McArthur River Mine

Overburden Management Project

Executive Summary

Draft Environmental Impact Statement

E. Executive Summary

The Overburden Management Project (the 'Project') for McArthur River Mine (MRM) originated from an improved understanding of the geochemistry of the overburden and the need to manage it differently. However, the extensive studies conducted for this draft Environmental Impact Statement (EIS) have also facilitated a site-wide assessment of environmental management and mine closure planning which has refined a number of previous strategies.

Mining commenced at MRM in 1995 and its current operations were approved by the Northern Territory (NT) Government in 2013 as the Phase 3 Development Project (Phase 3). This project elevated the mining rate to 5.5 million tonnes per annum (Mtpa) and extended the mine life to 2036. In the future, the open cut mining method, zinc and lead concentrate products produced and transport logistics utilised by MRM will not change. The Phase 3 was undertaken by Xstrata, the then owners of McArthur River Mining Pty. Ltd. (McArthur River Mining). Since then Glencore merged with Xstrata and during this time have come to an improved understanding of the overburden geochemistry which has in turn led to the requirement for this EIS.

The key elements of the Project proposed by the EIS are:

- redesign of the overburden emplacement facilities to manage overburden geochemistry;
- reduction in the footprint of overburden emplacement facilities by increasing the height of the main, north facility from 80 metres (m) to 140 m, and positioning others inside rather than outside the mine levee wall to improve overburden management methods and water management;
- reprocessing of tailings and placement within the open cut final void upon cessation of processing, removal of the Tailings Storage Facility (TSF) and rehabilitation of the former facility area;
- a revised open cut final void closure strategy; and
- an acknowledgement of the need and plan for ongoing monitoring and management in the long term to ensure the protection of the environment around the mine site and downstream.

The Project now comprises four distinct phases which have been subject to extensive technical analysis within this EIS. These include:

- Stage 1: Operations (2018-2037 inclusive);
- Stage 2: TSF Reprocessing (2038-2047);
- Stage 3: Decommissioning and Rehabilitation (2048-2072); and
- Stage 4: On-going Monitoring and Maintenance (from 2073).

The resulting greater certainty for the end of mine-life has enabled McArthur River Mining to advance closure planning. Revised Project closure objectives have substantially refined or altered the strategy previously considered and led to the following important changes:

- overburden materials from the last six years of mining and the tailings from re-mining will be deposited into the open cut void;
- over several wet seasons, water will be pumped into the open cut void to create a mine pit lake; and
- subject to water monitoring, McArthur River Mining ultimately plan to open the upstream and downstream sections of the mine levee wall to enable water to flow through the original path of the McArthur River.

An extensive consultation program tested the proposed Project elements and closure planning with residents of the gulf region, Aboriginal custodians from the four local language groups and NT based government and non-government agencies. Significantly, the vast majority of those consulted have supported the Project and recognise the potential benefits for employment and economic growth. There was also a positive response to the closure planning. Importantly, the custodial elders of the Gurdanji people, on whose country the mine is located, have given their consent to the planned overburden management strategies, taking into consideration impacts on cultural heritage and their effective management.

This Project estimates significant benefits arising from the approved mine life with taxes and royalties exceeding $1.5 billion over the four phases, jobs for approximately 840 people during operations, and continuing community investment through the successful implementation of the MRM Community Benefits Trust (CBT), which supports the socio-economic development of the region.

In short, a Project which began with evaluating a geochemical matter associated with the overburden has now informed and influenced the processes for environmental management and operations for the remainder of the mine-life and created greater clarity and planning around long term mine closure and rehabilitation for the benefit of the region.

E.1 Project Location and Background

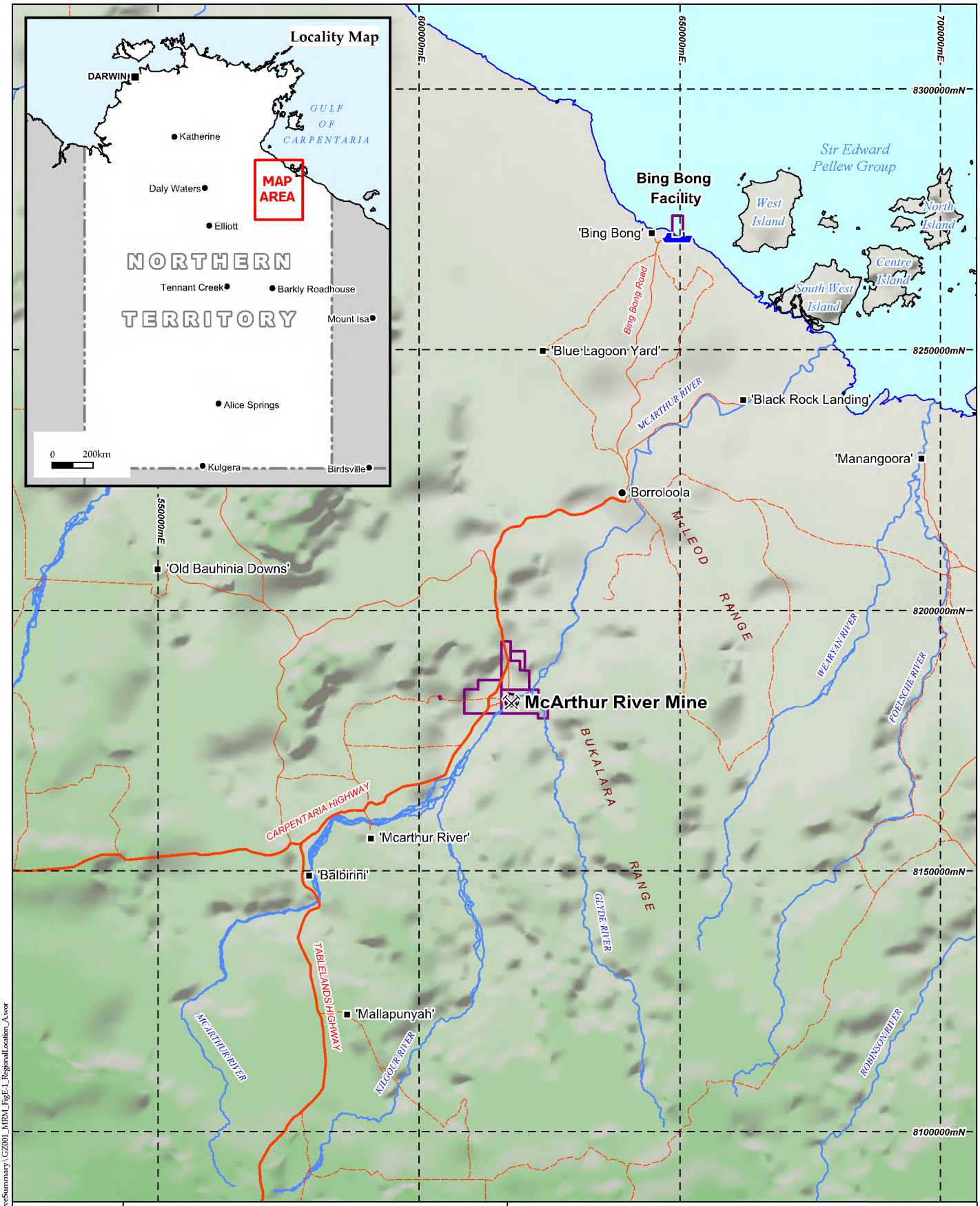
MRM is a major open cut operation, developing one of the largest known sedimentary stratiform zinc-lead-silver deposits in the world. MRM is located approximately 65 kilometres (km) southwest of the township of Borroloola by road, in the Gulf of Carpentaria, Northern Territory. The site regional location is presented in **Figure E-1.**

MRM is currently operating in accordance with its Phase 3 approval conditions and an approved Mining Management Plan (MMP) and associated amendments. The current mining operations are approved and, as per the approved Terms of Reference (TOR) for this EIS from the Environmental Protection Authority (EPA), they are excluded from the scope of this EIS. Therefore this EIS covers the operating period from approximately mid-2018 onwards.

This EIS is required due to an improved understanding of the overburden geochemistry at MRM. Previously, it was estimated that 35% of the total overburden material to be excavated during the life of the mine would be potentially acid forming (PAF) material with the remaining material being non-acid forming (NAF), and therefore of low risk to the environment. Improved overburden geochemical understanding has determined that while these proportions haven't substantially changed, a large proportion of the NAF material is potentially non-benign and may have environmental implications if not managed appropriately. Non-benign NAF material has the potential to produce metalliferous mine drainage and/or saline drainage in neutral conditions. Improved overburden geochemical understanding has required McArthur River Mining to revise the overburden classification system and management practices and to facilitate improved final landform designs.

The Project comprises a continuation of existing site operations and presents proposed refinements in environmental protection measures incorporated as part of amendments to the following site activities:

- overburden classification, management and emplacement closure;
- open cut development and closure;
- TSF decommissioning and closure;
- water management; and
- operations and closure timeframes.



LEGEND

- Town
- Homestead
- Mine
- Bing Bong Concentrate, Storage and Ship Loading Facility
- Principal Road
- Road (sealed)
- Road (unsealed)
- Watercourse
- Project Tenement

Data Source: Topography - Geoscience Australia; Tenement - NT Gov.

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McArthur River Mine
Overburden Management Project EIS

Regional Location

0 20 40

Kilometres

Scale: 1:1,000,000 (A4)

04/03/2017

Datum: GDA94
Projection: MGA53

FIGURE E-1

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E.2 Project Proponent

The Project proponent and current operator of the mine is McArthur River Mining; a wholly owned subsidiary of the Glencore plc (Glencore). The proponent's contact details for this EIS are provided below:

The EIS Project Manager
McArthur River Mining Pty. Ltd.
Address: PO Box 36821 Winnellie, Northern Territory, Australia 0821
Telephone: Information Line: 1800 211 573
Email: mrmprojenq@glencore.com.au
Website: www.mcarthurrivermine.com.au

E.3 Legislative Framework

E.3.1 Northern Territory Environmental Assessment Process

This EIS has been prepared in accordance with the Northern Territory *Environmental Assessment Act* (EA Act). McArthur River Mining provided a Notice of Intent (NOI) to the Northern Territory Environmental Protection Authority (NT EPA) on 27 June 2014 for consideration under the EA Act. The NT EPA under clause 14A (3) of the Environmental Assessment administrative procedures determined that the MRM Overburden Management Project required assessment at the level of an EIS on 10 July 2014.

The TOR were developed for the EIS and issued to MRM on 23 September 2014.

E.3.2 Commonwealth Environmental Assessment Process

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), any development requires assessment if it has the potential to affect one or more of the nine Matters of National Environmental Significance.

McArthur River Mining referred the Project under the EPBC Act to the Commonwealth Department of the Environment on 14 May 2014. A determination was made and communicated to McArthur River Mining on 15 June 2014 confirming that the Project constituted a 'Controlled Action' and would require approval under the EPBC Act before it can proceed. It was decided that the Project would be assessed via the accredited assessment process agreed between the Northern Territory Government and the Commonwealth.

There are several other legislative requirements McArthur River Mining has considered into consideration relevant to the Project scope. These are further outlined in **Chapter 2 – Legislative Framework**.

E.4 Project Description

E.4.1 Project Overview

The Project has been necessitated by an improved understanding of the site's overburden geochemistry and the required amendments to the Project operations and management practices in order to maintain protection of the downstream environment. The EIS TOR required a site-wide assessment, which subsequently led to a review of all operations relating to the management of overburden. As a result, opportunities to improve site-wide environmental management were identified and incorporated into the Project. Hence a number of Project aspects are proposed to be modified and are discussed further below. **Figure E-2** presents an overview of the key Project components within the three key Project domains.

Life of mine management of the Project will be conducted in accordance with the Project design philosophy, which is driven by the closure objectives and focuses on managing key long-term environmental risks from the outset as part of the Project design and operational phases. This approach reduces the reliance on mitigation during closure by addressing potential long-term environmental risks in the shorter term. This will include implementation of a rigorous design program and (upon approval) implementation of a comprehensive risk-based operational development program. The design process has also identified a number of alternatives and contingencies available to support the management of environmental performance to drawn upon where monitoring indicates an altered approach to achieving the closure objectives is required.

The assessment and implementation of risk reduction measures has been, and will continue to be, undertaken at all stages of the Project development including:

- planning and design;
- operational development; and
- decommissioning and rehabilitation.

The water management strategy has been updated to maintain protection of downstream environmental values. This includes the management of various water classes on site, with a combination of different water management strategies being implemented (depending on the class of water) including:

- upgraded seepage prevention and collection practices and infrastructure;
- water storage in dams and resultant evaporation;
- water storage in dams and discharge to the environment under regulated conditions;
- water treatment with subsequent storage and evaporation;
- water treatment and discharge to the environment under regulated conditions; and
- water blending (via dams) and discharge.

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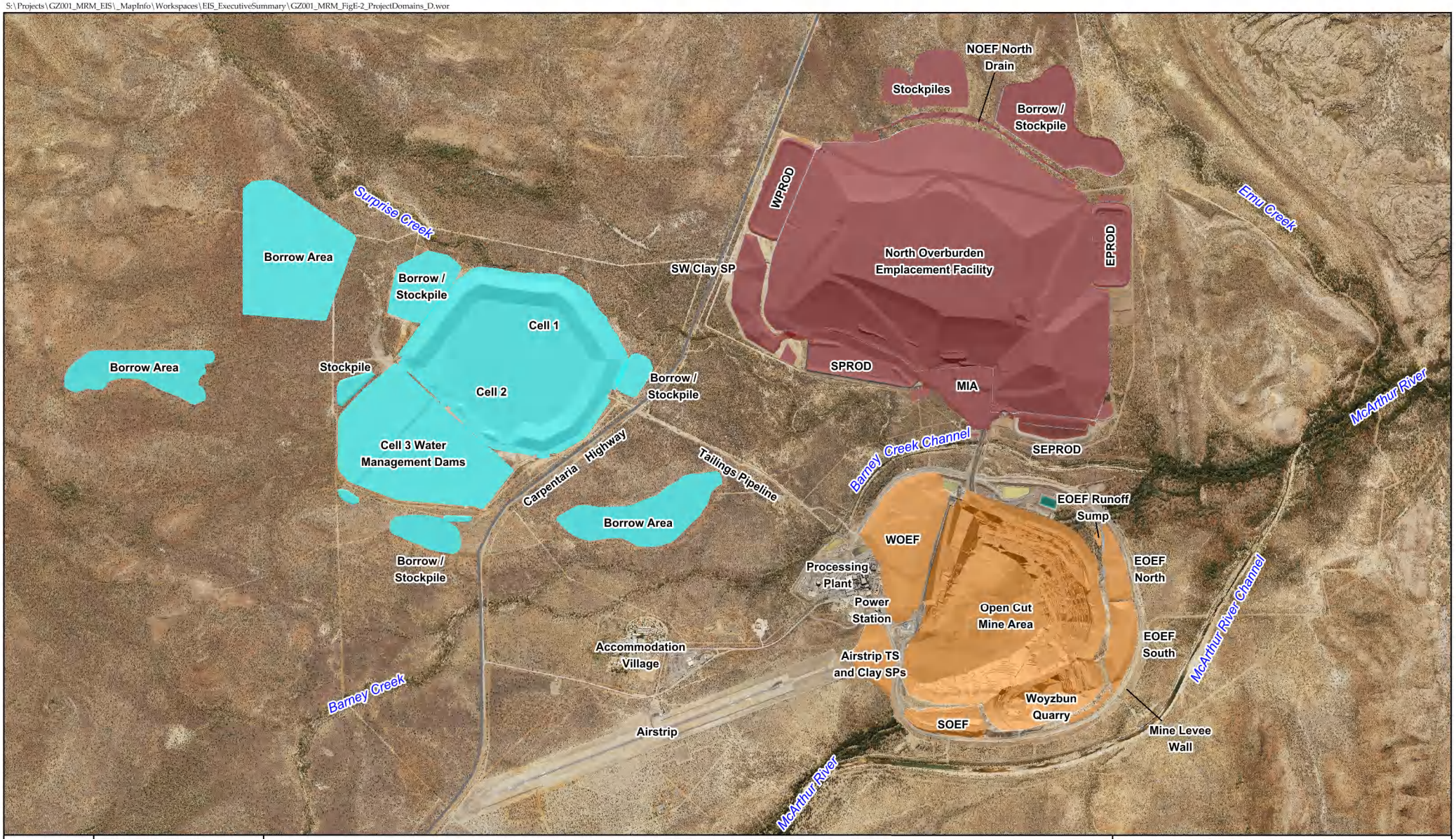

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LEGEND

Project Domains

- Tailings Storage Facility
- North Overburden Emplacement Facility
- Open Cut

Data Source: Hillshade Rasters - Glencore (Jun 2016); Aerial - McArthur River Mining Pty Ltd (Jul 2016); Project Domains - MetServe (Feb 2017)

McArthur River Mine
Overburden Management Project EIS
Project Layout and Key Infrastructure Components

800 0 800

Metres

Scale: 1:45,000 (A4)

14/03/2017

Datum: GDA94
Projection: MGA53

FIGURE E-2

Mining within the open cut will continue to target the same orebody as that under the current approvals using conventional mining methods. The proposed mining process will be similar to the current operations and will result in the open cut being progressively excavated from west to east, deepening towards the final void limit. This is anticipated to continue from 2018 through to the cessation of mining in 2037. Additional areas within the mineral leases will be quarried to source benign material for utilisation in construction and closure. The placement of additional temporary stockpiles around the open cut perimeter (inside the mine levee wall) is also proposed during operations. Material from these stockpiles, along with operational overburden from the last six years of mining, will be placed within the open cut upon cessation of mining. This will create a permanent underwater storage for this material that will prevent oxidation and mitigate generation of acid and metalliferous drainage.

Management practices that prevent or limit the oxidation of MRM's overburden material are paramount in managing its potential for environmental harm. Non-benign NAF materials that are maintained in a stable non-oxidising environment are anticipated to behave in a similar way to benign NAF material. This is a fundamental concept in understanding the potential risks posed by MRM overburden and to implementing solutions that enable the deposit to be mined whilst meeting the environmental objectives. It is the primary concept behind the design and construction of overburden emplacement facilities (OEFs) including internal architecture and cover systems.

The South Overburden Emplacement Facility (SOEF) and East Overburden Emplacement Facility (EOEF), originally proposed for permanent location outside the mine levee wall adjacent to the McArthur River, will be managed differently. The material previously proposed for placement in these facilities will now be predominantly placed in the North Overburden Emplacement Facility (NOEF) that has been designed to manage oxidation and production of oxidation products.

The NOEF has been redesigned. Construction and encapsulation methods have been adjusted to specifically manage the overburden, based on the refined geochemical classifications and modelled geochemical behaviour. The redesign has focussed on reducing oxygen and water ingress and therefore the potential for geochemical reactions to occur. The geometry of the NOEF has been altered to reduce the footprint whilst maintaining sufficient capacity for storage of the majority of Project overburden. As a result, the previously proposed NOEF height has been increased. Trilinear concave batters are to be utilised on the final landform to both limit erosion and provide a final landform similar in batter profile to surrounding hills. The proposed in-pit storage of non-benign overburden allows the NOEF to be completed, encapsulated and rehabilitated early in the Project life, prior to the cessation of mining.

The TSF will continue to be operated in a similar manner to current operations. However, the previously proposed Cell 4 will not be required or constructed. The height of the existing TSF will be increased to accommodate the additional tailings in order to eliminate the need for tailings storage in Cells 3 & 4. Improved water management and seepage collection infrastructure is proposed to assist with the protection of environmental values downstream of the mine. Cell 3 (the existing Water Management Dam (WMD)) will be developed into two separate lined cells for site-wide water management purposes. Upon cessation of mining in the open cut, the tailings will be re-mined from the TSF, reprocessed through the processing plant and deposited in the open cut for permanent underwater storage. Storage in the open cut will mitigate generation of acid and metalliferous drainage from the tailings. The former TSF area will then be rehabilitated.

Following closure of the NOEF and reprocessing and deposition of the tailings into the open cut, the remaining open cut capacity (approximately 170 m from the surface), will be filled with water sourced from the McArthur River to create a mine pit lake. This will be completed over a period of approximately five years when McArthur River flows provide sufficient surplus to meet filling requirements. This rapid filling will enhance the mitigation of acid and metalliferous drainage from the tailings and overburden that will be stored in the open cut.

Mine pit lake water quality will be monitored and once deemed at acceptable discharge levels, the northern (downstream) end of the mine levee wall will be opened to the McArthur River via an engineered weir. This will create a 'backwater' connection with the McArthur River during high flow events. This system will be monitored and, once deemed appropriate, the southern (upstream) end of the mine levee wall will also be opened to the McArthur River via a similar weir structure. This will create a 'flow-through' connection with McArthur River during high flow events. The deposited tailings and overburden placed within the base of the open cut are not anticipated to materially affect the surface waters of the mine pit lake that will interact with the McArthur River.

A period of regular monitoring will follow completion of the mine pit lake development and will address performance across the site in the context of the Project closure objectives. Where monitoring indicates rehabilitation requires intervention, adaptive management practices will be implemented to investigate, rectify and further monitor project closure performance.

Ten Project closure objectives have been developed as part of the EIS. They are:

- Post-mining landscape will be left in a condition safe and secure for humans and animals:
    - safe and secure for short term (0-100 years); and
    - safe for long term (100-1,000 years).
- Landform stability:
    - Geotechnical stability will be maintained at these standards:
        - NOEF: Long-term static drained Factor of Safety of 1.5; Maximum Design Earthquake (MDE) – 1 in 1,000 year event;
        - open cut walls: Probability of Failure for inter-ramp slopes of <5%; and
        - TSF: as per ANCOLD (2012) guidelines.
    - Erosional stability; maintainable for these aspects:
        - cover system and landform to maintain functionality;
        - sediment release from erosion does not adversely impact on water quality;
        - erosion does not affect functionality of the landform; and
        - resulting suspended solids can be mitigated.
    - Geochemical stability will be defined, managed and monitored:
        - seepage water quality at toe/base of landforms; and
        - water quality within the mine pit lake.
- Manage surface water and groundwater such that environmental values and ecosystems are maintained downstream of the lease boundary in the short term (0-100 years), and within the McArthur River in the long term (100-1,000 years).
- Rehabilitated areas will provide appropriate habitat for fauna utilization – abundance and diversity will be appropriate.
- Metal levels for fauna comparable to background levels.
- Landform will host suitable vegetation for post-mining land use:
    - for traditional land use areas:
        - have similar environmental values as surrounding areas; and
    - for cattle grazing land use areas:
        - grasslands.
- Manage soil to meet post mining land use.

- No infrastructure left on-site unless a beneficial gain is identified and agreed with stakeholders.
- Maintain custodians' access to areas of cultural significance.
- Foster economic opportunities for custodians and local communities.

Key milestones in the proposed Project schedule include:

- 2018 project commencement following EIS approval and authorisation of an associated MMP;
- 2037 completion of mining activities;
- 2047 completion of operational activities;
- 2072 completion of Project decommissioning and rehabilitation activities; and
- 2100 represents the point in time when:
    - all rehabilitated areas are anticipated to be self-sustaining with no need for active management;
    - any significant changes to site management/infrastructure are anticipated to have been identified as part of the adaptive management period; and
    - monitoring and maintenance will continue.

E.4.2 Project Definition Process

The Project definition process has been thorough, iterative and incorporates the following key developments:

- development of Project closure objectives;
- development of a Project conceptual model and Project alternatives;
- refinement of the Project conceptual model;
- establishment of a preferred design; and
- completion of a Project Risk assessment and management process.

The process incorporated acknowledgement that the site will require ongoing monitoring and management following mine closure to maintain long term protection of the downstream environment. As a result, a number of closure monitoring and management phases, including short-term adaptive management, long-term proactive monitoring and long-term reactive monitoring are proposed. These are described in further detail in **Chapter 3 – Project Description and Justification.**

E.4.3 Project Scope and Key Changes

Existing operations that continue in accordance with the previous Phase 3 are not subject to this EIS. The components of the MRM operations which have significantly changed since the original assessment of the Phase 3 EIS and hence have been included in the Project EIS include:

- overburden management and NOEF design and closure;
- open cut development and closure;
- TSF closure;
- water management; and
- long-term closure management and phasing.

Table E-1 presents the key components of the current MRM operation and identifies how they will change with the Project. **Figure E-3** presents the Project footprint compared with the previously approved Phase 3 (or prior) footprint.

Table E-1 Comparison of Current Operations to Project Operations

Component	Current Operations (i.e. Phase 3 Operations + MMP amendments)	The Project Operations
Ore remaining from 2018	90 million tonnes (Mt)	92 Mt
Mining Rate	Up to 5.5 Mtpa of ROM ore.	No change.
Mining Life	Until 2036 (at 5.0 Mtpa).	Until 2037 (at 5.0 Mtpa) plus 10 years of tailings reprocessing (to 2047).
Mining Method	Open cut mine using conventional drilling, blasting, loading and haulage methods.	No change.
Open Cut Dimensions	Length: 1,750 m Width: 1,500 m Depth: 420 m Overall footprint - 210 hectares (ha) (within the existing approved bunded area).	Length: 1,950 m Width: 1,550 m Depth: 420 m Overall footprint - 265 ha (within the existing approved bunded area).
Overburden	530 Mt Existing West Overburden Emplacement Facility (WOEF) and NOEF. SOEF, and EOEF extending outside the mine levee wall.	595 Mt (includes additional benign material specifically mined to supply closure material). Existing WOEF and redesigned NOEF. Temporary SOEF and EOEF inside mine levee wall.
Processing	Heavy media plant (HMP) treats some ore in a pre-concentration phase. Flotation process producing bulk concentrate and separate zinc and lead concentrates.	No change to HMP. No material change to processes or concentrates produced.
Power	Gas power station with a capacity total of 54 MW.	No change.
Product	800 kilotonnes per annum (ktpa) of total concentrates, comprising bulk lead and zinc concentrates.	No change.

Component	Current Operations (i.e. Phase 3 Operations + MMP amendments)	The Project Operations
Tailings	Tailings discharged to TSF. Proposed Cells 2, 3 and 4 to be utilised. 2017 amendment uses Cells 1 and 2 only.	No change to tailings deposition details during operations (Cells 1 and 2 only). Tailings reprocessed and placed into Open Cut when mining complete. The TSF footprint will be rehabilitated.
Transport	Concentrate trucked 115 km to Bing Bong port, transferred to barge, barged to offshore loading area onto bulk carriers (18 truck movements per day and 250 barge movements per year). Lead concentrate transported to Mount Isa or Darwin.	No change.
Water Management System	Bore fields for water supply. Mine water collected and utilised in the process. Evaporation from on-site dams. Water discharge licence granted. TSF Cell 3 dams and NOEF perimeter runoff dams (PRODs) for water management. Water treatment plant (6 megalitres per day (ML/day)).	No material change to TSF Cell 3 dam and PROD concepts. Increased water treatment plant capacity (to 15 ML/day total).
Workforce	Approximately 440 permanent staff and contractors. Construction phase workforce peak at approximately 930. Operational phase workforce peak at approximately 735 permanent staff and contractors.	Operational phase workforce average at approximately 840 permanent staff and contractors with fluctuations between 550 and 1,020 depending on Project stage and activities. Tailings reprocessing phase average of approximately 180 staff and contractors.

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LEGEND

OMP (Project) EIS

Maximum Proposed Footprint

Previously Approved Disturbance

Existing and/or Approved Footprint

Highway

Mine Access Road

Data Source: Mine Access Road, Project Footprints, Aerial - McArthur River Mining Pty Ltd (2012-2016); Highway - NT Gov. (2012)

McArthur River Mine
Overburden Management Project EIS
Maximum Footprint
(Project vs Phase 3 or Prior Approvals)

800 0 800

Metres

Scale: 1:45,000 (A4)

14/03/2017

Datum: GDA94
Projection: MGA53

FIGURE E-3

E.5 Project Need and Benefits

E.5.1 Project Need

MRM comprises one of the largest known zinc deposits in the world, and makes a significant contribution to the global zinc supply. Zinc is required for use in many areas and its demand is expected to continue to grow. The market opportunity for the Project is significant.

Existing approvals provide that the mine can continue, in its current form, until approximately 2020, however should the Project not be approved, a revision to current operating plans would be evaluated. Any material changes to the Project may result in the loss of economic benefits for the NT and Commonwealth, including:

- contributions to government mining royalties and taxes;
- trade and export opportunities;
- employment for the existing workforce; and
- regional socio-economic benefits associated with the mining operations.

E.5.2 Project Benefits

The Project will secure a substantial and long term mining operation which will produce significant direct and indirect benefits to the NT and Australia generally. These benefits include:

- contributions to government revenue over the operational period (30 year duration), including an estimated:
    - $117.4 million in total payroll taxes paid to the Northern Territory Government;
    - $435 million in royalties paid to the Northern Territory Government; and
    - $1.038 billion in corporate taxes paid to the Commonwealth (subject to change based on commodity price changes, future production levels or official tax rates).
- creation of significant employment opportunities and long-term job stability spanning multiple generations, with an MRM target to reaching 20% Indigenous employment on site, and estimated average annual site labour force of:
    - 845 positions during the operational stage;
    - 184 positions during the tailings reprocessing and rehandling stage;
    - 17 positions during the decommissioning and rehabilitation stage; and
    - 7 positions during the longer term adaptive management and monitoring stage.
- the creation of these abovementioned employment opportunities will result in:
    - payment of an estimated $261.5 million directly to McArthur River Mining's employees in the Borroloola/Gulf area; and
    - injection of an estimated $177.1 million directly into the local Borroloola/Gulf area from income paid to local employees.
- ongoing opportunities for local and regional businesses to engage with McArthur River Mining;
- provision of support for youth training and employment, including a continuation of McArthur River Mining's partnership with Borroloola School to encourage education outcomes and pathways to employment;
- an extension of the McArthur River Mining's CBT for the life of mining, which currently receives in excess of $1.25 million per year in direct investment by McArthur River Mining;
- increased opportunities for custodians/Indigenous leaders to be involved in the rehabilitation process and other cultural heritage management activities; and

- increased frequency and scope of environmental monitoring.

Chapter 12 – Socio-economic Environment provides further details on these benefits.

E.6 Project Alternatives

As part of the Project definition process, a number of design, operational and closure alternatives were identified and assessed for each of the key Project aspects. Alternatives were considered in the context of the closure objectives.

Project alternatives considered include:

- Project versus No-Project scenario;
- design alternatives for the NOEF and the TSF;
- mine layouts and configurations to improve Project outcomes, such as location of OEFs;
- mine sequencing and scheduling;
- alternative processes, methods and lifecycles;
- closure and rehabilitation planning opportunities;
- consideration of alternative environmental management measures for key risks and impacts;
- various water infrastructure alternatives to capture and manage mine affected water; and
- final void management and closure.

A multi-criteria analysis (MCA) was undertaken on the alternatives for key aspects of the Project. The preferred alternative for each key aspect was further refined throughout the EIS process. The analysis of each alternative was semi-quantitative in approach, and considered a number of equally weighted key criteria including environmental performance, constructability and maintenance, societal and stakeholder benefits and financial costs.

The feasible alternatives identified through the MCA process that were not captured as part of the project description provide a source of potential management contingencies during the adaptive management phase. These may be drawn upon where monitoring identifies a requirement to alter management practices.

E.7 Materials Characterisation

McArthur River Mining has subsequently refined the overburden classification system; with overburden material now characterised into one of five distinct categories, based on geochemical properties and predicted behaviour. The classes reflect the respective acid and metalliferous drainage (AMD) generation potential of the material and each class is managed differently to minimise environmental impacts. The five classes of overburden material, in order of increasing potential to effect water quality, are:

- low salinity non-acid forming material (high capacity) (LS-NAF(HC));
- metalliferous saline non-acid forming material (high capacity) (MS-NAF(HC));
- metalliferous saline non-acid forming material (low capacity) (MS-NAF(LC));
- potentially acid forming material (high capacity) (PAF(HC)); and
- potentially acid forming material (reactive) (PAF(RE)).

McArthur River Mining maintains a model of the in-situ overburden yet to be mined (the block model). This has been developed over time and has been significantly refined in recent years following investigatory drilling programs and extensive geochemical testing. The block model is utilised to estimate the location and quantities of the various overburden classes and has informed the open cut and NOEF development schedules.

E.8 Project Risk Assessment

McArthur River Mining has implemented a comprehensive risk identification and assessment program over a two and a half year period to review the existing Phase 3 risks and identify and assess any potential new Project risks. This has been an iterative process that has been refined as the results of the Project's stakeholder engagement program and supporting technical studies have been obtained.

The risk identification and assessment program has also taken into consideration the results of other in-house risk assessment programs as well as Project risks identified and assessed by third parties. Specifically this has included:

- The Northern Territory Government, which identified a number of key risks as part of a Preliminary assessment of the Project, and has prescribed in the EIS TOR that they be assessed (or reassessed) as part of this Project EIS.
- The Independent Monitor reports. The Independent Monitor has been appointed by the Northern Territory Department of Primary Industry and Resources (DPIR) to develop annual Environmental Performance Reports on the MRM site, with the latest report having been released in 2016. The scope of these reports is to provide an independent monitoring assessment of the environmental performance of MRM and its regulation. As part of these reports, site-wide environmental risk assessments are developed, and are reviewed and updated on an annual basis.
- The Mine Risk Register report (2016). This site-wide report was developed by an external risk specialist and encompassed all areas of MRM's operational activities plus its proposed Project activities.
- An internal Failure Modes and Effects Analysis (FMEA) process, which was conducted with the assistance of an external risk specialist.

A final Project Risk Register was developed, which incorporated the above inputs, the results of which were integrated with the Project design process.

The process adopted for each identified risk included an assessment of the inherent (or Pre-Project EIS) risk, based on existing mitigation measures, and the residual (or Post-Project EIS) risk, based on proposed additional mitigation measures. A combination of the likelihood of occurrence and consequence of failure was considered for each risk event. The analysis technique evaluated the effects of such failures on the larger systems of which they formed a part, including:

- Environmental;
- Regulatory;
- Community and Stakeholder;
- Health and Safety; and
- Economic.

A total of 97 Project risks were identified as a result of the risk review workshops. Some of these risks were new Project risks and hence are not represented in the inherent risk count below. With the adoption of the mitigation measures proposed as part of the Project, the following changes to the Project risk profile were determined:

- High risks will decrease from 18 (inherent) to zero (residual);
- Medium risks will decrease from 52 (inherent) to 42 (residual); and
- Low risks will increase from 23 (inherent) to 55 (residual).

Figure E-4 provides a Project risk profile, and summarises the identified Project risks in order of risk ranking. Pre-EIS inherent risk rankings and post-EIS residual risk rankings have been provided for comparison purposes.

Risk identification, analysis and mitigation are an integral part of the proposed Project. McArthur River Mining's approach includes adoption of a combination of systems and hazard specific management measures. These will comprise a combination of the following controls in order to align with the approach to life of mine management.

- project design controls;
- operational engineering and administrative controls; and/or
- monitoring and reactive management controls.

Each of these classes of controls aims to either limit the likelihood of a hazard occurring, or, in the event that it does occur, limit the resultant consequence.

Risk management at MRM is embedded through a structured framework that establishes a common approach across projects and operations for identifying, assessing, treating and monitoring business risks that include risks to the environment and risks to corporate reputation.

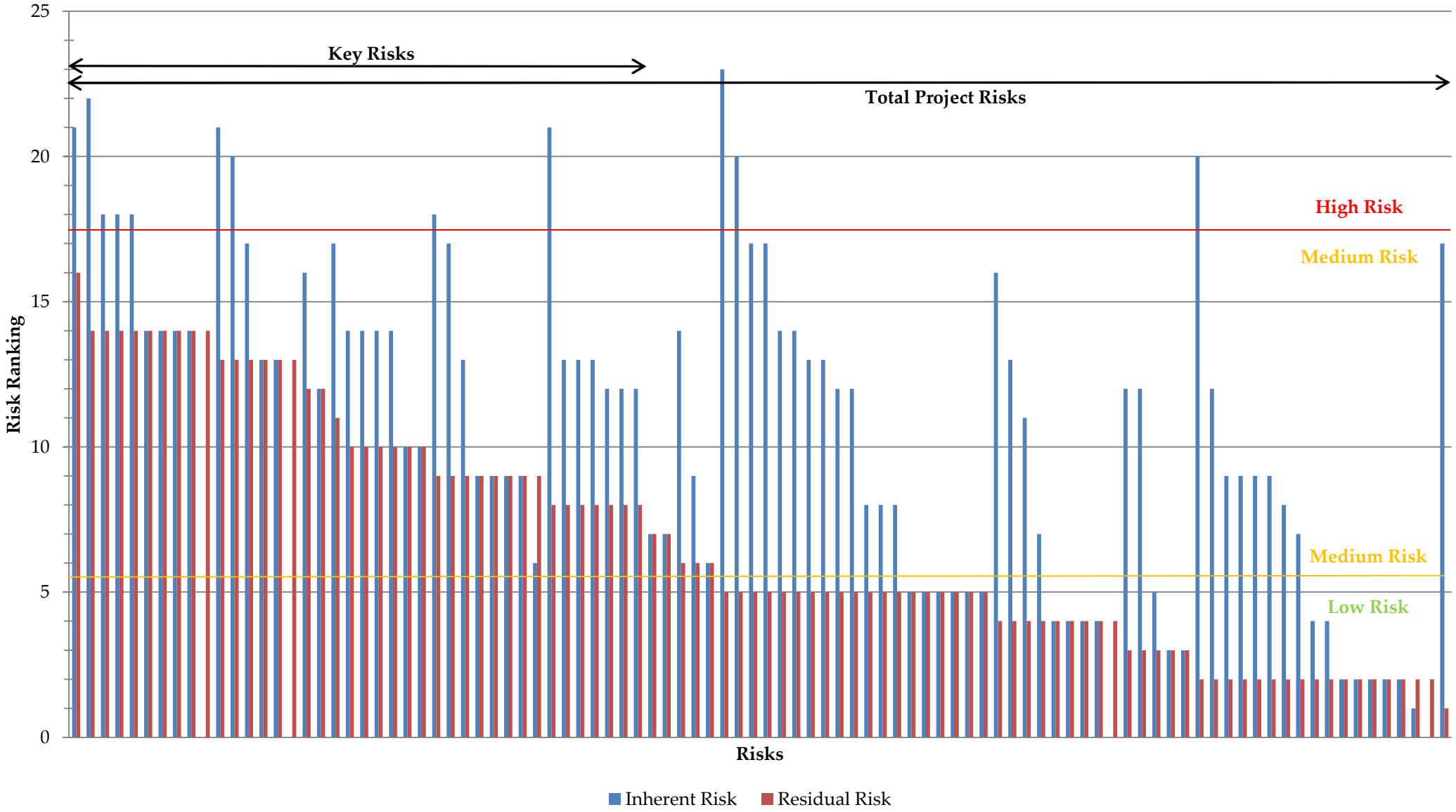

Figure E-4 Project Risk Profile

E.9 Water Resources

The effective management of water resources has been an integral component of the Project development and a key focus of the EIS. The existing water management strategy has been updated to maintain protection of downstream environmental values. These include:

- aquatic and terrestrial ecosystems;
- primary industries including stock drinking water, irrigation and general water uses;
- recreation and aesthetics; and
- cultural and spiritual values.

The adopted surface water quality indicators relevant to protecting the downstream environmental values are those documented in McArthur River Mining's Waste Discharge Licence (WDL) and are measured at several locations on and off-site, including the downstream compliance point (SW11).

Given MRM's proximity to the McArthur River, the groundwater and surface water systems are highly connected, with one system often influencing the other. McArthur River Mining has undertaken significant fieldwork and groundwater model calibration to develop a robust understanding of the levels and movement of groundwater, and its interaction with surface water systems and Project infrastructure. The work has demonstrated that beyond the influence of the open cut dewatering drawdown zone, groundwater flows regionally towards the McArthur River, and locally towards the local ephemeral creek system, where discharge occurs. Thus, groundwater migrates into surface water on the lease, or into the dewatered open cut/underground water management system.

The catchment area is predominately characterised by flat areas bordered by low hilly land that is subject to flooding during the wet season, with most of the mine site located within the McArthur River floodplain. The surface water quality within the MRM region is naturally affected by seasonal stream flows and elevated levels of metals, particularly copper, lead, zinc and aluminium. The groundwater system has three main groundwater bearing units which extend across the Project area, these include: alluvium, weathered bedrock and bedrock (fractured and intact) and are generally connected hydraulically.

MRM is an established mining operation and implements a comprehensive groundwater and surface water management system as part of daily operations. Since a review in 2015, McArthur River Mining has implemented a water classification system which includes six water classes. Wherever possible, water at MRM is managed in a way that separates water classes to limit the volume of poor quality water and process water within the system.

The water management system will incorporate a water treatment plant that will be utilised throughout the operational period. The Project will increase the capacity for water treatment in order to better protect the quality of water in the downstream environment. The treatment plant will operate at different capacities through different stages of the Project. It will be utilised to manage surplus mine affected water and facilitate releases of treated water to the McArthur River system. The water treatment plant will operate in conjunction with a network of dams, drains, pumps, evaporation systems and pipes which deliver, store, evaporate and transfer water around the site.

McArthur River Mining has operated three borefields over the life of the mine to supply water for various uses. Presently, the Mount Isa Mines Exploration (MIMEX) borefield is used for potable water supply and process water for the mill. Emu borefield also supplies raw water for processing (MRM, 2015). The Donkey borefield was effectively decommissioned in 2009, with negligible abstraction since.

The primary open cut dewatering activity at MRM requires pumping from the underground voids from the original MRM underground operation. Additionally, a series of collection sumps along the open cut perimeter collect groundwater from the northern, eastern and southern open cut walls.

McArthur River Mining maintains an existing water balance model which incorporates the flows and storages of the various water classes including inputs from and losses to the groundwater system. It is utilised to manage the various water classes around site and maintain sufficient capacity in storages and sufficient supply to water consuming site processes.

Updates to the existing water management system and water balance have been prepared to accommodate the proposed changes to the mine site layout and maintain protection of downstream environments. The management system will be dynamic and will be adjusted according to the mine activities and in response to climatic events and monitoring.

Key components of the water management system associated with the Project include:

- a new NOEF East Perimeter Runoff Dam (EPROD) to augment the existing water storage capacity in the three existing NOEF perimeter runoff dams (west, south and southeast – WPROD, SPROD and SEPROD respectively);
- an upgraded water treatment plant with increased capacity from 6 ML/d to up to 15 ML/d to manage water inventory on site; and
- sediment management structures that passively or actively releases water to the receiving waters following sediment removal.

The water balance modelling results indicate that with the proposed additional water management measures in place, the proposed water management system will be robust and will have adequate storage capacity to manage surface water runoff generated within the MRM site for a wide range of possible climatic conditions, including extended wet and dry periods.

The water management system has been designed to manage and mitigate the following potential effects associated with mine infrastructure to protect downstream environments:

- modified groundwater baseflow discharges to creeks, rivers and diversions;
- sulphate migration within the groundwater system down-gradient of mine overburden, TSF and water management facilities during the life of mine; and
- increases in sulphate loads to the Barney Creek Channel, primarily associated with long-term seepage from the NOEF, peaking post-closure following establishment of the mine pit lake.

Specific seepage collection systems have been proposed to manage the dry season baseflow to the Barney Creek channel.

Most of the existing and proposed mining infrastructure is located within the McArthur River floodplain and potentially affected by McArthur River, Barney Creek and/or Surprise Creek floodwaters. The existing flood mitigation measures at the MRM site will remain during the proposed Project operations. Additional measures are proposed to mitigate the potential impact of flooding on proposed mine infrastructure.

The flood modelling results indicate the proposed flood management measures would adequately mitigate the potential impacts of flooding on and downstream of the MRM site. Flood modelling results also indicate the mine levee wall provides flood protection to the open cut area from the McArthur River for flood events up to the 0.1% Annual Exceedance Probability with a 0.4 m freeboard during the proposed Project operations.

The Project water management system aims to manage the quality of surface waters in Surprise Creek, Barney Creek and Little Barney Creek adjacent to mining areas. Without appropriate mitigation, these creeks may be affected locally by groundwater inflow that is potentially affected by basal seepage from the TSF and/or NOEF as well as natural mineralised zones near the surface. Potential localised surface water impacts in Surprise Creek associated with TSF seepage are predicted to reduce significantly over time as residual groundwater is gradually diluted by groundwater recharge after the TSF is removed, prior to mine closure. Long-term management strategies are proposed to manage the potential localised surface water effects in Surprise and Barney creeks associated with the NOEF. These are predicted to stabilise over the long term as basal seepage from the NOEF stabilises and the groundwater table stabilises after the mine pit lake is formed. Specific mitigation measures are proposed to maintain protection of the downstream environment throughout all phases of operation and rehabilitation.

McArthur River Mining currently operates a comprehensive surface water monitoring network and data collection program within and in the vicinity of the mine site to collect:

- water level and flow data in the McArthur River, Barney Creek and Surprise Creek;
- water quality data in the natural streams upstream and downstream of the mine site, and through the mine site;
- water quality data in MRM's water storages and sumps on the mine site; and
- water quality at the site compliance station, SW11 that represents all water from the site.

Currently, surface water is monitored at 32 stream locations within and in the vicinity of the mine site and at 55 artificial surface water sites, including 48 storages and sumps.

A number of minor refinements to improve and expand the current surface water monitoring program are proposed to account for changes in site layout and better understand the site surface water characteristics. No changes are proposed to the existing suite of parameters monitored or the monitoring frequency presently.

McArthur River Mining will continue to implement the current groundwater monitoring program. Additions are proposed to regularly verify the timing and magnitude of impacts to groundwater values and to improve the understanding of source-pathway-receptor processes across the site. The program will be based on the principle of adaptive management and will facilitate early preventative action should monitoring suggest impacts may occur at different receptors, or in a way different to that predicted by the modelling works.

E.10 Biodiversity

The biodiversity values of the MRM region are well known due to extensive flora and fauna surveys spanning several decades. Flora surveys of the MRM mineral leases have detected 445 species of vascular plant, with a further 727 species known from the broader region (20 km from the Project). Fauna surveys of the MRM mineral leases have also detected 26 species of amphibian, 79 species of reptile, 216 species of bird and 39 species of mammal. Thirty-seven species that are protected under the EPBC Act as threatened species or migratory species were noted as potentially occurring within, or visiting, the MRM mineral leases. Twenty of these species have previously been recorded within the MRM leases. Five additional species, which are not protected under the EPBC Act, are threatened species under the *Territory Parks and Wildlife Conservation Act* (TPWC Act).

Potential impacts of the Project on the above threatened and migratory species have been assessed in detail. In addition, species that occur at or near the edge of their geographic distribution, and those that are classified as near threatened or data deficient under the TPWC Act, have also been discussed.

The potential risks that the Project poses to biodiversity values are assessed over two chapters of the EIS. **Chapter 9 – Biodiversity** assesses the risks of the Project to overall biodiversity, with a particular focus on species protected under the TPWC Act, while **Chapter 10 – Matters of National Environmental Significance** assesses the risks of the Project to species and ecological communities protected under the EPBC Act. The approach taken for assessing risks to biodiversity values in each chapter is similar and has included the following:

- data from field surveys and publicly available databases are used to generate a list of protected species that may be present within the region;
- the likelihood of each species being present on-site is individually assessed, which is then used to generate an inherent risk (risks without control measures) of being impacted by the Project; and
- for species considered to be of medium to high inherent risk of impacts, potential impacts are discussed in detail and mitigation measures are proposed with residual risks being assessed.

Three threatened species are considered to have a medium residual risk of being negatively impacted, including:

- Gouldian Finch, *Erythrura gouldiae* (Endangered under the EPBC Act; Vulnerable under the TPWC Act);
- Largetooth Sawfish, *Pristis pristis* (Vulnerable under the EPBC Act; Migratory under the EPBC Act; Vulnerable under the TPWC Act; protected under the *Fisheries Act*); and
- Mertens' Water Monitor, *Varanus mertensi* (Vulnerable under the TPWC Act).

Eight species that are listed as Near Threatened under the TPWC Act are also considered to have a medium residual risk of impact including:

- Australian Bustard (*Ardeotis australis*);
- Bush Stone-curlew (*Burhinus grallarius*);
- Emu (*Dromaius novaehollandiae*);
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus*);
- Northern Nailtail Wallaby (*Onychogalea unguifera*);
- Purple-crowned Fairy-wren (*Malurus coronatus macgillivrayi*);
- Buff-sided Robin (*Poecilodryas cerviniventris*); and
- Orange Leaf-nosed Bat (*Rhinonicteris aurantia*).

For all 11 species listed above, the medium risk category arises from a combination of partial habitat loss with a resultant negligible to minor consequence to the species. For all 11 species, the risk of being impacted by the Project is similar to or less than the risk posed by the former Phase 3 project. A monitoring program is proposed to test the adequacy of the mitigation measures employed. Ongoing monitoring is also designed to enable the timely detection of unanticipated impacts (those that deviate from assessment predictions) of the Project, allowing for early remediation and the initiation of additional mitigation measures.

E.11 Air Quality

An air quality assessment was undertaken to assess the potential impacts associated with the Project. The climatic conditions in the area surrounding the Project are typical of northern Australia which is characterised by two distinct seasons per year; the dry season occurring from April to November and the wet season from December to March. The ambient air quality monitored at various locations beyond the influence of the mining operation indicate that air quality in the region is generally good and is typically below the relevant air quality criteria.

The assessment predicted that potential off-site air quality impacts are within acceptable criteria for the townships of Borroloola, Devils Spring, Campbell Springs and the identified areas of temporary occupation.

Potential on-site air quality related impacts were associated with fugitive dust emissions from operational activities and sulphur dioxide emissions from reactive overburden and tailings.

McArthur River Mining's proposed mitigation measures to manage the impacts of sulphur dioxide emissions and potential spontaneous combustion include adoption of selective handling and placement of overburden material, in order to reduce the potential for water and oxygen ingress into the NOEF.

Additionally, spontaneous combustion will also be managed through adoption of various monitoring programs, including:

- in-pit thermal monitoring prior to and during drill and blast operations to detect potentially problematic material;
- daily NOEF visual and thermal inspections to detect areas of material with the potential to combust (abnormal surface moisture, elevated temperatures, cracks, heaving, or efflorescent salts);
- daily gas monitoring including sulphur dioxide levels on the NOEF to identify potential hazards and areas requiring intervention; and
- development of weekly NOEF hazard maps of temperature and gas levels to identify areas of concern.

There are several dust mitigation measures which are implemented at the MRM site and will continue to be adopted including:

- site inductions to include air quality management requirements to reinforce employee awareness of visual dust plumes and potential impacts;
- watering of haul road surfaces;
- minimising material being deposited or spilled on haul roads;
- enforcement of speed limits on all roads;
- trafficable areas to be clearly marked, minimised, and vehicle movements restricted to these areas;
- regular maintenance of trafficable areas and vehicle manoeuvring areas;
- rehabilitation of disused roads as soon as practicable;
- visual monitoring and inspections of unsealed roads to determine control effectiveness;
- use of water sprays and/or water carts during dusty periods; and
- continual visual surveillance of dust during periods of activity.

An operational air quality management plan for the management of offsite air quality is currently being developed at MRM in consultation with government agencies.

E.12 Cultural Heritage

The region in which the MRM is located has long been, and continues to be, an area of importance to Aboriginal people. The Gurdanji and Yanyuwa people traditionally use the lands within which the Project is located. Other Aboriginal groups, including the Garawa and Mara people are representative of Borroloola and its surrounding area.

Archaeological surveys of the Project were undertaken in 2011 as part of the Phase 3 EIS to verify results of previous studies. It was identified that some cultural heritage sites within the Project area would be impacted.

There are a number of registered and recorded sacred sites in the vicinity of the Project area regulated by the Aboriginal Areas Protection Authority (APAA). McArthur River Mining currently holds several authority certificates for areas within the mineral leases in accordance with Section 22 of the Northern Territory *Aboriginal Sacred Sites Act*. New certificates will be applied for or amended where required by the Project, however no sacred sites will be disturbed.

In addition, agreements have been reached with custodians for the:

- relocation of MRM4 to an area closer to Barramundi Dreaming; and
- increase in height of the NOEF, which will reduce the NOEF footprint.

McArthur River Mining will continue to implement a series of management measures to protect sites of cultural significance in accordance with AAPA certificates. These include a cultural heritage awareness component in the site induction for new employees and contractors. McArthur River Mining also implements a permit to dig/clear system which requires all disturbance activities and all works that impact vegetation to be assessed and approved by McArthur River Mining Community Relations personnel. This is usually in the company of custodians and environmental personnel to manage the preservation of important areas in accordance with all approvals, including Aboriginal Areas Protection Authority certificate conditions.

E.13 Socio-economic Environment

The mine site is located in the Roper Gulf Regional Council (RGRC) which is defined by the Australian Bureau of Statistics (ABS) as the Roper Gulf Statistical Local Area (Roper Gulf SLA) and has been used in this assessment as a boundary for describing the baseline social characteristics and values of the region. The RGRC comprises 14 key towns, two of which are significant to the Project (Borroloola and Robinson River) and 26 outstations located at varying distances from Borroloola. Other communities considered relevant include King Ash Bay.

The Project will provide several positive socio-economic outcomes for surrounding communities as well as the NT and Australian economies. These are described in **Section E.5.**

An extensive and thorough Stakeholder Consultation Program implemented for the Project EIS identified significant support for the Project and the employment and training opportunities it generates. Where concerns were expressed they were mainly associated with the Project's perceived environmental risks and what direct or indirect effects on the community may result. The management of environmental risks is discussed in relevant sections.

Risk assessment of feedback received through this Program indicated all concerns or issues raised have been addressed and/or mitigated through both Project planning and existing community engagement and benefits initiatives.

An Economic and Social Impact Management Plan (ESIMP) was developed as part of the Socio-economic Assessment. This ESIMP is in line with international best practice for stakeholder engagement to ensure opportunities to inform, consult, engage and empower community members are offered in a way which is timely, genuine, inclusive and culturally appropriate.

Key initiatives supported by community feedback include:

- **MRM Community Benefits Trust (CBT) continuation:** The CBT is established for the life of mining operations and invests in the socio-economic development and liveability of the region. Its Board includes one representative of each local Aboriginal language group and an elected representative of community organisations.
- **Annual consultation for the MRM CBT:** Community visits will continue to be conducted by the appointed Project Officers on behalf of the CBT Board each year to ensure the CBT is investing in programs targeting the needs and interests of the community. These include meetings with local community organisations and the Borroloola School.
- **MRM Community Reference Group:** MRM has an established Community Reference Group (CRG) providing an overarching management tool to enable MRM to monitor impacts of the Project on the community and facilitate the provision of Project information and receipt of feedback. All community members are invited to attend. MRM will continue to host CRG meetings throughout the life of mine, with the aim to:
    - report on the progress of activities and commitments;
    - respond to community enquiries and complaints;
    - resolve disputes with stakeholders;
    - develop action plans with stakeholder involvement for ongoing social and community support;
    - monitor through stakeholder feedback the effectiveness of their community engagement processes; and
    - adjust mitigation strategies to achieve optimal outcomes for all parties.

E.14 Health and Safety

In accordance with McArthur River Mining's Health, Safety, Environment and Community Management System (HSEC MS) requirements, operational risk assessments have been undertaken to identify and assess existing operational health and safety risks on site. The findings of this risk assessment indicate the key site risks were mostly associated with the following activities:

- mining activities;
- aerodrome incidents;
- blasting;
- mobile equipment and maintenance;
- ore processing;
- dewatering operations;
- tyre management; and
- supply of hazardous substances/explosives.

Many of the potential risks posed to the health and safety of Project employees, contractors, visitors and the surrounding communities are similar to the existing approved operation and consequently many of the potential risks are already known, understood and managed. Well-established health and safety procedures are currently in place and these procedures will be applied to the Project with all necessary variations and adaptions.

There have been a limited number of new potential health and safety hazards identified for the Project. Where existing management measures do not adequately address new hazards, revised management and mitigation measures have been developed. These will be integrated into the existing HSEC management systems prior to Project commencement.

E.15 Environmental Management Plan

McArthur River Mining's established HSEC MS applies to the site. This system is consistent with ISO 9001, ISO 14001, OHSAS 18001 and the International Council on Mining and Metal (ICMM) Sustainable Development Framework. The implementation of the HSEC MS supports the achievement of leading HSEC performance and follows the "plan-do-check-act" methodology.

For each identified area of required environmental management, a strategic environmental management plan (EMP) has been developed. These plans provide a framework for environmental management by identifying proposed mitigation measures, monitoring, reporting activities and corrective actions. To support this EMP, a list of proponent EIS commitments has been compiled and is provided in **Appendix AB – Commitments** of the Project EIS.