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APPLICANT: KUDUMANE MANGANESE RESOURCES (PTY) LTD

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ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT FOR THE ADDITIONAL PLANNED MINING AREAS AT KUDUMANE MANGANESE MINE

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Project Manager	Caitlin Hird & Suan Mulder
Author	Caitlin Hird
Reviewer	Brandon Stobart
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ACRONYMS AND ABBREVIATIONS

Below is a list of acronyms and abbreviations used in this report.

Acronyms / Abbreviations	**Definition**
ABC	Acid Base Accounting
ADT	Articulated Dump Trucks
ARD	Acid Rock Drainage
BID	Background information document
CEC	Cation Exchange Capacity
CO	Carbon Monoxide
CD	Compact Disc
DAFF	Department of Agriculture, Forestry and Fisheries
dBA	A-weighted decibel
DENC	Department of Environment and Nature Conservation
DMR	Department of Mineral Resources
DPWRT	Department of Public Works, Roads and Transport
DRDLR	Department of Rural Development and Land Reform
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental impact assessment
EMP	Environmental management programme
EMS	Environmental Management Services
GGP	Gross Geographic Product
GN	General Notice
Ha	Hectares
IAPs	Interested and/or affected parties
IUCN	International Union for Conservation of Nature
IWWMP	Integrated Waste & Water Management Plan
Km	Kilometres
Kv	Kilovolts
m	Meters
MAMSL	Metres above mean sea level
mm	Millimetres
MPRDA	Mineral and Petroleum Resources Development Act
MR	Mining Right
mVa	Megavolt Amps
NEMA	National Environmental Management Act
NEM:WA	National Environmental Management: Waste Management Act
NGO	Non-government organisation
NOx	Nitric oxide and nitrogen dioxide
NP	Neutralising Potential
^{O}C	Degrees Celsius
PAG	Potentially Acid Generating
PrSciNat	Registered professional in natural science
ROM	Run-of-mine
RWD	Return Water Dam
SACNSP	South African Council for Natural Scientific Professionals
SAHRA	South African Heritage Resources Agency
SANS	South African National Standards
SAWS	South African Weather Service
SLR	SLR Consulting (Africa) (Pty) Ltd
SO2	Sulphur Dioxide

Acronyms / Abbreviations	**Definition**
TDS	Total dissolved solids
TSF	Tailings Storage Facility
WESSA	Wildlife and Environmental Society of South Africa
WRD	Waste Rock Dump
WULA	Water Use License Application

EXECUTIVE SUMMARY

Kudumane Manganese Resources (Pty) Ltd (Kudumane), a South African mining company holds a mining right on the farms York A 279 (York) and Telele 312 (Telele) located approximately 3 km south-west of the town of Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape. Refer to Figure 1 and Figure 2 for the regional and local settings respectively.

Kudumane now wishes to expand its mining operations and has applied for a new mining right to include the farms Kipling 271 (Kipling), Devon 277 (Devon) and Hotazel 280 (Hotazel). In addition to adding new mining rights to its existing mining rights areas, Kudumane intends to add additional infrastructure in support of its existing mining right (covering York and Telele).

SLR Consulting (Africa) (Pty) Ltd (SLR), an independent firm of environmental consultants, has been appointed to manage the environmental assessment processes.

The EIA/EMP process comprises two phases: a scoping phase and an environmental impact assessment phase combined with the environmental management programme (EIA/EMP) phase. This report describes the EIA/EMP phase for the proposed project.

Project motivation (need and desirability)

The addition of the farms Devon, Hotazel and Kipling to the mining rights area will optimise the extraction of the mineral resources at Kudumane. The proposed inclusion of additional mining areas will benefit society and the surrounding communities both directly and indirectly by extending the life of mine, generating additional employment (as well as job continuity) and extracting additional resources. Direct economic benefits will be derived from wages, taxes and profits. Indirect economic benefits will be derived from the procurement of goods and services and the spending power of employees.

Legal framework: required for new mining rights area

Prior to the commencement of the proposed project, environmental authorisation is required from government departments. These include:

- environmental decision from the DMR in terms of the Mineral and Petroleum Resources Development Act, 28 of 2002 (MPRDA) which will cater for the new mining rights area and the associated infrastructure;
- environmental authorisation from the Northern Cape Department of Environment and Nature Conservation (DENC) in terms of the National Environmental Management Act NEMA, 107 of 1998 (NEMA). The proposed project incorporates several listed environmental activities. An application was submitted by SLR to DENC and was accepted by the department. The EIA regulation being followed for this project is Regulation 543 (2010 EIA Regulations);

- a water use license from the Department of Water Affairs (DWA) in terms of the National Water Act (NWA) 36 of 1998. The applicable water uses in terms of Section 21 of the NWA include (a) (g) and (j). It should be noted that a WULA was submitted to the DWA in 2012 to cater for water uses associated with the existing approved EIA/EMP report; and
- the approval of a biodiversity offset programme by the Department of Forestry and Fisheries (DAFF) and DENC. With the establishment of the approved infrastructure, the removal of protected trees (10107 Acacia erioloba and 8738 Acacia haemotoxylon) triggered the implementation of a biodiversity off-set project in terms of the internal DAFF guidelines. Additionally, Kudumane has committed to a voluntary biodiversity offset as part of the approved EIA/EMP. In this regard a biodiversity off-set plan has been undertaken as part of the biodiversity specialist study.

The related environmental assessment process, with regards to the requirements of the MPRDA, incorporated the following steps:

- The scoping process was conducted to identify relevant environmental, social and economic issues and to define the terms of reference for the required specialist studies and the EIA/EMP.
- Specialist studies were commissioned in accordance with the relevant terms of reference. The specialists were selected on the basis of their expertise and knowledge of the project area.
- The EIA/EMP report was compiled on the basis of the findings of the specialist studies and the project team.
- The EMP incorporates Kudumane's existing mitigation and management commitments in addition to those mitigation commitments that have been identified and described in the EIA/EMP.

Stakeholder engagement

The stakeholder engagement process commenced prior to scoping and has continued throughout the environmental assessment process. As part of this process, authorities and interested and affected parties (IAPs) were given the opportunity to attend scoping meetings, submit questions and comments to the project team, and review the background information document (BID), scoping report and now the EIA/EMP reports. All comments that have been submitted to date by the authorities and IAPs have been included and addressed in the EIA/EMP report. Further comments arising from the EIA/EMP report review process will be handled in a similar manner.

Impact assessment findings

The key factors that contribute to the potential impacts associated with the project are its size, its nature, its duration, its location and its economic implications. '

The addition of Kipling, Devon and Hotazel as mining rights areas is an economically viable option for Kudumane, and will optimise the extraction of mineral resources.

The proposed additional infrastructure and mining areas will cover a disturbance footprint of roughly 200 ha, although some of this land (for example the Devon pit area) has already been heavily disturbed due to historical mining activities. It follows that there are no formal land use agreements for grazing rights within the new mining rights area, however ad-hoc cattle grazers have been observed to occur within the area and in this regard the related land use impacts should be considered. With regards to the re-mining of the historical pit on Devon, it is expected that this will only take place for one year, thereby limiting the associated impacts for potential receptors. Moreover, given the temporary nature of the proposed project, it is expected that following successful rehabilitation the land use potential of the area will be re-established. It should be noted that whilst the proposed tailings storage facility (TSF) and waste rock dumps (WRDs) will remain as permanent landforms, rehabilitation will be undertaken so as to ensure that a productive landuse can take place post closure (even though it is unlikely to be at the same carrying capacity).

Cumulative impact assessment summary

A tabulated summary of the cumulative impacts associated with the Kudumane mine is provided in Table 1 below.

TABLE 1: SUMMARY OF POTENTIAL CUMULATIVE IMPACTS ASSOCIATED WITH THE KUDUMANE MINE

Section	Potential impact	Significance of the impact (the ratings are negative unless otherwise specified)	
		Unmitigated	Mitigated
Geology	Sterilisation of mineral resources	**M**	**L**
Topography	Hazardous excavations and infrastructure	**H**	L
Soils and land capability	Loss of soil resources and land capability through pollution	**H**	L
	Loss of soil resources and land capability through physical disturbance	**H**	**M**
Biodiversity	Physical disturbance of biodiversity	**H**	**M**
	General destruction of biodiversity	**H**	**M**
Surface water	Pollution of surface water resources	**H**	**L**
	Alteration of natural drainage patterns	**H**	**L**
Groundwater	Contamination of groundwater	**H**	**L**
	Dewatering	**H**	**L**
Air quality	Air pollution	**M-H (H for Devon)**	**M**
Noise	Noise pollution	**M**	**M**
Blasting	Blasting impacts	**H**	**M**
Traffic	Road disturbance and traffic safety	**H**	**L**
Visual	Visual impact	**M**	**M (L at closure)**
Heritage and cultural resources	Heritage impacts	**H**	**L**
Socio-economic	Economic impact	**H+**	**H+**
	Inward migration	**H**	**M**

Section	Potential impact	Significance of the impact (the ratings are negative unless otherwise specified)	
		Unmitigated	Mitigated
Land use	Land use impacts	**H**	**M-L**

Project timing

The project will only proceed if approved. Table 2 sets out the related time frames.

TABLE 2: PROJECT TIME FRAMES

Aspect	Timeframe
Hotazel	
Start construction	Construction will commence in 2015 subject to authorisation
Life of operation	Approximately 6 years
Kipling	
Start construction	Construction will commence in 2021 subject to authorisation
Life of operation	Approximately 13 years
Devon	
Start construction	Construction will commence in 2034 subject to authorisation
Life of operation	Approximately 1 year

Conclusion

The EIA/EMP amendment report presents the project plan as defined by Kudumane, presents findings of specialist studies, identifies and assesses potential impacts on the receiving environment in both the unmitigated and mitigated scenarios, including cumulative impacts, and identifies measures together with monitoring programmes to monitor and mitigate potential impacts.

The assessment of the proposed project presents the potential for negative impacts to occur (in the unmitigated scenario in particular) on the bio-physical, cultural and socio-economic environments both on the project area and in the surrounding area. With mitigation these potential impacts can be prevented or reduced to acceptable levels.

The economic impact assessment concluded that the development of the project will have positive economic impacts. Moreover, the integrated alternative land use assessment concluded that the proposed project components are the preferred land use alternative.

It follows that provided the EMP is effectively implemented there is no environmental, social or economic reason why the project should not proceed.

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT FOR THE ADDITIONAL PLANNED MINING AREAS AT KUDUMANE MANGANESE MINE

INTRODUCTION AND LEGAL FRAMEWORK

Introduction

Kudumane Manganese Resources (Pty) Ltd (Kudumane), a South African mining company holds a mining right on the farms York A 279 (York) and Telele 312 (Telele) located approximately 3 km south-west of the town of Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape. Refer to Figure 1 and Figure 2 for the regional and local settings respectively.

The Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP) submitted as part of the approved mining right application covers the opencast mining and infrastructure on the farm York and underground mining on the farm Telele under the DMR authorisation (NC 30/6/1/2/2/268 MR). In broad terms, the approved EIA/EMP included the establishment of an opencast and future underground mining operation, associated residue handling and disposal facilities, a crushing and screening plant, water management facilities, rail and road transport infrastructure and various support infrastructure and services.

Kudumane now wishes to expand its mining operations and has applied for a new mining right to include the farms Kipling 271 (Kipling), Devon 277 (Devon) and Hotazel 280 (Hotazel). In addition to adding new mining rights to its existing mining rights areas, Kudumane intends to add additional infrastructure in support of its existing mining right (covering York and Telele).

Kudumane submitted a new mining right application for the inclusion of additional mining areas in November 2013. The application was accepted by the Department of Mineral and Resources (DMR) on 5 December 2013 (NC 30/5/1/2/2/10053MR). In line with the requirements of the MPRDA, an environmental impact assessment has been undertaken and an EIA/EMP is being submitted in support of the new mining right application. Kudumane has also submitted a Section 102 application in order to add additional infrastructure to its existing mining right (NC 30/6/1/2/2/268 MR). In this regard, Kudumane is also undertaking an environmental impact assessment process to amend its approved EIA/EMP to incorporate the additional infrastructure which has been proposed. This process will be run in parallel to the mining right application process.

The following infrastructure and activities are proposed on the additional planned mining rights area (DMR reference number NC 30/5/1/2/2/10053MR):

- Devon: mining and removal of manganese ore from the historical pit and tailings storage facility (TSF);

- Hotazel: opencast activities (mining and removal of manganese from the historical pit). This will include haul roads and utilisation of the existing road network; conveyor system to York; and
- Kipling: this farm has been included for the purposes of potential future mining operations. No information is currently available concerning infrastructure. In this regard, when such information becomes available, this will be catered for through an EIA/EMP amendment application.

It should be noted that although this EIA/EMP will be submitted in support of the new mining right application (NC 30/5/1/2/2/10053MR), the infrastructure/activities proposed within these areas are reliant on the processing facilities located in the existing mining rights area (NC 30/6/1/2/2/268 MR) and are therefore not viable when considered in isolation. In this regard, detail regarding the existing mining rights area (and the proposed additional infrastructure) is presented below and in Section 2 for background purposes.

SLR Consulting (Africa) (Pty) Ltd (SLR), an independent firm of environmental consultants, has been appointed to manage the environmental assessment processes.

The EIA/EMP process comprises two phases: a scoping phase and an environmental impact assessment phase combined with the environmental management programme (EIA/EMP) phase. This report describes the EIA/EMP phase for the proposed project.

Project motivation (need and desirability)

The addition of the farms Devon, Hotazel and Kipling to the mining rights area will optimise the extraction of the mineral resources at Kudumane. The proposed inclusion of additional mining areas will benefit society and the surrounding communities both directly and indirectly by extending the life of mine, generating additional employment (as well as job continuity) and extracting additional resources. Direct economic benefits will be derived from wages, taxes and profits. Indirect economic benefits will be derived from the procurement of goods and services and the spending power of employees.

Legal framework: required for new mining rights area

Prior to the commencement of the proposed project, environmental authorisation is required from government departments. These include:

- environmental decision from the DMR in terms of the Mineral and Petroleum Resources Development Act, 28 of 2002 (MPRDA) which will cater for the new mining rights area and the associated infrastructure;
- environmental authorisation from the Northern Cape Department of Environment and Nature Conservation (DENC) in terms of the National Environmental Management Act NEMA, 107 of 1998 (NEMA). The proposed project incorporates several listed environmental activities. An application was submitted by SLR to DENC and was accepted by the department (Appendix A). The applicable

list of activities is provided in Section 2.5. The EIA regulation being followed for this project is Regulation 543 (2010 EIA Regulations);

- a water use license from the Department of Water Affairs (DWA) in terms of the National Water Act (NWA) 36 of 1998. The applicable water uses in terms of Section 21 of the NWA include (a) (g) and (j). It should be noted that a WULA was submitted to the DWA in 2012 to cater for water uses associated with the existing approved EIA/EMP report; and
- the approval of a biodiversity offset programme by the Department of Forestry and Fisheries (DAFF) and DENC. With the establishment of the approved infrastructure, the removal of protected trees (10107 Acacia erioloba and 8738 Acacia haemotoxylon) triggered the implementation of a biodiversity off-set project in terms of the internal DAFF guidelines. Additionally, Kudumane has committed to a voluntary biodiversity offset as part of the approved EIA/EMP. In this regard a biodiversity off-set plan has been undertaken as part of the biodiversity specialist study (Appendix G).

This report is the environmental impact assessment (EIA) (Section 1) and environmental management programme (EMP) (Section 2) which satisfies the DMR requirements only. In this regard, this report has been compiled to meet the requirements of the 2010 EIA Regulations and MPRDA Regulations and the new DMR report structure template has been used. To assist with cross-referencing in the report, the chapter numbering in the EMP section follows on from the chapter numbering in the EIA section.

TABLE 3: REQUIREMENTS FOR EIA AND EMP REPORTS

Mining Regulation 527	Section in report
Environmental Impact Assessment	
Assessment of the environment likely to be impacted by the mining operations including cumulative impacts	Section 1 Section 2
An assessment of the environmental likely to be affected by the identified alternative land use or developments, including cumulative environment impacts	Section 4 and 5
An assessment of the nature, extent, duration, probability and significance of the identified potential environmental, social and cultural impacts of the proposed mining operations, including cumulative environmental impacts	Section 7
Determine the appropriate migratory measures for each significant impact of the proposed mining operation	Section 7
-	Section 7.3
An comparative assessment of the identified land use and development alternatives and their potential environmental, social and cultural impacts	Section 8
Details of the public engagement process and identification of how all issues raised have been addressed	Section 10
Knowledge gaps, adequacy of predictive measures, assumptions and uncertainties	Section 11
Description of the arrangement for monitoring and management of environmental impacts	Section 12
-	Section 27

Mining Regulation 527	**Section in report**
Environmental Impact Assessment	
-	
Include appendices for supporting and technical information	Section 13
Environmental Management Plan	
Description of management/technical options chosen	Section 19
Description of objectives and specific goals for mine closure, and management of environmental impacts, socio-economic conditions (SLP), historical and cultural aspects	Section 14, 15, 16 and 17
Description of the appropriate technical and management options chosen for each environmental impacts, socio-economic condition and historical and cultural aspect for each phase of the mining operation	Section 18
Action plans to achieve the objectives and specific goals that must include a time schedule to implement migratory measures for the prevention, management and remediation of each environmental impact, socio-economic condition and historical and cultural aspects for each phase of the mining operation	Section 19
-	
Procedures for environmental related emergencies and remediation	Section 20
Planned monitoring and environmental management performance assessment	Section 21
Financial provision including the determination of the quantum of the financial provision and details of the method providing for financial provision	Section 22
Environmental awareness plan	Section 23
Supporting information	Section 24
Capacity to rehabilitate the environment	Section 25
Undertaking of the applicant	Section 26

FIGURE 1: REGIONAL SETTING

FIGURE 2: LOCALITY PLAN

EIA approach and process

The process has been run in support of four distinct regulatory requirements: DMR new mining right application, DMR Section 102 amendment to add additional infrastructure to the existing mining rights area, DENC application for listed activities associated with both mining rights areas, and WULA associated with the new infrastructure on both mining rights areas. A summary of the combined approach is outlined in Table 4 below.

TABLE 4: EIA PROCESS

Objectives	Corresponding activities
Project initiation and application phase (April 2013 – December 2013)	
• Notify the decision making authorities of the proposed project. • Initiate the environmental impact assessment process.	• DMR notified by means of a notification letter sent on 28 May 2014. Refer to Appendix A for a copy of the notification letter. • NEMA application for listed activities was submitted to DENC on 14 April 2013 in terms of the 2010 EIA regulations. Application accepted 15 April 2013. Refer to Appendix A for a copy of the application form.
Scoping phase (October 2013 – May 2014)	
• Identify interested and/or affected parties (IAPs) and involve them in the scoping process through information sharing. • Determine the issues associated with the proposed project. • Consider alternatives. • Identify any fatal flaws. • Determine the terms of reference for additional assessment work.	• Landowners were notified by means of a notification letter sent on 12 March 2014. Refer to Appendix A for a copy of the landowner notification letter. • Notify IAPs of the project and environmental assessment process (deed search, distribution of background information documents (BIDs), newspaper advertisements, telephone calls and site notices) in November 2013. • Public scoping meeting (November 2013). • Compile scoping report (November 2013 – March 2014). • Distribute scoping report to DMR, IAPs and other regulatory authorities for review (April 2014). • Record comments (April-May 2014).
EIA/EMP phase (March 2014 – October 2014)	
Detailed specialist investigations (March 2014 – July 2014)	
• Describe the affected environment. • Assess potential impacts. • Provide management and monitoring recommendations.	• Investigation by technical project team and appointed specialists (as per the terms of reference in the scoping report)
EIA/EMP phase (March 2014 – October 2014)	
• Assess potential impacts with assistance from appointed specialists where required. • Design requirements and management and mitigation measures. • Receive feedback on application.	• Compile EIA/EMP report (April 2014 to September 2014) • Distribute the EIA/EMP report to DMR, IAPs and other regulatory authorities for review (September 2014). • Public feedback meetings with IAPs (if required) (September/October 2014). • Record comments (September/October 2014). • Forward IAP comments to DMR (October /November 2014). • Circulate record of decision (on receipt of DMR decision).

EIA team

The project team is outlined in Table 5. Caitlin Hird (author and co-project manager) has approximately four years of relevant experience. Suan Mulder (co-project manager) has approximately seventeen years of relevant experience. Brandon Stobart (project reviewer) has over fifteen years of relevant experience and is registered as an environmental assessment practitioner with the interim certification board.

Neither SLR or any specialists which are being used as sub-consultants have any interest in the project other than fair payment for consulting services rendered as part of the environmental assessment process.

TABLE 5: PROJECT TEAM

Team	Name	Designation	Tasks and roles	Company
Project management	Caitlin Hird	Project manager and co-author	Management of the assessment process and report compilation.	SLR
	Suan Mulder	Co-project manager		
	Brandon Stobart	Project reviewer	Report and process review	
Specialist investigations	Garry Paterson	Soils specialist	Soils specialist study	ARC
	Natalie Birch	Ecological specialist	Ecological specialist study and biodiversity off-set	EMS
	Jenny Ellerton & Arnold Bittner	Geochemistry and Geohydrology report	Geochemical analysis	SLR
	Morgan Fitzpatrick	Air quality specialist	Air quality specialist study	SLR
	Darren Lafon-Anthony	Noise specialist	Noise specialist study	SLR
	Gerrie Muller	Economic landuse and sustainability specialist	Economic and sustainability analysis	Strategy4Good
	Wouter Fourie	Heritage resources specialist	Heritage resources assessment	PGS
	Gideon Groenewald	Palaeontological specialist	Palaeontological specialist study	GSPD Consulting
	Steve van Niekerk	Closure specialist	Closure cost report	SLR
	Paul van der Westhuizen	Traffic specialist	Traffic specialist study	Siyazi Gauteng
	Steve Dorman and Rene Pieper	TSF design engineering	TSF design report	SLR
	Paul Klimczak and Ryan Sweetman	Specialist engineer and specialist hydrologist	Hydrology, Stormwater management plan, River diversion study	SLR
	Sarah Planton & Mark Williams	Visual specialist	Visual assessment	SLR

Contact details for applicant

The contact details for the Kudumane project team/mine are included below.

Project applicant:	Kudumane Manganese Resources (Pty) Ltd
Contact person:	Babra Mudzanapabwe
Postal address:	PO Box 1010 Houghton

	2041
Telephone No:	Tel: (011) 880 7136
Fax No:	Fax: (011) 447 5912
E-mail Address:	babra.mudzanapabwe@kmr.co.za

Regional Setting

The regional and local setting of the mine and project is outlined below and illustrated in Figure 1 and Figure 2 respectively.

Aspect	Detail
Province	Northern Cape
Magisterial district	Kathu
Local authority	Joe Morolong Local Municipality and John Taolo Gaetsewe District Municipality
Municipal wards	Ward 4 of the Joe Morolong Local Municipality
Farms on which project will take place	Kudumane has applied to include the farms Devon, Kipling and Hotazel in its mining rights area. Refer to Section 1.3.4 for land ownership details.
Nearest town	The closest town is Hotazel located approximately 3 km north-east of Kudumane
Presence of servitudes	Powerlines, railway lines, water pipelines, and roads are located within and surrounding Kudumane (Section 1.3.4)
Use of immediately adjacent land	Immediate and adjacent land is utilised for agricultural purposes such as grazing activities as well as for mining activities
Water catchment and management area	Kudumane falls within the Lower Vaal water management area and is located within quaternary catchment D41K
Topographic landmarks	Kudumane is situated within a flat area located close to the non-perennial Ga-Mogara River
Co-ordinates of project area	22° 55' 44.06'' E 27° 13' 48.61'' S

SECTION 1 – ENVIRONMENTAL IMPACT ASSESSMENT

1 DESCRIPTION OF THE BASELINE ENVIRONMENT

Information in this section was sourced from the approved EIA/EMP (Metago, 2010) and the supporting specialist studies as well as new specialist studies undertaken for the proposed project.

1.1 ON-SITE ENVIRONMENT RELATIVE TO SURROUNDING AREA

1.1.1 GEOLOGY BASELINE

Information in this section was sourced from the geochemistry and groundwater specialist reports undertaken for the proposed project (SLR, June 2014) included in Appendix E as well as the approved EIA/EMP (Metago, 2010).

Introduction and link to impacts

As a baseline, the geology and associated structural features provides a basis from which to understand:

- the potential for sterilisation of mineral reserves;
- The geochemistry and related potential for the pollution of water from the open pits, mineralised waste facilities and stockpiles; and
- the potential for geological lineaments such as faults and dykes. Faults, dykes and other lineaments can act as preferential flow paths of groundwater which can influence both the dispersion of potential pollution plumes and the inflow of water into mine workings.

Geological processes also influence soils forms (see Section 1.1.4) and the potential for palaeontological resources (see Section 1.3.1).

To understand the basis of these potential impacts, a baseline situational analysis is described below.

Results

Regional geology

The world's largest land based sedimentary manganese deposit is contained in the Kalahari Manganese Field (KMF), situated 47km northwest of Kuruman in the Northern Cape. The KMF comprises five erosional, or structurally preserved, relics of the manganese bearing Hotazel Formation of the Paleoproterozoic Transvaal Supergroup (see Figure 4). These include the Mamatwan-Wessels deposit (also known as the main Kalahari Basin), the Avontuur and Leinster deposits, and the Hotazel and Langdon Annex/Devon deposits. The Kudumane Mine is located on the south-western outer rim of the KMF

Local and operational geology

Kudumane is exploiting the manganese from the Hotazel Formation (Transvaal Supergroup) as presented in Table 4 below. The Hotazel Formation consists primarily of the Banded Iron Formation (BIF). Three laterally continuous stratiform manganese layers are interbedded within the BIF; upper, middle and lower manganese bodies. The lower body represents the main ore bed and varies in thickness from 5 to 45m. The middle body contains uneconomic grades of manganese and is only 1 to 2 m thick at neighbouring mines. The upper body is mined on a local scale and averages between 5m and 20m thick. The ore layer dips gradually to the west at approximately eight degrees (Evans et al, 2001 as cited in Saad, 2010).

The Hotazel Formation is underlain by basaltic lava of the Ongeluk Formation (Transvaal Supergroup) and directly overlain by dolomite of the Mooidraai Formation (Transvaal Supergroup); however, the extent of the dolomite within the study area is not fully understood. The geological setting is illustrated in Figure 3 and Figure 3.

The Transvaal Supergroup is overlain unconformably by the Olifantshoek Supergroup which consists of arenaceous sediments, typically interbedded shale, quartzite and lavas overlain by coarser quartzite and shale (Table 4). The Olifantshoek Supergroup is overlain by Dwyka Formation which forms the basal part of the Karoo Supergroup. At the Kudumane Mine this consists of tillite (diamictite) which is covered by sands, claystone and calcrete of the Kalahari Group.

TABLE 6: GENERAL STRATIGRAPHIC COLUMN AND ASSOCIATED GEOLOGY AND AQUIFERS FOR THE KALAHARI MANGANESE FIELD (WGC, 2010)

<table>
<tr><th colspan="4">Supergroup / Group / Subgroup / Formation</th><th>Geological Description</th><th>Aquifer Type (See Section 4)</th></tr>
<tr><td colspan="4">Kalahari Group</td><td>Sand, clay and limestone / calcrete</td><td>Shallow unconfined aquifer</td></tr>
<tr><td colspan="4">Karoo Supergroup</td><td>Dwyka Tillite</td><td>Fractured aquifer – semi confined</td></tr>
<tr><td colspan="3" rowspan="2">Olifantshoek Supergroup</td><td>Lucknow Formation</td><td>Quartzite</td><td rowspan="2">Aquiclude</td></tr>
<tr><td>Mapedi Formation</td><td>Red and Grey Shales</td></tr>
<tr><td rowspan="11">Transvaal Supergroup</td><td rowspan="11">Postmansburg Group</td><td rowspan="10">Voelwater Subgroup</td><td>Mooidraai Formation</td><td>Dolomite</td><td rowspan="11">Deep fractured aquifer</td></tr>
<tr><td rowspan="9">Hotazel Formation</td><td>Iron Formation</td></tr>
<tr><td>Upper Manganese Ore Body</td></tr>
<tr><td>Middle Manganese Ore Body</td></tr>
<tr><td>Iron Formation</td></tr>
<tr><td>Manganese -rich Iron Formation</td></tr>
<tr><td>Lower Manganese Ore Body</td></tr>
<tr><td>Manganese -rich Iron Formation</td></tr>
<tr><td>Iron Formation</td></tr>
<tr><td colspan="2">Ongeluk Formation</td><td>Basaltic Lava</td></tr>
</table>

Structural geology

On a regional basis, the sedimentary rocks of the Transvaal Supergroup in the Northern Cape region are gently folded into a series of wide open synclinal (saucer-shaped) and anticlinal (dome-shaped) structures. The sequence generally dips at shallow angles, about eight degrees to the west (Evans et al, 2001 as cited in Saad, 2010) and has also been deformed by a series of north to south and to north-north-south to south-south-west trending normal faults.

The main structural feature is represented by a north-east to south-west trending dyke that runs through the existing mining rights area (York and Telele). The dyke splits up into two entities, which continue roughly parallel to each other towards the south-west. The main resource is located on York to the north of the dykes. South of the dyke the resource is down-faulted by between 30m and 60m and largely eroded by younger Dwyka glacial activity.

<u>Geochemical Signature of Local Geology</u>

Samples of ore-body material and non-ore body material have been collected from site for geochemical characterisation tests. The objectives of the tests were to identify material that would be potentially acid generating (PAG) or would produce poor quality leachate.

Nine (9) samples comprising the main lithologies at Kudumane, identified by an on-site geologist were collected from the York Pit walls and submitted to an accredited laboratory for Acid Base Accounting (ABA), leach tests and mineralogy testing. The results of the ABA and leach test are provided in Table 5 and Table 6 respectively (SLR, June 2014).

The Acid Base Accounting (ABA) results show that the total sulphur content and more importantly the sulphide sulphur content of all samples are low, with the majority below the laboratory detection limit of <0.01%. The low sulphide sulphur content suggests the potential to generate acid is negligible for all samples. In addition, the neutralising potential ratio (NPR) of all samples is above two, some significantly above two, which implies all lithologies have sufficient neutralising potential to offset the low acid potential. Based on these two criteria, the graph illustrates that all samples tested for are classified as Non-Potentially Acid Generating (Non-PAG).

In addition, the paste pH for all samples was neutral to alkaline and indicates that there is little potential for the generation of short-term acidity.

The mineralogy tests undertaken showed that the key minerals of each of the nine samples are consistent with the different lithological units mined at the site:

- quartz, calcite, the weathered clay mineral smectite, and palygorskite (magnesium aluminium phyllosilicate) are dominant in samples of the Kalahari Formation (sand, calcrete, clay and quartzite);
- quartz and calcite were also dominant in the Banded Iron Formation (BIF) sample, although 45% of the sample was made up of hematite; and
- manganese ore sample was made up of bixbyite (44%), a manganese iron oxide mineral, calcite and kutnahorite (calcium manganese carbonate).

Synthetic Precipitation Leaching Procedure (SPLP) tests were undertaken using distilled water (pH 7) to represent neutral drainage conditions, as suggested by the general presence of calcite in the samples. A preliminary risk assessment was undertaken through comparison of the results with the following water quality standards to indicate chemicals of concern (CoCs) and to subsequently assess potential environmental risk:

- World Health Organisation (WHO) Guidelines for drinking-water quality (WHO, 2011);
- International Finance Corporation (IFC) Guidelines for Mining Effluents (IFC, 2007); and
- South African National Standards (SANS) 241 (2011) Drinking Water.

The leach test results suggest:

- the final pH of the leachates was higher than the initial pH 7, which indicates the presence of leachable alkalinity in the Kudumane samples;
- a number of metals are leachable at concentrations in excess of relevant water quality standards including aluminium (Al), iron (Fe) and manganese (Mn); and
- cadmium (Cd), cobalt (Co), molybdenum (Mo), lead (Pb), antimony (Sb), and selenium (Se), which were identified as trace elements. Mineralogy test work in the sampled rocks were below laboratory detection limits in the leachates. This indicates that these elements are not leachable under the pH conditions of the test.

Modelled drainage quality, which considers potential site conditions in more detail, will provide an improved indicator of potential water quality risks from mining operations.

TABLE 7: ABA RESULTS FOR SAMPLES COLLECTED FROM THE KUDUMANE MINE (SLR, JUNE 2014)

Sample ID	Lab ID	Lithology	Paste pH	Acid Potential (AP) (kg/t)	Neutralization Potential (NP)	Nett Neutralization Potential (NNP) (NP-AP)	Neutralising Potential Ratio (NPR) (NP : AP)	NAG pH: (H2O2)	NAG (kg H2SO4 / t)	Total Sulphur (%)	Sulphate Sulphur (%)	Sulphide Sulphur (%)	Classification
Criteria			*>5.5 (Non-PAG)*	*-*	*-*	*NNP>0 (Non-PAG)*	*>2 (Non-PAG)*	*>4.5 (Non-PAG)*	*-*	*-*	*-*	*Sulphide-S >0.3 (Short-term PAG)*	
YGC1	1362	Red coarse sandy Top Soil	8.40	0.22	12.00	11.00	51.00	9.60	<0.01	0.01	0.01	<0.01	Non-PAG
YGC2	1363	Red coarse Kalahari Sand	8.60	0.21	2.50	2.30	11.90	8.70	<0.01	0.01	0.01	<0.01	Non-PAG
YGC3	1364	Red / white Calcrete	8.70	0.31	346.00	346.00	1105.00	11.20	<0.01	0.01	0.01	<0.01	Non-PAG
YGC4	1365	Red / white Clay	8.20	0.56	8.00	7.40	14.00	8.60	<0.01	0.02	0.01	0.01	Non-PAG
YGC5	1366	Red / white Quartzite	8.70	0.37	379.00	379.00	1021.00	10.90	<0.01	0.01	0.01	<0.01	Non-PAG
YGC6	1367	Red / white Pebbly Calcrete	8.60	0.31	175.00	174.00	560.00	10.00	<0.01	0.01	0.01	<0.01	Non-PAG
YGC7	1368	White Calcrete	8.40	1.29	135.00	134.00	105.00	9.70	<0.01	0.04	0.01	0.03	Non-PAG
YGC8	1369	Banded Iron Formation (BIF)	8.30	0.75	106.00	106.00	143.00	9.10	<0.01	0.02	0.01	0.01	Non-PAG
YGC9	1370	Manganese Ore Body	7.40	0.63	99.00	99.00	159.00	9.20	<0.01	0.02	0.02	<0.01	Non-PAG

(SLR, June 2014)

TABLE 8: LEACHATE RESULTS FOR SAMPLES COLLECTED FROM THE KUDUMANE MINE (SLR, JUNE 2014)

Sample ID	Lab ID	Relevant Water Quality Standards	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni
		WHO Standard for Drinking Water (2011)	N/A	N/A	0.01	2.4	0.7	N/A	N/A	N/A	0.003	N/A	0.05	2.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.07
		IFC Mining Effluent (2007)	N/A	N/A	0.1	N/A	N/A	N/A	N/A	N/A	0.05	N/A	0.1	0.3	2	N/A	N/A	N/A	N/A	N/A	N/A	0.5
		SANS 241 (2011) Operational	N/A	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		SANS 241 (2011) Aesthetic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.3	N/A	N/A	N/A	0.1	N/A	200	N/A
		SANS 241 (2011) Acute Heath	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		SANS 241 (2011) Chronic Health	N/A	N/A	0.01	N/A	N/A	N/A	N/A	N/A	0.003	0.5	0.05	2	2	N/A	N/A	N/A	0.5	N/A	N/A	0.07
		Lithology/ Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
YGC1	1362	Red coarse sandy top soil	<0.025	5.76	<0.010	<0.025	0.028	<0.025	<0.025	27	<0.005	<0.025	<0.025	<0.025	5.06	3.3	<0.025	2	0.111	<0.025	<2	<0.025
YGC2	1363	Red coarse Kalahari Sand	<0.025	6.49	<0.010	<0.025	0.036	<0.025	<0.025	15	<0.005	<0.025	<0.025	<0.025	3.89	3.6	<0.025	<2	0.232	<0.025	<2	<0.025
YGC3	1364	Red / white calcrete	<0.025	<0.100	<0.010	0.044	<0.025	<0.025	<0.025	8	<0.005	<0.025	<0.025	<0.025	<0.025	9.2	<0.025	3	<0.025	<0.025	10	<0.025
YGC4	1365	Red / white Clay	<0.025	<0.100	<0.010	0.035	<0.025	<0.025	<0.025	12	<0.005	<0.025	<0.025	<0.025	<0.025	2.3	<0.025	6	<0.025	<0.025	6	<0.025
YGC5	1366	Red / white quartzite	<0.025	<0.100	<0.010	<0.025	0.033	<0.025	<0.025	8	<0.005	<0.025	<0.025	<0.025	<0.025	1.3	<0.025	4	<0.025	<0.025	3	<0.025
YGC6	1367	Red / white conglomerate / pebble bed	<0.025	<0.100	<0.010	<0.025	0.063	<0.025	<0.025	10	<0.005	<0.025	<0.025	<0.025	<0.025	1.6	<0.025	3	<0.025	<0.025	4	<0.025
YGC7	1368	White calcrete	<0.025	<0.100	<0.010	<0.025	<0.025	<0.025	<0.025	15	<0.005	<0.025	<0.025	<0.025	<0.025	3.1	<0.025	4	<0.025	<0.025	5	<0.025
YGC8	1369	Banded Iron Formation (BIF)	<0.025	<0.100	<0.010	0.126	<0.025	<0.025	<0.025	17	<0.005	<0.025	<0.025	<0.025	0.098	1.4	<0.025	5	<0.025	<0.025	4	<0.025
YGC9	1370	Manganese Ore body	<0.025	<0.100	<0.010	0.138	0.163	<0.025	<0.025	14	<0.005	<0.025	<0.025	<0.025	<0.025	<1.0	<0.025	6	0.107	<0.025	<2	<0.025

(SLR, June 2014)

Conclusion

The north-east to south-west trending dyke that runs through the farm York and the farm Telele is the main geological feature in the area and creates a preferential groundwater flow path which can influence both the dispersion of potential pollution plumes and the inflow of water into mine workings. From the available information it appears that neither Devon nor Hotazel are affected by this geological feature.

The geochemical tests and analysis indicate that the lithologies tested are non-acid generating, however a number of metals may be leachable including aluminium (Al), iron (Fe) and manganese (Mn). If this material is stockpiled or used for backfill, it presents a potential pollution risk for both surface and groundwater in both the short and long term. It follows that leachate quality should be determined and where necessary, short and long term pollution prevention and/or treatment measures must be considered.

1.1.2 CLIMATE BASELINE

Information in this section was sourced from the original EIA/EMP report (Metago, 2010) and supplemented with readily available information from the nearest DWA weather station.

Introduction and link to impact

As a whole, the various aspects of the climate that are discussed influence the potential for environmental impacts and related mine/infrastructure design. Specific issues are listed below:

- rainfall could influence erosion, evaporation, vegetation growth, rehabilitation planning, dust suppression, and surface water management planning;
- temperature could influence air dispersion through impacts on atmospheric stability and mixing layers, vegetation growth, and evaporation which could influence rehabilitation planning; and
- wind could influence erosion, the dispersion of potential atmospheric pollutants, and rehabilitation planning.

To understand the basis of these potential impacts, a baseline situational analysis is described below.

Average rainfall data, was sourced from both the Milner (0393083) and Kuruman (0393806) Weather Service Stations located approximately 18km and 55km from the Kudumane Mine. Wind and temperature data were sourced from the Loclim programme (FAO, 2005).

24-hour rainfall depths for various return periods were calculated from single day rainfall results obtained from Water Research Commission (WRC) software developed in 2001, which has a database of rainfall stations records up to the year 2000.

Results

Regional climate

The Kudumane Mine falls within the northern steppe climatic zone as defined by the South African Weather Bureau. This is a semi-arid region characterised by seasonal rainfall, hot temperatures in summer, and cold temperatures in winter.

Rainfall

The rainfall data extracted using the Daily Rainfall Extraction Utility programme include the two SAWS stations, Winton (0392148 W) and Milner (0393083 W). The rainfall data extracted from the DWA online database is the Kuruman DWA station (D4E004). The rainfall data extracted from the WR2005 database is for quaternary D41K. Details of monthly rainfall from these sources are shown below in Table 9 below. The long-term average annual precipitation is approximately 382 mm with rainfall generally in the form of thunderstorms. The majority of the rainfall occurs during the summer months of October to April. Rainfall data from the Kuruman, Milner and Winton weather stations is provided in Table 9 below.

TABLE 9: SUMMARY OF MONTHLY RAINFALL FOR THE PROJECT AREA

MONTH	RAINFALL (mm)			
	Winton - 392148 W	**Milner - 393083 W**	**Kuruman - D4E004**	**WR2005**
January	56.3	59.8	85.3	63.8
February	63.5	63.0	84.7	52.2
March	62.7	72.3	92.7	53.3
April	34.2	39.9	49.1	29.5
May	16.4	19.2	23.9	10.0
June	5.1	9.1	7.5	4.4
July	3.4	1.3	3.7	2.2
August	5.5	5.4	8.4	3.4
September	6.2	6.4	8.0	8.5
October	14.7	19.2	25.9	26.2
November	24.5	31.5	42.9	40.5
December	42.3	44.5	45.9	50.1
Annual	**335**	**372**	**478**	**344**

The humidity in the area, sourced from the Kuruman weather station, ranges from 38% (in the afternoon) through 49% (early evening), which is relatively low. No humidity data was available at the Milner weather station.

The summary of the rainfall depths for the 5 minute duration up to the 1 day storm duration for various recurrence intervals are shown below in Table 10.

TABLE 10: ADOPTED STORM RAINFALL DEPTHS FOR THE PROJECT AREA

Duration	Rainfall Depth (mm)						
(m/h/d)	1:2 year	1:5 year	1:10 year	1:20 year	1:50 year	1:100 year	1:200 year
5 m	7.9	11.3	13.6	16.0	19.2	21.8	24.5
10 m	11.8	16.8	20.4	23.9	28.7	32.5	36.5
15 m	14.9	21.3	25.7	30.2	36.3	41.1	46.1
30 m	19.7	28.1	34.0	39.9	48.0	54.3	61.0
45 m	23.2	33.1	40.0	47.0	56.5	64.0	71.8
1 h	26.1	37.1	44.9	52.7	63.4	71.8	80.6
1.5 h	30.7	43.7	52.9	62.1	74.6	84.6	94.9
2 h	34.5	49.1	59.4	69.7	83.8	94.9	106.5
4 h	39.9	56.7	68.6	80.6	96.8	109.7	123.1
6 h	43.4	61.7	74.7	87.7	105.4	119.4	134.0
8 h	46.1	65.6	79.3	93.1	111.9	126.8	142.2
10 h	48.3	68.7	83.1	97.5	117.2	132.8	149.0
12 h	50.1	71.4	86.3	101.3	121.8	138.0	154.8
16 h	53.2	75.8	91.6	107.6	129.3	146.5	164.4
20 h	55.8	79.4	96.0	112.7	135.5	153.5	172.2
24 h	57.9	82.5	99.7	117.1	140.7	159.5	178.9
1 d	46.6	66.4	80.3	94.2	113.3	128.4	144.0

(SLR, July 2014)

Temperature and wind

Wind and temperature was obtained from the Loclim programme (FAO, 2005). The method selected to obtain the wind and the temperature data is based on the nearest neighbour method for which the user defines the search radius and number of stations selected. Table 11 below in is the output from the Loclim programme showing the summary of the temperature and wind speed data representative of the project site, which is based on interpolation from a maximum of 10 nearest stations.

TABLE 11: SUMMARY OF TEMPERATURE AND WIND SPEED DATA

Months	Average Temperature (°C)	Minimum Temperature (°C)	Maximum Temperature (°C)	Average Wind Speed (km/hour)
January	24.6	17	32	6.12
February	23.7	16.2	31	6.12
March	21	14.3	27.5	5.4
April	17.2	9.6	24.7	3.96
May	13.3	5	21.2	3.96
June	10.6	2	19.5	3.96
July	9.8	1.2	18.2	5.4
August	12.5	3.2	21.7	5.4
September	16.1	7.3	24.7	6.12
October	19.7	11	28.2	5.4
November	21.6	13	30	6.48

December	23.1	15.3	30.7	6.48

(SLR, July 2014)

Wind roses comprise spokes which represent the directions from which winds blew during the period. The colours reflected the different categories of wind speeds, the blue area, for example, representing winds of 0 m/s to 3 m/s. The circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency, at which calms occurred, i.e. periods during which the wind speed was below 1 m/s, is also indicated.

The seasonal variability wind roses recorded at Kuruman station in Figure 6 and the data in Table 11 above indicate that average annual wind speeds are approximately 5.3 m/s. During all seasons, winds from the north-east sectors are prevalent. During spring there is a dominant south-west wind.

Evaporation

Table 12 shows the evaporation figures based on monthly evaporation data that was obtained from the Water Resources of South Africa manual, (WR2005, 2009). The evaporation obtained is based on Symons pan evaporation measurements and needs to be converted to Lake evaporation. This is due to the Symons pan being located below the ground surface, and painted black which results in the temperature in the water being higher than of a natural open water body. The Symons pan is then multiplied by a lake evaporation factor[1] to obtain the adopted Lake evaporation.

TABLE 12: SUMMARY OF EVAPORATION DATA

Months	Symons Pan Evaporation (mm)	Lake Evaporation Factor	Lake Evaporation (mm)
January	276.9	0.84	232.6
February	209.9	0.88	184.8
March	193.3	0.88	170.1
April	144.1	0.88	126.8
May	114.7	0.87	99.8
June	91.0	0.85	77.3
July	106.0	0.83	88.0
August	153.8	0.81	124.5
September	213.0	0.81	172.5
October	269.7	0.81	218.4
November	248.0	0.82	232.9
December	294.6	0.83	244.5
Total	2351	N/A	1972

(SLR, July 2014)

Conclusion

The Kudumane project area is characterised by hot summers and cool winters with rain generally occuring in the form of thunderstorms that last for short periods at a time during rainy periods. High evaporation rates reduce infiltration rates, while rainfall events can increase the erosion potential and the formation of erosion gullies. The presence of vegetation does however allow for surface infiltration thereby reducing the effects of erosion. The mixing of layers resulting in the formation of temperature inversions, and the presence of cloud cover limits the dispersion of pollutants into the atmosphere. Wind significantly affects the amount of material that is suspended from exposed surface to the atmosphere. The wind speed determines the distance of downward transport as well as the rate of dilution of pollutants in the atmosphere. On average, wind speeds are below 5.3 m/s and not able to carry all types of dust particles. These climatic aspects need to be taken into consideration during rehabilitation and surface water management planning.

1.1.3 TOPOGRAPHY BASELINE

Information in this section was sourced from topographical maps, a land survey of the project area conducted by African Land Surveys (June 2014) and the previous EIA/EMP report (Metago, 2010).

Introduction and link to impacts

Changes to the current topography through the development of infrastructure and activities may impact on surface water drainage (discussed in Section 1.1.7), visual aspects (discussed in Section 1.1.11) and the safety of both people and animals. To understand the basis of these potential impacts, a baseline situational analysis is described below.

Results

The Kudumane Mine project area is relatively flat with a gentle slope towards the west where the Ga-Mogara flows along the western boundaries of York, Hotazel and Devon. On average, the elevation on site is 1040 m above mean sea level (mamsl). The highest topographical features near the mine are the Mamatwan waste rock dumps more than 10 km south south-east of the site. It should be noted that this and other mines and associated infrastructure have significantly altered the topography (see Figure 1 and Figure 2).

The topography surrounding the Kudumane Mine area has been disturbed as a result of the existing mining infrastructure and activities. Most notably open pits and WRDs.

Conclusion

Mining activities and infrastructure have the potential to alter the topography and the natural state of areas. An alteration of the natural topography has the potential to present dangers to both animals and people. The design of the proposed surface infrastructure should be such that any changes to topography result in stable topographic features, which do not pose significant risk to third parties and limit impacts on the visual character, water resources and the surrounding land users.

1.1.4 SOIL BASELINE

Information in this section draws upon the findings of the specialist soils study conducted by ARC Institute for Soil, Climate and Water (June, 2014) (Appendix F) as well as findings of the specialist study undertaken for the approved EIA/EMP (Metago, 2010).

Introduction and link to impacts

Soils are a significant component of most ecosystems. As an ecological driver, soil is the medium in which most vegetation grows and a range of vertebrates and invertebrates exist. In the context of mining operations, soil is even more significant if one considers that mining is a temporary land use whereafter rehabilitation (using soil) is the key to re-establishing post closure land capability that will support post closure land uses.

Mining projects have the potential to damage soil resources through physical loss of soil and/or the contamination of soils, thereby impacting on the soils' ability to sustain natural vegetation and altering land capability. Contamination of soils may in turn contribute to the contamination of surface and groundwater resources. Loss of the topsoil resource reduces chances of successful rehabilitation and restoration. To understand the basis of these potential impacts, a baseline situational analysis is described below.

Results

<u>Soil forms</u>

The soil study (ARC, June 2014) undertaken for the purposes of the project indicated that in general the area is characterised by the Hutton and Clovelly soil forms with a small percentage of rock outcrops and Mispah soils with shallow depth of soil to the underlying rock (Figure 7). A more detailed description of the soil form is provided below (ARC, June 2014).

Hutton (Hu)

The Hutton soil form comprises the following characteristics:

- homogeneous in terms of texture, structure, and soil depth;
- reddish brown apedal sandy topsoil on yellowish red apedal sandy subsoil;
- has a low clay content; and
- consists of deep (>1.5m) windblown sand and therefore drains rapidly.

Clovelly (Cl)

The Clovelly soil forms comprise the following characteristics:

- the Clovelly form has an orthic A horizon overlying a yellow-brown apedal B1-horizon with unspecified material under the apedal horizon;
- the horizons have apedal structure and friable consistence;
- soil texture is fine sandy to sandy-loam to loam for all horizons; and

- profiles were not shallower than 600 mm and some were deeper than 1500 mm.

Soil Physical and Chemical Characteristics

Dryland agriculture potential

The dryland production potential of the deep Hutton and Clovelly form soils is low. The soils of the area are sandy and deep, and therefore will drain rapidly. Due to this tendency, along with the lack of fertility as shown by the low CEC values, they have a low agricultural potential. Coupled with the hot, dry nature of the climatic regime, it can be said that this area is not suited to dryland arable agriculture, and most of the farming enterprises in the vicinity are either game farms or cattle ranches. (ARC, June 2014).

Irrigation potential

The irrigation potential for the soil forms identified within the study area is moderate due to the very low clay content. The sandy nature of the soils would necessitate very careful scheduling because of the very low water holding capacity of the soils. The soils would require a substantial and reliable supply of water to ensure optimum soil moisture at all times, even if such a water supply was available (ARC, June 2014).

Nutrient Storage and Cation Exchange Capacity (CEC)

The potential for a soil to retain and supply nutrients can be assessed by measuring the cation exchange capacity (CEC) of the soils. Low CEC values are an indication of soils lacking organic matter and clay minerals. Typically a soil rich in humus will have a CEC of 300 me/100g (>30 me/%), while a soil low in organic matter and clay may have a CEC of 1-5 me/100g (<5 me/%). The soils on site display low CEC values and low clay content. These factors coupled with the low annual rainfall and hot temperatures in the area, means that this area has a low potential for arable agriculture and that the area is best suited for extensive grazing.

Conclusion

Soil forms found within the study area are predominately friable, deep soils, that have a low clay content and are well drained. In general, the soil forms located within the study area are difficult to work and have a limited utilisation potential. No evidence of any arable cultivation is present and most of the farming enterprises in the vicinity are either game farms or cattle ranches.

Taking the above into consideration soils located within the study area will require appropriate management measures during construction and operation to prevent the loss of soil resources through pollution and erosion as soil resources form a crucial role during rehabilitation.

1.1.5 LAND CAPABILITY BASELINE

Information was sourced through the review of available literature which included previous EIAs compiled by Metago for Ntsimbintle (Metago 2009) and UMK (Metago 2007).

In addition to this observations made by SLR personnel during site visits, and the social scan conducted in 2009 were used.

Introduction and link to impacts

The land capability classification is based on the soil properties and related potential to support various land use activities. Mining operations in general have the potential to significantly transform the land capability if unmitigated. To understand the basis of this potential impact, a baseline situational analysis is described below.

Results

The project area falls within a rural setting characterised by farming activities, mining and associated communities, and supportive activities/infrastructure. The land capability at the Kudumane Mine is considered to be of low agricultural potential due to the low clay content of the soils and the low rainfall. Given this, the land at the Kudumane Mine is used for game farming and ad-hoc cattle grazing.

There is evidence of misuse where encroachment of alien/invasive plant species is present within the dry Ga-Mogara riverbed and at old mining sites as well as where overgrazing has occurred. When many of the old mines located within and near to the project area were closed, rehabilitation was not required by legislation. In this regard, these sites are often characterised by soil which is compacted and/or blackened with manganese dust, vegetation that has not recovered properly, encroachment of alien/invasive plant species and erosion.

Conclusion

The land capability at the Kudumane Mine is classified as having a grazing potential. The land capability at the Kudumane Mine has already been altered due to the presence of approved infrastructure and activities. Impact management, mitigation and rehabilitation planning will be required to achieve acceptable post rehabilitation land capabilities.

1.1.6 BIODIVERSITY BASELINE

The information in this section was sourced from the Biodiversity study and the Biodiversity Offset Plan (Appendix G), both conducted by Ecological Management Services (EMS) (EMS, June 2014) as well as the approved EIA/EMP (Metago, 2010).

Introduction and link to impacts

In the broadest sense, biodiversity provides value for ecosystem functionality, aesthetic, spiritual, cultural, and recreational reasons. The known value of biodiversity and ecosystems is as follows:

- soil formation and fertility maintenance;
- primary production through photosynthesis, as the supportive foundation for all life;
- provision of food and fuel;
- provision of shelter and building materials;
- regulation of water flows and water quality;
- regulation and purification of atmospheric gases;
- moderation of climate and weather;
- control of pests and diseases; and
- maintenance of genetic resources.

The establishment of infrastructure as well as certain supportive activities have the potential to result in the loss of vegetation, habitat and related ecosystem functionality through physical disturbance and/or contamination of soil and/or water resources.

As a baseline, this section provides an outline of the type of vegetation occurring on site and the status of the vegetation, highlights the occurrence of sensitive ecological environments including sensitive/ endangered species (if present) that require protection and/or additional mitigation should they be disturbed.

Results – Vegetation

<u>Vegetation types</u>

The project area falls within the Kathu Bushveld and Gordonia Duneveld. The Kathu Bushveld is open savannah with Acacia erioloba (Camel thorn), Diospyros lycioides (Karroo bluebush), and Lycium hirsutum (River honey-thorn) dominating the shrub layer and a highly variable grass layer. The Gordonia duneveld typically occurs on the undulating dunes, and consists of open shrubland with grasslands on the ridges and acacia haematoxylon (Grey camel thorn) on the dune slopes. Acacia mellifera (Black thorn) is prominent on the lower slopes and Rhigozum trichotomum (Three thorn) is found between the dunes.

The distribution of these vegetation types is illustrated in Figure 9 and a more detailed discussion of each vegetation type is provided below (EMS, May 2014).

Acacia haematoxylon Savannah

This vegetation types has a moderate grass cover (50-60%), the shrub layer is moderately developed. *Acacia haematoxlyon* is the dominant shrub species. The tree layer is poorly developed with individuals of *Acacia erioloba* (Camel Thorn) occurring within this vegetation type. Common grass species include, *Schmidtia pappophoroides* (dominant), *Eragrostis lehmanniana*, (Lehmanns love grass), *Eragrostis micrantha* (Finessa grass), *Stipagrostis uniplumis* (Silky bushmans grass), *Aristida congesta* (Tassel Three awn) and *Aristida stipitata* (Long-awned Three awn). Other common species within this vegetation type include *Acanthosicyos naudiniana* (Gemsbok cucumber), *Tribulus zeyheri* (Deils thorn), *Gnidia polycephala* (January Bush), *Helichrysum argyrosphaerum* (Hottentots tea) and *Monochema incanum*.

Mixed Acacia Savannah

This vegetation type is distinctive due to the height of the tree layer which is mainly comprised of tall *Acacia erioloba* (Camel Thorn) tree. Three vegetation strata are evident within this vegetation type. There is a prominent tree layer between 2.5m – 6m, a shrub layer between 1.5m – 2.5m and a grass layer with an average height of 70cm. Prominent species within this vegetation type include *Acacia erioloba* (Camel Thorn) *A. haematoxylon* (Grey Camel Thorn) and *A hebeclada* (Candle Thorn), however *Ziziphus muconatai* (Buffalo thorn), *Grewia flava* (Velvet raisin) and *A. mellifera* (Black Thorn) also occur. The grass layer consists of species such as *Eragrostis lehmanniana* (Lehmann's Love grass), *Stipagrostis uniplumis* (Silky bushman grass), *Schmidtia kalihariensis* (Sour grass), *Aristida stipitata* (Long-awned three awn) and *Aristida congesta* (Tassel Three awn) were common. Other common species include, *Gnidia polycephala* (January Bush), *Tribulus zeyheri* (Deils thorn), *Chrysocoma ciliate* (Bitter karoo) and *Walafrida geniculate* (Waterfinder bush).

Acacia Mellifera Mixed Woodland

Acacia Mellifera (black thorn) constitutes the dominant shrub species within this community. It is characterised by a moderate to high shrub density with a poor to moderate grass coverage (40 – 60 %). In some areas, the *Acacia mellifera* forms dense thickets. Other common shrub/tree species within this vegetation community include *Grewia flava* (Velvet raisin), *Acacia erioloba* (Camel Thorn), and *Ziziphus muconatai* (Buffalo thorn). Common grass species include *Eragrostis lehmanniana* (Lehmann's love grass), *Aristida congesta* (Tassel three awn), *Pogonarthria squarrosa* (Herringbone grass), *Eragrostis Tricophora* (Hairyflower love grass) *Eragrostis echinochloidea (*African Love Grass) *Aristida adscensionis* (Six-weeks three awn grass) *Schmidtia pappophoroides* (Sand quick) and Tragus racemosus (Stalked burr grass).

Acacia Erioloba Savannah

Acacia Erioloba (Camel Thorn) is the most prominent woody component within this vegetation type. This vegetation is distinctive owing to the height of the tree later which forms a distinct canopy coverage and three vegetation strata are evident within this vegetation unit. There is a prominent tree layer between 2.5 m – 8 m, a shrub later between 1.5 m – 2.5 m and a grass layer with an average height of 70 cm. *Acacia Erioloba* (Camel Thorn), *Ziziphus muconatai* (Buffalo thorn) and *Grewia flava* (Velvet raisin) are common within this vegetation unit. The grass later contained species such as *Schmidtia kalihariensis* (Sour grass), *Eragrostis lehmanniana*, (Lehmanns love grass), *Centrapodia glauca, Stipagrostis Uniplumis* (Silky bushman grass) and *Aristida congesta* (Tassel three awn). Other common species include *Tribulus zeyheri (*Diwiltjie*), Acanthosicyos naudiniana (*Gemsbok Cucumber*) and Asparagus spp* (Wild asparagus).

Tarchonanthus camphoratus Scrub

This vegetation type occurs on the well-drained shallow stony soils which are underlain by calcrete. This vegetation type is characteristically short and has a high percentage occurrence of *Tarchonanthus camphoratus* (Camphor bush). Although *Tarchonanthus camphoratus* (Camphor bush) is the dominant shrub, *Lycium hirsutum* (Desert thorn) and *Acacia mellifera (*Black thorn) are also present within this community. The grass layer consists of species such as *Shmidtia pappophoroides* (Sand quick)*, Eragrostis lehmanniana* (Lehmann's love grass), *Stipagrostis uniplumis* (Silky bushman grass)*, Aristida stipitata* (Long-awned Three awn) and *Aristida congesta* (Tassel three awn). Dwarf karroid shrubs are prominent within the community and consist of species such as, *Pentzia calcarea, Melolobium humile, Salsola patentipilosa* (Barbed goat grass) and *Thesium hystrix*. Other common species included *Berkheya Ferox, Dimorphotheca zeyheri,* and *Geigeria ornativa* (Vermeerbos).

Riverine Vegetation

This vegetation type is found within the Ga-Mogara non-perennial stream which runs through the study area. It consists of a grassy later with scattered trees and shrubs. Species such as *Acacia erioloba* (Camel Thorn), *Ziziphus mucronata* (Buffalo thorn) *Acacia karroo* (Sweet thorn), *Bosica albitrunc*a (Shepherd's tree*), Enneapogon cenchroides* (Nine-awned grass), *Aristida stipitata* (Long-awned Three awn), *Cyndon dactylon* (Devil's grass), *Cyperus margaritaceua* and *Eustachys paspaloides* (Red Rhodes grass) were noted within this vegetation type. In some areas this vegetation type has been heavily invaded by Prosopis glandulosa (Honey plant).

<u>Red data and protected species</u>

With the exception of Acacia erioloba (status declining), no red data plant species were recorded within the surface use area during the survey undertaken by EMS (EMS, June 2014).

Protected tree species that occur in the area include the *Acacia erioloba* (Camel thorn) and *Acacia haematoxylon (*Grey camel thorn) in terms of the National Forests Act of 1998 (Act 84 of 1998). A number of protected plant species in terms of the Northern Cape Nature Conservation Act (NCNCA) were found to occur on site. These include *Harpagophytum procumbens* (Devil's Claw) (Schedule 1) and *Moraea longistyla, Moraea pallida* and *Babiana hypogea (*Buchu) (Schedule 2).

<u>Alien and invasive species</u>

Alien and invasive plant species identified within the project area during the survey undertaken by EMS (EMS, June 2014) are provided in Table 13 below.

TABLE 13: ALIEN AND INVASIVE SPECIES IDENTIFIED WITHIN THE PROJECT AREA (EMS, JUNE 2014)

Scientific name	Common name	Category
Argemone Mexicana	Mexican Poppy	1
Argemone Ochroleuca	White Flowered Mexican Poppy	1
Atriplex Nummularia	Old Man Salt Bush	2
Pennisetum Sectaceum	Fountain Grass	1
Prosopis cf. Glandulosa	Mesquite	2
Prosopis velutina	Mesquite	2
Opuntia Humifusa	Prickly Pear	1

Alien and invasive species are controlled in terms of Regulation 15 and Regulation 16 (R. 280 of 2001) of the Conservation of Agricultural Resources Act (No. 43 of 1993). In this regard, plants classified in terms of Category 1 must be removed and destroyed immediately. These plants serve no economic purpose and possess characteristics that are harmful to humans, animals and the environment. Category 2 plants may only be grown under controlled conditions. These plants have certain useful qualities and are allowed in demarcated areas. In other areas they must be eradicated and controlled.

Areas of disturbance

As part of the survey undertaken by EMS (EMS, June 2014), areas of disturbance through previous mining and prospecting activities were observed, however these were generally restricted to the western section of the project area as well as around the historical Devon and Hotazel pits. The town of Hotazel is also located within the project area and in this regard is considered an area of disturbance. Other types of disturbances are associated with farming practices, such as disturbances caused by over grazing and trampling effects. These are most notable around water points in areas of kraals and around homesteads on the properties.

It is important to note that the vegetation types and associated plant species identified within the project area as part of the survey undertaken by EMS (EMS, June 2014), have been further disturbed due to the presence of Kudumane's approved and operational mining activities within the existing mining right area.

Ecological sensitivity

Overall the surface use area is uniform in terms of habitat structure and the types and nature of ecological processes that occur. However the Mixed *Acacia Savannah* and the *Acacia haematoxylon* Savannah have a slightly higher conservation priority. This is attributed to the presence of a number of protected tree species that occur within these vegetation types.

Conservation Area

It should also be noted that an area of 780 ha within the existing mining rights area has been set aside as part the biodiversity off-set project (see Figure 8). The following species have been identified by Kudumane to occur within the game enclosure (Kudumane, 2012):

- zebra;
- springbok;
- black Wildebeest;
- blue Wildebeest;
- waterbuck;
- gemsbok;
- red Hartebeest;
- blesbok;
- steenbok;
- duiker;
- eland; and
- kudu

Results – Animal life

Animal species

During the survey, little evidence of wild animal populations were noted due to disturbance effects from past farming activities within the project area as well as adjacent mining operations (Figure 2). It is important to note that Kudumane's existing mining activities and infrastructure have further influenced the natural remaining fauna within the surface use area (EMS, June 2014).

Red data species

Red data species likely to occur within the project area are provided in Table 14 below (EMS, June 2014).

TABLE 14: RED DATA ANIMAL SPECIES LIKELY TO OCCUR WITHIN THE SURFACE USE AREA (EMS, JUNE 2014)

Species	Common name	IUCN Red List Status*	Potential for occurrence within the surface use area
Mammals			
Rhinolophus denti	Dents' Horseshoe Bat	Vulnerable. Near threatened.	Low potential of occurrence
Mellivora capensis	Honey badger	Vulnerable. Near threatened.	High potential of occurrence
Miniopterus schreibersii	Schreiber's Long-fingered bat	Vulnerable. Near threatened.	Low potential of occurrence
Atelerix frontalis	South African Hedgehog	Vulnerable. Near threatened.	High to medium potential of occurrence
Birds			
Polemaetus bellicosus	Martial Eagle	Vulnerable. Near	High potential of occurrence

		threatened.	
Neotis ludwigii	Ludwig's Bustard	Vulnerable. Endangered.	Medium potential of occurrence
Sagittarius serpentarius	Secretary bird	Vulnerable. Near threatened.	High potential of occurrence
Gyps africanus	African Whitebacked Vulture	Vulnerable. Endangered.	High potential of occurrence
Ardeotis kori	Kori Bustard	Least concern Vulnerable.	Medium potential of occurrence
Ciconia bigra	Black Stork	Least concern Threatened.	Low potential of occurrence
Falco naumanni	Lesser Kestrel	Least concern Vulnerable.	Low potential of occurrence
Terathopius ecaudatus	Bataleur	Vulnerable.	Medium potential of occurrence
Torgos tracheliotos	Lappet faced vulture	Vulnerable.	High potential of occurrence

* International Union for Conservation of Nature

With reference to Table 14, it is important to note that as part of the faunal study undertaken by EMS (EMS, June 2014); the Ludwig's Bustard (*Neotis ludwigii*) was considered vulnerable and the Secretary bird (*Sagittarius serpentarius*) was considered near threatened in accordance with the Red Data List 2000. Further to this the Dent's Horseshoe Bat (*Rhinolophus denti*), Honey Badger (*Mellivora capensis*) and South African Hedgehog (*Atelerix frontalis*) were considered to be near threatened in accordance with the Red Data List 2000.

Conclusion

The placement of infrastructure as well as mining activities in general have the potential to disturb and/or destroy vegetation, habitat units and related ecosystem functionality including the disturbance of sensitive/ endangered species. Red data species potentially occurring on site include *Acacia erioloba* (Camel thorn) and *Acacia haematoxylon (*Grey camel thorn). A number of protected plant species in terms of the Northern Cape Nature Conservation Act (NCNCA) were found to occur on site. These include *Harpagophytum procumbens* (Devil's Claw) (Schedule 1) and Moraea longistyla, Moraea pallida and *Babiana hypogea (*Buchu) (Schedule 2).

It is important to note that the Kudumane Mine falls within the Griqualand West Centre of Endemism (GWC) (EMS, June 2014) (Figure 10). The GWC is one of the 85 centres of endemism and one of 14 centres in southern Africa, and these centres are of global conservation significance. The GWC is considered a priority in the Northern Cape, as the number of threats to the area is increasing rapidly and it has been little researched and is poorly understood. Furthermore, this centre of endemism is extremely poorly conserved, and is a national conservation priority.

As part of the study undertaken by EMS, (EMS, June 2014), a site sensitivity map was compiled (Figure 11). This map is based on information collected at various levels (including the national conservation status of the vegetation, the presence of species of special concern, as well as the condition of vegetation) and includes areas of low, moderate and high sensitivity. It follows that the majority of the proposed surface infrastructure/activities fall within the area of low sensitivity. Although the re-mining of the historical Devon pit is proposed to take place within an area shown to be of high sensitivity, it should be noted that the proposed activities will take place within an area which has already been heavily disturbed and it is therefore highly unlikely that the sensitivity of this area will be compromised any further.

It is important to note that prior to the establishment of the Kudumane Mine, the natural vegetation and animal life had already been disturbed due to farming activities within the surface use area as well as adjacent mining activities. The natural vegetation and animal life has been further disturbed due to Kudumane's existing mining activities.

During the design of the infrastructure layout, areas of sensitivity should be taken into consideration in order to minimise the disturbance and destruction of these areas. In addition to this, mitigation measures need to be formulated to conserve and reduce the impacts that the proposed project as well as the existing operations may have towards these areas.

1.1.7 SURFACE WATER BASELINE

The information in this section was sourced from the hydrology study undertaken by SLR (SLR, July 2014) (Appendix H) as well as the approved EIA/EMP (Metago, 2010). The mean annual runoff (MAR) was sourced by the SLR project team from the existing WR 2005 database.

Data used in determining the surface water characteristics includes climatic data (section 1.1.2) and topographical data (section 1.1.3).

Introduction and link to impacts

Surface water resources include drainage lines, paths of preferential flow of stormwater runoff as well as the channelling and/or collection of water on the surface such as irrigation canals and dams. Mine related activities have the potential to alter the drainage of surface water through the placement of both temporary (such as processing infrastructure and support facilities) and permanent infrastructure (such as mineralised waste facilities) and/or result in the contamination of the surface water resources through seepage and/or spillage of process materials, non-mineralised and mineralised wastes. To understand the basis of these potential impacts, a baseline situational analysis is described below.

Results

<u>Catchments within the context of South Africa</u>

The Kudumane mine is located within quaternary catchment D41K which falls within the Lower Vaal Water Management Area (SLR, July 2014). The quaternary catchment D41K has a catchment area of 4216 km^2 and a mean annual runoff (MAR) of 1.92 million m^3 (see Figure 12 and Figure 13).

Surface water resources and catchment boundaries

With reference to Figure 12 and Figure 15, the non-perennial Ga-Mogara river runs through the proposed project area. A tributary of the Ga-Mogara, the non-perennial Witleegte river joins the Ga-Mogara in the southern reaches of the project area. There is no permanent surface water in the vicinity of the proposed project area and the riverbeds are usually dry except for periods of high rainfall.

Several minor non-perennial rivers form tributaries of the Ga-Mogara River and are located on the western, southern and south-eastern boundary of the Kudumane catchment. These drain runoff into the Ga-Mogara River. These tributaries include the Dooimansholte, Ga-Mmatshephe, Olifantsloop, Vlermuisleegte, Witleegte and various other unknown non-perennial rivers (SLR, July 2014). The catchment characteristics of some of these tributaries are provided in Table 15 below.

TABLE 15: CHATCHMENT CHARACTERISTICS

Catchment Name	Area (km^2)
Ga-Mogara River Catchment (upstream of the Kudumane site)	8053
Witleegte (tributary of Ga-Mogara)	538

(SLR, July 2014)

The normal dry weather flow of watercourses in the region is no flow.

Flood peaks, volumes and floodlines

An estimate of peak flows within the Ga-Mogara River is presented in Table 16 below.

TABLE 16: REGIONAL MAXIMUM FLOOD PEAK FOR THE GA-MOGARA RIVER

Event	**Peak Flow (m^3/s)**
	K = 1.7
Regional Maximum Flood (RMF)	400
1:200	251
1:100	198
1:50	154

(SLR, July 2014)

With reference to Figure 15, the floodlines generally fall within 100 m of the Ga-Mogara River, although there are some areas where the floodlines are wider than the 100 m buffers. The majority of surface infrastructure is located outside of the floodlines and outside of the 100 m buffer, the exceptions to this being the Hotazel pit which falls within the 100 m buffers but is outside of both the 1:50 and 1:100 year floodlines.

Wetlands

No wetlands are located within the surface use area (SLR, July 2014).

Surface water use

Surface water in the area is potentially used for livestock watering and for limited domestic purposes. However, no reliable water use is possible from any of the watercourses (Gamogara, Witleegte, tributaries) due to their non-perennial nature and related seasonal river flow (SLR, July 2014).

Surface water quality

No surface water quality samples could be taken as part of the hydrology specialist study process as there was no surface flow at the time of undertaking the study (SLR, July 2014).

Conclusion

The additional infrastructure within the new mining rights area is such that it presents real potential for pollution of water resources that in some cases (when water is available in the non-perennial drainage lines) may be used by third parties for domestic and livestock purposes (although this is highly unlikely). In light of this, infrastructure must be managed/implemented in a way that pollution of water resources is prevented. Moreover, care is required to ensure that surface run-off patterns are disturbed as little as possible to promote the continued flow of water and nutrients.

Even though the Hotazel opencast pit is outside both the 1:50 and 1:100 year flood-lines, it slightly encroaches into the 100 m buffer. This may require some consideration of flood risk management from the perspective of open pit management.

1.1.8 GROUNDWATER BASELINE

The information in this section was sourced from the geohydrology specialist study undertaken by SLR in June 2014 (Appendix E) as well as the approved EIA/EMP (Metago, 2010).

A hydrocensus was undertaken in October 2009 to identify groundwater users in the area and to determine the depth of groundwater. This was augmented by a further hydrocensus in May 2013 (as required by DWA), which focussed only on farms relevant to the proposed project (refer to Figure 16 for all relevant hydrocensus points).

Four additional boreholes were drilled on farms York and Hotazel in February 2014. The main purpose of the drilling was to assess the aquifer characteristics through pumping tests and to provide long term groundwater monitoring boreholes.

Introduction and link to impacts

Groundwater is a valuable resource and is defined as water which is located beneath the ground surface in soil/rock pore spaces and in the fractures of lithological formations. Activities such as the handling and storage of hazardous materials and handling and storage of mineralised and non-mineralised wastes have the potential to result in the loss of groundwater resources, both to the environment and third party users, through pollution. In addition, where mining requires dewatering in order to provide a safe working environment, there is the potential for a dewatering cone to develop and this can result in a loss of water supply to surrounding users. To understand the basis of these potential impacts, a baseline situational analysis is described below.

Results

Groundwater zone (aquifers)

The Kudumane Mine is underlain by two aquifers, namely a shallow aquifer made of sands and calcrete of the Kalahari Beds, and a deep fractured aquifer made of the Dywka clay and the Mooidraai dolomite Formation (SLR, June 2014).

The Kalahari sand and the sediment beds with its associated underlying calcrete layer overlie the low permeability Dwyka clay bed. Beneath a thick clay layer, which acts as a confining layer, the Mooidraai dolomite Formation and Dwyka clay contact forms the deeper fractured bedrock aquifer.

The average yield for the shallow aquifer system is 0.1 to 0.5 L/s, although areas of York, Hotazel and Kipling average yield increases to 0.5 to 2.0 L/s. The average yield for the deep aquifer is approximately 0.1 to 0.5 L/s.

As identified in the original EIA/EMP, the aquifers underlying the Kudumane Mine are classified as a poor to minor aquifer system. This implies a low to negligible yielding aquifer system of moderate to poor water quality albeit that some farms in the area rely on groundwater for livestock watering and domestic purposes.

Groundwater flow directions

In general, the regional groundwater flow within the shallow aquifer reflects topography, with groundwater flow from high lying areas in the east and south-west towards the north in the direction of low lying drainage features. The Ga-Mogara River, which runs along the western boundary of farms York, Devon, Hotazel and Kipling. The existing and proposed mine are located in close proximity to the Ga-Mogara and Witleegte Rivers, however there is no confirmed correlation between groundwater levels and the base flow of these rivers which only flow after extremely heavy rainfall events on an infrequent basis (WGC, 2010).

Groundwater flows in the deeper aquifer are associated with the secondary fracturing in the competent rock and as such will be along discrete pathways associated with the fractures

Groundwater levels

The Kudumane Mine lies within catchment D41K where water levels are typically 40mbgl (WGC, 2010).

Based on groundwater level data collected in the October 2009 and May 2013 hydrocensuses, the Based on the October 2009 hydrocensus, groundwater levels varied between 19.0 mbgl (Point 27) and 47.5 mbgl (Point 16).

Groundwater use

Due to the arid nature of the area, groundwater forms the main source of water supply to the local landowners/land users. Groundwater is abstracted for domestic and stock water use through boreholes (SLR, June 2014).

Groundwater quality

Based on groundwater quality data collected during the May 2013 hydrocensus, samples collected during the February 2014 site investigation (drilling and pump tests) and on-going groundwater monitoring undertaken at the site, the following conclusions can be made with regards to groundwater quality (Table 17 and Table 18):

- when compared to the relevant water quality standards elevated concentrations of electrical conductivity (EC), total dissolved solids (TDS), nitrate (NO_3), chloride (Cl), iron (Fe) and manganese (Mn) are generally recorded;
- the elevated iron and manganese concentrations recorded in the boreholes are likely to be attributed to the local geology (Banded Iron Formation);
- elevated EC TDS and Cl are likely to be attributed to this factor and the natural salinity found in the Kalahari; and
- nitrate can be attributed to explosives used in the blasting processes used on mine sites. Elevated nitrates can also be attributed to agricultural fertilisers, inappropriate sanitation and wastewater treatment and livestock concentration at watering points near boreholes.

TABLE 17: GROUNDWATER QUALITY RESULTS (SLR JUNE 2014)

			Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Mo	Na	Ni	P	Pb
DWAF Agriculture and Livestock Watering (2009) TWQR			N/A	0-10	0-1	0-5	N/A	N/A	N/A	0-1000	0-0.01	0-1	0-1	N/A	0-5	N/A	N/A	0-500	0-10	0-0.01	0-2000	0-0.1	N/A	0-0.1
SANS 241 (2011) Operational			N/A	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SANS 241 (2011) Aesthetic			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.3	N/A	N/A	N/A	0.1	N/A	200	N/A	N/A	N/A
SANS 241 (2011) Acute Heath			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SANS 241 (2011) Chronic Health			N/A	N/A	0.01	N/A	N/A	N/A	N/A	N/A	0.003	0.5	0.05	2	2	N/A	N/A	N/A	0.5	N/A	N/A	0.07	N/A	0.01
Borehole ID	Lab ID	Farm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
T1	8006	Telele	<0.025	<0.100	<0.010	3.12	0.170	<0.025	<0.025	25	<0.005	<0.025	<0.025	<0.025	<0.025	8.3	<0.025	41	<0.025	<0.025	184	<0.025	0.155	<0.020
T2	8007	Telele	<0.025	<0.100	0.031	0.554	0.140	<0.025	<0.025	37	<0.005	<0.025	<0.025	<0.025	<0.025	10.2	<0.025	60	0.098	<0.025	142	<0.025	0.214	<0.020
T3	8008	Telele	<0.025	<0.100	<0.010	0.595	0.083	<0.025	<0.025	30	<0.005	<0.025	<0.025	<0.025	<0.025	5.6	<0.025	32	0.245	<0.025	82	<0.025	0.121	<0.020
T4	8009	Telele	<0.025	<0.100	<0.010	1.16	<0.025	<0.025	<0.025	12	<0.005	<0.025	<0.025	<0.025	<0.025	7.1	<0.025	56	0.081	<0.025	208	<0.025	0.137	<0.020
T6	8010	Telele	<0.025	<0.100	<0.010	0.543	<0.025	<0.025	<0.025	4	<0.005	<0.025	<0.025	<0.025	<0.025	6.8	<0.025	31	<0.025	<0.025	103	<0.025	0.167	<0.020
T16	8011	Telele	<0.025	0.106	<0.010	0.654	0.036	<0.025	<0.025	79	<0.005	<0.025	<0.025	<0.025	<0.025	8.9	<0.025	78	0.087	<0.025	114	<0.025	0.123	<0.020
T39	8012	Telele	<0.025	<0.100	<0.010	1.05	0.165	<0.025	<0.025	13	<0.005	<0.025	<0.025	<0.025	0.963	12.1	0.192	19	0.619	<0.025	218	<0.025	0.149	<0.020
T42	8013	Telele	<0.025	<0.100	<0.010	0.431	0.268	<0.025	<0.025	34	<0.005	<0.025	<0.025	<0.025	0.346	18.4	0.098	48	0.496	<0.025	98	<0.025	0.164	<0.020
T43	8014	Telele	<0.025	0.102	<0.010	0.799	2.65	<0.025	<0.025	54	<0.005	<0.025	<0.025	<0.025	10	44	1.42	46	7.10	0.036	276	<0.025	0.312	<0.020
T44	8015	Telele	<0.025	0.122	<0.010	0.210	0.136	<0.025	<0.025	123	<0.005	<0.025	<0.025	<0.025	<0.025	17.3	<0.025	69	0.265	<0.025	85	<0.025	0.115	<0.020
H6	8016	Hotazel	<0.025	<0.100	<0.010	0.502	<0.025	<0.025	<0.025	3	<0.005	<0.025	<0.025	<0.025	<0.025	9.3	<0.025	29	<0.025	<0.025	96	<0.025	0.111	<0.020
H8	8017	Hotazel	<0.025	<0.100	<0.010	0.748	0.284	<0.025	<0.025	5	<0.005	<0.025	<0.025	<0.025	<0.025	7.1	<0.025	33	0.050	<0.025	101	<0.025	0.086	<0.020
H12	8018	Hotazel	<0.025	0.113	<0.010	1.82	0.057	<0.025	<0.025	85	<0.005	<0.025	<0.025	<0.025	<0.025	4.4	<0.025	46	<0.025	<0.025	113	<0.025	0.046	<0.020
H14	8019	Hotazel	<0.025	<0.100	<0.010	0.611	0.049	<0.025	<0.025	8	<0.005	<0.025	<0.025	<0.025	<0.025	3.4	<0.025	29	0.108	<0.025	39	<0.025	0.060	<0.020
H26	8020	Hotazel	<0.025	<0.100	<0.010	0.818	0.108	<0.025	<0.025	5	<0.005	<0.025	<0.025	<0.025	4.79	3.5	<0.025	15	0.097	<0.025	95	<0.025	0.099	<0.020
Y23	8021	York	<0.025	<0.100	<0.010	0.476	0.119	<0.025	<0.025	35	<0.005	<0.025	<0.025	<0.025	<0.025	4.2	<0.025	42	0.477	<0.025	42	<0.025	0.046	<0.020
Y61	8022	York	<0.025	0.125	<0.010	1.04	0.444	<0.025	<0.025	70	<0.005	<0.025	<0.025	<0.025	0.025	2.9	<0.025	20	3.65	<0.025	62	<0.025	0.096	<0.020
Y74	8023	York	<0.025	<0.100	<0.010	0.051	0.206	<0.025	<0.025	48	<0.005	<0.025	<0.025	<0.025	<0.025	4.9	<0.025	8	2.56	<0.025	4	<0.025	0.241	<0.020
Y83	8024	York	<0.025	0.112	<0.010	0.392	0.251	<0.025	<0.025	73	<0.005	<0.025	<0.025	<0.025	<0.025	4.8	<0.025	49	<0.025	<0.025	92	<0.025	0.085	<0.020
Y87	8025	York	<0.025	0.118	<0.010	0.799	0.083	<0.025	<0.025	95	<0.005	<0.025	<0.025	<0.025	<0.025	4.4	<0.025	56	0.049	<0.025	49	<0.025	0.120	<0.020
Y88	8026	York	<0.025	<0.100	<0.010	0.164	0.132	<0.025	<0.025	45	<0.005	<0.025	<0.025	<0.025	<0.025	2.6	<0.025	17	0.072	<0.025	12	<0.025	0.213	<0.020
Y110	8027	York	<0.025	0.131	<0.010	0.570	0.463	<0.025	<0.025	129	<0.005	<0.025	<0.025	<0.025	<0.025	7.7	<0.025	57	1.69	<0.025	45	<0.025	0.365	<0.020

			S	Sb	Se	Si	Sn	Sr	Ti	V	W	Zn	Zr	pH	EC	Redox Potential in mV *	TDS	Total Alkalinity as $CaCO_3$	Bicarbonate as HCO_3 *	Carbonate as CO_3 *	Chloride as Cl	Sulphate as SO_4	Fluoride as F	Nitrate as N
DWAF Agriculture and Livestock Watering (2009) TWQR			N/A	N/A	0-50	N/A	N/A	N/A	N/A	0-1	N/A	0-20	N/A	N/A	N/A	N/A	1000-3000	N/A	N/A	N/A	0-3000	0-1000	0-6	0-100
SANS 241 (2011) Operational			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5 - 9.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SANS 241 (2011) Aesthetic			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	N/A	170	N/A	1200	N/A	N/A	N/A	300	250	N/A	N/A
SANS 241 (2011) Acute Heath			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	500	N/A	11
SANS 241 (2011) Chronic Health			N/A	0.02	0.01	N/A	N/A	N/A	N/A	0.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.5	N/A
Borehole ID	Lab ID	Farm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	pH	mS/m	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
T1	8006	Telele	0.41	<0.010	<0.020	3.0	<0.025	0.467	<0.025	<0.025	<0.025	0.042	<0.025	7.7	144	191	946	348	424	<5	273	<5	0.8	<0.2
T2	8007	Telele	17.00	<0.010	<0.020	5.5	0.074	0.440	0.121	<0.025	<0.025	0.061	<0.025	7.4	144	214	816	328	400	<5	271	34	<0.2	<0.2
T3	8008	Telele	1.46	<0.010	<0.020	2.1	<0.025	0.258	<0.025	<0.025	<0.025	0.042	<0.025	7.6	95	210	452	124	151	<5	231	5	0.3	<0.2
T4	8009	Telele	62.00	<0.010	<0.020	1.2	0.042	0.075	0.025	<0.025	<0.025	0.043	<0.025	8.2	153	209	854	228	278	<5	277	157	0.3	1.2
T6	8010	Telele	5.20	<0.010	<0.020	0.5	0.035	0.026	0.086	<0.025	<0.025	0.031	<0.025	9.3	107	147	468	248	156	72	221	11	0.2	0.3
T16	8011	Telele	30.00	<0.010	<0.020	13.3	<0.025	0.660	<0.025	<0.025	<0.025	<0.025	<0.025	7.9	163	173	940	300	356	<5	225	84	0.3	47
T39	8012	Telele	1.89	<0.010	<0.020	1.6	0.028	0.295	<0.025	<0.025	0.030	0.079	<0.025	9.3	133	166	956	280	244	48	282	<5	0.5	<0.2
T42	8013	Telele	1.50	<0.010	<0.020	1.5	0.025	0.597	<0.025	<0.025	<0.025	0.031	<0.025	8.3	125	177	834	160	195	<5	281	<5	0.3	<0.2
T43	8014	Telele	7.19	<0.010	<0.020	4.0	<0.025	0.981	<0.025	<0.025	<0.025	0.085	<0.025	7.2	223	-97.5	1 848	400	488	<5	457	<5	0.7	<0.2
T44	8015	Telele	12.00	<0.010	<0.020	6.1	<0.025	0.770	<0.025	<0.025	<0.025	0.025	<0.025	7.2	186	69.1	1 134	164	200	<5	455	28	<0.2	<0.2
H6	8016	Hotazel	<0,100	<0.010	<0.020	0.4	<0.025	<0.025	0.025	<0.025	<0.025	0.033	<0.025	9.7	89.9	40.3	428	180	122	48	203	<5	<0.2	<0.2
H8	8017	Hotazel	<0,100	<0.010	<0.020	0.5	<0.025	0.311	<0.025	<0.025	<0.025	0.029	<0.025	9.1	106	64.3	548	180	171	24	231	<5	0.3	<0.2
H12	8018	Hotazel	34.00	<0.010	<0.020	13.5	<0.025	0.584	<0.025	<0.025	<0.025	0.038	<0.025	7.6	139	200	874	332	405	<5	140	80	0.7	36
H14	8019	Hotazel	2.01	<0.010	<0.020	0.3	<0.025	0.058	<0.025	<0.025	<0.025	0.031	<0.025	8.6	51	183	250	180	219	<5	69	<5	0.5	0.2
H26	8020	Hotazel	0.64	<0.010	<0.020	0.7	<0.025	0.142	<0.025	<0.025	<0.025	0.046	<0.025	9	61.6	179	406	232	283	<5	79	14	0.9	<0.2
Y23	8021	York	14.00	<0.010	<0.020	2.0	<0.025	0.170	<0.025	<0.025	<0.025	0.036	<0.025	7.9	83.4	186	426	156	190	<5	161	30	0.3	<0.2
Y61	8022	York	2.40	<0.010	<0.020	9.7	<0.025	0.248	<0.025	<0.025	<0.025	0.052	<0.025	7.3	85.6	193	482	228	278	<5	143	<5	0.3	0.8
Y74	8023	York	1.14	<0.010	<0.020	11.3	<0.025	0.111	<0.025	<0.025	<0.025	0.041	<0.025	7.4	35	190	272	180	219	<5	5	<5	0.2	1.5
Y83	8024	York	7.48	<0.010	<0.020	12.9	<0.025	0.546	<0.025	<0.025	<0.025	0.045	<0.025	7.7	114	189	676	420	512	<5	141	13	0.4	1.7
Y87	8025	York	17.00	<0.010	<0.020	27	0.033	0.623	<0.025	<0.025	<0.025	0.079	<0.025	7.4	120	185	694	364	444	<5	132	37	0.3	16
Y88	8026	York	2.71	<0.010	<0.020	10.4	<0.025	0.183	<0.025	<0.025	<0.025	0.028	<0.025	7.5	40.1	178	214	164	200	<5	28	5	0.2	1.2
Y110	8027	York	18.00	<0.010	<0.020	30	<0.025	0.641	<0.025	<0.025	<0.025	0.070	<0.025	7.2	136	193	802	424	517	<5	136	41	0.2	29

TABLE 18: WATER QUALITY RESULTS FOR THE BOREHOLES DRILLED IN FEBRUARY 2014.

				Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	K
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg
Sample ID	Lab ID	Borehole	DWAF Agriculture and Livestock Watering (2009) TWQR	N/A	0-10	0-1	0-5	N/A	N/A	N/A	0-1000	0-0.01	0-1	0-1	N/A	0-5	N/
			SANS 241 (2011) Operational	N/A	0.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/
			SANS 241 (2011) Aesthetic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.3	N/
			SANS 241 (2011) Acute Heath	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/
			SANS 241 (2011) Chronic Health	N/A	N/A	0.01	N/A	N/A	N/A	N/A	N/A	0.003	0.5	0.05	2	2	N/
HGW2	31961	HGW2 Post Slug Test	Shallow Kalahari	<0.025	0.149	<0.010	1.21	0.088	<0.025	<0.025	114	<0.005	<0.025	<0.025	<0.025	<0.025	6.
YGW2	31962	YGW2 Post Slug Test	Shallow Kalahari	<0.025	0.157	<0.010	0.586	0.153	<0.025	<0.025	145	<0.005	<0.025	<0.025	<0.025	<0.025	7.
YGW1-1	31963	YGW1 Pre Pump Test	Deep fractured bedrock	<0.025	0.148	<0.010	0.425	0.028	<0.025	<0.025	130	<0.005	<0.025	<0.025	<0.025	<0.025	4.
YGW1-2	31964	YGW1 Post Pump Test	Deep fractured bedrock	<0.025	0.145	<0.010	0.412	<0.025	<0.025	<0.025	133	<0.005	<0.025	<0.025	<0.025	<0.025	4.

				S	Sb	Se	Si	Sn	Sr	Ti	V	W	Zn	Zr	pH	EC	T
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH Unit	mS/m	m
Sample ID	Lab ID	Borehole	DWAF Agriculture and Livestock Watering (2009) TWQR	N/A	N/A	0-50	N/A	N/A	N/A	N/A	0-1	N/A	0-20	N/A	N/A	N/A	1000
			SANS 241 (2011) Operational	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5 - 9.7	N/A	N
			SANS 241 (2011) Aesthetic	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	N/A	N/A	170	1
			SANS 241 (2011) Acute Heath	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N
			SANS 241 (2011) Chronic Health	N/A	0.02	0.01	N/A	N/A	N/A	N/A	0.2	N/A	N/A	N/A	N/A	N/A	N
HGW2	31961	HGW2 Post Slug Test	Shallow Kalahari	37	<0.010	<0.020	17.4	<0.025	1.07	<0.025	<0.025	<0.025	<0.025	<0.025	7.6	174	1
YGW2	31962	YGW2 Post Slug Test	Shallow Kalahari	17	<0.010	<0.020	13.0	<0.025	1.39	<0.025	<0.025	<0.025	<0.025	<0.025	7.5	222	1
YGW1-1	31963	YGW1 Pre Pump Test	Deep fractured bedrock	13	<0.010	<0.020	25	<0.025	1.09	<0.025	<0.025	<0.025	0.604	<0.025	7.5	174	1
YGW1-2	31964	YGW1 Post Pump Test	Deep fractured bedrock	13	<0.010	<0.020	23	<0.025	1.09	<0.025	<0.025	<0.025	0.264	<0.025	7.6	175	1

Note: Highlighted cells refer to the water quality standard that has been exceeded

Conclusion

Proposed infrastructure/activities within the new mining rights area are such that they present a potential for the pollution of groundwater resources and the lowering of groundwater levels that in some cases may be used by third parties for livestock watering and domestic purposes. Infrastructure/activities should therefore be implemented/managed in a way that pollution and reduction of groundwater resources is prevented as far as possible.

1.1.9 AIR QUALITY BASELINE

Information in this section was sourced from the specialist air quality impact assessment undertaken by SLR (July 2014) (Appendix I), on-going monthly air quality monitoring data at the Kudumane Mine, as well as the air quality specialist study undertaken by Airshed Planning Professionals for the approved EIA/EMP (Metago, 2010).

Introduction and link to impact

Existing sources of emissions in the region and the characterisation of existing ambient pollution concentrations is fundamental to the assessment of cumulative air impacts. A change in ambient air quality can result in a range of impacts which in turn may cause a nuisance and/or health impacts to nearby receptors. Receptor sites include the residential areas and communities and natural environments that have been described in Section 1.3.4. To understand the basis of these potential impacts, a baseline situational analysis is described below.

Results

<u>Regional air quality</u>

As part of the air quality study (Airshed, April 2009) undertaken for the approved EIA/EMP (Metago, May 2010) process, the following regional sources of emissions were identified:

- fugitive dust: Occur as a result of vehicle entrainment of dust from local paved and unpaved roads, wind erosion from open areas and dust generated by agricultural activities. Given that the agriculture in the area is primarily restricted to livestock and game farming, agriculture is not anticipated to contribute significantly to ambient dust rates. Vehicle entrainment from the various unpaved farm and public roads is anticipated to be a significant but localised source of dust;
- current mining operations in the area: Operating mines in relatively close proximity to the Kudumane Mine include Assmang's N'Chwaning and Gloria Mines, Samancor's Wessels and Mamatwan Mines. (N'Chwaning I, Black Rock, Hotazel, Langdon-Annex, Devon, York, Perth, Smart, Adams and Middelplaats are no longer in operation). The N'Chwaning (shafts 2 and 3), Gloria and Wessels mines are exclusively underground operations, whereas opencast mining is practiced at Mamatwan. Mamatwan is also the only mine in the area that currently has on-site sintering. BHP Billition's Hotazel Manganese Mines, Delta Electrical industries Limited and United Manganese of Kalahari. Fugitive dust sources from the abovementioned mining operations may

include wind blown dust from open areas, vehicle entrained dust from paved and unpaved roads, dust from materials handling operations and crushing and screening operations. Mamatwan opencast and sintering operations may also include fugitive dust emissions from drilling and blasting as well as point source emissions from the sinter plant. Delta Electrolytic Manganese Dioxide (EMD), owned by Delta Electrical industries Limited, is an ore reduction facility. Atmospheric emissions from this facility may occur as a result of fugitive dust sources (materials handling, vehicle entrainment, wind erosion, etc.) in addition to process emissions from their kiln operations;

- vehicle tailpipe emissions: Significant primary pollutants include carbon dioxide (CO_2), carbon monoxide (CO), hydrocarbons (HCs), sulphur dioxide (SO^2), oxides of nitrogen (mainly NOx), particulates. Secondary pollutants include NO^2, photochemical oxidants (ozone), sulphur acid, sulphates and nitric acid. Given the relatively low volumes of traffic in the region, atmospheric emissions from vehicle activity are anticipated to be a relatively minor source of air pollution;
- household fuel combustion: It is likely that households within the district municipality utilise coal or wood for cooking and space heating (during winter) purposes. Emissions from domestic burning include PM_{10}, nitrogen dioxide (NO_2), carbon dioxide (CO_2), carbon monoxide (CO), polycyclic aromatic hydrocarbons, particulate benzo(a)pyrene and formaldehyde;
- rail related emissions: Emissions from diesel generated locomotives include particulates, nitrogen oxides (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO) and various volatile organic compounds including polycyclic aromatic hydrocarbons;
- veld burning: Represents significant sources of combustion-related emissions in many areas of the country;
- long-range transport of aerosols: Regionally-transported, aged aerosols (particulates) have been shown to contribute significantly to background particulate concentrations over much of the country including remote sites. The four main source types include aeolian crustal material consisting of mineral soil dust, marine aerosols from the two adjacent oceans, biomass burning particles, aerosols from industrial emissions; and
- biomass burning: Biomass burning emissions include with carbon monoxide (CO), methane (CH_4) and nitrogen dioxide (NO_2) gases

Local Air Quality

The activities associated with the new mining rights area that will contribute to ambient air quality include (SLR, July 2014):

- excavations;
- earthworks / landscaping;
- ground preparations prior to construction of the buildings;
- grading and levelling of the ground prior to construction of new roads;
- removal of soil;
- storage of materials;
- vehicles on haulage routes and public roads.

- materials handling (loading / unloading from trucks and conveyors);
- vehicle entrainment of dust on haul road;
- wind erosion on exposed areas (e.g. stockpiles, TSF, WRDs); and
- drilling and blasting.

Potential receptor sites

There are numerous receptor sites that may be susceptible to air pollution within and surrounding the mining operations at the Kudumane Mine (Section 1.3.4). The closest receptor sites to Kudumane include (see Figure 17):

- Hotazel 1: Residential area adjacent to the railway siding (southern end)
- Hotazel 2: Residential area adjacent to railway sidings (northern end)
- Hotazel 3: Residential area located on southern Hotazel, western boundary
- Hotazel 4: Residential area located on central Hotazel, western boundary
- Hotazel 5: Residential area located on northern Hotazel, western boundary
- Devon 1: Residential to north of R31 (close to Devon Pit)
- Devon 2: Residential to north of R31 (close to Devon Pit)
- Botha 1: Unoccupied residence south of the approved mining operations

Dust fallout data

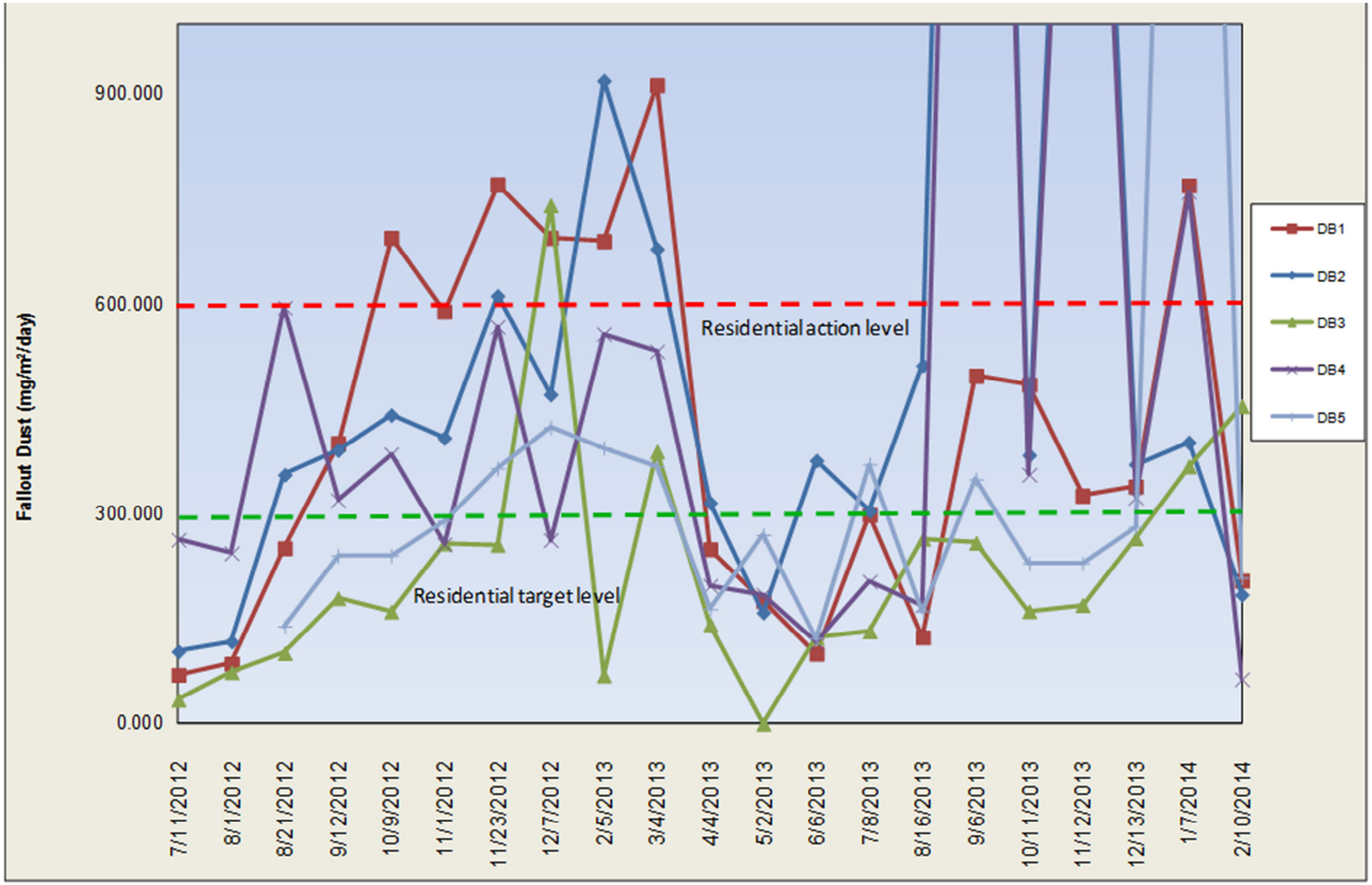
Kudumane currently has a network of five dust buckets for the purpose of monitoring monthly dust fallout. This monitoring is undertaken in accordance with South African National Standards (SANS 1929:2011) guidelines. In this regard, dust fallout rates should not exceed 1200 ($mg/m^2/day$) for industrial areas over a period of 30 days. Monitoring data for the period June 2012 to February 2014 was considered for the purposes of the air quality impact assessment. This has been presented in Figure 3.

Results have been compared to South African National Standards (SANS 1929:2011) however it should be noted that the monitoring locations do not represent sensitive receptors either residential or industrial. The average results are skewed by a small number of isolated events that exceeded the 'alert' threshold. In general average results are below the residential action level. A review of the data indicates that background dust deposition may be in the region of between approximately 200 and $500mg/m^2/day$ as a monthly average.

PM_{10} data

The Air Quality Assessment for the approved project included a collation and review of existing monitoring sets in the area (Airshed, 2010). The review included suspended total particulate concentrations and ambient manganese concentrations recorded in the study region by the Counsel for Scientific and Industrial Research (CSIR). In addition, monitoring data obtained from the EMPRs for Wessels and Mamatwan mines was considered, however this is of little value in that monitoring was undertaken in close proximity (circa 20 m) to sources at the mines.

FIGURE 3: KUDUMANE DUST FALLOUT (22 JUNE 2012 TO 10 FEBRUARY 2014)



(SLR, JULY 2014)

Conclusion

The Kudumane Mine is situated within a region that is surrounded by activities and infrastructure that contribute towards sources of emissions such as dust fallout and PM_{10}. Average dust fallout results are skewed by a small number of isolated events that exceeded the 'alert' threshold. In general average results are below the residential action level. A review of the data indicates that background dust deposition may be in the region of between approximately 200 and 500mg/m^2/day as a monthly average.

Management measures for current approved mining activities as well as those which are being proposed need to be complied with at all times to effectively manage operational contributions to ambient dust fallout.

1.1.10 NOISE BASELINE

Data in this section was sourced from the Noise Specialist Study undertaken by SLR (July 2014) (Appendix J) as well as data collected from previously measured ambient noise levels for the approved EIA/EMP (Metago, 2010).

Introduction and link to impact

Certain noise generating activities associated with the new mining rights area and associated infrastructure/activities could cause an increase in ambient noise levels in and around the project area. This may cause a disturbance to nearby receptors. Potential receptor sites include the residential areas that have been described in Section 1.3.4. To understand the basis of these potential impacts, a baseline situational analysis is described below.

Results

The greater area is generally defined by rural features and is not subjected to elevated noise levels. Existing noise within the area is mainly caused by surrounding farming activities, localised traffic, train movements and mining operations.

Based on the guidance contained in SANS 10103:2008 and the IFC General EHS Guidelines for Environmental Noise Management, the following limits for noise have been adopted which reflect the character of the identified receptors (see Table 19 below).

TABLE 19: SANS 10103:2008 AND IFC GENERAL EHS GUIDELINES FOR ENVIRONMENTAL NOISE MANAGEMENT

Location	Type of District	Daytime, $L_{Req,d}$	Night-time, $L_{Req,n}$
L1 – Hotazel	Suburban district with little road traffic	50	40

L2 – Langdon	Rural	45	35
L3 – Devon/Telele	Rural	45	35

Baseline environmental noise surveys were undertaken during April 2013 to determine the prevailing baseline noise climate at the following noise-sensitive receptors considered to be the nearest to operations in, and around Hotazel (see Figure 18 for the location of noise monitoring points).

The results presented below show exceedances at Hotazel (midweek daytime) and Langdon (weekend and midweek daytime). It should be noted that the exceedances at Hotazel and Langdon were due to normal local activities and the existing operations at Kudumane were not audible from these receptor locations. In this regard the baseline conditions in the area are generally considered to be of a rural nature.

TABLE 20: SUMMARISED NOISE MONITORING RESULTS

Receptor	Period	$L_{Aeq,T}$	L_{A90}	L_{Amax}
L1 – Manganiet Lane, Hotazel	Weekend	35.0	29.8	56.9
	Midweek	58.7	34.5	63.9
L2 – Langdon Adj. Receptor	Weekend	49.2	30.2	75.9
	Midweek	57.2	31.4	84.7
L3 – Devon/Telele	Weekend	35.6	24.2	57.1
	Midweek	43.4	34.8	73.3

Conclusion

The proposed project has the potential to increase disturbing noise levels within and surrounding the project area. It is however important to note that the current mining activities at the Kudumane Mine already generate noise (although this was not audible from any of the noise monitoring locations). Potential human noise sensitive receptors within close proximity of the project area include the residential areas (Section 1.3.4). Careful planning should therefore be taken into consideration for the proposed project in order to minimise increasing disturbing noise levels.

1.1.11 VISUAL BASELINE

Information in this section was sourced from the Visual Impact Assessment undertaken by SLR (July 2014) (Appendix K).

Introduction and link to impacts

Mining infrastructure has the potential to alter the landscape character of the site and surrounding area through the establishment of both temporary and permanent infrastructure. To understand the basis of these potential impacts, a baseline situational analysis is described below.

Results

The various aspects of the visual baseline are set out below.

Landscape character

The proposed project area lies in a flat, open area characterised by semi-arid vegetation and ephemeral drainage lines. Livestock and game farms and associated farm settlements are typical of the region. Located on the eastern sub-outcrop of the Hotazel Formation, the landscape is characterised by scattered operational and closed mining operations and supportive infrastructure such as rail and road networks, powerlines, and the residential and business centre of Hotazel (Figure 2).

Within the project area, the landscape character has been transformed due to the current approved mining activities.

Scenic quality

The overall scene surrounding the project area is characterised by open views with grazing lands and mining structures and associated activities. The result is that the overall scenic quality of the landscape is compromised. The scenic quality of the landscape within the project area is therefore rated as moderate to low. This is due to the fact that the adjacent background landscape types with high scenic quality are mixed with those of a lower quality for the site and area immediately adjacent to the proposed site.

Sensitivity of Visual Resource

It follows that the highest value visual resource described above is also the most sensitive to changes. In contrast, areas which are not considered to have a high scenic value, are expected to be the least sensitive to change such as the mining and infrastructure areas.

Sense of place

The sense of place results from the combined influence of landscape diversity and distinctive features. The primary informant of these qualities is the spatial form and character of the natural landscape taken together with the cultural transformations and traditions associated with the historic use and habitation of the area. The proposed site is located within a “mining belt”. The mining activity, and the infrastructure that supports these mines, dominates the agricultural type landscape characteristics of the area immediately adjacent to the project area. The fact that the proposed project will take place within the context of these existing mining activities, gives the immediate study area a relatively weak sense of place (when the viewer is within the mining belt). However, seen in context with the site surrounded by large open spaces of arid vegetation and sand dunes the harsh nature of the mining activities is "softened". When the viewer views the area from outside the "mining belt", the larger area has a stronger sense of place.

Visual receptors

When viewed from the perspective of tourists and residences within the area, mining activities could be associated with a sense of disenchantment. People who benefit from Kudumane (employees, contractors, service providers etc.) may not experience this disenchantment but rather see the mine with a sense of excitement and anticipation.

It follows that the sensitive viewers are a combination of landowners/land users on surrounding farms and possibly the residents of Hotazel village, albeit that this is a mining village.

Conclusion

Visual impacts require consideration, particularly as part of closure planning, but none of the potential visual impacts are considered new given the existing mining activities and infrastructure on site and in the greater area.

1.2 ENVIRONMENTAL ASPECTS WHICH MAY REQUIRE PROTECTION OR REMEDIATION

Existing environmental aspects both on the site and in the surrounding area which may require protection or remediation is discussed further in this section. Based on the concise description provided above, these include:

- the sterilisation of mineral resources;
- the loss of soil resources and land capability within the footprint of project infrastructure;
- the loss of protected species;
- groundwater resources; and
- ambient air quality.

1.3 LAND USES, CULTURAL AND HERITAGE ASPECTS AND INFRASTRUCTURE

A description of the specific land uses, cultural and heritage aspects and infrastructure on site and on neighbouring properties/farms is provided in this section. This section identifies whether or not there is potential for the socio-economic conditions of other parties to be affected by the proposed operations.

1.3.1 CULTURAL ASPECTS

Cultural aspects of the proposed project areas are discussed below as part of the heritage discussion.

1.3.2 HERITAGE BASELINE (INCLUDING CULTURAL RESOURCES)

Information in this section was sourced from the heritage study (PGS, June 2014) (Appendix L) as well as the approved EIA/EMP (Metago, 2010).

Introduction and link to impacts

The placement of infrastructure and related construction and operational activities associated with the proposed new mining rights areas has the potential to impact heritage, cultural and palaeontological resources. To understand the basis of potential impacts, a baseline situational analysis is provided below.

Results – Heritage and cultural resources

The Kudumane Mine is situated in an area that as a whole has a relative low human presence due to the dryness of the region, and as such if there are human settlements they tend to be located on or near watercourses.

As part of the heritage study (PGS, June 2014), a low density scatter of stone tools was identified (Figure 19) near the proposed road on Hotazel. As indicated in the figure, the site is situated on the eastern banks of the Ga-Mogara River. The site is approximately 100 m from the river and is located on the sloping banks of the river, extending approximately 250 m along the river and covering an area of approximately 50 m wide along the down slope towards the river.

Results – Palaeontological resources

Based on the findings of the Palaeontoligcal Specialist Study undertaken by GSPD Consulting (May, 2014), no conclusive evidence of fossils could be found in either the red claystone, conglomeratic limestone, calcareous sandstone of sand dunes of this formation. During the study undertaken in 2011, for the approved EIA/EMP (GSPD 2011) two “pseudo-bone” remains were recorded after two days of field investigations.

There is however a possibility that the Hotazel Formation manganese ore body could contain stromatolites. Taking this into consideration it is possible that fossil resources may be found at the mine. These resources are protected by the National Heritage Resources Act (No 25 of 1999) and may not be affected (demolished, altered, renovated, removed) without approval.

Conclusion

Although no palaeontological resources were found on site, there is a possibility that the Hotazel Formation manganese ore body could contain stromatolites and this should be taken into account during the planning and development phases of the proposed project. A low density scatter of stone tools was identified as resources of heritage and cultural significance and these resources are important to the history of South Africa and are protected by national legislation. In addition to the resources identified, chance finds will require a permit from the South African Heritage Resources Agency (SAHRA) if these sites were to be altered.

1.3.3 SOCIO-ECONOMIC

Information in this section was sourced from the Joe Morolong Local Municipality (JMLM) Integrated Development Plan (IDP) and Budget (JMLM, 2013/2014), the John Taolo Gaetsewe District Municipality (JTGDM) Spatial Development Framework (JTGDM, 2012), the Northern Cape Provincial Spatial Development Framework (PSDF, July 2012) and Statistics South Africa. Given that these sources and related information do not differ from what was used in the 2010 EIA/EMP, the specialist study (Appendix N) focussed more on the economic and land use impacts and less on the social baseline and related impacts.

Introduction and link to impact

The mine and proposed project have the potential to result in both positive and negative socio-economic impacts.

The positive impacts are usually economic in nature with mines contributing directly towards employment, procurement, skills development and taxes on a local, regional and national scale. In addition, mines indirectly contribute to economic growth in the local and regional economies because the increase in the number of income earning people has a multiplying effect on the trade of other goods and services in other sectors.

The negative impacts can be both social and economic in nature. In this regard, mines can cause:

- influx of people seeking job opportunities which can lead to increased pressure on basic infrastructure and services (housing, health, sanitation and education), informal settlement development, increased crime, introduction of diseases and disruption to the existing social structures within established communities; and
- a change to not only pre-existing land uses, but also the associated social structure and meaning associated with these land uses and way of life. This is particularly relevant in the closure phase when the economic support provided by mines ends, the natural resources that were available to the pre-mining society are reduced, and the social structure that has been transformed to deal with the threats and opportunities associated with mining finds it difficult to readapt.

To understand the basis of these potential impacts, a baseline situational analysis is described below.

Data collection

Data was collected by SLR through the review of available literature.

Results – Provincial level (Northern Cape)

Population

According to the Northern Cape PSDF, the total population of the Northern Cape Province consists of approximately 1 128 700 million (PSDF, July 2012).

Economic activity

The Northern Cape Province is the smallest contributing province to South Africa's economy. According to Labour Statistics South Africa (2012), the mining sector is the largest contributor to provincial GDP, at 26 %.

Unemployment

It was estimated that 18.1% of the Northern Cape Province population is unemployed (PSDF, July 2012).

Education

According to Statistics South Africa, 5.5% of the Northern Cape's Province adult population have a tertiary qualification. In the Northern Cape Province, 19.7% of the adult population have had no schooling at all.

Basic Services

According to a 2007 community survey, approximately 80 % of households have access to piped water inside dwellings or yards. Approximately 14% of households have access to piped water outside a yard and 5% have no access to piped water. Approximately 57% of the population residing in the Northern Cape has access to flushing toilets. According to the LED strategy, approximately 70% of the Northern Cape Province has access to electricity (PSDF, July 2012).

Housing

According to the community survey undertaken in 2007, the Northern Cape Province consists of approximately 80.4% formal housing and 10.5% informal housing (PSDF, July 2012).

Results – Local level (Jo Morolong Municipality and John Taolo Gaetsewe District Municipality)

Population

According to the census undertaken in 2009 the population in the John Taolo Gaetsewe District Municipality was recorded at 209 892 people (JTGDM, 2012). The total population in Joe Morolong Local Municipality is presently at 187 111 with majority of the population residing in the Joe Morolong municipal area (JMLM, 2013/2014).

Economic activity

Within the Joe Morolong Local Municipality and John Taolo Gaetsewe District Municipality it was estimated that, in 2011, the most dominant employment sector contribution to the provinces GGP is the mining sector (JTGDM, 2012).

Unemployment

It was estimated that the unemployment rate for the John Taolo Gaetsewe District Municipality in 2011 was approximately 44.8% (JMLM 2012/2013) with the worst scenario being found in the Joe Morolong Local Municipal area.

Education

According to Statistics South Africa, 1.8% of the district's population has some form of tertiary education. 67.4 % of the district's population has some form of education with approximately 27.6 % having no education at all.

Basic Services

According to a 2007 community survey, approximately 3.9 % of households in the Joe Morlong Local municipal area have access to piped water inside dwellings or yards whilst 76 % of households have access to a water point outside of their yards. 42.0 % households in the John Taolo Gaetsewe District Municipality area have access to piped water inside dwellings or yard whilst 49 % of households in the district have access to a water point outside of their yards (JTGDM, 2012).

Approximately 2.4% of the population residing in the Joe Morolong area has access to flushing toilets whilst an estimated 33.8 % of the population residing in the district area has access to flushing toilets (JMLM 2012/2013). According to the LED strategy, approximately 8.5% of the Joe Morolong area has access to electricity, in comparison to the John Taolo Gaetsewe district area, in which 90 % of the population has access to electricity (JMLM 2012/2013).

Housing

According to a community survey undertaken in 2007, the John Taolo Gaetsewe Municipality consists of approximately 8.5% informal housing (PSDF, July 2012).

Conclusion

In general mining activities has the potential to influence socio-economic conditions both positively and negatively. In the context of the approved mine and proposed amendment to the infrastructure and mining activities, positive socio-economic influences include contributions in various ways to the local and regional economies while negative socio-economic influences include inward migration of people with the resultant pressure on basic infrastructure and services, informal settlement development, increased crime, introduction of diseases and disruption to the existing social structures within established communities.

1.3.4 LAND USES

Information provided in this section was sourced by SLR as part of the proposed project. Mining right and land ownership details were sourced from Kudumane and a deedsearch undertaken by SLR as part of the proposed project. On-site and surrounding land use data was sourced from site observations, and the review of topographical maps and satellite imagery. In addition to this, information was sourced from the Alternative Land Use Assessment undertaken by Strategy4Good (S4G, June 2014) (Appendix N).

Introduction and link to impacts

Mining activities have the potential to affect landuses both within the project area and in the surrounding areas. This can be caused by physical land transformation and through direct or secondary impacts. The key related potential environmental impacts are: loss of soil, loss of biodiversity, pollution of water, dewatering, air pollution, noise pollution, damage from blasting, visual impacts and the influx of job seekers with related social ills. To understand the basis of the potential land use impacts, a baseline situational analysis is described below.

Results – Mineral and prospecting rights

Kudumane Manganese Resources (Pty) Ltd holds an approved mining right which authorises opencast mining and infrastructure on the farm York and underground mining on the farm Telele under the DMR authorisation (NC 30/6/1/2/2/268 MR). The mining right was executed on 26th April 2013. Kudumane also submitted a new mining right application for the inclusion of additional mining areas in November 2013. The application was accepted by the Department of Mineral and Resources (DMR) on 5 December 2013 (NC 30/5/1/2/2/10053MR).

Results – Land ownership within and surrounding the surface use area

The surface right owners and corresponding title deeds numbers of the land in and adjacent to the surface use area is listed in Table 21 and Table 22 respectively.

TABLE 21: LAND OWNERSHIP WITHIN THE APPROVED AND NEW MINING RIGHTS AREA

Farm Name	Portion Number	Title deed number	Landowner (as at March 2014)
Kipling 271	0	T953/1968	Assmang Ltd
Hotazel 280	0	T3049/2010	Hotazel Manganese Mines (Pty) Ltd
	2	T1414/1991	Telkom SA (Ltd)
	3	T643/2009	Samancor Manganese (Pty) Ltd
York A 279	0	T2968/2007	Jansen Jacobus Petrus
	1 (excluded)	T2426/2010	Hotazel Manganese Mines (Pty) Ltd
	2	T650/2011	Kudumane Manganese Resources (Pty) Ltd
	3	T838/1963	Transnet Ltd
	4	T382/1964	Transnet Ltd

	6	T521/1992	Transnet Ltd
	8	T1475/1997	Frederick Eduard Jacobs
Devon 277	0	T3044/2012	Kudumane Manganese Resources (Pty) Ltd
	1	T1050/1992	Transnet Ltd
Telele 312	0	T740/1973	Assmang Ltd
	1	T19/2013	Kudumane Manganese Resources (Pty) Ltd

TABLE 22: LANDOWNERS ADJACENT TO APPROVED AND NEW MINING RIGHTS AREA

Farm Name	Portion number	Title deed number	Landowner (as at March 2014)
Gasesa 272	RE	T175/2010	Tsineng Communal Property Association (Local Authority)
	1	T145/1931	Tsineng Communal Property Association (Local Authority)
East 270	0	T791/2002	Nicolaas Jacobus Pretorius
	2	T993/1972	Nicolaas Jacobus Pretorius
Langdon 278	0	T1459/2001	Dawid Hermanus Fourie
London 275	1	T1236/2001	KLK Landbou Ltd
Botha 313	0	T2386/1996	Terra Nominees (Pty) Ltd
Kongoni 311	0	T2309/2010	Amari Manganese (Pty) Ltd
	1	T818/1957	Amari Manganese (Pty) Ltd
Gama 283	1	T2793/2010	Amari Manganese (Pty) Ltd
Olive Pan 282	0	T2793/2010	Amari Manganese (Pty) Ltd
Umtu 281	0	T2793/2010	Amari Manganese (Pty) Ltd
Gloria 266	0	T1488/2011	Ntsimbintle Mining (Pty) Ltd
	1	T506/1966	Assmang Ltd
Perth	0	G30/1950	Eben Zikmann Anthonissen
	1	T985/1955	Transnet

Results – Land claims

According to the Department of Rural Development and Land Reform (DRDLR) land claims have been lodged on Portions 1, 2 and 3 of Hotazel 280 and on the whole farm Kipling 271. Kudumane and DRDLR have been in contact in this regard (Appendix A) and DRDLR has advised that their legal department has commissioned an independent body to research the claims and that they will revert back to Kudumane once this research has been completed.

Results - Land use within the surface use area

Land use within the project area is limited to the mining activities and infrastructure associated with the Kudumane Mine as well as ad-hoc game and cattle grazing.

Result - Land use surrounding the surface use area

Land use surrounding the surface use area is a mixture of agriculture, isolated residence/ residential areas, infrastructure/servitudes and mining activities. More detail is provided below:

Agriculture

Agricultural activities currently undertaken within the areas surrounding the project area includes game farming and livestock grazing.

Isolated residence/ residential area

With reference to Figure 17, the nearest residential areas to the Kudumane Mine include the following:

- Hotazel 1: Residential adjacent to the railway siding (southern end)
- Hotazel village: (points 2, 3 and 4)
- Hotazel 5: Residential located on northern Hotazel, western boundary
- Devon 1: Residential to north of R31 (close to Devon Pit)
- Devon 2: Residential to north of R31 (close to Devon Pit)
- Botha: Unoccupied residence on Botha

Due to the lack of available surface water resources in the area, no informal settlements are located in immediate proximity to the Kudumane Mine. There are sparsely situated residences and farmhouses on the surrounding farms. These are owned and/or occupied by farmers and farm workers.

Infrastructure and servitudes

Various infrastructure and servitudes are located within the areas surrounding the project area. Further information is provided below.

A network of roads which exist within the vicinity of the project area (refer to Figure 2) include:

- the tarred R31 between Kuruman and Hotazel;
- the R380 between Kathu and Hotazel;
- the D3336 road which runs through the project area (linking the R31 and the project site). A portion of this road has been closed.
- the D3340 dirt road which branches off the D3336 road to the south of the site and runs past UMK mine towards the R380;
- various un-tarred farm access roads; and
- a railway line connecting Kathu, Mamatwan and Hotazel runs along the eastern boundary of the site, parallel to the R380.

Existing powerlines within the project area includes (refer to Figure 20):

- a 11 KVa powerline which passes to the east of the site along the R380 road; and
- Umtu line “Turn Line” with a maximum transmission capacity of 150 MVa

Existing pipelines within the project area includes (refer to Figure 20):

- Sedibeng Kathu main line; and
- internal network feeding off the Sedibeng Main line.

Surrounding mines

Various other mining operations located within 15 km of the proposed project area include:

- Assmang's Gloria and Nchwaning mines (7 km and 12 km north of the Kudumane project area, respectively);
- BHP Biliton's Wessels Mine (approximately 15 km north north-west of the proposed project area);
- UMK Mine (approximately 10 km south-west of the proposed project area);
- Samancor's Mamatwan (approximately 15 km south of the project area);
- Tshipi Borwa Mine (approximately 15 km south of the project area); and
- several closed/dormant mines (Hotazel Mine, Annex Langdon-Devon Mine, Perth and Smart Mines).

Conclusion

There are a number of land uses surrounding the existing and proposed new project area which may be influenced by the proposed project and associated potential environmental impacts. It should however be noted that the surface use area as well as areas surrounding the surface use area, have already been significantly influenced through mining, agricultural as well as infrastructure and servitudes.

1.4 MAPS SHOWING THE SPATIAL LOCALITY AND AERIAL EXTENT OF ENVIRONMENTAL FEATURES

This section includes a series of maps that show the spatial locality and aerial extent of all environmental, cultural/heritage, infrastructure and land use features identified on site and on the neighbouring properties and farms. These maps include:

- Geological Setting of the Kudumane Mine (Figure 5)
- Seasonal windroses (Figure 6)
- Soil forms (Figure 7)
- 780 ha game enclosure within the existing mining rights area (Figure 8)
- Vegetation types (Figure 9)
- Griqualand West Centre of Endemism (Figure 10)
- Site sensitivity map (Figure 11)
- Local hydrology, topography and drainage paths (Figure 12)
- Gauged and project catchments (Figure 13)

HYDROGEOLOGY OF THE PROJECT AREA (

- Figure 14)
- Air quality sensitive receptors (Figure 17)
- Noise sensitive receptors (Figure 18)
- Heritage resources (Figure 19)

FIGURE 4: SIMPLIFIED PLAN AND CROSS SECTION OF THE KMF

FIGURE 5: GEOLOGICAL SETTING OF THE KUDUMANE MINE (SLR, JUNE 2014)

FIGURE 6: SEASONAL WINDROSES (SLR, JULY 2014)

FIGURE 7: SOIL FORMS (ARC, JUNE 2014)

FIGURE 8: 780 HA GAME ENCLOSURE LOCATED WITHIN THE APPROVED MINING RIGHTS AREA AS PART OF THE BIODIVERSITY OFFSET PLAN

FIGURE 9: VEGETATION TYPES (EMS, JUNE 2014)

FIGURE 10: GRIQUALAND WEST CENTRE OF ENDEMISM (EMS, JUNE 2014)

FIGURE 11: SITE SENSTIVITY (EMS, JUNE 2014)

FIGURE 12: LOCAL HYDROLOGY, TOPOGRAPHY AND DRAINAGE PATHS (SLR, JULY 2014)

FIGURE 13: HYDROGEOLOGY OF THE PROJECT AREA (SLR, JUNE 2014)

FIGURE 14: GAUGED AND PROJECT CATCHMENTS (SLR, JULY 2014

FIGURE 15: MODELLED 1:50 YEAR AND 1:100 YEAR FLOODLINE AND 100 M BUFFER

FIGURE 16: HYDROCENSUS MAP

FIGURE 17: PROPOSED AIR QUALITY SENSITIVE RECEPTORS (SLR, JULY 2014)

FIGURE 18: NOISE SENSITIVE RECEPTORS (SLR, JULY 2014

FIGURE 19: HERITAGE RESOURCE LOCATION (PGS, JUNE 2014)

2 PROPOSED MINING AND EXPANSION PROJECT

The information in this section was obtained from project information provided to SLR by the Kudumane project team and the approved EIA/EMP (Metago, 2010).

Kudumane currently operates the Kudumane Mine located on the farms York A 279 (York) and Telele 312 (Telele) (NC 30/6/1/2/2/268 MR). Kudumane now wishes to expand its mining operations and has applied for a new mining right to include the farms Kipling 271 (Kipling), Devon 277 (Devon) and Hotazel 280 (Hotazel) (NC 30/5/1/2/2/10053 MR). In addition to adding new mining rights to its existing mining rights area, Kudumane intends to establish additional infrastructure to what has already been approved on York and Telele. Refer to Figure 2 for an indication of the setting of the farms. Refer to Figure 20 for the approved mining rights area and approved infrastructure. Refer to Figure 21 for the proposed new mining rights areas and associated infrastructure as well as the additional proposed infrastructure within the approved mining rights area.

Given that the infrastructure/activities proposed as part of the new mining rights area relies on the existing operations on York for processing and other support facilities, the Section below takes into consideration both the new mining rights area (and associated infrastructure/activities) as well as the approved mining rights area (and proposed changes to infrastructure/activities thereon). The impact assessment (Section 7) however focuses only on the new mining rights area. It should further be noted that given that the detailed design information for Kipling has not yet been finalised, Kipling has been included for the purposes of the project description but has not been considered in the impact assessment section (Section 7).

2.1 MINERAL TO BE MINED

The existing mining right, executed on 26 April 2014, allows for the mining of manganese ore on the remaining extent and portion 1 of Telele and the remaining extent and portion 2 of the farm York. The approved EIA/EMP in support of this mining right catered for both opencast mining (York) and underground mining (Telele). The proposed amendment to this mining right will not result in any changes to the mineral being mined, but caters only for additional surface infrastructure proposed within the existing mining rights area.

The new mining right application which was accepted by the DMR on on 5th December 2013 caters for the opencast mining of manganese ore on the farms Devon, Kipling and a portion of the farm Hotazel. In this regard, the proposed mining right application does not result in any changes to the mineral currently being mined at Kudumane, given that opencast mining operations are currently underway at York and the mining operations proposed within the new mining areas will comprise the re-mining of historical pits on Devon and Hotazel.

2.2 MINING METHOD TO BE EMPLOYED

2.2.1 OPEN PIT AND UNDERGROUND MINING METHOD

In order to clearly describe the mining methodology, specific distinction has been made between the following areas:

- approved mining rights area: mining will continue to be undertaken as has been approved in the existing EIA/EMP (i.e. opencast mining at York and underground mining at Telele). Given that this has been approved and will not change, the focus in the sections which follow will only be on the amendments to support infrastructure/activities and
- proposed new mining rights area: it is proposed that the historical pits on Devon and Hotazel will be re-mined using opencast mining methods. In this regard, the mining methodology together with all support infrastructure/activities is described in detail below.

Approved mining rights area: Opencast and underground mining (current)
Within the existing mining rights area (York and Telele), the reef is currently targeted via open pit on the farm York. Although underground mining on the farm Telele has not yet commenced, it has already been approved in the existing EIA/EMP (Metago, 2010). The depth of the manganese resource at the mining start point on York is approximately 65 m below surface extending to approximately 170 m or more below surface. Underground mining on Telele will commence at approximately 170 m below surface. Ore to the west of the York opencast mining area cannot be viably accessed via opencast mining hence the decision to establish underground operations through the York pit. These underground workings will be accessed through a portal that has three adits, two of which will be used for intake airways i.e. ore conveyance, personnel and material transport; and a single return airway.

According to the approved EIA/EMP, the York open pit will be active for 13 years and with the addition of the Telele underground mine operations, the life of the mine was extended to 30 years. It is anticipated that between 2.5 and 4.5 million tonnes of manganese product will be produced per annum. It should be noted that even though the mining production rate and scheduled life of the York pit remains the same in line with the approved EIA/EMP, the dimensions of the pit will change and the western boundary may extend within 100 m of the Ga-Mogara. In this regard a river diversion as outlined in Section 2.7.2 is considered in case the pit is extended within 100 m of the Ga-Mogara to allow access to the ore body.

As indicated, the above mining methodology was approved as part of the existing EIA/EMP and the proposed amendments to infrastructure/activities within the existing mining rights area will not result in changes to the opencast mining method which is currently employed and approved at York. Moreover, the underground operations at Telele will be developed and operated according to the approval given by the DMR. In this regard, the existing mining rights area is only considered in so far as the changes to infrastructure/activities is concerned, and is therefore only discussed to a limited extent in this section.

Proposed new mining rights area: Opencast mining

Within the new mining rights area (Devon, Kipling and Hotazel), the reef will be targeted via existing (historical) open pits on the farms Devon and Hotazel. It is expected that a standalone pit will be developed on the farm Kipling (this will not be an extension of the Hotazel pit as previously indicated). In this regard a preliminary investigation has commenced. Once the project detail becomes available, Kudumane will initiate a separate environmental authorisation process. The two open pit operations at Hotazel and Devon will be based on conventional opencast mining methods making use of drilling and blasting followed by loading and hauling utilising trucks and shovels (similar to that employed at York). The footprint of the open pits is not expected to materially differ from the existing on site historical pits.

As outlined in the amended Mine Works Programme, which was submitted to the DMR in December 2013, the open pit parameters for the new mining rights area is as follows:

TABLE 23: OPEN PIT PARAMETERS FOR THE NEW MINING RIGHTS AREA

Parameter	Hotazel Pit	Kipling Pit	Historical Devon Pit
Length	728m	To be determined	700m
Width	417m	To be determined	380m
Depth	80m	To be determined	60m
Area	24.6ha (246 315m^2)	To be determined	23.1ha (231 000m^2)
Ore	1.5 million tons	4.5 million tons	1.0 million tons
Waste	15 million tons	36 million tons	8 million tons
Pit LOM	6 years	13 years	1 year

Site preparation

Site preparation for opencast mining includes the clearing of vegetation and topsoil stripping for new disturbance areas associated with the pits, WRDs, roads, and other support infrastructure. Topsoil will be stockpiled, for later use in rehabilitation.

Earthworks

Following site preparation all topsoil and some waste rock will be dozed and stockpiled separately for re-use for other construction and rehabilitation activities.

Drilling and blasting

Blasting and drilling methods will be used to loosen the remaining waste rock and ore in the open pits. The blast programme will be changed as required during the life of the mine. Blasting is expected to occur twice per week for each pit. Blasting will not be undertaken on weekends.

Removal of waste rock

Truck and shovel methods will be used to load and haul the waste rock materials to the WRDs.

Removal of run-of-mine

ROM will be delivered to the plant by trucks.

Rehabilitation

Once the open pits reach a steady state, on-going rehabilitation of the mined out areas will occur as mining advances. In this regard, waste rock will be used to backfill the pit voids and then topsoil will be placed over the waste rock and vegetation will be re-established. No final void is anticipated in the current scenario because there will be sufficient waste rock and topsoil to backfill and rehabilitate the open pits.

2.2.2 MINERAL PROCESSING METHOD

Proposed new mining rights area

To exploit the deposit, Kudumane intends mining roughly 350 000 tons of ROM per annum (from each of the pits in the new mining rights area). This ROM will be transported by trucks to the processing plant already approved on the farm York. Whilst no significant changes to the approved processing plant are being proposed, some minor changes have been incorporated in order to optimise the efficiency of the facility. In this regard, fines produced from the secondary crushing stages will be pumped to a thickener where the fines will be settled out (underflow) and process water will be recovered. The underflow from the thickener containing fines will then be pumped to the proposed new TSF on Devon, whilst the recovered water will be utilised within the process water circuit.

Approved mining rights area

As per the Mine Works Programme, at steady state, Kudumane intends mining 3.6 million tons of ROM per annum (from the existing and approved pit on York and the approved underground operations on Telele). It should be noted that the mineral processing method that was approved as part of the existing EIA/EMP for the existing mining rights area will not be changed. The proposed EIA/EMP amendment caters for changes to support infrastructure/activities and in this regard, the mineral processing method will remain unchanged (with the exception of a washing plant which will be added).

FIGURE 20: INFRASTRUCTRE AND MINING AREAS AS APPROVED IN THE ORIGINAL EIA/EMP (METAGO, 2010)

FIGURE 21: INFRASTRUCTURE AND MINING AREAS AS PROPOSED IN THE CURRENT EIA/EMP

FIGURE 22: PREFEASIBILITY DESIGN LAYOUT FOR THE TSF ON DEVON (SLR, JUNE 2014)

FIGURE 23: TSF SITE SELECTION PROCESS

2.3 LIST OF MAIN ACTIONS/ACTIVITIES/PROCESSES ON SITE

Table 24 below shows the activities that currently take place at the Kudumane Mine, those proposed to take place within the new mining rights area and those proposed to take place in the existing mining rights area (as a result of the proposed infrastructure amendments) during each phase (construction, operational, decommissioning, closure). Unless otherwise indicated using brackets in column one, the activity relates to all three of the abovementioned scenarios.

For the purposes of this report, in broad terms, construction is the phase in which infrastructure is established, operation covers the production phase, decommissioning covers infrastructure removal and site rehabilitation, and the closure phase refers to the period of time when maintenance and aftercare of rehabilitated areas and facilities is required to ensure closure objectives are met.

This table reflects the chosen preferred alternative. Alternatives considered in the development of the proposed project plan are discussed in Section 2.8.

TABLE 24: LIST OF ACTIONS / ACTIVITIES / PROCESSES

Main activity/process	Typical sub-activities	Construction	Operation	Decommissioning	Closure
Site preparation	Bush clearing	As required			
	Removal of existing structures (if present).	As required			
Earthworks	Vehicle maintenance, wash bays, storage of fuel and lubricants	On-going	As required	As required	
	Stripping and stockpiling of soil resources in line with soil management programme	On-going	As required	As required	
	Cleaning, grubbing and bulldozing activities	On-going	As required	As required	
	Digging trenches and foundations. Possible blasting	On-going	As required	As required	
	Establishing stormwater controls (channels, berms) as per storm water management plan	At start of phase	As required	As required	
Civil works Civil works on site relate mainly to any steel and concrete work.	General building activities and erection of structures	On-going	As required	As required	
	Foundation excavations and compaction	On-going	As required	As required	
	Use of scaffolding and cranes	On-going	As required	As required	
	Erection and destruction of scaffolding	On-going	As required	As required	
	Mixing of concrete and concrete work including silos, culverts and plinths	On-going	As required	As required	
	Steel work (including grinding and welding)	On-going	As required	As required	
	Vehicle maintenance and wash bays	On-going	As required	As required	
	Storage and handling of fuel, lubricants, sand, rock, cement, chemical additives in cements	On-going	As required	As required	
	Installing re-enforcement steel	On-going	As required	As required	
Open pit mining including WRDs and stockpiles (Approved for existing mining rights area. Proposed on Devon, Hotazel and Kipling)	Drilling and blasting	At start of phase (open the pit)	On-going		
	Removal of waste rock by dozing and load and haul	On-going	On-going		
	Stockpiling of waste rock for backfilling into the open pit as part of concurrent rehabilitation	On-going	On-going		
	Removal of ore by dump trucks and transported to the temporary crushing plant		On-going		
	Use of crushers (primary and secondary) to size the ROM		On-going		
	Water management facilities include: - collection of dirty run-off water in settling facilities and re-used - clean run-off and drainage sheet flow will be	On-going	On-going	On-going	

Main activity/process	Typical sub-activities	Construction	Operation	Decommissioning	Closure
	diverted around dirty areas				
	Construction and utilisation of site supporting services: - access control and security - change house - parking area for cars - contractors yard - workshop/maintenance area - laydown area - stores - wash bays - temporary storage area for hazardous and non-hazardous waste - formal ablution facilities within contractor yard - diesel tanks (above and underground) - ROM stockpile	On-going	On-going	On-going	
	Dewatering of the open pit and storage for re-use in the storage dams		As required		
	Cessation of dewatering activities			Occasionally if required	
	Delivery of ROM from loading area onto trucks and/or trains for removal off-site		On-going		
	Establishment of river diversion for the extension of the York pit (if deemed necessary).	7 years into LOM of York	On-going	On-going	On-going
Underground Mining (adit) (approved for existing mining rights area, but not yet operational. Not relevant for new mining rights area)	Sinking of shafts and underground mining using drilling and blasting methods	On-going			
	Construction and operation of shaft supporting infrastructure typically includes: - a winder house - ventilation shafts or surface holdings with fans - compressor infrastructure - headgear - batching plant conveyor belts	On-going	On-going		
	Water management facilities include:	On-going	On-going	On-going	

Main activity/process	Typical sub-activities	Construction	Operation	Decommissioning	Closure
	- Diversion of clean water - Separation of dirty water and clean water - Collection of dirty water using pollution control dams for recycling and re-use - Dewatering, storage, treatment, re-use and discharge (in line with water licence)from shafts - Service water containment dams - Sludge dams for the further collection and settling of fine material from sludge pumped from underground for its processing at the concentrator. In addition there is the evaporation or reuse of the remaining service water				
	Waste rock dumps: stockpiled, crushed by third parties for third party use	On-going	On-going	On-going	Some will be permanent
	Backfilling/stabilisation of shafts (providing support)		On-going	On-going	
	Construction and utilisation site support services include: - Workshop equipped with washbays, including underground workshops - Office complex - Change house and ablution facilities - Underground sewage collection area for discharge to conservancy tank with sewage pump station, conservancy tank which is emptied by honeysucker or directly into sewer lines - Silos - Diesel storage tanks (re-fuelling of equipment) - Wash bays - Parking area - Explosive depot and used packaging burning bay and disposal area - Explosives magazine - Stores - Storage area for hazardous and non-hazardous input materials and waste - ROM stockpiles	On-going	On-going		

Main activity/process	Typical sub-activities	Construction	Operation	Decommissioning	Closure
	- Canteen - First aid station				
Processing Plant (Approved for existing mining rights area)	Delivery of ROM by truck (by conveyor for underground mining)		On-going		
	Crushing and Screening process: - Sized material screened through a vibrating grizzley - Oversize material directed through a crusher - Sized material will then pass through a sizing screen whereby material <6mm will be directed to the relevant product stockpile. Material between 75mm and 6mm will pass through a flopper gate and sizing screen which will sort the material into lots of -75 +6mm, -75 +25mm and -25 +6mm. - Dust suppression spraying via macro-nozzles will take place throughout the processing circuit		On-going		
	Transport of product: - Product will be moved via conveyors to the stackers and stockpile area within the railway loading loop for dispatch.		On-going		
	Disposal of secondary screening fines via a thickener:: - Wet fines will be transported (via internal pipelines) to the TSF		On-going		
Tailings dam (New mining rights area)	Delivery of secondary screening undersize to the thickner plant via conveyor		On-going		
	Delivery of tailings from thickener plant via pipeline		On-going		Some will be permanent
	Water management facilities include: - run-off on tailings intercepted by step ins - trenches collect run-off and seepage and divert it to the return water dam - return water dam emergency spillway	On-going	On-going	On-going	
	Construction and utilisation of site support services include: - return water pump station	On-going	On-going		

Main activity/process	Typical sub-activities	Construction	Operation	Decommissioning	Closure
	- access roads constructed from gravel material - perimeter fence - tailings slurry delivery pipelines to transport slurry from the thickener to the tailings dam - return water pipelines to return water from the return water dam to the processing plant for re-use				
Water supply and use	Construction, operation and maintenance of pipelines for water supply (process and potable)	On-going	On-going		
	Sourcing water from the Vaal Ga-Mogara Water Scheme	On-going	On-going		
	Recycling and re-use via pipelines from the following sources: - Sewage treatment plants; - Tailings return water system; - Process water dams - Storm water control dams - Shaft and open pit ingress water - Sludge dams and water control dams - Water holding facilities - Effluent water sourced externally to be used as make up water	On-going	On-going	On-going	
	Pipeline diversions	On-going	On-going	On-going	
Power supply and use	Construction, operation and maintenance of electrical overhead power lines to substation	On-going	On-going	On-going	
	Construction, operation and maintenance of substation and transformers	On-going	On-going	On-going	
	Installation of lighting plants (typically used for lighting up open pit areas)		On-going		
	Mobile diesel powered generators (typically used during construction by contractors and for back-up power)	On-going	On-going	On-going	
Transport systems	Construction, operation and maintenance of railway line	On-going	On-going	On-going	
	Construction, operation and maintenance of gravel roads	On-going	On-going	On-going	

Main activity/process	Typical sub-activities	Construction	Operation	Decommissioning	Closure
	Use of conveyors to transport manganese ore between various crushers		On-going	On-going	
	Vehicle, train and equipment servicing and maintenance workshops, spray painting and wash bays.	On-going	On-going	On-going	
	Installation and use of parking, loading and off-loading areas for trucks, buses and other vehicles	On-going	On-going	On-going	
	Transportation of staff to and from site using buses and private cars via gravel roads	On-going	On-going	On-going	
	Transportation of raw material and domestic waste using tucks/tankers via gravel roads	On-going	On-going	On-going	
	Transportation of ROM, soil and waste rock via trucks		On-going	On-going	Limited
	Transportation of product off-site via rail and truck		On-going		
Non-mineralised waste management (general and industrial hazardous)	Handling, storage and disposal of general waste on site: - Domestic waste - Uncontaminated PPE - Garden waste - Food waste - Building rubble - Paper - Plastics - Glass - Scrap metals - Rubber - Wood	On-going	On-going	On-going	
	Handling, storage and disposal of hazardous waste on site: - Batteries - Inorganic chemical waste (laboratory chemicals) - Waste oils and grease - Organic compounds and solvents (reagents, chemicals etc) - WEEE waste (electrical and electronic equipment, cartridges etc)	On-going	On-going	On-going	

Main activity/process	Typical sub-activities	Construction	Operation	Decommissioning	Closure
	- Health care risk waste (clinic waste) - Sewage sludge (sewage plant) - Explosives packaging waste - Contaminated metals, plastic, rubber and wood				
	Separation of oil and water at wash bays	On-going	On-going	On-going	Limited
	Disposal and/or treatment of contaminated soils	On-going	On-going	On-going	
	Temporary storage of domestic and hazardous waste within dedicated demarcated containers/areas	On-going	On-going	On-going	
	Removal of waste by contractor for recycling, re-use or final disposal at permitted waste disposal facilities	On-going	On-going	On-going	
	Treatment of sewage sludge at sewage treatment facility at Kudumane. The treated effluent is returned to the process water circuit.		On-going	On-going	
General site management	Appointment of contractors and establishment of contractor working camps and areas	On-going	On-going	On-going	Limited
	Site management (monitoring, inspections, maintenance, security, access control)	On-going	On-going	On-going	On-going
	Environmental awareness training and emergency response	On-going	On-going	On-going	On-going
	On-going rehabilitation of facilities/disturbed areas (where possible)	On-going	On-going	On-going	On-going
	Implementing and maintaining management plans	On-going	On-going	On-going	On-going
Other support services and amenities	First aid clinic	On-going	On-going	On-going	
	Training facilities	On-going	On-going	On-going	
	Main procurement stores with bulk storage of fuel, lubricants and chemicals	On-going	On-going	On-going	
	Main and satellite fuel storage areas	On-going	On-going	On-going	
	Various office and administration areas	On-going	On-going	On-going	
	Laboratory	On-going	On-going	On-going	
Demolition	Removing construction contractor's area			At end of phase	
	Dismantling and demolition of infrastructure and equipment. Possible blasting			On-going	
	Utilisation of site supporting services:			On-going	

Main activity/process	Typical sub-activities	Construction	Operation	Decommissioning	Closure
	- access control and security - contractors yard - workshops and wash bays - general stores - storage area for hazardous and domestic waste - formal ablution facilities within contractor yard - diesel tanks (re-fuelling equipment)				
Rehabilitation	Backfill and rehabilitating of pit void with provision for preventing surface subsidence		On-going	On-going	As required
	Replacing soil resources		On-going	On-going	As required
	Slope stabilisation and erosion control		On-going	On-going	As required
	Landscaping		On-going	On-going	As required
	Re-vegetation of disturbed areas and where infrastructure was removed		On-going	On-going	As required
	Removal of alien invasive species from rehabilitated sites		On-going	On-going	As required
	Restoration of natural drainage patterns as far as practically possible		On-going	On-going	As required
	Rehabilitation of all mineralised waste facilities and other stockpiles (TSF)		On-going	On-going	As required
	Rehabilitation of access roads		On-going	On-going	As required
	Remediation of groundwater		As required	As required	As required
Maintenance and aftercare	Initiation of aftercare and maintenance program			At end of phase	
	Maintenance and repair of post closure landforms, facilities, and rehabilitated areas, including river diversion (if deemed necessary)				On-going

2.4 PLAN SHOWING LOCATION AND EXTENT OF OPERATIONS

2.4.1 APPROVED INFRASTRUCTURE: EXISTING MINING RIGHTS AREA

The infrastructure and mining areas that were approved as part of the EIA/EMP process undertaken in 2010 (Metago, 2010) are illustrated in Figure 20.

Key approved surface infrastructure includes:
- York open cast pit (although the pit will be extended within 100 m from the Ga-Mogara river);
- topsoil stockpiles, WRDs, ROM and manganese ore stockpiles;
- stockpiling of low-grade ore;
- backfilling of York opencast pit;
- road and rail weigh bridges;
- pit dewatering and abstraction of groundwater;
- power generation facilities;
- piping and water treatment infrastructure;
- facilities associated with the transmission and distribution of electricity (below ground);
- storage and handling of spares and dangerous goods (fuel, lubricants, explosives, etc);
- maintenance and servicing areas;
- change houses and ablution facilities;
- mobile plant lighting;
- temporary waste storage and handling area;
- administration buildings;
- staff parking; and
- security and access control;

The following infrastructure approved as part of the existing EIA/EMP is yet to be established:
- crushing and screening plant for the high grade manganese ore;
- conveyors systems for crushed ore;
- stacker reclaimers and silo for the loading of crushed ore onto rail and road trucks;
- first aid clinic;
- lighting and communication infrastructure;
- surface infrastructure associated with the underground mining on Telele
- maintenance workshops and washing bays; and
- diesel holding facilities

2.4.2 PROPOSED ADDITIONAL ACTIVITIES/INFRASTRUCTURE AND MINING AREAS

Proposed changes are listed below and illustrated in Figure 21. These changes include:

Approved mining rights area

Changes to the approved infrastructure and activities associated with the existing mining rights areas (York and Telele) will result in the establishment of the following:

- extension of the York pit within 100 m of the Ga-Mogara river
- water management infrastructure, some of which was included in the approved EIA/EMP;
- soil and overburden/spoil stockpiles;
- security block;
- change houses;
- internal roads;
- waste management complex;
- sewage treatment plants;
- sewer;
- emulsion storage area (200 ton capacity);
- settlement pond;
- refuelling area; and
- pollution control dam.

Although not yet confirmed, the York pit may in future extend within 100 m of the Ga-Mogara River in which case a river diversion is being proposed as part of the Section 102 EIA/EMP which will be submitted in support of the proposed infrastructural changes within the existing mining rights area. This proposed diversion will extend onto Gama 283. Although the river diversion is addressed in Section 2 of the report, it should be noted that the impact assessment thereof will be addressed in the report submitted in support of the Section 102 EIA/EMP amendment, given that the potential need for the river diversion forms part of the existing mining rights area.

New mining rights area

The facilities listed below will be established on the additional mining rights area (Devon, Kipling and Hotazel):

- additional open pits and associated haul roads on Hotazel, Devon and Kipling;
- water management infrastructure, some of which was included in the approved EIA/EMP;
- soil and overburden/spoil stockpiles (WRDs);
- access and internal roads; and
- TSF.

2.5 LISTED ACTIVITIES IN TERMS OF NEMA EIA REGULATIONS

Activities that were authorised as part of the approved EIA/EMP (Metago, 2010) in accordance with NEMA Regulations 386 and 387 of July 2006 are included in Table 25.

The listed activities for the proposed project that are currently being applied for in terms of NEMA Regulation 544 of June 2010 are included in Table 26.

TABLE 25: APPROVED ACTIVITIES IN TERMS OF OLD NEMA REGULATIONS

Activity number	Description
	Environmental Regulation GN 386
1b	The aboveground storage of 1000 tons or more, but less than 10 000 tons of ore
1k	(i) The bulk transportation of sewage and water, including stormwater, in pipelines with – An internal diameter of 0.36 metres or more; or (ii) A peak throughput of 129 litres per second or more.
1 l	The transmission and distribution of electricity above ground with a capacity of more than 33 kilovolts and less than 120 kilovolts
1p	The temporary storage of hazardous waste
1s	The treatment of effluent, waste water or sewage with an annual throughput capacity of more than 2000 cubic metres but less than 15 000 cubic metres.
7	The aboveground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic metres but less than 1000 cubic metres at any one location or site.
13	The abstraction of groundwater at a volume where, any general authorization issued in terms of NWA 36 of 1998, will be exceeded
14	The construction of a mast of any material or type and of any height, including those used for telecommunication broadcasting and radio transmission, but excluding – (a) mast of 15 m of lower exclusively used (i) by Radio amateurs; or (ii) for lighting purposes (b) flagpoles; and (c) lightning conductor poles
15	The construction of a road that is wider than 4 metres or that has a reserve wider than 6 metres excluding roads that fall within the ambit of another listed activity or which are access roads of less than 30 metres.
	Environmental Regulation GN 387
1c	The aboveground storage of a dangerous good, including petrol, diesel, liquid petroleum gas or paraffin in containers with a combined capacity of 1000 cubic metres or more at any one location or site including the storage of one or more dangerous good, in a tank farm.
1f	The recycling, re-use handling, temporary storage or treatment of general waste with a throughput capacity of 50 tons or more daily average measured over a period of 30 days
1g	The manufacturing, storage or testing of explosives, including ammunition but excluding licensed retail outlets and the legal end use of such explosives.
1h	The manufacturing, storage, or testing of explosives including ammunition, but excluding licensed retail outlets and the legal end use of such explosives.
1l	The transmission and distribution of aboveground electricity with a capacity of 120 kilovolts or more
1p	
1s	Rail transportation, excluding railway lines and sidings in industrial areas and underground railway lines in mines but including – railway lines; stations; or shunting yard.
2	Any development activity, including associated structures and infrastructure where the total area of the development area, is or is intended to be 20 hectares or more
3	The construction of a filling station including associated structures and infrastructure, or any other facility for the underground storage of a dangerous good, including petrol diesel, liquid

Activity number	Description
	petroleum gas, or paraffin.
7	Reconnaissance, exploration, production and mining as provided for the Mineral and Petroleum Resources Development Act 2002 (Act 28 of 2002) as amended in respect of such permits and rights
8	In relation to permits and rights granted in terms of 7 above, or any other right granted in terms of previous mineral legislation, the undertaking of reconnaissance exploration, production or any other related activity or operation within an exploration, or mining area, as defined in terms of Section 1 of the Mineral and Petroleum Resources Development Act 2002 (Act 28 of 2002).

TABLE 26: NEMA LISTED ACTIVITIES CURRENTLY BEING APPLIED FOR AS PER THE JUNE 2010 REGULATIONS

Activity Number	Listed Activity	Description of activity: Approved mining rights area	Description of activity: Proposed new mining rights area
Notice 544, 18 June 2010			
9	The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water – (i) with an internal diameter of 0.36 metres or more; or (ii) with a peak throughput of 120 litres per second or more, Excluding where: a. such facilities or infrastructure are for the bulk transportation of water, sewage or storm water, or storm water drainage inside a road reserve; or b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	Pipelines longer than 1 000 metres will be established on-site for the bulk transportation of water, storm water and sewage.	Pipelines longer than 1 000 metres will be established on-site for the bulk transportation of water, storm water and sewage.
10	The construction of facilities or infrastructure for the transmission and distribution of electricity - (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or		Establishment of 3mVA powerlines within the new mining rights area.
11	The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more Where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	The approved York pit may extend into the Ga-Mogara watercourse which will require the establishment of a diversion channel up to a maximum of 85m from the original watercourse. This will however be confirmed for the purposes of the EIA/EMP amendment in support of the proposed changes within the existing mining rights area.	
13	The construction of facilities or infrastructure for the storage, and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic meters.	An emulsion storage area (200 ton capacity) will be constructed on York.	The diesel storage area within the new mining rights area will cater for the storage of 200 cubic metres of diesel

Activity Number	Listed Activity	Description of activity: Approved mining rights area	Description of activity: Proposed new mining rights area
22	The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 meters or, (ii) where no reserve exists where the road is wider than 8 meters.	Private roads will be established for mining vehicles	
28	The expansion of or changes to existing facilities for any process or activity where such expansion or changes to will result in the need for a permit or license in terms of national or provincial legislation governing the release of emissions or pollution, excluding where the facility, process or activity is included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply.		
37	The expansion of facilities or infrastructure for the bulk transportation of water, sewage or storm water where: (a) the facility or infrastructure is expanded by more than 1 000 metres in length; or (b) where the throughput capacity of the facility or infrastructure will be increased by 10 % or more- excluding where such expansion: (i) relates to transportation or water, sewage or storm water within a road reserve; or where such expansion will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.	Existing pipeline infrastructure for the bulk transportation of water will be expanded by more than 1 000 metres.	
Notice 545, 18 June 2010			
5	The construction of facilities or infrastructure for any process or activity which requires a permit or license in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent and which is not identified in Notice No. R.544 of 2010 or included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case that Act will apply	The proposed changes to the existing mining rights area, will require an amendment to the Water Use License Application that has been submitted to the Department of Water Affairs. The additional sewage treatment plants, changes to the footprint of the York pit, stormwater management facilities and dewatering activities will require authorisation.	The following will require a Water Use License Application to be submitted to the Department of Water Affairs in terms of the National Water Act, 36 of 1998: TSF and WRDs, sewage treatment plants, additional open pits, stormwater management facilities and dewatering activities
15	Physical alteration of undeveloped vacant or derelict land for residential retail, commercial, recreate; except where such physical alteration takes place for: (i) linear development activities; or (ii) agricultural or afforestation where activity 16 in this schedule (R.545) will apply.	The footprint of the proposed river diversion (if required) will require an alteration of undeveloped land on the farm Gama 283.	The footprint of the proposed surface infrastructure, including the open pits and WRDs will require an alteration of undeveloped land on the farms Hotazel and Devon.
Notice 546, 18 June 2010			

Activity Number	Listed Activity	Description of activity: Approved mining rights area	Description of activity: Proposed new mining rights area
3	The construction of masts or towers of any material or type used for telecommunication broadcasting or radio transmission purposes where the mast: (a) is to be placed on a site not previously used for this purpose, and (b) will exceed 15 metres on height, but excluding attachments to existing buildings and masts on rooftops.	A telecommunications mast will be established on site.	
14	The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation; (a) in the Northern Cape Province; (i) All areas outside urban areas.	The proposed development will require the clearance of an area larger than 5 hectares of indigenous vegetation.	The proposed development will require the clearance of an area larger than 5 hectares of indigenous vegetation.

2.6 INDICATION OF PHASES AND TIMEFRAMES ASSOCIATED WITH THE MAIN ACTIONS/ ACTIVITIES/ PROCESSES

Should the proposed project components (new mining right application and amendment to existing mining rights area) received a positive record of decision from the authorising officials, it is expected that construction will commence at the end of 2015. Should the mining right amendment and new mining right application be approved, it is expected that the life of mine will be extended as follows:

- York and Telele (opencast and underground): 30 years from start of mining operations in 2013. The life of mine of York pit alone will be 13 years;
- Hotazel (opencast): 6 years, starting in 2015
- Kipling (opencast): 13 years starting from 2021 (refined project detail still to be confirmed)
- Devon (opencast): 1 year

2.7 ADDITIONAL INFORMATION

This section provides additional technical information relative to the construction, operation, decommissioning and closure phases for the proposed project components.

2.7.1 CONSTRUCTION PHASE: NEW MINING RIGHTS AREA AND EXISTING MINING RIGHTS AREA

The construction phase that will take place for the new mining rights area as well as that which will take place in order to construct the additional infrastructure which is proposed as part of the amendment to the approved EIA/EMP incorporates by and large similar construction phase activities (unless otherwise indicated).

Contractor facilities

For the most part, existing approved contractor's working areas (see area labelled as mining support infrastructure and services in Figure 20) will be used by contractors during the construction phases both for the new mining rights area as well as for the existing mining rights area. Additional facilities required for construction include: a proposed refuelling area, wash bay and stores. These areas are indicated as proposed infrastructure on Figure 21.

Given that these facilities will still be required in the operational phase, they will be not be decommissioned at the end of closure but will form part of the operational infrastructure layout.

Employment and housing for the construction phase

The construction phase workforce is expected to be approximately 150 people. At peak construction, there will therefore be 750 workers on site, comprising the 150 construction phase workers and the

600 workers already on site (200 of which are focussing on existing construction activities). No housing is provided on site. Instead construction workers will be accommodated in the nearby communities and towns.

Transportation (routes and mechanisms) for the construction phase

Roads and access points

There is an existing network of roads in the project area (see Figure 2) that is currently utilised for the current operations. The delivery of consumables and staff will use the R31 from Kuruman and the R380 between Kathu and Black Rock. The N14 from Gauteng will also be used for the transportation of both consumables and product. Main access will be achieved via the original gravel road (D3336), which was recently tarred, off the R380/R31 adjacent to the eastern Hotazel access turnoff.

The types of materials that could be transported to and from the Kudumane Mine include:

- **To site:**
  - Staff;
  - building materials;
  - mining and plant equipment; and
  - consumables.
- **From site:**
  - Staff; and
  - Domestic, industrial and sewage waste.

During the construction phase, existing internal haul roads (as authorised in the approved EIA/EMP (Metago, 2010)) will be used to transport material and staff. Where new roads are required to connect to new infrastructure, these roads will be constructed from suitably sized and compacted waste rock as per the existing roads.

Railway siding

As part of the approved EIA/EMP (Metago 2010), a railway siding was built between the regional Transnet railway line (adjacent to the R380) and the Kudumane Mine (Figure 20). In this regard no additional construction phase facilities relating to the railway siding will be required.

Pipelines

The groundwater quality is not suitable for potable water therefore potable water will sourced from the Sedibeng Vaal-Ga Mogara pipeline. Kudumane has a signed contractual agreement with Sedibeng Water for an annual off-take of 40 000 m^3 per annum (with a minimum of 32 000 m^3 per annum). Water for construction purposes will be sourced from the infrastructure which has already been established on site. It is not anticipated that the proposed project will influence approved pipeline routes.

<u>Conveyors</u>

As per the approved EIA/EMP, when underground mining takes place, ROM will be transported via conveyor systems. These conveyor systems will be developed during the construction phase within the existing mining rights area. Where required, material will also be transported via conveyor systems through the crushing plant, onto the product stockpiles and ultimately through to the silo/loading area. Dust suppression at material transfer points (where required) will be by means of water sprays.

Power supply and use for construction

During the construction phase in both the new mining rights area and within the approved mining rights area, power will be sourced from the approved power supply (3.6 mVA was indicated as part of the original EIA/EMP) and where there is an additional requirement, less than 10 megawatts in total, this will be sourced from portable generators. The generators will be placed on impermeable floors with bunds and traps to collected any spilled diesel and lubricants.

Water supply and use for construction

Due to the expected volume of water ingress into the mine workings, no other options were considered for plant and general dust suppression water. In this regard, dewatered water from the open pits will be used for construction purposes.

Stormwater control for construction

Stormwater measures as outlined in Section 2.7.2 will be established at the start of the construction phase.

Non-mineralised waste management for construction

<u>General and hazardous waste</u>

The types of wastes that could be generated during the construction phases include:

- general waste such as office waste, building rubble and scrap metals; and
- hazardous waste such as electrical/plastic/material off-cuts, used oil and grease, polluted soil (from accidental spills), paints and solvents.

General and hazardous waste generated on site will be temporarily handled and stored on site as per current practices before being removed by contractors for reuse, or disposal at an appropriately licensed waste disposal facility in Kuruman (general) and Holfontein (hazardous). Further detail relating to general and hazardous waste management procedures is outlined in Table 34.

<u>Sewage</u>

During construction phase activities, mobile enclosed portable toilets will be placed at construction sites. The enclosed chemical toilets will be cleaned and serviced twice a week by a contractor. Three sewage treatment plants will be developed during the construction phase as part of the amendments to the existing mining rights area. These will be self-contained systems designed for a combined maximum flow rate of 21 000 litres per day.

Timing for the construction phase

Should the new mining right and mining right amendment be granted, construction phase activities are expected to commence during the latter half of 2015.

2.7.2 OPERATIONAL PHASE: NEW MINING RIGHTS AREA AND EXISTING MINING RIGHTS AREA (EXISTING AND PROPOSED INFRASTRUCTURE)

Employment and housing for the operational phase

The proposed operational phase workforce is expected to be approximately 100 people (for the additions), on top of the 400 existing operational staff. No housing is provided on site. Instead construction workers are accommodated in the nearby communities such as Kathu, Hotazel and Kuruman.

Transportation (routes and mechanisms) for the operational phase

During the operational phase, there will be additional employees and contractors travelling to and from site, vehicles transporting ROM (both new and approved mining rights areas), and conveyors transporting ROM (underground mining on existing mining rights area only), vehicles removing waste material, and trucks and trains transporting manganese product. Table 27 below provides a conceptual indication of the traffic volumes associated with the operational phase of the Kudumane Mine when both road and rail transport is used).

TABLE 27: OPERATIONAL PHASE TRAFFIC: MATERIALS AND STAFF (WHEN BOTH ROAD AND RAIL TRANSPORT IS USED)

Items to be transported		Transport mechanism	Approximate trips per day – 6 days a week	Most likely route
Group	Specific			
Staff and visitors	Skilled, semi-skilled and unskilled	Private vehicles / mini bus/ buses	156 / day	From Kathu, Hotazel and Kuruman.
Raw materials and domestic waste	Plant raw materials	30-tonne trucks	5 / week	From Kuruman or Gauteng via the N14, the R31 and/or the R380.
	Explosives	30-tonne trucks	5/ week	
	Diesel	Tanker	2 / week	
	Spares truck	30-tonne trucks	1 / week	
	Other consumables	Trucks	1 / week	
	Domestic and industrial waste collection	Trucks	1 / week	

Items to be transported		Transport mechanism	Approximate trips per day – 6 days a week	Most likely route
Group	Specific			
Within the mining operation	Ore	Haul trucks	From Hotazel = 179 loads per day From Devon = 179 loads per day	From mining areas to processing and crushing areas. Public road to be crossed.
	Tailings	Pipelines	Within the boundaries of the surface use area	Internal pipelines established for the project.
	Process water	Pipelines		
	Potable water	Pipelines		
Outside the mining operation	Manganese product	By rail.	Between 1 and 2 trains a day. No road vehicles.	Export manganese product to the coast using railway line.

Roads and access points

Access will be by means of the routes and mechanisms described under the construction phase in Section 2.7.1.

Pipelines

Operational pipelines are the same as those described under the construction phase in Section 2.7.1.

Conveyors

Operational conveyors are the same as those constructed during the construction phase and detailed in Section 2.7.1.

Railway siding

During the operational phase, the railway siding will enable transportation of product and some incoming materials by means of trains. Initially one train load per day of product will be transported from site. This may increase to two trains a day if production increases as planned. Loading of trains at night on weekends will be limited if possible. In addition, Kudumane will adhere to any specific conditions imposed by Transnet for the operation of the railway siding.

Power supply and use for the operational phase

The power requirements for the mine will not be greater than the approved 3.6 mVA at full production. The primary source of this power will be Eskom but in the short term, diesel generators (up to a maximum of 10 megawatts) will be used until Eskom is in a position to supply the required power. Thereafter the diesel generators will be retained as a back-up to Eskom power.

A substation has been constructed in order to receive power from a regional Eskom powerline (Eskom's planned Kalagadi powerline). The substation is equipped with transformers and switchgear to enable the voltage from the regional line to be stepped down and internally distributed. The substation is also equipped with impermeable floors, bunds and collection traps where required to contain any spills of lubricants.

Internal power reticulation (from the diesel generators and the substation) will be by means of a distribution network comprising powerlines and mini substations.

Water supply and use for the operational phase

The groundwater quality is not suitable for potable water therefore potable water will sourced from the Sedibeng Vaal-Ga Mogara pipeline. Kudumane has a signed contractual agreement with Sedibeng Water for an annual off-take of 40 000 m^3 per annum (with a minimum of 32 000 m^3 per annum).

Stormwater control for operations

As per the approved EIA/EMP (Metago, 2010) water management systems have been designed, implemented, and managed in accordance with the provisions of Regulation 704, 4 June 1999 (Regulation 704) for water management on mines. In general, the footprint of all dirty areas will be minimised by isolating these areas from clean water runoff and dirty water will be contained in designated systems. In this regard the management of stormwater generated at the mine includes the diversion of clean water.

The approved EIA/EMP (Metago, 2010) made provision for some water management infrastructure which included clean water diversions, dirty water interception channels, a dirty water containment facility as well as water containment channels around the pit. These plans are being expanded on in order to cater for the new mining rights areas and infrastructure as well as the infrastructural changes that will take place within the existing mining rights areas.

The key features of the proposed conceptual stormwater management plan which has been designed to cater for new mining rights area and additional infrastructure/activities within the existing mining rights area, include the following (see Appendix H for detail):

- off-site runoff from clean catchment to the east of the mine will be diverted around dirty areas and allowed to flow towards the river;
- dirty storm water from the TSF will drain along with any process water to a suitably sized return water dam and re-used at the processing plant;
- dirty stormwater from the WRDs, stockpile areas, railways siding, wash bay, weigh bridge, refuelling or vehicular servicing areas, any contractors areas, and the processing plant will be conveyed to one of five suitably sized pollution control dams (PCDs) and re-used at the processing plant or used for dust suppression subject to water quality; and
- dirty stormwater generated within the pits and from areas which drain into the pits will be collected within a drainage sump along with any groundwater seepage, and pumped out for re-use or used for dust suppression subject to water quality.

In order to meet the design principles above, the following stormwater management measures are proposed:

- five PCDs;

- two in-pit drainage sumps;
- five clean water diversion channels; and
- twelve dirty water interception channels.

The report has sized PCDs for dirty stormwater to accommodate runoff from the 1:50 year design rainfall (24 hour) event and the highest monthly rainfall (February) falling over the catchment, less the corresponding monthly evaporation (February) taking place over the surface area of the proposed containment facility. This does not include the addition of any process water and/or dewatering inputs.

A pre-feasibility study (PFS) design for the TSF was undertaken by SLR in April 2014 (Appendix P), which recommends that a HDPE lined return water dam (RWD) of 37 380m^3 is required to store runoff and process water from the TSF to ensure it is unlikely to spill more than once in 100 years. It is recommended that this volume is checked by a daily timestep water balance model during detailed design of the TSF to ensure the design is compliant with Condition 6 of GN 704.

Disturbance of watercourses: Existing mining rights area

The Ga-Mogara river, a major river within quaternary catchments D41K and D41J, is the closest watercourse to the Kudumane Mine, and it is expected that at full extent, the York pit may encroach within 100 m of the river. Should this be the case, SLR will design a conceptual river diversion plan which will be submitted as part of the Section 102 EIA/EMP in support of the changes to the approved mining rights area and which will allow for the river to be diverted around and away from the pit. A preliminary design has been considered, and if it is decided that the river diversion will be undertaken, it will incorporate the following aspects:

- a 1:50 year peak flow of 55m^3/s was estimated from a comprehensive flood study which drew from regional and local hydrological information, anecdotal evidence from historical events, and flow estimates using regional methodologies;
- to account for the uncertainties in the estimation of the flood peak it has been recommended that a 1 m freeboard is applied to the resulting water levels;
- over the 30 year life of the mine there is a 45% probability of an event less frequent than that designed for flooding the pit;
- the diversion channel will be located a maximum of 85 m west of existing Ga-Mogara as illustrated in Figure 21;
- the diversion channel will be 1000 m in length and typically 3 m deep with a 13 m wide base. The majority of the channel length will be in-cut apart from a short length at the entrance where an embankment will be required to direct flows from the existing channel into the diversion. The end of the channel follows a 181 m radius curve to take it back onto the existing watercourse alignment. Where it re-enters the existing watercourse a low stone weir is proposed to locally

control flow velocities. For this channel geometry, the design flow depth will be 2 m giving a freeboard of 1 m;
- erosion protection will be included within the diversion channel and based on estimate of flow velocities, a lining of 30 – 35 mm diameter inert stone material is proposed;
- the channel bed slope is designed to match that of the natural river channel; and
- preliminary design focused on surface/flood flow element only and no consideration has been made for sub-surface flow paths at this stage.

If it is necessary to divert the river, the final design of the river diversion will take the following into consideration:
- the requirements of the Department of Water Affairs, including the consideration of a temporary or permanent diversion;
- an assessment of the consequences of design exceedance which may result in flooding of the open pit and underground workings;
- management of potential sub-surface (hyporheic) flow paths if present; and
- management of ecological impacts by recreating any lost in-channel habitats within the diversion channel.

It should be noted that in the absence of information regarding whether the proposed river diversion will be permanent or temporary in nature, a worst case scenario approach will be taken whereby the following applies:
- preliminary engineering design and footprint;
- the presence of sub-surface (hyporheic) flow paths. This aspect will be investigated prior to finalising the design;
- a reliance on the sub-surface water by riverine vegetation. This aspect will be investigated prior to finalising the design; and
- the diversion will be of a permanent nature which implies that the original watercourse will not be re-instated after the cessation of mining activities.

Whilst information pertaining to the possible river diversion has been included for the purposes of the project description, it should be noted that the diversion is proposed within the existing mining rights area and will therefore not be assessed in the impact assessment section (Section 7) of this report given that this report will be submitted in support of the new mining right application. Instead, the river diversion impacts will be assessed in the EIA/EMP amendment report which is submitted in support of the Section 102 application and is run in parallel to the current EIA/EMP process. Should it not be necessary to divert the river around the pit (i.e. the pit will not encroach within 100 m of the pit), then this will not be assessed in the Section 102 EIA/EMP report.

Water balance

A site wide water balance was undertaken as part of the specialist hydrology study (Appendix H). The water balance shows that during the initial years of mining when negligible groundwater inflow to the pits is expected, makeup water will be required during the dry season but excess water is anticipated during the wet season. During the later years when groundwater inflows are higher, excess water is anticipated in both the wet and the dry season.

Non-mineralised waste management for the operational phase

General and hazardous waste

The types of wastes that could be generated during the operational phase include:

- general waste such as office waste, building rubble, scrap metal and rubber, glass, plastic, wood, garden waste, food waste and uncontaminated PPE; and
- hazardous waste such as electrical/plastic/material off-cuts, used oil and grease, used chemicals, polluted soil (from accidental spills), paints and solvents, medical and laboratory waste, explosive packaging, contaminated metals, plastic, rubber.

General and hazardous waste generated on site will be temporarily handled and stored on site before being removed by contractors for reuse, or disposal at an appropriately licensed waste disposal facility (Kuruman for general waste and Holfontein for hazardous waste). Further detail relating to general and hazardous waste management procedures is outlined in Table 34.

Sewage

Three treatment plants will be developed during the construction phase within the existing mining rights area. These will be self-contained systems designed for a combined maximum flow rate of 21 000 litres per day.

The position of the sewage treatment plants is shown in Figure 21. With reference to Figure 24 below, the sludge activated sewage treatment process and stages are described in further detail below.

Anaerobic treatment

Raw sewage stored in the inlet buffer tanks is pumped to the anoxic tank for anaerobic treatment. Anaerobic treatment allows for bacterial processes to be carried out in the absence of oxygen to allow for the digestion of sludge.

Aeration treatment

Sewage effluent from the anoxic tank will be transferred to the aeration tank, where air (oxygen) will be introduced into the system by means of a Diffused Air Header, driven by Side Channel Blowers. Aeration treatment allows for bacterial processes to occur which enables bacteria to rapidly consumes organic matter.

Any debris (floating fraction of sewage solids) collected on the surface of the sewage effluent during aeration treatment will be removed and stored in a conservancy tank prior to being removed off-site by a certified contractor

Settling

Effluent from the aeration tank will be transferred to the settling tank. Solids (sludge) settle out in the bottom of the tank and clear supernatant flows upwards and over to the collection weir to the Chlorine Contact Tank. Sludge that has settled at the bottom of the settling tank will be sent back to the anoxic tank for further treatment. Any excess sewage sludge remaining in the settling tank will be removed by a certified contractor, when required.

Chlorination

The sewage effluent in the chlorine contact tank is subjected to inline chlorination by means of Sodium Hypo-chloride, calcium hypo-chloride or chlorine gas. Chlorination ensures that any remaining bacteria is killed.

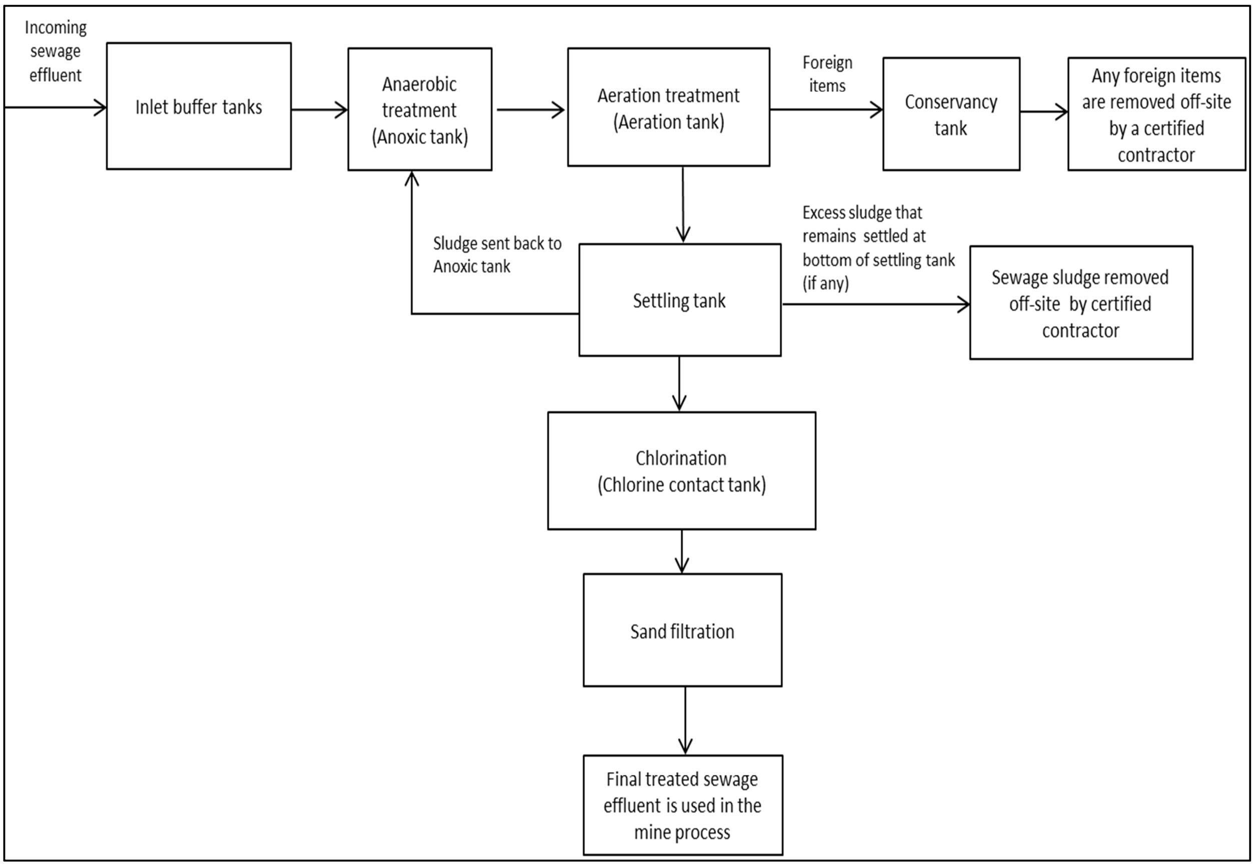
Filtration

The final effluent is processed through a series of sand filters to remove any remaining suspended solids.

Treated sewage effluent

Treated sewage effluent will be collected in a lined dam and re-used within the mine process. The treated sewage effluent will not be used for domestic purposes. Any sewage sludge will be removed off site by a certified contractor and disposed of at a licensed sewage works.

FIGURE 24: SEWAGE TREATMENT PLANT PROCESS



Mineralised waste management for the operational phase

The relevant mineralised wastes are discussed below:

Waste rock dumps (WRDs) (new and approved mining rights area)

The approved EIA/EMP (Metago, 2010) made provision for two WRDs and a low grade ore/waste rock stockpile. The position of the approved WRDs is illustrated in Figure 20. Three additional WRDs are being proposed on Hotazel (two WRDs) and Devon (one WRD) to cater for the mining of the historical pits. The design features (of both the approved and proposed WRDs), in compliance with Section 73 of Regulation 527, is outlined in Table 28 below.

TABLE 28: DESIGN FEATURES FOR THE APPROVED (AND NEW) WASTE ROCK DUMPS (METAGO, 2010 AND SLR 2014)

Feature	Detail
Physical Dimensions	The total area to be covered by the three new WRDs over the life of the mine is approximately 160 ha, with an approximate total volume of 90 Million tons storage capacity.
Physical characteristics	The material comprises waste rock of large rock and stone sizes. The water content is expected to be about 5%. The void ratio is approximately 0.5.
Chemical characteristics	In its natural form the polluting potential is expected to be less than that of the

Feature	Detail
	tailings (see Section 1.1.1).
Management, transport, placement and mine void backfilling	Waste rock will be loaded onto trucks and transported to the WRDs. As part of ongoing rehabilitation and pollution control, the open pit will be backfilled with the aim of reinstating the original profile comprising topsoil on top, with soft subsoil (excavatable) material and the harder rock material in the layers below.
Diversion	Storm water trenches will be provided around the WRDs to direct clean storm water, run-off around and away from the WRDs.
Topsoil Stripping	Topsoil in the WRD footprint areas will be stripped and stockpiled in accordance with the soil conservation procedure (Table 35) and will be stockpiled at the topsoil stockpile near the TSF area. Stripping and stockpiling of topsoil will be done immediately in advance of dumping.
Lining	No lining will be provided for the waste rock dumps which have already been approved. The lining of the proposed new WRDs which are yet to be constructed will be confirmed by DWA.
Side slopes	The slopes of the WRDs should not exceed 26 degrees.
Under Drains	No under drainage will be provided.
Access and Access Control	Mining haul roads will be constructed using waste rock. No perimeter fence will be provided around the individual WRD. Rather a perimeter fence around the whole of the mine site will be installed.
Waste Minimisation	Waste rock will be used to construct foundations and haul roads if required. It will also be used to backfill the open pit as part of the rehabilitation process.
Monitoring	A monitoring strategy will be developed to manage excessive surface cracking, bulging, foundation creep, and seepage at the WRD.
Dust Control	Operational Phase: Roads will be watered using water and/or chemical solutions for dust suppression. Post Operational Phase: No measures necessary due to rehabilitation. Monitoring will form part of the overall site monitoring.
Closure	Material from the WRDs will be used during the backfilling of the pits. Where WRDs remain after mining because of the bulking factor, these will be flattened to a maximum side slope of 1V: 8H. Land use options for rehabilitation will be considered during the life of mine. On closure of any remaining WRDs, access ramps and berms will be eliminated prior to rehabilitation to reduce erosion risks.

The safety classification for the proposed WRDs was determined in accordance with the South African Code of Practice for Mine Reside *Safety classification of waste* Deposits (SANS 10286:1998) and the requirements of Mineral Regulation 527 of 23 April 2004. The summarised classifications are included in Table 29.

TABLE 29: SAFETY CLASSIFICATION CRITERIA FOR THE WASTE ROCK DUMPS

Criteria No.	Criteria		Comment	Safety Classification
1	No. of Residents in Zone of Influence	0 (Low hazard)	There are no farmhouses or other structures within the zone of influence.	Low Hazard
		1 -10 (Medium hazard		
		>10 (High hazard)		
2	No. of Workers in Zone of Influence	<10 (Low hazard)	The waste rock dumps are located near the open pits and as such mine workers may be located in the zone of influence, however majority of the main activities will take place in the pit areas.	Low Hazard
		11 – 100 (Medium hazard)		
		>100 (High hazard)		
3	Value of third party property in zone of influence	0 – R2 Million (Low hazard)	No formal assessment of the value of property has been done in the zone of influence. The characteristics of the waste rock dumps are such that catastrophic failures will be localised and no extended flow will be experienced.	Low Hazard
		R2 – R20 million (Medium hazard)		
		>R20 million (High hazard)		
4	Depth to underground mine workings	>200 m (Low hazard)	There are no known underground mine workings beneath WRDs.	Low Hazard
		50 m – 200 m (Medium hazard)		
		<50 m (High hazard)		

With reference to Table 29 above, the proposed WRDs are classified as a low safety risk.

Environmental classification for the waste rock dumps

The WRDs may be associated with leachate contamination that could impact groundwater resources. In addition to the above, dust emissions pose a potential risk to the surrounding environment. The WRDs are therefore classified as having a potentially significant environmental impact. In the mitigated scenario, the WRDs impacts on air and water can be mitigated to a lower significance. In this scenario there is less potential for significant impact on the environment. More discussion on the impacts and proposed management measures are included in Sections 7 and 19 of the EIA/EMP report.

<u>Tailings Storage Facility (TSF) (New mining rights area only)</u>

SLR has undertaken the Prefeasibility Study for the proposed Kudumane TSF (Appendix P). The conceptual design features associated with the TSF which will be located on the farm Devon, have been developed in compliance with Section 73 of Regulation 527, and are outlined in Table 30 below. The proposed TSF layout has been included in Figure 22.

TABLE 30: DESIGN FEATURES FOR THE PROPOSED TSF ON DEVON (SLR, JUNE 2014)

Feature	Detail
Physical Dimensions	Footprint = 220 000 m^2 (22 ha); Max height = 15.4 m; Volume = 2.8 million tons, deposition of solids per year = average of 70 000 t
Physical properties	Particle size = less than 0.15mm, Solids mass = 20%, liquid mass = 80%, particle specific gravity = 3.8, slurry density = 1.2 t/m^3, dry density of slurry = 0.2 t/m^3 (1.8 after consolidation), average void ratio = 0.85.
Chemical properties (based on conclusions for a neighbouring operations EIA)	SLR experience on similar tailings at surrounding manganese mines is that all heavy metals that may leach are expected to be within the acceptable risk limit. Potentially elevated manganese levels are not expected to contaminate. There is no measurable potential to generate acid on oxidation of sulphides, which are virtually absent. Confirmatory test work is part of the recommendations once tailings samples become available.
Lining	The TSF will not be lined. The TSF basin will be prepared by means of site clearing, topsoil removal and basic compaction.
Delivery and Deposition	The tailings will be deposited via a steel spigot pipeline along the length of the starter walls. Once the tailings has reached the elevation of the starter walls, tailings depositing will cycle from one end of the spigot pipeline to the other to allow the formation of bund walls for the continual raising of the spigot pipeline. The TSF will be developed by upstream method of tailings deposition. The rate of rise of the TSF is limited to a maximum of 1.8 m/year or less to ensure that the deposited tailings sufficiently dries and consolidates, and has sufficient shear strength to support additional newly placed tailings material and wall. The life of the first phase will be approximately 14 years; during the 12^{th} year of operation, the construction of phase 2 should take place. Decanting will be via penstock inlets throughout the life of the TSF. The decanted pool water discharges via a penstock outfall pipeline into an energy dissipater structure, from where decant water flows into a concrete lined solution trench which in turn conveys water into the concrete lined silt trap. The silt trap discharges water directly into the return water dam (RWD).
Rate of rise	The allowable rate of rise is the time it takes a layer to reach a moisture content at which shrinkage ceases. The rate of rise of the TSF is limited to a maximum of 1.8 m/year.
Storm water diversion	The stormwater system has a stormwater trench and berm system (using a cut-to-fill operation) adjacent to the north and north-western slope of TSF phase 1, to direct runoff around the TSF. Any rainfall falling on the TSF or between the TSF and the solution trench, is directed to the RWD.
Topsoil Stripping	Topsoil will be stripped to a depth of between 0.3 m to 0.5m and stockpiled in accordance with the soil conservation procedure. Stripping and stockpiling of topsoil will be done as part of the initial TSF construction.
Embankments /slopes and walls	The overall side slopes of the TSF will be limited to a maximum of 1:3 for rehabilitation purposes. The TSF will have placed waste rock starter walls with a crest width of 8m and height of 6m constructed from waste rock stripped at the pit.
Under Drains	The tailings and underlying soils are free draining, but will have a relatively low water content and will produce a small amount of supernatant water. Despite this, provision has been made for under drainage located at the toe of the TSF.
Decant System	Decanting will be via penstock inlets throughout the life of the TSF. The decanted pool water discharges via a penstock outfall pipeline into an energy dissipater structure, from where decant water flows into a concrete lined solution trench which in turn conveys water into the concrete lined silt trap. The silt trap discharges water directly into the RWD.
Access and	Access to the TSF will be via an 8 m wide access road located around the

Feature	Detail
Access Control	perimeter of the facilities. The road is to be constructed using waste rock sourced from overburden stripped from the pits. The TSF and stormwater dam are to be surrounded by a 2 m high 6 stranded barbed wire fence so as to prevent unauthorised entry.
Waste Minimisation	This EIA/EMP only makes provision for a 30 year life of mine. After the 30 years, re-mining of the proposed TSF may be considered and a new TSF may be required. Should this be a feasible option for Kudumane, the EIA/EMP report would need to be amended in future and the necessary environmental approvals obtained to cater for these changes.
Rehabilitation	Rehabilitation will be conducted concurrently as the outer wall rises. The exposed face of the TSF, upon reaching the designated toeline, is to be covered with waste rock to reduce dust and assist with access. Waste rock and/or vegetation will be used for concurrent rehabilitation of the out walls.
Monitoring	A management system and monitoring programme should be established prior to commissioning of the facility. The facility operator will typically need to ensure that: • beach formation and pond location are controlled; • the minimum specified freeboard is maintained; • the rate of rise of the facility is kept within prescribed limits; • the tailings deposition cycle is controlled to optimise drying; • the concentration, flow and discharge of storm water is controlled such that damage is prevented; and • access is controlled.
Dust Control	The TSF access roads and ramps will be watered as necessary to ensure that dust pollution is kept to a minimum. In addition, concurrent rehabilitation through waste rock and/or vegetation of the TSF outside slopes will further reduce dust emission rates.
Closure	At the end of the dam's life the tailings surfaces will be covered with waste rock and/or vegetation. It is envisaged that the remaining surfaces will be accessible within the first month following closure for the removal of pipelines, valves, etc.; minor earthworks to roads, trenches, etc.; and reshaping of the storm water dam and spillway

Safety classification of the proposed tailings dam

The safety classification for the proposed TSF was determined in accordance with the South African Code of Practice for Mine Residue Deposits (SANS 10286:1998) and the requirements of Mineral Regulation 527 of 23 April 2004. The summarised classifications are included in Table 31.

TABLE 31: SAFETY CLASSIFICATION CRITERIA FOR THE PROPOSED TSF (SLR 2014)

Number of Residents in Zone of Influence	Number of Workers in Zone of Influence	Value of Property in Zone of Influence	Depth to Underground Mine Workings	Classification
0	**< 10**	**0 – R2m**	**> 200m**	**Low**
1 – 10	11 – 100	R2m – R20m	50 – 200m	Medium
> 10	> 100	> R20m	< 50m	High

With reference to Table 31, the Kudumane Mine TSF therefore classifies as a Low hazard dam with a low risk of occurrence (SLR, 2014). The low hazard classification is based on the current layout of the mine plan with the TSF at the downstream boundary of the Devon mine site and the surrounding mixed woodland vegetation zones which have been rated as having low sensitivity.

In accordance with regulation 73 of the MPRDA Regulation 527 (April 2004), a risk analysis is required before project implementation.

Environmental classification for the tailings dam

The TSF does not pose a potential threat to the contamination of groundwater resources from leachate given that the facility is lined. Dust emissions however do pose a potential risk to the surrounding environment. In the mitigated scenario, the TSF impacts on air can all be mitigated to a lower significance. The TSF is therefore classified as a low to medium hazard facility because with mitigation there is less potential for significant impact on the environment. More discussion on the impacts and proposed management measures are included in Sections 7 and 19 of the EIA and EMP report.

Additional support services and facilities

Diesel storage facilities

Kudumane has approval for the storage of diesel on site at York. Additional diesel will be stored for the purposes of the new and amended project scope. The existing diesel storage and refuelling area is located within the existing mining rights area (see Figure 21 for the location of the refuel area). Additional diesel storage facilities (with a capacity of 200 000 l will be constructed within the new mining rights area, and this has also been indicated on Figure 21). The combined volume (volume already approved together with the additional diesel requirement) will be below the NEM: AQA threshold of 1000 m^3 and therefore does not trigger an Air Emissions License.

Offices and workshop infrastructure

Kudumane is proposing to build a new wash bay, stores, admin area and related infrastructure within the new mining rights area on Hotazel. The position of the approved location of these facilities is illustrated in Figure 21.

Low grade stockpile

The approved EIA/EMP made provision for a low grade ore stockpile area. Refer to Figure 20 for the position of the stockpile. It is expected that the revised location of the low grade ore stockpile is indicated as “stockpile area” in Figure 21 (also within the existing mining rights area).

Operating times

As per the approved EIA/EMP (Metago, 2010), mining and related activities will occur continuously (24 hours a day, 7 days a week).

2.7.3 DECOMMISSIONING PHASE: NEW MINING RIGHTS AREA AND EXISTING MINING RIGHTS AREA

The approved EIA/EMP (Metago, 2010) noted the environmental objective is to restore the pre-mining potential of the land. An overview of the decommissioning activities that will take place on site during the decommissioning phase (both within the new mining rights area as well as within the existing mining rights area) is provided in Table 24 in Section 2.3.

Decommissioning activities that will be undertaken include the following:
- dismantling and demolishing of infrastructure;
- backfilling the open pits with waste rock material;
- replacing topsoil resources on disturbed areas;
- stabilising underground mine workings (existing mining rights area only);
- stabilising and profiling of permanent WRDs;
- rehabilitation of the disturbed areas where infrastructure has been removed by sloping, filling in excavations and re-vegetating where possible;
- the surface of the tailings dam will be covered with waste rock and/or vegetation (new mining rights area only);
- dismantling and rehabilitation of railway tracks and rehabilitation of roads (depending on end use); and
- ensure that vegetation on rehabilitated areas is sustainable.

2.7.4 CLOSURE PHASE: NEW MINING RIGHTS AREA AND EXISTING MINING RIGHTS AREA

An overview of the closure activities that will take place on site during the closure phase are listed in Table 24 in Section 2.3. Further detail were required is provided below. The closure activities include:
- there will be a period of active after-care followed by a passive after-care phase;
- maintenance of vegetation where this is used for rehabilitation;
- maintenance of facilities such as fencing, fire breaks, access roads and ramps, overflow structures;
- removal of any invasive species from the rehabilitated sites;
- inspecting on an annual basis to repair any erosion gullies; and
- monitoring of potential groundwater pollution plumes.

2.8 PROJECT ALTERNATIVES

2.8.1 TECHNOLOGY ALTERNATIVES

<u>Mineral processing method (New mining rights area)</u>

No significant mineral processing alternatives have been considered for the purposes of the project. The approved method currently in place at York was deemed to be the most suitable processing method considering the nature and type of materials mined on site. Given that the proposed new mining rights area will allow for the mining of similar (or identical) ore, it is assumed that the current mineral processing method be continued for the processing of the ROM mined from the new mining rights area as well.

2.8.2 LAYOUT ALTERNATIVES

Surface infrastructure layout option (New mining rights are and existing mining rights area)

No alternatives for the location of surface infrastructure area has been considered given that the location of the historical pits and the existing pit on York is fixed, and the support surface infrastructure needs to be located within close proximity to this. In addition to this, the infrastructure needs to fall within the dirty stormwater containment systems and needs to cover the smallest possible footprint area. For the purposes of the existing mining rights area, no alternative locations for the additional infrastructure has been considered given that the additional infrastructure (PCD, stockpile etc.) need to be located within close proximity to the existing operations on site so as to serve as support infrastructure to the current operations.

Moreover, for both the new and existing mining rights area, the location of surface infrastructure is further limited by the fact that the project areas are bordered by the Ga-Mogara river to the west. Further constraints relate to the geotechnical suitability (load-bearing capability) of the ground on which structures can be built and stockpiles established.

Tailings Storage Facility (new mining rights area only)

Normally a fairly rigorous site selection process is applied in which the trade-offs, reliability and affordability can be assessed for alternatives and method of TSF development. Given the uniformity of the conditions across site, the site selection process is largely driven by the layout and requirements of the mine (pits, WRDs, stockpiles, infrastructure positions etc.)

In considering the placement of the TSF, various larger areas as indicated in Figure 23 were evaluated as proposed alternative areas within which the TSF could be placed. These areas therefore do not pinpoint an exact location alternative for the TSF itself, but rather provided an initial indication of the suitability of positioning the TSF within the larger area from an environmental perspective. The evaluation of the sites is summarised in Table 32

For the purpose of identifying suitable alternatives within the current mining rights as well as proposed mining rights areas, the following larger areas, as indicated in Table x, were considered:

- Area 1, located on the farm Hotazel;
- Area 2, located on the farm Telele; and

- Area 3; located on the farm Devon

TABLE 32: ALTERNATIVES ASSESSMENT TO IDENTIFY PREFFERED AREA FOR THE LOCATION OF THE TSF

Criteria	Assessment			Discussion
	Area1	Area 2	Area 3	
Biodiversity (terrestrial and aquatic fauna, flora)	1	3	2	The entire project area falls within the Griqualand West Centre of Endemism. Area 2 is located with the Mixed Woodland and Acacia Erioloba Savannah vegetation zones, which have been allocated a sensitivity rating of low and high, respectively (EMS, June, 2014). Areas 1 and 3 are located in Mixed Woodland vegetation zones, which have been rated as having a low sensitivity. It should be noted that Area 3 will be in close proximity to the proposed biodiversity off-set area to the north west.
Heritage and palaeonotological resources	2	1	1	The only heritage resources identified within the project area, are located on Hotazel (Area 1). This identified area however falls outside the proposed TSF location within Area 1.
Soils	1	1	1	All three sites are located within predominantly Hutton soil types, with small portions of Area 2 and 3 incorporating some Mispah soils. None of these soils have been identified as being sensitive.
Groundwater regime and impacts on downstream users	1	1	1	General aquifer configurations are not expected to differ considerably between the three areas. In this regard, we expect to find shallow weathered aquifer underlain by deeper fractured aquifer across all three areas. The deeper fractured aquifer might show different characteristics due to potential preferred pathways along dykes and geological contacts. However, the area in which the mine is located is classified as a poor to minor aquifer region, which implies a low to negligible yielding aquifer system of moderate to poor water quality. It is expected that the groundwater impacts associated with the TSF would be similar for all three areas.
Proximity to surface water resources	2	3	3	The Ga-Mogara river is in close proximity of the all the areas. Should the TSF be located in Area 2, on the farm Telele, it would require the pumping of tailings across the Ga-Mogara. This presents a risk for surface water pollution associated with leaking or burst pipelines and has therefore been given a higher rating. Area 3 is furthermore located to the east of the Ga-Mogara and north of the non-perennial Witleegte river, a tributary to the Ga-Mogara. When considering the final placement of the TSF within the preferred area, consideration will be given to the final proximity to the Ga-Mogara as well as the Witleegte.

Criteria	Assessment			Discussion
	Area1	Area 2	Area 3	
Visual impact – proximity to residents in the surrounding communities	3	2	2	Although the topography of the project area is relatively flat, Area 1 (Hotazel) is located closer to the Hotazel town and is therefore given a higher risk rating than the other two areas. From a visual perspective, a TSF located within Area 2 or 3 will be visible from the publicly used roads. It should also be noted that a farmhouse is located south of Area 2 and Area 3 on the farm Botha 313. Although it is currently unoccupied, consideration should be given to the fact that it could become occupied in future.
Dust and noise impacts- proximity to residential areas from	3	1	1	Area 1 (Hotazel) is located closer to the Hotazel town and is therefore given a higher risk rating than the other two areas. Given the fact that the predominant wind direction is from a north-easterly direction, Area 2 and 3 are expected to have a similar impact on the residential area in Hotazel (i.e. wind blows away from the town), which is located over 3.5 km to the north-east. It should also be noted that a farmhouse is located south of Area 2 and Area 3 on the farm Botha 313. Although it is currently unoccupied, consideration should be given to the fact that it could become occupied in future.
Sterilisation of minerals	1	3	1	Telele has been earmarked for underground mining operations and there is therefore a potential for sterilising minerals underlying Area 2. At this stage the mining depths and associated safety buffers have not yet been concluded and in line with this a higher risk rating has been attached to Area 2. Based on available geological information, no mineral resources are located beneath Areas 1 and 2.
Proximity and potential interference with surface infrastructure/activities – 3rd party	3	2	3	Area 1 (Hotazel) is located closer to the Hotazel town and is therefore given a higher risk rating than the other two areas. All three alternative sites are located in close proximity to roads used by third parties. A farmhouse is located south of Area 2 and Area 3 on the farm Botha 313. Powerline, pipeline and rail infrastructure runs along the northern boundary of area 3. It should be noted that Kudumane owns portion 0 of Devon (Area 3) and Portion 1 of Telele (Area 2).
Total	**17**	**17**	**15**	**Area 3 is preferred**

Although only marginally, Area 3 was identified as the preferred alternative option for the final positioning of the proposed TSF when considered as a function of all required criteria. The conclusion for the site selection process is that the TSF can be placed anywhere within Area 3, with the only consideration being its location relative to the non-perennial rivers (Witleegte and Ga-Mogara) and mine infrastructure (pits etc.).

A further qualified subjective approach instead of a quantified numeric approach was therefore applied by the engineers responsible for the designing of the TSF facility to identify the final location within Area 3. The results of the qualified approach are:

- **TSF volumetric capacity and footprint:** The flat nature of the site makes it possible to place the TSF anywhere on site. This is therefore not a compelling factor with regards to site selection;
- **topography and drainage:** The topography is flat and uniform across the site. The site is located to the east of the non-perennial Ga-Mogara and to the north of the Witleegte river, a non-perennial tributary to the Ga-Mogara. The TSF site placement therefore needed to be cognisant of this fact;
- **government legislation:** The entire site (Devon) is outside the 1:100 year floodline and is more than 100 m from the nearest watercourse, estuary or well. This factor therefore has no impact;
- **depth to underground workings:** The planned (and approved) underground workings on Telele will be approximately 650 m deep. This factor therefore has a negligible impact;
- **distance from blasting area:** The proposed site for the TSF is over 500 m from the planned and approved open pit operations. This factor therefore has a negligible impact;
- **distance from plant area:** The TSF is positioned according to the requirements of the mining operations. The TSF does not have the plant within its zone of influence (failure zone) as prescribed in the SANS 10286 (Code of Practice for Mine Residue Deposits). This factor therefore has a negligible impact;
- **geology and hydrogeology:** Although a specialist geohydrological study has been undertaken (SLR, July 2014), no modelling was done as part of the scope of this report. In light of this, the impacts of the TSF can only be concluded once the modelling has been done. This has been included as a recommendation in the geohydrology specialist study and will be undertaken for the purposes of the WULA;
- **infrastructure and settlements:** The TSF is positioned at the downstream end of the site and a sufficient distance (more than 500 m) away from pits and plant such that these infrastructures fall outside its zone of influence. The predominant north-easterly wind will result in dust being blown away from the plant and pit areas. This factor has a minimal impact.

2.8.3 THE "NO PROJECT" OPTION

The assessment of this option requires a comparison between the options of proceeding with the project with that of not proceeding with the project.

The consequence of not proceeding with project associated with the new mining rights area as well as the existing mining rights area is that the life of the opencast operations at Kudumane will be reduced which will have negative economic consequences both for the employment of opencast operations workers as well as for optimising resource extraction. The knock-on consequence will be a reduction in the stimulation of the local, regional and national economy.

3 POTENTIAL IMPACTS

3.1 LIST OF POTENTIAL IMPACTS ON ENVIRONMENTAL ASPECTS

This section provides a list of potential impacts on environmental aspects (excluding social and cultural aspects – see Section 6) in respect of each of the main project actions / activities and processes. The potential impacts are presented for each of the project phases in tabular format (Table 33). It should be noted that as indicated in Section 2, the impact assessment which follows relates only to the proposed infrastructure on Hotazel and Devon. It is expected that the Kipling pit will be developed at a later stage. In this regard a preliminary investigation has commenced and once the project detail becomes available, Kudumane will initiate a separate environmental authorisation process and the impacts associated therewith will then be assessed.

TABLE 33: LIST OF POTENTIAL IMPACTS AS THEY RELATE TO PROJECT ACTIONS / ACTIVITIES / PROCESSES (EXCLUDING SOCIAL AND CULTURAL)

Main activity/process	Phase	Impacts (unmitigated)
Site preparation	Construction	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Air pollution Noise pollution Visual impacts Land use
Earthworks	Construction Operation Decommissioning	Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Noise pollution Visual impacts Land use
Civil works Civil works on site relate mainly to any steel and concrete work.	Construction Operation Decommissioning	Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Noise pollution Visual impacts Land use
Open pit mining (includes WRDs and stockpiles)	Operation	Loss and sterilization of mineral resources Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Dewatering Air pollution Visual impacts

Main activity/process	Phase	Impacts (unmitigated)
		Land use
Tailings dam	Operation Decommissioning	Loss and sterilization of mineral resources Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts Land use
Water supply and use	Operation	Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Visual impacts Land use
Power supply and use	Operation	Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Visual impacts Land use
Transport systems	Operation	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Noise pollution Road disturbance and traffic safety Visual impacts Land use
Non-mineralised waste management (general and industrial hazardous)	Operation	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts Land use

Main activity/process	Phase	Impacts (unmitigated)
General site management	Construction Operation Decommissioning	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts Land use
Other support services and amenities	Operation	Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts Land use
Demolition	Decommissioning	Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Noise pollution Visual impacts Land use
Rehabilitation	Decommissioning	Loss and sterilization of mineral resources Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Noise pollution Land use
Maintenance and aftercare of final landforms	Closure	Loss and sterilization of mineral resources Hazardous excavations and infrastructure Loss of soil resources and land capability through pollution Loss of soil resources and land capability through physical disturbance Physical disturbance of biodiversity General disturbance of biodiversity Pollution of surface water resources Alteration of natural drainage patterns Contamination of groundwater Air pollution Visual impacts Land use

3.2 LIST OF POTENTIAL CUMULATIVE IMPACTS

This section provides a list of potential cumulative environmental impacts (excluding social and cultural aspects – see Section 6):

- Hazardous excavations and infrastructure
- Loss of soil resources and land capability through pollution
- Loss of soil resources and land capability through physical disturbance
- Physical destruction of biodiversity
- General disturbance of biodiversity
- Alteration of natural drainage patterns
- Contamination of groundwater
- Dewatering
- Pollution of surface water resources
- Alteration of natural drainage patters
- Air pollution
- Noise pollution
- Visual impacts
- Land use impacts

3.3 POTENTIAL FOR ACID MINE DRAINAGE OR GROUNDWATER CONTAMINATION

Detailed information on these issues is provided in Section 1.1.1. In summary, geochemical tests and analysis indicate that the waste rock material is non-acid generating, and although no tailings samples were available for analysis, based on SLRs experience in the local area, the potential for the tailings material to be potentially acid generating (PAG) is negligible. There is however the potential for seepage from the tailings and waste rock facilities. This presents a pollution risk for both surface and groundwater in both the short and long term.

4 ALTERNATIVE LAND USE OR DEVELOPMENT

It should be noted that the Hotazel Town Planning Board indicated, on 12 February 2014 that future town planning will extend to the north of the existing village. In this regard, Kudumane and BHP Billiton are currently in discussions with the possibility that a portion of Hotazel 280 (that which is in question for the housing development) be transferred to Kudumane in return for a portion of the land on the farm Kipling so that the proposed development plans can continue towards Kipling. A record of communications is provided in Appendix C. For the purposes of the assessment, the impacts on this proposed planning development are not different to the impacts as assessed on the current village.

5 POTENTIAL IMPACTS OF ALTERNATIVE LAND USE OR DEVELOPMENT

With reference to Section 4, as no alternative land uses have been identified, no potential impacts have been identified.

6 POTENTIAL SOCIAL AND CULTURAL IMPACTS

6.1 LIST OF POTENTIAL IMPACTS ON SOCIO-ECONOMIC CONDITIONS OF THIRD PARTY LAND USE ACTIVITIES

Potential impacts on the socio-economic conditions of other parties land use activities surrounding the Kudumane Mine are discussed in detail in Section 7 and listed below.

- Loss of current land uses through impacts on the bio-physical environment;
- Dust generation;
- Noise disturbance;
- Pollution of groundwater and surface water resources;
- Project-related road use and traffic;
- Blasting damage;
- Economic impacts (positive and negative); and
- Inward migration: Informal settlements, safety, security and services and associated social ills.

6.2 CULTURAL ASPECTS AND POTENTIAL IMPACTS THEREON

Cultural aspects are discussed as part of heritage discussion below.

6.3 HERITAGE FEATURES AND POTENTIAL IMPACTS THEREON

6.3.1 HERITAGE (AND CULTURAL) FEATURES

With reference to Section 1.3.2, a low density scatter of stone tools was identified on the farm Hotazel. There are deemed to be resources of heritage and cultural significance which are important to the history of South Africa and are protected by national legislation. The area in which the heritage resources were found (Figure 19) shall be demarcated from the mining operations. Additional measures to prevent damage may include the placement of infrastructure and control of Kudumane activities to prevent physical disturbance of the resources, access barriers such as fences, and/or information/warning signs if within close proximity to mining operations. Refer to Appendix L for the relevant specialist study undertaken.

6.3.2 PALAEONTOLOGICAL FEATURES

With reference to Section 1.3.2) there is a low potential for palaeontological resources to occur at the Kudumane Mine, therefore no impacts are expected to occur. Refer to Appendix M for the relevant specialist study undertaken.

6.4 QUANTIFICATION OF IMPACT ON SOCIO-ECONOMIC CONDITIONS

Refer to Section 7.2.17 for the impacts associated with the loss of land per hectare as well as Kudumane's contribution to the provincial and national economy. Refer to Appendix N for the relevant specialist study undertaken.

7 ASSESSMENT AND EVALUATION OF POTENTIAL IMPACTS

7.1 LIST OF EACH POTENTIAL IMPACT

Potential environmental and socio-economic impacts were identified by SLR and other stakeholders. The impacts are discussed under issue headings in this section. All identified impacts are considered in a cumulative manner such that the current baseline conditions on site and in the surrounding area are discussed and assessed together.

It should be noted that the assessment below comprises an incremental assessment of the proposed activities/infrastructure in the proposed new mining rights area (NC 30/5/1/2/2/10053 MR) as well as a cumulative impact assessment of the above within the context of the existing mining operations (given that the proposed infrastructure/activities in the new mining rights area are not viable without the support of the processing plant which is located in the existing mining rights area.

Environmental impacts that will be assessed in this section include the following:

- Loss and sterilization of a mineral resource (7.2.1)
- Hazardous excavations and infrastructure (Section 7.2.2)
- Loss of soil resources through pollution (Section 7.2.3)
- Loss of soil resources and land capability through physical disturbance (Section 7.2.4)
- Physical destruction of biodiversity (Section 7.2.5)
- General disturbance of biodiversity (Section 7.2.6)
- Pollution of water resources (Section 7.2.7)
- Alteration of natural drainage patterns (Section 7.2.8)
- Contamination of groundwater (Section 7.2.9)
- Dewatering (Section 7.2.10)
- Air pollution (Section 7.2.11)
- Noise pollution (Section 7.2.12)
- Blasting impacts (Section 7.2.13)
- Road disturbance and traffic safety (Section 7.2.14)
- Visual impacts (Section 7.2.15)
- Loss of heritage, cultural and palaeontological resources (Section 7.2.16)
- Economic impacts (7.2.17)
- Inward migration impact (Section 7.2.18)
- Land use impact (Section 7.2.19)

7.2 IMPACT RATING FOR EACH POTENTIAL IMPACT

The impact rating for each potential impact is provided in the section below. The criteria used to rate each impact as part of this report is outlined in Section 7.3. The potential impacts are rated with the assumption that no mitigation measures are applied and then again with mitigation. An indication of the phases in which the impact will occur is provided below and summarised in Section 7.4 together with the estimated timeframes for each rated impact.

The reader should keep in mind that the impact assessment that follows in the sections below has been done in a two-fold approach (unless otherwise indicated), as follows:

- an assessment of the incremental impacts associated with the addition of the new mining rights area (NC 30/5/1/2/2/10053 MR);
- a cumulative assessment of the above within the context of the current approved mining operations in their entirety (given the dependence of the new mining rights area operations on the existing approved operations for processing etc.).

To assist the reader, the approach above will be re-iterated at the beginning of each impact assessment section.

GEOLOGY

7.2.1 ISSUE: LOSS AND STERILIZATION OF MINERAL RESOURCE

Information in this section was sourced from the project team.

Introduction

Mineral resources can be sterilised and/or lost through the placement of infrastructure and activities in close proximity to mineral resources, by preventing access to potential mining areas, and through the disposal of mineral resources onto mineralised waste facilities or as backfill in the underground mine.

By the nature of mining projects the geology is exploited for the target minerals therefore the impact on the geology will be high in all project phases without mitigation.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Civil works	Civil works Open pit mining Tailings dam WRDs/stockpiles	Civil works Tailings dam WRDs/stockpiles Rehabilitation	Maintenance and aftercare of final landforms

Rating of impact

Severity / nature

In the normal course of mining a certain degree of sterilisation is required to ensure safe underground workings. Typically mines sterilise resources by leaving support pillars underground and by leaving safe barriers between the base of open pits and the roof of underlying mining areas. This routine sterilisation is not assessed below because it is necessarily linked to safe mining conditions at Kudumane.

Aside from the abovementioned issues, the severity of sterilising mineral resources is considered to be high because of the associated potential economic value that is lost when sterilisation occurs. In the unmitigated scenario, this may occur in the event that Kudumane develops or decommissions infrastructure in a manner that it prohibits the mining of feasible resources, or where it disposes of feasible mineral resources onto waste facilities in a manner that makes it difficult or impossible to access the resources.

In the mitigated scenario, planning and coordination between the mining, infrastructure projects and processing decision makers can help to prevent the unacceptable sterilisation of resources, without compromising safety requirements. The mitigated severity reduces to low.

Duration

If unplanned sterilisation of resources occurs it is likely that the related impact will extend beyond the life of Kudumane. This is a long term duration.

Spatial scale / extent

The spatial extent of the physical impact is linked to the spatial extent of the Kudumane mining rights area. This is a localised spatial extent.

Consequence

The unmitigated consequence is high. The mitigated consequence is medium.

Probability

In the mitigated scenario, Kudumane has planning structures in place to avoid infrastructure and development related sterilisation.

Significance

The unmitigated significance is medium and the mitigated significance is low.

Unmitigated – summary of the rated loss and sterilisation of mineral resources impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	L	H	L	M

Mitigated – summary of the rated loss and sterilisation of mineral resources impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	H	L	M	L	L

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

To prevent unacceptable mineral sterilisation.

Actions

Kudumane will incorporate cross discipline planning structures for mining and infrastructure developments to avoid mineral sterilisation. A key component of the cross cutting function is communication with the underground and surface mining managers.

Where feasible, Kudumane will make provision for the processing of waste rock and/or allowing third parties to crush and use it for aggregate.

The TSF will be designed in such a way that reprocessing is possible.

Mine workings will be developed and designed so as not to limit the potential to exploit deeper minerals but to mine optimally.

Emergency situations

None identified.

TOPOGRAPHY

7.2.2 ISSUE: HAZARDOUS EXCAVATIONS AND INFRASTRUCTURE

Information in this section was sourced from the project team.

Introduction

Hazardous excavations and infrastructure include all structures into or off which third parties and animals can fall and be harmed. This includes the failure of the proposed TSF and the subsidence of backfilled open pits. Hazardous excavations and infrastructure occur in all mine phases from construction through operation to decommissioning and closure.

In the construction and decommissioning phases these hazardous excavations and infrastructure are usually temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long term hazardous excavations and infrastructure and the closure phase will present final land forms (such as the WRDs and TSF) that may be considered hazardous. The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works	Earthworks Civil works Open pit mining Tailings dam WRDs/stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities	Earthworks Civil works Tailings dam WRDs/stockpiles Demolition Rehabilitation	Maintenance and aftercare of final landforms

Rating of impact

Severity/ nature

The infrastructure associated with the proposed new mining rights area (open pits, TSF, WRDs etc.) presents a risk of injury and/or death to both people and animals. When considered incrementally, this has a high severity in the unmitigated scenario, reducing to low with appropriate mitigation measures.

The cumulative severity rating assesses the impact of infrastructure/activities associated with the new mining rights area and then considers these within the context of the current approved mining operations where there are already potential hazardous excavations and infrastructure. It follows that this has a high severity in the unmitigated scenario when considered cumulatively within the context of the current approved operations, reducing to low with mitigation.

Duration

In the context of this assessment, death or permanent injury is considered a long term, permanent impact and therefore has a high duration regardless of whether assessed incrementally or cumulatively.

Spatial scale/ extent

Impacts of injury or death associated with the hazardous infrastructure and excavations will be felt beyond the site boundary with or without mitigation because death or injury can influence the related families/communities. This therefore has a medium spatial scale regardless of whether assessed incrementally or cumulatively in the context of the current approved operations.

Consequence

The consequence is high in the unmitigated scenario and medium in the mitigated scenarios as the severity of the impact reduces.

Probability

An important element in the consideration of probability is the restriction of access to third parties in accordance with current Kudumane practices. In addition, no third party or animal related incidents have been recorded to date. In the unmitigated scenario, without design and management interventions the impact probability is expected to be medium regardless of whether assessed incrementally for the new mining rights area or cumulatively in the context of the current approved operations. With mitigation measures that focus on infrastructure safety design and implementation as well as on limiting access to third parties and animals the probability of the impact occurring reduces.

Significance

In the unmitigated scenario, the significance of this potential impact is high. In the mitigated scenario, the significance of this potential impact is low because there will be a reduction in probability that the impact occurs. This is relevant both when considered incrementally and when considered cumulatively.

Unmitigated – summary of the cumulatively rated hazardous excavations and infrastructure impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the cumulatively rated hazardous excavations and infrastructure impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	H	M	M	L	L

Description of proposed mitigation measures

Mitigation measures provided below are applicable to all three scenarios and have been tabulated in the EMP (Section 19).

Objectives

The objective is to prevent physical harm to third parties and animals from potentially hazardous excavations and infrastructure.

Actions

All proposed mineralised waste facilities will be designed, constructed, operated and closed in a manner to ensure that stability and related safety risks to third parties and animals are addressed. These issues will be monitored according to a schedule that is deemed relevant to the type of facility by a professional engineer.

Kudumane will survey all the proposed project areas and update its surface use area map on a routine basis to ensure that the position and extent of all potential hazardous excavations, hazardous infrastructure is known. It will furthermore ensure that appropriate management measures are taken to address the related safety risks to third parties and animals.

During construction and operation the safety risks associated with identified hazardous excavations, subsidence and infrastructure will be addressed through one or more of the following:

- fencing, berms, barriers and/or security personnel to prevent unauthorised access; and
- warning signs in the appropriate language(s). Warning pictures can be used as an alternative.

Where Kudumane has caused injury or death to third parties and/or animals, as a result of their mining operations, appropriate compensation will be provided.

During the decommissioning planning of any part of the mine, provision will be made to address long term safety risks in the decommissioning and rehabilitation phases.

At closure, the hazardous infrastructure will either have been removed or decommissioned and rehabilitated in a manner that it does not present a long term safety and/or stability risk. It should furthermore be noted that the TSF and WRDs will remain in perpetuity and in this regard will be made safe and rehabilitated.

At closure the hazardous excavations will be dealt with as follows: monitoring and maintenance will take place to observe whether the relevant long term safety objective have been achieved and to identify the need for additional intervention where the objectives have not been met.

Hazardous excavations and infrastructure will be surveyed annually and inspections will take place on a routine basis to ensure that measures for preventing injury to third parties and animals are being implemented and maintained.

Emergency situations

If people or animals fall off or into hazardous excavations or infrastructure causing injury, or if any mineralised waste or water facilities fail causing injury to people or animals, the Kudumane emergency response procedure (Section 20 and Appendix R) will be initiated.

SOILS AND LAND CAPABILITY

7.2.3 ISSUE: LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH POLLUTION

Information in this section was sourced from the specialist soils study conducted by ARC Institute for Soil, Climate and Water (June, 2014) (Appendix F) as well as findings of the specialist study undertaken for the approved EIA/EMP (Metago, 2010).

Introduction

Soil is a valuable resource that supports a variety of ecological functions. Mining projects in general have the potential to damage soil resources through contamination. Contamination of soils also has the potential to impact biodiversity, surface and groundwater resources (see Sections 7.2.7 and 7.2.9, for water related impacts). The loss of soil resources has a direct impact on the potential loss of the natural capability of the land. This section focuses on the potential contamination of the soil resources and the effect this has on land capability.

There are a number of sources in all phases that have the potential to pollute soil resources. In the construction and decommissioning phases these activities are temporary in nature, usually existing from a few weeks to a few months. The operational phases will present more long term activities and the closure phase will present final land forms (such as the TSF and WRDs) that may be susceptible to erosion. The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Rating of impacts

<u>Severity/nature</u>

The proposed infrastructure and activities (open pits, TSF, WRDs, dirty water circuit, hydrocarbon handling etc.) present numerous sources of soil pollutants that can result in a loss of soils (and associated land capability) as a resource and as an ecological driver because it can create a toxic environment for vegetation and ecosystems that rely on the soil. In the unmitigated scenario, the proposed infrastructure and activities will add sources of soil pollutants. This is a high severity in the unmitigated scenario when considered incrementally, reducing to medium with mitigation. When considered in the context of existing operations, the conclusions are similar.

Duration

In the unmitigated scenario, most pollution impacts and associated loss in land capability will remain long after closure and in this regard are rated as having long term duration. This is particularly so given that the TSF and WRDs will remain in perpetuity (although rehabilitated), thereby serving as permanent potential pollution sources. In the mitigated scenario most of these potential impacts should either be avoided or be remedied by the effective reaction time of the clean-up team and the chosen remediation methods. This would reduce the duration to within the project life, therefore a medium duration. When considered from a cumulative perspective, the duration rating is the same.

Spatial scale/extent

In the unmitigated scenario for all phases the potential loss of soil resources and associated land capability through pollution will extend beyond the site boundary (especially if there is inadequate management during the off-site transportation of potentially polluting substances). With mitigation, the potential loss of soil resources and associated land capabilities will be restricted to within the site boundary, thereby reducing from medium to low, both when considered incrementally as well as when considered cumulatively within the context of the current approved operations.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario the consequence is reduced to medium as the severity, duration and spatial scale of the impact is reduced.

Probability

Without any mitigation the probability of impacting on soils and land capability through pollution events is high. With mitigation, the probability will be significantly reduced to low because emphasis will be placed on preventing pollution events and on quick and effective remediation if pollution events do occur.

Significance

In the unmitigated scenario, the significance of this potential impact is high. In the mitigated scenario, the significance reduces to low, both when considered incrementally and cumulatively because with mitigation the probability and consequence associated with the potential impact are reduced.

Unmitigated – summary of the cumulatively rated loss of soil resources and land capability through pollution impact per phase

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the cumulatively rated loss of soil resources and land capability through pollution impact per phase

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	L	M	L	L

Description of proposed mitigation measures

Mitigation measures are given below and have been tabulated in the EMP (Section 19).

Objectives

The objective is to prevent soil pollution.

Actions

In the construction, operation and decommissioning phases the mine will ensure that all hazardous chemicals (new and used), dirty water, mineralised wastes and non-mineralised wastes are transported, handled and stored in a manner that they do not pollute soils. This will be implemented through a procedure(s) covering the following:

- pollution prevention through basic infrastructure design pollution prevention through maintenance of equipment;
- pollution prevention through education and training of workers (permanent and temporary);
- pollution prevention through appropriate management of hazardous materials and wastes;
- the required steps to enable fast reaction to contain and remediate pollution incidents. In this regard the remediation options include containment and in-situ treatment or disposal of contaminated soils as hazardous waste. In-situ treatment is generally considered to be the preferred option because with successful in situ remediation the soil resource will be retained in the correct place. The in-situ options include bioremediation at the point of pollution, or removal of soils for washing and/or bio remediation at a designated area after which the soils are returned; and
- specifications for post rehabilitation audit criteria to ascertain whether the remediation of any polluted soils and re-establishment of soil functionality has been successful and if not, to recommend and implement further measures.

The designs of any permanent and potentially polluting structures (mineralised waste facilities) will take account of the requirements for long term soil pollution prevention, land function and confirmatory monitoring.

Kudumane will ensure that the handling and disposal of general and hazardous waste is undertaken in accordance with the waste management procedures as outlined in Table 34.

TABLE 34: WASTE MANAGEMENT PROCEDURES FOR NON MINERALISED WASTE

Items to be considered		**Intentions**
General	**Specific**	
Classification and record keeping	General	The waste management procedure for the proposed mine will cover the storage, handling and transportation of waste to and from the mine. The mine will ensure that the contractor's responsible are made aware of these procedures.
	Waste opportunity analysis	In line with DWAs' strategy to eliminate waste streams in the longer term, the mine will assess each waste type to see whether there are alternative uses for the material. This will be done as a priority before the disposal option.
	Classification	Wastes will be broadly classified in terms of the DWA Minimum Requirements for Waste Disposal (DWA, 1998).
	Inventory of wastes produced	An inventory of wastes will be compiled and will include estimated quantities of waste. The inventory will be kept up to date.
	Disposal record	Written evidence of safe disposal of waste will be kept.
Waste management facilities	Collection points	Designated waste collection points will be established on site. Care will be taken to ensure that there will be sufficient collection points with adequate capacity and that these are serviced frequently.
	Laydown/ salvage areas	During decommissioning and closure, lay down areas for re-usable non-hazardous materials will be established. Mixing of re-usable materials with other wastes, especially hazardous wastes will be prevented.
	General waste	Will be stored in designated skips and removed by an approved contractor for disposal at a licensed facility.
	Scrap metal and building rubble	Care will be taken to ensure that scrap metal and building rubble does not become polluted or mixed with any other waste. The scrap metal will be collected in a designated area for scrap metal (salvage yard). It will be sold to scrap dealers. Building rubble will be used to backfill mining voids
	Hazardous wastes	Medical waste, laboratory chemicals, explosives packaging, used chemicals and chemical containers will be temporarily stored in sealed containers in a bunded store before removal by an approved waste contractor and disposal in a licensed facility.
	Oil and grease	Oil and grease will be collected in suitable containers at designated collection points. The collection points will be bunded and underlain by impervious materials to ensure that any spills are contained. Notices will be erected at each waste oil point giving instructions on the procedure for waste oil discharge and collection. An approved subcontractor will remove oil from site.
	Any soil polluted by a spill	If remediation of the soil *in situ* is not possible, the soils will be classified as a waste in terms of the Minimum Requirements and will be disposed of at an appropriate permitted waste facility.
	Sewage sludge	Sludge (and screenings) produced by the sewage process will be dried on conventional drying beds and when adequately dried, removed. This material will then either (subject to appropriate classification and DWA approval) be composted with other suitable organic material generated on the mine (wood chips, sawdust, grass & tree cuttings) to provide a suitable composted material for application on rehabilitation areas, or it will be stored in sealed containers and taken for treatment to the Kuruman or Kathu treatment works as required

Items to be considered		Intentions
General	**Specific**	
Disposal	Off-site waste disposal facilities	Waste will be disposed of at appropriate permitted waste disposal facilities as outlined below. For general waste the closest permitted site is in Kuruman. For hazardous waste the closest permitted site is Holfontein.
Waste transport	Contractor	A qualified waste management subcontractor will undertake the waste transport. The contractor will provide an inventory of each load collected and proof of disposal at a licensed facility.
Banned practices	Long-term stockpiling of waste	Stockpiling of waste is a temporary measure. Waste stockpiling sites must have an impervious floor, be bunded and have a drainage system for collection and containment of water on the site.
	Burying of waste	No wastes other than mine residues will be placed on site.
	Burning of waste	Waste may only be burned in legally approved incinerators, which includes the explosives wastes destruction bay.

Emergency situations

Major spillage incidents will be handled in accordance with the Kudumane emergency response procedure (Section 20 and Appendix R).

7.2.4 ISSUE: LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH PHYSICAL DISTURBANCE

Information in this section was sourced from the specialist soils study conducted by ARC Institute for Soil, Climate and Water (June, 2014) (Appendix F) as well as the approved EIA/EMP (Metago, 2010).

Introduction

Soil is the key to re-establishing post closure land capability. There are a number of activities/infrastructure in all phases that have the potential to disturb soils and related land capability through removal, compaction and/or erosion. In the construction and decommissioning phases these activities could be temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long term activities such as the WRDs and TSF and at closure the closure these will remain as final land forms that may be susceptible to erosion.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Construction	Operational	Decommissioning	Closure
	General site management		

Rating of impact

Severity/nature

In the unmitigated scenario, physical soil disturbance can result in a loss of soil functionality as an ecological driver. In the case of erosion, the soils will be lost to the area of disturbance, and in the case of compaction the soils functionality will firstly be compromised through a lack of rooting ability and aeration, and secondly the compacted soils are likely to erode because with less inherent functionality there will be little chance for the establishment of vegetation and other matter that naturally protects the soils from erosion. Any soils that remain beneath the permanent landforms (TSF and WRDs) will be a lost resource and the associated land capability will be permanently altered. This amounts to a high severity when considered incrementally given that the soils and associated land capability beneath this infrastructure will not be reinstated. With mitigation however, the disturbance to soils can be limited and in this regard land capability can be reinstated as far as possible with the correct rehabilitation measures. The severity therefore reduces to medium.

Similarly, the severity of the potential loss of soils through physical disturbance, when considered cumulatively is high, reducing to medium with mitigation.

Duration

In the unmitigated scenario the loss of soil and related land capability is long term and will continue after the life of the mine. In the mitigated scenario, most of the soil is conserved and used for rehabilitation which reduces the duration of the impact to the life of the operations which is a medium duration.

When considered cumulatively, the duration is the same in the unmitigated and mitigated scenarios.

Spatial scale/extent

In both the unmitigated and mitigated scenario for all phases associated with both the incremental and cumulative assessment, the potential loss of soil resources and associated land capability through physical disturbance will be restricted to within the site boundary, thereby having a low spatial scale.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario the consequence reduces to medium as the severity reduces.

Probability

Without any mitigation the probability of losing soil and related land capability is definite. Even with mitigation, most of the topsoil can be conserved for use in rehabilitation, and most of the land capability can be re-established save for the TSF and WRD areas. Although these will remain in perpetuity, with rehabilitation, useful land capability can be established, thereby reducing the probability to a medium.

Significance

In the unmitigated scenario the impact is high. In the mitigated scenario the significance of this impact reduces to medium as the consequence and probability are reduced.

Unmitigated – summary of the cumulatively rated loss of soil resources and land capability through physical disturbance impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	L	H	H	H

Mitigated – summary of the cumulatively rated loss of soil resources and land capability through physical disturbance impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	L	M	M	M

Description of proposed mitigation measures

Mitigation measures specific to the proposed project are provided below and tabulated in the EMP (Section 19).

Objective

The objective is to minimise the loss of soil resources and related land capability through physical disturbance, erosion and compaction.

Actions

In the construction, operation and decommissioning phases a soil management plan, with the following key components, will be implemented:

- limit the disturbance of soils to what is absolutely necessary for earthworks, on-going activities, infrastructure footprints and use of vehicles; and
- where soils have to be disturbed the soil will be stripped, stored, maintained and replaced in accordance with the specifications of the soil management principles in Table 35 and the detailed Kudumane soils management procedure.

TABLE 35: SOIL MANAGEMENT PRINCIPLES

Steps	**Factors to consider**	**Detail**

Steps	Factors to consider	Detail
Delineation of areas to be stripped		Stripping will only occur where soils are to be disturbed by activities and infrastructure that are described in the EIA/EMP report, and where a clearly defined end rehabilitation use for the stripped soil has been identified.
Reference to biodiversity mitigation		All requirements for moving and preserving fauna and flora according to the biodiversity mitigation measures will be adhered to.
Stripping	Topsoil	As a general rule 50cm of topsoil must be stripped.
	Subsoil	Given the nature of the soils, no distinction needs to be made between subsoil and the topsoil.
Delineation of stockpiling areas	Location	Stockpiling areas have been identified in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas.
	Designation of the areas	Soil stockpiles will be clearly marked to identify both the soil type and the intended area of rehabilitation.
Stockpile management	Vegetation establishment and erosion control	Rapid growth of vegetation on the topsoil stockpiles will be promoted (e.g. by means of watering or fertilisation). The purpose of this exercise will be to encourage vegetation growth on soil stockpiles and to combat erosion by water and wind.
	Storm water controls	Stockpiles will be established with storm water diversion berms to prevent run off erosion.
	Height and slope	Soil stockpiles height will be restricted to avoid compaction and damage to the underlying soils. The ideal stockpile height for storage periods greater than 3 years is 2m. For short-term stockpiles (less than 3 years), the maximum allowable height is 15m but these stockpiles should be benched. Each bench should ideally be 1.5m high and 2m wide. The stockpile side slopes should be 1 vertical: 3 horizontal to promote vegetation growth and reduce run-off related erosion.
	Waste	No waste material will be placed on the soil stockpiles.
	Vehicles	Equipment movement on top of the soil stockpiles will be limited to avoid topsoil compaction and subsequent damage to the soils and seedbank.
Rehabilitation of disturbed land: restoration of land capability	Placement of soil	As a general rule, a minimum layer of 50cm of topsoil will be replaced.
	Fertilisation	A few samples of stripped soils will be analysed to determine the nutrient status of the soil. As a minimum, the following elements will be tested for cation exchange capacity, pH, and phosphate. These elements provide the basis for determining the fertility of soil. Based on the analysis, fertilisers will be applied if necessary.
	Erosion control	Erosion control measures will be implemented to ensure that the topsoil is not washed away and that erosion gulleys do not develop prior to vegetation establishment.
Pollution of soils	In situ remediation	If soil (whether stockpiled or in its undisturbed natural state) is polluted, the first management priority is to treat the pollution by means of in situ bio-remediation at the designated site. The acceptability of this option must be verified by an appropriate soils expert and by DWA, on a case-by-case basis, before it is implemented.
	Off-site disposal	If in situ treatment is not possible or acceptable then the polluted soil must be classified according to the Minimum Requirements for the Handling, Classification, and Disposal of Hazardous Waste (DWAF 1998) and disposed at an appropriate, permitted, off-site waste facility.

To prevent the erosion of topsoils, management measures may include berms, soil traps, hessians and stormwater diversions away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any drainage lines and areas susceptible to erosion.

All areas affected by construction should be rehabilitated upon completion of the construction phase of the development. Permanent infrastructure should be suitably re-vegetated, if possible.

Emergency situations

None identified.

BIODIVERSITY

By way of introduction to this section of the impact assessment, the International Council for Mining and Metals (ICMM) has been instrumental in research and development of good environmental practices in mining. The ICMM's Good Practice Guidance for Mining and Biodiversity provides some useful insights into issues around biodiversity. In the broadest sense, biodiversity provides value for ecosystem functionality, aesthetic, spiritual, cultural, and recreational reasons. The known ecosystem related value is listed as follows:

- soil formation and fertility maintenance;
- primary production through photosynthesis, as the supportive foundation for all life;
- provision of food and fuel;
- provision of shelter and building materials;
- regulation of water flows and water quality;
- regulation and purification of atmospheric gases;
- moderation of climate and weather;
- control of pests and diseases; and
- maintenance of genetic resources (key for medicines, crop and livestock breeding).

The assessment covers the following broad issues: physical destruction of biodiversity and related functions, and general disturbances to biodiversity. Each of these issues is individually assessed below.

7.2.5 ISSUE: PHYSICAL DESTRUCTION OF BIODIVERSITY

Information in this section was sourced from the biodiversity study undertaken by Ecological Management Services (EMS, June 2014) included in Appendix G and the approved 2010 EIA/EMP (Metago, 2010).

Introduction

There are a number of activities/infrastructure in all phases that have the potential to destroy biodiversity in the broadest sense. In this regard, the discussion relates to the physical destruction of specific biodiversity areas, of linkages between biodiversity areas and related species which are considered to be significant because of their status, and/or the role that they play in the ecosystem.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Rating of impact

Severity/nature

Areas of high ecological sensitivity are functioning biodiversity areas with species diversity and associated intrinsic value. In addition, some of these areas host protected species. The linking areas have value because of the role they play in allowing the migration or movement of flora and fauna between the areas which is a key function for the broader ecosystem. The transformation of land for any purpose, including mining and associated activities, increases the destruction of the site specific biodiversity, reduces its intrinsic functionality and reduces the linkage role that undeveloped land fulfils between different areas of biodiversity importance.

When considering the surface infrastructure/activities proposed, it should be noted that some infrastructure will be placed within areas of high sensitivity (see Figure 11). This is specifically the case for the re-mining of the historical Hotazel pit (which has been allowed to rehabilitate since previous mining activities). This amounts to a high severity when unmitigated. With the correct mitigation measures being put in place, the physical disturbance to biodiversity can be limited somewhat, however by the very nature of opencast mining, the proposed activities will still be invasive. If the correct mitigation measures are put in place, some of the destruction could be avoided entirely and where such destruction has occurred, rehabilitation could establish a functional ecosystem. This amounts to a mitigated severity of medium.

When considered cumulatively within the context of the current approved mining operations, the assessment remains the same as when assessed incrementally as above.

Duration

In the unmitigated scenario, when considered incrementally, the loss of biodiversity and related functionality is long term and will continue after the life of the mine (particularly considering the permanent nature of the TSF and WRDs). With mitigation biodiversity and related functionality may be partially restored during the operational, decommissioning and closure phases. It should however be noted that the areas beneath the TSF and WRDs imply a perpetual destruction of biodiversity unless the correct mitigation measures are applied. In this regard, the duration remains high without mitigation, reducing to medium with adequately applied mitigation measures. When considering the project within the context of the existing approved operations, it follows that the existing infrastructure on York (pit and WRD) is much the same as that being proposed (also pits and WRDs) and in this regard the duration in the cumulative context is the same as when considered incrementally.

Spatial scale / extent

Given that biodiversity processes are not confined to the proposed new project area, the spatial scale of impacts will extend beyond this boundary in both the mitigated and unmitigated scenario. Key related issues are the migration of species, the flow of nutrients and linkages between biodiversity areas. The spatial scale is therefore medium in both the unmitigated and mitigated scenarios regardless of whether being assessed incrementally for the new mining rights area or whether assessed cumulatively in the context of the existing approved operations on site.

Consequence

In the unmitigated and mitigated scenario, the consequence of this potential impact is high.

Probability

Without mitigation the probability is definite. With mitigation, the probability may be reduced to medium with correct management measures and concurrent rehabilitation.

Significance

The significance of this impact is high without mitigation, reducing to medium with the correct mitigation measures.

Unmitigated – summary of the cumulatively rated loss of biodiversity through physical destruction impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the cumulatively rated loss of biodiversity through physical destruction impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	M	M	M	M

Description of proposed mitigation measures

Mitigation measures are presented below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent the unacceptable loss of biodiversity and related ecosystem functionality through physical disturbance.

Actions

Activities and infrastructure will be confined to the infrastructure layout as described and assessed in this EIA/EMP report. This requires that no land disturbance is allowed outside of the infrastructure footprint.

Kudumane will prevent the disturbance of high sensitivity areas and important linkages between these areas so that the species composition and ecosystem functionality remain intact. Some surface disturbance is planned to occur close to areas of higher sensitivity, and in this regard a buffer zone will be implemented in order to protect these areas. In this regard:

- the project footprint area will be clearly marked;
- barriers will be erected to ensure that accidental intrusions into the high sensitive areas do not occur;
- a long-term comprehensive alien/invasive species eradication and monitoring programme and will also be implemented; and
- an environmental awareness and training programme for employees will implemented (Appendix R).

The mitigation of the destruction of vegetation is closely linked to the conservation of soil resources and the re-establishment of land capability and vegetation. In this regard, Kudumane will ensure that the waste management and soil conservation programmes presented in Table 34 and Table 35 respectively, are followed.

As part of the rehabilitation programme, Kudumane will re-establish natural vegetation as outlined below:

- a 780 ha non-mining area of the farm York A 279 between the R380 and the project area has been set aside. This is considered an offset. During the life of the project this area will be returned to its natural state through the control of pioneer species, the eradication of alien/invasive species and the ceasing of current grazing activities.
- once the topsoil has been replaced, seedlings and small trees and shrubs grown in the nursery area (within the game enclosure, close to the lodge) (see Figure 8) will be planted and re-seeding will also take place. In this regard a seed mixture reflecting the natural vegetation as is currently found in the area will be used. In conjunction with commercially available seeds, the harvesting of seed from similar areas within the study area will be undertaken as follows:

  - species such as Stipagrostis are good sand binders and aid in stabilising the substrate and are present within the study area;
  - where applicable, all protected trees smaller than 2 meters occurring on the site (species such as *Acacia erioloba, Acacia haematoxlon* and *Boscia albitrunca*) will be relocated to an appropriate site;
  - pods of *Acacia erioloba*, and *Acacia haematoxylon* seeds will be collected during December to March and October to December, respectively, for planting during the rehabilitation phase;
  - *Boscia* seeds will be stored in small quantities in cotton bags to provide good ventilation and sowed within 4 weeks of collection;
  - *Acacia* pods will be scared to break the dormancy of the pods prior to sowing; and
  - during rehabilitation, pioneer and alien/invasive species will be controlled. In this regard, the use of chemicals and herbicides will be limited as far as possible, and the use of products with bromacil and tebuthiuron as active ingredients will be avoided at all times.
- where protected plant and/or tree species are going to be removed/destroyed the relevant permits must be obtained. An ecology expert should be engaged prior to the vegetation clearing phase to make the necessary applications for the outstanding permissions; and
- there will be implementation of an alien/invasive/weed management programme in collaboration with DAFF, DWA and Working for Water to control the spread of these plants onto and from disturbed areas. Care will be taken to prevent the encroachment of these species into rehabilitated areas.

Regarding the threat of potential veld fires Kudumane will comply with the National Veld and Forest Fire Act, Act 101 of 1998 (NVFFA) as amended. Accordingly, Kudumane will:

- prepare and maintain a firebreak on its side of the boundary between mine property any adjoining land;
- have equipment and trained personal to extinguish fires; and
- co-operate with the local Fire Protection Association (FPA).

Regarding the impact on vegetation caused by the lowered groundwater levels due to mine dewatering, it is proposed to recharge the shallow aquifer using surplus pit inflow water. In this regard, only water of an acceptable quality will be used.

For a period of at least five years after the re-establishment of vegetation, a programme of monitoring and "after care" will be implemented to ensure that vegetation is recovering and that pioneer and alien/invasive species are not becoming an ecological problem. This issue will be revisited as part of the detailed closure planning for the project.

Emergency situations

None identified.

7.2.6 ISSUE: GENERAL DISTURBANCE OF BIODIVERSITY

Information in this section was sourced from the biodiversity study undertaken by Ecological Management Services (EMS, June 2014) included in Appendix G and the approved 2010 EIA/EMP (Metago, 2010).

Introduction

There are a number of activities/infrastructure that have the potential to directly disturb vegetation, vertebrates and invertebrates in all project phases, particularly in the unmitigated scenario. In the construction and decommissioning phases these activities are temporary in nature, usually existing for a few weeks to a few months. The operational phase will present more long term occurrences and the closure phase will present final land forms (specifically the TSF and WRD) that may have pollution potential through long term seepage and/or run-off.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Rating of impact

<u>Severity / nature</u>

In the unmitigated scenario, biodiversity may be disturbed in the following ways:

- lighting can attract large numbers of invertebrates which become easy prey for predators. This can upset the invertebrate population balances;
- powerlines can lead to bird kills;
  people may kill various types of species for food, for sport, for fire wood etc.;
- people may illegally collect and remove vegetation, vertebrate and invertebrate species;
- excessive dust fallout from various dust sources (the TSF, WRDs and stockpiles) may have adverse effects on the growth of some vegetation, and it may cause varying stress on the teeth of vertebrates that have to graze soiled vegetation;
- noise and vibration pollution (from the additional pits, vehicle movement, materials handling etc.) may scare off vertebrates and invertebrates. In some instances the animals may be deterred from passing

close to noisy activities which can effectively block some of their migration paths. In other instances, vertebrates and invertebrates that rely on vibration and noise senses to locate for, and hunt, prey may be forced to leave the vicinity of noisy, vibrating activities;

- the increased presence of vehicles in the area can cause road kills especially if drivers speed;
- the presence of additional mine water impoundments and pipelines may lead to drowning of fauna; and
- an increase in pollution emissions and general litter may directly impact on the survival of individual plants, vertebrates and invertebrates.

Taken together, the disturbances will have a high severity in the unmitigated scenario. In the mitigated scenario, many of these disturbances can be prevented or mitigated to acceptable levels, which reduces the severity to low. The assessment is the same when considered cumulatively.

Duration

In both the unmitigated scenario, the impacts are long term because where biodiversity is compromised, killed or removed from the area this impact is likely to exist beyond the life of the project. With mitigation this reduces to medium. This is the case regardless of whether considered incrementally or cumulatively.

Spatial scale / extent

Given that biodiversity processes are not confined to the Kudumane Mine, the spatial scale of general disturbances will extend beyond the site boundary in the unmitigated and mitigated scenario. Key related issues are the migration of species and linkages between biodiversity areas. This is a medium spatial scale both when considered incrementally and when considered cumulatively.

Consequence

In both the unmitigated scenario, the consequence of this potential impact is high. With mitigation, this reduces to medium because the severity and duration reduce.

Probability

Without any mitigation, the probability of negatively impacting on biodiversity through multiple disturbance events is high. This is particularly the case within the new mining rights area, given that baselines levels of disturbance are low in comparison to the existing mining rights area. With mitigation, the probability reduces to medium.

Significance

In the unmitigated scenario, the significance of this potential impact is high reducing to medium with mitigation.

Unmitigated – summary of the cumulatively rated general disturbance of biodiversity impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the cumulatively rated general disturbance of biodiversity impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	M	M	M	M	M

Description of proposed mitigation measures

Mitigation measures specific to the proposed project are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the management measures is to prevent unacceptable disturbance of biodiversity and related ecosystem functionality.

Actions

In the construction, operation and decommissioning phases the mine will ensure that:

- the use of light is kept to a minimum and where it is required, yellow lighting is used where possible and vertebrates are kept away from the area around the lights with appropriate fencing;
- there is zero tolerance of killing or collecting any biodiversity;
- the use of poisons will be prohibited;
- powerlines will be underground or in trenches where possible and reflectors will be fitted to above ground powerlines and other infrastructure which could pose a bird collision risk;
- zero tolerance of littering;
- strict speed control measures for all project related traffic;
- dust control measures are implemented (see Section 7.2.11);
- noise control measures are implemented (see Section 7.2.12);
- pollution prevention measures are implemented (see Sections 7.2.3 and 7.2.7); and
- vegetation rehabilitation measures are implemented (see Section 7.2.5).

Furthermore, the establishment and environmental management of the non-mining game enclosure area (within the approved mining rights area) will act not only as habitat nursery but also a faunal nursery for the re-establishment of natural biodiversity in the rehabilitated project area.

Emergency situations

Major spillage incidents will be handled in accordance with the Kudumane emergency response procedure included in Section 20 and Appendix R.

SURFACE WATER

The proposed project could result in an alteration of drainage patterns, as well as potentially contaminate surface water resources. These issues are assessed separately below.

7.2.7 ISSUE: POLLUTION OF WATER RESOURCES

Information in this section was sourced from the hydrology study undertaken by SLR (SLR, July 2014) included in Appendix G as well as the approved 2010 EIA/EMP (Metago, 2010).

Introduction

There are a number of pollution sources that have the potential to pollute surface water, particularly in the unmitigated scenario. In the construction and decommissioning phases these potential pollution sources are temporary in nature. Although these sources may be temporary, the potential pollution may be long term. The operational phase will present more long term potential sources and the closure phase will present final land forms (for example the TSF and WRDs) that may have the potential to contaminate surface water through long term seepage and/or run-off.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Rating of impacts

Severity/nature

In the unmitigated scenario, surface water may collect contaminants (hydrocarbons, salts, and metals) from numerous sources associated with infrastructure and activities being proposed.

Potential pollution sources when considered cumulatively include:

- sedimentation due to runoff containing high loads of suspended solids;
- contamination of the surface water due to spillages of hazardous substances related to the mining activities such as hydrocarbons, leachate from mineralised waste storage and spillage of sewage effluent, and
- contamination of surface water due to overflowing of PCDs; and
- spillages/leaks from workshop/laydown areas.

At elevated concentrations contaminants can exceed the relevant limits imposed by DWA and can be harmful to humans and livestock if ingested directly and possibly even indirectly through contaminated vegetation, vertebrates and invertebrates (impacts on biodiversity have been assessed in Section 7.2.6 and will not be reassessed in this section). Infrastructure and activities being proposed present a potential risk of the above.

When considered incrementally, the severity is high in the unmitigated scenario. The additional WRDs, TSF and pits (both historical and new) are all potential sources of pollution. When considered cumulatively within the context of the existing mining operations, the severity remains high. With mitigation, clean water will be diverted away from the operational sites and contaminated run-off and process water will be contained and re-used in the normal course. The severity can therefore be reduced to medium both for the incremental and cumulative assessment.

<u>Duration</u>

In the unmitigated scenario, the pollution of surface water resources will occur for periods longer than the life of mine (especially with regards to the TSF, WRDs and additional pits). With mitigation, pollution can be prevented and/or managed and as such the impacts can be reversed or mitigated within the life of mine.

<u>Spatial scale / extent</u>

In the unmitigated scenarios the spatial scale is likely to extend beyond the proposed project area because contamination is mobile once it reaches flowing water courses. This will be more of an issue in the rainy season because all of the watercourses are non-perennial. In the mitigated scenario, the spatial scale is expected to be restricted to the site boundary both when considered incrementally and when considered cumulatively.

<u>Consequence</u>

In the unmitigated scenario the consequence is high and can be reduced to medium with mitigation.

<u>Probability</u>

The probability of the impact occurring relies on a causal chain that comprises three main elements:

- Does contamination reach surface water resources?

- Will people and animals utilise this contaminated water?
- Is the contamination level harmful?

The first element is that contamination reaches the surface water resources adjacent to the mine and project site. Due to the proximity of the proposed TSF, Hotazel pit and WRDs to the Ga-Mogara River, contaminants could reach surface water resources. It should however be noted that this river is non-perennial in nature and as such contaminants might only reach this river once in flow.

The second element is that third parties and/or livestock use this contaminated water for drinking purposes. There is a limited possibility that this will occur given that there is no reliance on surface water resources in the area, for domestic use or livestock watering.

The third element is that it is likely that only some contaminants will be at a level which is harmful to humans and livestock. This is influenced both by the quality of any discharged water and by the diluting effect of any rainwater particularly in the rainy season.

As a combination, when considering the nature and location of the proposed infrastructure in proximity to the Ga-Mogara River, the unmitigated probability is medium, reducing to low with mitigation, both when considered incrementally and when considered cumulatively.

Significance

It follows that the significance, when considered both incrementally and cumulatively is high without mitigation, reducing to medium with mitigation.

Unmitigated – summary of the cumulatively rated pollution of water resources impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the cumulatively rated pollution of water resources impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M	M	L	M	L	L

Description of proposed mitigation measures

Mitigation measures are provided below and specific tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent pollution of surface water resources and related harm to surface water users.

Actions

Management measures will focus on the prevention of pollution, the containment of pollution sources, and the remediation of contamination incidents should they occur:

- the soil resource will be conserved and managed as detailed in Section 7.2.3;
- prevention of contamination and containment of potential pollution sources will be achieved as described in Section 2.7.2;
- the clean and dirty water systems (as described in Section 2.7.2) will be designed, implemented and managed in accordance with the provisions of Regulation 704 for water management on mines. In this regard:
    - clean water will be diverted around operational areas, including flood protection bunds to safeguard the Hotazel open pit from flood events greater than the 1:100 year flood;
    - dirty water will be contained in the dirty water run-off and/or process water system that comprises dirty water pipes, berms and channels, and dams, and from which dirty water will be reused as a priority and/or treated prior to being discharged to the environment; and
    - these systems will be routinely inspected to detect possible breaches and implement preventative or corrective action.
- as part of closure planning, final landforms will be designed and stabilised so as to prevent erosion and associated suspended solids. Monitoring of potential seepage from these landforms will be conducted;
- the water balance for the project will be refined on an ongoing basis during the life of the project. Flow meters will be installed in the mine water circuit to provide actual data on water flows to confirm or amend predictions made in the water balance model. The water balance will be used to check on an ongoing basis that the capacity of the dirty water holding facilities is adequate, taking the operational distribution and use of water into account:
    - an annual water balance report will be submitted to DWA, providing information on the status of the water balance in the wet and dry season and under conditions of extreme rainfall.
- water quality monitoring will take place as detailed in Section 12;
- if an incident occurs where water has been contaminated to levels exceeding the maximum acceptable limits agreed to by DWA, the mine will immediately notify DWA and then identify the source of the contamination and implement measures to prevent further contamination in consultation with DWA;

Emergency situations

Any significant pollution incident is considered an emergency situation. In such instances, the emergency procedures described in Section 20 and Appendix R will be followed.

7.2.8 ISSUE: ALTERATION OF NATURAL DRAINAGE PATTERNS

Information in this section was sourced from the hydrology study undertaken by SLR (SLR, July 2014) included in Appendix G and the approved 2010 EIA/EMP (Metago, 2010).

Introduction

Pre-mining natural drainage across the site was via sheet flow and/or non-perennial preferential flow paths (drainage lines). With reference to the table below, there are a number of activities/infrastructures which will alter drainage patterns either by reducing the volume of run-off into the downstream catchments or through their location within watercourses.

During the decommissioning phase, these activities will continue until such time as mine and project infrastructure can be removed and/or the areas rehabilitated. During the closure phase rehabilitation will allow for the restoration of drainage patterns as far as possible except where final landforms remain.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Rating of impacts

Severity / nature

During the construction, operation, decommissioning, and to a lesser extent, the closure phases, rainfall and surface water run-off will be collected in all areas that have been designed with water containment infrastructure. Additional aspects that can influence this impact are the surface subsidence impacts associated with pits that are incorrectly back-filled and rehabilitated. The collected run-off will therefore be lost to the catchment and can result in the alteration of drainage patterns. The quaternary catchment D41K has a catchment area of 4216 km^2 and a mean annual runoff (MAR) of 1.92 million m^3. When considered cumulatively in the context of the existing operations at York and the proposed projects (new mining rights and Section 102), it follows that the new infrastructure and existing infrastructure will reduce the run-off of quaternary catchment D41K by approximately 0.11%.

Despite this seemingly insignificant reduction in MAR, this amounts to a medium severity (despite the substantial size of the catchment area) given that there is seldom enough rainfall for rivers to flow and in this regard every small reduction in MAR is considered important. This severity reduces to low with mitigation measures such as stormwater control infrastructure.

Duration

Without mitigation, drainage patterns would continue to be impacts post-closure and this is a high durations. With mitigation however, run-off patterns should be re-established reducing the duration to medium, both when considered incrementally and cumulatively.

Spatial scale / extent

In the mitigated and unmitigated scenario the physical alteration of drainage patterns will extend beyond the site boundary as flow reduction impacts could extend further downstream. This holds for both the incremental and cumulative assessment.

Consequence

In the unmitigated scenario the consequence is high. In the mitigated scenario it reduces to low because the severity and duration reduce.

Probability

The probability of the alteration of drainage patterns is definite without mitigation. With mitigation, the re-establishment of run-off patterns reduces the probability of this impact to low.

Significance

The significance is high in all phases without mitigation, reducing to low with mitigation.

Unmitigated – summary of the cumulatively rated alteration of natural drainage patterns impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	M	H	M	H	H	H

Mitigated – summary of the cumulatively rated alteration of natural drainage patterns impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	M	M	L	L	L

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent unacceptable alteration of drainage patterns and related reduction of downstream surface water flow.

Actions

The impacts of stormwaters in disturbed areas are closely related to the conservation of soil resources. In this regard, the soil conservation measures set out in Section 7.2.3 will be followed. With reference to stormwater control measures referred to in Section 2.7.2 and detailed in the surface water management plan attached in Appendix H, stormwaters are to be diverted, via a system of trenches and berms, around areas of disturbance and associated exposed soils and vulnerable vegetation. These measures will be implemented in accordance with the requirements of Regulation 704 (Water management regulations for mines).

Where clean water is discharged at a defined point, Kudumane will establish controls (such as gabions) which reduce the velocity and erosive energy of these waters.

With regard to potential surface subsidence, professional engineers will be consulted in ensuring that:

- the backfilling of the pits will be executed in a manner which will account for settling such that excessive subsidence past the pre-project state does not occur; and
- should surface subsidence occur or slopes become unstable, the situation is rectified.

Emergency situations

None identified.

GROUNDWATER

7.2.9 ISSUE: CONTAMINATION OF GROUNDWATER

Information in this section was sourced from the geochemistry and geohydrology studies undertaken by SLR (SLR, June 2014) included in Appendix E and the approved 2010 EIA/EMP (Metago, 2010).

Introduction

There are a number of sources in all mine phases that have the potential to pollute groundwater. In the construction and decommissioning phases some of these potential pollution sources are temporary and diffuse in nature. Even though the sources are temporary in nature, related potential pollution can be long term. The operational phase will present more long term potential sources and the closure phase will present final land forms (such as the proposed TSF and WRDs) that may have the potential to pollute water resources through long term seepage and/or run-off.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Rating of impacts

Severity / nature

The proposed new infrastructure (TSF, WRDs, pits etc.) will serve as potential groundwater pollution sources. The sources that have been identified with respect to the proposed infrastructure include:

- accidental spills and leaks from vehicles and equipment have the potential to reach shallow groundwater during the construction, operational and decommissioning phases;
- the WRDs, dirty water containment areas and other stockpiles have the potential to impact upon groundwater during all project phases, as well as after closure through seepage; and
- the TSF has the potential to impact upon groundwater during all project phases, as well as after closure through seepage.

The geochemical tests and analysis indicate that the waste rock lithologies tested are non-acid generating, however a number of metals are leachable including aluminium (Al), iron (Fe) and manganese (Mn). In addition, it is possible that blast residue related nitrates can be associated with some waste rock. If this material is stockpiled or used for backfill, it presents a potential pollution risk for both surface and groundwater in both the short and long term.

In the case of tailings, potentially elevated manganese levels are not expected to contaminate and no other leachate concerns have been identified. Moreover, there is no measurable potential to generate acid on oxidation of sulphides, which are virtually absent.

It follows that without mitigation, the potential groundwater pollution that could arise from the WRDs, open pits, TSF, dirty water facilities, stockpiles, and other ad-hoc spills amounts to a high severity both when considered incrementally as well as when considered cumulatively. With mitigation, this reduces to low because pollution is controlled at source.

Duration

Groundwater contamination and the potential related health impacts are long term in nature, occurring for periods longer than the life of project if unmitigated, and this is taken into account in the duration assessment below.

The TSF, WRDs and backfilled pits will remain in perpetuity (although rehabilitated) and may present a potential for pollution beyond the life of the project. In this regard, when considered incrementally for the new mining rights area, the duration is high, reducing to medium with mitigation. The same is assumed for the cumulative assessment.

Spatial scale / extent

It is possible that potential contaminants and pollution plumes could extend beyond the project area even though the dewatering cone from the various pits will limit the potential for contaminants to migrate off-site. The spatial scale is therefore medium. When assessed incrementally and when assessed cumulatively the rating remains the same.

Consequence

The unmitigated consequence is high. With mitigation this reduces to low.

Probability

The probability of the impact occurring relies on a causal chain that comprises three main elements:

- Does contamination reach groundwater resources?
- Will people and animals utilise this contaminated water?
- Is the contamination level harmful?

The first element is that contamination reaches the groundwater resources underneath or adjacent to the mine and project area. Due to the proximity of the sources to groundwater in the shallow aquifer, contaminants could reach groundwater resources.

The second element is that third parties and/or livestock use this contaminated water for drinking purposes. This possibility will only arise if third party boreholes used for domestic purposes and/or livestock watering are contaminated. Using the precautionary approach, the assumption has been made that despite the effect of the dewatering cone (which will draw water towards the pits prior to closure), it is possible for some contamination to reach the closest third party boreholes.

The third element is whether contamination is at concentrations which are harmful to users. Given that existing groundwater qualities are moderate to poor, with elevated TDS, EC, nitrates, chloride, iron and manganese, it is not a certainty that mine related contamination will worsen the water quality, particularly in the mitigated scenario.

As a combination, when considering the nature and location of the proposed infrastructure in proximity to surrounding groundwater users, the unmitigated probability is medium, reducing to low with mitigation, both when considered incrementally and when considered cumulatively.

Significance

The unmitigated significance is high and the mitigated significance is low, both when considered incrementally and when considered cumulatively.

Unmitigated – summary of the cumulatively rated contamination of groundwater impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the cumulatively rated contamination of groundwater impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	L	M	M	L	L	L

Description of proposed mitigation measures

Mitigation measures are provided below and are tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent pollution of groundwater resources and related harm to water users.

Actions

Kudumane will comply with both the National Water Act (36 of 1998) and Regulation 704 (4 June 1999) or any future amendments thereto, and the terms and conditions of water authorisations/licenses.

In the construction, operation and decommissioning phases the mine will ensure that all hazardous chemicals (new and used), mineralised wastes and non-mineralised wastes are handled in a manner that they do not pollute groundwater. This will be implemented through a procedure(s) covering the following:

- pollution prevention through basic infrastructure design;
- pollution prevention through maintenance of equipment;
- pollution prevention through education and training of workers (permanent and temporary);
- pollution prevention through appropriate management of hazardous chemicals, materials and non-mineralised waste;
- the required steps to enable containment and remediation of pollution incidents; and
- specifications for post rehabilitation audit criteria to ascertain whether the remediation has been successful and if not, to recommend and implement further measures.

Infrastructure that has the potential to cause groundwater contamination will be identified and included in a groundwater pollution management plan which will be implemented as part of the operational phase. This plan has the following principles:

- map potential pollution sources;
- track (through groundwater modelling updates every 3 years) the extent of the existing or potential contamination plume;
- design and implement intervention measures to prevent, eliminate and/or control the pollution plume;
- monitor (according to Section 21) all existing and potential impact zones and related third party boreholes to track pollution and mitigation impacts; and
- where monitoring results indicates that third party water supply has been polluted by Kudumane, Kudumane will ensure that an alternative equivalent water supply will be provided.

Emergency situations

Discharge incidents that may result in pollution of groundwater resources will be handled in accordance with the Kudumane emergency response procedure (Appendix R).

7.2.10 ISSUE: DEWATERING

Information in this section was sourced from the geochemistry and geohydrology studies undertaken by SLR (SLR, June 2014) included in Appendix E and the approved 2010 EIA/EMP (Metago, 2010).

Introduction

The pumping of groundwater inflows from the additional pits on Hotazel and Devon has the potential to cause dewatering in the operational phase, which may cause a loss in water supply to surrounding borehole users. As concluded in the Metago 2010 EIA/EMP, since there is no correlation between groundwater levels and the base flow of surrounding rivers (which only flow during heavy rainfall events), no impacts are expected on the base flow of the rivers. This section therefore focuses on the impact of lowering of groundwater levels on surrounding third party water users.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operation	Decommissioning	Closure
N/A			N/A
	Opencast mining	Opencast mining	

Rating of impact

Severity / nature

The pumping of groundwater inflows from the additional pits on Hotazel and Devon has the potential to cause dewatering in the operational phase, which may cause a loss in water supply to surrounding borehole users.

The approved EIA/EMP concluded (on the basis of modelling) that a dewatering cone could be expected and that this could impact the borehole yields of surrounding groundwater users. The addition of the Hotazel and Devon pits does not change this conclusion. In the unmitigated scenario, the reduction in borehole yields has a potential high severity, reducing to low with mitigation, regardless of whether considered incrementally or cumulatively.

Duration

In the unmitigated scenario, the duration of the impacts is linked to the duration of the dewatering and the recharge time thereafter. This will extend post-closure and has a high duration. With mitigation, the duration is reduced to medium term because provision of an alternative water supply will take place in a timeframe that is less than the life of the project. This is relevant both when considered incrementally and cumulatively.

Spatial scale / extent

In the modelling done for the approved EIA/EMP, the cone of dewatering was expected to extend predominantly in an easterly direction (2.5 km) within the Kalahari Formation shallow aquifer and in a north-westerly direction (10 km) within the Hotazel Formation deep aquifer. The addition of the Devon and Hotazel pits is expected to extend the cone of dewatering in the shallow aquifer to the south-east and the north-west of the previously modelled scenario by similar scales. This is a medium spatial scale both with or without mitigation, regardless of whether considered incrementally or cumulatively.

Consequence

In the unmitigated scenario the consequence is high. With mitigation it reduces to low.

Probability

In the unmitigated scenario it is possible that dewatering activities at the mine will impact third party boreholes and result in a decrease in water supply. With mitigation the probability of loss in water supply reduces to low, because alternative water will be supplied. This is relevant both when considered incrementally and when considered cumulatively taking into consideration the existing dewatering impacts within the approved mining rights area.

Significance

In the unmitigated scenario the significance is high. This reduces to low with mitigation.

Unmitigated – summary of the cumulatively rated dewatering impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Operation						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the cumulatively rated dewatering impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Operation						
Mitigated	L	M	M	L	L	L

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent water losses to third party water users.

Actions

If any mine related loss of water supply is experienced by the surrounding borehole users, Kudumane will provide compensation that could include an alternative water supply of equivalent water quality. In order to determine this, all boreholes potentially in the impact zone will form part of the Kudumane monitoring programme (see Section 20.1) in consultation with the relevant landowners/land users. In addition, model updates every 3 years will be done to assist with quantification of the impact zone as mining develops and additional information becomes available.

Emergency situations

None identified.

AIR QUALITY

7.2.11 ISSUE: AIR POLLUTION

Information in this section was sourced from the air quality specialist impact assessment undertaken by SLR (July 2014) and included in Appendix I.

Introduction

There are a number of activities/infrastructure in all phases that have the potential to pollute the air. In the construction and decommissioning phases these activities are temporary in nature. The operational phase will present more long term activities and the closure phase will present final land forms (i.e. the TSF and WRDs) that may have the potential to pollute the air through long term wind erosion.

Air pollution related impacts on biodiversity have been discussed in Section 7.2.6 and therefore this section focuses on the potential for human health impacts.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Transport infrastructure Other support services and amenities General site management	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Rating of impact

Severity / nature

The main contaminants associated with the proposed activities include: inhalable particulate matter less than 10 microns in size (PM_{10}), including manganese, larger total suspended particulates (TSP) that relate to dust fallout, and gas emissions mainly from vehicles and generators. Emissions from vehicles and generators are not considered significant and therefore the assessment below focusses on PM_{10} and dust fallout.

The current approved mine presents a number of sources of both PM_{10} and dust fallout emissions. The proposed additional project components have the potential to contribute to these sources.

The main sources of emissions include:

- land clearing activities;
- materials handling;

- wind erosion of mineralised stockpiles such as the existing WRDs (approved mining rights area) and the proposed new WRDs and TSF (new mining rights area)
- wind erosion of disturbed areas, not yet rehabilitated; and
- vehicle movement along unpaved roads.

The manganese content of the ore is reported to be approximately 32%. To represent a precautionary assessment, it has been assumed that the manganese fraction of the PM_{10} released from ore handling activities is also 32%. Manganese emissions have therefore been estimated from the following sources:

- wind erosion of TSF;
- materials handling of ore and product;
- screening and crushing; and
- drilling and blasting.

The most notable additional sources of emissions will include:

- additional open pit mining (Devon and Hotazel pits);
- additional WRDs;
- a TSF; and
- associated vehicle movement, materials handling and wind erosion of disturbed areas.

In order to determine the potential for health impacts, reference is made to South African (SA) National Ambient Air Quality Standards (NAAQS) for pollutants as outlined in Table 36 below. These standards stipulate an annual PM_{10} standard of 40µg/m^3 and a daily NAAQS permitting a maximum of four days of exceedance of 75µg/m^3.

TABLE 36: AIR POLLUTION EVALUATION CRITERIA

POLLUTANT	AVERAGING	LIMIT VALUE (µg/m³)	FREQUENCY OF EXCEEDENCE	COMPLIANCE DATE
PM_{10}	24 hour	120	4 days per year	Immediate-31 Dec 2014
	24 hour	75 [(a)]	4 days per year	1 Jan 2015
	1	50	0	Immediate-31 Dec 2014
	1	40 [(a)]	0	1 Jan 2015
POLLUTANT	APPLICATION	LIMIT VALUE (MICROGRAM M^2/DAY)		COMPLIANCE DATE
TSP[(a)]	Industrial	1200		Current
	Residential	600		Current

(a) - Used in the assessment of impacts.

The annual threshold value for manganese is 0.15 µg/m3 in line with the WHO requirements. In the absence of manganese threshold values in SA, the WHO threshold value was used.

Construction phase (also applicable to decommissioning phase): Dust fallout and PM_{10}

When considered incrementally, without mitigation the proposed construction phase activities will result in an increase in contribution to the annual and 24-hour mean PM_{10} concentration, however the contribution is significantly below the NAAQS, even without mitigation. When considered cumulatively without mitigation, the concentrations also do not exceed the NAAQS. With the application of mitigation measures it is predicted that contributions can be further below the NAAQS.

The proposed construction phase activities will result in an increase in contributions to dust fallout, however the contribution is significantly below the Residential Target Limit even without mitigation. Therefore, the cumulative severity of the proposed impact, is low in the construction phase regardless of mitigation.

Operational phase: Dust fallout and PM_{10}

The proposed operational phase infrastructure/activities, when considered in isolation will result in air pollution through wind erosion of the TSF and WRDs. The mining of the Hotazel and Devon pits, the handling of materials, movement of vehicles etc. will also be additional sources of air pollution.

The predicted contribution from the proposed pits on Hotazel and Devon to annual mean PM_{10} concentrations at the sensitive receptor locations is well below the NAAQS for both the unmitigated and mitigated scenarios. The application of dust abatement measures reduces predicted exposure significantly. When considered cumulatively in the context of the existing mining activities, the proposed activities represent an increase in the contribution, however the cumulative contribution remains below the NAAQS for the unmitigated and mitigated scenarios.

Exceedances of the 24-hour mean PM_{10} concentrations are predicted at Botha, Devon 1 and Devon 2 (Figure 17) in the unmitigated scenario. With mitigation the concentration from the Devon pit is reduced close to the NAAQS, however the levels are still exceeded. This results in a high severity impact in the mitigated scenario for the duration of mining activities at the Devon pit specifically.

As manganese is a constituent of PM_{10}, it follows the same dispersion patterns as PM_{10}. It follows that receptors close to the Devon pit are at risk of exceedances of the WHO threshold value during the operational phase of the Devon Pit with exceedances predicted at the closest receptors in the unmitigated and mitigated scenarios (Devon 1). Notwithstanding this, it should be noted that the Devon pit is only expected to be operational for 1 year.

The predicted contribution of dust fallout resulting from the proposed infrastructure on Hotazel and Devon is below the Residential Target Value at all receptors locations for both the mitigated and un-mitigated scenario

Therefore, in summary, the severity of the impact in the unmitigated scenario is high, reducing to medium for all receptors except Devon 1 with mitigation.

Closure: Dust fallout and PM_{10}

At closure, the WRDs and TSF will remain as permanent landforms and might be subject to on-going wind erosion. It follows that in the unmitigated scenario, the severity is medium, reducing to low with mitigation. When considered cumulatively, the rating remains the same.

Duration

Without mitigation, the duration of health related impacts could extend beyond closure when considered incrementally or cumulatively, particularly given that the TSF and WRDs will remain in perpetuity (although these will be rehabilitated). With mitigation, the duration of impacts could be reduced or avoided. However, with regards to the duration of the Devon pit, in the mitigated and mitigated scenario, the duration will be low as the mining of the pit will only be one year and therefore it is likely that related impacts on receptors will not last for longer than the duration of the total mine project. It follows that the unmitigated duration is medium to high, reducing to low with mitigation.

Spatial scale / extent

The spatial scale of the potential impact could extend off site in both the mitigated and unmitigated scenario. This is particularly the case given the air pollution potential associated with the WRDs, TSF and re-mining of the historical pits. The same holds when considered cumulatively given the additional potential pollution sources added by the new mining rights area. This is a medium spatial scale.

Consequence

Without mitigation the consequence is high. With mitigation the consequence reduces to medium both when considered incrementally and when considered cumulatively, with the exception of the Devon where it reduces from high to medium.

Probability

The health impact probability is linked to the probability of ambient concentrations exceeding the evaluation criteria. Given that there is potential for exceedances of the criteria, the probability is medium in the unmitigated scenario when considered incrementally as well as when considered cumulatively taking into account the overall operations. The probability remains medium with mitigation, particularly because of the potential impacts associated with the Devon pit.

Significance

The significance of this impact is high to medium (high for Devon) in the unmitigated scenario, reducing to medium with mitigation.

Unmitigated – summary of the cumulatively rated air pollution impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	M-H	M	M-H (H for Devon)	M	M-H (H for Devon)

Mitigated – summary of the cumulatively rated air pollution impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M (H for Devon)	L	M	L (M for Devon)	M	M

Description of proposed mitigation measures

Mitigation measures are provided below and are tabulated in the EMP (Section 19).

Objective

To manage the generation of dust such that third party receptors do not experience exceedances of dust fallout, PM_{10} and inhalable manganese limits.

Actions

The following actions apply:

Opencast mining

Doubling the moisture content of materials handled in opencast operations has been shown to reduce dust generation by 62%. Due to the expected groundwater inflows into the mine workings materials within the pit will already have elevated water contents when compared to on-surface stockpiled materials. Therefore, the need for additional wetting of the opencast workings will be based on monitoring results.

The use of wet and chemical dust suppression at mining and stockpiles will be investigated based on monitoring results.

A 75% reduction in dust emissions from unpaved in-pit haul roads can be achieved through effective water sprays combined with chemicals. Although water spraying of unpaved in-pit haul roads will be conducted, the need for chemical dust suppression additives will be assessed based on monitoring results. Kudumane will also use dust suppression spraying at drilling sites within pit. The Australian NPi estimates that a 70% reduction in dust emissions from drilling can be achieved through effective water sprays.

TSF

Dust suppression will be achieved by capping the side walls and surface as part of on-going rehabilitation and final closure of the TSF. The choice of capping material is either rock or vegetation of a combination.

Plant and materials handling areas

Dust suppression by the application of water

Vehicle entrainment on unpaved roads

The following measures will be taken to reduce emissions from roads (outside the pit):

- access roads will be tarred;
- restrictions will be placed on traffic volumes and vehicle speeds; and
- wet suppression spraying of unpaved roads will take place daily. Should only water be applied, the amount needed to ensure 75% control efficiency on the various unpaved roads was calculated to be 1.23 litres/m²/hour during road use. The need for chemical dust suppression additives will be assessed based on monitoring results.

Monitoring Requirements

Air quality monitoring should be continued as is currently taking place at Kudumane. A detailed air quality monitoring programme is provided in Section 12. This monitoring programme includes three additional proposed dust fallout monitoring points and one additional PM_{10} monitoring point. With regards to the PM_{10} monitoring point, it is suggested that the existing location DB1 (at the lodge) should relocated to Devon for the duration of the re-mining of the Devon pit. Following the cessation of the opencast operations at Devon, it could be located immediately outside the Hotazel town (as indicated Figure 17), depending on access to power and security or alternatively at the lodge where it has been placed for the purposes of current operations.

Health Risk Assessment

If monitoring determines that third parties will be exposed to unacceptable cumulative concentrations of manganese or PM_{10}, a health risk assessment will be commissioned. Commissioning this health risk assessment, including the implementation of any related management measures, is the responsibility of both Kudumane and other contributing mines.

Emergency situations

None identified.

NOISE

7.2.12 ISSUE: NOISE POLLUTION

Information in this section was sourced from the noise specialist impact assessment undertaken by SLR (SLR July 2014) and included in Appendix J as well as the approved EIA/EMP (Metago, 2010).

Introduction

Two types of noise are distinguished: noise disturbance and noise nuisance. The former is noise that can be registered as a discernible reading on a sound level meter and the latter, although it may not register as a discernible reading on a sound level meter, may cause nuisance because of its tonal character (e.g. distant humming noises).

Proposed activities/infrastructure present the possibility of generating both noise disturbances and noise nuisance in the project phases prior to closure.

Potential noise impacts on biodiversity have been addressed in Section 7.2.6 and so this section will focus on the potential human related noise impacts.

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure
			N/A
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Tailings dam Demolition Rehabilitation General site management	

Rating of impact

<u>Severity / nature</u>

Based on the guidance contained in SANS 10103:2008 and the IFC General EHS Guidelines for Environmental Noise Management, the following limits for noise have been adopted which reflect the character of the identified receptors. The SANS guidelines (SANS:10103, 2008) stipulate that noise levels from a development that cause ambient background noise levels to increase in excess of 3 to 5dBA will create a noise disturbance. In addition, SANS specifies that the guideline limits for suburban areas are 50dBA (day) and 40dBA (night) and the guideline limits for rural areas are 45 dBA at during the day and 35dBA at night.

Section 1.1.10 explores the baseline conditions on and around the project area. The results showed exceedances at Hotazel (midweek daytime) and Langdon (weekend and midweek daytime). It should be noted that the exceedances at Hotazel and Langdon were due to normal local activities and the existing operations at Kudumane were not audible from these receptor locations. In this regard, the baseline conditions in the area are generally considered to be of a rural nature.

The additional activities/infrastructure will add to the existing noise levels in the area. According to the noise assessment undertaken, it is expected that no discernible impacts will be experienced in the community of Hotazel (L1). It is expected that there would be a maximum change of 3.4 dB in the day-time ambient noise levels at L2 (Langdon) given the proximity of this receptor to the Devon pit. Both of the above fall into the “little” category for estimated community response which could lead to sporadic complaints.

Although there will be more significant increases above the ambient noise levels at L3 when the site is fully operational, it should be noted that the proposed project does not contribute to this impact as it relates to the activities and infrastructure that has already been approved as part of the existing 2010 EIA/EMP. Moreover, the homestead at L3 is currently unoccupied and in this regard, the impacts would be felt only if and when there are residents.

When considering night-time noise levels, it is predicted that operations would result in a change in prevailing ambient noise levels at L2 and L3 in excess of 15 dB, therefore falling into the “very strong” category for estimated community response which could lead to vigorous community or group action. It must be noted that the proposed project only influences the night-time noise at L2, because the predictions for L3 are linked to the already approved mining operations only.

This translates into a day-time medium severity without mitigation, reducing to low with mitigation. In the case of the Devon pit, the night-time severity is high without mitigation, reducing to medium with mitigation.

<u>Duration</u>

When considered incrementally or cumulatively, in both the unmitigated and mitigated scenarios the noise pollution impacts will generally occur until the closure phase of the mine when the noise generating activities are stopped. This is a medium duration. In the case of the Devon pit, the impacts will be for one year only, which is a low duration.

<u>Spatial scale / extent</u>

When considered incrementally, in the unmitigated scenario, the noise impact may extend beyond the site boundary given the nature of the noise generating activities. With mitigation, even with the correct noise attenuation measures, this remains medium.

Consequence

In the unmitigated scenario the consequence is medium, and low in the mitigated scenario (remaining medium for Devon).

Probability

The unmitigated probability of the predicted noise increases causing a noise related disturbance at the receptors is considered to be high without mitigation. With mitigation the probability reduces to medium.

Significance

The significance in the unmitigated scenario is medium, remaining medium with mitigation.

Unmitigated – summary of the cumulatively rated noise pollution impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	M (H for Devon)	M (L for Devon)	M	M	H	M

Mitigated – summary of the cumulatively rated noise pollution impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Mitigated	L (M for Devon)	M (L for Devon)	M	L (M for Devon)	M	M

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

To prevent public exposure to disturbing noise. In general, this limit is considered an increase of 5dB, but this may be as low as 3dB depending on the sensitive nature of the receptor.

Actions

In general, the management actions included in the approved 2010 EIA/EMP apply and these are set out below.

The overburden and low-grade ore stockpiles will act as a noise berm around the mining operations.

No blasting will take place at night. As a general rule the following restrictions also apply to weekends:

- the mine will not operate on Sundays;
- no crushing at night on weekends;
- no train loading at night on weekends; and
- no blasting on weekends.

All diesel-powered earth moving equipment will be of high quality and will be well maintained. Regular maintenance schedules must include the checking and replacement of exhaust and intake silencers.

The mine will record and respond immediately to complaints about disturbing noise. All such complaints will be documented and recorded as incidents. Monitoring to verify noise levels and impacts may be required as part of this process. The measures taken to address these complaints will be included in the documentation. These records will be kept for the life of mine.

In addition, specific actions are required to prevent or mitigate impacts associated with the Devon pit and WRD. In this regard, night-time noise impacts are the most critical issue and therefore Kudumane will not operate noise generating activities at the Devon pit and WRD between 18h00 and 06h00 unless an alternative agreement with the receptors at Langdon is obtained. Similarly, if the homestead on Botha is ever occupied, measures to mitigate cumulative noise impacts associated with Kudumane should be agreed with the tenants as required.

Emergency situations

None identified.

BLASTING IMPACTS

7.2.13 ISSUE: BLASTING IMPACTS

Information in this section was sourced from the Kudumane project team.

Introduction

Blasting is required for the additional opencast mining of the Hotazel and Devon pits as proposed within the new mining rights area.

Air quality impacts are discussed in Section 7.2.11 and biodiversity impacts are discussed in Section 7.2.6. These will therefore not be re-assessed in this section.

The impact timing table below refers to the project phases during which the impact will be felt.

Activities and infrastructure - link to mine phases

Construction	Operational	Decommissioning	Closure
N/A		N/A	N/A
	Earthworks Civil works Opencast mining		

Rating of impact

Severity / nature

Fly rock generation is related to the energy or mass of explosives and the containment of the energy on all sides of the blast area. In general, larger blastholes tend both to throw larger rocks over greater distances. Containment of fly rock is important because it has the potential to cause injury and death to people and animals. It can also damage structures. In unmanaged scenarios fly rock can extend more than 1000m from the blast site. This could harm or kill people, animals and/or structures up to 1500m from the blasting site as listed in

Table 37 below. In the managed scenario, this can be kept within a range of less than 500m. Death or injury to a third party is considered a high severity impact in both the unmitigated and mitigated scenarios.

Ground vibrations from blasting travel directly through the ground. The related impact on structures (such as buildings and reservoirs) depends on velocity and frequency of vibrations and the integrity of the built structures. The United States Bureau of Mines (USBM) standard of 12mm/s peak particle velocity is applied as a general guideline for blast management in South Africa as a "safe" limit for brick and mortar structures in the usual range of blasting vibration frequencies (4 – 12 Hz). In the unmanaged scenario, a limited number of third party structures could be at risk where peak particle velocities greater than 12mm/s are generated by blasting. In the managed scenario, assuming that the blast design will consistently result in a peak particle velocity of 12mm/s or below at all third party structures, these should not be damaged. As a result, the blast design must be specific to manage impacts on surrounding structures.

Airblast is an air pressure pulse that has both a high frequency audible sound and a low frequency inaudible concussion. If the pressure is great enough damage can be caused to structures. If the airblast is contained to 130 dB or less, then damage should not be caused to surrounding structures. In the unmanaged scenario, a limited number of third party structures could be at risk outside where airblast greater than 130 dB is generated by blasting. In the managed scenario, assuming that the blast design will consistently result in airblast of 130 dB or below, third party structures should not be damaged. As a result, the blast design must be specific to manage impacts on surrounding structures.

It is noted that some or all of the above issues could have greater severity if blasting takes place at the same time as neighbouring mines, and/or when climatic conditions such as low cloud cover, temperature inversions, and unfavourable wind direction occur at the time of blasting.

In the unmitigated scenario, when considered incrementally or cumulatively in the context of the blasting which already takes place at the York pit, the additional surface blasting activities associated with the Devon and Hotazel pits could cause injury to third parties and livestock through fly rock. The severity is therefore high in the unmitigated scenario. In the mitigated scenario, this severity reduces to medium because measures can be taken to control blasts and associated impacts and the reduction of ground vibrations.

Duration

Although blasting and the resultant fly rock, ground vibrations and airblast will only take place during the life of the project, injury or death of a third party as a result of fly rock is permanent and extends beyond the life of mine in both the unmanaged and managed scenarios.

Damage to property caused by ground vibration and airblast will extend beyond the life of mine in the unmitigated scenarios. Any such damage is quickly reversible in the managed scenarios.

Spatial scale / extent

The majority of infrastructure within the blasting impact zone belongs to Kudumane. The table below lists all third party infrastructures within 2 km of the Hotazel and Devon pits. Taking this into account the spatial scale is medium in both the mitigated and unmitigated scenario.

TABLE 37: PROXIMITY OF STRUCTURES TO THE HOTAZEL AND DEVON PITS

500 m	1 km	2 km
HOTAZEL PIT		
Fences Potential livestock and herders on surrounding properties	Fences Heritage resources Potential livestock and herders on surrounding properties	Fences R380 (third party traffic) R31 (third party traffic) Potential livestock and herders on surrounding properties
DEVON PIT		
Fences R31 (third party traffic) Potential livestock and herders on surrounding properties Devon 1 residence	Fences R31 (third party traffic) Potential livestock and herders on surrounding properties Devon 1 residence Devon 2 residence	Fences R380 (third party traffic) R31 (third party traffic) Potential livestock and herders on surrounding properties Devon 1 residence Devon 2 residence

Consequence

The consequence is high in the unmitigated scenario and the mitigated scenario.

Probability

Due to the fact that blasting on surface will only take place when required, the likelihood of this impact occurring is seldom and as such the probability is medium in the unmitigated scenario, reducing to low with mitigation.

Significance

The significance is high in the unmitigated scenario, reducing to medium with mitigation.

Unmitigated – summary of the cumulatively rated blasting impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Operational						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the cumulatively rated blasting impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Operational						
Mitigated	M	H	M	H	L	M

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objectives

The objective of the management measures is to prevent harm to people, animals and structures.

Actions

The following specific actions are required in addition to compliance with the relevant blasting and explosives legislation including the Explosives Act and the Mine Health and Safety Act.

The blast design will, as a minimum standard, ensure that the peak particle velocity from all blasts is less than 12mm/s at all vulnerable third party structures, that flyrock is contained within 500 m of each blast and that the airblast is less than 130 dB at third party structures for all blasts. Monitoring of these three aspects (fly rock, airblast and ground vibration) will be undertaken to determine whether the blasts are within compliance.

All vulnerable structures (see Table 37) within 1000 m of the blast will be marked on a site plan and surveyed photographically in the presence of the owner before blasting takes place. If surrounding property owners have vulnerable structures outside of this zone, they can request Kudumane to have them included in the pre blast survey. All parties that exist and/or that have property and/or that provide services within 3000m of the blast sites will be informed, prior to mining, about the blast programme and associated safety precautions.

In deciding whether or not to set off blasts, a procedure must be developed to take temperature inversions, low cloud cover, and wind direction into account.

For each blast, the mine will observe the following procedural safety steps:

- the fly rock danger zone associated with each blast is delineated and people and animals are cleared from this zone before every blast;

- an audible warning is given at least three minutes before the blast is fired; and
- the Hotazel Manganese Mine landing strip will be contacted in order to ensure no risk is posed to aircraft and/or associated third parties.

The mine will respond immediately to any blast related complaints. These complaints and the follow up actions will be dated, documented, and kept as records for the life of mine. Where the mine has caused blast related damage it will provide appropriate compensation.

Emergency situations

Any significant damage or death from flyrock is considered an emergency situation. In such instances the emergency procedure included in Section 20 and Appendix R will be followed.

TRAFFIC

7.2.14 ISSUE: ROAD DISTURBANCE AND TRAFFIC SAFETY

Information in this section was sourced from the traffic impact assessment undertaken by Siyazi Gauteng (Pty) Ltd and included in Appendix O as well as the approved EIA/EMP (Metago, 2010).

Introduction

Traffic impacts are expected from construction through to the end of the decommissioning phases when trucks, buses, and private vehicles make use of the private and public transport network in and adjacent to the mine. The key potential traffic related impacts are on road capacity and public safety.

The traffic impact assessment below considers the most conservative scenario which is the scenario in which all incoming material and outgoing product is transported by road. The reason why this is conservative is because rail transport for the product is part of the originally approved project plan.

The impact timing table below refers to the project phases during which the impact will be felt.

Activities and infrastructure - link to mine phases

Construction	Operation	Decommissioning	Closure
			N/A
Site preparation Transport infrastructure General site management	Opencast mining WRDs/Stockpiles Transport infrastructure Other support services and amenities General site management	Demolition Rehabilitation General site management	

Rating of impact

Severity / nature

Existing traffic volumes (comprising both Kudumane and public traffic) are associated with an acceptable level of service in the context of the existing public and private road infrastructure. The inclusion of additional mining areas and activities will increase the material requirements, employment numbers and product, all of which will generate higher volumes of traffic, particularly in the scenario where all transport is by road. Despite this, it is the finding of the specialist traffic investigation that when considered both incrementally and cumulatively, the impact on traffic will be manageable.

The following safety risks apply when additional traffic associated with the proposed project is added to the transport network:

- pedestrian accidents; and
- vehicle accidents.

When assessing the severity from a cumulative perspective and considering the existing traffic volumes required for the existing mining operations, it follows that the additional traffic generated as a result of the new mining rights area will contribute substantially to the overall traffic volumes on site, thereby impacting road disturbance and traffic safety. Moreover, given that the processing plant is located within the existing mining rights area and this plant will be used to process the additional ROM tonnage mined from the pits on Hotazel and Devon, the transportation of the ROM from the new mining rights area to the plant in the existing mining rights area implies an additional impact on road disturbance and traffic safety. It follows that in the unmitigated scenario, when considered cumulatively, the severity is high. With mitigation this is reduced to low given that the potential and frequency of accidents is expected to decrease.

Duration

Any serious injury or death is a long term impact in both the unmitigated and mitigated scenarios.

Spatial scale / extent

Possible accident sites could be located within or outside the Kudumane Mine given that both private and public roads are and will continue to be used for the transport of ore, materials and personnel. Any indirect impacts associated with any injuries or fatalities will extend to the communities to which the injured people/animals belong. This is a medium spatial scale both with and without mitigation, regardless of whether assessed incrementally or cumulatively.

Consequence

The consequence is high without mitigation, reducing to medium with mitigation.

Probability

When considered incrementally the probability of accidents occurring as a result of the new mining results area is medium because although there is a possibility that traffic accidents could occur these are not expected to occur on a continuous basis. With mitigation this reduces to low. When considered cumulatively, the assessment remains the same.

Significance

Without mitigation, the significance is high. With mitigation, this reduces to low.

Unmitigated – summary of the cumulatively rated road disturbance and traffic safety impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	M	H

Mitigated – summary of the cumulatively rated road disturbance and traffic safety impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Mitigated	L	H	M	M	L	L

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent transport related accidents and/or injury to people and livestock.

Actions

The following actions will be taken by Kudumane in order to reduce the impact of the project on surrounding traffic:

- proper intersection lighting should be installed at the intersections of the R380, local mine road and the eastern access road to Hotazel;
- roads R380 and R3;
- necessary traffic and information signs and road markings should be provided to ensure safe access to the proposed mining development as part of the detailed design process;
- in terms of workers at the mine, dedicated loading and off-loading facilities need to be provided;
- in order to ensure effective and efficient access control management, it would be necessary, as part of the implementation process to review the mine access point on the premises of the mine. This

includes all types and modes and is required in order to ensure proper and safe flow of traffic while security measures are applied.

- it is recommended that the necessary road traffic information signs should be provided where mine vehicles will cross the R380 (from the Devon pit);
- detailed design drawings will need to be submitted to the various authorities for approval purposes, and where necessary the required way leaves should be obtained in order to conduct the required upgrades;
- in terms of road safety it is recommended that the intersection between the R380 and R31 is upgraded by adding a dedicated right turning lane from the western approach and a taper from the southern approach. Collaboration with adjacent mining operations is necessary in terms of the proposed upgrading since the activities related to adjacent mining developments also have an impact on this intersection. In this regard, Kudumane will initiate a forum in which the above will be discussed and actioned;
- it is recommended that the necessary road network signage be provided at the intersection of the R380, R31 and the local mine road in order to inform the public that no through movement is allowed
- Kudumane will make use of high passenger capacity busses and taxis for staff transport; and
- Kudumane will co-operate with surrounding mines and the provincial roads department with regards to service levels and safety of the broader road network used by mining related traffic.

Emergency situations

Any road accident involving or caused by mine related traffic will be handled in accordance with the Kudumane Mine emergency response procedure in Section 20 and in Appendix R.

VISUAL

7.2.15 ISSUE: VISUAL IMPACTS

Information in this section was sourced from the visual impact specialist assessment undertaken by SLR (SLR July 2014) and included in Appendix K as well as the approved EIA/EMP (Metago, 2010).

Introduction

Visual impacts may be caused by activities and infrastructure in all mine phases. The more significant visual impacts relate to the larger infrastructure components (such as the TSF and WRDs) which are also longer term infrastructure, some of which will remain post closure (although they will have been rehabilitated)

The impact timing table below refers to the project phases during which the impact will be felt.

Project phase and link to activities/infrastructure

Construction	Operational	Decommissioning	Closure

Construction	Operational	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Opencast mining Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Rating of impacts

Severity / nature

The severity of visual impacts is determined by assessing the change to the visual landscape as a result of mine related infrastructure and activities.

As discussed in Section 1.1.11, the visual landscape is determined by considering: landscape character, sense of place, scenic quality, sensitivity of the visual resource and sensitive views.

In this regard, the Kudumane Mine project area lies in a flat, open area characterised by semi-arid vegetation and ephemeral drainage lines. Livestock and game farms and associated farm settlements are typical of the region. Located on the eastern sub-outcrop of the Hotazel Formation, the landscape is characterised by scattered operational and closed mining operations and supportive infrastructure such as rail and road networks, powerlines and the residential and business centre of Hotazel (Figure 2).

When considering the potential change to the visual landscape the key issues are: visual exposure, visual intrusion, and sensitivity of receptors.

When considered incrementally, the severity of the visual impact associated with the additional infrastructure proposed within the new mining rights area (most specifically the WRDs, the TSF, and night lighting) will be low, given that this infrastructure will merely add to a landscape that has already been affected by similar infrastructure. When considering cumulatively, the rating is the same.

Duration

When considered incrementally or cumulatively, the duration is high without mitigation. With mitigation, and the resultant rehabilitation of final landforms (either through removal or measures to blend these in to the environment), the duration reduces to medium.

Spatial scale / extent

When considering the spatial scale incrementally for the new mining rights area, it follows that the visual impact will extend beyond the site boundary (this is particularly so given that the operations on Hotazel will be visible to receptors in and around the town of Hotazel) and the operations at Devon will be visible to residential receptors located nearby (refer to Figure 17). Even with mitigation, final landforms will remain and in this regard the spatial scale remains medium.

Consequence

The unmitigated consequence is medium reducing to low with mitigation at closure.

Probability

The probability of visual impacts occurring as a result of the new infrastructure within the new mining rights area is medium because of the nature of existing landscape. At closure when final landforms have been rehabilitated, there may still be a visual impact however the probability will be reduced to low.

Significance

The significance is medium for all phases except for closure. At closure, with the correct mitigation measures put in place, the visual impact reduces from high to low.

Unmitigated – summary of the cumulatively rated visual impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	L	H	M	M	M	M

Mitigated – summary of the cumulatively rated visual impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation, decommissioning						
Mitigated	L	H	M	M	M	M
Closure						
Mitigated	L	M	M	L	L	L

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to limit negative visual impacts.

Actions

The key to mitigation of visual impacts is successful implementation of the decommissioning and closure activities which are set out below.

Decommissioning activities that will be undertaken include the following:

- dismantling and demolishing of infrastructure;
- backfilling the open pits with waste rock material;

- replacing topsoil resources on disturbed areas;
- stabilising underground mine workings (existing mining rights area only);
- stabilising and profiling of permanent WRDs;
- rehabilitation of the disturbed areas where infrastructure has been removed by sloping, filling in excavations and re-vegetating where possible;
- the surface of the tailings dam will be covered with waste rock and/or vegetation (new mining rights area only);
- dismantling and rehabilitation of railway tracks and rehabilitation of roads (depending on end use); and
- ensure that vegetation on rehabilitated areas is sustainable.

Closure phase activities that will be undertaken include the following:
- there will be a period of active after-care followed by a passive after-care phase;
- maintenance of vegetation where this is used for rehabilitation;
- maintenance of facilities such as fencing, fire breaks, access roads and ramps, overflow structures;
- removal of any invasive species from the rehabilitated sites;
- inspecting on an annual basis to repair any erosion gullies; and
- monitoring of potential groundwater pollution plumes.

In addition, the successful management of the visual impact is also reliant on the successful management of the following related issues:
- impacts on topography and drainage patterns will be managed as outlined in Section 7.2.2 and Section 7.2.8;
- impacts on biodiversity will be managed as detailed in Section 7.2.5 and Section 7.2.6;
- dust control will achieved as described in Section 7.2.11;
- disturbed areas will be rehabilitated as detailed in Section 7.2.4, Section 7.2.5, and Section 7.2.6;
- ongoing “roll-over” backfilling and rehabilitation of the project area will take place as detailed in Section 2; and
- lighting will be controlled as follows:
  - lights will be directed downwards;
  - fitted with containment shields to prevent light shining directly away from the proposed operations; and
  - security flood lighting and operational lighting will only be used where absolutely necessary and carefully directed, preferably away from sensitive viewing areas.

Emergency situations

None identified.

HERITAGE, PALAEONTOLOGICAL AND CULTURAL RESOURCES

7.2.16 ISSUE: LOSS OF HERITAGE, PALAEONTOLOGICAL AND CULTURAL RESOURCES:

Introduction

Information in this section was sourced from the heritage and palaeontological specialist assessments undertaken by PGS Consulting (June, 2014) and GSPD Consulting (June, 2014) respectively. These reports are included in Appendix L and Appendix M respectively.

No palaeontological resources were found on site, however there is a low possibility that the Hotazel Formation manganese ore body could contain stromatolites and this should be taken into account during the planning and development phases of the proposed project. The potential impact on palaeontological resources is therefore not assessed further however the mitigation measures cover the steps to be taken should there be any chance finds.

There are a number of activities/infrastructure in all phases prior to closure that have the potential to damage heritage and cultural resources, either directly or indirectly, and result in the loss of the resource for future generations. Heritage and cultural resources include sites of archaeological, cultural or historical importance.

The impact timing table below refers to the project phases during which the impact will be felt.

Activities and infrastructure - link to mine phases

Construction	Operation	Decommissioning	Closure
			N/A
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining WRDs/Stockpiles Transport infrastructure General site management	Earthworks Civil works Opencast mining Demolition Rehabilitation General site management	

Rating of impact

<u>Severity / nature</u>

As part of the heritage study (PGS, June 2014), a low density scatter of stone tools was identified (Figure 19). As indicated in the figure, the site is situated on the eastern banks of the Ga-Mogara River. The site is approximately 100 m from the river and is located on the sloping banks of the river. The site extends approximately 250 m along the river and covers an area of approximately 50 m wide along the down slope towards the river.

Given current planning, no infrastructure/activities should influence this site. In the unmitigated scenario where activities are uncontrolled, damage to this site could occur. Even though this site has been rated as having a low heritage significance, it cannot be disturbed or damaged without a permit. It follows that in the unmitigated scenario, the severity could be high. With mitigation, the site would be protected and will remain undisturbed which reduces the severity to low.

Duration

If the heritage resources are removed, damaged or destroyed the impact duration is long term. In the mitigated scenario the duration reduces to less than the project life.

Spatial scale / extent

The spatial scale is low both with or without mitigation.

Consequence

The unmitigated scenario the consequence is high. In the mitigated scenario the consequence reduces to low as the spatial scale, duration and severity is reduced.

Probability

The unmitigated probability is medium, reducing to low with mitigation.

Significance

The unmitigated significance is high and the mitigated significance is low.

Unmitigated – summary of the cumulatively rated heritage resources impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases prior to closure						
Unmitigated	H	H	L	H	M	H

Mitigated – summary of the cumulatively rated heritage resources impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases prior to closure						
Mitigated	M	L	L	L	L	L

Description of proposed mitigation measures

Mitigation measures are provided below and are tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent the loss of heritage and cultural resources that may be caused by mining activities.

Actions

Although the potential impacts on palaeontological resources has not been identified as an issue, for purposes of completeness, mitigation measures relating thereto have been included below.

Project infrastructure, activities and related disturbance will be limited to those specifically identified and described in this report. Where future plans require a change in mine footprint, a project specific heritage study will be done to identify any project specific heritage and cultural resources that may be affected and to detail the mitigation plan where required. If removal or damage to resources is unavoidable, the necessary authorisations will be obtained from SAHRA prior to the removal or damage occurring.

All workers (temporary and permanent) will be educated about the heritage and cultural sites that may be encountered in their area of work and about the need to conserve these.

In the event that new heritage and/or cultural resources are discovered during the construction, operation and decommissioning phases, the mine will follow an emergency procedure prior to damaging or moving these, which includes the following:

- work at the find will be stopped to prevent damage;
- an appropriate heritage specialist will be appointed to assess the find and related impacts; and
- permitting applications will be made to SAHRA, if required.

In the event that any graves are discovered during the construction, operational or decommissioning phases, prior to damaging or destroying any identified graves, permission for the exhumation and relocation of graves must be obtained from the relevant descendants (if known) and the relevant local and provincial authorities.

Emergency situations

If there are any chance finds of heritage and/or cultural sites, Kudumane will follow its emergency response procedure contained in Section 20 and Appendix R.

SOCIO-ECONOMIC

In the broadest sense, all activities associated with the approved mine and proposed project will have socio-economic impacts in all phases. Some of these are considered to be positive impacts and others are considered to be negative impacts. Each impact is assessed separately below. The specialist study (Appendix N) focussed more on the economic and land use impacts and less on the social baseline and related impacts because the social component (both baseline and assessment remain largely unchanged).

7.2.17 ISSUE: ECONOMIC IMPACT

Information in this section was sourced from the Alternative Land Use Assessment undertaken by Strategy4Good (S4G, June 2014) (Appendix N) as well as the existing EIA/EMP (Metago, 2010).

Introduction

The reader of the section below should keep in mind that the potential positive economic impacts have been assessed only from a cumulative perspective given that the new mining rights area will rely on the plant within the existing operations for processing and the benefits of the increased revenue associated with the additional ROM being mined will only be realised with the support offered by the facilities within the existing mining rights area.

The mine has a positive economic impact on the local, regional and national economies. Direct benefits are derived from wages, taxes and profits. Indirect benefits through the procurement of goods and services, and the increased spending power of employees. The proposed extension to the existing mining rights area will support the continuation and potential increase of these positive impacts. These are discussed further below.

The impact timing table below refers to the project phases during which the impact will be felt. In this regard, the list of activities/infrastructure in the table below applies within the context of the current approved mining operations, given that the new mining rights area cannot be considered in isolation in so far as additional revenue is concerned. The impact timing table below therefore shows all activities/infrastructure which may lead to additional employment/job continuity at Kudumane.

Activities and infrastructure - link to mine phases

Construction	Operation	Decommissioning	Closure
			N/A
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Opencast mining Tailings dam Demolition Rehabilitation General site management	

Rating of impact

<u>Severity / nature</u>

The following positive aspects apply (Strategy4Good, June 2014):

- the net GDP gain to the economy as a result of the mine development is estimated at R1.28 billion in today's money. Adding the property values gained (from mining) and lost (to cattle grazing and related land use), the net value to the economy amounts to R1.793 billion; and
- the total net employment added to the economy is potentially 308 jobs. This is the net difference between mining jobs created and potential agricultural jobs lost. The mine employment is adjusted downwards to accommodate for a life of mine that is shorter than an economic generation.

It follows that when considered incrementally or cumulatively without mitigation the economic contribution is high and the potential loss to agriculture is relatively low so the net impact severity is high positive.

Duration

In the normal course, the direct positive economic impacts associated with the mine will occur for the life of mine. After closure there may still be some positive impacts through maintenance and aftercare activities. Furthermore, the project would have contributed to the establishment of a critical economic mass and hence the benefits of wealth creation and a better skilled workforce are expected to continue beyond the life of mine. Quantitatively assessing the post closure impacts is not possible because there are a number of important unknown factors such as the general state of the future economy (local, national and world wide) and the future state of the mining sector in particular.

The negative impacts on the farming sector may continue post closure or they may be improved post closure depending on the success of the mine rehabilitation and closure plan in the context of the collective efforts of the other mines in the region.

Spatial scale / extent

In both the mitigated and unmitigated scenarios regardless of whether considered incrementally or cumulatively, the spatial scale of the impact is high because it will extend far beyond the Kudumane mine on a regional and national scale.

Consequence

In both the unmitigated and mitigated scenarios the consequence is high and positive.

Probability

In the normal course of economic activity the net positive impacts will definitely occur. With mitigation, the potential negative impacts on farming are reduced. However this cannot be reduced for final landforms (TSF and WRDs) as this agricultural land will be transformed and is likely to have a lower carrying capacity.

Significance

In the unmitigated scenario, the significance of this potential impact is high positive. In the mitigated scenario, the significance is further increased.

Unmitigated – summary of the cumulatively rated economic impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H+	H	H	H+	H	H+

Mitigated – summary of the cumulatively rated economic impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	H+	H	H	H+	H	H+

Description of proposed mitigation measures

Mitigation measures are provided below and are tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to enhance the positive economic impacts and limit the negative economic impacts. Part of this objective is to enhance the contribution to the local economy in particular.

Actions

In order to enhance the local economic impacts, Kudumane will consider ways to empower, support and use local people for employment and local business for procurement. It will also consider other ways to enhance local economic development. Kudumane will, where possible, provide wealth creation and life skills training as part of its skill development programmes to assist employees post closure. The mine will continue to implement the commitments in its social and labour plan in accordance with the employment, procurement and social investment principles of the Mining Charter.

Closure planning must include economic planning as described in the above Sections.

Emergency situations

None identified.

7.2.18 ISSUE: INWARD MIGRATION

Information in this section was sourced from the approved EIA/EMP (Metago, 2010).

Introduction

Mining projects tend to bring with them an expectation of employment in all project phases prior to closure. This expectation can lead to the influx of job seekers to an area which in turn increases pressure on existing communities, housing, basic service delivery and raises concerns around safety and security. This section focuses on the potential for the inward migration and associated social issues.

The reader of the section below should keep in mind that the potential for and impacts associated with inward migration has been assessed only from a cumulative assessment given that the new mining rights area operations cannot proceed (in isolation) without the approved and operational processing plant within the existing mining rights area.

The impact timing table below refers to the project phases during which the impact will be felt. In this regard, the list of activities/infrastructure in the table below applies within the context of the current approved mining operations, given that the new mining rights area cannot be considered in isolation in so far as inward migration is concerned. The impact timing table below therefore shows all activities/infrastructure which may lead to inward migration as a result of the Kudumane operations in their entirety.

Activities and infrastructure - link to mine phases

Construction	Operation	Decommissioning	Closure
			N/A
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Opencast mining Tailings dam Demolition Rehabilitation General site management	

Rating of impact

Severity / nature

The effects of inward migration can be significant. These effects could include, but not be limited to:

- potential establishment or expansion of informal settlements;
- increased pressure on housing, water supply infrastructure, sanitation and waste management systems and infrastructure, health care and community services and infrastructure;
- potential for increased pressure on natural resources such as water, fauna, flora and soils;
- increase in crime; and
- spread of disease, most notably HIV/Aids and tuberculosis.

It is not possible to predict how significant the inward migration may be, however this impact severity has been rated as high in line with the precautionary approach and given the proposed increase in workforce needed for the proposed project. It may be possible to mitigate this impact by managing expectations with regard to employment through communication structures at Kudumane.

Duration

In the normal course, social impacts associated with each phase of the project will occur for the life of the project, but negative social issues associated with inward migration can continue beyond the closure of the mine, particularly in the unmitigated scenario.

Spatial scale / extent

In both the unmitigated and mitigated scenarios, the impacts of inward migration could extend beyond the Kudumane Mine area and into surrounding communities.

Consequence

In the unmitigated scenario the consequence associated with inward migration is high. In the mitigated scenario, the consequence is reduced to medium.

Probability

In the unmitigated scenario the impact is considered to be possible because although this type of pressure has been experienced in the communities around other mining operations, no informal settlements have been observed in the immediate vicinity associated with the current mine. With mitigation, probability reduces to low.

Significance

In the unmitigated scenario, the significance of this potential impact is high. With mitigation this may reduce to medium.

Unmitigated – summary of the cumulatively rated inward migration impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the cumulatively rated inward migration impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Construction, operation and decommissioning						
Mitigated	M	H	M	H	L	M

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to limit inward migration and related social impacts.

Actions

All workers at the mine will be housed in formal housing. Kudumane will implement necessary systems to ensure this happens. Two key components are:

- workers will qualify for a housing allowance only for formal housing; and
- Kudumane will audit the living conditions of its workers.

Recruitment will occur in the nearest towns, away from the gate of the mine. Recruitment will take place with the assistance of the Department of Labour as well as other government employment agencies in the area. Job interviews and applications will take place at the offices of the Department of Labour.

Kudumane, will co-operate with the Hotazel security forum and SAPS in insuring that informal settlements do not develop. In this regard a procedure will be developed to inspect and manage vacant land in the vicinity of the mine.

Emergency situations

If an informal settlement starts to develop, this is considered and emergency situation and will be handled in accordance with the procedure attached in Section 20 and Appendix R.

LAND USE

7.2.19 ISSUE: LAND USE IMPACTS

Information in this section was sourced from the Alternative Land Use Assessment undertaken by Strategy4Good (S4G, June 2014) (Appendix N) as well as the existing EIA/EMP (Metago, 2010).

Introduction

There are mine and project related activities and infrastructure that may have an impact on other land uses in the area in all mine phases. This section focuses on potential impacts affecting land use on and surrounding the project sites.

The impact timing table below refers to the project phases during which the impact will be felt.

Activities and infrastructure - link to mine phases

Construction	Operation	Decommissioning	Closure
Site preparation Earthworks Civil works General site management	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities General site management	Earthworks Civil works Opencast mining Tailings dam Demolition Rehabilitation General site management	Maintenance and aftercare of final landforms

Construction	Operation	Decommissioning	Closure

Rating of impact

Severity / nature

Regardless of mitigation measures proposed, it is expected that the proposed additional infrastructure and mining areas will cover a disturbance footprint of roughly 200 ha. Although no formal land use agreements for grazing rights within the new mining rights area are in place, ad-hoc cattle grazers have been observed to occur within the area and in this regard the related land use impacts should be considered. In the unmitigated scenario the disturbance zone may extend beyond this 200 ha due to associated impacts listed below:

- physical disturbance to soils/vegetation/land surface;
- groundwater (dewatering or contamination);
- air pollution;
- noise pollution; and
- blasting.

Moreover, it should be noted that potential land uses are not only limited to ad-hoc cattle farmers, but also include surrounding residential land use at Botha residence (although currently unoccupied), Devon /Langdon residences, railway residences as well as residents of the Hotazel town. The proposed town planning development which may result in an extension of Hotazel village to the north is not considered materially different to the existing Hotazel village. Assessments related to this existing village would therefore equally apply to the proposed development.

Phsyical disturbance of soils/vegetation/land surface

When considering physical disturbance to soil, vegetation and land surface within the context of current grazing and farming activities, whilst some additional grazing will be lost to the ad-hoc farmers, it should be noted that the majority of the infrastructure/activities associated with the new mining rights area will be within the existing disturbance footprints of the historical mines (Devon and Hotazel). With mitigation, this disturbance can be limited to what is absolutely necessary. It should furthermore be noted that the historical Devon pit, as it currently stands, has had no form of rehabilitation since the cessation of historical mining activities. Given Kudumane’s commitment to rehabilitating this footprint at closure, it is expected that the land use associated with this area will in fact result in a positive improvement. With reference to the additional WRDs and TSF which will remain as final landforms, rehabilitation will be undertaken so as to ensure that a productive landuse can take place post closure (even though it is unlikely to be at the same carrying capacity).

In light of the above, the unmitigated severity is medium without mitigation, reducing to low with mitigation.

Groundwater (dewatering or contamination)

When considering the potential loss of quality and quantity of available groundwater, there could be a potential impact to all landusers that utilise groundwater. With mitigation however, such impacts can be reduced given that compensation (equivalent volume and quality of water supply) can be provided. This amounts to a low severity with mitigation.

Air pollution

It is expected that during the construction phase there may be negative impacts for the homestead on Botha. It should however be noted that this is relevant only if and when the homestead becomes occupied. With reference to the residents at Langdon/Devon, it is expected that there will be exceedances associated with the mining of the historical Devon pit, regardless of the short period over which this will take place. The severity of impacts associated with the railway and Hotazel residences are considered negligible. There may be potential impacts to ad-hoc farmers, although the extent thereof is difficult to quantify given that they are not confined to a particular area. In totality the potential air impact severity is medium to high without mitigation, reducing to medium to low with mitigation.

Noise pollution

It is expected that the noise pollution impacts associated with the proposed project will have a high severity at Langon/Devon without mitigation. With mitigation, the severity reduces to medium. With regards to the homestead on Botha, impacts will only be experience if the homestead is occupied. It should however be noted that these impacts will be short-lived. It is not expected that the railway and Hotazel village residents will experience any noise associated impacts. There may be potential impacts to ad-hoc farmers, although the extent thereof is difficult to quantify given that they are not confined to a particular area.

Blasting

It follows that the residences on Langdon/Devon fall within the blast impact zone. In this regard, there will be impacts regardless of mitigation (although these can be somewhat reduced). Such impacts include the inconvenience caused by the compulsory evacuation procedure. There may be potential impacts to ad-hoc farmers, although the extent thereof is difficult to quantify given that they are not confined to a particular area and could potentially move away from the blast impact zone.

In summary, when taken together, the unmitigated severity is high (for the residence of Langdon/Devon in particular), reducing to medium to low with mitigation.

<ins>Duration</ins>

In the unmitigated scenario the impact on land use/land users will extend beyond mine closure. With mitigation the impacts are expected to be limited to the life of mine. With reference to the additional

WRDs and TSF, whilst these features will remain as final landforms, rehabilitation will be undertaken to ensure that as far as is practically possible, a productive landuse can take place (although it is unlikely to be at the same carrying capacity).

Spatial scale / extent

The spatial scale extends beyond the site boundary, with or without mitigation.

Consequence

The unmitigated consequence is high, reducing to medium with mitigation.

Probability

In the unmitigated scenario, where environmental and social impacts are uncontrolled, the probability that land uses will be impacted by mining is definite. With mitigation, the probability reduces to medium.

Significance

The unmitigated significance is high, reducing to low with mitigation.

Unmitigated – summary of the cumulatively rated land use impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Unmitigated	H	H	M	H	H	H

Mitigated – summary of the cumulatively rated land use impact per phase of the project

Management	Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
All phases						
Mitigated	M-L	M	M	M-L	M	M-L

Description of proposed mitigation measures

Mitigation measures are provided below and tabulated in the EMP (Section 19).

Objective

The objective of the mitigation measures is to prevent unacceptable negative impacts on surrounding land uses.

Actions

Kudumane will implement mitigation measures as laid out from sections 7.2.1 to 7.2.18 so as to minimise the environmental and social impacts.

Managing impacts on land users requires both communication and collaboration between the mine and land users. In this regard, the mine will hold a minimum of quarterly stakeholder meetings and will extend water, air, blasting and noise monitoring to the land users identified in this section as required.

Emergency situations

Major spillage incidents will be handled in accordance with the Kudumane Mine emergency response procedure (Section 20 and Appendix R).

7.3 DEFINITION OF CRITERIA USED

Both the criteria used to assess the impacts and the method of determining the significance of the impacts is outlined in Table 38. This method complies with the method provided in the EIA guideline document. Part A provides the approach for determining impact consequence (combining severity / nature, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D. Unmitigated scenario is considered for each impact

7.4 PHASES AND TIMEFRAMES OF POTENTIAL IMPACTS

An indication of the phases in which impacts could occur is included in Section 7.2. This section also provides an indication of the duration of potential impacts. Potential impacts associated with the project have the potential to occur in almost all project phases and on a continuous basis if unmitigated. With the implementation of the mitigation as presented in Section 19 and Appendix A, the monitoring programmes as presented in Section 21 and the emergency response procedures as presented in Section 20 the timeframe of potential impacts will be reduced significantly.

TABLE 38: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity / nature, spatial extent and duration**
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. Irreplaceable loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. Limited loss of resources.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE/ EXTENT of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE					
			SEVERITY / NATURE = L		
DURATION	Long term	**H**	**Medium**	**Medium**	**Medium**
	Medium term	**M**	**Low**	**Low**	**Medium**
	Short term	**L**	**Low**	**Low**	**Medium**
			SEVERITY / NATURE = M		
DURATION	Long term	**H**	**Medium**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Low**	**Medium**	**Medium**
			SEVERITY / NATURE = H		
DURATION	Long term	**H**	**High**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Medium**	**Medium**	**High**
			L	**M**	**H**
			SPATIAL SCALE / EXTENT		

PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	**Medium**	**Medium**	**High**
	Possible/ frequent	**M**	**Medium**	**Medium**	**High**
	Unlikely/ seldom	**L**	**Low**	**Low**	**Medium**
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact.**

8 COMPARATIVE LAND USE ASSESSMENT

8.1 ALTERNATIVE LAND USES WHICH COULD BE IMPACTED ON

Given that the mine is approved and already in existence, there are no practical alternative land uses or developments for the land on which the mine and related infrastructure/activities are located. Therefore there are no alternative land use impacts to consider.

Impacts of the mine on surrounding existing land uses have been assessed in Section 7.2.19. In addition, the impacts on the proposed extension of Hotazel village has also been assessed because the impacts relevant to the current Hotazel village apply equally to the expansion.

9 LIST OF SIGNIFICANT IMPACTS

A list of significant cumulative impacts, when considered without mitigation, as identified in the assessment conducted in Section 7 is provided below.

- Sterilisation of mineral resources (Medium)
- Hazardous excavations and infrastructure (High)
- Loss of soil resources and land capability through pollution (High)
- Loss of soil resources and land capability through physical disturbance (High)
- Physical destruction of biodiversity (High)
- General disturbance of biodiversity (High)
- Pollution of surface water resources (High)
- Alteration of natural drainage patterns (High)
- Dewatering (High)
- Contamination of groundwater (High)
- Air pollution (Medium-High) (High for Devon)
- Noise pollution (Medium)
- Blasting (High)
- Road disturbance and traffic safety (High)
- Visual impacts (Medium)
- Economic impact (High positive) (Only assessed cumulatively)
- Inward migration impact (High) (Only assessed cumulatively)
- Heritage resources impact (High)
- Land use impacts (High)

10 STAKEHOLDER ENGAGEMENT PROCESS

This section provides a description of the engagement process with interested and affected persons (IAPs) followed during the course of the environmental assessment process. It outlines how IAPs were identified, confirms the details of the engagement process (with supporting documentation included as appendices), and indicates how issues raised have been addressed.

10.1 IDENTIFICATION OF INTERESTED AND AFFECTED PARTIES

The stakeholder engagement process commenced with a social scan to reconfirm established key stakeholders and to identify and include any new stakeholders in order to identify parties to be involved during the environmental assessment process and associated communication structures. This was done by updating the existing database by sourcing IAPs details through a deeds search of the relevant properties within the surface use area and immediately adjacent portions of land, social scans including site visits, networking and direct discussions with IAPs. Key stakeholders identified for the project include:

IAPs

- landowners and land users;
- mines and industries surrounding the Kudumane; and
- non-government organisations and associations (Wildlife and Environmental Society of South Africa (WESSA)).

Regulatory authorities

- Department of Mineral Resources (DMR);
- Department of Water Affairs (DWA);
- Department of Environment and Conservation (DENC);
- South African Heritage Resource Agency (SAHRA);
- Department of Agriculture, Forestry and Fisheries (DAFF);
- The Northern Cape Department of Rural Development and Land Reform and (DRDLR); and
- Department of Public Works, Roads and Transport (DPWRT).

Local authorities

- Joe Morolong Local Municipality;
- John Taolo Gaetsewe District Municipality; and
- ward councillors (Ward 4).

Parastatals

- Transnet

- Eskom;
- Telkom; and
- Sedibeng water

Other

- Mac Mac Agri

A full list of landowners name, other IAPs and non-government organisations consulted is provided in the IAPs and regulatory authorities' database included in Appendix B. The database is updated on an ongoing basis throughout the environmental process.

10.2 DETAILS OF ENGAGEMENT PROCESS

Stakeholder engagement is an integral component of any development process. The goal of stakeholder engagement is to facilitate and improve communication between stakeholders (including the applicant) in the interest of facilitating better decision-making and more sustainable development (DEAT, 2002). In accordance with the requirement of Chapter 6 of the EIA Regulations, 2010, a stakeholder engagement programme has been developed to set out a coordinated process through which IAPs are informed of the proposed development and environmental assessment process and provided with an opportunity to provide input into the project plan, the assessment and proposed mitigation measures. By consulting with authorities and IAPs, the range of environmental issues to be considered in the EIA has been given specific context and focus. Included below is an outline of the process followed, and the people engaged. Refer to Section 10.3 for a list of issues that were identified during the engagement process.

10.2.1 STEPS IN THE PUBLIC PARTICIPATION PROCESS

Steps in the process that have been conducted to date are set out in Table 39 below.

TABLE 39: CONSULTATION PROCESS WITH IAPS AND AUTHORITIES

Task	Description	Date
Notification - regulatory authorities and IAPs		
Notification of DMR and applications submitted to DENC	The DMR was notified by means of a formal notification letter sent on 27 May 2014 (new mining right application) and a formal application was submitted by SLR to DENC on 14 April 2013.	August 2012 to April 2014
Notification of the land claims commissioner	The land claims commissioner was consulted on 30 May 2013 by SLR in order to verify if any land claims had been lodged on the farms in question.	May 2013
Land owner notification	Landowners were notified of the proposed project by means of a letter of intent notification sent 12 March 2014.	March 2014
Compilation of stakeholder database	The original stakeholder database, for which a social scan was carried out, was updated in the following manner: • Performing a deed search • Contacting IAPs on the database to verify and update their details	May 2013 to March 2014

Task	Description	Date
	• Obtain details of additional IAPs identified during the deed search, and scoping meeting • Obtain details for farmers associations (i.e. Mac Mac Agri)	
Distribution of background information document (BID)	A BID was produced for the proposed project. The purpose of the BID was to inform IAPs and authorities about the project, the environmental assessment process, possible environmental impacts and means of inputting into the environmental assessment process. Attached to the BID was a registration and response form, which provided IAPs with an additional opportunity to submit their names, contact details and comments on the project. The BID was distributed to IAPs by hand, email, post and fax using contact details obtained during the social scan and public scoping meetings. BIDs were sent by fax and/or e-mail to the regulatory authorities on the project's public involvement database. A copy of the BID (in English/ Afrikaans) is attached in Appendix C.	26 November 2013
Site notices	Laminated A2 site notices (in English and Afrikaans) were placed at key conspicuous positions by SLR in and around the project area.	November 2013
Newspaper advertisements	Block advertisements were placed in the Kalahari Bulletin and Kathu Gazette newspapers on 31 October and 2 November 2013 respectively.	November 2013
Scoping stage meeting		
Information-sharing scoping meeting	A general public scoping meeting was held on 26 November 2013 at the Hotazel Recreational Club. The purpose of the general public scoping meeting was to: • Inform IAPs about the proposed project • Inform IAPs about the stakeholder engagement process and how IAPs can have input into the process • Provide information about the baseline environment and obtain input thereon • Provide information about the potential impacts of the project and obtain input thereon • Provide an opportunity for IAPs to raise issues and concerns. These issues and concerns were used to inform the Plan of Study for the EIA Phase.	November 2013
Regulatory authority scoping meeting	Regulatory authorities were invited to attend a regulatory authority scoping meeting. No officials arrived for the meeting.	November 2013
Authorities site visit	DENC requested a site visit. This was held on 22 May 2014.	May 2014
Review of scoping report		
Public review of scoping report	The scoping report was subject to public review from 14 April 2014 to 30 May 2014. Copies of the scoping report were made available at the following venues: • Joe Morolong Local Municipality • John Taolo Gaetsewe District Municipality • Hotazel Public Library • Kathu Public Library. Summaries of the scoping report were sent via post or e-mail to all IAPs and authorities that were registered on the public involvement database at the time of distribution. Electronic copies of the scoping report were made available on request.	April 2014 to May 2014
Regulatory authority review of scoping report	The scoping report was subject to review by regulatory authorities from 14 April 2014 to 30 May 2014. Copies of the scoping report were made available for review to DMR, DENC, DWA, DAFF, SAHRA, DRDLR, DPWRT, Joe Morolong Local Municipality and John Taolo Gaetsewe District Municipality. Following the review of the scoping report by IAPs and regulatory authorities the updated scoping report was submitted to DENC	April 2014 to July 2014
Review of EIA and EMP		

Task	Description	Date
Public review of the EIA and EMP amendment report	Copies of the EIA/EMP amendment report will be made available for public review as was done with the scoping report.	September 2014 to November 2014
Public feedback meetings (if requested)	The purpose of the public feedback meetings will be to provide IAPs with the opportunity to liaise with the EIA technical and specialist team on a one-to-one basis.	November 2014
Regulatory authority review of the EIA and EMP amendment report	Copies of the EIA/EMP amendment report will be made available for review as was done with the scoping report.	September 2014 to November 2014

10.2.2 SPECIALIST TEAM

Upon input from IAPs on the potential impacts that may arise as a result of the proposed development, several specialists (see Table 5 for a complete list of all appointed specialist, their roles and responsibilities) were appointed to assess the potential impact of the proposed development. Where required, specialists consulted with stakeholders directly during their specialist studies. Details are provided in the specialist reports included as appendices.

10.2.3 REVIEW OF EIA AND EMP AMENDMENT REPORT BY IAPS

Copies of the EIA/EMP report will be made available for public review as follows:

- Joe Morolong Local Municipality;
- John Taolo Gaetsewe District Municipality;
- Hotazel Public Library; and
- Kathu Public Library.

Electronic copies of the EIA/EMP report will be made available to IAPs on request (electronically by e-mail or on disk). A summary of the EIA/EMP amendment report (in English) will be compiled and distributed to all IAPs registered on the project's public involvement database by post and/or e-mail. IAPs will be given 40 days to review the EIA/EMP amendment report and submit comments in writing to SLR.

10.2.4 REVIEW OF THE EIA AND EMP AMENDMENT REPORT FOR BY REGULATORY AUTHORITIES

The EIA/EMP amendment report will be distributed to regulatory authorities for review as follows:

- a hard copy of the EIA/EMP report will be forwarded to the following regulatory and local authorities: DWA, DAFF, DRDLR, DPWRT, Joe Morolong Local Municipality and the John Taolo Gaetsewe District Municipality;
- a copy of the EIA/EMP will be uploaded electronically onto the SAHRA website for review;
- six hard copies and a CD of the EIA/EMP amendment report will be submitted to the DMR who will distribute to other regulatory authorities as required; and

- One hard copy of the draft EIA/EMP report will be submitted to DENC for record keeping purposes.

Following the IAP and regulatory authority review, three hard copies and two electronic copies of the updated EIA/EMP amendment report (with comments) will be forwarded to DENC.

10.3 MANNER IN WHICH ISSUES RAISED WERE ADDRESSED

Stakeholder meetings and public review of the scoping reports provided IAPs an opportunity to comment on the baseline environment and potential impacts of the project (including social and cultural impacts). All views, issues and concerns raised have been captured into the comments and response report (Appendix D). The comments and response report provides responses to issues raised and identifies where the issues have been addressed in the EIA/EMP report. A summary of the issues and concerns raised include:

- increase in dust emissions;
- increase in disturbing noise levels;
- surface water quality issues relating to the end use of treated sewage effluent;
- groundwater quantity (relating to the Kathu Grysland reserve, the cumulative effects of dewatering and the capacity of the Sedibeng pipeline);
- blasting activities;
- loss of heritage/cultural resources;
- land use issues pertaining to the encroachment of Kudumane mine towards Hotazel town;
- waste related issues pertaining to the dumping of litter and domestic waste on local roads;
- negative socio-economic issues relating to the influx of people, lack of employment opportunities, and associated crime such as stock-theft and fire hazard posed by job-seekers making fires on roadsides; and
- land claim issues pertaining to Hotazel and Kipling.

11 ADEQUACY OF PREDICTIVE METHODS AND ASSUMPTIONS AND UNCERTAINTIES

Assumptions, uncertainties and limitations associated with the proposed project are included below.

11.1 ENVIRONMENTAL ASSESSMENT LIMIT

The EIA/EMP focused on third parties only and did not assess health and safety impacts on workers because the assumption was made that these aspects are separately regulated by health and safety legislation, policies and standards, and that Kudumane will adhere to these.

11.2 PREDICTIVE MODELS IN GENERAL

All predictive models are only as accurate as the input data provided to the modellers. If any of the input data is found to be inaccurate or is not applicable because of project design changes that occur over time, then the model predictions will be less accurate.

11.3 MONITORING INFORMATION

The monitoring results utilised in this report were sourced from the SLR specialist monitoring teams who consult to Kudumane on an independent basis.

11.4 SOILS AND LAND CAPABILITY

None.

11.5 BIODIVERSITY

The major potential limitation associated with the sampling approach is the narrow temporal window of sampling. Ideally a site should be visited several times during the different seasons to ensure that a full complement of plant and animal species present are captured. However this is rarely possible due to time and constraints. The information presented in the Biodiversity report (EMS, June 2014) represent a wet season survey, and this information will be augmented with a dry season survey. A full plant species list was compiled for the site from the site visit, this was complemented by a list of any species which are known from other studies to occur in the broad vicinity of the site. The list of amphibians, reptiles and mammals for the site are based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat preferences. This represents a sufficiently conservative and cautious approach which takes account of the study limitations (EMS, June 2014).

11.6 HYDROLOGY (SURFACE WATER)

As with all assessment methodologies there are inherent limitations and a range of assumptions must be made. The most significant assumptions and limitations are described below (SLR, July 2014):

- the limitations on peak flow estimates are discussed in Section 3 of the specialist report (Appendix H). Where additional data becomes available which may change the estimates of peak flows, then the flood modelling should be updated otherwise no further work is considered necessary;
- where input parameters have not been forthcoming from the wider project team, this study makes use of assumed parameters and consequently the results should be considered to be indicative only until the input parameters have been confirmed or revised. It is recommended that the water balance is updated when such data is available; and
- whilst the recommended flows take into account a comprehensive review of available data, it should be noted that there remain significant uncertainties associated with flood estimation within an ungauged catchment, even more so for a watercourse with a catchment area in excess of 8 000km^2 which only flows during exceptional conditions. Further uncertainties include the impact of mining on groundwater levels in the vicinity of the Ga-Mogara which are likely to draw down groundwater levels and further reduce the likelihood of baseflow within the river. It is recommended that these uncertainties are managed by applying suitable freeboard to design levels for any infrastructure within close proximity to the Ga-Mogara including the possible river diversion channel and any flood protection bunds.

11.7 GROUNDWATER

The groundwater assessment in this report is based on an update of the 2010 conceptual model. Prior to submission of the WULA required for the new activities proposed in this EIA/EMP and as part of the commitment to on-going model updates (every 3 years), the conceptual model requires conversion into a site specific numerical model.

11.8 AIR QUALITY

As with all assessment methodologies there are inherent limitations and a range of assumptions must be made. The most significant assumptions and limitations are described below (SLR, July 2014):

- emission estimations were based on process descriptions and mine layout available at the time of the assessment. Where detailed design of WRD layouts was not available (e.g. on Devon) assumptions on areas have been made on the basis of known volumes/tonnages;
- assumptions were made regarding silt content and particle size fractions based on experience from other mine sites and literature. It is likely that moisture, silt content and particle size fractions will vary across the site e.g. from roads to pits. As the site is developed further information can be collected;

- fugitive dust releases driven by intermittent activity and meteorological conditions cannot be accurately represented in the dispersion model, e.g. dust from vehicle entrainment, or dust eroded and released by wind flow, the periodic abatement provided by rainfall, or the binding of particles due to crusting. As such steady state conditions in terms of emissions have been assumed (with the exception of blasting) and wind erosion;
- the minimum time-step of the model is 1-hour, as such short term releases such as from blasting cannot be accurately modelled. Blasting was accounted for in the modelling, simulated as if occurring for an hour every day; and
- combustion emissions would be released from mine vehicles and power generators. Considering the stand-off distance to local receptors from both generators and haulage routes, typically in excess of 1km, emissions are unlikely to be significant in comparison to particulate emissions which are the focus of this assessment.

It should furthermore be noted that at the time the modelling was undertaken by the air quality specialist, the impacts from the potential Kipling pit (at the time considered to be a possible extension to the Hotazel pit) were included with the modelling of the Hotazel pit. This is a conservative approach which possibly leads to over-prediction of impacts.

11.9 NOISE

It is recommended that periodic ambient noise monitoring during operation of the site is undertaken to verify the results of the noise predictions. Periodic ambient noise monitoring can also help determine the effectiveness of any mitigation measures implemented to reduce noise impacts. It is recommended that the noise monitoring scheme is implemented once the site is fully operational.

11.10 VISUAL IMPACT ASSESSMENT

In preparing the LVIA for the proposed development at the Kudumane Manganese Mine, a number of limitations and constraints have been identified and assumptions made, which are set out below:

- whilst all endeavours are made to obtain the most current published reports and publically available copies of relevant previous reports on the area, the assessment is made on the basis of the professional expertise and judgement of the assessor and cannot be taken as final and definitive for anything other than the purposes of this report. Wherever possible the assumptions made concerning the nature of development or its extents and impacts are set out within the body of the document;
- the report is reliant on the digital data supplied and the accuracy of the findings is constrained by the accuracy of that information;
- the report is therefore dependant on the public availability of sufficiently accurate and geo-referenced digital terrain data for the surrounding area, and detailed digital site survey data with which to establish the baseline situation;

- detailed digital models of the development proposals are required to enable the modelling of the development within the landscape, to enable the 3D modelling to be undertaken, providing quantifiable and traceable assessment data. Any inaccuracies in the data have the potential to constrain the accuracy of the conclusions drawn;
- the photographs are included as representative illustrations of views from the surrounding area, they should not be considered as definitive or all inclusive. Their selection is based on previous professional experience of the likely locations from which representative viewpoints would be obtained, not from an exhaustive study of the area on site; and
- the location and directions of view of the photographs are determined by the photographer on site using GPS co-ordinates where they are available.

11.11 HERITAGE AND CULTURAL RESOURCES

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.

11.12 ECONOMIC LANDUSE AND SUSTAINABILITY

- the first and most important assumption is that the proposed mining activities will be economically viable. Without economic viability (that is an acceptable risk-return rate is attained on investment), the probability of achieving the stated economic benefits are non-existent. This assessment accepts the rational investor concept, thus the investments to be committed are undertaken by a rational economic agent and the probability of achieving economic viability is high;
- this study is limited in its scope as S4G worked mainly with “inferred economic data”, thus we limited ourselves to a site visit, desktop research, telephonic interviews and relied on independent information from the mine promoter and SLR environmental consultants;
- the macro-economic data for this analysis was supplied by Quantec, a reliable regional economic data provider in SA;
- the basic premise of the economic impact assessment is to compare the potential land-use benefits and losses due to the proposed mining activities of Kudumane. The potential economic losses are calculated as the sum of the estimated property values substituted and the annual operational value lost from existing land. The potential property value lost is the estimated average Rand per hectare of existing land prices multiplied by the amount of hectares. Furthermore, the operational eco-agricultural value lost is simply calculated as the average number of employees per hectare multiplied by the GDP per employee in the eco-agricultural industry. The land impacted is the direct

land that will be impacted (thus the direct eco-agricultural land to be mined), and an added buffer to be conservative;

- it is assumed that the land deemed to be potentially lost to agriculture and eco-tourism is utilised at the average productivity of the country's output for those sectors. The need to work on macro-averages is due to the fact that statistics supplied by individuals are regarded as private and is rarely shared in the public domain;
- the receptor area is the John Taolo Gaetsewe District Municipality;
- the project is evaluated over the period of an economic generation, even though the life of mine is slightly less than this. The valuations are done on a DCF basis, thus discounting all benefits over an economic generation. (In essence this reduces the economic value of the mine relative to existing land-use);
- it is assumed that the land impacted by mining will be sterile and of no real use economically after mining. (Note, this is not always the case, but is done to be conservative and in the light of the many environmental legacy issues caused by mining.) It can be argued that such land indeed has a cost to the next generation, as the land would have to be "maintained" to ensure no further degeneration. These costs are, however, uncertain and far out in the future and it would not make much economic sense to factor in. This report does, however, write off a large portion of the initial value of mine land due to the amortisation effects of mining and to account for possible sterilisation;
- in this analysis it is assumed that mining and eco-agricultural is a zero-sum outcome, thus the benefits to the one are a loss to the other. (In reality the spirit of sustainable development is for economic agents to co-operate constructively in order for society to achieve a win-win, however, such an outcome is uncertain and naïve to assume);
- the economic analysis section of this study adopts a dispassionate compassionate stance, thus it concerns itself with the benefits or costs to the economy in a macro-economic and quantitative manner. The mathematical results, based on stated assumptions, therefore speak for themselves;
- the evaluation of the total sustainability value to society is attempted in the integrated development trade-off analysis below, where the economy, society and the environment's costs and benefits are compared. In this analysis subjective ratings were used and the outcome could differ from stakeholder to stakeholder. These results are based on SLR's ratings and S4G calculated the averages and weighted averages. Both parties are independent consulting firms; and
- this analysis should not be used for compensation negotiations between the mine and affected stakeholders simply because its intent is to compare a better alternative land-use, using economic macro-variables and not micro-magnitudes. Micro-compensation negotiations are a matter of law and each stakeholder would have to present their own case.

11.13 TRAFFIC IMPACT ASSESSMENT

For the purposes of the traffic assessment, the following assumptions were made:

- the average rate of growth in through traffic along the R380 will be 6 % per annum between 2013 and 2018. (Background traffic growth);
- the average rate of growth in through traffic along the R31 will be 6 % per annum between 2013 and 2018. (Background traffic growth);
- the proposed development will be fully operational within less than 5 years from the base year 2013; and
- the absorption rate by all other types of completed development will maintain the same for the next five years.

11.14 CLOSURE COST ESTIMATE

The closure liability calculations are based on the following assumptions:

- no allowance for salvage and recycled/scrap material has been considered; and
- all infrastructure will be demolished and no handover of any facilities (for post closure use) has been allowed for.

12 ARRANGEMENT FOR MONITORING AND MANAGEMENT OF IMPACTS

This section describes the arrangements for monitoring and management of environmental impacts. It identifies the impacts that require monitoring programmes and outlines the functional requirements, roles and responsibilities and timeframes for the monitoring programmes. Further detail on each monitoring programme is included in Section 19.

12.1 IMPACTS THAT REQUIRE MONITORING PROGRAMMES

Impacts that require monitoring include:
- Hazardous excavations and infrastructures;
- Physical destruction and general disturbance of biodiversity;
- Pollution of surface water resources;
- Contamination of groundwater;
- Increase in air pollution; and
- Blasting damage.

In addition to the above, the commitments as included in Section 19 will require monitoring to a) ensure that they are being implemented and b) that they are effective in mitigating potential impacts on the environment, socio-economic conditions of third parties and heritage/cultural aspects. This will be done through regular internal auditing by mine personnel.

12.2 FUNCTIONAL REQUIREMENTS OF MONITORING PROGRAMMES

The purpose of the monitoring programmes is to review the mine's impact on various aspects of the environment and to report on changes needed to the management programme.

As a general approach, the mine will ensure that the monitoring programmes comprise the following:
- a formal procedure;
- appropriately calibrated equipment;
- where samples require analysis they will be preserved according to laboratory specifications;
- an independent, accredited laboratory will undertake sample analyses and/or internal laboratory results will periodically be checked by independent and accredited laboratories;
- parameters to be monitored will be identified in consultation with a specialist in the field and/or the relevant authority;
- if necessary, following the initial monitoring results, certain parameters may be removed from the monitoring programme in consultation with a specialist and/or the relevant authority;
- monitoring data will be stored;
- data will be interpreted and reports on trends in the data will be compiled; and

- both the data and the reports will be kept on record for the life of mine.

12.3 ROLES AND RESPONSIBILITIES

The roles and responsibilities for the execution of the monitoring programmes are defined below.

- Senior Operational Manager and Environmental Department Manager:
    - ensure that the monitoring programmes are scoped and included in the annual mine budget;
    - identify and appoint appropriately qualified specialists/engineers to undertake the programmes; and
    - appoint specialists in a timeous manner to ensure work can be carried out to acceptable standards.

12.4 TIMEFRAMES FOR MONITORING AND REPORTING

The timeframes for monitoring and reporting thereof are detailed in the monitoring programme (see Section 21). A summary is provided below:

Programme	Monitoring: Timeframe and frequency	Reporting
Tailings storage facility, waste dumps and water dams	All project phases On-going by dam operators and quarterly by professional engineer	On-going by professional engineer
Bio-monitoring	All project phases	As required by specialist
Groundwater and surface water	All project phases As per requirements of water use license	As per requirements of water license
Air	All project phases	Monthly by specialist
Blasting	Every surface blast	As required by specialist
Internal auditing	From start of construction to end of closure On-going	As required
External auditing	From start of construction to end of closure Every two years	Every two years to DMR

13 TECHNICAL SUPPORTING INFORMATION

The following specialist studies are attached as appendices to this report:

- Geochemical and groundwater study (Appendix E)
- Soils specialist study (Appendix F)
- Biodiversity specialist study and Biodiversity offset plan (Appendix G)
- Hydrology study (Appendix H)
- Air quality impact assessment (Appendix I)
- Noise impact assessment (Appendix J)
- Visual impact assessment (Appendix K)
- Heritage impact assessment (Appendix L)
- Palaeontological impact assessment (Appendix M)
- Alternative land use assessment (Appendix N)
- Traffic impact assessment (Appendix O)
- TSF prefeasibility study (Appendix P)
- Closure cost liability (Appendix Q)
- Environmental awareness and emergency plan (Appendix R)

SECTION 2 – ENVIRONMENTAL MANAGEMENT PROGRAMME

14 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR CLOSURE

14.1 ENVIRONMENTAL ASPECTS THAT DESCRIBE THE PRE-MINING ENVIRONMENT

Environmental aspects that describe the pre-mining environment as informed by the baseline description (Section 1.1) are listed below. This list serves to guide the setting of environmental objectives for mine closure.

- relatively flat topography;
- pre-mining soils supported grazing capabilities. Closure objectives around land capability and use must be informed by consensus with relevant stakeholder;
- a functioning ecosystem;
- non-perennial drainage patterns;
- moderate to good groundwater quality;
- stable water table providing groundwater as a water supply source; and
- quiet, rural environment.

14.2 MEASURES TO CONTROL OR REMEDY ANY CAUSES OF POLLUTION OR DEGRADATION

Measures required to contain or remedy any causes of pollution or degradation or migration of pollutants, both for closure of the mine and post-closure are listed below.

- implement a waste management procedure for general and hazardous waste on site;
- ensure immediate clean-up of any spills as per the emergency response procedures (Section 20);
- establish and maintain dirty stormwater control measures in line with regulatory requirements, until such time as potentially polluting areas are rehabilitated;
- contain pollutants at source by storing and handling potentially polluting substances on impermeable substrates, within bunded areas and with the capacity to contain spills;
- design, construct and/or operation of the proposed TSF with decant and drainage systems and runoff control measures;
- design, construct and/or operate existing and new WRDs with runoff control measures; and
- rehabilitate the site in line with a detailed closure plan to be developed at least five years prior to decommissioning.

Further detail on the proposed action plans and mitigation measures is included in Section 19.

15 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR MANAGEMENT OF IDENTIFIED ENVIRONMENTAL IMPACTS

The environmental objectives and specific goals for the management of identified environmental impacts are detailed in this section.

15.1 IMPACTS THAT REQUIRE MONITORING PROGRAMMES

Impacts that require monitoring include:

- Hazardous excavations and infrastructures;
- Physical destruction and general disturbance of biodiversity;
- Pollution of surface water resources;
- Contamination of groundwater;
- Increase in air pollution; and
- Blasting damage.

15.2 ACTIVITIES AND INFRASTRUCTURE

The source activities of potential impacts which require management are detailed in Section 2.3 and listed below.

- Site preparation
- Earthworks
- Civil works
- Open pit mining
- Underground mining (only for the approved operations)
- Tailings dam
- Water supply and use
- Power supply and use
- Transportation system
- Non-mineralised waste management
- General site management
- Other support services and amenities
- Demolition
- Rehabilitation
- Maintenance and aftercare

15.3 MANAGEMENT ACTIVITIES

Management activities which will be conducted to control the project actions, activities or processes which have the potential to pollute or result in environmental degradation are detailed in Section 19

15.4 ROLES AND RESPONSIBILITIES

The key personnel to ensure compliance to this EMP report will be the operations executive, the environmental department manager and the stakeholder engagement manager. As a minimum, these roles as they relate to the implementation of monitoring programmes and management activities will include:

- Senior Operational Manager and Environmental Department Manager:
  - ensure that the monitoring programmes and audits are scoped and included in the annual mine budget;
  - identify and appoint appropriately qualified specialists/engineers to undertake the programmes; and
  - appoint specialists in a timeously manner to ensure work can be carried out to acceptable standards.
- Stakeholder engagement department:
  - liaise with the relevant structures in terms of the commitments in the SLP;
  - ensure that commitments in the SLP are developed and implemented timeously;
  - establish and maintain good working relations with surrounding communities and landowners; and
  - facilitate stakeholder communication, information sharing and grievance mechanism.

16 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR SOCIO-ECONOMIC CONDITIONS

16.1 ASPECTS OF THE SOCIO-ECONOMIC CONDITIONS

The socio-economic conditions surrounding the proposed project sites are described in Section 1.3.3.

16.2 OBJECTIVES AND GOALS

Specific environmental objectives and goals to control, remedy or stop potential impacts emanating from the proposed project which may impact on communities and IAPs are described below. The information is presented in tabular format (Table 40).

TABLE 40: ENVIRONMENTAL OBJECTIVES AND GOALS – SOCIO-ECONOMIC CONDITIONS

Aspect	Environmental objective	Goals
Land uses	To prevent unacceptable impacts on surrounding land uses and their economic activity	• To co-exist with existing land uses • To negatively impact existing land uses as little as possible
Blasting	To minimise the potential for third party damage and/or loss	• To protect third party property from blasting-related activities, where possible • To ensure public safety
Traffic	To reduce the potential for safety and vehicle related impacts on road users	• To ensure the mine's use of public roads is done in a responsible manner
Socio-economic	To enhance the positive economic impacts and limit the negative economic impacts	• To work together with existing structures and organisations
Inward migration/Informal settlements	To limit the impacts associated with inward migration	• To establish and maintain a good working relationship with surrounding communities, local authorities and land owners

17 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR HISTORICAL AND CULTURAL ASPECTS

A low density scatter of stone tools was identified as resources of heritage and cultural significance and these resources are important to the history of South Africa and are protected by national legislation. In addition to the resources identified, chance finds will require a permit from the South African Heritage Resources Agency (SAHRA) if these sites were to be altered.

18 APPROPRIATE TECHNICAL AND MANAGEMENT OPTIONS CHOSEN FOR EACH IMPACT

18.1 PROJECT ACTIONS, ACTIVITIES AND PROCESSES

All activities associated with the approved Kudumane Mine infrastructure as well as the proposed additional mining rights areas and proposed additional infrastructure/activities within the existing mining rights area have the potential to cause pollution or environmental degradation. These are described in Section 2 of this EIA/EMP report.

18.2 TECHNICAL AND MANAGEMENT OPTIONS

Appropriate technical and management options chosen to modify, remedy, control or stop any action, activity or process associated with the proposed projects which will cause significant impacts on the environment, socio-economic conditions and historical and cultural aspects are listed in the table below (Table 41) and described in detail in Section 7. In addition to these, the mine will implement an environmental management system to assist in the implementing and monitoring of commitments included in this EIA and EMP report.

TABLE 41: TECHNICAL AND MANAGEMENT OPTIONS

Potential impact	Technical and management options
Loss and sterilization of mineral resources	Mine workings well be developed and designed taking cognisance of potential ore reserves Extraction of all possible minerals prior to final disposal
Hazardous excavations and infrastructure	Construction of berms, fencing, barriers and access control Warning signs Sealing and backfilling shaft Implement monitoring programme Implement an emergency response procedure
Loss of soil resources and land capability through pollution	Implement hazardous waste, dirty water and mineralised and non-mineralised waste management procedures Permanent infrastructure designs to take long term soil prevention, land function and confirmatory monitoring into account
Loss of soil and land capability through physical disturbance	Implementation of a soil management plan Limiting disturbance of soil to what is necessary Stripping, storing, maintenance and replacement of topsoil in accordance to soil management procedures
Physical destruction of biodiversity	Implementation of the biodiversity management plan Restrict project footprint Limit disturbance on high biodiversity areas Investigation of a biodiversity offset if required Implementation of monitoring programmes Rehabilitate disturbed areas
General disturbance of biodiversity	Prevention of the killing of animal species Implementation of dust control measures Pollution prevention measures Prevention of the disturbance of ecosystems

Potential impact	Technical and management options
Pollution of surface water resources	Appropriate design of polluting facilities and pollution prevention facilities (by qualified person) Implement and maintain storm water controls that meet regulatory requirements Implement site-specific soil management plan Implement a monitoring programme (water use, process water quality, rainfall-related discharge quality) Provide an alternative equivalent water supply if third party water supply has been polluted Implement emergency response procedure Implementation and maintenance of licence requirements
Alteration of natural drainage lines	Implement and maintain storm water controls that meet regulatory requirements
Contamination of groundwater	Appropriate design of pollution facilities Correct handling of hazardous wastes, mineralised and non-mineralised wastes Provide an alternative equivalent water supply if third party water supply has been polluted Implement and maintain terms and conditions of regulatory requirements Implementation of a monitoring programme Implement emergency response procedure Implementation and maintenance of licence requirements
Dewatering	Provide an equivalent water supply if dewatering causes loss of water supply to third parties Implementation of monitoring programme
Air pollution	Implementation of air quality management plan Implementation an air quality monitoring programme Control dust plumes Implementation of an air complaints procedure Implement an emergency response procedure
Noise pollution	Maintenance of vehicles and equipment Implementation of a noise complaints procedure Educate workers Equip machinery with silencers if required Construction of noise attenuation measures such as noise barriers
Blasting damage	Implementation of a blast management plan Communication of planned blasting times with stakeholders Pre-blast warning Monitoring blasts Audit and review to adjust blast design were necessary Investigate blast related complaints Rectify damage to third party structures if the damage is caused by the mine Implementation of a blasting complaints procedure Implement emergency response procedure
Traffic increase	Implementation of a traffic safety programme Education and awareness training of workers Placement of signage to create awareness Maintenance of the transport systems Implementation of a traffic complaints procedure Implement emergency response procedure

Potential impact	Technical and management options
Visual impacts	Limit the clearing of vegetation Limit the emission of visual air plumes Use of screening berms Concurrent rehabilitation Painting infrastructure to compliment the surrounding environment where possible Implementation of a closure plan Management through care and aftercare
Heritage and cultural	Limit project infrastructure, activities and related disturbances to demarcated areas Demarcation of heritage sites that are within close proximity to mining activities Education of workers Implement emergency response procedure
Economic impact	Hire people from closest communities as far as possible To extend the formal bursary and skills development to closest communities Local procurement of goods and services as far as possible Closure planning to make consideration for skills, economic consideration and the needs of future farming
Inward migration	Good communication in terms of recruitment, procurement and training Number of temporary and permanent new job opportunities and procurement will be made public Employment and procurement opportunities provided to closest communities when possible No recruitment at the mine gate Monitor and prevent the development of informal settlements through the interaction with neighbours, local authorities and law enforcement officials Implement a health policy on HIV/AIDs and tuberculosis to promote awareness and training
Land use	Implementation of EMP commitments that focus on environmental and social impacts Take necessary steps to prevent negative impact on surrounding land Appropriate compensation where Kudumane's mining infrastructure will cause a loss of third party agricultural cultivation activities Closure planning to incorporate measures to achieve future land use plans

19 ACTION PLANS TO ACHIEVE OBJECTIVES AND GOALS

Action plans to achieve the objectives and goals set out in Section 15 (bio-physical environment), Section 16 (socio-economic conditions) and Section 17 (historical and cultural) above, are listed in tabular format together with timeframes for each action. The action plans include the timeframes and frequency for implementing the mitigation measures as well identifies the responsible party.

Action plans as described below, include technical and management options as per the approved EIA/EMP (Metago, 2010) for all existing operations currently being undertaken at the Kudumane Mine, as well as any new technical and management options that are not currently in place but are however relevant to the proposed project (namely the additional mining rights area as well as the additional infrastructure being proposed within the existing mining rights area). It should be noted that any new technical and management options are indicated in blue in the tables below. Technical and management options have been identified for the following impacts:

- Loss and sterilisation of mineral resources (Table 42)
- Hazardous excavations and infrastructure (Table 43)
- Loss of soil resources and land capability through pollution (Table 45)
- Loss of soil resources and land capability through physical disturbance (Table 46)
- Physical destruction of biodiversity (Table 47)
- General destruction of biodiversity (Table 48)
- Pollution of water resources (Table 49)
- Alteration of natural drainage patters (Table 50)
- Contamination of groundwater (Table 51)
- Dewatering (Table 52)
- Air pollution (Table 53)
- Noise pollution (
- Table 54)
- Blasting (
-
- Table 55)
- Traffic impacts (Table 56)
- Visual impacts (Table 57)
- Destruction of heritage, paleontological and cultural resources (Table 58)
- Economic impact (
- Table 59)
- Inward migration (Table 60)
- Land use (Table 61).

TABLE 42: ACTION PLAN – LOSS AND STERILISATION OF MINERAL RESOURCES

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Civil Works	M	L	• Kudumane will incorporate cross discipline planning structures for mining and infrastructure developments to avoid mineral sterilisation. A key component of the cross cutting function is communication with the underground and surface mining managers. • Where feasible, Kudumane will make provision for the processing of waste rock and/or allowing third parties to crush and use it for aggregate. • The TSF will be designed in such a way that reprocessing is possible. • Mine workings will be developed and designed so as not to limit the potential to exploit deeper minerals but to mine optimally.	On-going As required As required On-going	On-going As required As required On-going	Mine resource manager Mine resource manager Mine resource manager Mine resource manager Mine resource manager
Operation	Civil works Open pit mining Tailings dam WRDs/stockpiles						
Decommissioning	Civil works Tailings dam WRDs/stockpiles Rehabilitation						
Closure	Maintenance and aftercare of final landforms						

TABLE 43: ACTION PLAN – HAZARDOUS EXCAVATIONS AND INFRASTRUCTURE

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H	L	• All proposed mineralised waste facilities will be designed, constructed, operated and closed in a manner to ensure that stability and related safety risks to third parties and animals are addressed. These issues will be monitored according to a schedule that is deemed relevant to the type of facility by a professional engineer. • Kudumane will survey all the proposed project areas and update its surface use area map on a routine basis to ensure that the position and extent of all potential	On-going As required	On-going As required	Professional engineer Professional engineer
Operation	Earthworks Civil works Open pit mining Tailings dam WRDs/stockpiles Water supply infrastructure Power supply infrastructure						

Phase of operation	Activities (see Table 24)	Sig UM	Sig M	Technical and management options	Action plan: Timeframe	Action plan: Frequency	Action plan: Responsible parties
	Transport infrastructure Non-mineralised waste management Other support services and amenities			hazardous excavations, hazardous infrastructure is known. It will furthermore ensure that appropriate management measures are taken to address the related safety risks to third parties and animals.			
Decommissioning	Earthworks Civil works Tailings dam WRDs/stockpiles Demolition Rehabilitation			• During construction and operation the safety risks associated with identified hazardous excavations, subsidence and infrastructure will be addressed through one or more of the following: o fencing, berms, barriers and/or security personnel to prevent unauthorised access; and o warning signs in the appropriate language(s). Warning pictures can be used as an alternative.	As required	As required	Senior Operational Manager
				• Where Kudumane has caused injury or death to third parties and/or animals, as a result of their mining operations, appropriate compensation will be provided.	As required	As required	Senior Operational Manager
				• During the decommissioning planning of any part of the mine, provision will be made to address long term safety risks in the decommissioning and rehabilitation phases.	As required	As required	Senior Operational Manager
				• At closure, the hazardous infrastructure will either have been removed or decommissioned and rehabilitated in a manner that it does not present a long term safety and/or stability risk. It should furthermore be noted that the TSF and WRDs will remain in perpetuity and in this regard will be made safe and rehabilitated.	As required	As required	Senior Operational Manager
				• At closure the hazardous excavations will be dealt with as follows: monitoring and maintenance will take place to observe whether the relevant long term safety objective have been achieved and to identify the need for additional intervention where the objectives have not been met.	As required	As required	Senior Operational Manager

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				• Hazardous excavations and infrastructure will be surveyed annually and inspections will take place on a routine basis to ensure that measures for preventing injury to third parties and animals are being implemented and maintained.	On-going	On-going	Senior Operational Manager
Closure	Maintenance and aftercare of final landforms	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 44: ACTION PLAN – SURFACE SUBSIDENCE

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works	H	L	• Open pit backfilling operations must take the possibility of surface subsidence into account. This requires compaction of backfilled material, the calculation of a bulking factor, and the initial creation of a slight swell above ground level. • Final replacement of topsoil onto the backfilled waste rock material should be done with the understanding that if subsidence occurs thereafter, re-stripping of topsoil and additional backfilling with waste rock will be required. Thereafter the topsoil will have to be replaced. • Appropriate support pillars must be in place at the underground mining section. This must form part of the detailed underground mine planning. • Until hazardous excavations are rehabilitated and closed, they will each have a barrier to prevent access by people and animals. The barrier may be in the form of fences, walls or berms. In addition, the barriers must have warning signs at appropriate intervals. These warning	On-going	On-going	Environmental and mine managers
Operation	Earthworks Civil works Open pit mining Tailings dam WRDs/stockpiles Transport infrastructure Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam WRDs/stockpiles Demolition Rehabilitation						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				signs must be in picture format and/or written in English. • Dams with a safety risk will be monitored by a professional civil engineer in accordance with Section 21.1.6. • The environmental manager and appointed engineer are responsible for ensuring that these actions are implemented during the construction phase of the excavations, and that they are maintained until rehabilitation and closure.			
Closure	Maintenance and aftercare of final landforms	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 45: ACTION PLAN – LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH POLLUTION

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H	L	In the construction, operation and decommissioning phases the mine will ensure that all hazardous chemicals (new and used), dirty water, mineralised wastes and non-mineralised wastes are transported, handled and stored in a manner that they do not pollute soils. This will be implemented through a procedure(s) covering the following: • pollution prevention through basic infrastructure design pollution prevention through maintenance of equipment; • pollution prevention through education and training of workers (permanent and temporary); • pollution prevention through appropriate management of hazardous materials and wastes; • the required steps to enable fast reaction to contain and remediate pollution incidents. In this regard the	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam Demolition						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Rehabilitation			remediation options include containment and in-situ treatment or disposal of contaminated soils as hazardous waste. In-situ treatment is generally considered to be the preferred option because with successful in situ remediation the soil resource will be retained in the correct place. The in-situ options include bioremediation at the point of pollution, or removal of soils for washing and/or bio remediation at a designated area after which the soils are returned; and • specifications for post rehabilitation audit criteria to ascertain whether the remediation of any polluted soils and re-establishment of soil functionality has been successful and if not, to recommend and implement further measures. • The designs of any permanent and potentially polluting structures (mineralised waste facilities) will take account of the requirements for long term soil pollution prevention, land function and confirmatory monitoring. • Kudumane will ensure that the handling and disposal of general and hazardous waste is undertaken in accordance with the waste management procedures as outlined in Table 34.			
Closure	Maintenance and aftercare of final landforms						

TABLE 46: ACTION PLAN - LOSS OF SOIL RESOURCES AND LAND CAPABILITY THROUGH PHYSICAL DISTURBANCE

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation	H	M	In the construction, operation and decommissioning phases a	On-going	On-going	Environmental manager

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	Earthworks Civil works			soil management plan, with the following key components, will be implemented: • limit the disturbance of soils to what is absolutely necessary for earthworks, on-going activities, infrastructure footprints and use of vehicles; and • where soils have to be disturbed the soil will be stripped, stored, maintained and replaced in accordance with the specifications of the soil management principles in Table 35 and the detailed Kudumane soils management procedure. • To prevent the erosion of topsoils, management measures may include berms, soil traps, hessians and stormwater diversions away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any drainage lines and areas susceptible to erosion. • All areas affected by construction should be rehabilitated upon completion of the construction phase of the development. Permanent infrastructure should be suitably re-vegetated, if possible.			
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam Demolition Rehabilitation						
Closure	Maintenance and aftercare of final landforms						

TABLE 47: ACTION PLAN – PHYSICAL DESTRUCTION OF BIODIVERSITY

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H	M	Kudumane will prevent the disturbance of high sensitivity areas and important linkages between these areas so that the species composition and ecosystem functionality remain intact. Some surface disturbance is planned to occur close to areas	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining						

Phase of operation	Activities (see Table 24)	Sig UM	Sig M	Technical and management options	Action plan: Timeframe	Action plan: Frequency	Action plan: Responsible parties
	Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities			of higher sensitivity, and in this regard a buffer zone will be implemented in order to protect these areas. In this regard: • the project footprint area will be clearly marked; • barriers will be erected to ensure that accidental intrusions into the high sensitive areas do not occur; • a long-term comprehensive alien/invasive species eradication and monitoring programme and will also be implemented; and • an environmental awareness and training programme for employees will implemented (Appendix R). • The mitigation of the destruction of vegetation is closely linked to the conservation of soil resources and the re-establishment of land capability and vegetation. In this regard, Kudumane will ensure that the waste management and soil conservation programmes presented in Table 34 and Table 35 respectively, are followed. • As part of the rehabilitation programme, Kudumane will re-establish natural vegetation as outlined below: o a 780 ha non-mining area of the farm York A 279 between the R380 and the project area has been set aside. This is considered an offset. During the life of the project this area will be returned to its natural state through the control of pioneer species, the eradication of alien/invasive species and the ceasing of current grazing activities. o once the topsoil has been replaced, seedlings and small trees and shrubs grown in the nursery area (within the game enclosure) will be planted and re-			
Decommissioning	Earthworks Civil works Tailings dam Demolition Rehabilitation						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				seeding will also take place. In this regard a seed mixture reflecting the natural vegetation as is currently found in the area will be used. In conjunction with commercially available seeds, the harvesting of seed from similar areas within the study area will be undertaken as follows: - species such as Stipagrostis are good sand binders and aid in stabilising the substrate and are present within the study area; - where applicable, all protected trees smaller than 2 meters occurring on the site (species such as *Acacia erioloba, Acacia haematoxlon* and *Boscia albitrunca*) will be relocated to an appropriate site; - pods of *Acacia erioloba*, and *Acacia haematoxylon* seeds will be collected during December to March and October to December, respectively, for planting during the rehabilitation phase; - *Boscia* seeds will be stored in small quantities in cotton bags to provide good ventilation and sowed within 4 weeks of collection; - *Acacia* pods will be scared to break the dormancy of the pods prior to sowing; and - during rehabilitation, pioneer and alien/invasive species will be controlled. In this regard, the use of chemicals and herbicides will be limited as far as possible, and the use of products with bromacil and tebuthiuron as active ingredients will be avoided at all times.			

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				• where protected plant and/or tree species are going to be removed/destroyed the relevant permits must be obtained. An ecology expert should be engaged prior to the vegetation clearing phase to make the necessary applications for the outstanding permissions; and • there will be implementation of an alien/invasive/weed management programme in collaboration with DAFF, DWA and Working for Water to control the spread of these plants onto and from disturbed areas. Care will be taken to prevent the encroachment of these species into rehabilitated areas. • Regarding the threat of potential veld fires Kudumane will comply with the National Veld and Forest Fire Act, Act 101 of 1998 (NVFFA) as amended. Accordingly, Kudumane will: o prepare and maintain a firebreak on its side of the boundary between mine property any adjoining land; o have equipment and trained personal to extinguish fires; and o co-operate with the local Fire Protection Association (FPA). • Regarding the impact on vegetation caused by the lowered groundwater levels due to mine dewatering, it is proposed to recharge the shallow aquifer using surplus pit inflow water. In this regard, only water of an acceptable quality will be used. • For a period of at least five years after the re-establishment of vegetation, a programme of monitoring and "after care" will be implemented to ensure that			

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				vegetation is recovering and that pioneer and alien/invasive species are not becoming an ecological problem. This issue will be revisited as part of the detailed closure planning for the project.			
Closure	Maintenance and aftercare of final landforms						

TABLE 48: ACTION PLAN – GENERAL DISTURBANCE OF BIODIVERSITY

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H	M	In the construction, operation and decommissioning phases the mine will ensure that: • the use of light is kept to a minimum and where it is required, yellow lighting is used where possible and vertebrates are kept away from the area around the lights with appropriate fencing; • there is zero tolerance of killing or collecting any biodiversity; • the use of poisons will be prohibited; • powerlines will be underground or in trenches where possible and reflectors will be fitted to above ground powerlines and other infrastructure which could pose a bird collision risk; • zero tolerance of littering; • strict speed control measures for all project related traffic; • dust control measures are implemented (see Section 7.2.11); • noise control measures are implemented (see Section 7.2.12);	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam Demolition Rehabilitation						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				• pollution prevention measures are implemented (see Sections 7.2.3 and 7.2.7); and • vegetation rehabilitation measures are implemented (see Section 7.2.5). Furthermore, the establishment and environmental management of the non-mining game enclosure area (within the approved mining rights area) will act not only as habitat nursery but also a faunal nursery for the re-establishment of natural biodiversity in the rehabilitated project area.			
Closure	Maintenance and aftercare of final landforms						

TABLE 49: ACTION PLAN – POLLUTION OF WATER RESOURCES

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H	L	Management measures will focus on the prevention of pollution, the containment of pollution sources, and the remediation of contamination incidents should they occur: • the soil resource will be conserved and managed as detailed in Section 7.2.3; • prevention of contamination and containment of potential pollution sources will be achieved as described in Section 2.7.2; • the clean and dirty water systems (as described in Section 2.7.2) will be designed, implemented and managed in accordance with the provisions of Regulation 704 for water management on mines. In this regard: o clean water will be diverted around operational areas, including flood protection bunds to safeguard the Hotazel open pit from	On-going	On-going	Professional engineer and environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam Demolition Rehabilitation						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				flood events greater than the 1:100 year flood; o dirty water will be contained in the dirty water run-off and/or process water system that comprises dirty water pipes, berms and channels, and dams, and from which dirty water will be reused as a priority and/or treated prior to being discharged to the environment; and o these systems will be routinely inspected to detect possible breaches and implement preventative or corrective action. • as part of closure planning, final landforms will be designed and stabilised so as to prevent erosion and associated suspended solids. Monitoring of potential seepage from these landforms will be conducted; • the water balance for the project will be refined on an ongoing basis during the life of the project. Flow meters will be installed in the mine water circuit to provide actual data on water flows to confirm or amend predictions made in the water balance model. The water balance will be used to check on an ongoing basis that the capacity of the dirty water holding facilities is adequate, taking the operational distribution and use of water into account: o an annual water balance report will be submitted to DWA, providing information on the status of the water balance in the wet and dry season and under conditions of extreme rainfall. • water quality monitoring will take place as detailed in Section 12; • if an incident occurs where water has been contaminated to levels exceeding the maximum acceptable limits agreed to by DWA, the mine will immediately notify DWA and then identify the source of the contamination and implement measures to prevent further contamination in consultation with DWA;			
Closure	Maintenance and						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
	aftercare of final landforms						

TABLE 50: ACTION PLAN – ALTERATION OF NATURAL DRAINAGE PATTERNS

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H	L	• The impacts of stormwaters in disturbed areas are closely related to the conservation of soil resources. In this regard, the soil conservation measures set out in Section 7.2.3 will be followed. With reference to stormwater control measures referred to in Section 2.7.2 and detailed in the surface water management plan attached in Appendix H, stormwaters are to be diverted, via a system of trenches and berms, around areas of disturbance and associated exposed soils and vulnerable vegetation. These measures will be implemented in accordance with the requirements of Regulation 704 (Water management regulations for mines). • Where clean water is discharged at a defined point, Kudumane will establish controls (such as gabions) which reduce the velocity and erosive energy of these waters. • With regard to potential surface subsidence, professional engineers will be consulted in ensuring that: • the backfilling of the pits will be executed in a manner which will account for settling such that excessive subsidence past the pre-project state does not occur; and • should surface subsidence occur or slopes become unstable, the situation is rectified.	On-going	On-going	Project manager and environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam Demolition Rehabilitation						
Closure	Maintenance and aftercare of final landforms						

TABLE 51: ACTION PLAN – CONTAMINATION OF GROUNDWATER

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Earthworks Civil works	H	L	• Kudumane will comply with both the National Water Act (36 of 1998) and Regulation 704 (4 June 1999) or any future amendments thereto, and the terms and conditions of water authorisations/licenses. • In the construction, operation and decommissioning phases the mine will ensure that all hazardous chemicals (new and used), mineralised wastes and non-mineralised wastes are handled in a manner that they do not pollute groundwater. This will be implemented through a procedure(s) covering the following: o pollution prevention through basic infrastructure design; o pollution prevention through maintenance of equipment; o pollution prevention through education and training of workers (permanent and temporary); o pollution prevention through appropriate management of hazardous chemicals, materials and non-mineralised waste; o the required steps to enable containment and remediation of pollution incidents; and o specifications for post rehabilitation audit criteria to ascertain whether the remediation has been successful and if not, to recommend and implement further measures.	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Water supply infrastructure Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam Demolition Rehabilitation						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				• Infrastructure that has the potential to cause groundwater contamination will be identified and included in a groundwater pollution management plan which will be implemented as part of the operational phase. This plan has the following principles: o map potential pollution sources; o track (through groundwater modelling updates every 3 years) the extent of the existing or potential contamination plume; o design and implement intervention measures to prevent, eliminate and/or control the pollution plume; o monitor (according to Section 21) all existing and potential impact zones and related third party boreholes to track pollution and mitigation impacts; and o where monitoring results indicates that third party water supply has been polluted by Kudumane, Kudumane will ensure that an alternative equivalent water supply will be provided.			
Closure	Maintenance and aftercare of final landforms						

TABLE 52: ACTION PLAN – DEWATERING

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	N/A	H	L	If any mine related loss of water supply is experienced by the surrounding borehole users, Kudumane will provide compensation that could include an alternative water supply of equivalent water quality. In order to determine this, all	On-going	On-going	Environmental manager
Operation	Opencast mining						
Decommissioning	Opencast mining						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				boreholes potentially in the impact zone will form part of the Kudumane monitoring programme (see Section 20.1) in consultation with the relevant landowners/land users. In addition, model updates every 3 years will be done to assist with quanitification of the impact zone as mining develops and additional information becomes available.			
Closure	N/A						

TABLE 53: ACTION PLAN –AIR POLLUTION

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	**M-H (H for Devon)**	**M**	The following actions apply: *Opencast mining* • Doubling the moisture content of materials handled in opencast operations has been shown to reduce dust generation by 62%. Due to the expected groundwater inflows into the mine workings materials within the pit will already have elevated water contents when compared to on-surface stockpiled materials. Therefore, the need for additional wetting of the opencast workings will be based on monitoring results. • The use of wet and chemical dust suppression at mining and stockpiles will be investigated based on monitoring results. • A 75% reduction in dust emissions from unpaved in-pit haul roads can be achieved through effective water sprays combined with chemicals. Although water spraying of unpaved in-pit haul roads will be conducted,	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Transport infrastructure Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam Demolition Rehabilitation						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				the need for chemical dust suppression additives will be assessed based on monitoring results. Kudumane will also use dust suppression spraying at drilling sites within pit. The Australian NPi estimates that a 70% reduction in dust emissions from drilling can be achieved through effective water sprays. *<u>TSF</u>* • Dust suppression will be achieved by capping the side walls and surface as part of on-going rehabilitation and final closure of the TSF. The choice of capping material is either rock or vegetation of a combination. *<u>Plant and materials handling areas</u>* • Dust suppression by the application of water *<u>Vehicle entrainment on unpaved roads</u>* The following measures will be taken to reduce emissions from roads (outside the pit): • access roads will be tarred; • restrictions will be placed on traffic volumes and vehicle speeds; and • wet suppression spraying of unpaved roads will take place daily. Should only water be applied, the amount needed to ensure 75% control efficiency on the various unpaved roads was calculated to be 1.23 litres/m²/hour during road use. The need for chemical dust suppression additives will be assessed based on monitoring results.			

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				Monitoring Requirements • Air quality monitoring should be continued as is currently taking place at Kudumane. A detailed air quality monitoring programme is provided in Section 12. This monitoring programme includes three additional proposed dust fallout monitoring points and one additional PM_{10} monitoring point. With regards to the PM_{10} monitoring point, it is suggested that the existing location DB1 (at the lodge) should relocated to Devon for the duration of the re-mining of the Devon pit. Following the cessation of the opencast operations at Devon, it could be located immediately outside the Hotazel town (as indicated Figure 17), depending on access to power and security or alternatively at the lodge where it has been placed for the purposes of current operations. *Health Risk Assessment* • If monitoring determines that third parties will be exposed to unacceptable cumulative concentrations of manganese or PM_{10}, a health risk assessment will be commissioned. Commissioning this health risk assessment, including the implementation of any related management measures, is the responsibility of both Kudumane and other contributing mines.			
Closure	Maintenance and aftercare of final landforms						

TABLE 54: ACTION PLAN – NOISE POLLUTION

Phase of operation	Activities (see Table 24)	Sig	Technical and management options	Action plan		
				Timeframe	Frequency	Responsible parties

		UM	M				
Construction	Site preparation Earthworks Civil works	M	M	In general, the management actions included in the approved 2010 EIA/EMP apply and these are set out below: • The overburden and low-grade ore stockpiles will act as a noise berm around the mining operations. • No blasting will take place at night. As a general rule the following restrictions also apply to weekends: o the mine will not operate on Sundays; o no crushing at night on weekends; o no train loading at night on weekends; and o no blasting on weekends. • All diesel-powered earth moving equipment will be of high quality and will be well maintained. Regular maintenance schedules must include the checking and replacement of exhaust and intake silencers. • The mine will record and respond immediately to complaints about disturbing noise. All such complaints will be documented and recorded as incidents. Monitoring to verify noise levels and impacts may be required as part of this process. The measures taken to address these complaints will be included in the documentation. These records will be kept for the life of mine. • In addition, specific actions are required to prevent or mitigate impacts associated with the Devon pit and WRD. In this regard, night-time noise impacts are the most critical issue and therefore Kudumane will not operate noise generating activities at the Devon pit and WRD between 18h00 and 06h00 unless an alternative agreement with the receptors at Langdon is obtained. Similarly, if the homestead on Botha is ever occupied, measures to mitigate cumulative noise impacts	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Tailings dam Demolition Rehabilitation						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				associated with Kudumane should be agreed with the tenants as required.			
Closure	N/A			-	-	-	-

TABLE 55: ACTION PLAN – BLASTING DAMAGE

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	N/A	H	M	The following specific actions are required in addition to compliance with the relevant blasting and explosives legislation including the Explosives Act and the Mine Health and Safety Act: • The blast design will, as a minimum standard, ensure that the peak particle velocity from all blasts is less than 12mm/s at all vulnerable third party structures, that flyrock is contained within 500 m of each blast and that the airblast is less than 130 dB at third party structures for all blasts. Monitoring of these three aspects (fly rock, airblast and ground vibration) will be undertaken to determine whether the blasts are within compliance. • All vulnerable structures (see Table 37) within 1000 m of the blast will be marked on a site plan and surveyed photographically in the presence of the owner before blasting takes place. If surrounding property owners have vulnerable structures outside of this zone, they can request Kudumane to have them included in the pre blast survey. All parties that exist and/or that have property and/or that provide services within 3000m of the blast	On-going	On-going	Mine Safety and operational manager
Operation	Earthworks Civil works Opencast mining						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				sites will be informed, prior to mining, about the blast programme and associated safety precautions. • In deciding whether or not to set off blasts, a procedure must be developed to take temperature inversions, low cloud cover, and wind direction into account. • For each blast, the mine will observe the following procedural safety steps: o the fly rock danger zone associated with each blast is delineated and people and animals are cleared from this zone before every blast; o an audible warning is given at least three minutes before the blast is fired; and o the Hotazel Manganese Mine landing strip will be contacted in order to ensure no risk is posed to aircraft and/or associated third parties. • The mine will respond immediately to any blast related complaints. These complaints and the follow up actions will be dated, documented, and kept as records for the life of mine. Where the mine has caused blast related damage it will provide appropriate compensation.			
Decommissioning	N/A	-	-	-	-	-	-
Closure	N/A	-	-	-	-	-	-

TABLE 56: ACTION PLAN – TRAFFIC IMPACT

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Transport infrastructure	H	L	• The following actions will be taken by Kudumane in order	On-going	On-going	Mine Safety and environmental manager

<table>
<tr><th rowspan="2">Phase of operation</th><th rowspan="2">Activities (see Table 24)</th><th colspan="2">Sig</th><th rowspan="2">Technical and management options</th><th colspan="3">Action plan</th></tr>
<tr><th>UM</th><th>M</th><th>Timeframe</th><th>Frequency</th><th>Responsible parties</th></tr>
<tr><td>Operation

Decommissioning</td><td>Opencast mining
WRDs/Stockpiles
Transport infrastructure
Other support services and amenities

Demolition
Rehabilitation</td><td></td><td></td><td>to reduce the impact of the project on surrounding traffic:
o proper intersection lighting should be installed at the intersections of the R380, local mine road and the eastern access road to Hotazel;
o roads R380 and R31;
• necessary traffic and information signs and road markings should be provided to ensure safe access to the proposed mining development as part of the detailed design process;
• in terms of workers at the mine, dedicated loading and off-loading facilities need to be provided;
• in order to ensure effective and efficient access control management, it would be necessary, as part of the implementation process to review the mine access point on the premises of the mine. This includes all types and modes and is required in order to ensure proper and safe flow of traffic while security measures are applied.
• it is recommended that the necessary road traffic information signs should be provided where mine vehicles will cross the R380 (from the Devon pit);
• detailed design drawings will need to be submitted to the various authorities for approval purposes, and where necessary the required way leaves should be obtained in order to conduct the required upgrades;
• in terms of road safety it is recommended that the intersection between the R380 and R31 is upgraded by adding a dedicated right turning lane from the western approach and a taper from the southern approach.</td><td></td><td></td><td></td></tr>
</table>

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				Collaboration with adjacent mining operations is necessary in terms of the proposed upgrading since the activities related to adjacent mining developments also have an impact on this intersection. In this regard, Kudumane will initiate a forum in which the above will be discussed and actioned; • it is recommended that the necessary road network signage be provided at the intersection of the R380, R31 and the local mine road in order to inform the public that no through movement is allowed • Kudumane will make use of high passenger capacity busses and taxis for staff transport; and • Kudumane will co-operate with surrounding mines and the provincial roads department with regards to service levels and safety of the broader road network used by mining related traffic.			
Closure	N/A	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 57: ACTION PLAN – VISUAL IMPACTS

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	M	M	The key to mitigation of visual impacts is successful implementation of the decommissioning and closure activities which are set out below: • Decommissioning activities that will be undertaken include the following: o dismantling and demolishing of infrastructure; o backfilling the open pits with waste rock material;	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste						

<table>
<tr><th rowspan="2">Phase of operation</th><th rowspan="2">Activities (see Table 24)</th><th colspan="2">Sig</th><th rowspan="2">Technical and management options</th><th colspan="3">Action plan</th></tr>
<tr><th>UM</th><th>M</th><th>Timeframe</th><th>Frequency</th><th>Responsible parties</th></tr>
<tr><td></td><td>management
Other support services and amenities</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="3">o replacing topsoil resources on disturbed areas;
o stabilising underground mine workings (existing mining rights area only);
o stabilising and profiling of permanent WRDs;
o rehabilitation of the disturbed areas where infrastructure has been removed by sloping, filling in excavations and re-vegetating where possible;
o the surface of the tailings dam will be covered with waste rock and/or vegetation (new mining rights area only);
o dismantling and rehabilitation of railway tracks and rehabilitation of roads (depending on end use); and
o ensure that vegetation on rehabilitated areas is sustainable.
• Closure phase activities that will be undertaken include the following:
o there will be a period of active after-care followed by a passive after-care phase;
o maintenance of vegetation where this is used for rehabilitation;
o maintenance of facilities such as fencing, fire breaks, access roads and ramps, overflow structures;
o removal of any invasive species from the rehabilitated sites;
o inspecting on an annual basis to repair any erosion gullies; and
o monitoring of potential groundwater pollution plumes.</td><td></td><td></td><td></td></tr>
<tr><td>Decommissioning</td><td>Earthworks
Civil works
Opencast mining
Tailings dam
Demolition
Rehabilitation</td><td></td><td></td><td></td></tr>
<tr><td>Closure</td><td>Maintenance and aftercare of final landforms</td><td>M</td><td>L</td><td></td><td></td><td></td></tr>
</table>

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				• In addition, the successful management of the visual impact is also reliant on the successful management of the following related issues: o impacts on topography and drainage patterns will be managed as outlined in Section 7.2.2 and Section 7.2.8; o impacts on biodiversity will be managed as detailed in Section 7.2.5 and Section 7.2.6; o dust control will achieved as described in Section 7.2.11; o disturbed areas will be rehabilitated as detailed in Section 7.2.4, Section 7.2.5, and Section 7.2.6; o ongoing “roll-over” backfilling and rehabilitation of the project area will take place as detailed in Section 2; and o lighting will be controlled as follows: - lights will be directed downwards; - fitted with containment shields to prevent light shining directly away from the proposed operations; and - security flood lighting and operational lighting will only be used where absolutely necessary and carefully directed, preferably away from sensitive viewing areas.			

		Rehabilitation

TABLE 58: ACTION PLAN – DESTRUCTION OF HERITAGE, PALEONTOLOGICAL AND CULTURAL RESOURCES

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H	L	• Although the potential impacts on palaeontological resources has not been identified as an issue, for purposes of completeness, mitigation measures relating thereto have been included below: o Project infrastructure, activities and related disturbance will be limited to those specifically identified and described in this report. Where future plans require a change in mine footprint, a project specific heritage study will be done to identify any project specific heritage and cultural resources that may be affected and to detail the mitigation plan where required. If removal or damage to resources is unavoidable, the necessary authorisations will be obtained from SAHRA prior to the removal or damage occurring. o All workers (temporary and permanent) will be educated about the heritage and cultural sites that may be encountered in their area of work and about the need to conserve these. • In the event that new heritage and/or cultural resources are discovered during the construction, operation and decommissioning phases, the mine will follow an emergency procedure prior to damaging or moving these, which includes the following: o work at the find will be stopped to prevent damage; o an appropriate heritage specialist will be appointed to assess the find and related impacts; and	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining WRDs/Stockpiles Transport infrastructure						
Decommissioning	Earthworks Civil works Opencast mining Demolition						
Closure	N/A						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
				o permitting applications will be made to SAHRA, if required. o o In the event that any graves are discovered during the construction, operational or decommissioning phases, prior to damaging or destroying any identified graves, permission for the exhumation and relocation of graves must be obtained from the relevant descendants (if known) and the relevant local and provincial authorities.			

TABLE 59: ACTION PLAN – ECONOMIC IMPACT

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H+	H+	• In order to enhance the local economic impacts, Kudumane will consider ways to empower, support and use local people for employment and local business for procurement. It will also consider other ways to enhance local economic development. Kudumane will, where possible, provide wealth creation and life skills training as part of its skill development programmes to assist employees post closure. The mine will continue to implement the commitments in its social and labour plan in accordance with the employment, procurement and social investment principles of the Mining Charter. • Closure planning must include economic planning as described in the above Section.	On-going	On-going	Human resources and mine manager
Operation	Earthworks						

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
					Timeframe	Frequency	Responsible parties
	Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Opencast mining Tailings dam Demolition Rehabilitation						
Closure	N/A						

TABLE 60: ACTION PLAN – INWARD MIGRATION

Phase of operation	Activities (see Table 24)	Sig		Technical and management options	Action plan		
		UM	M		Timeframe	Frequency	Responsible parties
Construction	Site preparation Earthworks Civil works	H	M	• All workers at the mine will be housed in formal housing. Kudumane will implement necessary systems to ensure this happens. Two key components are: o workers will qualify for a housing allowance only for formal housing; and o Kudumane will audit the living conditions of its workers. • Recruitment will occur in the nearest towns, away from the gate of the mine. Recruitment will take place with the assistance of the Department of Labour as well as other government employment agencies in the area. Job interviews and applications will take place at the offices of the Department of Labour. • Kudumane, will co-operate with the Hotazel security	On-going	On-going	Human resources and mine manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Opencast mining Tailings dam Demolition Rehabilitation						

Phase of operation	Activities (see Table 24)	Sig UM	Sig M	Technical and management options	Action plan Timeframe	Action plan Frequency	Action plan Responsible parties
				forum and SAPS in insuring that informal settlements do not develop. In this regard a procedure will be developed to inspect and manage vacant land in the vicinity of the mine.			
Closure	N/A						

TABLE 61: ACTION PLAN – LAND USE IMPACTS

Phase of operation	Activities (see Table 24)	Sig UM	Sig M	Technical and management options	Action plan Timeframe	Action plan Frequency	Action plan Responsible parties
Construction	Site preparation Earthworks Civil works	**H**	**M-L**	• Kudumane will implement mitigation measures as laid out from sections 7.2.1 to 7.2.18 so as to minimise the environmental and social impacts. • Managing impacts on land users requires both communication and collaboration between the mine and land users. In this regard, the mine will hold a minimum of quarterly stakeholder meetings and will extend water, air, blasting and noise monitoring to the land users identified in this section as required.	On-going	On-going	Environmental manager
Operation	Earthworks Civil works Opencast mining Tailings dam WRDs/Stockpiles Power supply infrastructure Transport infrastructure Non-mineralised waste management Other support services and amenities						
Decommissioning	Earthworks Civil works Opencast mining Tailings dam Demolition Rehabilitation						
Closure	Maintenance and aftercare of final landforms						

20 EMERGENCY RESPONSE PROCEDURES

20.1 ON-GOING MONITORING AND MANAGEMENT MEASURES

The on-going monitoring as described in Section 21 will be undertaken to provide early warning systems necessary to avoid environmental emergencies.

20.2 PROCEDURES IN CASE OF ENVIRONMENTAL EMERGENCIES

Emergency procedures apply to incidents that are unexpected and that may be sudden, and which lead to serious danger to the public and/or potentially serious pollution of, or detriment to the environment (immediate and delayed). Procedures to be followed in case of environmental emergencies are described in the table below (Table 62).

20.2.1 GENERAL EMERGENCY PROCEDURE

The general procedure that should be followed in the event of all emergency situations is as follows.

- Applicable incident controller defined in emergency plans must be notified of an incident upon discovery
- Area to be cordoned off to prevent unauthorised access and tampering of evidence
- Undertake actions defined in emergency plant to limit/contain the impact of the emergency
- If residue facilities/dams, stormwater diversions, etc., are partially or totally failing and this cannot be prevented, the emergency siren is to be sounded (nearest one available). After hours the Operations Engineer on shift must be notified
- Take photographs and samples as necessary to assist in investigation
- Report the incident immediately to the environmental department for emergencies involving environmental impacts or to the safely department in the case of injury
- The Environment department must comply with Section 30 of the National Environmental Management Act (107 of 1998) such that:
  - o The Environmental department must immediately notify the Director-General (DWA and DEA, DMR and Inspectorate of Mines as appropriate), the South African Police Services, the relevant fire prevention service, the provincial head of DENC, the head of the local municipality, the head of the regional DWA office and any persons whose health may be affected of:
    - The nature of the incident
    - Any risks posed to public health, safety and property
    - The toxicity of the substances or by-products released by the incident
    - Any steps taken to avoid or minimise the effects of the incident on public health and the environment
  - o The Environment department must as soon as is practical after the incident:

- Take all reasonable measures to contain and minimise the effects of the incident including its effects on the environment and any risks posed by the incident to the health, safety and property of persons
- Undertake clean up procedures
- Remedy the effects of the incident
- Assess the immediate and long term effects of the incident (environment and public health).

o Within 14 days the Environment department must report to the Director-General DWA and DEA, the provincial head of DENC, the regional manager of the DMR, the head of the local and district municipality, the head of the regional DWA office such information as is available to enable an initial evaluation of the incident, including:
- The nature of the incident
- The substances involved and an estimation of the quantity released
- The possible acute effects of the substances on the persons and the environment (including the data needed to assess these effects)
- Initial measures taken to minimise the impacts
- Causes of the incident, whether direct or indirect, including equipment, technology, system or management failure
- Measures taken to avoid a recurrence of the incident.

20.2.2 IDENTIFICATION OF EMERGENCY SITUATIONS

The site wide emergency situations that have been identified together with specific emergency response procedures are outlined in Table 62.

20.3 TECHNICAL, MANAGEMENT AND FINANCIAL OPTIONS

Technical, management and financial options that will be put into place to deal with the remediation of impacts in cases of environmental emergencies are described below.

- The applicant will appoint a competent management team with the appropriate skills to develop and manage a mine of this scale and nature.
- To prevent the occurrence of emergency situations, the mine will implement as a minimum the mine plan and mitigation measures as included in this EIA/EMP report.
- The mine has an environmental management system in place where all operation identify, report, investigate, address and close out environmental incidents.
- As part of its annual budget, the mine will allow a contingency for handling of any risks identified and/or emergency situations.
- Where required, the mine will seek input from appropriately qualified people.

TABLE 62: EMERGENCY RESPONSE PROCEDURES

Item	Emergency Situation	Response in addition to general procedures
1	Spillage of chemicals, engineering substances and waste	Where there is a risk that contamination will contaminate the land (leading to a loss of resource), surface water and/or groundwater, Kudumane will: • Notify residents/users downstream of the pollution incident. • Identify and provide alternative resources should contamination impact adversely on the existing environment. • Cut off the source if the spill is originating from a pump, pipeline or valve (e.g. Tailings delivery pipeline, refuelling tanker) and the infrastructure ‘made safe’. • Contain the spill (e.g. construct temporary earth bund around source such as road tanker). • Pump excess hazardous liquids on the surface to temporary containers (e.g. 210 litre drums, mobile tanker, etc.) for appropriate disposal. • Remove hazardous substances from damaged infrastructure to an appropriate storage area before it is removed/repaired.
2	Discharge of dirty water to the environment	Apply the principals listed for Item 1 above. To stop spillage from the dirty water system the mine will: • Redirect excess water to other dirty water facilities where possible; • Pump dirty water to available containment in the clean water system, where there is no capacity in the dirty water system • Carry out an emergency discharge of clean water and redirect the spillage to the emptied facility. • Apply for emergency discharge as a last resort.
3	Pollution of surface water	• Personnel discovering the incident must inform the Environmental department of the location and contaminant source. • Apply the principals listed for Item 1 above. • Absorbent booms will be used to absorb surface plumes of hydrocarbon contaminants.

Item	Emergency Situation	Response in addition to general procedures
		• Contamination entering the surface water drainage system should be redirected into the dirty water system. • The Environmental department will collect in-stream water samples downstream of the incident to assess the immediate risk posed by contamination.
4	Groundwater contamination	• Use the groundwater monitoring boreholes as scavenger wells to pump out the polluted groundwater for re-use in the process water circuit (hence containing the contamination and preventing further migration). • Investigate the source of contamination and implement control/mitigation measures.
5	Burst water pipes (loss of resource and erosion)	• Notify authority responsible for the pipeline (if not mine responsibility). • Shut off the water flowing through the damaged area and repair the damage. • Apply the principals listed for Item 1 above if spill is from the dirty/process water circuit.
6	Flooding from failure of surface water control infrastructure	• Evacuate the area downstream of the failure. • Using the emergency response team, rescue/recover and medically treat any injured personnel. • Temporarily reinstate/repair stormwater diversions during the storm event (e.g. emergency supply of sandbags). • Close the roads affected by localised flooding or where a stormwater surge has destroyed crossings/bridges.
7	Risk of drowning from falling into water dams	• Attempt rescue of individuals from land by throwing lifeline/lifesaving ring. • Get assistance of emergency response team whilst attempting rescue or to carry out rescue of animals and or people as relevant. • Ensure medical assistance is available to recovered individual.
8	Veld fire	• Evacuate mine employees from areas at risk. • Notify downwind residents and industries of the danger. • Assist those in imminent danger/less able individuals to evacuate until danger has passed. • Provide emergency fire fighting assistance with available trained mine personnel and equipment.
9	Injury from fly rock	• The person discovering the incident will contact the mine emergency response personnel to recover the injured person or animal and provide medical assistance. • Whilst awaiting arrival of the emergency response personnel, first aid should be administered to the injured

Item	Emergency Situation	Response in addition to general procedures
		person by a qualified first aider if it is safe to do so.
10	Falling into hazardous excavations	• Personnel discovering the fallen individual or animal must mobilise the emergency response team to the location of the incident and provide a general appraisal of the situation (e.g. human or animal, conscious or unconscious, etc.). • The injured party should be recovered by trained professionals such as the mine emergency response team. • A doctor (or appropriate medical practitioner)/ambulance should be present at the scene to provide first aid and transport individual to hospital.
11	Property damage from blasting	• Should third party property be damaged from blasting, suitable compensation will be provided.
12	Road traffic accidents (on site)	• The individual discovering the accident (be it bystander or able casualty) must raise the alarm giving the location of the incident. Able personnel at the scene should shut down vehicles where it is safe to do so. • Access to the area should be restricted and access roads cleared for the emergency response team. • Vehicles must be made safe first by trained professionals (e.g. crushed or overturned vehicles). • Casualties will be moved to safety by trained professionals and provided with medical assistance. • Medical centres in the vicinity with appropriate medical capabilities will be notified if multiple seriously injured casualties are expected. • A nearby vet should be consulted in the case of animal injury
13	Uncovering of graves and sites	• Personnel discovering the grave or site must inform the Environment department immediately. • Prior to damaging or destroying any of the identified graves, permission for the exhumation and relocation of graves must be obtained from the relevant descendants (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local Police. • The exhumation process must comply with the requirements of the relevant Ordinance on Exhumations, and the Human Tissues Act, 65 of 1983.
14	Development of informal settlements	• The mine will inform the local authorities (municipality and police) that people are illegally occupying the land and ensure that action is taken within hers.

Item	Emergency Situation	Response in addition to general procedures
15	Overtopping or failure of the tailings storage facility	• Sound the alarm to evacuate danger area. • Pump water from top of dam and follow redirection of water as indicated in Item 2 above. • Stop pumping tailings to the tailings. • Recover casualties resulting from dam failure using the emergency response team. • Make the remaining structure safe. • Apply the principles of Item 1 above.

21 PLANNED MONITORING AND EMP PERFORMANCE ASSESSMENT

21.1 PLANNED MONITORING OF ENVIRONMENTAL ASPECTS

Environmental aspects requiring monitoring are listed below.

- Hazardous excavations and infrastructure – see 21.1.1 for details
- Water resources (surface water and groundwater) – see Section 21.1.2 for details
- Air – see Section 21.1.3 for details
- Blasting – see Section 21.1.5 for details
- Tailings storage facility, waste rock dumps and other water dams – see Section 21.1.6 for details

21.1.1 HAZARDOUS INFRASTRUCTURE AND EXCAVATIONS

Hazardous excavations and infrastructure will be surveyed annually and inspections will take place on a routine basis to ensure that measures for preventing injury to third parties and animals are being implemented and maintained.

21.1.2 WATER RESOURCES

Groundwater and surface water monitoring

Groundwater quality and quantity are currently being monitored on a quarterly basis at the Kudumane Mine in accordance to the monitoring programme set out in the approved EIA/EMP report (Metago, 2010).

Refer to Figure 25 for the location of the groundwater monitoring points at the Kudumane Mine. An additional four monitoring boreholes were drilled in February 2014. Further additional boreholes have been proposed as part of the specialist geohydrological study, and have been included in Figure 25.

The groundwater monitoring parameters in accordance with the SANS water quality Standards and the DWAF guideline limits for livestock watering that are relevant to the Kudumane mine are set out in Table 63 below (SLR, June 2014).

TABLE 63: ANALYTICAL SUITE FOR GROUNDWATER SAMPLES

Parameters	
pH	Copper as Cu
Electrical Conductivity (EC)	Iron as Fe
Redox Potential (Eh)	Lead as Pb
Total Dissolved Solids (TDS)	Lithium as Li
Alkalinity as $CaCO_3$	Magnesium as Mg
Bicarbonate as HCO_3	Manganese as Mn
Carbonate as CO_3	Molybdenum as Mo

Chloride as Cl	Nickel as Ni
Sulphate as SO4	Phosphorous as P
Fluoride as F	Potassium as K
Nitrate as N	Selenium as Se
Aluminium as Al	Silicon as Si
Antimony as Sb	Silver as Ag
Arsenic as As	Sodium as Na
Barium as Ba	Strontium as Sr
Beryllium as Be	Sulphur as S
Bismuth as Bi	Tin as Sn
Boron as B	Titanium as Ti
Cadmium as Cd	Tungsten as W
Calcium as Ca	Vanadium as V
Chromium as Cr	Zinc as Zn
Cobalt as Co	Zirconium as Zr

SLR, June 2014

Process water

Process water quality from dirty water dams will be monitored on a quarterly basis. The parameters to be monitored are outlined in Table 63.

Rainfall related discharges will be monitored as required according to the parameters in Table 63. If the quality of the monitored discharge is above acceptable levels, additional measures will be identified and implemented to prevent the future potential for surface water related pollution.

Water balance and salt balance

The water balance is updated on a monthly basis from recorded flow measurements and production figures.

21.1.3 AIR QUALITY

With reference to Figure 26, a dust fallout and PM_{10} (including inhalable manganese) monitoring network has been established. Given the additional sources identified as part of this EIA report, the dust fallout monitoring network will be expanded to include additional monitoring points. These are also indicated on Figure 26. The programme for monitoring is monthly for dust fallout and continuous for $PM_{10.}$

The established weather station should be serviced and maintained so that climatic data is more readily available.

It is further recommended that Kudumane co-operate with the neighbouring Kalagadi, Hotazel Manganese Mine, and the planned Kongoni (Amari Manganese) mines to establish and maintain an optimal regional monitoring network.

21.1.4 BIODIVERSITY MONITORING PROGRAMME

On-going monitoring

Prior to the construction of any future project, detailed baseline studies of selected fauna and flora groups within the impact zone will be undertaken. During operation and decommissioning, Kudumane will implement a monitoring programme which will be aimed at monitoring selected indicator species. This monitoring, which will include the species selection and determination of monitoring intervals, will be performed by a specialist.

Alien invasive species programme

During operation, decommissioning and closure Kudumane will implement an alien/invasive /weed management programme to control the spread of these plants onto and form disturbed areas. This will be achieved by active eradication and the establishment of natural species and through on-going monitoring and assessment. The use of herbicides will be limited and focussed and will only be used under strict controls. Herbicides will be selected to ensure least residual harm. Herbicides will be administered by suitably qualified people.

Continued monitoring will be undertaken to ensure that the alien invasive species have been eradicated and are controlled for both controlled sites as well as rehabilitated areas. Repeat surveys should be carried out annually for at least the first three years post-rehabilitation.

Rehabilitation

For each area requiring rehabilitation specific landscape functionality objectives will be set with expert input and the associated targets and monitoring program will follow accordingly.

21.1.5 BLASTING

Monitoring will be done for each blast to verify that fly rock is being contained within 500m from the blast. On a sample basis to verify that the air blast is less than or equal to 130 dB at third party structures and that the ground vibration is less than or equal to a peak particle velocity of 12mm/s at third party structures.

21.1.6 MINERALISED WASTE FACILITIES AND WATER DAMS

In addition to the abovementioned environmental monitoring programmes, all mineralised waste facilities and water dams will be monitored to ensure stability, safety and prevention of environmental impacts. The frequency of the monitoring and the qualification of the monitoring personnel will be determined on an infrastructure specific basis and in consultation with an appropriately qualified engineer.

The findings will be documented for record-keeping and auditing purposes and addressed where relevant to achieve the stated objectives.

With regards to the TSF:

A management system and monitoring programme should be established prior to commissioning of the facility. The facility operator will typically need to ensure that:

- beach formation and pond location are controlled;
- the minimum specified freeboard is maintained;
- the rate of rise of the facility is kept within prescribed limits;
- the tailings deposition cycle is controlled to optimise drying;
- the concentration, flow and discharge of storm water is controlled such that damage is prevented; and
- access is controlled.

21.2 AUDITING AND PERFORMANCE ASSESSMENTS

The environmental department manager will conduct internal management audits against the commitments in the EMP. These audits will be conducted on an on-going basis until final closure. The audit findings will be documented for both record keeping purposes and for informing continual improvement. In addition, and in accordance with mining regulation R527, an independent professional will conduct an EMP performance assessment every 2 years. The site's compliance with the provisions of the EMP and the adequacy EMP report relative to the on-site activities will be assessed in the performance assessment.

21.3 FREQUENCY FOR REPORTING

As a minimum, the following documents will be submitted to the relevant authorities from the start of construction until mine closure:

- EMP performance assessment, submitted every two years to DMR
- Updated closure and rehabilitation cost estimate, submitted annually to the DMR in accordance to DMR requirements
- Water monitoring reports, submitted to DWA in accordance with water use license
- Air quality monitoring reports, submitted to the relevant authority in accordance with the departmental requirements
- Detailed plan for decommissioning/closure, submitted in accordance to DMR requirements 5 years before closure.

FIGURE 25: GROUNDWATER MONITORING PROGRAMME

FIGURE 26: AIR QUALITY MONITORING PROGRAMME

22 FINANCIAL PROVISION

The information in this section was sourced from the closure cost calculation study completed by SLR (June, 2014) and is included in Appendix Q.

22.1 PLAN SHOWING LOCATION AND AERIAL EXTENT OF PROPOSED OPERATION

The plan showing the location and aerial extent of the entire Kudumane operation including the proposed changes to the planned surface infrastructure is illustrated in Figure 21.

22.2 ANNUAL FORECASTED FINANCIAL PROVISION

The current scheduled liability for current Kudumane operations including the proposed infrastructure within the new mining rights area is **R 44 518 776.** The annual forecasted financial provision for the first 10 years is provided in Table 64 below.

TABLE 64: FINANCIAL PROVISION (SLR, JULY 2014)

Year	Financial provision (R, including VAT)
2014 (Current)	R 10,515,928
2015	R 23,674,831
2016	R 30,695,894
2017	R 35,182,935
2018	R 38,516,869
2019	R 41,850,803
2020	R 41,850,803
2021	R 41,850,803
2022	R 41,850,803
2023	R 41,850,803
2024	R 41,850,803
2045 Life of project (scheduled closure)	R 44,518,776

22.3 CONFIRMATION OF AMOUNT TO BE PROVIDED

The current financial guarantee for the approved mining rights area (NC 30/6/1/2/2/268 MR) is R60 000 000. The financial liability for the proposed new mining rights area (NC 30/5/1/2/2/10053 MR) is R44 518 776. In this regard, an additional R44 518 776 should be provided in order to cater for the closure liability associated with the new mining rights area.

22.4 METHOD OF PROVIDING FINANCIAL PROVISION

The financial provision will be provided by means of an insurance policy with Lombard Financial Group.

23 ENVIRONMENTAL AWARENESS PLAN

This section includes an environmental awareness plan for the mine. The plan describes how employees will be informed of environmental risks which may result from their work, the manner in which the risk must be dealt with in order to avoid pollution or degradation of the environment and the training required for general environmental awareness and the dealing of emergency situations and remediation measures for such emergencies.

All contractors that conduct work on behalf of Kudumane are bound by the content of the EMP and a contractual condition to this effect will be included in all such contracts entered into by the mine. If contractors are used, the responsibility for ensuring compliance with the EMP will remain with Kudumane.

The purpose of the environmental awareness plan is to ensure that all personnel and management understand the general environmental requirements of the site. In addition, greater environmental awareness must be communicated to personnel involved in specific activities which can have a significant impact on the environment and ensure that they are competent to carry out their tasks on the basis of appropriate education, training and/or experience. The environmental awareness plan should enable Kudumane to achieve the objectives of the environmental policy.

23.1 ENVIRONMENTAL POLICY

Kudumane will display the environmental policy prominently at the mine entrance and key notice boards at the mine's business units. Kudumane's environmental policy is described below: To achieve world class environmental performance in a sustainable manner Kudumane is currently committed to:

- to minimise the impact of Kudumane's mining operations on the environment wherever possible;
- to comply with all applicable environmental legislation and the commitments contained in Kudumane's Environmental Management Plan (EMP);
- to ensure that all Kudumane's employees, contractors and sub-contractors:
  - are aware of the impact of their activities on the environment;
  - are informed about the measures required to prevent, mitigate and manage environmental impacts; and
  - apply these principles whilst carrying out their work
- to establish and maintain a good relationship with surrounding communities, industries and other interested and affected parties, with regard to Kudumane's activities;
- to develop a localised environmental strategy with the local authority and nearby mines and industries; and
- to provide relevant and constructive consultation/public participation on the managements of the potential environmental impacts posed by the mine in the future.

23.2 STEPS TO ACHIEVE THE ENVIRONMENTAL POLICY OBJECTIVES

Kudumane's environmental policy will be realised by setting specific and measurable objectives. It is proposed that new objectives are set throughout the life of mine, but initial objectives are as follows:

- Management of environmental responsibilities:
  - Kudumane will establish and appoint an Environmental Manager at senior mine management level, who will be provided with all necessary resources to carry out the management of all environmental aspects of the site irrespective of other responsibilities, for example:
    - compliance with environmental legislation and EMP commitments;
    - implementing and maintaining an environmental management system;
    - developing environmental emergency response procedures and coordinating personnel during incidents;
    - manage routine environmental monitoring and data interpretation;
    - environmental trouble shooting and implementation of remediation strategies; and
    - closure planning.
- communication of environmental issues and information:
  - meetings, consultations and progress reviews will be carried out, and specifically Kudumane will:
    - set the discussion of environmental issues and feedback on environmental projects as an agenda item at all company board meetings;
    - provide progress reports on the achievement of policy objectives and level of compliance with the approved EMP to the Department of Minerals Resources;
    - ensure environmental issues are raised at monthly mine management executive committee meetings and all relevant mine wide meetings at all levels; and
    - ensure environmental issues are discussed at all general liaison meetings with local communities and other interested and affected parties.
- environmental awareness training:
  - Kudumane will provide environmental awareness training to individuals at a level of detail specific to the requirements of their job, but will generally comprise:
    - basic awareness training for all prior to granting access to site (e.g. short video presentation requiring registration once completed). Employees and contractors who have not attended the training will not be allowed on site;
    - general environmental awareness training will be given to all employees and contractors as part of the Safety, Health and Environment induction programme. All non-Kudumane personnel who will be on site for more than five days must undergo the SHE induction training; and

  - specific environmental awareness training will be provided to personnel whose work activities can have a significant impact on the environment (e.g. workshops, waste handling and disposal, sanitation, etc.).
- review and update the environmental topics already identified in the EMP which currently includes the following purpose:
  - geology (sterilisation of mineral resources);
  - topography (hazardous excavations and surface subsidence);
  - soil and land capability management (loss of soil resource);
  - land capability (loss of land with agricultural and conservation/ecotourism potential);
  - surrounding land use (traffic management, reduction in land available to livestock grazing, and damage from blasting);
  - management of biodiversity (impacts on land and water related habitats and species);
  - surface water management (alteration of surface drainage and pollution of surface water);
  - groundwater management (reduction in groundwater levels/availability and groundwater contamination);
  - management of air quality (dust generation);
  - noise (specifically management of disturbing noise);
  - visual aspects (reduction of negative visual impacts);
  - heritage resources (management of archaeological, palaeontoligcal, cultural and historical sites);
  - socio-economic impacts (management of positive and negative impacts); and
  - interested and affected parties
- all mine projects will be designed to minimise impact on the environment and to accomplish closure/rehabilitation objectives;
- Kudumane will maintain records of all environmental training, monitoring, incidents, corrective actions and reports; and
- contractors and employees will be contractually bound to participate in the achievement of environmental policy objectives and compliance with the EMP.

23.3 TRAINING OBJECTIVES OF THE ENVIRONMENTAL AWARENESS PLAN

The environmental awareness plan ensures that training needs are identified and that appropriate training is provided. The environmental awareness plan should communicate:

- the importance of conformance with the environmental policy, procedures and other requirements of good environmental management;
- the significant environmental impacts and risks of individuals work activities and explain the environmental benefits of improved performance;
- individuals roles and responsibilities in achieving the aims and objectives of the environmental policy; and
- the potential consequences of not complying with environmental procedures.

23.3.1 General Contents of the Environmental Awareness Plan

To achieve the objectives of the environmental awareness plan the general contents of the training plans are as follows:

- Module 1 – Basic training plan applicable to all personnel entering the site:
  - short (15 min) presentation to indicate the site layout and activities at specific business units together with their environmental aspects and potential impacts; and
  - individuals to sign off with site security on completion in order to gain access to the site.
- Module 2 – General training plan applicable to all personnel at the site for longer than 5 days:
  - general understanding of the environmental setting of the mine (e.g. local communities and industries and proximity to natural resources such as rivers);
  - understanding the environmental impact of individuals activities on site (e.g. excessive production of waste, poor housekeeping, energy consumption, water use, noise, etc.);
  - indicate potential site specific environmental aspects and their impacts;
  - Kudumane's environmental management strategy;
  - identifying poor environmental management and stopping work which presents significant risks
  - Reporting incidents;
  - examples of poor environmental management and environmental incidents; and
  - procedures for emergency response and cleaning up minor leaks and spills.
- Module 3 – Specific training plan:
  - environmental setting of the workplace (e.g. proximity of watercourses, vulnerability of groundwater, proximity of local communities and industries, etc.); and
  - specific environmental aspects such as:
    - spillage of hydrocarbons at workshops;
    - spillage of explosive liquids in open pits;
    - poor waste management such as mixing hazardous and general wastes, inappropriate storage and stockpiling large amounts of waste;
    - poor housekeeping practices; and
    - poor working practices (e.g. not carrying out oil changes in designated bunded areas).
  - impact of environmental aspects, for example:
    - groundwater contamination also resulting in loss of resource due to potential adverse aesthetic, taste and health effects; and
    - dust impacts on local communities (nuisance and health implications).
  - Kudumane's duty of care (specifically with respect to waste management); and
  - purpose and function of Kudumane's environmental management system.

Individuals required to complete Module 3 (Specific training module) will need to complete Modules 1 and 2 first. On completion of the Module 3, individuals will be subject to a short test (written or verbal) to ensure the level of competence has been achieved. Individuals who fail the test will be allowed to re-sit the test after further training by the training department.

The actual contents of the training modules will be developed based on training needs analysis.

Key personnel will be required to undergo formal, external environmental management training (e.g. how to operate the environmental management system, waste management and legal compliance).
In addition to the above Kudumane will:

- conduct refresher training/presentations on environmental issues for mine employees (permanent and contractors) at regular intervals;
- promote environmental awareness using relevant environmental topic posters displayed at strategic locations on the mine. These topics will be changed monthly, and will be reviewed annually by the Environmental Department Manager to ensure relevance; and
- participate and organise events which promote environmental awareness, some of which will be tied to national initiatives e.g. National Arbour Week, World Environment Day and National Water Week.

24 TECHNICAL SUPPORTING INFORMATION

The following specialist studies are attached as appendices to this report:

- Geochemical and groundwater study (Appendix E)
- Soils specialist study (Appendix F)
- Biodiversity specialist study and Biodiversity offset plan (Appendix G)
- Hydrology study (Appendix H)
- Air quality impact assessment (Appendix I)
- Noise impact assessment (Appendix J)
- Visual impact assessment (Appendix K)
- Heritage impact assessment (Appendix L)
- Palaeontoligical impact assessment (Appendix M)
- Alternative land use assessment (Appendix N)
- Traffic impact assessment (Appendix O)
- TSF prefeasibility study (Appendix P)
- Closure cost liability (Appendix Q)
- Environmental awareness and emergency plan (Appendix R)

25 CAPACITY TO MANAGE AND REHABILITATE THE ENVIRONMENT

25.1 AMOUNT REQUIRED TO MANAGE AND REHABILITATE THE ENVIRONMENT

The mine manages the environmental impacts throughout the value chain and puts preventative and mitigating measures in place to achieve this as required. It is the mines policy to always adopt best practice and the budget provided by the mine to manage all identified environmental aspects per annum amounts to approximately 3 million Rands.

25.2 AMOUNT PROVIDED FOR

The amount required as per the above budget has been provided for in the current Kudumane budgeting period.

26 UNDERTAKING SIGNED BY APPLICANT

COMMITMENT/UNDERTAKING BY APPLICANT

I,...

the undersigned and duly authorised thereto by

....…………………………………

undertake to adhere to the requirements and to the conditions set out in the approved EMP with the exception of the exemption(s) and amendment(s) agreed to be relevant by the Regional Manager: __________________________ (include relevant province).

Signed at: ....…………….

On: ....

Signature: …………………...……………….

Designation: ……………………..…………….

REGIONAL MANAGER: _______________________ REGION

In terms of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) this document of ………………………………….……………………… is approved subject to the conditions as set out in the letter of approval.

Signed at: ....………………...

On: ....

Signature: …………………………………..

Designation: …………………………………..

REGIONAL MANAGER: _________________

27 ENVIRONMENTAL IMPACT STATEMENT & CONCLUSION

This document presents the project plan as defined by Kudumane, presents findings of specialist studies, identifies and assesses potential impacts on the receiving environment in both the unmitigated and mitigated scenarios, including cumulative impacts, and identifies measures together with monitoring programmes to monitor and mitigate potential impacts.

A summary of the potential impacts (as per Section 7 of the EIA/EMP report) in the unmitigated and mitigated scenarios for all project phases is included in Table 65 below.

It should be noted that unless otherwise indicated in the introduction to each impact assessment section, the impact assessment was done in a two-fold approach as follows:

- an assessment of the incremental impacts associated with the addition of the new mining rights area (NC 30/5/1/2/2/10053 MR); and
- a cumulative assessment of the above within the context of the current approved mining operations in their entirety.

TABLE 65: SUMMARY OF POTENTIAL CUMULATIVE IMPACTS ASSOCIATED WITH THE KUDUMANE MINE

Section	Potential impact	Significance of the impact (the ratings are negative unless otherwise specified)	
		Unmitigated	Mitigated
Geology	Sterilisation of mineral resources	**M**	**L**
Topography	Hazardous excavations and infrastructure	**H**	L
Soils and land capability	Loss of soil resources and land capability through pollution	**H**	L
	Loss of soil resources and land capability through physical disturbance	**H**	**M**
Biodiversity	Physical disturbance of biodiversity	**H**	**M**
	General destruction of biodiversity	**H**	**M**
Surface water	Pollution of surface water resources	**H**	**L**
	Alteration of natural drainage patterns	**H**	**L**
Groundwater	Contamination of groundwater	**H**	**L**
	Dewatering	**H**	**L**
Air quality	Air pollution	**M-H (H for Devon)**	**M**
Noise	Noise pollution	**M**	**M**
Blasting	Blasting impacts	**H**	**M**
Traffic	Road disturbance and traffic safety	**H**	**L**
Visual	Visual impact	**M**	**M (L at closure)**

Section	**Potential impact**	**Significance of the impact (the ratings are negative unless otherwise specified)**	
		Unmitigated	**Mitigated**
Heritage and cultural resources	Heritage impacts	**H**	**L**
Socio-economic	Economic impact	**H+**	**H+**
	Inward migration	**H**	**M**
Land use	Land use impacts	**H**	**M-L**

The assessment of the mine including the proposed project presents the potential for significant negative impacts to occur (in the unmitigated scenario in particular) on the bio-physical, cultural and socio-economic environments both on the mine site and in the surrounding area. With mitigation these potential impacts can be prevented or reduced to acceptable levels.

The economic impact assessment concluded that the development of the project will have significant positive economic impacts.

It follows that provided the EMP is effectively implemented there is no environmental, social or economic reason why the project should not proceed.

Caitlin Hird **Suan Mulder** **Brandon Stobart**

SLR Consulting (Africa) (Pty) Ltd

28 REFERENCES

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SLR, Surface Water Study for the Kudumane Manganese Mine, July 2014

SLR, Kudumane Manganese Mine prefeasibility study for the Tailings Storage Facility, April 2014

SLR, Noise Impact Assessment for the Kudumane Manganese Mine, July 2014

SLR, Closure Liability for the EMP Amendment, June 2014

SLR, Visual Impact Assessment for the Kudumane Manganese Mine, July 2014

Strategy4Good, Kudumane Alternative Land Use Economic Assessment, June 2014

APPENDIX A: INFORMATION SHARING WITH AUTHORITIES

- DMR notification letter (May 2014)
- Submission of NEMA application (March 2013)
- Land Claims Commissioner notification and responses
- Regulatory Authorities scoping meeting invitation
- DENC site visit minutes (May 2014)
- Signed attendance register of DENC site visit (May 2014)
- Proof of submission of the scoping report to Regulatory Authorities
- Comments received from authorities during the scoping phase

APPENDIX B: IAP DATABASE

APPENDIX C: INFORMATION SHARING WITH IAPS

- Proof of landowner notification (March 2014)
- Site notice in English and Afrikaans, and photographs showing the placement of site notices
- Advertisements placed in the Kalahari Bulletin and Kathu Gazette newspapers on 31 October and 4 November 2013 respectively
- Background Information Document
- General Scoping meeting invitation
- Minutes of general scoping meeting
- Signed attendance register from the general scoping meeting
- Proof of submission of the scoping report to IAPs
- Summary of the scoping report sent to IAPs
- Comments received from IAPs during the scoping phase

APPENDIX D: ISSUES AND CONCERNS RAISED

APPENDIX E: GEOCHEMICAL AND GROUNDWATER STUDY

APPENDIX F: SOILS SPECIALIST STUDY (ARC, JUNE 2014)

APPENDIX G: BIODIVERSITY STUDY AND BIODIVERSITY OFFSET PLAN REPORT

APPENDIX H: HYDROLOGY STUDY

APPENDIX I: AIR QUALITY ASSESSMENT (SLR, JULY 2014)

APPENDIX J: NOISE ASSESSMENT (SLR, JULY 2014)

APPENDIX K: VISUAL ASSESSMENT (SLR, JULY 2014)

APPENDIX L: HERITAGE IMPACT ASSESSMENT (PGS CONSULTING, JUNE 2014)

APPENDIX M: PALAEONTOLOGICAL IMPACT ASSESSMENT (GSPD CONSULTING, JUNE 2014)

APPENDIX N: ALTERNATIVE LAND USE ASSESSMENT (STRATEGY4GOOD, JUNE 2014)

APPENDIX O: TRAFFIC IMPACT ASSESSMENT (SIYAZI, AUGUST 2013)

APPENDIX P: TSF PREFEASIBILITY STUDY (SLR, MAY 2014)

APPENDIX Q: CLOSURE COST LIABILITY (SLR, JUNE 2014)

APPENDIX R: ENVIRONMENTAL AWARENESS AND EMERGENCY PLAN

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