

8. Environmental and Social Management

Strong emphasis on ensuring that conditions of operation and commitments made by KMS are translated into defined actions or work practices with allocated responsibilities for work on the ground.



8.1 Framework

This section highlights the influences that have shaped the project and KMS' management of environmental and social impacts.

8.1.1 Principles of Environmental Protection

Principles of sustainability were placed at the centre of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

These principles are:

- The Precautionary Principle.
- The Principle of Intergenerational Equity.
- The Principle of the Conservation of Biological Diversity and Ecological Integrity.
- Principles relating to improved valuation, pricing and incentive mechanisms.

These principles provide a direction for state legislation to achieve sustainable outcomes. In 2003, the Western Australian EP Act was amended to include these principles, and the principle of waste minimisation, as objectives of the Act.

EPA Position Statement No. 7, Principles of Environmental Protection (EPA, 2004c), provides a summary of these principles and guidance on

their application in the EPA decision-making process. The way these principles have been considered in and integrated into the design, operation and closure of the Mungada Ridge Hematite Project is presented in Table 8.1.

8.1.2 Principles of Enduring Value

The Mineral Council of Australia (MCA) is the peak industry body for Australia's exploration and mining industries. In June 2005, it released its strategic position paper for the delivery of sustainable performance for the mining industry, *Enduring Value – The Australian Minerals Industry Framework for Sustainable Development* (MCA, 2005).

Enduring Value is described by MCA as:

the centrepiece of industry's commitment to achieving continual improvement in its environmental, social and economic performance, accountability, and ensuring industry operates in a manner that is attuned to community expectations.

As a member of the MCA, Gindalbie (and hence KMS) is committed to applying the principles of Enduring Value to its mining and exploration projects. Box 8.1 outlines the principles of Enduring Value.

Table 8.1 Principles of environmental protection and their relationship to the Hematite Project

Principle	Relevant (Yes/No)	If Relevant, Consideration in the Project	Addressed (Yes/No)	Section(s) in PER
<p>1. The precautionary principle</p> <p>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</p> <p>In applications of this precautionary principle, decisions should be guided by:</p> <ul style="list-style-type: none"> (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment. (b) an assessment of the risk-weighted consequences of various options. 	Yes.	<p>KMS has commissioned technical specialists to collect baseline information on the current health and diversity of the project area to enable the assessment of the potential for environmental change from project activities.</p> <p>In addition, government regulators, special interest groups and technical specialists have been consulted during all stages of planning and environmental approval to identify and evaluate the potential impacts to the environment and to assess the consequences of various project options.</p> <p>KMS is also committed to the production of environmental management plans based on construction and operations risks to identify and implement appropriate mitigation measures to eliminate/minimise the potential impacts from those risks.</p>	Yes.	<p>Section 10.</p> <p>Section 4.</p> <p>Section 8.</p>
<p>2. The principle of intergenerational equity</p> <p>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</p>	Yes.	The specialist studies enabled baseline information to be gathered with regard to the current health and diversity of the region and have identified appropriate mitigation measures that enable productivity while maintaining the health, diversity and productivity of the environment.	Yes.	<p>Section 7.4.</p> <p>Section 7.5.</p> <p>Section 7.7.</p> <p>Section 8.2.</p>
<p>3. The principle of the conservation of biological diversity and ecological integrity</p> <p>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</p>	Yes.	Local flora and fauna specialist were commissioned to conduct the baseline flora and fauna studies. The studies assessed the species diversity within the project area, the potential impacts of the project on a local, regional and national scale and provided recommendations on mitigation measures to eliminate or minimise, the potential impacts to biological diversity and ecological integrity.	Yes.	<p>Section 7.4.</p> <p>Section 7.5.</p> <p>Section 7.7.</p>

Table 8.1 Principles of environmental protection and their relationship to the Hematite Project

Principle	Relevant (Yes/No)	If Relevant, Consideration in the Project	Addressed (Yes/No)	Section(s) in PER
4. Principles relating to improved valuation, pricing and incentive mechanisms (a) Environmental factors should be included in the valuation of assets and services. (b) The polluter pays principles - those who generate pollution and waste should bear the cost of containment, avoidance and abatement. (c) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. (d) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefit and/or minimise costs to develop their own solutions and responses to environmental problems.	Yes.	When considering the options for all elements of the project in the feasibility phase (including equipment selection and site layout), environmental factors were considered and, where necessary, changes to the project were made. Environmental factors will be reconsidered during the design phase. KMS will adopt a 'reduce, reuse and recycle' approach to waste management. Where waste generation is unavoidable, KMS will ensure that the waste is disposed of appropriately. KMS is committed to their environmental policy and achieving the objectives outlined within the policy (see Section 8.2.1).	Yes.	Section 6.13. Section 6.14.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes.	KMS will implement a 'reduce, reuse and recycle' approach to waste management at all components and phases of the project. The strategies for waste minimisation will be outlined within the EMS.	Yes.	Section 6.13. Section 6.14.

Box 8.1 Principles of Enduring Value

1. Implement and maintain ethical business practices and sound systems of corporate governance.
2. Integrate sustainable development considerations within the corporate decision-making process.
3. Uphold fundamental human rights and respect cultures, customs and values in dealings with employees and others who are affected by our activities.
4. Implement risk management strategies based on valid data and sound science.
5. Seek continual improvement of our health and safety performance.
6. Seek continual improvement of our environmental performance.
7. Contribute to conservation of biodiversity and integrated approaches to land use planning.
8. Facilitate and encourage responsible product design, use, re-use, recycling and disposal of our products.
9. Contribute to the social, economic and institutional development of the communities in which we operate.
10. Implement effective and transparent engagement, communication and independently verified reporting arrangements with our stakeholders.

Source: Minerals Council of Australia (2005).

8.1.3 Corporate Charter and Policies

The activities of Gindalbie (and hence KMS) are governed by its corporate charter and directed through various policies (available on Gindalbie's website at www.gindalbie.com.au).

The charter and policies are in alignment with the principles outlined in the MCA's Enduring Value statement and supplement the mission and vision of Gindalbie Metals (Box 8.2). The charter and policies are further supplemented by the mitigation measures and commitments presented in this PER document. This relationship is presented in Table 8.2.

Box 8.2 Gindalbie Metals mission and vision statements

OUR MISSION

Our mission is to work with the Midwest community to unlock its vast and relatively untapped iron ore potential and to see the region benefit economically, socially and environmentally as Gindalbie Metals pioneers a new iron ore province in Western Australia.

OUR VISION

Our vision is to become the leading independent iron ore producer in the Midwest by 2010 and a major investor, employer and partner in the region through the development of major iron ore projects at Karara and Mungada. Our growth strategy is focussed on the delivery of diversified iron products including quality hematite, high-grade magnetite concentrate and blast furnace quality pellets.

Table 8.2 Relationship of corporate policies with the principles of Enduring Value

Enduring Value Principle	Company Policy/Project Commitment	Reference
Implement and maintain ethical business practices and sound systems of corporate governance.	Policy on Code of Conduct. Policy on Continuous Disclosure. Policy on Trading in Company Shares. Audit Committee Charter. Project EMS. Annual Report.	www.gindalbie.com.au/CorpGov/Code_Of_Conduct.pdf . www.gindalbie.com.au/CorpGov/Policy_On_Continuous_Disclosure.pdf . www.gindalbie.com.au/CorpGov/Policy_On_Trading_In_Company_Shares.pdf . www.gindalbie.com.au/CorpGov/Audit_Committee_Charter.pdf . Section 8 – PER. www.gindalbie.com.au/Annual_Reports.htm .
Integrate sustainable development considerations within the corporate decision-making process.	Community Consultation Approach. Sustainability.	www.gindalbie.com.au/Community.htm . Section 8 – PER.
Uphold fundamental human rights and respect cultures, customs and values in dealings with employees and others who are affected by our activities.	Remuneration Committee. Indigenous Policy. Heritage.	www.gindalbie.com.au/CorpGov/Remuneration_Committee_Charter.pdf . www.gindalbie.com.au/Indigenous_Policy.htm . Section 7.12 – PER.
Implement risk management strategies based on valid data and sound science.	Environmental and Social Impact Assessment.	Section 7 – PER.
Seek continual improvement of our health and safety performance.	Health and Safety Policy. Hazardous Materials Management. Safety and Security Management. Public Safety.	www.gindalbie.com.au/Health_Safety.htm . Section 6.14 – PER. Section 6.15 – PER. Section 7.10 – PER.
Seek continual improvement of our environmental performance.	Environmental Policy. Environmental Management System and Reporting.	Section 8 – PER. Section 8 – PER.
Contribute to conservation of biodiversity and integrated approaches to land use planning.	Environmental Policy. Environmental and Social Impact Assessment. Vegetation and Soil Management. Rehabilitation and Mine Closure.	Section 8 – PER. Section 7 – PER. Section 6.16 – PER. Section 6.17 – PER.

Table 8.2 Relationship of corporate policies with the principles of Enduring Value (cont'd)

Enduring Value Principle	Company Policy/Project Commitment	Reference
Facilitate and encourage responsible product design, use, re-use, recycling and disposal of our products.	Environmental Policy. Non-process Waste Management. Water Recycling.	Section 8 – PER. Section 6.13 – PER. Section 6.9.4 – PER.
Contribute to the social, economic and institutional development of the communities in which we operate.	Indigenous Policy. Socio-economic Aspects. Project Benefits.	www.gindalbie.com.au/Indigenous_Policy.htm . Section 7.11 – PER. Section 2 – PER.
Implement effective and transparent engagement, communication and independently verified reporting arrangements with our stakeholders.	Policy on Continuous Disclosure. Policy to Promote Effective Communication with Stakeholders. Community Consultation Approach. Stakeholder Consultation. Project Reporting. Website Information & Reporting. Annual Report.	www.gindalbie.com.au/CorpGov/Policy_On_Continuous_Disclosure.pdf . www.gindalbie.com.au/CorpGov/Policy_To_Promote_Effective_Comm_With_Shareholders.pdf . www.gindalbie.com.au/Community.htm . Section 4 – PER. Section 8 – PER. www.gindalbie.com.au . www.gindalbie.com.au/Annual_Reports.htm .

8.2 Management

This section describes the environmental management system (EMS) that will be applied to the project. It describes the elements of the system that will be used to achieve the environmental and social objectives, targets and commitments of the project and to achieve the application of mitigation measures described in the PER.

The EMS is a structured, documented approach to managing risks and potential environmental or social impacts arising from the project. The principle steps in the process are:

- An assessment of environmental or social risks (based on specialist studies and corporate knowledge and experience).
- Identification of relevant government policy, law and guidelines.
- Incorporation of conditions of approval, commitments and performance criteria.
- Development and implementation of environmental management plans (EMPs) and procedures.
- Monitoring of environmental impacts and performance.
- Review of procedures and plans to ensure continual improvement.

In particular, the EMS has a strong emphasis on ensuring that conditions of operation and commitments made by KMS are translated into defined actions or work practices with allocated responsibilities for work on the ground. In-built quality assurance practices help to ensure that the work is carried out as described in the PER and that there is continuous improvement in standards and outcomes.

8.2.1 Environmental Management System

KMS is committed to developing and implementing an EMS in accordance with ISO 14001:2004 to promote excellence in environmental management and to ensure continual improvement.

The main elements of the corporate EMS include:

- Policy.
- Planning.
- Implementation and operation.
- Checking and corrective action.
- Management review.

Further detail on each element is discussed in the sections below.

Policy

KMS is committed to managing its activities in an environmentally responsible manner as reflected in the draft statement of commitments (Box 8.3). The statement of commitments defines the aspirations of the company in relation to the environment and provides the guiding philosophy for its implementation through the EMS.

Planning

Planning helps to ensure that clearly stated environmental objectives, consistent with the environmental policy, are considered in the company's economic and mine planning processes. Good planning also ensures that KMS is aware of, and addresses, its ongoing legal obligations and that preferred environmental outcomes are achieved in the most efficient manner.

Implementation and Operation

Practical procedures (i.e., EMPs) within the EMS will help ensure compliance with obligations and environmental performance criteria for all works in the field. These EMPs will clearly document and define roles and responsibilities for environmental management and will be integrated with other standard operating procedures at each site. The implementation process will begin at induction and continue through ongoing training.

KARARA IRON ORE PROJECT STATEMENT OF COMMITMENT

Karara Management Services Pty Ltd prides itself on recognising the ecological significance and heritage value of the natural area under its influence.

In accordance with the Environmental Policy, the following operational-specific objectives have been established, which represent the company's environmental commitment:

1. We will comply with all legal and regulatory requirements and the obligations of the Australian Minerals Industry Code of Environmental Management.
2. We will operate an Environmental Management System, which accurately defines the environmental aspects and impacts of what we do, and build what we learn from this knowledge into operational systems that minimise risk to the environment and the community.
3. We will adopt techniques that minimise land disturbance and ecosystem degradation.
4. We will employ techniques that will minimise airborne emissions, greenhouse gas emissions, and mineral and non-mineral wastes.
5. We will set environmental improvement targets and publicly report our environmental performance annually.
6. We will strive to use resources efficiently by reducing, reusing, and recycling waste products.
7. We will employ techniques that will maximise efficient use of energy, water, and land resources.
8. We will develop a mine closure and progressive rehabilitation plan that addresses regulatory requirements, risk minimisation, potential future land use and stakeholder views.
9. We will rehabilitate in accordance with latest technology and information, ensuring the establishment of self-sustaining ecosystems.
10. We will provide clear and concise guidelines and procedures for practises that impact upon the environment.
11. We will identify, report, and remediate environmental incidents and employ changes that reduce the likelihood and/or consequence of occurrences.
12. We will actively promote environmental awareness and training to all employees and contractors.
13. We will encourage a comprehensive understanding of the full life cycle and safe use of our products.
14. We will design, operate, maintain and decommission all facilities and associated infrastructure to prevent or minimise environmental impact.
15. We will allocate sufficient resources to ensure these objectives can be achieved.

Checking and Corrective Action

Regular inspection and auditing is a necessary step to assess compliance with environmental management objectives and commitments. It will also provide a system of dealing with non-compliance, incidents and complaints, data recording and reporting (including the key statutory requirement for reporting, the Annual Environmental Report, that will be tailored to meet the requirements of the various State Government agencies).

Management Review

Internal review of the EMS will help ensure continual improvement in levels of compliance and consistency across the organisation. Objectives and targets set during the PER process will provide benchmarks upon which performance against the KMS corporate environmental policy will be measured. As necessary, the project EMPs will be reviewed and modified to reflect issues that arise as the project develops.

8.2.2 Environmental Management Plans

Environmental management plans (EMPs) are the primary tools for the implementation of the EMS. EMPs will be developed in consultation with the relevant decision-making authorities to control the environmental aspects affected by exploration and mining activities.

Flora and Fauna EMPs and a Conceptual Mine Closure Plan have been provided as supplementary information to this PER. KMS will develop additional EMPs for issues identified through the ongoing assessment and consultation processes.

8.3 Offset Strategy

The proposed Mungada Ridge Hematite Project includes progressive removal of native vegetation and fauna habitat during the development of the mine and its related facilities. In addition, it potentially constrains recreational opportunities and will visually impact the aesthetics of the immediate area from a public perspective.

Flora and fauna surveys have therefore not only been conducted to characterise the existing values of the project area but to support the assessment of impacts in a local and regional context. During this process, relevant government agencies have been continually consulted.

As a direct result of these proponent initiated surveys, species previously unrecognised within taxonomic literature have been identified. While these discoveries are significant and beneficial in terms of regional floristic knowledge, it does not necessarily imply that the species discovered are rare or endangered but may simply reflect the limits of scientific research in what is generally recognised as a remote and little populated and visited part of Australia. The status of the newly discovered species can only be determined through further research, which will form a component of the company's project offset strategy.

To a varying degree, the net impacts can and will be reduced through the application of mitigation measures during project design, operation and closure.

8.3.1 Formulation of Environmental Offsets

KMS has formulated an offsets package for the project in accordance with the guidance provided in EPA Position Statement No. 9, Environmental Offsets (EPA, 2006c). This statement outlines the expectations of the EPA when unavoidable, adverse environmental impacts occur as a result of development.

Mitigation measures that already have been or will be applied to manage the environmental impacts of the Mungada Ridge Hematite Project are, in order of preference:

1. Avoidance – avoiding adverse environmental impacts by siting the project, or components of the project, in less sensitive environments.
2. Minimisation – limiting the magnitude of impact by taking all appropriate and practicable steps to minimise impact.
3. Rectification – repairing, rehabilitating or restoring the impacted site as soon as possible.
4. Reduction – gradually eliminating the adverse impact over time by rehabilitation and maintenance operations during the life of the project.
5. Environmental offsets – environmentally beneficial activities undertaken to counterbalance an adverse, residual environmental impact.

The first four types of mitigation measures are discussed in previous sections of this document, primarily in Chapters 6 and 7.

The fifth type of mitigation measure, environmental offsets, is recognised as being the least preferred, but is sometimes the only option available, for maintaining environmental values. This is the case for mining projects where, for example, the mine's open pit can only be sited where the orebody is located and adverse impacts are unavoidable, should the project be approved.

Two types of offsets are recognised in the EPA Position Statement:

- *Direct Offsets*: Direct environmental offsets are intended to achieve 'no net

environmental loss' or, aspirationally, a 'net environmental benefit'. Examples include the restoration, rehabilitation or re-establishment of existing degraded ecosystems outside of the impact area of the project, as well as the acquisition of land for formal conservation purposes.

- *Contributing Offsets*: These complement and enhance direct offsets. They do not contribute to a 'no net loss' outcome but do add materially to environmental knowledge, research, management and protection of the direct offset site(s). Types of activities may include the development of recovery plans; on-going management, including education and research aimed at addressing environmental issues of relevance to the project or establishing a trust fund, or similar, to provide funds to support on-going environmental activities.

KMS proposes to offer both direct and contributing offsets in respect to this project.

8.3.2 Offsets Proposed for the Hematite Project

KMS proposes to implement an offsets package for the Mungada Ridge Hematite Project that has been developed on the basis of consultation to date with DEC, the EPA and relevant industry bodies (Table 8.4).

It is important to note that a more extensive but complimentary package of offsets is also proposed for the Karara Magnetite Project, which is in close proximity to the Mungada Ridge Hematite Project.

KMS proposes to further consult with DEC and other research bodies and may explore other offsets in the future, which clearly support the initiatives and objectives outlined below.

Table 8.3 Offsets Proposed for the Hematite Project		
Offset No.	Offset Description	Type of Offset
1	KMS have purchased Badja Station. In consultation with DEC, KMS will undertake a biodiversity assessment of Badja Station with the aim of identifying high floristic value areas suitable for management as conservation areas and potential incorporation into the State conservation estate.	Direct.
2	<p>KMS proposes to establish an environmental trust fund to support the following activities for the life of the Mungada Ridge Hematite Project:</p> <ol style="list-style-type: none"> 1. DEC management, research and community liaison initiatives that support and enhance the values of the proposed conservation park project, should it be established. 2. The development of a 'Karara Block' Strategic Management Plan that will examine the biodiversity and recreational values of the Karara Block and make recommendations for management. In addition to the trust fund potentially assisting with funding the development of the plan, KMS will consider other funding opportunities from the fund which enhance recreational opportunities, nature conservation and interpretation, visitor management and viewpoint facilities within Karara Station. 3. DEC's existing program of fencing for goat exclusion and goat control. <p>KMS are further willing to provide a leadership role in facilitating and coordinating collaboration between industry and DEC to achieve the most cost effective approach to management of the conservation area.</p>	Contributing.
3	Subject to project approval, KMS will undertake additional botanical surveys over the BIF ridges adjacent to the Karara Iron Ore Project minesite for the three years commencing spring 2008. This will be undertaken to further enhance information available on the status of significant flora species and communities unique to the BIF.	Contributing.
4	KMS will contribute to specific regional floristic research initiatives, which will contribute to the management of species identified in the project proposal. A component of this initiative will be to facilitate the systematic identification of existing degraded ecosystems in the region with an objective of identifying potential candidate sites for restoration or rehabilitation programs.	Contributing.

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9. Environmental and Social Management Commitments

Through integration of economic progress, responsible social development and effective environmental management, the industry is committed to contribution to the sustained growth and prosperity of current and future generations.

Enduring Value, MCA, June 2005



In planning for the Mungada Ridge Hematite Project, KMS has identified, and/or already undertaken in the design process, a large number of actions (avoidance, mitigation and management) with respect to the management of potential and residual environmental and social impacts. These are documented throughout this PER (primarily in Chapters 6, 7 and 8).

Environmental and social issues will be actively managed through the development and application of an EMS and supporting EMPs (as discussed in Chapter 8). The EMS will focus on the important, high-risk issues. Towards this goal, KMS has compiled the set of commitments presented in Table 9.1.

Table 9.1 Environmental and social management commitments

No.	Topic	Action	Objectives	Timing	Advice From ¹
1	Environmental management system	Develop and implement an Environmental Management System in accordance with ISO 14001:2004.	1) Establish a framework to assess and manage environmental risks across the project, and to drive continual improvement.	Detailed design phase (prior to construction) and bi-annually during operations.	
2	Stakeholder consultation	Prepare a Stakeholder Consultation EMP. Identify and consult with, key stakeholders on a regular basis.	1) Ensure that, for the life of the project, the views and concerns of key project stakeholders are understood and taken into consideration for all project-related activities.	Detailed design phase (prior to construction).	
3	Fauna	Prepare a Fauna EMP that addresses: <ul style="list-style-type: none"> • Demarcation of identified habitat and refuge of significant fauna. • Minimisation of clearing habitat and refuge of significant fauna. • Conservation measures for Malleefowl. • Death or injury of significant fauna and reporting of such events. 	1) Maintain the abundance, diversity, geographic distribution, conservation status and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Detailed design phase (prior to construction).	Department of Environment and Conservation.
4	Flora	Prepare a Flora EMP that addresses: <ul style="list-style-type: none"> • Demarcation of identified significant vegetation and flora. • Minimisation of clearing significant vegetation and flora. • Connectivity of remnant vegetation patches (for example, TEC Plant Assemblages of the Koolanooka System). • Collection of native plant propagules for use in rehabilitation. • Classification and management of soils to be used in rehabilitation. • Fire prevention. 	1) Maintain the abundance, diversity, geographic distribution, conservation status and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge, particularly for: <ul style="list-style-type: none"> • Floristic Community Types of high conservation significance (FCTs 8, 11, 12, and 13) • Acacia woodmaniorum ms. • Halosarcia bulbosa. 2) Maintain the integrity, nutrient value, and viability of native seed and micro-organisms in recovered topsoil for use in site rehabilitation.	Detailed design phase (prior to construction).	Department of Environment and Conservation. Department of Industry and Resources.

Table 9.1 Environmental and social management commitments (cont'd)

No.	Topic	Action	Objectives	Timing	Advice From ¹
5	Weeds, feral animals, and pathogens	Prepare a Weed, Feral Animal and Pathogen EMP that addresses: <ul style="list-style-type: none"> • Weed and pathogen hygiene for earthmoving equipment entering and exiting the project site. • A coordinated, regional eradication program in consultation with DEC. • Impacts of feral animals on significant flora and fauna. 	1) Prevent the introduction of weeds, feral animals and exotic pathogens within the project area. 2) Prevent the spread and proliferation of existing weeds (in particular, <i>Echium plantagineum</i> and <i>Galium aparine</i>), feral animals and exotic pathogens as a result of the implementation of the project. 3) Control or eradicate weeds, feral animals and exotic pathogens within the project area.	Detailed design phase (prior to construction).	Department of Environment and Conservation.
6	Water	Prepare Water EMPs to address: <ul style="list-style-type: none"> • Potential environmental impacts from the supply and use of water. • Surface water drainage. • Groundwater quality. • Water efficiency. 	1) Maintain the quality and quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected. 2) Maintain the integrity, ecological functions and environmental values of drainage systems. 3) To ensure that any discharge to surface water and surface water runoff does not adversely affect environmental values or health, welfare and amenity of people and surrounding land uses by meeting statutory requirements and acceptable standards.	Detailed design phase (Prior to Construction).	Department of Water.
7	Dust	Prepare an Air Quality and Dust EMP.	1) To ensure that emissions do not adversely affect environmental values or health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	Detailed design phase (prior to construction).	Department of Environment and Conservation.

Table 9.1 Environmental and social management commitments (cont'd)

No.	Topic	Action	Objectives	Timing	Advice From ¹
8	Heritage	<p>Prepare a Cultural Heritage EMP in consultation with relevant indigenous representative groups that addresses:</p> <ul style="list-style-type: none"> • Identification, protection and management of archaeological, historical and culturally significant sites. • Reporting of newly discovered sites during the course of project activities. 	1 To ensure that changes to the biophysical environment from project activities do not adversely affect historical and cultural associations and that any site disturbance complies with relevant heritage legislation.	Detailed design phase (prior to construction).	Department of Indigenous Affairs and the Heritage Council of Western Australia.
9	Rehabilitation and Closure Plan	<p>Prepare a Rehabilitation and Closure Plan in accordance with:</p> <ul style="list-style-type: none"> • ANZMEC & MCA Strategic Framework for Mine Closure. • Commonwealth of Australia Mine Rehabilitation Guidelines. • Commonwealth of Australia Mine Closure and Completion Guidelines. 	<p>1) To ensure, as far as practicable, that rehabilitation achieves a stable, non-polluting, functioning and aesthetically compatible landform which is consistent with the surrounding landscape and other environmental values.</p> <p>2) Establish sustainable endemic vegetation communities, consistent with the natural ecosystems of the surrounding landscape.</p> <p>3) Ensure that rehabilitation is carried out in a coordinated, progressive manner and is integrated with development planning, consistent with current best practice and the agreed end land use.</p>	Detailed design phase (prior to construction), and biannually during operations.	Department of Industry and Resources and the Department of Environment and Conservation.

¹ Only included if the expertise and/or statutory responsibility of a third party is relevant to implementing the commitment.

10. Study Team

KMS appointed Enesar Consulting Pty Ltd to prepare this PER. The document draws on the work of a range of specialist consultants and their contributions are gratefully acknowledged.

The individuals listed in the following sections contributed to the preparation of this PER.

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12. Glossary

12.1 Units, Symbols and Prefixes

12.1.1 Units

Unit Symbol	Unit of Measurement / Usage
g	gram; a unit used to express weight.
L	litre; a unit used to express volume.
m	metre; a unit used to express length.
bcm	bank cubic meters; a unit used to describe the volume of in-situ rock.
dB	decibel; unit used to express sound intensity.
h	hour; a unit used to express time.
ha	hectare; a unit used to express area.
m ²	square metre; a unit used to express area.
m ³	cubic metre; a unit used to express volume.
V	volt; a unit used to express the potential difference across a conductor.
VA	volt-amp; a unit used to express apparent power; is equal to voltage applied multiplied by current drawn.
yr	year.
s	second; a unit used to express time.
ppm	parts per million; a unit used to express concentration.
ppt	parts per thousand; a unit used to express concentration.
T	tonne.

12.1.2 Symbols

Symbol	Expansion
%	percentage (proportion out of one hundred).
/	per.
p	per.
\$	Australian dollars.
a	annum; year.
°C	degree celsius

12.1.3 Prefixes

Prefix	Factor
G	10^9 .
M	10^6 .
k	10^3 .
d	10^{-1} .
c	10^{-2} .
m	10^{-3} .
μ	10^{-6} .
N	10^{-9} .

12.2 Words

Term	Expansion / Definition
acid	substance with a pH less than 7.0; the lower the pH the higher the corrosive ability of the substance.
acid formation	the process whereby acid is formed by the oxidation of minerals (particularly sulfides) exposed to air and water.
acidic	having a pH less than 7.0.
ACIL Tasman	ACIL Tasman Pty Ltd.
ACMC	Aboriginal Cultural Material Committee.
AIC	Australian Interaction Consultants.
ALARP	as low as reasonably practicable.
alkaline	substance with a pH greater than 7.0; the higher the pH the higher the corrosive ability of the substance.
AMD	acid mine drainage; runoff of acidic water from mined materials following acid formation within the material.
amenity	the desirability of an area.
amphibians	animals (such as frogs) adapted to live both on land and in water.
Anben	Anben Steel Group Company. Formed in 2006 by the merger of AnSteel and Benxi Steel.
ANFO	ammonium nitrate/fuel oil.
Ansteel	Anshan Iron and Steel Group Corporation.
aquifer	a water-bearing layer of sediment or rock.
ARI	average recurrence interval; a measure of the rarity of a rainfall event.
arid lands	in Western Australia arid lands are usually considered to be areas with an average rainfall of less than 250 mm and support pastoral activities instead of broad acre cropping.
artefact	anything made by human workmanship, particularly by previous cultures (such as chipped and modified stones used as tools).
ASL	above sea level.
AUSPLUME	proprietary air dispersion modelling software for modelling emissions of wastes to air.
AWS	Automatic Weather Station.
background	the conditions (e.g., noise levels, bird populations) already present in an area before the commencement of a specific activity (e.g., a mining operation).
Bamford	Bamford Consulting Ecologists.
best practice	a best practice is a process, technique, or use of technology, equipment or resource that has a proven record of success.

Term	Expansion / Definition
BIF	banded iron formation.
bioregion	a complex land area composed of a cluster of interacting ecosystems that are repeated in similar form. It describes the dominant landscape scale attributes of climate, lithology, geology, landforms and vegetation. It is based on the Interim Biogeographic Regionalisation for Australia (see IBRA).
biodiversity	the diversity of different species of plants, animals and microorganisms, including the genes they contain, in the ecosystem of which they are part.
Biota	Biota Environmental Scientists.
blasting	detonation of explosive charge in a mine to assist in the removal of hard rock.
BoM	Bureau of Meteorology.
bore	a well, usually of less than 20 cm diameter, sunk into the ground and from which water is pumped.
bund	an earth, rock, or concrete embankment constructed to prevent the inflow or outflow of liquids or the transmission of noise.
CALM	Department of Conservation and Land Management; merged with DoE in 2006 to form DEC.
catchment	the entire land area from which water (e.g., rainfall) drains to a specific water course or waterbody.
chert	a variety of silica that contains microcrystalline quartz
clay	a discrete mineral species, belonging to the layered silicate group of less than 2 microns in diameter.
Coffey	Coffey Mining Pty Ltd.
compaction	the process of close packing of individual grains in a soil or sediment as a response to pressure.
concentration	the amount of a substance per unit of mass or volume of the medium in which it occurs.
conservative	a prediction, assumption, or measurement that errs on the side of safety.
contractor	specialist brought in to perform a specific task, such as the construction of mine infrastructure or the excavation (mining) of the open pit.
CoRTN	Calculation of Road Transport Noise algorithms.
costean	costeans are created by the process of costeaning, which is the process by which miners seek to discover metallic lodes. It consist of sinking small pits through the superficial deposits to the solid rock and then driving from one pit to another across the direction of the vein, in such manner as to cross all the veins between the two pits.
craton	a large portion of a continental plate that has been relatively undisturbed since the Precambrian era
cross-section	a two-dimensional diagram of an object presented as if the object had been cut along its length.
crusher	that part of an ore-processing plant where the ore is mechanically crushed into smaller pieces.
CVRD	Companhia Vale do Rio Doce.
DEC	Department of Environment and Conservation; formed in 2006 by the merger of DoE and CALM.
DEH	Department of the Environment and Heritage; renamed the Department of the Environment and Water Resources.
density	the mass of a substance divided by its volume.
deposition	laying down of particulate material.
DIA	Department of Indigenous Affairs.

Term	Expansion / Definition
dispersive	refers to soils that are structurally unstable and disperse in water into basic particles i.e. sand, silt and clay. Dispersible soils tend to be highly erodible and present problems for successfully managing earth works
distribution of species	the entire area in which a population of a species, subspecies or other taxon is found.
DOC	dissolved organic carbon.
DoCEP	Department of Consumer and Employment Protection.
DoE	Department of Environment; merged with CALM in 2006 to form DEC.
DoH	Department of Health.
DoHW	Department of Housing and Works.
DoIR	Department of Industry and Resources.
DoPI	Department of Planning and Infrastructure.
DoW	Department of Water.
drawdown	a reduction in water level and/or pressure level in an aquifer as a result of groundwater extractions.
DRF	Declared Rare Flora.
drilling	the action of boring holes (usually less than 30 centimetres in diameter and up to several hundred metres deep) into the ground, typically to establish a water bore or to investigate the geology found at depth.
EC	electrical conductivity.
ecosystem	an interacting system of animals, plants, other organisms and non-living parts of the environment.
eH	a parameter used to quantify the activity of electrons.
emission	a discharge of a substance (e.g., dust) into the environment.
EMP	Environmental Management Plan.
EMS	Environmental Management System.
endemic	native to, or restricted to, a certain country or area.
environment	a general term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms (including human beings) exists.
EP Act	<i>Environmental Protection Act 1986.</i>
EPA	Environmental Protection Authority.
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999.</i>
ephemeral	not permanent, e.g., a stream that flows only seasonally or after rainfall or a lake that periodically dries out.
erosion	the wearing away of the land surface (whether natural or artificial) by the action of water, wind and ice.
excavator	vehicle used to excavate holes and move soil, earth, or rocks.
fauna	a general term for animals (birds, reptiles, marsupials, fish etc.), particularly in a defined area or over a defined time period.
FCT	Floristic Community Type.
feasibility study	a preliminary technical and economic study to assess the viability of a project.
feed	material being fed into a process.
FIFO	fly-in-fly-out.
flora	a general term for plants, particularly those found in a defined area or characteristic of a defined time period.
foraging	searching for food over a wide area.

Term	Expansion / Definition
formation	a large stratigraphic sequence of rock beds (sandstone, shale, limestone, etc.) generally deposited over a distinct geological period (e.g., during a glacial period).
GCA	Graeme Campbell and Associates Pty Ltd.
gilgai	the micro relief of soils, generally with high clay content, produced by expansion and contraction with changes in moisture.
Gindalbie	Gindalbie Metals Ltd.
gnamma	a rock hole, usually in granite, that is capable of holding water.
GPA	Geraldton Port Authority.
grade	the concentration of metal, e.g., iron either in an individual rock sample or averaged over a specified volume of rock.
grader	vehicle used to smooth a soil or rock surface.
gradient	rate of change of a given variable (such as temperature or elevation) with distance.
greenhouse gases	carbon dioxide, methane, nitrous oxide, perfluorocarbons, hydrofluorocarbons and sulfur hexafluoride.
ground vibration	vibration transmitted through the ground following blasting.
groundwater	all waters occurring below the land surface; the upper surface of the soils saturated by groundwater in any particular area is called the water table.
GRP	Gross Regional Product; the market value of all final goods and services produced within a region in a given period of time.
GSP	Gross State Product; the market value of all final goods and services produced within a state in a given period of time.
GST	Goods and Services Tax.
habitat	the particular local environment occupied by an organism.
haul trucks	heavy vehicles used for the transportation of ore or waste rock.
Heggies	Heggies Australia Pty Ltd.
hydrology	the study of water, particularly its movement in streams, rivers, or underground.
IBRA	Interim Biogeographic Regionalism for Australia. Biogeographic regions used to classify Australia's land surface. They have been delineated on the basis of specialist ecological knowledge combined with regional and continental scale data on climate, geomorphology, landform, lithology and characteristic flora and fauna. IBRA regions are periodically revised as better information becomes available.
infrastructure	the supporting installations and services that supply the needs of a project.
introduced	introduced to a particular environment; exotic.
intruded	geological term for (igneous) rock formed by the injection of molten magma up into the earth's crust and its subsequent cooling and crystallisation.
invertebrates	commonly, animals without a backbone (jellyfish, worms, molluscs, etc.).
irrigation	the artificial flooding of agricultural land to promote cultivation.
KMS	Karara Management Services Pty Ltd.
LA ₁₀	a noise level audible to human ears that is exceeded for 10% of the time that is measured during a measurement period.
LA _{eq}	the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.
landform	a specific feature of a landscape (such as a hill) or the general shape of the land.
leach	dissolution and removal of a soluble substance from a soil or a rock, e.g., the leaching of salt (by water) from a soil or the leaching of gold (by cyanide) from a rock.
lithology	the description of rocks on the basis of colour, mineralogical composition, and grain size.
Lloyd Acoustics	Lloyd Acoustics Pty Ltd.

Term	Expansion / Definition
load	the amount of a substance discharged into a body of water (e.g., salt or sediment); usually expressed as mass over a specified time (e.g., tonnes per year).
massive	soil or rock with no observable structure.
MCA	Minerals Council of Australia.
mesocavern	cavity within a rock with a diameter of between 0.1 cm and 20 cm.
metallurgical	pertaining to metals, particularly their extraction from ore.
Midwest Corporation	Midwest Corporation Limited.
mine waste	by-products of mining operations with no economic value.
mineralisation	the occurrence of metals or ore-bearing minerals within a rock sequence.
Mining Act	<i>Mining Act 1978.</i>
model	a mathematical simulation of a natural system (such as the variation of particulate levels within a lake) used to predict how the system will change with time, particularly where external changes have been imposed upon it (such as from mining operations).
monitoring	systematic sampling and, if appropriate, sample analysis to record changes over time caused by impacts such as mining.
MOU	memorandum of understanding.
MPG	Malleefowl Preservation Group.
NAF	non-acid forming.
native	belonging to, or found naturally, in a particular environment.
natural	existing in, or formed by, nature (generally excludes anything obviously modified by human beings).
NEPM	National Environment Protection Measure.
neutral	neither acidic nor basic (e.g., a pH equal to 7.0).
nitrate	NO ₃ ⁻ , nitrogen compound commonly found in waterbodies and used by plants and algae as a nutrient.
nutrients	generally refers to nitrogen and phosphorus, which are essential for biological growth.
ODAC	Office of Development Approval Co-ordination.
open pit	large hole excavated in an open-cut mining operation to remove the ore.
operations	mining and ore processing activities.
Operating Licence	a licence to operate a prescribed premises, issued by DEC.
operational phase	that period of the mining project, after construction and prior to decommissioning, during which pit excavation and metal extraction takes place.
ore	a mineral or mixture of minerals containing a metal in sufficient amounts for its extraction to be profitable.
ore processing	the mechanical and chemical process by which a metal is extracted from an ore.
orebody	a solid mass of ore (both high and low grade) that is geologically distinct from the rock that surrounds it and that is commercially extractable.
overburden	material that overlies a deposit of ore.
oxidation	the process by which an element or compound undergoes a chemical reaction involving the removal of electrons; often involves reaction with oxygen to form an oxide (e.g., the rusting of iron).
PAF	potentially acid forming.
passive	performing a function without electrical or mechanical action or movement.
PATN	proprietary software package that aims to try and display patterns in complex data.
PAWC	plant available water capacity or plan-available water capacity.
PER	public environmental review.

Term	Expansion / Definition
perimeter	outer boundary.
permeability	the ability of a rock or soil to allow fluid to pass through it.
pH	percentage hydrogen; a measure of the degree of acidity or alkalinity of a solution; expressed numerically (logarithmically) on a scale of 1 to 14, on which 1 is most acid, 7 is neutral and 14 is most basic (alkaline).
pit	see open pit.
pit water	water inflow into the pit from incident rainfall or groundwater seepage from pit walls.
PM ₁₀	the fraction of dust with a particle size of 10 µm or less. A health indicator for the fine particles of respirable dust capable of being inhaled into the lungs.
PM _{2.5}	the fraction of dust with a particle size of 2.5 µm or less. A health indicator for the very fine particles of respirable dust capable of deep penetration into the lungs and alveoli.
potable water	water of quality suitable for human consumption.
PPE	personal protective equipment.
precipitation	1. the process of changing from a dissolved compound into a solid, insoluble compound.
precipitation	2. rain, hail and snow.
Prescribed Premise	a premise that falls into the categories prescribed in Schedule 1 of the <i>Environmental Protection Regulations 1987</i> .
progressive rehabilitation	rehabilitation of mined or disturbed areas as soon as practicable after they are released during the life of the mine.
project area	the total area covered by the project, including pit, processing plant, stockpiles, haul road, rail siding, port facilities etc.
PTA	Public Transport Authority.
quadrat	a square measuring area used in ecological studies such as the distribution of plants or animals in an area. Quadrats can vary in size depending largely on the focus of the study.
rainfall event	period of rainfall.
receptor	a designated place at which an impact may occur (e.g., a dwelling).
recharge	the addition of water to an aquifer, directly from the surface, indirectly from the unsaturated zone, or by discharge from overlying or underlying aquifer systems.
regolith	a layer of loose, heterogeneous material covering solid rock.
rehabilitation	the restoration of a landscape and especially the vegetation following its disturbance.
reptiles	cold-blooded vertebrates, including lizards, snakes, turtles, and crocodiles.
reserve	the calculated tonnage and grade of ore which can be extracted profitably from a mineral deposit; classified according to the level of confidence that can be placed in the data.
residual impacts	impacts from an activity (e.g., mining) that remain after mitigation measures.
resource	the calculated amount of material in a mineral deposit, based on exploration drilling information.
richness (of fauna or flora)	a measure of the number of species in a given area or assemblage.
Rockwater	Rockwater Pty Ltd.
ROM	run-of-mine; see ROM pad.
ROM pad	the stockpile of freshly mined ore used to feed the mill and process plant.
runoff	that portion of precipitation (rain, hail and snow) that flows from a specific area as water.
SAG	semi-autogenous grinding.
sand	siliceous group of particles within the size range 63 microns to 2 millimetres.
scree	small, loose rocks that gather on a slope and often at the bases of cliffs.
seepage	1. subsurface movement of water.

Term	Expansion / Definition
seepage	2. emergence of subsurface flow at the ground surface.
sequence (geological)	layers of (predominantly) sedimentary rocks sourced from a common geological environment or period.
sheet flow	runoff that is of substantial lateral extent and relatively uniform depth (rather than concentrated in channels).
silt	a sediment with particles finer than sand and coarser than clay, i.e., 2 to 63 microns.
site-specific	an observation that is particular to one site.
slurry	mixture of fluid and solid.
SMS	safety management system.
species	a taxonomic grouping of organisms that are able to interbreed with each other but not with members of other species.
SRE	short-range endemics.
stockpile	a pile used to store material (such as low-grade ore) for future use.
stockpiled	stored in a stockpile.
storage capacity	the maximum volume of liquid able to be retained in a structure or container (e.g., a reservoir or lake).
stripping	removal of vegetation and topsoil.
stygofauna	groundwater inhabiting aquatic fauna.
subregion	a subdivision of a bioregion which contains distinctive geomorphic units that closely align with land capability and development potential. The names of subregions are generally those of IBRA subregions (see IBRA).
substrate	an underlying layer.
sump	pit sunk to collect water.
surface water	water flowing over, or contained on, a landscape (e.g., runoff, streams, lakes, etc.).
suspended (solids)	solids held in suspension by the turbulent flow of a fluid.
SWIS	South West Interconnected System.
tailing	by-product of the metal extraction process consisting of crushed rock from which the metal has been extracted (the solid fraction or portion) and a liquid fraction or portion composed of water and residual chemicals used in the extraction process.
TAPM	The Air Pollution Model.
taxa	plural of taxon.
taxon	A group or category, at any level, in a system for classifying plants or animals. Animal or plant group having natural relations.
TBT	tributyl tin.
TDS	total dissolved solids; a common measure used to determine dissolved solids concentrations in a waterbody and expressed in terms of mass per unit of volume (e.g., milligrams per litre).
TEC	threatened ecological community.
throughput	quantity of material (ore, chemicals, etc.) moving through a system (e.g., an ore-processing plant).
topography	physical relief and contour of a region.
topsoil	upper layer of soil, usually containing more organic material and nutrients than the subsoil beneath it.
troglofauna	obligate cave or karst-dwelling, terrestrial subterranean fauna occurring above the water table
TSF	tailing storage facility; a storage facility for tailing.
TSP	total suspended particulates; mass of all suspended particulates.

Term	Expansion / Definition
TSS	total suspended solids; a common measure used to determine suspended solids concentrations in a waterbody and expressed in terms of mass per unit of volume (e.g., milligrams per litre).
variable	not constant, subject to change.
velocity	speed in a given direction.
vibration	oscillating movement.
vug(s)	small to medium sized cavity within a rock that is linked with crystals.
vugginess	degree to which a rock contains vugs.
waste rock	uneconomic rock extracted from the ground during a mining operation to gain access to the ore.
water balance	the sum of the inputs and outputs and changes in storage levels of water in a given locality.
water quality	degree of the lack of contamination of water.
watertable	the surface of the groundwater, below which soil and rock are saturated.
watercourse	stream or river, running water.
weathering	the in-situ physical disintegration and chemical decomposition of rock materials at or near the earth's surface.
weed	any plant (in particular an herbaceous one) that survives in an area where it is harmful or troublesome to the desired land use.
wetland	a low-lying area regularly inundated or permanently covered by shallow water.
WHO	World Health Organization.
wind erosion	wearing away of exposed soil, earth, or rock surfaces by the abrasive action of wind-blown particles (e.g., grains of sand).
WMC	Western Mining Corporation.
Woodman Environmental	Woodman Environmental Consulting Pty Ltd.
Works Approval	an approval, under Part V of the EP Act, to authorise work to be undertaken (including construction) on a prescribed premise.
yield (of a water bore)	1. the capacity of the bore to produce water.
yield (of a water bore)	2. the amount of water actually withdrawn.

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