leachate is made up of ILS solution mixed with sulphuric acid using an inline mixer and is irrigated on the primary portion of the heap. The Pregnant Leach Solution (PLS) produced from the primary leach percolation contains the highest copper tenor and represents the final leach solution.

PLS is pumped from the PLS Pond to the Primary Mix Tank in the SX plant extraction circuit.

RGS 2016 undertook a geochemical assessment of heap leach residue for the proposed Mt Dore Heap Leach Project based on approximately 13.2Mt of ore material. The three heap leach residue samples received and tested by RGS represent spent heap leach residue material from pilot scale heap leach metallurgical studies on representative composite ore samples from within the reduced size Mt Dore open pit as proposed in early 2014. The main findings of geochemical assessment are:

- As a bulk material, the heap leach residue is likely to be classified as NAF and have a low risk of generating additional acidity through sulphide oxidation.
- Initial and ongoing surface runoff and seepage from heap leach residue materials is likely to be slightly acidic and contain a relatively low concentration of dissolved salts.
- Some of the heap leach materials are variably enriched with a number of metal/metalloids (arsenic, cadmium, copper, lead and zinc) compared to average crustal abundance in soils.
- Whilst some of the identified enriched metals/metalloids are sparingly soluble in leachate, the dissolved concentrations of cadmium, copper and lead in leachate from some materials are persistently elevated compared to applied water quality guideline criteria.

As a result of the geochemical assessment work completed on heap leach residue materials from the Project, a number of recommendations are provided. It is recommended that:
The optimum strategy for managing the heap leach residue material at the end of mine life should be selected and may include passive drainage management, addition of alkalinity and drainage monitoring, in situ cover placement, and/or in-pit disposal, either to a part of an active open pit or as a component of backfill for an existing open pit void.

The selected management strategy should aim to limit any potential for seepage to impact upon existing surface water and groundwater systems during operations and post-closure. Operational sampling and geochemical testing of heap leach residue materials and operational and post-closure water quality monitoring should also be used to verify the veracity of the selected management strategy.

The merits of flushing the heap leach residue material with water and/or some alkalinity added to the material and/or flush water as part of the selected management strategy should be investigated using KLC tests. It is expected that the flushing process will reduce the inherent acidity of the heap leach residue and encourage the precipitation of dissolved metals/metalloids, such that there would be a reduced potential for any seepage to impact upon surface water and groundwater resources.

Rehabilitation field trials for heap leach residue materials should be completed when the mine is operational and bulk materials become available. It should be noted from the results of the kinetic leach testing that all elements showed decline over the 12 month leaching period. Sulphate, electrical conductivity, aluminium, copper, cobalt, zinc, nickel, selenium, manganese showed significant declines indicating that they will readily flush from the system. Cadmium elevations in regards to one sample showed significant initial decline followed by a minor increase. It is expected that any sphalerite (as the source of the cadmium from the leach residue Composite 1) should oxidise and liberate cadmium mostly during the expected 5 year operational period. It is noted from the report that Composite 1 still had significant copper values (3,490mg/kg – 42% leached) indicating that initial pilot scale metallurgical leaching was incomplete and contributed to the elevated cadmium levels in the residue. It is reasonably expected that effective leaching (80%) would result in residual copper levels of approximately 1,680mg/kg and would further reduce any available cadmium by further oxidising any remaining sphalerite in the system. Liming of the leach material after the peak metal discharge would serve to limit any further metal production and generally increase material pH for final rehabilitation.

### 7.3.2 Environmental Values Likely to be Affected

The following is a summary of environmental values likely to be affected by the proposed activities:

**Land Impacts:**
- Permanent loss of habitat below the Heap Leach Pad.
Water Impacts:
- The Heap leach pad water circuit will contain highly acidic and saline water draining to a stormwater pond. The Heap Leach and Stormwater Dam will require double lining (clay and plastic liners) to prevent impacts to groundwater.
- The Stormwater Pond is considered to be a High Hazard Dam will be designed to capture an AEP 1:100 - 2 month wet season (561.2mm) in accordance with the *Manual for assessing consequence categories and hydraulic performance of structures* (DEHP, 2016).
- Pumping capacity of a minimum 10L/sec to the Southern Tailings Dam will also be available as a contingency.
- The Heap Leach and Stormwater Dam liners will incorporate leak detection to detect any passage of a wetting front or entrained contaminants through either the sides or floor.
- The Heap Leach, Stormwater Dam and SXEW plant are located in an area designated by hydrologists as an aquiclude (Staveley Formation) which limits the potential for impact to groundwater.
- All clean catchments will be diverted around the disturbed area.
- Monitoring bores will be established around the perimeter to measure any potential seepage.
- The spent heap leach material will have a reducing metal content (improving water quality) after production which will need to be managed with potential for lime addition to stabilise the material post operation.

Noise Impacts:
- Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.

Waste Impacts:
- The Heap Leach circuit is not considered to generate any waste. Water will be RECYCLED within the system with make-up water added as required.

7.3.3 Emissions or Releases Likely to be Generated
- The Heap Leach material will be maintained in a moist state with little potential for dust generation.
- Heap Leach emitters or drippers are designed to maximise efficient wetting of the agglomerate bed and minimising evaporative losses. There is unlikely to be any fugitive aerosol emissions of leach fluid.
- The spent heap leach material will have a reducing metal content (improving water quality) after production which will need to be managed with potential for lime addition to stabilise the material post operation.
7.3.4 Risk and Likely Magnitude of Impacts

The most significant risks associated with this activity are summarised in Table 13.

<table>
<thead>
<tr>
<th>Site</th>
<th>Hazard</th>
<th>Unwanted Event</th>
<th>High Risk Rating (No Controls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponds and pipelines</td>
<td>Pipeline failure</td>
<td>Contamination of surface or groundwater</td>
<td>H5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contamination of soils</td>
<td>H8</td>
</tr>
<tr>
<td>Heap Leach Pad</td>
<td>Failure to contain</td>
<td>Contamination of surface or groundwater</td>
<td>M9</td>
</tr>
</tbody>
</table>

- The potential for contamination of surface or groundwater is a significant risk for ponds, pipelines and the heap pad.
- The heap leach pad water circuit will contain highly acidic and saline water draining to a double lined (clay and plastic liners) stormwater pond.
- Monitoring bores will be established around the perimeter to measure any potential seepage.
- The spent heap leach material will have a reducing metal content (improving water) after production which will need to be managed with potential for lime addition to stabilise the material post operation.

7.3.5 Proposed Management Practices

- The Stormwater Pond is considered to be a High Hazard Dam will be designed to capture an AEP 1:100 - 2 month wet season (561.2mm) in accordance with the Manual for assessing consequence categories and hydraulic performance of structures (DEHP, 2016).
  - Catchment area – 369,275 m$^2$
  - AEP 1:100 - 2 month wet - 561.2mm
  - Event volume required - 207,237 m$^3$
  - Proposed design volume – 289,780m$^3$

  Note that process fluids are in circulation and have not been considered in regards to process inputs. However there is 82,543m$^3$ additional volume in the stormwater pond as well as pumping capacity to the Southern Tailings Dam.
- Pumping capacity of a minimum 10L/sec to the Southern Tailings Dam will also be available as a contingency.
- The Heap Leach and Stormwater Dam will require double lining (clay and plastic liners) to prevent impacts to groundwater.
- The Heap Leach and Stormwater Dam liners will also incorporate leak detection to detect any passage of a wetting front or entrained contaminants through either the sides or floor.
Leak detection will include a series of shallow bores along each side of the heap leach pad and process ponds.

The Heap Leach, Stormwater Dam and SXEW plant are located in an area designated by hydrologists as an aquiclude (Staveley Formation) which limits the potential for impact to groundwater.

Deeper groundwater bores will surround the wider processing area.

The spent heap leach material will have a reducing metal content (improving water quality) after production which will need to be managed with the potential for lime addition to stabilise the material post operation.

All clean catchments will be diverted around the disturbed area.

7.3.6 Proposed Rehabilitation

- The spent heap leach material will have a reducing metal content (improving water quality) after production, which will need to be managed with the potential for lime addition to stabilise the material post operation.
- The existing stormwater pond would be maintained while metal discharge from spent heap leach material is stabilised. Discharge from the system post operation is unlikely as the drying heap leach material will act as a buffer to surface run-off and the stormwater pond has significant design capacity (1:00 2month wet season).
- Any residual leachate can be transferred to the Southern Tailings Dam prior to decommissioning.
- The material (lime stabilised if required) will then be battered to a slope of 15-20° and revegetated directly.
- Exposed plastic liners would either be removed or covered by a minimum of 1 metre of material.
- The stormwater pond would be maintained without liner (once metal leachate production has ceased) to capture any erosion of material longer term and to continue to monitor water quality.

7.4 Solvent Extraction – Electro-Winning

7.4.1 Proposed Activities

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 (E1 and E2) 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 in excess of 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 in order 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.
**Process Reagents:**
Table 15 below provides a summary of the process reagents and volumes required to be transported and stored on site for the project.

### Table 15

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit Size</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activated Clay</td>
<td>25kg bags</td>
<td>150kgs</td>
</tr>
<tr>
<td>Diatomaceous earth</td>
<td>25kg bags</td>
<td>175kg</td>
</tr>
<tr>
<td>Diluent</td>
<td>55kL</td>
<td>330kL</td>
</tr>
<tr>
<td>Guar</td>
<td>25kg bags</td>
<td>10kg</td>
</tr>
<tr>
<td>Extractant</td>
<td>1000L IBC</td>
<td>2,000L</td>
</tr>
<tr>
<td>Sulphuric Acid</td>
<td>10,000kL</td>
<td>8,355kL</td>
</tr>
<tr>
<td>Cobalt sulphate</td>
<td>25kg bags</td>
<td>25kg</td>
</tr>
</tbody>
</table>

**Sulphuric Acid:**
Sulphuric acid (98%) is delivered by road tanker to the sulphuric acid offloading area. An offloading station is provided to transfer the sulphuric acid into the 10,000 m³ Sulphuric Acid Storage Tank providing 4-6 weeks storage capacity. Acid is pumped from this tank to three areas:
- Heap Leach,
- Electrowinning Electrolyte Circulation Tank and
- Agglomeration Acid Tank.

The Agglomeration Acid Tank provides an additional 8 hours storage for consumption of acid in agglomeration. The acid is added by means of the Agglomeration Acid Pump.

Sulphuric acid is added to the crushed ore during agglomeration at an addition rate of 50-80% of the gangue acid consumption rate at 98% w/w. The remaining acid requirement for leaching is added to the Intermediate Leach Solution and Raffinate Ponds after dilution with process water via Inline Acid Mixers.

Sulphuric acid is added to the electrolyte circulation tank to maintain a free acid concentration of 180 g/L in spent electrolyte for the purpose of effectively stripping copper from the loaded organic in the SX circuit. The acid rate of addition is dictated by the flow rate of electrolyte bleed from the electrowinning circuit.

**Extractant:**
Extractant is used in the solvent extraction process at a concentration of 20 %v/v. Entrained and evaporative losses of organic requires replenishment on an on-going basis.
The extractant is delivered to site in 1 m$^3$ intermediate bulk containers (IBCs), off-loaded with a forklift and stored in a covered shed. Extractant is pumped to the SX circuit on a demand basis using a single peristaltic transfer pump, connected via a flexible coupling to individual containers. Spillage in the area is collected and disposed of by the Reagent Mixing Area Sumps and Pumps to the Run-Off Collection Pond.

Diluent:
High flash point diluent is delivered to site by road tanker and off-loaded into the diluent storage tank of 55 m$^3$ nominal storage capacity.

Diluent is transferred to the solvent extraction circuit on a demand basis using a single centrifugal pump to replenish circuit losses. The storage tank is located within a dedicated bunded area. Spillage in the area is collected and disposed of by the Reagent Mixing Area Sumps and Pumps to the Run off Collection Pond.

Cobalt Sulphate:
Cobalt sulphate is supplied in 25 kg bags and added to the Cobalt Make-Up Tank with RO water to produce the required cobalt solution concentration.

Cobalt sulphate is added to the electrolyte to reduce the anode over potential and subsequently reduce the rate of anode corrosion and lead spalling. Powdered cobalt sulphate is made up with water in a small agitated tank in the electrowinning area and the solution transferred to the Electrolyte Circulation Tank. Cobalt in the circulating electrolyte stream is maintained at a concentration of 180 ppm and the rate of cobalt sulphate addition to achieve this target is dictated by the flow rate of electrolyte bleed from the electrowinning circuit.

Guar:
Guar is supplied in 25 kg bags and is added to a skid mounted Guar Mixing Plant as required.

Guar is a natural long chain polymer which is added to the electrolyte to improve the morphology of the deposited copper. Guar is nominally added to the strong and circulating electrolyte streams at a rate equivalent to 0.25 kg/t of deposited cathode copper but the actual dosage can vary according to operating current density.

7.4.2 Environmental Values Likely to be Affected
The following is a summary of environmental values likely to be affected by the proposed activities:

Land Impacts:
- Temporary loss of habitat below haul the Heap Leach Pad.

Water Impacts:
- The process water circuit will contain highly acidic and saline water draining to bunded areas to prevent impacts to surface and groundwater.
- The SXEW plant is located in an area designated by hydrologists as an aquiclude (Staveley Formation) which limits the potential for impact to groundwater.
- All clean catchments will be diverted around the disturbed area.
- All run-off from this area reports to the Raffinate Pond and Stormwater Pond.

**Noise Impacts:**
- There is likely to be a moderate amount of noise generated. Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.

**Waste Impacts:**
- The SXEW circuit will generate waste from reagent containers and bags. Containers will be returned for **RE-USE** where possible and otherwise **DISPOSED** by a suitable regulated waste contractor or on-site for general waste.
- Water will be **RECYCLED** within the system with make-up water added as required.
- Crud will be **DISPOSED** to the Southern Tailings Dam.

### 7.4.3 Emissions or Releases Likely to be Generated

- The SXEW is unlikely to generate any dust or aerosol emissions.
- There is likely to be a moderate amount of noise generated. Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.

### 7.4.4 Risk and Likely Magnitude of Impacts

The most significant risks associated with this activity are summarised in Table 16.

<table>
<thead>
<tr>
<th>Site</th>
<th>Hazard</th>
<th>Unwanted Event</th>
<th>High Risk Rating (No Controls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponds and pipelines</td>
<td>Pipeline failure</td>
<td>Contamination of surface or groundwater</td>
<td>H5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contamination of soils</td>
<td>H8</td>
</tr>
</tbody>
</table>

- The process water circuit will contain highly acidic and saline water draining to bunded areas to prevent impacts to surface and groundwater.
• Pipelines will need to be bunded to contain any leaks or to have an environment dam in place immediately downstream should any leaks or pipe failure occur. Daily inspection and maintenance of pipelines will also be carried out.
• The SXEW plant is located in an area designated by hydrologists as an aquiclude (Staveley Formation) which limits the potential for impact to groundwater.
• All clean catchments will be diverted around the disturbed area.
• All run-off from this area reports to the Raffinate Pond and Stormwater Pond.

7.4.5 Proposed Management Practices
• The process water circuit will contain highly acidic and saline water draining to bunded areas to prevent impacts to surface and groundwater.
• The SXEW plant is located in an area designated by hydrologists as an aquiclude (Staveley Formation) which limits the potential for impact to groundwater.
• All clean catchments will be diverted around the disturbed area.
• A run-off from this area reports to the Raffinate Pond.
• The processing area will include concrete sumps with pumping capacity to the Raffinate Pond to manage any spills.

7.4.6 Proposed Rehabilitation
• The process plant and associated pipework will be removed.
• Any remaining concrete foundation will be excavated and placed into 257 open pit.
• Any contaminated soil will be removed and placed into 257 open pit.
• The area will then be ripped and seeded.

7.5 Mt Dore Village

7.5.1 Proposed Activities
The existing Mt Dore village has been used in various forms since at least 1987 when it serviced the Selwyn Mining Operation.

Water Treatment
The Mt Dore camp currently has an 80,000L/day Reverse Osmosis (RO) water treatment plant which treats raw water from the Mt Dore Aquifer. An 80,000L RO plant produces 1,800L/h (0.5L/s) waste water which will be transferred via the existing dewatering pipeline to the Southern Tailings Dam.

Sewerage Treatment
The Mt Dore personnel will utilise the existing 50m³ Heal secondary treatment plant with effluent transferred to the Southern Tailings Dam. If the plant operates at full capacity which is unlikely, the effluent will add approximately 0.6L/sec to the mine
dewater being transferred to the Southern Tailings Dam. Effluent will be irrigated onto the existing oval.

7.5.2 Environmental Values Likely to be Affected

Land Impacts:
- Nil – the camp area has been cleared and established since 1986.

Water Impacts:
- The RO waste water will have slightly elevated salinity and is managed by being pumped to the Southern Tailings Dam for containment.
- Sewerage effluent will be irrigated onto the camp oval with required controls to limit exposure to staff.

Noise Impacts:
- There is likely to be a limited amount of noise generated as the camp will be required to maintain 24/7 operation. Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.

Waste Impacts:
- RECYCLING opportunities are limited by the remote nature of the site. Waste RECYCLING is limited to aluminium cans. The remaining general waste will be DISPOSED to the general waste site at Mt Dore. Grease traps will be periodically cleared and DISPOSED by a licensed contractor.

7.5.3 Emissions or Releases Likely to be Generated

- There is likely to be a limited amount of noise generated as the camp will be required to maintain 24/7 operation. Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.

7.5.4 Risk and Likely Magnitude of Impacts

- There will be no increased risk from the proposed activities based on the previously approved operation of the camp.

7.5.5 Proposed Management Practices

- The RO waste water will have slightly elevated salinity and is managed by being pumped to the Southern Tailings Dam for containment.
- Sewerage effluent will be irrigated onto the camp oval with required controls to limit exposure to staff.
- General waste will be disposed at the approved general waste facility at Mt Dore.
- Limited recycling of aluminium cans will occur.
• Regulated waste will be removed by a licensed contractor.

7.5.6 Proposed Rehabilitation

• Potential exists for elements of the camp to remain as a property asset.
• The remaining infrastructure will be removed for scrap or disposed into an open pit.
• Any remaining concrete foundation will be excavated and placed into an open pit.

8 OTHER PROPOSED AMENDMENTS

A number of other amendments are also proposed for the existing environmental authority which are not specific to the proposed Mt Dore Heap Leach Project.

8.1 Approval of general waste disposal to open pits

DEHP have highlighted during a recent financial assurance review that disposal of general waste and limited regulated waste (tyres) to the existing open pits is not an approved activity.

8.1.1 Proposed Amendment

The Starra Open pits have been used for waste disposal from the early Selwyn operation which commenced in 1987. Starra 251 and 257 have recently been used for disposal of PAF material, general mineralised material, contaminated soil and concrete foundations.

It is proposed that the practice of PAF and contaminated soil and foundation removal would continue. This includes the disposal of drill core refuse. Open pits generally are also used for disposal of large and bulky items of waste which would otherwise fill the general waste disposal facility at Mt Dore requiring increased land disturbance for further trenches.

Waste tyres will also be disposed into the open pits.

8.1.2 Environmental Values Likely to be Affected

Land Impacts:
• Nil – the open pits are existing disturbances from previous operations.
• There is a positive impact to use open pits rather than create additional trench disposal sites.

Water Impacts:
• The Starra line open pits are associated with a confined fractured rock aquifer.
• General waste disposal and disposal of tyres is unlikely to cause unfavourable water quality impacts.
• Disposal of PAF, contaminated soil and foundation will have negligible impact on water quality as compared to the existing mineralised exposures in the open pits. Any adverse water quality impacts will be contained.

Noise Impacts:
• There is likely to be a limited amount of noise generated by the disposal operations. Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.

Waste Impacts:
• RECYCLING opportunities are limited by the remote nature of the site.
• DISPOSAL to the open pits will not impact adversely on groundwater due to the confined and existing mineralised nature of the disposal sites.

8.1.3 Emissions or Releases Likely to be Generated
• There is likely to be a limited amount of noise generated by the disposal operations. Noise impacts from the operation (5 years) are unlikely to impact any sensitive receptors. There are no sensitive receptors with 37 kilometres with the nearest residence being Chatsworth Station 37 kilometres south west.

8.1.4 Risk and Likely Magnitude of Impacts
• There will be no increased risk from the proposed activities.
• There is a beneficial outcome from backfilling open pits and limiting the requirement for additional trench disposal sites.

8.1.5 Proposed Management Practices
• Ensure PAF, contaminated soil and foundations are stored a minimum of 2 metres below the lowest point of the pit rim.
• Covering PAF, contaminated soil and foundations with a minimum of 1 metres of benign waste rock.
• Ensure general waste is stored below the lowest point of the pit rim.
• Covering general waste with a minimum of 0.5 metres of benign waste rock.

8.1.6 Proposed Rehabilitation
• Covering PAF, contaminated soil and foundations with a minimum of 1 metres of benign waste rock.
• Covering general waste with a minimum of 0.5 metres of benign waste rock.
8.2  Add Mort River as a Receiving Water Reference Site

8.2.1  Proposed Amendment

The Mort River water monitoring site has been established since 2012 when the Mt Dore Project was initially considered. There have been approximately 40 water samples obtained both from a rising stage sampler and grab samples. This site provides data from significant flow events in the non-mine affected Mort River.

8.2.2  Environmental Values Likely to be Affected

• Nil

8.2.3  Emissions or Releases Likely to be Generated

• Nil

8.2.4  Risk and Likely Magnitude of Impacts

• Nil

8.2.5  Proposed Management Practices

• Nil

8.2.6  Proposed Rehabilitation

• Removal of the RSS on project completion.

8.3  Removal of RSS14 (Compliance Site) and BS06 (Reference Site) – Mt Cobalt

8.3.1  Proposed Amendment

It is proposed to remove both RSS14 and BS06 from the Cloncurry Project EA as there has been no mining activity in the area and the impacts being monitored relate to historic mining activity that predates the current ML. RSS14 has been monitored since at least 1994 and regularly exceeds EA limits for arsenic and lead. BS06 is the reference site for RSS14 but rarely has measureable flows. CRCM is the holder of ML2732 (granted 1988) which surrounds ML2466 (granted 1973 and expired 2015) was previously held by Mt Cobalt Mining Pty Ltd.

ML2466 was located primarily over the historic Mt Cobalt tailings dam and ML2732 located over the old workings, waste rock dump and remnant machinery.

Mt Cobalt has been mined for cobalt at various times since the late 19th century. Historical grades of up to 5.8% cobalt have been reported (Qld Government Mining Journal, 20th April 1944, p96-97). Figure 24 below is an historical image of the Mt
Cobalt mining activity from the Chinova files (original source unknown). Figure 25 shows the mining lease in relation to the historic disturbance. Note recent activity relates to exploration drilling only.

Figure 24 – Mt Cobalt Historical Mining
Figure 25 – Current Mining Leases over Mt Cobalt
8.3.2 Environmental Values Likely to be Affected

- Nil

8.3.3 Emissions or Releases Likely to be Generated

- Nil

8.3.4 Risk and Likely Magnitude of Impacts

- Nil

8.3.5 Proposed Management Practices

- Nil

8.3.6 Proposed Rehabilitation

- Removal of the RSSs from the locations.

8.4 Remove monitoring bore MLMD1 from the EA

8.4.1 Proposed Amendment

MLMB1 is listed in the EA for monitoring of groundwater downstream of Merlin. MLMB1 has previously registered elevated total copper values of 1.98 mg/L (March 2011) and 0.98 mg/L (April 2014) with no measurable dissolved copper values. Occasional values for total mercury, molybdenum, chromium and aluminium have also been elevated.

MLMB1 is not an appropriate compliance monitoring bore due to the fact it has not been constructed as a monitoring bore and is known to have intersected copper mineralisation (1,200mg/kg at 42 to 44m) when drilled in 2010 as a geotechnical hole (MDQ383) for the development of the Merlin decline. The geotechnical hole does not include grouting, gravel packing or screening that would effectively exclude mineralised particulate matter from the open hole.

It should be noted that this ‘bore’ is also located in an aquiclude (Staveley Formation - identified in the Rockwater Report, 2011). This ‘bore’ was first monitored in September 2010 and had a standing water level of 44.55m BTOC (RL 331.32m) before the Mt Dore aquifer dewatering and Merlin decline commenced. The water level read in January 2016 was 38.68m (RL 337.19) indicating a rise in water level despite mining and dewatering activity in the nearby Merlin Mine. It should be noted that the water level in the Mt Dore Aquifer was measured at RL193.58m in
October 2015, demonstrating no link between MLMD1 and the Merlin Mine or the Mt Dore Aquifer.

It is recommended that MLMD1 be removed from the EA.

8.4.2 Environmental Values Likely to be Affected

- Nil

8.4.3 Emissions or Releases Likely to be Generated

- Nil

8.4.4 Risk and Likely Magnitude of Impacts

- Nil

8.4.5 Proposed Management Practices

- Nil

8.4.6 Proposed Rehabilitation

- Capping of MLMD1.

8.5 Amend Water Schedule Elements and Levels

8.5.1 Proposed Amendment

The following geochemical assessments are relevant to the determination of the parameters required for water and stream sediment monitoring for the Cloncurry Project:

- **RGS 2011 Geochemical Assessment of Ore, Waste Rock and Tailings Material from the Ivanhoe Cloncurry Project** – ore and waste rock from the Merlin Project has As, Cd, Co, Pb, Mo & Zn enriched above average crustal abundance. Ore materials may release soluble Cu, Se & Zn in concentrations that may exceed water quality guidelines. As & Cu were elevated in the ore and waste rock samples taken from the legacy sites. The water extract from the Lady Ella Rom ore stockpile contained Co, Cu & Ni at concentrations exceeding the water quality guidelines. Tailings from the ETD were enriched with Co, Cu & Se above average crustal abundance. Fe was the only element from water extracts exceeding the water quality guidelines for the ETD.

- **RGS 2011 Geochemical Assessment of Waste Rock from the Proposed Starra 276 Underground Mine** - the water extract from the waste rock samples showed no significant metal concentrations exceeding the water quality guidelines. A minor exception was one of the 5 waste rock samples for
As all waste rock has been removed from surface and disposed into 257 open pit there is no environmental risk posed by any of this material.

- **RGS 2013 Geochemical Assessment of Mine Materials from the Proposed Mt Dore Copper Heap Leach Operation** – Ore samples were enriched for Co, Cu & As. Cu was elevated in some waste rock samples. Mo & Se showed low potential for mobilisation from waste rock.
- **RGS 2016 Geochemical Assessment of Heap Leach Residue Mt Dore Copper Heap Leach Project** – some of the heap leach materials were variably enriched with As, Cd, Cu, Pb & Zn compared to average crustal abundance. Cu, Pb & Cd were elevated in leachate.

Mercury was noted as elevated in one of the 5 waste rock sample water extracts for the geochemistry of the Starra 276 mine. It is not noted in any of the other geochemical assessments. Review of water monitoring data from the Starra 276 Environment Dams from 2011-2015 indicate no mercury occurrences from the waste rock and ore that was stockpiled on site during that time. This material has subsequently been removed and backfilled into the Starra 257 open pit.

Based on the above assessments As, Cd, Co, Cu, Mo, Ni, Pb, Se & Zn will need to be included in the project compliance monitoring.

The Cloncurry REMP Report 2016 identifies the principal impacts of concern expected from mine related impacts include:

- increased salinity (EC) and sulphates
- reduction in pH
- mobilisation of metals (Cu and Co principally), and
- elevated total suspended solids

The summary from receiving water quality for the previous 12 months included: ‘All pH readings were consistent with regional reference sites and electrical conductivities were below the default trigger level of 435µS/cm emphasising the lack of impact from disturbed areas. Total suspended solids were again elevated above ‘normal’ (maximum of 87,000 mg/L from RSS MLD-1 - Merlin) in significant flows recorded in March 2016, but were consistent the highest recorded level of 110,000mg/L measured in the Mort River (not an EA reference site) during the same event. Copper results were consistent with reference site 95th percentile values despite exceeding the default limit.

Elevations of non-mine related elements (aluminium, lead and uranium) at compliance sites continue to cause unnecessary technical non-compliances without any relevance to mine related impacts. Other parameters including bismuth, boron, chromium, fluoride, iron, manganese, nickel, selenium and silver do not add any value to the monitoring of mine related impacts on this project area.

The following are recommendations from the receiving water data review:
• It is recommended that RSS14 is removed from the EA, as no mining activities have been undertaken by Chinova and it is effectively an historic site on a separate mining lease.
• It is recommended that the Central 95th percentile copper value be included in the EA to avoid further technical non-compliance for copper.
• It is recommended that aluminium be removed as a compliance element in the EA.
• It is recommended that bismuth, boron, chromium, fluoride, iron, lead, manganese, nickel, selenium and silver, uranium be removed from the EA.
• It is recommended that the Mort be added as a reference site in the EA.

The summary from groundwater quality for the previous 12 months included:

‘There has been no migrating impact detected around the ETD, with water quality in the compliance monitoring bores being dissimilar to the seepage water quality measured at the western ETD Duckpond and northern ETD Seepage Pond. The three monitoring bores around the STD have been dry since their installation. The site specific key indicators of impacts (EC, pH, total sulphates) have been generally consistent since 2006 with no identified trends that would indicate the onset of any mine related impact during the past year. Cobalt and copper concentrations during the past year have also been consistent with data collected since 2008 and have not exceeded contaminant limits.

The following are recommendations from the groundwater data review:
• It is recommended that a more appropriate contaminant limit for EC is applied using the data from relevant reference bores to avoid continued technical non-compliances.
• It is recommended that a more appropriate contaminant limit for sulphate is applied using the data from relevant reference bores to avoid continued technical non-compliances.
• It is recommended that compliance bore MLMB1 be removed from the EA.
• It is recommended that MDWB27 is included in the EA as a regional reference bore.
• It is recommended that aluminium, bismuth, boron, iron, lead, manganese, mercury, nickel, selenium, silver and uranium be removed from the EA.’

It should be noted that DEHP has raised concerns with groundwater sampling methodology which Chinova has committed to resolve by employing a low flow groundwater sampling methodology. For this reason it is unlikely that historic data will be accepted for the purposes of determining acceptable 80th and 95th percentile values for use in the EA.

It is recommended that:
• The Mort River receiving water reference site be included in the EA.
• Al is included in the EA for interpretation purposes only.
• F, Bi, B, Cr, Mn, Hg, Fe, Ag & U be removed from the receiving water monitoring.
• The pH Limits be updated to 5 – 9 to account for the range noted in receiving water reference sites.
• Suspended solids be removed as a compliance element.
• Stockwater guideline limits be applied for total metals in receiving water excepting copper and lead.
• Copper and lead limits for total metals should be derived from the reference site 95th percentile for Central.
• Dissolved metal trigger and limit values should be derived from the 80th and 95th percentile data from reference sites.
• The stream sediment monitoring table is updated to reflect the elements included in the receiving water table.
• The groundwater monitoring table is updated to reflect the changes to the receiving water table with uranium included.
• Groundwater triggers and limits (including sulphate and EC) be set at 80th and 95th percentile of reference sites or the default value whichever is greater.

8.5.2 Environmental Values Likely to be Affected
• Nil

8.5.3 Emissions or Releases Likely to be Generated
• Nil

8.5.4 Risk and Likely Magnitude of Impacts
• Nil

8.5.5 Proposed Management Practices
• Nil

8.5.6 Proposed Rehabilitation
• Nil

9 ENVIRONMENTALLY RELEVANT ACTIVITIES
The EA which this EM Plan supports is for mining activities. Table 17 below provides a summary of the environmentally relevant activities to be undertaken on the Mt Dore Project which form part of the mining activities and which will be authorised by the environmental authority (mining lease).
<table>
<thead>
<tr>
<th>ERA Number</th>
<th>Name</th>
<th>Description</th>
<th>AES</th>
</tr>
</thead>
<tbody>
<tr>
<td>7(3)(d)</td>
<td>Chemical manufacturing</td>
<td>Manufacturing, in a year, a total of 200t or more of any of explosives.</td>
<td>138</td>
</tr>
<tr>
<td>8(1)(c)</td>
<td>Chemical storage</td>
<td>Consists of storing 200m3 or more of liquids.</td>
<td>31</td>
</tr>
<tr>
<td>14(1)</td>
<td>Electricity generation</td>
<td>Consists of generating electricity by using fuel at a rated capacity of 10MW or more.</td>
<td>72</td>
</tr>
<tr>
<td>31(2)(a)</td>
<td>Mineral processing</td>
<td>(2) Processing, in a year, more than 1,000 t but less than 100,000 t of mineral products other than coke.</td>
<td>179</td>
</tr>
<tr>
<td>33 (1)</td>
<td>Miscellaneous activities</td>
<td>Crushing, milling, grinding or screening</td>
<td>No score</td>
</tr>
<tr>
<td>60(1)(d)</td>
<td>Waste disposal</td>
<td>1) Waste disposal: operating a facility for disposing of, in a year, more than 200,000 t of only regulated waste, under subsection (1)(a)</td>
<td>110</td>
</tr>
<tr>
<td>60(2)(a)</td>
<td>Waste disposal</td>
<td>2) Waste disposal: operating a facility for disposing of, in a year, 50 t to 2,000 t or more of waste under subsection (1)(b)</td>
<td>13</td>
</tr>
<tr>
<td>63(1) a &amp; b</td>
<td>Sewage treatment</td>
<td>(1) Sewage treatment— Operating sewage treatment works, other than no-release works, with a total daily peak design capacity of more than 100 but not more than 1500EP- (l) treated effluent is discharged from the works to an infiltration trench or through an irrigation scheme.</td>
<td>27</td>
</tr>
<tr>
<td>19</td>
<td>Mining metal ore</td>
<td>Mining copper ore</td>
<td>217</td>
</tr>
</tbody>
</table>

### 10 WASTE MANAGEMENT

#### 10.1 General Waste

The main motor vehicle workshop at the Merlin will be used to provide maintenance for the light and heavy equipment fleet. Work carried out at the workshop includes maintenance checks, general repairs and machinery rebuilds. Wastes generated at the workshop are typical of any mining operation and include lead batteries, waste hydrocarbons, and materials contaminated by hydrocarbons (including greases, waste oils, filters, soils, absorbent matting and rags). Used tyres are also collected at the workshop, as well as coolants and degreasers. Smaller underground workshops are used for maintenance checks and general repairs.

Hydrocarbon drums are disposed of by cleaning and crushing oil drums which are then removed as scrap steel, and filling empty grease drums with filters and oily rags for removal as regulated waste.

A traditional trenching system is used to dispose of putrescibles wastes at the Mt Dore site, with the residential workforce (approximately 150 people) generating approximately 250 t of general waste per year. A trench cage is used to minimise wind borne litter and entry into the pit by fauna. Open pits at Starra 222, 244 and 257 are also used for disposal of larger items of general waste or drill core. Table 18
provides details of the main types of wastes generated at the Mine and summarises the management strategies used to minimise the potential for environmental impacts.

**Table 18 – Main Waste Types**

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Average Quantity/annum</th>
<th>Waste Management Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyres</td>
<td>250</td>
<td>Disposed under rock fill in the open pit or waste rock dumps</td>
</tr>
<tr>
<td>Batteries</td>
<td>6t</td>
<td>Temporarily stored on-site. Periodically removed by regulated waste transported for off-site recycling.</td>
</tr>
<tr>
<td>Reagent, solvent and lubricant drums</td>
<td>1t</td>
<td>Cleaned and crushed on-site and periodically removed as scrap.</td>
</tr>
<tr>
<td>Waste oil and lubricants</td>
<td>80 kL</td>
<td>Temporarily stored on-site. Periodically collected by a Regulated Waste Contractor for off-site disposal.</td>
</tr>
<tr>
<td>Wood</td>
<td>50 m³</td>
<td>Wooden pallets reused where possible. All other wooden materials are disposed of at an area utilised for fire training exercises. This area is bunded to contain surface runoff.</td>
</tr>
<tr>
<td>Sewage sludge</td>
<td>3 m³</td>
<td>Disposed of in pre-existing evaporation areas.</td>
</tr>
<tr>
<td>General waste</td>
<td>150 t</td>
<td>Disposed of in on-site landfill.</td>
</tr>
</tbody>
</table>

Waste will be managed in accordance with the CRCM Waste Management Plan which is attached in Appendix 4.

**10.2 Sewerage and Water Treatment**

Sewerage and water treatment activities will generate liquid and solid wastes as defined in table 19 below.

**Table 19 – Sewerage and Water Treatment**

<table>
<thead>
<tr>
<th>Site</th>
<th>System Type</th>
<th>Capacity</th>
<th>Effluent Discharge</th>
<th>Sludge Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt Dore Camp</td>
<td>50m³ Heal – AST Wastewater Treatment Plant</td>
<td>165 EP</td>
<td>Irrigated to existing sports oval</td>
<td>Sludge pit near sewage plant</td>
</tr>
<tr>
<td>Mt Dore Camp</td>
<td>RO Plant</td>
<td>80,000L/day</td>
<td>0.5L/sec wastewater to Southern Tailings Dam</td>
<td>Nil</td>
</tr>
</tbody>
</table>

**11 REHABILITATION AND MINE CLOSURE**

Chinova Resources has developed a Closure Plan that has the following general objectives:

1. Enable all stakeholders to have their interests considered during the mine closure process;
2. Allow closure to occur in an orderly, cost effective and timely manner;
3. Enable the costs to be adequately represented in Company accounts;
4. Provide clear accountability and adequate resources for closure;
5. Establish a set of indicators which will demonstrate the successful completion of the closure process; and
6. Reach a point where the company has met agreed completion criteria to the satisfaction of the regulator.

Following these general objectives, the rehabilitation goals that CRCM is seeking to achieve during the mine closure process include:

- Ensuring the safety of humans and fauna is protected;
- Developing non-polluting and stable landforms with low maintenance requirements;
- Achieving an agreed final land use consistent with pre-existing and surrounding systems; and
- Ensuring the impact on natural systems is limited.

### 11.1 DEHP Rehabilitated Landform Criteria

DEHP has included in the Cloncurry project EA rehabilitated landform criteria including the following conditions:

**(E6)** Rehabilitated areas must be managed to minimize the proliferation of species not consistent with rehabilitation objectives.

**(E7)** All land subject to mining activities must be rehabilitated to:
- **(a)** Stable landforms with a self-sustaining vegetation cover and species that are similar to adjoining undisturbed areas;
- **(b)** Safe landforms, which are non-polluting, geo-chemically and geotechnically stable.
- **(c)** Ensure that any final landforms do not require ongoing maintenance.
- **(d)** Ensure that the maintenance requirements for rehabilitated land, is no greater than that required for the land prior to its disturbance by mining activities.

**(E8)** Maintenance of rehabilitated areas must take place to ensure and demonstrate that:
- **(a)** Landforms are stable.
- **(b)** Erosion control measures remain effective.
- **(c)** Stormwater run-off and seepage from rehabilitated areas does not negatively affect the environmental values of any waters.
- **(d)** Plants show healthy growth and recruitment is occurring.
- **(e)** Rehabilitation areas are free of any declared pest species.
Rehabilitation can be considered successful when:
(a) The site can be managed for its designated land-use (e.g. similar to that of surrounding undisturbed areas).
(b) No greater management input is required than for other land in the area being used for a similar purpose and there is evidence that the rehabilitation has been successful for at least three (3) years.
(c) The rehabilitation is carried out in accordance with the requirements, objectives, indicators and completion criteria as specified in Schedule E – Table E1 (rehabilitation Requirements) and in the Post Mine Land Use Plan.
(d) Written agreement is obtained from the landowner/holder and administering authority.

11.2 Mine Closure Goals
Consistent with community expectation and the EA conditions, the rehabilitation goals Chinova will be seeking to achieve during mine closure include:
- Ensuring the safety of humans and fauna is protected;
- Developing non-polluting and stable landforms with maintenance requirements consistent with undisturbed landforms;
- Providing opportunity for habitat development by using native species in the revegetation program;
- Excluding pest and invasive species in revegetation and rehabilitation;
- Achieving an agreed final land use consistent with pre-existing and surrounding systems; and
- Ensuring impact on natural ecosystems is limited.

11.3 Indicators
Rehabilitation indicators provide defensible measurements of progress towards the rehabilitation objectives. Environmental indicators may involve the measurement of a single parameter or they may involve the amalgamation of measurements of several parameters into an index or model. There could be several indicators for one objective and one indicator may have relevance to more than one objective. Some may be important over a wide area while others may have a local significance or relate to how a particular objective is to be achieved for a particular mine. Although there will be site-to-site variations in the indicators, some regional groupings are expected to emerge as knowledge improves and is shared among companies and consultants.

The properties of a good indicator (CSIRO 1998) are that it:
- has an agreed, scientifically sound meaning;
- represents an environmental aspect of importance to society;
- tells us something important and its meaning is readily understood;
- has a practical measurement process;
• helps focus information to answer important questions;
• assists decision making by being effective and cost-efficient.

As rehabilitation deals with complex systems, and the relationships between indicators and objectives may not be well understood at the mine planning stage, there needs to be appropriate mechanisms for reviewing the indicators if improved information or more cost effective rehabilitation techniques become available during the life of the mine. If the proposed change to an indicator is to be accompanied by a change in the rehabilitation objectives for a particular domain, an amendment of the environmental authority will be required. If there is likely to be a significant change to the level of environmental impact, the administering authority must require the amendment to be publicly notified.

For all indicators that are selected, the environmental authority holder will:
• state what objective(s) the indicator relates to;
• justify the selection of the indicator, including how the relationship between the indicator and the objective has been established (supported by references to authoritative sources or relevant monitoring data);
• state how the indicator is to be measured;
• state how the results will be reported and interpreted.

The indicators proposed to be used for assessment of the achievement of the rehabilitation objectives include:
• Infrastructure acceptance;
• Geotechnical stability;
• Geochemical stability;
• Water quality;
• Vegetation composition and projective cover;
• Land use; and
• Land contamination.

11.4 Completion Criteria

Completion criteria are used to facilitate the fulfilment of closure objectives and are generally specific to each Project. With respect to completion criteria, ANZMEC and MCA (2000) state:

• Completion criteria are specific to the mine being closed, and should reflect its unique set of environmental, social and economic circumstances.
• Completion criteria are the basis on which successful reclamation is determined, and should be developed in consultation with stakeholders. This ensures that there is broad agreement on both the end land use objectives and the basis for
measuring the achievement of that objective. Ideally, completion criteria should reflect the specific environmental and socio-economic circumstances of the site.

- Completion criteria should be flexible enough to adapt to changing circumstances without compromising the agreed end objective. This provides certainty of process and outcome (relinquishment of tenement when the conditions have been met). There should be an agreed process for the periodic review and modification of completion criteria in light of improved knowledge or changed circumstance.

Completion criteria should aim to be:

- clear and as simple as possible;
- continually improved (i.e. criteria may change in light of improved knowledge and/or changes in best practice management); and
- assessed at various stages of reclamation (criteria should be assessed as early as possible to enable ameliorative action if necessary).

DEHP, 2014 indicate that the completion criteria must provide a clear definition of successful rehabilitation for each domain at the mine site in the form of a set of measurable benchmarks against which the rehabilitation indicators can be compared to determine whether the objectives are being met. At least one completion criterion must be developed for each indicator. Completion criteria should specifically relate to the environmental, social and economic context of the mine site. However, it is possible that some completion criteria may be applied uniformly across a region if supported by technical evidence.

The criteria should be developed in consultation with stakeholders (e.g. the landowner, local government, indigenous groups, community groups and various State departments). The criteria are of importance to landowners because they may set limitations on the agreed future land use and expose the landholder to risks and potential costs associated with maintaining the former mine site in a safe and productive condition.

Sections 9.5 to 9.11 detail the specific criteria applicable to assessing completion of each domain.

11.5 Infrastructure Acceptance Criteria

All infrastructure that remains on land will be accepted in writing by the relevant landholder or authority.
11.6 Geotechnical Stability Criteria

11.6.1 Low Risk Landforms
For general landforms where there is low risk of failure there should be:
- A stable landform with erosion characteristics consistent with the analogue sites;
- Rock armoured slope angles consistent with analogue sites; and
- Roughened surface and slope break benches and/or contours to reduce flow velocities.

11.6.2 High Risk Landforms
For landforms encapsulating acid producing material there will be:
- Structures able to withstand rainfall and flood conditions with a recurrence interval of 150 years without damage;
- Structures able to withstand rainfall and flood conditions with a recurrence interval of 500 years with limited damage;
- Structures able to withstand probable maximum flood conditions (PMF) with damage but without failure of the works;
- Seepage will remain below ground and not visibly impact on vegetation; and
- Erosion gullies forming in cover materials or on the side slopes of confining embankments will not result in exposure of the tailings over a period of 500 years.

11.6.3 Open Pits
For open pits these criteria will be achieved:
- A geotechnical review of stability will be undertaken to determine any areas of instability;
- Rock bunds will be constructed of fresh end dumped rock;
- Bunds will be a minimum of 2 metres in height and 4 metres base width;
- Bunds will be located a minimum of 10 metres beyond any areas of instability;
- Vehicle access into the voids will be gated and locked; and
- A hydrological review of the void water balance and the potential to impact on surface and ground water resources.

11.6.4 Underground Voids
For underground voids these criteria will be achieved:
- A geotechnical review will be undertaken to determine potential for failures to affect the ground surface stability;
• Any identified areas would be subject to subsidence monitoring for a recommended period;
• Any surface depressions caused by subsidence would be monitored for progress;
• Any subsidence features will be backfilled progressively until stable;
• Fencing or rock bunding would be established to protect the safety of stock and humans in relation to any subsidence issues;
• Any areas subject to potential for long term subsidence will be fenced and signed; and
• A hydrological review of the void water balance and water quality and potential to impact on surface and ground water resources.

11.7 Geochemical Stability Criteria

Waste rock and remnant ore stockpiles will be assessed for:
• Acid forming potential – Net Acid Producing Potential and Net Acid Generation;
• Metal content and mobility; and
• Salinity;

To demonstrate that they are non-polluting when compared with appropriate reference sites.

11.8 Water Quality Criteria

11.8.1 Onsite Waters

The principle use of surface and ground water in the region is for stock watering. Contained surface water should not exceed stock water guidelines. Exceptions to this would include water in open pits where evaporation exceeds precipitation by a factor of 10:1 and hypersaline conditions are reasonably expected in the long term.

The Chinova Cloncurry Project EA provides these water quality criteria as agreed between the company and the DEHP and represented in Table 20 below.
### Table 20 – Water Quality Criteria

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Contaminant Limit Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>pH</td>
<td>6-9</td>
</tr>
<tr>
<td>EC</td>
<td>µS/cm</td>
<td>1,000</td>
</tr>
<tr>
<td>Sulphate</td>
<td>mg/L</td>
<td>1,000</td>
</tr>
<tr>
<td>Arsenic (t)</td>
<td>mg/L</td>
<td>0.5</td>
</tr>
<tr>
<td>Cadmium (t)</td>
<td>mg/L</td>
<td>0.01</td>
</tr>
<tr>
<td>Copper (t)</td>
<td>mg/L</td>
<td>1.0</td>
</tr>
<tr>
<td>Cobalt (t)</td>
<td>mg/L</td>
<td>1.0</td>
</tr>
<tr>
<td>Lead (t)</td>
<td>mg/L</td>
<td>0.1</td>
</tr>
<tr>
<td>Nickel (t)</td>
<td>mg/L</td>
<td>1.0</td>
</tr>
<tr>
<td>Selenium (t)</td>
<td>mg/L</td>
<td>0.34</td>
</tr>
<tr>
<td>Zinc (t)</td>
<td>mg/L</td>
<td>20</td>
</tr>
</tbody>
</table>

Note 1 – Contaminant limits only apply to point source releases
Note 2 – All metals and metalloids must be measured as total (unfiltered) and dissolved (filtered).

#### 11.8.2 Water Quality Downstream

Any surface water discharging from the rehabilitated mine areas into the ephemeral streams in the surrounding area, after an appropriately defined mixing zone, must not exceed the limits defined in Table 21. Likewise pH should range between 5th percentile and 95th percentile for the reference sites. The existing monitoring network will be maintained to ensure these criteria are met.
Table 21 - Receiving Water Contaminant Trigger Levels

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Contaminant Trigger Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>pH</td>
<td>5&lt;sup&gt;th&lt;/sup&gt; &amp; 95&lt;sup&gt;th&lt;/sup&gt; percentile of reference</td>
</tr>
<tr>
<td>EC</td>
<td>µS/cm</td>
<td>435 µS/cm</td>
</tr>
<tr>
<td>Turbidity</td>
<td>NTU</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference or 15</td>
</tr>
<tr>
<td>Sulphate</td>
<td>mg/L</td>
<td>1,000</td>
</tr>
<tr>
<td>Hardness</td>
<td></td>
<td>For the purpose of interpretation particularly in regards to metals analysis</td>
</tr>
<tr>
<td>Cyanide (free)</td>
<td>µg/L</td>
<td>7</td>
</tr>
<tr>
<td>Cyanide (WAD)</td>
<td></td>
<td>For interpretation</td>
</tr>
<tr>
<td>Arsenic</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference or 13</td>
</tr>
<tr>
<td>Cadmium</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference or 0.2</td>
</tr>
<tr>
<td>Copper</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference sites or 1.4</td>
</tr>
<tr>
<td>Cobalt</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference sites</td>
</tr>
<tr>
<td>Lead</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference sites or 3.4</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference sites or 34</td>
</tr>
<tr>
<td>Nickel</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference sites or 1.1</td>
</tr>
<tr>
<td>Rhenium</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference sites</td>
</tr>
<tr>
<td>Selenium</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference sites or 11</td>
</tr>
<tr>
<td>Zinc</td>
<td>µg/L</td>
<td>95&lt;sup&gt;th&lt;/sup&gt; percentile of reference sites or 8</td>
</tr>
</tbody>
</table>

Note 1 – Contaminant limits only apply to point source releases
Note 2 – All metals and metalloids must be measured as total (unfiltered) and dissolved (filtered).

11.8.3 Pit and Underground Void Water Quality

It is unlikely with the climatic conditions prevalent at the Cloncurry Project where evaporation exceeds precipitation by a ratio of 10:1, that good water quality can be achieved in the longer term in open pit voids. Voids will be used to store mineralized waste and minor hydrocarbon contaminated soils.

Likewise voids created by underground mining activity will likely be affected by the exposure of sub-ore grade material to percolating groundwater.

Thorough hydrogeological assessments will be undertaken to demonstrate that any contaminants will be contained and do not impact on surface water or identified groundwater resources in surrounding areas. Assessments will include a determination of long term water quality and level within each void.

Where open pit contained water exceeds stockwater guidelines, fencing will be installed to allow for management of stock.
11.9 Vegetation Criteria

11.9.1 Revegetation Methods

Significant revegetation trials have occurred at the Osborne Project since 1996, including the batters of Tailings Storage Facility 1 and the waste rock dumps. Information relating to these trials is reported in the Osborne Closure Plan, 2009 and summary information provided below:

- Native flora appears to offer the best opportunity for developing a sustainable vegetation cover.
- Previous trial work has demonstrated no discernible benefit from fertilizer addition at Osborne.
- It is noted that buffel tends to colonise bare areas during good seasons, although it appears severely affected during drier years, allowing for native recruitment particularly by spinifex.
- Use of rock mulch on slopes will be essential to assuring long term slope stability and providing suitable habitat for relevant species.

Gillespie et al, 2015 undertook an assessment of the waste rock rehabilitation at Phosphate Hill Mine in semi-arid north-west Queensland. A feature of the north-west Queensland climate is long dry periods interspersed with short periods of frequently intense rainfall, both of which have important effects on landscape stability and vegetation development. Because the transition from dry to wet seasons is abrupt the most erosive rainfall events often occur when vegetation cover is at or close to the minimum for the year. Consequently it is unlikely that vegetation will contribute to a reduction in surface erosion. Further it was indicated that the requirement for a constructed landform to not erode more than the analogue landscape requires that slopes more than 5 degrees should be constructed from competent rock and should not be covered with topsoil. It is considered inadvisable to rely on vegetation cover for erosion control on such surfaces, but it is expected that vegetation will develop eventually both through introduction and self-colonisation.

Figure 26 below shows a rock cover on the Osborne mineralised waste rock dump that is successfully recruiting native plants. This supports the preference for rock mulch cover particularly on landform slopes. The rock mulch will significantly improve landform stability and also provide a suitable analogue substrate for native recruitment. Tongway, 2007 when reporting on the initial Landscape Functional Analysis for the Osborne Project noted that ‘Rehabilitation sites with rocky surfaces, whether flats or slopes appeared to suffer no soil erosion and present no hindrance to spinifex and acacia establishment.’
The selected species will be direct seeded onto the landforms when appropriate moisture condition allow. While native seed collection by Traditional Owners is supported by the mine, it will also need to be supplemented with commercially purchased seed. Previous experience indicates that premature seeding and absence of a significant wet season can result in seeding failure, as new growth without sufficient follow up rainfall is ‘burnt off’ before setting seed. Dependent on the results, additional seeding will be undertaken in follow up seasons, until a self-sustaining cover has been established.

Landscape Functional Analysis has previously been used on the Osborne Project since 2007. It is considered by Chinova that the assessment of elements of LFA can be very subjective and the relevance of the micro-level assessments to the overall closure goals is poor. Erskine and Fletcher (2015) considered the relevance of LFA in the Central Queensland Coalfields and concluded that LFA transects and the LFA generated scores do not adequately reflect the functional success of rehabilitated coal mine lands.

It must be understood that the full re-establishment of pre-existing mature vegetation systems on landscapes that have been severely impacted by the mining process is not practical. This is particularly true in the case of the resource-limited rangeland environments of semi-arid Queensland.

Queensland’s *Vegetation Management Act 1999* defines remnant vegetation as being woody regrowth where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of the stratum and is dominated by species characteristic of the vegetation’s undisturbed canopy.

Chinova’s aim will be to achieve rehabilitation that meets the remnant vegetation definition using the Biocondition Benchmarks for Regional Ecosystems Condition Assessment for the North West Highlands (Department of Science Information and Technology, 2016). The following regional ecosystems will be used to define canopy height, species richness and projective cover:
- For waste rock dumps, ROM pads and heap leach facilities – RE 1.7.1 *Eucalyptus leuophloia* (snappy gum) low open-woodland on skeletal soils on lateritic scarps and plateaus.
- For Trekelano – RE 1.11.3 *Corymbia terminalis* low open woodland on basic volcanics.

**Table 22 – Vegetation Criteria**

<table>
<thead>
<tr>
<th>RE</th>
<th>Canopy height (m)</th>
<th>Tree canopy cover (%)</th>
<th>Shrubs (%)</th>
<th>Grass (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7.1</td>
<td>3-7</td>
<td>0-15</td>
<td>10-25</td>
<td>5-13</td>
</tr>
<tr>
<td>1.11.3</td>
<td>3-10</td>
<td>2-29</td>
<td>1-15</td>
<td>0-43</td>
</tr>
</tbody>
</table>

The established vegetation cover will be assessed to ensure vegetation stability is maintained by:
- viable seed production;
- drought and fire tolerance; and
- absence of declared weed species.

Annually captured satellite and UAV imagery will also be used to assess landform stability and vegetation at landform scale, to demonstrate achievement of the closure criteria. Each rehabilitated landform will also include a 100 metre transect which will be used to calibrate aerial imagery and to measure species richness and canopy height.

### 11.10 Land Use Criteria

The Cloncurry Project mining leases are mostly located on Starcross Station owned by Chinova Cloncurry Mines. Some mining leases are located on the neighbouring Chatsworth Holding owned by MDH Pty Limited, including Victoria, part of Mt Cobalt, Selwyn Hematites no3 and a minor portion of the main Starra mining lease. Regardless the pre-mine land use in the area ranged from class vii land on the flat areas to class viii land in the elevated rocky terrain, particularly around the Starra and Merlin lines. Stock are grazed on both properties with Bob McDonald (MDH Pty Limited) also holding a sub-lease over Starcross Holding.

Due to the diversity of habitats available within the Selwyn Ranges, the natural values of the land are considered to be quite high, and conservation land use has been identified as a priority in rehabilitation planning. Flora and fauna studies have identified the elevated ridgeline habitats as important refuges for threatened and other species. Rehabilitation of waste rock dumps will therefore attempt to replicate habitat characteristics consistent with these areas.

Sensitive or high risk landforms such as open voids, subsidence areas, covered tailings dams and covered sulphide waste rock dumps will be excluded from stock
access. Fencing will allow the land manager to manage and control access to these areas.

The post-mine land-use will therefore be a combination of class viii, class vii (where possible) and conservation land uses. The relevant land-use outcomes will be highlighted in section 8.3 Reclamation and Closure Works.

11.11 Land Contamination

Environmental Investigation Levels (EILs) and Health Investigation Levels (HILs) are not clean-up or response levels, nor are they desirable soil quality criteria. They are to be used for assessment of existing contamination only and are intended to prompt an appropriate site specific assessment when they are exceeded (NEPC, 1999).

As previously stated there is a significant history of surface soil and stream geochemistry available pre-disturbance (1987) on which to base the clean-up and response levels for land contamination assessment. The fact that the land surface subject to the Cloncurry project is known to be heavily mineralised, naturally contributes to resilient flora and fauna species within this region.

In accordance with the Cloncurry Project EA condition E22 the authority holder will undertake detailed land contamination assessments of the relevant areas in accordance with the administering authority’s Guideline for the Assessment and Management of Contaminated Land in Queensland.
12 REFERENCES


Exploration Permit 3370 Report - Geochemical Orientation Investigation Report on the Results of Stage 1, September 1986 for the Authority to Prospect (Exploration Permit) 3370.


Metago Environmental Engineers (Australia) Pty Ltd, June 2011. Mt Dore Evaporation Facility Design.


Place Design Group, 28th July 2012. Chinova Resources Cloncurry Mines Post Wet Season Ecological Assessment for the Mt Dore ML Expansion.


RGS Environmental Pty Ltd, February 2013. Geochemical Assessment of Mine Materials from the Proposed Mt Dore Copper Heap Leach Operation.

RGS Environmental Pty Ltd, February 2013. Geochemical Assessment of Mine Materials from the Proposed Mt Dore Copper Heap Leach Operation.

Rob Lait and Associates Pty Ltd April 2011. Geochemical Assessment of Heap Leach Residue. Mt Dore Copper Heap Leach Project.


Rockwater Pty Ltd, September 2010. Summary of the Mt Dore Aquifer.


Water Outflow Assessment 251 Ore Body – Selwyn Mine Report G260/1 Coffey Partners International Pty Ltd
APPENDIX A – FLORA AND FAUNA REPORTS

- Place Baseline Ecological Assessment 2010
- Place Post Wet Season Assessment 2011
- Place Mt Dore Ecological Assessment 2012
- FRC Baseline Aquatic Ecology Survey 2012
- *Pseudantechinus mimulus* Report 2014
- *Mt Dore Pseudantechinus mimulus* Camera Trapping Report 2016
14 APPENDIX B – HYDROLOGY REPORTS

- Rockwater Mt Dore Aquifer Report 2011
- Lait Report on Merlin Dewatering License 2015
- Lait Report on Mt Dore Open Pit Inflow Modelling 2016
15 APPENDIX C – WASTE CHARACTERISATION REPORTS

- RGS Mt Dore Geochemical Report 2013
- RGS Mt Dore Residue Geochemistry 2016