Department of Environment and Resource Management

EIS Assessment Report for the Mungana Gold Open Pit Development Project

September 2011

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1 Introduction

This report provides an assessment of the environmental impact statement (EIS) pursuant to Chapter 3 of the *Environmental Protection Act 1994* (EP Act) for the Mungana Gold Open Pit Development Project (MGOPDP), which is proposed by Kagara Limited (Kagara).

The Department of Environment and Resource Management (DERM) as the administering authority of the EP Act, coordinated the EIS process. This assessment report has been prepared pursuant to Sections 58 and 59 of the EP Act. Section 58 of the EP Act lists the criteria that the DERM must consider when preparing an EIS assessment report, while section 59 of the Act requires that the content of this EIS assessment report must:

(a) address the adequacy of the EIS in addressing the final terms of reference (TOR)

(b) address the adequacy of the draft environmental management plan (EM plan)

(c) make recommendations about the suitability of the project

(d) recommend any conditions on which any approval required for the project may be given.

In providing the required content, this assessment report will summarise key issues associated with the potentially adverse and beneficial environmental, economic and social impacts of the MGOPDP. It will discuss the management, monitoring, planning and other measures proposed to minimise any adverse environmental impacts of the project. It will also discuss those issues of particular concern that were either not resolved or require specific conditions for the project to proceed.

Chapter 2 of this EIS assessment report outlines the project to provide context for the findings of the report. Chapter 3 outlines the EIS process that has been followed for the MGOPDP and the approvals that are currently known to be necessary for its commencement. Chapter 4 addresses the adequacy of the EIS, discusses the main issues with regard to the environmental management of the project, and outlines the environmental protection commitments made in the EIS. Chapter 5 of this EIS assessment report assesses the adequacy of the environmental management plan (EM plan) for the project in incorporating the environmental protection commitments, and meeting the content requirements of section 203 of the EP Act. Chapter 6 comments on the recommendations for conditions to be included in the draft environmental authority.

The giving of this EIS assessment report to the proponent completes the EIS process under the EP Act.

2 Project details

The MGOPDP would involve open pit mining of a high grade gold resource at a rate of approximately 1.2 million tonnes a year for approximately 3.5 years, adjacent to polymetallic reserves currently being mined at Mungana. The project would be situated on the existing Red Dome Project leases, which lie 15 kilometres west of Chillagoe in north Queensland. The existing tenures are mining leases (ML) 4928, 4977, 5176 and 5319, and Exploration Permit Minerals 15458. A new mining lease, 20640, would be required.

The former Red Dome Gold Mine operated on the site from 1988 until 1997. It included open pit mining and the production of gold and copper concentrates via heap leaching, carbon-in-pulp, carbon-in-leach and flotation processes. Rehabilitation of the Red Dome site was carried out at that time following the cessation of mining.

Kagara recommenced operations in 2006 to bring several polymetallic lenses into production. The current Mungana polymetallic underground mine lies within the existing mining leases on land previously disturbed by mining or exploration. Kagara is undertaking the current underground mining under an existing approval, which permitted the construction of associated infrastructure such as offices, workshops, power corridor, roads, water impoundments and a tailings storage facility, though the latter has not yet been used.

The proposed Mungana open pit on ML5319 would lie approximately 800 m to the north-west of the current underground mine portal and its associated infrastructure. The new pit would have a depth of approximately 260 metres and an area of approximately 21.2 hectares, which is a similar footprint to the existing Red Dome Pit.

Development would include construction of a waste rock dump for non-acid-forming and potentially-acid-forming material on the proposed new lease, ML20640, but also extending onto the existing lease, ML5176, immediately to the north west of the existing Raw Water Dam. The waste rock dump would cover an area of approximately 75 ha.

A new tailings storage facility has been largely constructed on ML5176 under an existing approval. It has an area of approximately 33 ha. Further work will be needed to complete the tailings storage facility as discussed in section 4.7 of this report.

The MGOPD would use existing infrastructure originally intended for processing of polymetallic minerals with yet to be constructed modifications for: gold and copper recovery; additional crushing and grinding; copper flotation filtration; carbon-in-leach process; elution circuit; gold room; and a cyanide treatment circuit. The existing processing facilities have been constructed under an existing approval, but are as yet unused.

3 The EIS process

3.1 Timeline of the EIS process

The EIS process was initiated by Kagara on 7 July 2009 by application to DERM to prepare a voluntary EIS under section 70 of the EP Act. DERM approved the application to undertake a Voluntary EIS on 10 July 2009.

Kagara submitted a draft TOR for the EIS on 31 July 2009.

DERM issued a notice of publication of the draft TOR to Kagara on 25 August 2009. DERM placed a public notice (the TOR notice) announcing the start of the comment period for the draft TOR on its website on 31 August 2009, and in the Courier-Mail and Cairns Post on 29 August 2009 and the Atherton Tablelander on 1 September 2009. The comment period for the draft TOR ran from Monday, 31 August 2009, till close of business on Friday, 9 October 2009.

DERM received comments on the draft TOR from seven stakeholders within the comment period. Two other stakeholders provided comments soon after the close of the comment period. These comments, together with those provided by DERM, were forwarded to Kagara on 23 October 2009. DERM considered all comments received on the draft TOR and Kagara's response prior to issuing the final TOR on 18 December 2009.

NRA Environmental Consultants (NRA) on behalf of Kagara submitted the draft EIS on 7 July 2010 to DERM for review. DERM then considered whether the draft EIS addressed the final TOR in an acceptable form. On 27 August 2010, DERM decided to allow the EIS to proceed, and on 9 September 2010 issued a notice of the decision to Kagara. The public submission period was set at 30 business days starting on Monday, 27 September 2010, until close of business on Friday, 5 November 2010.

DERM placed a public notice (the EIS notice) announcing the start of the submission period for the draft EIS on its website on Monday, 27 September 2010, and in the Courier-Mail and Cairns Post on Saturday, 25 September 2010 and the Atherton Tablelander on Tuesday, 28 September 2010. Kagara also provided copies of the EIS notice to affected and interested persons.

DERM received seven submissions on the draft EIS within the submission period. The submissions were all from state government departments and agencies. DERM received another submission from an environmental interest group after the close of the submission period. All eight submissions were accepted in accordance with section 55 of the EP Act. The submissions, together with a submission from the DERM, were forwarded to Kagara on 19 November 2010 for consideration and response.

Kagara provided a response to submissions on 17 December 2010. Copies of the response to submissions were distributed for their review to those stakeholders who had made a submission on the draft EIS. However, the response to submissions was not accompanied by the amendments to the EIS. Consequently, on 3 February 2011, DERM issued a notice under s555 of the EP Act extending the period for the decision under s56A of the EP Act in order to allow Kagara time to provide the amendments. Kagara provided the response to submissions and amendments to the EIS on 23 February 2011. However, as a review of the response and amendments showed that Kagara needed to provide additional information that would comprise part of the EIS, another extension notice was issued on 3 March 2011 and again on 22 March 2011, 29 April 2011 and 27 May 2011, 10 June 2011, 24 June 2011, 8 July 2011, 5 August 2011 and 2 September 2011.

On 17 May 2011, Kagara lodged an amendment application for the existing environmental authority in regard to the MGOPDP. On 27 May 2011, DERM made an assessment level decision that an EIS was required for the application. Consequently, the EIS process ceased to be voluntary and became required. The key criterion for the decision was the project's close proximity (200m) to sections of the Chillagoe-Mungana Caves National Park, a protected area, which is a Category A environmentally sensitive area under the Environmental Protection Regulation 2008.

DERM decided under s56A of the EP Act on 6 September 2011 that the submitted EIS should proceed under Division 5 (EIS assessment report) and Division 6 (Completion of process) of the EP Act. A notice of the decision to allow the submitted EIS to proceed was issued to Kagara on 6 September 2011.

DERM, in the preparation of this EIS assessment report, considered submissions and comments from members of the advisory body (see section 1.3.2 for advisory body constituents) and other interested parties made at all stages of the EIS process. This EIS assessment report will be available on DERM's website (www.derm.qld.gov.au).

3.2 Approvals

The Mungana Gold Open Pit Development Project will require an amendment of the existing environmental authority under Chapter 5 of the EP Act. The amended environmental authority will cover the following activities that are directly associated with, or facilitate or support, the mining activities, and which would otherwise require approval under the EP Act as environmentally relevant activities through the Integrated Development Assessment System under the *Sustainable Planning Act 2009*:

- ERA 7 Chemical manufacturing, processing or mixing
- ERA 8 Chemical storage (including petroleum storage)
- ERA 16 Extracting rock or other material: >1 million t/yr
- ERA 17 Abrasive blasting – permanent location or mobile and temporary
- ERA 31 Mineral processing; >100,000t/yr
- ERA 43 Concrete batching: 200t/yr or more
- ERA 60 Waste disposal
- ERA 61 Incinerating or thermally treating general waste: <5,000t/yr
- ERA 63 Sewage treatment: >100-1,500 equivalent persons.

The project will also require a new mining lease, which has been designated with the number 20640.

Dewatering of groundwater from the pit will require a water licence under the *Water Act 2000* in accordance with the Water Resource (Mitchell) Plan 2007.

3.3 Consultation program

3.3.1 Public consultation

In addition to the statutory requirements for advertising the TOR and EIS notices and the mailing of the notices to interested and affected parties, the proponent undertook community consultation with members of the public and other stakeholders during the public submission period of the draft EIS. The proponent also circulated information about the MGOPDP to the Chillagoe community and conducted surveys on their views about the proposal.

3.3.2 Advisory Body

DERM invited the following organisations to assist in the assessment of the TOR and EIS by participating as members of the advisory body for the MGOPDP:

- Department of Communities
- Department of Community Safety
- Department of Education and Training
- Department of Employment, Economic Development and Innovation (DEEDI)
- the former Department of Infrastructure and Planning, now part of DEEDI
- Department of Transport and Main Roads
- Queensland Health
- Queensland Police Service
- Queensland Rail
- Queensland Treasury

- Tablelands Regional Council
- the former Commonwealth Department of the Environment, Water, Heritage and the Arts, now the Department of Sustainability, Environment, Water, Population and Communities
- North Queensland Land Council
- Wakamin People
- Mitchell River Watershed Management Group
- Construction, Forestry, Mining & Energy Union.

An advisory body briefing for the project was held in Brisbane on 8 October 2010 during the EIS public submission period. In addition, a field trip to inspect the project site was held on 21 October 2010.

3.3.3 Public notification

In accordance with the statutory requirements, public notices were placed in the Courier-Mail, Cairns Post and Atherton Tablelander to notify the availability of the draft TOR and draft EIS for review and public comment as stated in Section 1.3.1 above. In addition, notices advising the availability of the draft TOR and the draft EIS for public comment were displayed on the DERM website.

The draft TOR and draft EIS were placed on public display at the following locations during their respective public comment and submission periods:

- DERM Website (draft TOR only)
- DERM Customer Service Centre, 160 Ann Street, Brisbane (draft TOR only)
- DERM office, 400 George Street, Brisbane (draft EIS only)
- DERM office, 5B Sheridan Street, Cairns
- Chillagoe Library, The Hub, King Street, Chillagoe
- Mareeba Library, 221 Byrnes Street, Mareeba (draft EIS only).

3.4 Matters considered in the EIS assessment report

Section 58 of the EP Act requires, when preparing this EIS assessment report, the consideration of the following matters:

- the final TOR for the EIS;
- the submitted EIS;
- all properly made submissions and any other submissions accepted by the chief executive;
- the standard criteria;
- another matter prescribed under a regulation.

These matters are addressed in the following subsections.

3.4.1 The final TOR

The final TOR document, issued on 18 December 2009, was considered when preparing this EIS assessment report. While the TOR were written to include all the major issues associated with the project that were required to be addressed in the EIS, they were not exhaustive, nor were they to be interpreted as excluding all other matters from consideration.

Where matters outside of those listed in the final TOR were addressed in the EIS, those matters have been considered when preparing this EIS assessment report.

3.4.2 The submitted EIS

The "submitted EIS" was considered when preparing this EIS assessment report. The "submitted EIS" comprised the:

- the EIS that was made available for public submissions on 27 September 2010
- the response to submissions and amendments to the EIS received by DERM on 23 February 2011
- additional information provided by Kagara on 29 April 2011, 9 May 2011, 19 August 2011 and 30 August 2011.

3.4.3 Properly made submissions

DERM received seven submissions on the submitted EIS within the submission period and one after the submission period ended. However, all eight of the submissions were accepted under section 55 of the EP Act. Those submissions were received from the following stakeholders:

- Department of Communities
- Department of Community Safety
- Department of Education and Training
- Department of Employment, Economic Development and Innovation
- Department of Infrastructure and Planning
- Department of Transport and Main Roads
- Queensland Health
- Cairns and Far North Environment Centre Inc.

DERM provide its own submission on the EIS to the proponent.

In addition, there has been correspondence from stakeholders regarding the proponent's response to submissions on the EIS and supplementary information. All submissions and other comments made by stakeholders on the EIS documents were considered when preparing this EIS assessment report.

3.4.4 The standard criteria

Section 58 of the EP Act requires that, among other matters, the standard criteria listed in Schedule 3 of the EP Act must be considered when preparing the EIS assessment report. The standard criteria are:

a. the principles of ecologically sustainable development as set out in the *National Strategy for Ecologically Sustainable Development*; and

b. any applicable environmental protection policy; and

c. any applicable Commonwealth, State or local government plans, standards, agreements or requirements; and

d. any applicable environmental impact study, assessment or report; and

e. the character, resilience and values of the receiving environment; and

f. all submissions made by the applicant and submitters; and

g. 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

h. 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

i. the public interest; and

j. any applicable site management plan; and

k. any relevant integrated environmental management system or proposed integrated environmental management system; and

l. any other matter prescribed under a regulation.

DERM has considered the standard criteria when assessing the project.

3.4.5 Prescribed matters

In addition, section 58 of the EP Act requires that the following prescribed matters, under the Environmental Protection Regulation 2008, are considered when making an environmental management decision for this project:

- Section 51, matters to be considered for environmental management decisions
- Section 52, conditions to be considered for environmental management decisions
- Section 53, matters to be considered for decisions imposing monitoring conditions
- Section 55, release of water or waste to land
- Section 56, release of water, other than stormwater, to surface water
- Section 57, release of stormwater
- Section 60, activity involving storing or moving bulk material
- Section 62, activity involving acid-producing rock
- Section 64, activity involving indirect release of contaminants to groundwater.

3.5 Environment Protection and Biodiversity Conservation Act 1999

The Red Dome Project, which included the development of an open pit at the Mungana deposit, was referred by the proponent in 2006 to the then Department of the Environment and Heritage under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 3 April 2006, the Department of the Environment and Heritage determined the project to be not a controlled action provided that it is undertaken in a particular manner specified in the Commonwealth Government decision notice.

Consequently, the EIS process for the MGOPDP was not accredited under An Agreement Between the Australian Government and the State of Queensland Under Section 45 of the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* Relating to Environmental Assessment (commonly called the Bilateral Agreement), and there is no requirement for this EIS assessment report to specifically address matters of national environmental significance.

4 Adequacy of the EIS in addressing the TOR

Table 4.1 lists the main aspects of the project addressed in the EIS and highlights the significant issues associated with those aspects. The table notes whether the submitted EIS adequately addressed the matters described in the TOR. The subsections of this chapter enlarge on some of those significant issues, discuss the findings of the EIS in regard to them and outline the environmental protection commitments made by the proponent.

Table 4.1 Summary of the adequacy of the EIS in addressing the TOR

Matters included in the TOR	Significant issues	Were issues adequately addressed in the EIS?
Introduction	▪ Overview of the project, its objectives and scope. ▪ Outline of the necessary approvals and their assessment processes.	Yes to both.
Project need and alternatives	▪ Project justification and any alternatives.	Yes
Project description	▪ Location of the project in the regional and local contexts. ▪ Description of the construction phase of the project. ▪ Description of the operational phase of the project.	Yes to all.
Climate	▪ Climatic conditions at the site	Yes
Land	▪ Geology of the proposed open pit and relationship to nearby karst limestone formations. ▪ Resource utilisation. ▪ Land use. ▪ Land disturbance. ▪ Land contamination. ▪ Landscape character and visual amenity.	Yes to all.
Transport	▪ Transportation of personnel by road. ▪ Impacts on air traffic of fly-in, fly-out workforce. ▪ Transportation of ore concentrates by road.	Yes to all
Waste	▪ Waste rock, particularly potentially acid forming rock. ▪ Tailings from the mineral processing plant.	Yes to both.
Water resources	▪ Surface watercourses and overland flow ▪ Groundwater	Yes to both.
Air quality	▪ Dust ▪ Greenhouse gases ▪ Other air emissions	Yes to all.
Noise and vibration	▪ Noise at sensitive receptors ▪ Noise impacts on wildlife ▪ Vibration due to blasting	Yes to all
Ecology	▪ Terrestrial plants ▪ Terrestrial animals ▪ Aquatic ecology ▪ Groundwater dependent ecosystems	Yes to all
Cultural heritage	▪ Indigenous cultural heritage ▪ Non-indigenous cultural heritage	Yes to both
Social issues	▪ Impacts on local community ▪ Impacts due to fly-in, fly-out workforce	Yes to both

Matters included in the TOR	Significant issues	Were issues adequately addressed in the EIS?
Health and safety	▪ Air and water emissions. ▪ Road haulage through Chillagoe town	Yes to both
Economy	▪ Alienation of grazing land ▪ Effects on the local economy ▪ Effects on the state economy	Yes to all
Hazard and risk	▪ Unplanned discharges to air, water or land ▪ Transportation, storage and use of hazardous substances ▪ Emergency response	Yes to all
Rehabilitation	▪ Rehabilitation of areas affected by mining activities	Yes

4.1 Introduction

The EIS provided an adequate introduction to the project, its objectives and scope. It adequately identified the necessary approvals and outlined the assessment and approval processes.

4.2 Project need and alternatives

The EIS adequately described the need for the project, and briefly outlined the social, economic and environmental benefits and costs, which were addressed in more detail in later sections of the EIS. This section of the EIS noted that open pit mining is the best alternative for development of the resource, as underground mining of this particular deposit is unlikely to be suitable. It also noted that the block caving method of mining may be another practical method for extraction of the resource. However, the EIS only addressed the open pit option.

4.3 Project description

The EIS adequately described the location, scope and phases of the project. No submissions on the EIS requested additional information. An outline of the project has been provided in section 2 of this report.

4.4 Climate

The EIS adequately described the local climate with regard to how the climate could affect the potential for environmental impacts and the management of operations at the site.

The climate of the area is monsoonal, with relatively dry winters and wet summers. Ninety one percent of the 864 mm mean annual rainfall occurs in the wet season months from November to March inclusive. The mean monthly maximum temperature for the area ranges from 25.5°C in July to 33.9°C in December, while the mean monthly minimum temperature ranges from 11.2° C in July to 21°C in February. The winds are very predominantly from the east, which means that Chillagoe is upwind of the mine site for nearly the whole year.

4.5 Land

The final EIS adequately described those aspects of the site and project related to the existing and proposed qualities and characteristics of the land. The following subsections address those qualities and characteristics in more detail.

4.5.1 Geology of the pit and nearby karst limestone formations

DERM's submission on the EIS noted inconsistencies in the EIS's illustration of the geology of the proposed pit area and the nearby karst limestone systems. The EIS stated the pit would excavate some limestone, and the issue of concern is that the limestone could contain a karst cave that is connected to the cave system in a nearby section

of the Chillagoe-Mungana Caves National Park and thereby cause impacts due, for example, to drainage of groundwater into the pit.

Kagara's response provided a revised geological map and cross-section based on exploration drilling that adequately addressed the requirements of the TOR. The revised cross section showed the limestone lens in the pit area as isolated by faulting and other types of rocks from the nearby national park limestone. This supported the view of the first version of the EIS that the pit would be unlikely to intersect a cave that is connected to the cave system in a nearby section of the Chillagoe-Mungana Caves National Park.

However, Kagara's EM plan did not provided adequate contingency measures for the, albeit unlikely, possibility that a cave would be intersected during mining and cause environmental harm. On 15 April 2011, DERM requested that Kagara revise the EM plan to include adequate contingency measures. In the response received on 19 August 2011, Kagara argued that it is impossible to foresee the magnitude of groundwater interception that could be encountered. It follows that measures to stop any inflow to the pit from the interception of a karst groundwater aquifer would have to be developed to meet the particular circumstances at that time. DERM accepted this point of view. However, it is recommended that the environmental authority contain a proposed condition that no subterranean cave system should be intercepted by open pit mining, which would ensure that Kagara would have to take prompt measures to be in compliance with the environmental authority if a cave was intercepted.

4.5.2 Resource utilisation

The EIS adequately addressed resource utilisation. It stated that there would be no permanent sterilisation of a mineral resource. Although the "crown pillar", which is the portion of the resource that would be between the bottom of the proposed pit and the current underground workings, would be left temporarily, it is likely that future operations will mine the material.

4.5.3 Land use

The dominant land uses within the project area are grazing and mining, plus conservation and tourism at the nearby sections of national park.

No areas used for conservation or tourism would be disturbed by the mining activities.

No Good Quality Agricultural Land occurs on or near the MGOPDP site. The majority of the areas that would be disturbed by mining activities were classified as Land Suitability Class 4 or 5 (grazing), with some patches of Land Suitability Class 3 (grazing) where the waste rock dump would be located. [NB: Land Suitability Class 1 is the highest, while Land Suitability Class 5 is the lowest.] The potentially affected land of the lowest category, Land Suitability Class 5, is mostly in the area that would be occupied by the residual void.

Some disturbed land will be rehabilitated to support grazing. However, approximately 110 ha of land, including the residual void, will be permanently alienated from productive grazing. The economic consequences of that alienation are discussed in the section 4.14 of this report.

4.5.4 Land disturbance

The MGOPD would result in a total of 380.4 ha of disturbance, including approximately 110 ha of woodland. The residual void would be about 250 m deep and have an area of about 21.2 ha. A single waste rock dump would reach a maximum of 65 m above natural ground level and be approximately 75 ha in area. The tailings storage facility (TSF), which has been largely constructed under an existing approval, would have a footprint of about 33 ha.

Rehabilitation of the disturbed land is addressed in detail in section 4.17 of this report.

4.5.5 Land contamination

The EIS included a preliminary site investigation for contaminated land as required by the TOR. The investigation found that concentrations of some heavy metals, including zinc and lead, and potentially toxic metalloids, such as arsenic and antimony, are significantly but naturally higher than average in the project area due to the

mineralisation that is targeted by mining. There was no indication that the elevated concentrations of those metal and metalloids in the MGOPDP area were caused by human activity.

The proposed mining activities will inevitably result in some contamination of land. While the locations of accidental spills, such of fuel oils, and some operational activities could be completely remediated, the construction of a waste rock dump containing mineralised and potentially acid forming material, and a tailings storage facility will leave contaminated material that will remain on site, albeit encapsulated and rehabilitated on the surface.

If the MGOPDP site is not already included in the area covered by a previous registration, the presence after mining ceases of a waste rock dump containing mineralised and potentially acid forming material, and a rehabilitated tailings storage facility will likely necessitate the recording of the site on the Environmental Management Register. The proponent of the activities on the registered site will be required to provide a management plan for the site to ensure that it poses a low risk to human health and the environment. The Environmental Management Register will provide information about the site that is searchable for any future owners or users of the site.

The area within Kagara's mining leases close to the MGOPDP site has been the subject of previous toxicological investigation. In 2002, a study undertaken by the National Research Centre for Environmental Toxicology (EnTox) examined the uptake of a range of heavy metals and metalloids by cattle grazing on rehabilitated areas of the Red Dome Gold Mine site. The study assessed the risks associated with element uptake by cattle and the risk to humans of consuming meat from those animals. The study was a significant part of establishing the suitability of rehabilitated land used by mining activities associated with the Red Dome Pit for its proposed post-mining land use of cattle grazing. The EIS stated that the EnTox report demonstrated that although elevated element concentrations [of toxic metals and metalloids] occur on the Red Dome Mine site, they do not significantly impact on the suitability of the land for low intensity cattle grazing.

4.5.6 Landscape character and visual amenity

The region around the MGOPDP site has a dry tropical, rural landscape that largely reflects the underlying geology. The sandstones, chert and greywacke of the Chillagoe Formation form low rolling hills and rises covered by open woodland, while the Dargalong Metamorphic country is characterised by gently undulating rises. The limestone of the Chillagoe Formation forms a karst landscape with distinctive, prominent towers and cliffs.

The area has been changed by human activities. The Burke Developmental Road runs through the area in a generally east-west direction. The abandoned Mungana township and nearby Girofla and Lady Jane Mines and smelter works include a number of ruins mostly associated with mining activities of the late 19th and early to mid 20th centuries. More recent mining activity has left the decommissioned Red Dome Mine pit and the associated rehabilitated waste rock dumps and tailings dam. Current mining activities have also affected the landscape, and include: buildings; an active waste rock dump; dams including a relatively large impounding reservoir; a partially completed mineral processing plant; and the embankments of an as yet unused tailings storage facility.

The MGOPDP would further affect the landscape by leaving another residual void, a rehabilitated waste rock dump and a rehabilitated tailings storage facility. Other features of the mining activities, such as the mineral processing plant, could be decommissioned and removed.

The activities of the MGOPDP and its residual features would be hidden by higher ground and vegetation from the view of people travelling on the Burke Developmental Road and those visiting the former Mungana township. Only visitors to the Eclipse Tower and Mungana 2 Tower limestone formations would be able to see the residual features of the MGOPDP. The view from the base of the towers is likely to be obscured by vegetation, but those who climb the towers would have a clear view of the residual void and the rehabilitated waste rock dump. The rehabilitated tailings storage facility will be somewhat distant and fully or partially screened by the ridge of the Southern Sentinel Range. Vegetation on the rehabilitated waste rock dump and tailings storage facility will soften the visual impact, but the residual void will remain a prominent but unavoidable impact from a few vantage points.

4.6 Transport

The EIS predicted that addition road traffic would be generated by the MGOPDP as detailed in the following table.

Table 4.2 Expected traffic generation

Traffic type	Vehicle type	From	To	Material	vpd	Total trips
Construction traffic	19m semi-trailer (empty on return trip)	Balcooma	Mungana	Plant	<1	15
		Ravenshoe	Mungana	Plant	<1	1
		Townsville or Cairns	Mungana	Plant	<1	2
		Brisbane	Mungana	Core crusher unit	<1	2
	Low loader (empty on return trip)	Townsville or Cairns	Mungana	2 x leach tanks 6 x absorption tanks	<1	10
	Bus (20 seater, to and from site)	Chillagoe	Mungana	Construction crew	4	4 per day
Operational traffic	19m semi-trailer (empty on return trip)	Mt Isa	Mungana	Ammonium nitrate (explosive)	<1	A maximum of about 29 trips per week over all vehicle classes
		Mt Isa	Mungana	Slurry (explosive)	<1	
		Charters Towers	Mungana	Cyanide (poisonous)	<1	
		Townsville	Mungana	Grinding media	<1	
		Cairns	Mungana	Lime	<1	
		Townsville or Cairns	Mungana	Parts for workshop	<1	
		Cairns	Mungana	Plumbing and electrical equipment	<1	
	Truck and trailer	Cairns	Mungana	Fuel (flammable)	<1	
	B-Double	Brisbane	Mungana	Sodium metabisulfite	<1	
	Pantech	Cairns	Mungana	General freight	<1	
		Mt Isa	Mungana	Consumables (explosive)	<1	
	BAB or Type 2 road train	Mungana	Townsville Port via Xstrata shed	Concentrate (hazardous)	1	

Source: Mungana Gold Open Pit Development Project EIS (23 Feb 2011), Table 4.3.2 and accompanying text.
Notes: vpd = vehicle trips per day.

Mine workers during both the construction and operational stages will be accommodated in the existing workers camp on the outskirts of Chillagoe. Workers going on and off shift will be transported approximately 15 km between the camp and the mine site by a 20 seater bus along the Burke Developmental Road. The camp is on the

western side of Chillagoe, so the bus does not drive through the town on the way to and from the mine site. Approximately 40 workers will be needed during the construction phase and between 190 and 260 during the operational phase. The Burke Developmental Road has the capacity to accommodate the minor increase in passenger traffic associated with the MGOPDP without requiring an upgrade.

The Burke Developmental Road would experience the most increase in vehicular traffic, yet the increase would be relatively minor. Based on traffic volumes reported by the Department of Transport and Main Roads for the local area, the EIS predicted an increase of 2.2% in the overall Average Annual Daily Traffic volumes and a 1.7% increase in heavy vehicle traffic. The EIS assessed that these minor increases would not adversely impact on any state or local authority controlled roads.

The MGOPDP will not use rail freight. The old rail easement still exists for the Chillagoe Railway and Mining Company's line, which was opened from Mareeba to Mungana in 1901. However, regular rail services to Mungana ceased in 1958, and only extended beyond Chillagoe when needed to transport cattle. It is understood that the line is now disused. Nevertheless, the MGOPDP will not impact on the easement. Consequently, the MGOPDP will have no impact on rail infrastructure.

Operation of the MGOPDP will require an additional three flights per week into the Chillagoe Aerodrome to transport mine workers on shift from Cairns and Townsville. The Chillagoe Aerodrome has the capacity to accommodate the extra flights and the MGOPDP will have no impact on air transport infrastructure.

The Department of Transport and Main Roads provided a submission on the EIS that stated the EIS had adequately addressed the TOR with regard to transport issues.

4.7 Waste

The EIS identified four main types of waste that would be produced by the MGOPDP:

- waste rock
- tailings from processing ore on-site, including the solids and pore water, which can be partially decanted from the solids
- solid waste other than the above types of waste
- liquid waste other than tailings pore water.

4.7.1 Waste rock

The site already has waste rock dumps from current and previous mining activities. The dumps associated with the old Red Dome pit in the south eastern portion of the mining leases have been closed and rehabilitated. The active dump for the current underground workings lies immediately adjacent to the north side of the Mine Water Dam.

Kagara propose to construct a new waste rock dump for the MGOPDP adjacent to the north western end of the Raw Water Dam.

The EIS stated that consideration had been given to placing waste rock from the MGOPDP in the existing Red Dome residual void. However, this option was rejected because exploration has shown that potentially economic mineralisation extends underneath the Red Dome residual void, and the void may be used to give access to a new portal for future underground mining. During discussions between DERM and representatives of Kagara, the proponent was asked to consider other options for siting the waste rock dump. However, the proponent assured DERM that all other options for siting the WRD on the mining leases had been rejected because of potentially greater impacts due to unsuitable underlying geology or the destruction of cultural heritage values. DERM was then satisfied that the proposed location was the most suitable.

The first version of the EIS stated the dump would by the time of closure contain 52.5 million tonnes (Mt) of waste rock, including a cell for potentially acid forming material. Further work on mine planning reported in the amended EIS received with the response to submissions allowed the estimated amount of waste rock to be revised down. The revised estimate was that a total of 36.6 Mt of waste rock would be produced, comprising a maximum of 13.7 Mt (6.8 million cubic metres (Mm^3)) of reactive material, 20.9 Mt (10.5 Mm^3) of non-reactive rock and 1.9 Mt (1.1 Mm^3) of non-reactive earthen material.

In plan, the dump would be approximately rectangular with well rounded corners. The footprint would cover approximately 67 ha, being approximately 850 m in the north-south direction by 800 m in the east-west direction. The maximum height would be approximately 65 m above the natural ground surface.

The reactive material would be composed of the following main types:

- Potentially acid forming (PAF) rock containing sulfide minerals that can oxidise on contact with air and water releasing acid and mobilising metals and metalloids, resulting in an acidic, contaminated leachate.
- Reactive non-acid forming (NAF) rock that not only contains sulfide minerals, but also other minerals that could subsequently neutralise the acid produced by sulfide oxidation, resulting in a neutral or alkaline leachate contaminated by metals and metalloids.
- High soluble element NAF material, such as regolith that is already oxidised but has natural enrichment in metals and metalloids, and consequently could result in a neutral or alkaline, contaminated leachate.

In its submission on the EIS, DERM raised the following issues with the design and location of the waste rock dump:

- One illustration of geology showed a fault beneath the dump, while another did not.
- The EIS did not address whether there are any shallow alluvial aquifers or springs at the dump's location.
- The EIS did not satisfactorily address the potential for leachate to move laterally out of the WRD and contaminate the environment.

Kagara's response to submissions clarified that there is no geological fault beneath the proposed waste rock dump location and that the substrata were entirely composed of the Chillagoe Formation Sandstone. The response also clarified that there is no alluvial aquifer at the location and that there are no springs due to the low permeability of the Chillagoe Formation Sandstone.

Following consideration of the relevant factors, DERM accepted the proposed location for the WRD. However, there was still the matter of the potential movement of leachate from the WRD.

Leachate from the WRD can be generated in two main ways:

- lateral infiltration of water from overland flow at the base of the WRD
- vertical infiltration from rain water falling on the WRD.

Contaminated leachate, caused by infiltrated water interacting with reactive material, can be minimised by encapsulating the reactive rock in a cell that minimises the contact between water and that type of rock.

The EIS proposed that reactive material would be encapsulated within a cell (referred to as the PAF cell) measuring approximately 300 m by 580 m in the eastern part of the WRD. Infiltration modelling, reported in the EIS, estimated that water would accumulate at the base of the WRD to a height of no more than 0.3m before flowing laterally out of the WRD. Consequently, the EIS proposed that the PAF cell would have a basal platform made from non-reactive NAF material to raise the reactive material above any mounded water. The platform would have a 1 m thick basal seepage layer to preferentially move minimally contaminated water laterally through the base of the WRD into a seepage collection system. The top of the platform would be graded and covered with a low permeability layer to direct any seepage drainage that did penetrate the PAF cell across its surface towards the seepage collection system between the WRD and the Raw Water Dam.

The infiltration of water into the PAF cell would be minimised by capping layers. Prior to the start of each wet season, the upper layer of the recently deposited reactive material within the PAF cell would be profiled and covered with non-reactive earthy regolith material. That non-reactive material would be relatively fine grained and act to reduce the infiltration of water to the reactive material beneath. Once mining of the Mungana Open Pit has been completed a final capping layer would be placed over the PAF cell. The final layer would be 3.5 m thick and be made from non-reactive NAF rock and earthy waste materials. It would comprise a lower stratum at least 1 m thick with a low permeability of less than 1×10^{-8} m/sec, which would be covered with a 2.5 m layer of non-reactive material that would provide erosion protection and growth media for rehabilitation. The low-permeability final capping layer would extend beyond the lateral extent of the PAF cell and its basal platform to minimise vertical infiltration of water into the PAF cell.

The rest of the WRD would be covered with a layer of non-reactive material that would provide erosion protection and growth media for rehabilitation, but without the low-permeability layer. The final profile of the WRD would facilitate the shedding of rainfall by having outer slopes with a minimum gradient of 2%. Erosion would be minimised by forming external batters with a maximum slope of 4(H):1(V). Benches around the sides of the WRD and drop structures at the north eastern and south eastern corners of the WRD would direct surface runoff to the Raw Water Dam.

During operations, runoff and seepage from the WRD would be collected by temporary bunding and sumps, and then it would be directed into the process water circuit or pumped into the Red Dome void. The EIS concluded that the provision of capping layers during operations prior to wet seasons and at closure will prevent infiltration to such an extent that low-permeability side walls will not be needed for the PAF cell. However, DERM had concerns that the design of the PAF cell would be deficient without side walls as contaminated seepage could move laterally out of the WRD and bypass the seepage collection system. DERM was also concerned that the southern toe of the WRD would be within the Q100 flood level at RL 310.5 m. DERM put these concerns to Kagara in both the submission on the EIS and the additional comments provided to Kagara on 15 April 2011.

On 19 August 2011, Kagara provided a revised design for the WRD. The revised design has the footprint entirely above the RL 310.5 m Q100 flood level. The revised design also incorporates a bund along the edges of the basal platform from the middle of the side nearest the MGOPDP pit towards the eastern corner of the WRD, then along the south eastern side to the south corner, with a further short section from the south corner along the south western edge of the WRD. The bund would prevent uncontrolled lateral seepage off the PAF basal platform, but it would have openings at the drop structures at the eastern and southern corners to allow any seepage to pass off the basal platform into a seepage collection sump. The revised design also illustrated how the capping layer above the PAF cell would extend beyond the cell and over the drop structure at the southern corner.

DERM is satisfied that the proposed design would adequately manage the encapsulation of PAF material and deal with any seepage from the PAF cell during the operational phase of the MGOPDP. Furthermore, because any seepage would be directed to a particular location that can be readily monitored, the design will allow DERM to be satisfied that when the WRD is finally capped and closed there will be no significant legacy issues due to seepage after mine closure.

It is recommended that the draft environmental authority include conditions requiring the construction of the WRD at least to the standard shown in the design provided on 9 August 2011.

4.7.2 Tailings

4.7.2.1 Tailings properties

The EIS reported that the processing plant would produce three different types of tailings corresponding to the oxidised, transitional, and primary ores. In general, the physical properties of the tailings would be as follows:

- solids density: 2.79 t/m^3
- slurry density (solids concentration):
  - oxide ore 50% (wt/wt)
  - transitional ore 56% (wt/wt)
- average in storage dry density
  - settled condition: 1.1 t/m^3
  - consolidated/air dried condition: 1.6 t/m^3
- liberated tailings water (based on settled tailings density of 1.1 t/m3): 0.45 tonnes of water per tonne of tailings.

The geochemical properties would vary between the three different types of tailings. However, the mineralogy of all three tailings types would be dominated by quartz. In addition to quartz, the three types of tailings would contain the following minerals:

- oxide ore tailings: goethite, kaolinite, mica and hematite, with trace amounts of marcasite and anglesite.

- transitional ore tailings: siderite, chlorite and goethite, and traces of chalcopyrite, anglesite and hematite.
- fresh ore tailings: mica, chlorite, and feldspar, and traces of arsenopyrite, hematite, and ilmenite.

The tailings would have low to moderate acid neutralising capacity (between 9 kg and 22 kg H_2SO_4/tonne), and all would be non-acid forming (NAF) due to very low sulfide concentrations.

The EIS reported the analysis of tailings samples generated by bench scale processing of Mungana ore. In those samples tailings pore waters were alkaline (pH 8.1 – 9.0) and brackish to saline (total dissolved solids concentrations of 5,100 mg/L to 10,000 mg/L). The major-ion chemistry of the tailings pore water was dominated by sodium and sulfate due to the sulfur dioxide based treatment employed to detoxify the cyanide. Bicarbonate (HCO_3^-) concentrations of 410 mg/L to 1,000 mg/L result from the breakdown of cyanide and incomplete degassing of carbon dioxide from solution. Ammonia concentrations of 15 mg/L to 77 mg/L were also the result of the breakdown of cyanide. Total cyanide in the bench test samples were reported to range between 0.04 mg/L and 14 mg/L and 0.05 and 16 mg/L for the weak acid dissociable cyanide. Elevated copper (38 mg/L) and arsenic (4.6 mg/L) concentrations were found in the tailings slurry waters of the bench test samples.

4.7.2.2 Tailings storage facility

Tailings from the MGOPDP ores would be deposited in a tailings storage facility (TSF) on mining lease ML5176 in the south western part of the mining complex. Approval to construct the TSF was provided in the existing environmental authority, and the outer embankments have been completed.

The TSF sits entirely on rocks of the Dargalong Metamorphics, which have low permeability, and there are no faults below the footprint of the TSF. The low permeability basement rocks together with a clay liner will ensure there is minimal seepage from the TSF.

The EIS described the TSF as having the following features:

- earth and rock fill embankment to a crest level of RL 323 m
- clay lining of the storage floor, formed by conditioning and compaction of in situ soils
- emergency spillway located on the western corner of the TSF embankment and discharging to a tributary of Welcome Creek
- seepage collection system comprising an embankment underdrain, seepage collection sump and return water pump
- decant structure for the recovery of bleed tailings water and stormwater runoff from tailings beach areas
- tailings delivery line from the plant site to the TSF
- perimeter tailings deposition line with spigots
- return water line from the decant structure to the process pond.

The total requirement for tailings storage for the MGOPDP is 2,156 ML, plus a storage freeboard requirement for stormwater of 406 ML, giving a requirement for total TSF capacity of 2,562 ML. The constructed TSF has a capacity at spillway level of approximately 2,740 ML, which would allow the TSF to operate without overflowing except under extreme climatic conditions. Given the short length of time that the TSF would be operational, it is expected that the TSF will operate with zero discharge to the environment.

The seepage collection drain is located beneath the TSF embankment immediately downstream of a "cut-off key" that prevents lateral seepage below the embankment. The seepage collection drain extends around the external perimeter of the TSF, draining by gravity to a seepage collection sump. A seepage recovery pump would return seepage water to the TSF.

Tailings would be deposited "subaerially" (i.e. poured from open pipes onto beaches rather than discharged under water) from spigotted peripheral discharge pipelines. Discharge would occur from the southern, eastern and western embankments, forming the beach low point adjacent to the lower slopes of the range of hills that form the northern perimeter of the TSF. The cycling of discharge from the spigots would be designed to keep the beaches at least damp to reduce dust emissions.

The EIS originally proposed that a low point of the beaches at the northern side of the TSF would form a decant pond from which bleed tailings water and stormwater runoff would be pumped back to the process pond for reuse. The EIS originally stated that the decant system would be operated so that the water volume within the decant area would be generally kept at a minimum level. The response to comments received on 9 May 2011, stated that under normal operating conditions and seasonal rainfall patterns, the decant storage volume would be approximately 80 ML, which is a significant proportion of the freeboard capacity and would form a large open pond on the tailings.

The processing of gold ore would use cyanide. As much cyanide as possible would be recovered for reuse from the thickened tailings before their deposition in the TSF. However, the tailings and the bleed water that would decant out of the tailings after deposition would still contain some cyanide. The EIS proposed to dilute the thickened tailings with water of low cyanide content and then use the INCO process to further reduce cyanide content by chemical destruction. However, despite the relatively low concentrations of cyanide obtained in the bench test, the EIS committed only to achieving less that 50 mg/L of weak acid dissociable (WAD) cyanide in process effluent, and said that less than 20 mg/L of WAD cyanide would be achieved if possible.

DERM had concerns with that proposal for two main reasons. Firstly, a large open pond containing up to 50 mg/L of WAD cyanide that may be concentrated through evaporation would present unacceptable risks for wildlife, particularly birds, that may roost on, or drink from, the decant pond. Secondly, because the tailings would contain significant amounts of copper, and because cyanide may breakdown to ammonium ions in anaerobic conditions at the bottom of the decant pond and in contact with the copper bearing tailings, there would be the potential for the formation of copper amine complexes that are also toxic to wildlife. These concerns were provided to Kagara in DERM's submission on the EIS, and in DERM's comments provided on 15 April 2011 on the proponent's response to submissions.

In those written comments and in subsequent discussions with the proponent on this issue, DERM suggested that the solution would be to either reduce WAD cyanide concentrations in the effluent of an open pond to less than 10 mg/L, or to construct a separate decant pond that would segregate the decant liquid from contact with the tailings, and which would have netting or other mechanisms to deter wildlife from visiting the pond.

Kagara has consistently argued in its responses and additional information received between 23 February 2011 and 19 August 2011 that a concentration of 50 mg/L of weak acid dissociable (WAD) cyanide in process effluent was supported by relevant publications, in particular:

- Cyanide Management (Leading Practice Sustainable Development Program for the Mining Industry, Commonwealth of Australia, 2008)
- Sodium Cyanide, Priority Existing Chemical Assessment Report No.31 (National Industrial Chemicals Notification and Assessment Scheme, Commonwealth of Australia, 2010)

For example, Kagara's response received on 9 May 2011, quoted the Sodium Cyanide (2010) report as stating that 'field observations indicate that few wildlife mortalities are likely to occur at concentrations below [50mg/L WAD cyanide]'.

However, DERM's view is that Kagara has not fully appreciated the content of those publications. For example, the Cyanide Management (2008) handbook states 'The impact on wildlife is demonstrated to be low if tailings ponds contain WAD cyanide at levels less than 50 milligrams per litre, [and] **access to the ponded area is restricted**…' [DERM's emphasis]. Similarly, the Sodium Cyanide (2010) report stated that for Category 2 TSFs (i.e. those with between 10 mg/L and 50 mg/L of WAD cyanide) the strategy should be a 'reliance on a combination of concentration control **and wildlife exposure minimisation strategies to protect wildlife**' [DERM's emphasis]. Furthermore, the Sodium Cyanide (2010) report made the following statements:

> 'There is a body of evidence…that relatively few or no mortalities are observed at lower WAD CN [cyanide] concentrations [than 50 mg/L]. However some caution is needed because field observations to determine the extent of sublethal effects are lacking.'
>
> 'At concentrations of <50 mg/L WAD cyanide, available field data indicates that few **acute** [DERM's emphasis] mortalities are likely to occur.'

> 'Insufficient field evidence is available regarding the likelihood of sublethal effects arising such as greater predator susceptibility and reduced flying ability (important for migratory birds). Mortality or sublethal effects could vary between species (e.g. with drinking and swimming behaviour as well as species sensitivity), and with behaviour affected by local conditions (e.g. whether or not alternative water sources are available). Greater risks of mortality would be expected as the concentration in this range increased and with decreasing effectiveness of alternative measures.'
>
> 'At concentrations <10 mg/L WAD cyanide, no acute mortalities and minimal sublethal effects are expected.'

DERM's view is that the publications do not state that WAD cyanide concentrations of less that 50 mg/L would necessarily have no significant impact on wildlife. Rather, it is DERM's view that the publications support a spectrum of approaches that could range from taking no wildlife exclusion or deterrent measures only when the WAD cyanide concentration is less than 10 mg/L, to allowing a WAD cyanide concentration of 50 mg/L in the ponded effluent only if stringent measures, such as netting, are taken to exclude wildlife from contact with the effluent. A WAD cyanide concentration of between 50 mg/L and 10 mg/L may be considered in the ponded effluent depending on the expected effectiveness of measures proposed to exclude wildlife. However, Kagara had not proposed any restrictions for wildlife to the ponded area and had not committed to a WAD cyanide concentration of less than 50 mg/L.

In response to DERM's continued concerns expressed during discussions with the proponent after DERM provided written comments on 15 April 2011, Kagara provided a draft revised design for the TSF on 19 August 2011. The revised design included a decant ring structure to be built of no-fines rock fill linked by a rock causeway to the northern side of the TSF. The decant ring structure would be permeable so that water from the tailings would pass through and form an open pond within the structure, while solid, fine material would be retained outside the structure in the main part of the TSF. The pond within the ring would have a diameter of approximately 120 m. The height of the ring would be raised progressively ahead of the tailings beach to maintain adequate freeboard in the TSF by minimising the placement of rock fill within it. A sled-mounted pump would transfer decant water from the pond within the decant ring structure to the plant site for use in mineral processing.

The intent of the ring structure is to form a deeper pond of contaminated decant water with a much smaller surface area than was previously proposed, and with much reduced contact with the tailings solids. The smaller surface area of the decant pond, which would constitute only 4% of the total area of the TSF, would both reduce its attraction to birds and permit more concentrated efforts to deter birds from drinking from, or roosting on, the pond. Land animals could be excluded from the ring pond by constructing a gated fence across the causeway. It is recommended that the draft environmental authority include conditions requiring measures that would deter birds from the decant ring structure pond, and fencing to prevent access by macropods. The conditions should also require monitoring for bird and other animal mortalities, and corrective actions that should be undertaken if monitoring shows that significant numbers of mortalities are occurring.

Ponding of contaminated decant water on the tailings would be minimised by use of the decant ring structure. Most of the time during the dry season, the tailings beaches would be dry, but some ponding may be present outside the ring structure if wetter years occur during the operation of the TSF. The information provided with the revised design indicated that the maximum area of water on the tailings outside the ring structure during the dry season would be 8 ha, which is less than half the area originally proposed. Any such ponding would be preferentially removed for use in the process plant.

Copper amine complexes tend to form under anaerobic conditions due to the interaction of ammonium ions produced by anaerobic degradation of cyanide and copper in the tailings. Anaerobic conditions will be avoided when beaches are dry and be minimised during wet periods by removing ponded water as soon as possible from the surface of tailings. The proposed design is considered sufficient to mitigate the potential impacts on wildlife from copper amine complexes. Nevertheless, it is recommended that the draft environmental authority include conditions requiring additional measures to deter birds while a significant amount of contaminated decant water is ponded outside the ring structure. The amount of ponding considered significant should be defined in the conditions.

Kagara undertook additional modelling work to predict the concentration of WAD cyanide that is likely to occur in tailings effluent that may pond occasionally on beaches of the TSF outside the decant ring structure, and on 30 August 2011 proposed a new set of discharge criteria for WAD cyanide at the spigot discharge points. The new proposal was for a median concentration of 30 mg/L WAD cyanide as a rolling measure over any twelve consecutive samples taken at monthly intervals with a maximum at any time of 50 mg/L. The proponent's view was that they would incur unreasonably expensive additional operating costs of $10 million per year and unspecified additional capital costs for the processing plant if the WAD cyanide concentration was to be reduced to 10 mg/L.

It is DERM's view that Kagara has provided insufficient justification for their position that a median value of 30 mg/L WAD cyanide in discharged tailings is the best that can reasonably be achieved. Also, it is DERM view that the concentration of cyanide in the freestanding water bodies within or surrounding the decant ring structure is as important as the concentration in the discharge at the spigot. Furthermore, monthly sampling may not provide an adequate frequency depending on the finally agreed concentration limits for cyanide in the discharge to the TSF and the decant pond. More frequent sampling may be required, particularly if the concentration of cyanide rises above a yet to be agreed concentration of WAD cyanide at the spigot or decant pond.

Consequently, the EM plan for the project should propose additional measures for sampling of the decant water in freestanding ponds as well as at the spigot. The EM plan should also propose concentrations for cyanide in both the discharge at the spigot and any freestanding ponds of decant water. The concentrations will be decided by negotiation between Kagara and DERM after Kagara provides additional information on the practicality and costs of cyanide usage, recovery and destruction at the processing plant and TSF.

The EM plan should include detailed measures for excluding and/or deterring wildlife from freestanding water bodies that are contaminated with an agreed level of cyanide or other toxic substances. For example, the measures may be a combination of fencing, netting and/or bird scaring techniques. The EM plan should also propose adequate monitoring measures that would detect if a significant number of bird or other animal mortalities occurred, and corrective actions to be taken if the number of mortalities is unacceptable.

It is recommended that the draft environmental authority include conditions that:

- limit the WAD cyanide concentration to yet to be agreed values in spigot discharge and freestanding water bodies
- require the construction of the decant ring structure as in the design supplied on 19 August 2011
- require environmental protection commitments for wildlife exclusion or deterence from contaminated water bodies that will avoid significant mortalities of wildlife
- require effective monitoring for any significant mortalities of wildlife
- require the proponent to review available corrective actions and implement measures where necessary.

4.7.3 Other solid and liquid waste

The MGOPDP would produce a significant quantity of cleared vegetation. Section 4.11 of this report details the measures that would be undertaken to minimise the clearing of vegetation and deal with the cleared vegetation waste.

Waste concrete would be deposited in the WRD. Other construction or demolition waste would be recycled or removed from site by appropriately licensed waste contractors for disposal in an appropriately licensed off-site landfill.

Scrap metal will be recycled where possible or otherwise removed and disposed of by appropriately licensed waste contractors.

Hydrocarbon wastes, such as oils and grease, resins, paints, batteries and tyres are regulated wastes. They will be disposed of by appropriately licensed waste contractors continuing the current practice for the existing mine.

General and domestic type waste will continue to be taken to the Chillagoe landfill for disposal.

General recyclable waste will continue to be removed by a waste contractor for processing at facilities in Cairns or Mareeba.

The MGOPDP will not require the construction of a new sewage treatment facility.

Adequacy of the EIS with respect to waste issues

The final EIS, comprising the first version and subsequent information received, has adequately addressed the TOR with respect to waste issues

4.8 Water resources

The EIS adequately address the terms of reference with respect to water resources.

4.8.1 Surface waters

The MGOPDP site is within the catchment of the Walsh River, which itself is part of the Mitchell River catchment. The Mitchell River flows to the north west into the Gulf of Carpentaria.

Chillagoe is upstream of the mine site, and therefore could not be impacted by discharges to water from mining activities. The downstream catchment is only sparsely populated by isolated pastoral stations between the mine site and the community of Kowanyama, which lies approximately 400 km to the north west on the Gulf of Carpentaria.

The relevant environmental values for waters that could potentially be impacted by the MGOPDP are as follows:

- biological integrity of an aquatic ecosystems
- the suitability of the water for agricultural purposes, particularly watering of stock
- the suitability of the water for recreational use, particularly tourism
- the suitability of the water for producing the foods for human consumption, particularly fisheries.

There were no records of water downstream of the site being used for domestic or industrial use.

With regard to tourism, camping occurs on the Walsh and Mitchell Rivers.

With regard to fisheries, traditional and recreational fishing occurs mostly along the lower Mitchell River, but significant recreational fishing also occurs on sections of the Walsh River, particular during holiday periods. The Gulf of Carpentaria hosts a major commercial fishery centred on Karumba.

On a local scale, the MGOPDP site is within the catchments of Opera Creek, Welcome Creek and One Mile Creek. The EIS stated that only one watercourse would be directly affected by the MGOPD. The watercourse is a tributary of One Mile Creek between the north and south ridges of the Sentinel Range, and is an ephemeral, first-order stream channel. It would be almost completely buried by the MGOPDP Waste Rock Dump. However, the size of the catchment that would be excised is small and the MGOPDP would not impact significantly on the quantity of water flowing downstream. The other features of the MGOPD are in high points in the topography and are unlikely to significantly affect overland flow or watercourses.

The EIS presented data on water quality in Opera Creek, Welcome Creek and One Mile Creek, and compared the data to the trigger values in the ANZECC 2000 guidelines for both livestock drinking water and trigger values for slightly to moderately disturbed upland rivers in tropical Australia. Not surprisingly for a highly mineralised location, the water quality data showed background enrichment above trigger values in some metals and metalloids including arsenic, cadmium, cobalt, copper, lead, molybdenum, selenium and zinc.

There is an existing impounding water storage, called the Raw Water Dam, on Opera Creek. The Raw Water Dam is located between the western end of the Southern Sentinel Range and the proposed location of the MGOPDP's waste rock dump. Although its name may suggest that the dam is solely an impounding reservoir of clean runoff, it was constructed to take runoff from disturbed areas of the Red Dome Project, and served as a process residue pond during the operation of that mine. The quality of the water in the dam is hard with some elevated levels of metals and metalloids. Nevertheless, the quality is sufficiently good for stock watering, and the dam supports native aquatic plants and animals, including water lilies, water nymphs, fish, crustacea, and freshwater crocodiles.

The MGOPDP would involve the construction of additional storages including a Process Water Pond; Plant Site Sediment Dam; and the TSF (detailed assessment of the construction and management of the TSF has been discussed in the previous section of this report). The Process Water Pond and Plant Site Sediment Dam are not of

sufficient size to require approval under the *Water Act 2000* for the taking of overland flow. The process water circuit would also involve the existing Mine Water Dam, which collects water pumped from the current Mungana underground mine workings.

The Plant Site Sediment Dam would capture runoff from the MGOPDP plant site, and therefore would not be a true sediment dam because the runoff may be contaminated by material other than soil-derived sediment. The Process Water Pond would have a capacity of 3,000 m^3, and would provide buffer storage for water to be used in the process plant. It could receive water from a variety of sources including the Plant Site Sediment Dam, return water from the TSF circuit, and the Mine Water Dam.

The Plant Site Sediment Dam, Process Water Pond and Mine Water Dam would be in the catchment of the Raw Water Dam and could discharge to it. That is, all the water storages could receive contaminated runoff. Consequently, all the storages, including the Raw Water Dam, would be regulated dams, and each must be assigned a hazard category.

The residual void of the Red Dome Pit could also be used in the water circuit for the MGOPDP as a storage to which water could be pumped from other storages that are nearing their capacity under wet climatic conditions. The water balance model described in the EIS demonstrated that the existing Red Dome Pit would never discharge.

The EIS stated that during the first 6 months of mining and prior to plant commissioning, provision will be made for the ability, should it be needed, to pump water from the Plant Site Sediment Dam to the Mine Water Dam or Red Dome Pit. This is because the water balance modelling identified a risk that the Plant Site Sediment Dam could overflow during that first 6 months period, but not after.

The water balance model found that the TSF would never discharge subject to maintaining the design storage allowance at the start of each wet season (nominally 1 November).

As the water management system as a whole has been designed so that most storages would not discharge or would discharge to the Raw Water Dam, the only potentially significant source of discharge to the environment is from the Raw Water Dam. The Raw Water Dam has a relatively high potential frequency of discharge. The modelling undertaken for the EIS found there was a 62% chance of the Raw Water Dam discharging over its spillway within the 6 year modelled period. However, that is an averaged probability over a range of climatic conditions, and during La Nina events the Raw Water Dam is likely to overflow its spillway each wet season. The Raw Water Dam spillway discharges into Opera Creek, which flows into Welcome Creek, and eventually into the Walsh River approximately 30 km downstream.

In response to DERM's submission on the EIS, the proponent clarified that the water management system would have three component circuits:

- Clean Water Circuit comprising the Raw Water Dam, Red Dome Sediment Dam and reporting catchments. This circuit comprises the upstream catchment of the Raw Water Dam, excluding the contained catchments of the plant area and Run of Mine Ore Pad and Mine Water Dam catchment.
- Contaminated Water Circuit comprising the Mine Water Dam, Plant Site Sediment Dam, Pit Sump and Red Dome Pit. This circuit would manage runoff from the disturbed and/or contaminated areas associated with the proposed MGOPDP with water transferred into the Process Water Circuit (see below) when makeup is required, or alternatively transferred to the Red Dome Pit as a buffer storage. Under modelled conditions, the spill risk was less than 1% (AEP) during operations.
- Process Water Circuit comprising the TSF and Process Water Pond. This circuit would manage the process water and rain falling directly within the two containment systems. The system would on average be in water deficit, with makeup water sourced from the contaminated water circuit. Under modelled conditions, no spills would occur from this system during operations.

As the modelled probability of the Contaminated Water Circuit spilling into the Raw Water Dam is less than 1%, the consequent risk of the Raw Water Dam discharging contaminated water is also low. The Contaminated Water Circuit in particular should be managed so that there is adequate storage allowance at the start of each wet season for the risk of spill into the Raw Water Dam to be insignificant.

Seepage from the Waste Rock Dump during the operational phase of the MGOPDP would be collected and pumped to the Process Water Pond or the Red Dome Pit residual void. Any seepage from the Waste Rock Dump

after the closure and rehabilitation of the dump is expected to be minor in comparison to the volume of the Raw Water Dam, and not significantly contaminated because the PAF cell would be isolated from leaching. Consequently, any discharge from the Raw Water Dam is unlikely to significantly impact on the receiving environment.

Current conditions on the environmental authority for mining activities at the site require that the water quality of the Raw Water Dam will be maintained by not allowing any water that is of worse quality to flow or discharge into the dam. Those conditions will be continued when the environmental authority is amended for the MGOPDP.

With regard to the residual void after mining of the Mungana Open Pit is completed, the EIS made the following statement:

> The MGOPD pit will be developed almost wholly within the Chillagoe Formation Sandstone and Chert units. Post mining it is intended to divert water to the pit to ensure the water level approximates the pre mining level. Void inflow modelling indicates that a catchment diversion of 27 ha will ensure that the final water level reaches 2,310 mRL (the pre mining level and 27 m below the pit crest) approximately 27 years after cessation of mining. Modelling also indicates that water level will remain steady at this level and no discharge from the pit will occur.

That situation for the residual void would be acceptable to DERM.

4.8.2 Groundwater

Groundwater issues in the Mungana area have been extensively studied for some years because of on-going mining activities, and were adequately addressed in the EIS.

The Mungana Open Pit would be excavated entirely within rocks of the Chillagoe Formation. The large majority of the rocks that would be excavated are composed of sandstone, chert and breccia. A small amount of alluvium and limestone would also be excavated.

There is very little alluvium in the gullies and creeks of the project site. Consequently, there are no alluvial aquifers of any significance. The chert beds are of very low porosity, and are not aquifers, rather they act as aquitards.

The sandstones of the Chillagoe Formation provide low discharge aquifers. The EIS reported that there is little or no primary porosity associated with the sandstones, and that groundwater is constrained to fractures within the rock. The sandstones in the region of the proposed Mungana Open Pit have already experienced drawdown of the groundwater level due to dewatering for the existing underground mine.

Breccia may be expected to have greater groundwater yield than the sandstone due to more fracturing. However, the EIS showed the breccia at the proposed Mungana Open location as being contained in a lens that is surrounded by sandstone and not extending to locations outside the Mungana Open Pit. Consequently, it is unlikely that the breccia would have hydraulic connection to rocks of similar groundwater yield.

The primary aquifer in the region is the Chillagoe Formation limestone. However, there are significant variations in permeability and storativity within the limestones, and groundwater largely occurs in fractures, solution channels and larger caves in the karst development. Hydraulically, the aquifers within the limestone sequence are semi-confined or confined. The EIS reported widely varying depths to groundwater in the limestone formation immediately to the north west of the proposed Mungana Open Pit, which is indicative of the variable local permeability and hydraulic disruption.

Dewatering for the existing underground mine has had no significant impact on the water level in a monitoring bore at the nearby national park, and it is expected that the open pit would similarly have no significant impact. While the proposed Mungana open pit would excavate some limestone, the amount would be small at only 1% of the total pit material. Furthermore, the EIS reported that the limestone is isolated in two small 'pods' by low porosity sandstones from the regional karst system. Consequently, the excavation of the limestone is not expected to have an impact on groundwater in the caves of the nearby national park or the wider regional karst system. However, as noted previously in section 4.5.1, *Geology of the pit and nearby karst limestone formations*, it is recommended that

the environmental authority contain a condition that no subterranean cave system should be intercepted by open pit mining.

Using data obtained from the dewatering of the existing underground mine, the EIS reported on modelling of the expected drawdown in groundwater level due to the proposed dewatering of the Mungana Open Pit. The modelling predicted a relatively small area of influence that would extend approximately 1,500 m from the centre of the pit along the direction of strike (which is generally north west — south east) and only approximately 300 m normal to the direction of strike. The differences would be due to the differing perrmeabilities and hydraulic disruption in the beds of the Chillagoe Formation. Because of the short distances involved, the predicted area of influence for groundwater drawdown would be largely contained within the mining leases, and no impacts are expected on groundwater resources used by any neighbouring properties.

As noted above in section 4.8.1, after the pit is excavated and dewatering stops, the water level in the void would rise rapidly and would reach equilibrium within approximately six to ten years. The EIS proposed that runoff from approximately 27 ha of surrounding land would be diverted into the pit so that the equilibrium level in the void would be at approximately the same depth as the pre-mining groundwater level relative to the natural surface. That would mitigate the pit from acting as a groundwater sink and avoid residual drawdown. The equilibrium water level would be approximately 30 m below the pit crest and the pit would never overflow. The quality of water in the residual void is expected to be suitable for stock watering and is unlikely to impact on groundwater resources in the area due to lateral seepage.

The Water Resource (Mitchell) Plan 2007 regulates water in the area in which the MGOPDP would be located. Dewatering the pit in the operational phase of the project will require a water licence under the *Water Act 2000* in accordance with the Water Resource (Mitchell) Plan. However, the EIS did not provide sufficient detail for the development of recommended conditions for the water licence. Conditions will be developed when the application for the licence has been received and assessed by DERM.

4.9 Air quality

The air quality in the region of the mine site tends to vary with the seasons. The locality has a tropical climate with two distinct wet and dry seasons. During the summer wet season, the soil moisture increases and this encourages ground cover plants to grow. Both increased soil moisture and ground cover result in lower dust levels in the atmosphere. As the winter dry season progresses, soil moisture decreases, plants die off, and grass and bush fires become more frequent. All these effects increase particulate concentrations in the atmosphere from dust and smoke.

Kagara's mining leases that will contain the MGOPDP site are relatively isolated from other places of human habitation or work. Rockwood Station, which lies approximately 8 km north west of the site, is the nearest homestead to the mine, while Chillagoe, approximately 15 km east of the site, is the nearest residential community. As noted in section 4.4 of this report, the winds are very predominantly from the east, so neither Chillagoe or Rockwood Station are downwind of the MGOPDP site for any significant time and that, coupled with the separation of distance, means that neither of the localities is likely to experience any significant impacts on air quality.

However, there are several sections of the Chillagoe-Mungana Caves National Park very close or nearby to the proposed MGOPDP that are visited occasionally by Park Rangers and tourists. The Eclipse Tower section of the national park is only 200 m from the proposed pit and approximately 1 km from the existing ore crushing and processing area and the active waste rock dump, while the next closest section, Piano Tower, is 1.25 km to the east of the processing area and waste rock dump.

There are no other resource industry or industrial sources of air emissions within 15 km of Kagara's operations, and therefore none that could conceivably contribute to cumulative impacts on the airshed. Pastoral activities in the area must provide some contribution to particulates in the atmosphere due to the reduction of ground cover, the movement of beasts, and traffic on unsealed roads. However, that contribution cannot be separated from the natural background using available monitoring techniques.

Dust deposition rates are highly variable over time, with the highest measured rates (including a maximum of 110 mg/m^2/day at Chillagoe Camp on 30 November 2009) tending to occur late in the dry season (Oct—Nov

2009). However, the lowest measured rates at all the monitoring sites (including a minimum of <0.1 mg/m^2/day at Chillagoe Camp) also occurred in the dry season on 2 September 2009, so the correlation of dust deposition with the seasons is not strong.

A reference site towards the south east of Kagara's leases had an average dust deposition rate of 16 mg/m^2/day, while the average at the Eclipse and Mungana 2 Caves was 17 mg/m^2/day, leading the EIS to conclude that the current mining operations contribute 1 mg/m^2/day to dust deposition at the closest protected area.

Based on the ambient monitoring, the EIS estimated the fine particulate concentrations in air at least 1 km from the mine as follows[1]:

- $PM_{2.5}$ (24 hour) = 4 µg/m^3
- $PM_{2.5}$ (annual average) = 2 µg/m^3
- PM_{10} (24 hour) = 14 µg/m^3

The EIS based its predictions of emissions to air on a worse-case scenario comprising a fully developed mine with waste rock dumping at the maximum rate of 25 Mt/y and milling of ore also at the maximum rate of 1.2 Mt/y. The potential for impacts on air quality are primarily associated with emissions of dust (particularly from mineralised material) and cyanide from the ore processing and tailings disposal facilities. Emissions of oxides of sulfur or nitrogen, and of greenhouse gasses, would be relatively minor. A typographical error in the first version of the EIS, which stated the emissions of nitrogen oxides would be 305 kg/h, was corrected in Kagara's response to submissions to 0.305 kg/h.

DERM's submission on the EIS noted that the approach used to develop the air quality goal for ambient cyanide needed revision, because the EIS had extended the 8-hr time weighted average (TWA) occupational limit to 24 hours, which would effectively triple the exposure. DERM noted that the Victorian EPA State Environment Protection Policy (Air Quality Management) used a commonly adopted approach that divides the 8-hr TWA by 300 to derive a planning goal of 170 µg/m^3 cyanide per 3-minute interval, and that this should be used as the example of current best practice. In the response to submissions, Kagara remodelled the potential exposure using the Victorian EPA level as a planning goal. The result showed that the maximum concentration would be approximately 0.02 µg/m^3 compared to the goal of 170 µg/m^3, and therefore the operation would readily meet the 3 minute limit suggested by DERM.

The first version of the EIS (i.e. that available to the public during the submission period) found that the MGOPDP would meet the air quality objectives of the Environmental Protection (Air) Policy 2008 except that the $PM_{2.5}$ and PM_{10} 24 hour average objectives would be exceeded at the nearby Mungana 2 and Eclipse Caves. The EIS argued that the exceedences would not be hazardous to health as the risk from fine particulates is generally associated with urban sources, such as vehicle emissions, rather than the crustal material emitted by mining activities. However, neither DERM nor Queensland Health accept the view that only urban emissions of the $PM_{2.5}$ and PM_{10} particulate fractions can be hazardous to human health. Rather, fine particulates from any source should be assessed as potentially hazardous to health. Furthermore, the EIS did not provide an assessment of the potential impacts of metals in dust.

DERM's submission on the EIS requested an assessment of: the potential impacts associated with metals in dust; clarification of the modelling of $PM_{2.5}$ and PM_{10} and the potential impacts of those fine particulates at the nearby protected area; a reassessment of the potential for cyanide exposure; and other minor clarifications.

The revised EIS received on 23 February 2011 provided an assessment of metals in dust, specifically lead, cadmium and arsenic, which have air quality objectives in the EPP(Air). The assessment assumed that only ore, and not waste rock, would contribute metals. However, analyses presented elsewhere in the EIS showed that the concentrations of metals and metalloids, particularly arsenic and lead, in waste rock could exceed the concentrations in ore. Consequently, on 17 March 2011, DERM requested that the proponent reassess the potential impacts of metals in dust.

On 9 May 2011, the proponent provided a satisfactory response to the outstanding issues related to fine particulates and metals in dust. The response stated that first version of the EIS did not consider the mitigating effects of

[1] $PM_{2.5}$ and PM_{10} means particles in the air environment with equivalent aerodynamic diameters of not more than 2.5 or 10 microns respectively.

commonly used dust control measures when predicting exceedences of air quality objectives at the Mungana 2 and Eclipse Caves. The response stated that with the controls in place, reductions of approximately 35% could be achieved in the concentrations of fine particulates in air, and consequently the air quality objectives of the EPP(Air) would be achieved at the Mungana 2 and Eclipse Caves. The controls that would be used at the MGOPDP include wind breaks and water spraying of stockpiles.

The response received on 9 May 2011, also provided a reassessment of the potential impacts of metals in dust. The reassessment considered the average concentration of arsenic, lead and cadmium in waste rock as well as ore, and included the mitigating effects of commonly used dust control measures. The response concluded that all the air quality objectives of the EPP(Air) would be achieved even at the nearby Mungana 2 and Eclipse Caves.

The amendment to the EIS provided with the response received on 9 May 2011 committed to using the following mitigation measures for impacts on air quality:

- Water trucks will be used to dampen haul roads and exposed surfaces to minimise dust generation. Dust suppressant products may be used to assist in binding fine surface dust, improve water infiltration and reduce water usage.
- Operations upwind of the caves will be modified to provide additional dust controls such as additional watering of haul roads and spraying at truck dumping points.
- A windfield analysis will be undertaken and, if feasible, mounds will be placed to funnel wind flows around the caves.
- Blasting will be delayed or suspended when caves are downwind of the blast.
- Crushed product will be stored in a covered stockpile or ore bin.
- Transfer points on the process plant will be enclosed. Fixed water sprayers will be used in areas where dust generation regularly results in dust levels above relevant criteria.
- Hoses and manual spraying will be used to control dust generation from point sources where there is evidence of visible dust leaving the site.
- Rumble pads will be located at each of the main site exit points to clean trucks prior to leaving the site.
- Haul routes will be established as early as possible; stabilised material with low dust generating characteristics will be used to construct haul roads.
- Plant will be maintained in good working condition and dust controls will be regularly maintained. Where dry ore is crushed or similarly processed cyclones and/or dust filtration systems will be provided.
- Dust from the transportation of concentrate to Townsville will be controlled by covers on transport trucks.
- Dust from transport use of unsealed sections of the Burke Developmental Road that are in close proximity to residential areas will be managed by having reduced speed limits and designated locations for vehicles to drop dust.
- The existing Air Quality Monitoring Program will be continued. Monitoring of dust deposition and dust concentration will be undertaken at locations within 10 m of the opening of designated cave entrances at Eclipse Cave, Piano Cave, and the limestone karsts Mungana 2, Red Dome 4 and Red Dome 5. Since Red Dome 4 and Red Dome 5 are located relatively close together (approximately 130 m) it is considered acceptable to monitor Red Dome 5 only (Red Dome 4 and Red Dome 5 are equidistant from likely dust sources). Kagara will also investigate ways to minimise dust emissions from overburden dumping, particularly when there is an easterly wind. These may include orientation of overburden mounds, dumping dry material low in the dump and moist material high on the spoil mound.
- Develop and implement a Post-Mine Land Use Plan to achieve progressive rehabilitation of disturbed areas as soon as possible following disturbance.

Greenhouse gas emissions

The mining activity would not intercept any geological strata containing significant amounts of greenhouse gases. Greenhouse gases (GHG) would be directly and indirectly generated by the MGOPDP from machinery and vehicle

use at the mine, power usage, and blasting chemicals. The GHGs mainly produced would be carbon dioxide and nitrous oxide.

The EIS undertook a satisfactory assessment of potential GHG emissions using the National Greenhouse Accounts Factors published by the Commonwealth Department of Climate Change and Energy Efficiency. The total annual estimated emissions from the MGOPDP were estimated at 43,400 tonnes of carbon dioxide equivalent. That figure represents a $4x10^{-5}$ fraction of the national annual average emissions. Also, as the project has an expected life of only approximately 4 years, the overall emissions of greenhouse gases from the MGOPDP could be considered relatively minor.

Nevertheless, the EIS proposed several measures that could be used by Kagara for GHG abatement. Those direct and indirect measures include:

- Minimising clearing at the site.
- Integrating transport for the mine with other local industries so that GHG emissions from construction and operations are minimised.
- Maximising the use of renewable energy sources.
- Carbon sequestration at nearby or remote locations by:
  - progressive rehabilitation of disturbed areas
  - planting trees or other vegetation externally to the site to achieve greater biomass than that cleared for the site.
- Carbon trading through recognised markets.

Adequacy of the EIS with respect to air quality issues

The final EIS, comprising the first version and subsequent information received, has adequately addressed the TOR with respect to air quality issues

4.10 Noise and vibration

The submitted EIS adequately addressed the TOR with regard to the assessment of noise and vibration from the MGOPDP. DERM's submission on the EIS only raised a minor issue requesting that the monitoring of impacts on animals and the structure of nearby caves should be added to the EM plan.

4.10.1 Noise due to causes other than blasting

As noted in the preceding section on air quality, Rockwood station, which lies approximately 8 km north west of the site, is the nearest homestead to the mine, while Chillagoe, approximately 15 km east of the site, is the nearest residential community. Modelling of noise levels from the proposed mining operations undertaken for the EIS confirmed that these locations are sufficiently distant that they would not be impacted by noise or vibration from the MGOPDP at any time of day or under any climatic conditions. The modelling also confirmed that mining operations would not contribute to an increase in background noise levels (known as "background creep") at Chillagoe.

However, there are other sensitive receptors nearby that could be impacted, particularly the protected areas that comprise parts of the Chillagoe-Mungana Caves National Park. The Eclipse Tower section of the national park is closest at only 200 m from the proposed pit, while the next closest section, Piano Tower, is 1.25 km to the east of the ore crushing and processing area. Both sections of the national park have limestone karst geology that includes caves. The caves provide habitat for animals such as bats that may be sensitive to noise, and have stalactites and stalagmites that may be sensitive to vibration. The sections of the national park attract occasional visitors, but not as frequently as the show caves close to Chillagoe.

Other nearby sensitive receptors include the Mungana 2 cave (also only 200 m from the proposed pit) and the Red Dome 1 cave (750 m to the east) that are bat and quoll conservation zones associated with the requirements that must be undertaken in a particular manner by Kagara for the project not to be a controlled action under the EPBC Act.

Modelling undertaken for the EIS indicated that there would be a significant increase in noise levels at the Mungana 2 and Eclipse Tower caves in the early stages of the MGOPDP when mining operations are at, or near, the surface and until the pit has reached sufficient depth to shield the noise emissions. For mining operations not involving blasting, the calculated $L_{Aeq(1\ hour)}$ noise levels[2] for a variety of times of day and climatic conditions ranged from 50 dB(A)[3] to 67 dB(A) at the Mungana 2 cave and 54 dB(A) to 57 dB(A) at the Eclipse cave. The Environmental Protection (Noise) Policy 2008 (EPP(Noise)) does not set specific acoustic quality objectives for protected areas. Rather the EPP(Noise) objective for protected areas is that the level of noise should preserve the amenity of the existing area or place. Kagara will minimise the impact of noise at the caves by constructing a bund along the north and north eastern limits of disturbance between the pit and the Mungana 2 and Eclipse Tower caves to reduce the noise received at the caves.

Similar but lesser noise impacts are expected at the Red Dome 4 and 5 caves in the early stages of the MGOPDP. However, as the calculated LAeq(1 hour) noise level at those caves for any time of day or climatic conditions is 45 dB(A), and generally much lower, the impacts are not expected to be of sufficient magnitude or duration to require mitigation measures.

Road haulage associated with the MGOPDP would increase from approximately 10% of truck traffic on the Burke Developmental Road to 15%. However, the actual number of vehicle movements would still be relatively low at a maximum of 220 per week. Consequentially, any increase in noise near to the haul route is expected to be small. Nevertheless, to mitigate the impacts of road noise, Kagara will continue to require drivers to use low-noise driving techniques, including: low speeds in the vicinity of houses; no use of air brakes within 2 km of Chillagoe; and good maintenance of trucks to avoid rattles and other potential sources of increased vehicle noise.

4.10.2 Noise and vibration due to blasting

The DERM guideline, *Noise and vibration from blasting*, provides the following criteria:

Noise criteria

> Blasting activities must be carried out in such a manner that if blasting noise should propagate to a noise-sensitive place, then
>
> (a) the airblast overpressure must be not more than 115 dB(linear) peak for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts; and
>
> (b) the airblast overpressure must not exceed 120 dB(linear) peak for any blast.

Vibration criteria

> Blasting operations must be carried out in such a manner that if ground vibration should propagate to a noise-sensitive place:
>
> (a) the ground-borne vibration must not exceed a peak particle velocity of 5 mm per second for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts; and
>
> (b) the ground-borne vibration must not exceed a peak particle velocity of 10 mm per second for any blast.

The definition of a noise sensitive place includes a protected area, such as the Piano Tower and Eclipse Tower sections of the national park. Peak particle velocity (PPV) is a standard measure of vibration.

4.10.2.1 Assessment of the likely impacts of blasting

The EIS assessed that, with the exception of the Eclipse Cave, the MGOPDP will be able to meet those criteria, albeit by substantial modification to blasting practice for the Mungana 2 Cave. At the Eclipse Cave section of the national park, the EIS predicts a PPV of 25 mm/s and an air blast overpressure of 140 dB(linear) when blasting at the pit is closest.

[2] $L_{Aeq(1\ hour)}$ means an A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 1 hour period has the same mean square sound pressure of a sound that varies with time.

[3] dB(A) means decibels measured on the 'A' frequency weighting network.

However, the EIS correctly notes that the purpose of the criteria specified in the guideline is to minimise annoyance and discomfort at the noise sensitive place. Public access to the Eclipse Cave is only available through the Kagara lease area and visitors must sign in at the mine office. Consequently, access could be restricted when blasting is taking place, and the criteria need not necessarily apply. The main concern is whether airblast overpressure or vibration would cause structural damage to the stalactite and stalagmite formations in the cave, or impact on fauna using the cave habitat.

With regard to the airblast overpressure from a blast, the EIS assessed that the pressure wave would rapidly dissipate due to divergence effects once it had entered a cave. Consequently, it is unlikely that any structural damage or impacts on fauna in the cave would occur due to airblast overpressure, and no mitigation measures are needed.

The EIS reported on monitoring of the effects of ground vibration due to blasting that had been undertaken for the nearby Red Dome Mine, which was in close proximity to the Piano Tower section of the Chillagoe-Mungana Caves National Park. That section of the national park contains the Piano Cave and Stop Press Cave. Those monitoring studies found no discernable impacts on the structure of the Piano Cave or Stop Press Cave from vibration due to blasting. The EIS also reported on another experience at the Kartchner Caves in Arizona where blasting to provide public access was monitored. A feature of those caves is fragile straw-like stalactites, known as "soda straws". The studies at that site found there was "no observed increase in falling soda straws as the PPV increased to 50 mm/s". Consequently, the EIS assessed that the Eclipse Cave and other nearby caves, which contain more stable stalactite structures than the soda straws, should not be impacted by vibration from blasting at a PPV of 25 mm/s or lower, and no mitigation measures are needed.

However, while the EIS assesses that no mitigation measures are needed for the effects of noise and vibration due to blasting, the proponent will be required to undertake on-going monitoring of those effects on both bat and quoll populations using the caves and the structural integrity of the caves to ensure that the predictions are correct. Only if monitoring indicates that blasting is adversely impacting on the structure of the caves or the fauna that use them will the proponent be required to develop mitigation measures and discuss them with DERM.

4.11 Ecology

The EIS identified five regional ecosystems (RE) in the area that would be disturbed by the MGOPDP:

- RE 9.11.3a – Mixed Ironbark/Bloodwood Woodland (*Eucalyptus cullenii* ± *Corymbia clarksoniana* dominated woodland with mixed species on skeletal soils on metamorphic hills)
- RE 9.5.10b – Georgetown Box Woodland (*Eucalyptus microneura* ± *Corymbia* spp. ± *Terminalia* spp. woodland on sand sheets)
- RE 9.5.8 – Cullen's Ironbark/Bloodwood Woodland (*Eucalyptus cullenii* ± *Corymbia erythrophloia* ± *C. dallachiana* on undulating plains on remnant Tertiary surfaces)
- RE 9.3.13a – Riparian Woodland (Fringing woodland containing any combination of Paperbarks, Eucalypts, River Sheoak, *Lophostemon grandiflorus* (Northern Swamp Box)

The EIS reported the following REs as present in the local area, but they would not be directly impacted by the MGOPDP:

- RE 9.5.9a – *Eucalyptus leptophleba* and *E. platyphylla* +/- *Corymbia clarksoniana* woodland to open woodland on Tertiary remnant surfaces) – VMA class: Least concern; Biodiversity status: No concern at present
- RE 9.11.8a – Semi-deciduous Vine Thicket (Semi-deciduous Vine Thicket on limestone rock outcrops) – VMA class: Least concern; Biodiversity status: Of concern
- RE 9.11.25 – *Eucalyptus tardecidens* +/- *Corymbia* spp. low woodland on steep to rolling metamorphic hills – VMA class: Least concern; Biodiversity status: No concern at present

None of the REs in the general project area are listed in the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* Threatened Ecological Communities online database.

In the vicinity of the MGOPDP, there are no areas of critical or essential habitat under the *Nature Conservation Act 1992* or *Vegetation Management Act 1999* respectively.

Mining and grazing have already caused disturbance to habitats within the mining leases, and the MGOPDP would increase the disturbance. The areas of regional ecosystems that would be cleared, their class under the *Vegetation Management Act 1999* (VMA), and their DERM's biodiversity status are listed in Table 4.3.

Table 4.3 Areas of regional ecosystems to be cleared

Regional ecosystem	Area to be cleared (ha)	VMA class	Biodiversity status
9.11.3a – Mixed Ironbark/Bloodwood Woodland	61.0	Least concern	No concern at present
9.5.10b – Georgetown Box Woodland	32.0	Least concern	No concern at present
9.5.8 – Cullen's Ironbark/Bloodwood Woodland	17.8	Least concern	No concern at present
9.3.13a – Riparian Woodland	<1	Least concern	Of concern
Total	Approx. 110 ha		

The Mungana Pit would be entirely within RE 9.11.3a, while the Waste Rock Dump would cover areas of REs 9.11.3a, 9.5.10b and 9.5.8. Construction of the Tailings Storage Facility (TSF) has already impacted on a small area of RE 9.3.13a.

The sites to be cleared are surrounded by extensive areas of similar values, and clearing will not result in a reduction in connectivity between areas of high ecological value. The EIS proposed the following range of mitigation measures to deal with vegetation clearing and the cleared vegetation:

> Implementation of a Permit to Clear system whereby a Clearing Plan that clearly depicts (in plan drawing view) areas to be cleared is submitted to the Environmental Officer for approval. The plan is checked against the approved disturbance envelope, permitted disturbance area, environmentally sensitive areas (including cultural heritage sites) prior to approval.
>
> - All personnel authorised to undertake clearing are to undergo a site induction familiarising them with the Clearing Permit procedures.
> - Clearly mark (e.g. with flagging tape) the clearing limits near sensitive areas (e.g. conservation zones, riparian woodland, populations of significant plant species) prior to commencement of clearing. These areas are to remain marked for the entire clearing period to prevent unauthorised or unplanned clearing.
> - A site supervisor is to be present during clearing to ensure all works occur within the authorised limits of clearing areas.
> - Cleared vegetation is to be stockpiled for use in rehabilitation.
>   - Stockpiled vegetation not to be burnt intentionally.
>   - Stockpiled vegetation to be utilized as soon as practical after clearing.
>   - Stockpiled vegetation to be located away from volatile vegetation and infrastructure, and surrounded by a firebreak.
>   - Where possible, cleared woody weeds must not be mixed in with cleared stockpiled vegetation.

DERM considers those mitigation measures would be suitable. It is recommended that the draft environmental authority should include conditions requiring the implementation of those measures.

The EIS did not propose a specific offset strategy for the loss of ecosystem values, rather it stated that it was expected that an offset strategy will be a requirement of the environmental authority for the MGOPDP. Consequently, it is recommended that the environmental authority include a condition requiring the development and implementation of an offset strategy for the residual loss of regional ecosystems.

Common animals observed around the mining leases include a variety of macropods, such as antilopine wallaroo (*Macropus antilopinus*), eastern grey kangaroo (*Macropus giganteus*), whiptail wallaby (*Macropus parryi*) and common wallaroo (*Macropus robustus*).

The micro-bat community of the area consists of forest, cave, and crevice dwelling species. Forest-dwelling species recorded in the area include Gould's wattled bat (*Chalinolobus gouldii*), hoary wattled bat (*C. nigrogriseus*), Beccari's free-tail bat (*Mormopterus beccarii*) and yellow-bellied sheath-tail bat (*Saccolaimus flaviventris*). Cave dwelling species present in the area include eastern horseshoe bat (*Rhinolophus megaphyllus*), greater large-eared horseshoe bat (large form) (*R. philippinensis maros*), common sheath-tail bat (*Taphozous georgianus*), little bent-wing bat (*Miniopterus australis*) and northern bent-wing bat (*Miniopterus schreibersii orianae*). The greatest level of bat activity, measured by the recording of calls, has been detected at the Mungana 2 Tower, Eclipse Tower, Red Dome 4 and 5 Towers, around the Raw Water Dam and along One Mile Creek. Much less bat activity has been detected along Opera Creek.

Birds observed around the Raw Water Dam include waterfowl, marsh birds, shorebirds, gulls and terns; while raptors, insectivorous songbirds, omni-granivorous songbirds, bark-gleaning songbirds and ground-gleaning species have been observed in the wider area.

Migratory species commonly observed in the project area are the cattle egret (*Bubulcus ibis*) and the rainbow bee-eater (*Merops ornatus*). A single pair of white-bellied sea-eagles (*Haliaeetus leucogaster*) was observed at the Raw Water Dam during 2005–2006.

While other species are also likely to be present, the following reptiles have been observed in the area: two-lined Dragon (*Diporiphora australis*); dubious dtella (*Gehyra dubia*); Bynoe's gecko (*Heteronotia binoei*); *Nactus cheverti*; lined rainbow-skink (*Carlia jarnoldae*); open-litter rainbow-skink (*Carlia pectoralis*); tussock rainbow-skink (*Ctenotus robustus*); and straight-browed ctenotus (*Ctenotus spaldingi*). Freshwater crocodiles (*Crocodylus johnstoni*) have been observed in the Raw Water Dam.

However, only a single amphibian species, the introduced Cane Toad (*Bufo marinus*), has been recorded in the project area.

Seven plant species of conservation significance are present in, or have a high likelihood of occurrence in the vicinity of, the MGOPDP area. They are mostly associated with the limestone formations of the area. Their scientific names, common name if one exists, and status under the Nature Conservation (Wildlife) Regulation 2006 (NC(W) Reg) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are as follows:

- *Chamaesyce carissoides* (vulnerable – EPBC Act and NC(W) Reg)
- *Graptophyllum excelsum* – scarlet fuchsia (near threatened – NC(W) Reg only)
- *Lepturus minutus* (vulnerable – NC(W) Reg only),
- *Lepturus xerophilus* (near threatened – NC(W) Reg only)
- *Macropteranthes montana* (vulnerable – EPBC Act and NC(W) Reg)
- *Panicum chillagoanum* (near threatened – NC(W) Reg only)
- *Stictocardia queenslandica* (near threatened – NC(W) Reg only).

Ten animal species of conservation significance have been recorded at, or have a high likelihood of occurrence in the vicinity of, the MGOPDP area. Their scientific names, common name if one exists, and status under the Nature Conservation (Wildlife) Regulation 2006 (NC(W) Reg) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are as follows:

- *Dasyurus hallucatus* – northern quoll (endangered – EPBC Act)
- *Rhinolophus philippinensis maros* – greater large-eared horseshoe bat–large form (endangered – EPBC Act and NC(W) Reg).
- *Carlia rococo* – Chillagoe litter skink (near threatened – NC(W) Reg only)
- *Lerista storri* (near threatened – NC(W) Reg only)
- *Ephippiorhynchus asiaticus* – black-necked stork (near threatened – NC(W) Reg only)

- *Nettapus coromandelianus* – cotton pygmy-goose (near threatened – NC(W) Reg; EPBC Act listed marine species).
- *Lophoictinia isura* – square-tailed kite (near threatened – NC(W) Reg only).
- *Falco hypoleucos* – grey falcon (near threatened – NC(W) Reg only).
- *Petrogale mareeba* – Mareeba rock-wallaby (near threatened – NC(W) Reg only).
- *Hipposideros diadema reginae* – diadem leaf-nosed bat (near threatened – NC(W) Reg only).

Conservation zones have been established near the MGOPDP site primarily for habitat of the northern quoll and greater long-eared horseshoe bat. The conservation zones comprise areas within 100 m around the Mungana 2 Tower, Red Dome Tower, and sections of the Chillagoe-Mungana Caves National Park, including the Eclipse Tower. Those conservation zones would be continued as the MGOPDP proceeds, and because the plant and animal species of conservation significance are mostly associated with the limestone formations, the conservation zones will avoid significant long-term impacts on those species.

Mining activities, particularly noise from blasting, may cause short-term disturbance to fauna within the conservation zones, but it is expected that animals will habituate to the disturbance, which in any case will only occur for four years or so.

Blasting also has the potential to damage cave habitat due to vibration. A Blast Management Plan will be developed for the MGOPDP that will ensure that vibration is kept below levels that could potentially damage the structure of the nearby caves. It is recommended that the environmental authority include conditions limiting the peak particle velocity and maximum peak air overpressure to levels that would not cause structural damage.

With regard to aquatic biology, only the Raw Water Dam and the unnamed tributary of One Mile Creek have the potential to be significantly impacted by the MGOPDP.

The most dominant families of insects and crustacea observed at the Raw Water Dam in the wet season are mayflies (*Caenidae*), water boatmen (*Corixidae*) and the class of seed shrimps (*Ostracoda*); and in the dry season are the families of water boatmen (*Corixidae*), non-biting midges (*Chironominae*) and mudeyes (larval stage of dragonflies, *Libellulidae*). The Raw Water Dam has been stocked with local fish species, such as saratoga (*Scleropages leichardti*), sooty grunter (*Hephaestus fuliginosus*) and sleepy cod (*Oxyeleotris lineolatus*). Other native fish, such as rainbowfish, have colonised the dam.

The richness and abundance of taxa reported at One Mile Creek are variable between seasons and between years. The most dominant families of insects observed at One Mile Creek in the wet season are mayflies (*Caenidae*), water boatmen (*Corixidae*) and biting midges (*Ceratopogonidae*); and in the dry season are water boatmen (*Corixidae*), watermites (*Hydracarina*) and the subfamily of non-biting midges (*Tanypodinae*). Eastern rainbowfish (*Melanotaenia splendida splendida*) and spangled perch (*Leiopotherapon unicolor*) have been observed in One Mile Creek.

Native aquatic plants found in and around the Raw Water Dam include water nymph (*Naja tenuifolia*), prickly water nymph (*Najas marina*), water lily (*Nymphoides indica*), curly-leaf pondweed (*Potamogeton crispus*), floating pondweed (*Potamogeton tricarinatus*), *Vallisneria nana*, broadleaf cumbungi – a type of bulrush (*Typha orientalis*), and rushes (*Juncus* species). Curly-leaf pondweed, sedges (*Fimbristylis* species) and algae (*Chara* species) are present in the ephemeral streams during the wet season.

As noted in the section of this report dealing with water resources, the water quality of the Raw Water Dam will be maintained during operation of the MGOPDP, which will avoid impacts on the aquatic ecology of that water body and any downstream habitats into which it overflows. It is recommended that the environmental authority contain conditions that set limits on contaminants that could be discharged into the Raw Water Dam.

Fisheries Queensland within DEEDI supported the EIS's assessment that the highly ephemeral creeks and drainage lines within the project area are unlikely to support any permanent or ongoing fish communities. Fisheries Queensland stated there was no need for the MGOPDPD to provide fish passage within the project area, and that efforts should be concentrated on preventing mining activities from contaminating downstream waterways.

The loss of ephemeral stream habitat due to the construction of the waste rock dump will be addressed in the offset strategy, which will be developed for the MGOPDP.

The nearby karst system caves are known to host stygofauna. Some of the nearby limestone features and caves have been incorporated as sections of the Chillagoe-Mungana Caves National Park, and as such are a category A environmentally sensitive area under the Environmental Protection Regulation 2008. The Chillagoe Karst Area is listed on the Register of the National Estate. The EIS has stated that no karst system caves will be intercepted by the MGOPDP, which would avoid any impact on stygofauna. It is recommended that the environmental authority contain a condition requiring that no karst system caves will be intercepted. Furthermore, as noted in the section of this report dealing with water resources, the EIS has assessed that dewatering of the pit will not cause a lowering of the water table in the caves and that the cone of depression of the water table is unlikely to extend beyond the mining leases' boundaries, which would also avoid any impact on stygofauna or any other groundwater dependent ecosystems.

There are no Ramsar wetlands that could be impacted by the MGOPDP. However, the nearby Spring Tower Complex is listed as a wetland of national importance. The Spring Tower is within one of the conservation zones, which will avoid any impact on it.

The main weed species of present within the mining leases are chinee apple (*Ziziphus mauritiana*) and rubber vine (*Cryptostegia grandiflora*). Kagara has undertaken a weed control program since 2006, and has reduced the occurrence of these weeds to low levels in parts of the project area where they were previously dominant. The weed control program will be continued in the area of the MGOPDP.

Feral pigs, feral cats, rabbits, dingoes and other wild dogs have been documented in the area. Feral cats are considered a risk to northern quolls in the area. Kagara has an established program of trapping feral cats, and this will be continued.

The principal potential sources of impacts on ecological values are discharges of contaminants to surface waters, discharges of mineralised dust to land, and access of wildlife to contaminated wastes, such as tailings in the TSF. Of particular concern is the access of birds to decant liquid from tailings that may be contaminated by cyanide and/or copper amine complexes. The mitigation measures for those potential sources of impacts have been addressed in preceding sections of this report dealing with water resources, air quality and waste management.

4.12 Cultural heritage

The EIS has adequately addressed the TOR with respect to both Indigenous cultural heritage and non-Indigenous cultural heritage issues.

4.12.1 Indigenous cultural heritage

Because an EIS has been required for the MGOPDP, section 87 of the *Aboriginal Cultural Heritage Act 2003* requires that a cultural heritage management plan (CHMP) must be developed and approved under that Act either before the environmental authority is issued or that the environmental authority must include conditions to ensure that no disturbance due to mining activities occurs before approval of the CHMP.

Kagara Ltd and the Wakaman People #1 and the Wakaman People #2 Aboriginal Parties have developed draft Cultural Heritage Management Plan Agreements. The agreements require that cultural heritage data be kept confidential, and this is acknowledged by DERM. Consequently, this EIS assessment report provides no discussion of the findings of the Indigenous cultural heritage studies, nor does it address the proposed management measures, which it leaves to the CHMP.

It is understood that a CHMP that covers the proposed activities at the MGOPDP has not yet been approved by the chief executive responsible for the *Aboriginal Cultural Heritage Act 2003*. Unless the CHMP is approved under the *Aboriginal Cultural Heritage Act 2003* before the environmental authority is issued, it will be necessary, as noted above, for the environmental authority to include conditions requiring the approval of the CHMP prior to any disturbance due to mining activities for the MGOPDP.

4.12.2 Non-Indigenous cultural heritage

The wider area around Mungana was originally explored by Europeans in 1873. William Atherton named and settled the locality of Chillagoe in 1887, and established a cattle station the following year to supply beef to the

expanding mining operations in the area. He reported the existence of copper deposits, which attracted the attention of John Moffat, an established miner. Moffat acquired mineral rights over a considerable area around Chillagoe and Mungana. Mining started at Mungana around 1893 at the Girofla deposit. The miners at first lived in a tent township near the Girofla mine. Other nearby deposits were worked, such as the Lady Jane mine. After the Chillagoe Railway and Mining Company's line was opened from Mareeba to Mungana in 1901, the Mungana township was moved closer to the rail head.

The town prospered during the early twentieth century, peaking in 1920. However, mining then declined and the rail line was closed in 1958. Eventually, the Mungana township was completely abandoned, and all but a few of the buildings associated with the old Mungana settlement and mining activities have been removed.

The mining leases 15 km to the west of Chillagoe that are occupied by Kagara's present and proposed operations contain historical mine workings including the Girofla and Lady Jane mines and the site of the Mungana township. The site has been declared under the *Queensland Heritage Act 1992* as the Mungana Archaeological Area. While some parts of the Mungana Archaeological Area are within the mining leases held by Kagara, none is within the area that would be disturbed by the MGOPDP.

The MGOPDP area does contain fourteen sites identified in the EIS as having some non-Indigenous cultural heritage value. However, none have been assessed as having more than low significance. The sites in question were given the following site numbers in Appendix A6-4.9b of the EIS: 101 to 106; 114 to 119; 125 and 128.

Sites numbered 101 to 106 (excluding 104), 116, 118 and 125 were assessed as needing no further recording and no mitigation if disturbed by mining. The rest were assessed as requiring avoidance if possible; and if avoidance was not possible then detailed recording and collection of diagnostic material would be required.

Sites numbered 111, 112 and 113 do not lie within the proposed MGOPDP area but are close enough that they may be impacted if the mining layout changed. They too should be avoided, or subject to detailed recording and collection of diagnostic material if avoidance is not possible.

It is recommended that the draft environmental authority include conditions requiring the avoidance or recording of the relevant sites of non-Indigenous cultural heritage value.

4.13 Social issues

As noted in the section on noise, Rockwood station is the nearest homestead to the mine, while Chillagoe, is the nearest residential community. Chillagoe is in the Tablelands Regional Council area.

The Chillagoe town and surrounding area has a population of approximately 308 (2006 census). At the 2006 census, 26% of the population were visitors, most of whom were mine workers on a fly-in or drive-in shift roster whose principal place of residence was elsewhere. A slightly higher than average percentage of the population (53.7% compared to 49.4% nationally) are male. A relatively high percentage (23.9%) of the population is Indigenous. However, there are no native title claimants registered for the MGOPDP area.

The EIS reported that the town had 48 dwellings, of which 35 were occupied at the time of the count. Forty one percent of the population live in state housing. Of the houses in private ownership, a significantly higher percentage than the national average (55% compared to 33% nationally) were fully owned. Thirty one percent of houses were rented. Between the 2001 census and 2006, there was a marked trend for more of the mine workers to reside in the town rather than in accommodation out of town.

Unemployment was around the national average of 5.2%.

The population of Chillagoe has increased in the last decade by 43% mainly due to an increase in mining activity.

Kagara participates in a Community Consultative Committee (CCC) that was established on commencement of the Mungana project.

For the EIS, Kagara undertook a social impact assessment that included:

- Interviews with key community informants.
- Informing and updating the CCC of both the MGOPDP and the proposed SIA methods.

- Carrying out a community survey by the distribution of 120 surveys in letterboxes held at Chillagoe Post Office. The survey results were collated and formed the basis of the Social Impact Statement.
- Community endorsement of the Social Impact Mitigation Strategies.

The draft EM plan in the EIS included a section, entitled "Community", that provided the Community-Endorsed Social Impact Management Plan and Mitigation Strategies.

The EIS assessed there would be little impact on housing availability as the accommodation needs for the mine would be provided by Kagara, mostly at the existing accommodation camp. Nevertheless, the EIS did assess that there may be an increased demand for permanent housing in Chillagoe and the surrounding area, which may increase property values, but is unlikely to be of sufficient magnitude to create a housing shortage. The Department of Communities submission on the EIS recommended that mitigation strategies should be developed to address the potential issues of housing affordability, pressure on housing availability and other costs, and the demand for accommodation otherwise used for low cost tourism. The Department of Communities recommended that mitigation strategies for impacts related to these issues, should they occur, should be addressed in the project's social impact management plan.

Kagara will convene a public forum when mining activities for the MGOPDP start to increase public awareness of the project and how it will be managed.

Community safety issues were addressed in the EIS and are discussed in the Health and Safety section below.

Kagara will continue the current practice of organised sporting events at which both mine workers and others resident in the town can participate. The Department of Communities submission on the EIS supported Kagara's proposals in this area, and recommended linking into and building on the Tablelands Regional Council's *Tablelands Sport and Recreation Plan 2010*. The company will also continue to support community events, such as the Great Wheelbarrow Race, rodeos and the country music festival.

DEEDI's submission on the EIS requested a description of the skills requirements for the project and where specialist staff would be recruited. Kagara's response provided the information to DEEDI's satisfaction. DEEDI also requested additional information on:

- the cumulative effects of other major employers in the area and their recruitment schedules
- the likely lay-off schedules
- how the reductions in the workforce when mining ceases would potentially impact on employment patterns in the social and cultural area of influence.

Kagara responded that:

> The majority of the skills required are specific to the mining industry and so impacts on recruitment by other employers will affect similar mining operations. Recruitment of plant and machinery operators will lead to competition with local employers such as Councils and earth moving companies.
>
> This will be offset by:
>
> - providing opportunities for employees from other operations in NQ [north Queensland] operated by Kagara Ltd to move to the MGOPDP
> - training of operators.
>
> Impacts of workforce reductions will be mitigated by:
>
> - Staged wind-down of the operation; mining will cease at 2.5 years, processing will continue until 3.0 years, decommissioning and rehabilitation will continue until 3.5 years and beyond.
> - Personnel will have opportunities to relocate to other projects in NQ operated by Kagara Ltd.

The Department of Communities submission on the EIS raised the issue of training programs for local Indigenous people and the link to the social impact management plan. Kagara responded that they will continue the existing policy and process for creating employment opportunities for Indigenous and non-Indigenous people from the local community. The process includes a Traditional Owner contact list where training and employment vacancies are circulated. Candidates with relevant experience can apply directly, while long term unemployed job seekers are

assessed for inclusion in the Kagara block of trainees in the Myuma Civil and Mining Training program at Camooweal. Kagara has established an informal relationship with the Myuma program managers to have up to eight participants, in each 12 week program conducted on a bi-annual basis. Kagara also stated that they have started negotiations with the Tropical North TAFE College to deliver culturally appropriate training both in formal educational settings and in the workplace.

The Department of Communities was satisfied with the proponent's response to its submission on the EIS.

The Social Impact Assessment Unit (SIAU), formerly part of the Department of Infrastructure and Planning, now in DEEDI, provided a submission on the EIS. The submission recommended that the proposed strategy of public forums should commence at the construction stage, as the EIS gave the impression that the public forum would occur at the commencement of operational activities for the MGOPDP. Kagara responded that the CCC had already considered and provided feedback on the project, and that another CCC meeting would occur before the start of construction activities.

The SIAU also recommended that Kagara should align its Social Impact Management Plan with the *Guideline to preparing a social impact management plan*, published on 8 September 2010. Kagara responded that the EIS and its Community-Endorsed Social Impact Management Plan were developed before the guideline was published. The SIAU replied that the Community-Endorsed Social Impact Management Plan does not contain adequate commitments, performance indicators, monitoring requirements or accountability to the community. The SIAU recommended that the Community-Endorsed Social Impact Management Plan should be updated to explicitly include those features. However, at present there are no legislative mechanisms for ensuring the proponent makes the changes necessary to align the plan with the guideline.

The EIS study highlighted that it can be difficult for small regional communities to predict how they would be affected by, or react to, future developments. For this reason, the CCC and Kagara have agreed to continue their periodic discussions so that any adverse impacts on the community can be identified as MGOPDP activities progress and the associated issues can be addressed.

4.14 Economy

The economy of Chillagoe town has fluctuated with the fortunes of the local mining sector. The current population is only approximately 20% of that at the height of mining activity in 1909. Nevertheless, at the time of the 2006 census, mining was the biggest employer, at nearly 31% of the local workforce. Government services employed 24%, while 22% worked in businesses other than tourism.

Tourism has been attracted to the area, largely due to the Mungana-Chillagoe Caves National Park. At the time of the 2006 census, tourism employed 23% of the local workforce.

Pastoral leases were present before mining began in the area and continue to the present. The EIS estimated that between 35% and 48% of the population (84 in total) in the area surrounding Chillagoe were employed in the pastoral industry.

While employment rates were relatively high for a small regional town (5.2% unemployed), income levels were significantly lower than the national average for individual, household and family incomes (79%, 55% and 62% respectively of the national average).

The current land use at the Mungana mine site is low intensity grazing. While, some of the land could be rehabilitated for a mix of grazing and wildlife habitat, the establishment of the mine would result in the permanent alienation of some land from the pre-mining land use. For example, this would include 21.2 ha taken for the open pit. The EIS estimated that the capacity of grazing land would be reduced by approximately 110 ha, and based on that area the opportunity cost of the lost grazing would be approximately $1,372 per year. This would be offset by the wealth created by the mine.

The value of the gold ore that would be mined was estimated at $378 million. The royalties to the state were estimated to be approximately $5.7 million. The total employment related contribution to the local economy over the 3.5 years of operation of the MGOPDP was estimated at approximately $30 million.

The impacts of workforce reduction as mining of the MGOPDP is completed would be offset by a staged wind-down of operations and rehabilitation, and by opportunities for staff to work at other projects operated by Kagara locally or in the region.

The EIS assessed that the project would have little impact on ecosystems services (i.e. the benefits people obtain from natural ecosystems, such as their influence on climate, clean water, etc.).

DEEDI's submission on the EIS raised the issue of the Queensland government's Local Industry Policy. Kagara responded with an overview of its policy of giving preference to local suppliers, subject to price, quality, service and other relevant factors. Kagara noted that its policy includes building the capacity for local suppliers to provide the necessary specialised equipment and skills. Kagara also noted that it had expenditure totalling $207 million in Queensland for the 2010 calendar year. DEEDI was satisfied with the proponent's response.

The EIS has adequately addressed the TOR with respect to economic issues.

4.15 Health and safety

The Health and Safety section of the EIS adequately addressed the TOR with respect to the potential impacts of the project on the health and safety of the community. The potential impacts on the workforce are covered by other legislation and are not the subject of the EIS.

As previously noted in section 4.8, Chillagoe is upstream of the mine site, and therefore could not be impacted by discharges to water from mining activities. The downstream catchment is only sparsely populated by isolated pastoral stations between the mine site and the community of Kowanyama, which lies approximately 400 km to the north west on the Gulf of Carpentaria. Impacts on the health or safety of people downstream are unlikely, due to: the physical separation; sparse population; and proposed infrequency of any discharges to water.

While some mineral processing will be undertaken at the mine site, there will be no smelting that could result in potentially toxic air emissions. The EIS has demonstrated that, at a distance of 15 km, the mine site is sufficiently removed from Chillagoe for long-term impacts on health in the community due to discharges of dust to air from mining activities, to be unlikely. The modelling undertaken for the EIS predicted that the air quality objectives of the EPP(Air) for the protection of health and wellbeing would be met at any locations at least 1 km from the mine site.

Only the road haulage of hazardous substances, ore or concentrates has the potential to have adverse impacts on health or safety of people in the Chillagoe community. However, haulage through the town has been ongoing for some time and the existing satisfactory measures will be continued. The haulage of hazardous substances is addressed in more detail in the following section of this report.

The road through the Chillagoe town is sealed and haulage trucks will be covered. For vehicles entering Chillagoe and other communities from unsealed sections of road there are ‘Dust Drop Areas’, which are used by drivers to blow dust from brakes to minimise the amount of dust emitted in populated areas. Therefore, impacts on communities due to dust from road haulage are unlikely.

With regard to other unsealed roads that will be used for the MGOPDP, there are measures for the existing operations that will be continued. The speed of haulage vehicles is limited to 60 km/h on the Burke Developmental Road and the Almaden-Gingerella-Sundown (Ootann) Road to reduce the generation of airborne dust and thereby improve visibility. In addition, Kagara Ltd has a memorandum of understanding with Tablelands Regional Council to carry out maintenance operations along the haulage route from Mungana to the Kennedy Highway. This includes the use of two water trucks which deploy along unsealed sections of the route at the start and end of daylight hours, with additional runs to reduce dust when required.

To promote road safety in the community, road use curfews for haulage vehicles will be continued; for example, when children will be walking to and from school.

Kagara has agreed to continue the practice of at least once a year visiting the Chillagoe school to educate students and parents about how to safely share the road with haulage trucks. Articles dealing with road safety will also be prepared for the school newsletter.

Kagara will continue, and improve where possible, the procedures for drug and alcohol testing of all employees and contractors.

Queensland Health provided a submission on the EIS that noted general areas of concern regarding public health that the EIS should address, particularly with respect to: a health impact assessment; drinking water supply; air quality; waste management; worker accommodation; and medical entomology. Kagara's response addressed Queensland Health's submission and provided amendments to the EIS that clarified the company's approach to managing those areas of public health. The final EIS adequately addressed the areas of concern. In particular, the existing Site Management System includes satisfactory measures for the control of vermin and mosquitoes at the mine site and the Chillagoe accommodation camp for mine workers. Those measures will be continued for the expanded mining operation.

4.16 Hazard and risk

The EIS conducted a preliminary hazard analysis (PHA) of the potential impacts to people and property, and in particular the potential impacts of both natural and induced emergency situations, counter disaster and rescue procedures as a result of the MGOPDP's proposed activities. The PHA identified a total of 220 hazards, and prior to considering mitigation strategies, the EIS developed a qualitative risk assessment matrix that addressed, and provided a ranking for, each identified hazard. The breakdown of the hazards by risk ranking was as follows:

- 38 high risks
- 100 medium risks
- 66 minor risks
- 16 low risks.

The EIS then considered the risks with the application of mitigation strategies, and the residual risk rankings were grouped as follows:

- 0 high risks
- 21 medium risks
- 139 minor risks
- 60 low risks.

The EIS summarised the residual medium risks as involving the following sources of hazards and outlined management measures; many of the management measures are used for the existing mining operations and have proved effective:

- *Discharges from water storages* – Risk of reduction in surface water quality. Water storages would be built in accordance with environmental authority conditions and water quality will be monitored.
- *Landform alteration for mining operations* – Risk of reduction in land use productivity. Some loss of land use is unavoidable in this type of mining project. Any reduction in land capability is minimised through site procedures to minimise land clearing, as well as through progressive rehabilitation.
- *Extraction and use of water for mining* – Risk of reduction in groundwater quantity and/or quality. Groundwater will be extensively monitored in the area.
- *Blasting* – Risk of fly rock and airblast causing injury or damage. Incidents causing serious impact are considered unlikely. Blasting is managed through using experienced personnel, blast designs, blasting procedures and limiting access to the site.
- *On-site vehicles* – Interaction between vehicles and other mobile equipment and mine personnel or other persons visiting the mine site presents a risk of serious injury or death without appropriate management. Vehicle movement is managed though traffic management procedures, driver training and awareness and signage. In addition, access to the site requires inductions which will raise awareness of site traffic and will prevent unauthorised vehicles on site.

- *Increased traffic on local roads from mining operations* –Serious accidents are considered unlikely with the current traffic controls for mining related vehicles using public roads. While the increase in traffic will be minor compared to current operations, risks will continue to be managed through driver awareness and training, equipment maintenance, and community awareness and training.
- *Spills of hazardous substances during transport, storage or use* – Risk of reduction in water and soil quality and risk to human health and property. Incidents causing serious impact are considered unlikely. A more detailed discussion of the management of risks associated with hazardous substances is provided below.
- *Increased flight traffic transporting mining personal* – The increase in the number of flights will be relatively small (see the transport section above) and no changes are required to current management practices.
- *Physical interaction with high voltage power lines* – There is the potential for serious injury or death without appropriate management of activities near high voltage power lines. Electrical supply is managed through existing procedures that detail how to: work around powerlines; use and install electrical infrastructure; and restrict access to unauthorised personnel.
- *Discharges from Tailings Storage Facilities (TSF)* – Risk of reduction in surface water and groundwater quality. The outer wall for the TSF for the MGOPDP was built to an approved plan that was designed and supervised by suitably qualified and experienced engineers. The modification of the TSF (see the Waste section above) was also similarly designed and construction will also be supervised by a certified engineer. The site Water Management Strategy and tailings operational procedures are designed to minimise the chance of release from the TSF. Surface water and ground water will continue to be monitored to detect any seepage from the TSF.
- *Waste rock placement for rehabilitation* – Risk of final landforms not being attained, reduction in land capability/suitability, reduction in water quality from contaminated discharge. Incidents causing serious impact are considered rare. Waste rock for rehabilitation is managed through site research and planning, and rehabilitation monitoring.
- *Access to dangerous landforms, including dams, voids and waste dumps by mine personnel and visitors* – Risk of falls, drowning, or strikes by falling material resulting in injury or death. Access to dangerous landforms will continue to be managed through: restricting unauthorised access; site procedures; inductions; signage; and fencing. Dangerous landforms remaining at decommissioning will be managed in accordance with the Plan of Operations.

The MGOPDP will require the use of hazardous substances, including cyanide, explosives and flammable liquids, that will need to be transported to, and stored on, the mine site. A number of management measures were proposed in the EIS to minimise the risks associated with the transportation, storage and use of hazardous substances.

The haulage of hazardous substances on public roads would be undertaken in accordance with the *Dangerous Goods Safety Management Act 2001* and the *Transport Operations (Road Use Management) Act 1995* by contractors with the necessary Dangerous Goods Licences.

The EIS outlined the following measures to be used when the hazardous substances are received at the site:

- Suppliers, contractors, distribution service and delivery contractors will be informed that substances shall not be introduced to the mine site unless a Material Safety Data Sheet (MSDS) has been made available for review, risk assessment, inventory and cataloguing prior to delivery to site.
- Hazardous substances will be handled, stored and transported in accordance with statutory requirements and the National Occupational Health and Safety Commission (NOHSC) Guidance Notes and Code of Practice.
- An inventory or register of all hazardous materials will be established and maintained to assist with materials management, environmental management and emergency planning.
- The requirements for the storage, handling and use of hazardous substances will be subject to risk assessment prior to their being made available for site use.

The Department of Community Safety's submission on the EIS raised the issue of flood hazard for on-site buildings and access to the site relative to the 100 year average recurrence interval flood event. The proponent responded that the site buildings had been built above the "Q100", which was taken to mean the level of the 100 year average

recurrence interval flood event. Access to the site for emergency vehicles during major flood events would be cut at Chillagoe Creek on the Burke Developmental Road, which is under the control of the Tablelands Regional Council. Consequently, emergency evacuations from both the mine site and the accommodation camp when the Burke Developmental Road is cut by flood would necessarily be by helicopter. Both the mine offices and the accommodation camp are cyclone rated and have emergency food and medical supplies.

The Department of Community Safety also advised the proponent to consult with the relevant emergency services when developing emergency response plans. The proponent responded that emergency action plans are already in place at the mine site. However, they would consult the relevant emergency services when updating the emergency action plans for the MGOPDP, and would send them updated emergency action plans after their annual revisions.

The Department of Community Safety was satisfied with the proponent's response to their submission, and therefore the final EIS satisfactorily addressed issues related to hazard and risk.

For individual classes of hazardous substances, the EIS outlined the following measures:

Explosives

All explosives for the MGOPDP will be managed in accordance with the operational procedures for the transportation, storage and handling of explosives on site. Operational procedures were derived from the Site Management System and the following legislation and standards:

- *Explosives Act 1999*
- AS 2187.1-1998/Amdt 1-2000: *Explosives – Storage, transport and use – Storage*
- AS 2187.2-2006: *Explosives – Storage and use – Use of explosives*.

Flammable liquids

Fuel for the MGOPD will consist primarily of diesel which will be transported to the site by road and stored in appropriately bunded tanks. The on-site storage requirement for diesel stored was estimated at 180 kL. The rate of usage for diesel for the MGOPD is expected to be approximately 6,000 kL in any one year.

The types of lubricants to be used for the MGOPDP will include engine and hydraulic oils, brake fluid, transmission oil and gear oil. The MGOPDP will use approximately 150 kL of lubricants per year, with an expected maximum inventory of 10 kL.

The storage facilities for fuel and lubricants will be designed with bunding in accordance with AS 1940-2004: *The storage and handling of flammable and combustible liquids*. The MGOPDP's primary bulk fuel storage tanks will also be designed in accordance with AS 1692:1989: *Tanks for flammable and combustible liquids*, and will include waste oil collection and spill response facilities.

Emergency situations involving diesel fuel will be managed in accordance with the site's Emergency Action Plans and a procedure specifically designed for Mungana to guide emergency response to fuel incidents. The procedure details the response to a diesel emergency including responsibilities for the incident controller, safety officer and emergency response team. Lubricant emergencies such as leaks or spills will be managed in accordance with the Emergency Action Plans and the relevant MSDS.

Sodium cyanide

The MGOPDP will use a maximum of 1,500 tonnes of cyanide in any one year with a maximum expected inventory of 50 tonnes.

Sodium cyanide will be stored on-site in a bulk chemical storage facility for use within the MGOPDP processing plant. Sodium cyanide is classified in the Australian Dangerous Goods Code as a Class 6.1 Toxic Substance. In accordance with AS/NZS 4452-1997, *Storage and handling of toxic substances*, the following safety measures will apply:

- Bulk storage containers will be located above ground on stable, even foundations, with footings and support structures made from non-combustible, corrosion resistant materials.
- Transfer points will be fitted with shut off valves at or below the liquid line in the container pipework.

- All liquid lines connected at or below the liquid level will be fitted with a shut-off valve at the nozzle and at the tank end. A hydrostatic relief valve will be fitted in any line enclosed by two valves.
- Liquid lines will have clearly marked 'open' and 'closed' positions and will have remote activation.
- Vehicles will be able to load and offload the toxic substance without needing to enter the container compound.
- The transfer points will be clearly identifiable and marked to show product being transferred.
- Transfer points will:
  - be at least 10 m from the boundary of the site or from protected areas
  - be suitably anchored and not at risk from impact by vehicles or swinging loads
  - be situated as to enable vehicles to exit without reversing
  - have a warning system for the liquid cap
  - have a safety shower and eye wash present.
- A high level alarm will be fitted to bulk containers.
- All valve components that come into contact with cyanide will not be made with nonferrous metals or their alloys.

Sodium cyanide emergencies will be managed by the site's Emergency Action Plans and Kagara's operational procedure for responding to a sodium cyanide emergency. This procedure details the responsibilities, cyanide properties, containment, cleanup, medical treatment and first aid relevant to a sodium cyanide emergency.

Emergency response

The EIS outlined emergence response measures that will be in place for the MGOPDP. The measures address interaction with the Queensland Fire and Rescue Service, Queensland Ambulance Service, Emergency Management Queensland and the State Emergency Service. They also address the training and participation of employees and contractors in regular emergency drills and exercises. The EIS also noted that a Fire Management Plan has been developed for the site.

4.17 Rehabilitation

DERM was satisfied that the EIS adequately addressed the TOR with regard to the proposed rehabilitation of the MGOPDP site.

Kagara's leases are the location of previous and on-going mining activities. A Post-Mining Land Use Plan (PMLUP) was developed in 2008 for the Red Dome Project when the currently active, underground mine at Mungana was commissioned. This document will be updated to cover rehabilitation of the MGOPDP. Information and experience gained from the largely successful decommissioning and rehabilitation of the Red Dome Project will be used when updating the PMLUP.

The objectives of the current PMLUP are, and those of the updated PMLUP will be, constrained to some extent by requirements of both state and Commonwealth approvals, which are outlined below.

On 3 April 2006, the Commonwealth decided under the EPBC Act that the Red Dome Project, which includes development of the MGOPDP, was not a controlled action provided it is undertaken in a particular manner. The particular manner included a range of measures described in referral EPBC 2006/2639 that would avoid significant impacts on the greater large-eared horseshoe bat (*Rhinolophus philippinensis maros*) and the northern quoll (*Dasyurus hallucatus*). The referral proposed the following mitigation measures with respect to rehabilitation:

- Areas disturbed during mining will be progressively rehabilitated as soon as possible following disturbance.
- Rehabilitation will establish vegetation communities that reflect the surrounding landscape.
- Large hollow-bearing trees within the disturbance footprint that are cleared will be salvaged and placed back in rehabilitation areas as habitat features.
- Water bodies that are part of the process circuit will be decommissioned and remediated.

- Where possible habitats that are suitable for identified threatened species will be create or enhance in the post-mine landscape.

Those measures must continue to be used for the MGOPDP in order for the project to be conducted in the required particular manner.

The current environmental authority (EA MIN100610207) under state legislation includes the following rehabilitation criteria:

- waterbodies [left for the landowner after mining ceases] will contain water suitable for stock
- void slopes of consolidated material will not exceed 65 degrees
- the Raw Water Dam (RWD) will be managed to ensure that water quality in the dam is maintained or improved
- groundcover biomass and tree density will be equal to, or greater than, 50% of that of a corresponding measure in an analogue site of equivalent capability
- greater than five individuals of shrub, grass or tree species will be volunteers or 2nd generation volunteers and not weeds
- species richness will be equal to, or greater than, 50% of analogue sites of equivalent capability with a minimum of three groundcover species and three shrub or tree species
- 70% or more of trees and shrubs will be native species
- the remaining 30% or less of tree and shrub species may comprise recognised pasture species agreed in the PMLUP
- erosion will not prevent the reinstatement of the nominated land capability and land use with the following criteria: rill erosion depth <300 mm; gullies <2 m deep that are as wide as they are deep
- grazing and/or bushland will be allowed on the final landform, and grazing land will support at least one beast per 40 ha
- weeds will be controlled as required under the *Land Protection (Pest and Stock Route Management) Act 2002*.

With regard to dams containing hazardous material, the environmental authority holder must implement either:

- a plan for decommissioning the dam such that, amongst other things:
  - contaminated water will no longer be stored in the facility
  - the containment embankment and its contents will be structurally stable and resistant to erosion
  - any seepage or other emissions will not cause environmental harm

or

- a site management plan for the continued operation and maintenance of the dam.

It should be noted that land need not be exclusively rehabilitated either for grazing or as habitat for wildlife. It is possible that land that is rehabilitated to support grazing will also provide habitat value for wildlife.

Rehabilitation of non-Indigenous cultural heritage sites or conservation zones will largely comprise weed control during mining to maintain the integrity of these areas. Any disturbance will be revegetated to meet the criteria outlined above.

It is expected that those or better criteria would apply to the amended PMLUP. It is not necessary for the PMLUP to be finally developed at this stage of the project. It is an evolving document that is developed as needed for the progress and completion of rehabilitation. However, it is recommended that the draft environmental authority contain a condition specifying a date when the amended PMLUP will be submitted to DERM.

Rehabilitation strategy

To guide the evolution of the PMLUP, the proponent has made a range of commitments in a rehabilitation strategy that may be summarised as follows:

Tailings Storage Facility (TSF)

- A final campaign of tailings deposition will be put centrally within the TSF to infill any significant depression.
- Pump any remaining water to the pit void.
- Place a surface stabilisation layer (notionally 0.5 m coarse rock source from adjacent waste dumps) to provide a competent subgrade or bridging layer, which will evenly distribute the surcharge onto the tailings surface and thereby limit potential settlements.
- Place a sealing layer (notionally 0.5 m clay sourced from stockpiled material on site) to reduce the downward infiltration of surface water, which would otherwise act as a recharge to seepage. The sealing layer will extend over the full surface area of the storage.
- Place a surface protection layer (notionally 1 m oxidized waste rock sourced from adjacent waste dumps) over the full surface area. This layer could also provide a rooting zone for vegetation.

Waste Rock Dump

- A land contamination survey will be carried out and remediation measures implemented, including removing any contaminated material to the tailings storage facility.
- Surface drainage will be established and batters will be reprofiled to 1:4.
- The disturbed ground will be contour ripped.
- Top soil will be spread to a depth of at least 100 mm, and 200 mm where sufficient soil is available.
- Soil will be seeded with a sterile cover crop and native groundcover, shrub and tree species.

Those measures would also be applied to the ore pad and stockpile area, the plant site and infrastructure areas, and the dams and ponds containing hazardous material in addition to the measures described below

Ore pad and stockpile area

Any remaining stockpiled potentially acid forming material will be removed to the TSF.

Plant site and infrastructure areas

Plant will be maintained with the intention of resale at mine completion. Following removal of structures, major footings will be broken up and buried. Minor footings will be removed to the TSF or pit. Cabling and plumbing and other demolition waste will be removed to an off-site construction and demolition waste landfill.

MGOPD Pit

Water would be diverted to the pit to ensure the water level approximates the pre-mining level of groundwater. Void inflow modelling undertaken for the EIS indicated that a catchment diversion of 27 ha will ensure that the final water level reaches 2,310 mRL (the premining level and 27 m below the pit crest) approximately 27 years after mining ceases. Modelling also indicates that the water level will remain steady at this level and no discharge from the pit will occur.

Dams and ponds containing hazardous material (excluding the TSF)

Decommissioning plans will be prepared for each dam containing hazardous waste. The intended approach for these structures will be to:

- Pump any remaining water to the pit void.
- Remove contaminated sediments to the TSF.
- Remove liners and dispose of them at an off-site landfill.

Raw Water Dam

- Remove any pipe work to other parts of the site.
- Undertake erosion repairs.
- Retain the dam for future use as a water body with ecosystem and stock watering values.

Re-establishing vegetation

Experience gained in the rehabilitation of the Red Dome operations has been that the methods used were generally successful, and it is intended that a similar methodology will be adopted for the Mungana Development. The methodology would include the following measures:

- Re-establishment of vegetation will comprise a combination of seeding and planting seedlings.
- Seed and seedlings will be sourced from the local region. For the majority of plant species this will entail the collection of local seeds from within the mine lease and adjoining properties in the Chillagoe area.
- In areas where growing media will need to be imported (e.g. treated contaminated areas or the TSF) an assessment of the agronomic suitability of the media will be undertaken prior to use, and ripping and fertiliser specifications will be determined.
- For the balance of the rehabilitation areas, fertiliser would be applied at a rate of 250 kg per hectare using a low phosphate fertiliser, such as GrowForce 450 which has an NPK ratio of approximately 13.1N : 1.7 P : 13.9K.
- Areas that would receive direct seeding would be prepared prior to the wet season. This may include ripping and/or scarifying the ground. The decision to rip or not would be made based on the area's previous use and a visual assessment of the soil surface. For example, ripping would be carried out to break up compacted areas, such as hardstands, and scarifying would be used along contours to prepare a seed bed.
- The quantity of seed to be spread per hectare would depend on the target community, seed viability and cost. However, a typical seed mix will comprise:
  - 20 kg/ha to 40 kg/ha of cover crop using commercially available hybrid pasture species
  - 10 kg/ha of native grass seed
  - 2 kg/ha to 5 kg/ha of native tree seed
  - seed would be mixed with sieved topsoil or sand to facilitate even spreading.
- Seedlings would be grown from local seed collected within the mining leases or from nearby properties.
- Seedlings would be planted out at the start of the wet season.
- Planting density would be dependent on the nature of the substrate being treated and composition of the target community. For example, greater mortality would be expected on a waste rock dump bench and so a higher planting density would be used.
- Tree seedlings would generally be planted at 800 to 2,000 stems per hectare.

The EIS recommended the list of species in Table 4.4 for the site rehabilitation program. The list is not exhaustive, and other local species may be substituted depending on availability.

Table 4.4 Endemic species for use in rehabilitation

Species	Common name	Growth form
Local *Aristida* species, such as A. *holathera, A. calycina,* and *A. superpendens*	Wire grasses	Groundcover
Arundinella setosa	Reed grass	Groundcover
Dichanthium sericeum	Queensland Blue Grass	Groundcover
Local *Eriachne* species, such as *E. ciliata, E. filiformis, E. humilis,* and *E. vesiculosa*	Wanderrie grasses	Groundcover
Heteropogon contortus	Black spear grass	Groundcover
Heteropogon triticeus	Giant spear grass	Groundcover
Indigofera linnaei		Groundcover
Indigofera pratensis		Groundcover
Sarga plumosum	Native sorghum	Groundcover

Species	Common name	Growth form
Schizachyrium fragile	Fire grass	Groundcover
Themeda australis	Kangaroo grass	Groundcover
Acacia bidwillii		Shrub
Acacia holosericea		Shrub or tree
Acacia leptostachya		Shrub
Maytenus cunninghamii	Yellowberry bush	Shrub
Adenanthera abrosperma		Tree
Brachychiton chillagoensis	Kurrajong	Tree
Cochlospermum gillvraei		Tree
Corymbia clarksoniana	Bloodwood	Tree
Corymbia dallachiana	Dallachys Gum	Tree
Corymbia terminalis		Tree
Erythrophleum chlorostachys	Cooktown Ironwood	Tree
Erythroxylon ellipticum		Tree
Eucalyptus cullenii	Cullens Ironbark	Tree
Eucalyptus miniata		Tree
Grevillea striata	Beefwood	Tree
Lophostemon grandiflorus		Tree
Lysiphyllum hookeri	Red Bauhinia	Tree
Macropteranthes montana		Tree
Melaleuca argentaea		Tree
Terminalia aridicola	Brown Damson	Tree

Source: Mungana Gold Open Pit Development Project EIS (23 Feb 2011), Table 3.7.1

While the rehabilitation strategy may be adapted and improved by the time rehabilitation is completed, the EIS has adequately demonstrated that the MGOPDP could be rehabilitated to meet current standards and expectations.

5 Adequacy of the environmental management plan

A draft EM plan was included with the EIS. However, the version of the EM plan available when this EIS assessment report was written (that is, the EM plan submitted on 23 February 2011, and subsequently updated on 9 May 2011) did not yet contain all the environmental protection commitments that will be necessary for the EM plan to be in accordance with the additional information provided by the proponent on 19 August 2011 and yet to be provided information about the minimum achievable concentration of cyanide in tailings decant effluent. Consequently, for the purposes of the statutory requirements the latest EM plan cannot be considered adequate.

The recommendations outlined in this EIS assessment report should be fully integrated into the EM plan and include auditable commitments that will allow conditions to be developed for the draft environmental authority. The revised EM plan, which must meet the content requirements of s203 of the EP Act, must be resubmitted for assessment before the decision under s207 is made on whether to allow the application to proceed to the draft environmental authority stage.

6 Suitability of the project

DERM has considered the final TOR, the submitted EIS, all submissions on the submitted EIS, and the standard criteria. Despite the need for a revised EM plan, the submitted EIS has not identified impacts of sufficient magnitude to prevent the project from proceeding.

7 Recommended conditions

Section 59 of the EP Act states that this EIS assessment report must recommend any conditions on which any approval required for the project may be given. However, section 202 of the EP Act states it is the purpose of the submitted EM plan to propose environmental protection commitments to help the administering authority prepare the draft environmental authority for the application. As the submitted EM plan is not yet adequate and must be revised and resubmitted, there was insufficient information for this EIS assessment report to be able to recommend specific conditions for the draft environmental authority. Nevertheless, section 4 of this EIS assessment report has recommended several areas where conditions should be developed for inclusion in the draft environmental authority. The environmental authority will be drafted after the proponent has submitted a satisfactory EM plan.

As noted in section 4.8 of this report, dewatering the pit in the operational phase of the project will require a water licence under the *Water Act 2000* in accordance with the Water Resource (Mitchell) Plan 2007. However, the EIS did not provide sufficient detail for the development of recommended conditions for the water licence. Conditions will be developed when the application for the licence has been received and assessed by DERM.

8 Completion of this EIS process

This EIS assessment report has been approved by the delegate for the chief executive. The giving of this EIS assessment report to the proponent completes the EIS process.

Signature: Stuart Cameron Date: 7 September 2011

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