Anglo American: Kumba Iron Ore - Sishen Mine

Preliminary Closure Plan

February 2017

SHANGONI
Management Services (Pty) Ltd

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Preliminary Closure Plan

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SHANGONI
Management Services (Pty) Ltd

PROJECT DETAILS

Department of Mineral Resources (DMR)

Reference No.: 30/5/1/1/2/106 MRC (259 MR)

Project Title: **Preliminary Closure plan**

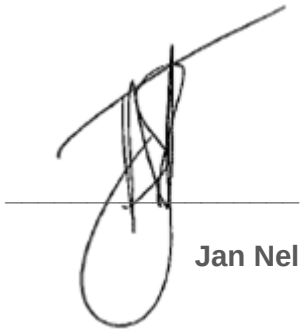
Project Number: **ANG-SIS-15-04-10**

Compiled by: **Emma Fourie**

Date: **February 2017**

Location: **Kathu, Northern Cape**

Technical Reviewer: Jan Nel



Jan Nel

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

EXECUTIVE SUMMARY

Kumba Iron Ore Ltd – Sishen Iron Ore Company requested Shangoni Management Services (Pty) Ltd to review and reformat the 2012 closure plan to meet the requirements of the Department of Mineral Resources (DMR).

Sishen mine is located 30 km from the town of Kathu in the Northern Cape Province of South Africa. It is one of the largest open pit iron ore producing mines in the world. Mining at Sishen is carried out as part of Anglo American's Kumba Iron ore operation. The mine accounts for the majority of Kumba's iron ore production.

The mining operation at Sishen dates to 1953. The first ore from the mine was exported in 1976. More than 900 million tonnes (mt) of iron ore has been produced over 60 years of the mine's operation. The life of Sishen mine is estimated to be 2031 (as per 2015 LOM Plan Report).

Closure Vision: The Sishen closure vision is to make sure that the Sishen zone of influence is a sustainable, safe, stable, non-polluting, and healthy environment with predominately grazing potential supporting small scale socio-economic enterprises.

The following **principles** were defined in support of the closure vision and applied in the development of closure success criteria:

- Identified risk (Safety, Health, Environment and social) will be mitigated to acceptable levels;
- Rehabilitation objectives will be achieved;
- Post closure remnants must confirm to the concept of sustainability; and
- Social closure will contribute to local economic development and manage direct socio-economic impact.

The **overarching goals** for closure are described below, and give effect to physical, biophysical, and social closure objectives tabled below:

- A walk-away closure with limited / no significant long-term liabilities that require management;
- Rehabilitation is of high quality and sustainable into the predictable future;
- Proposed post-closure land uses are sustainable;
- Stakeholder engagement is undertaken and their views have been taken into account in closure planning;
- Permanent Sishen employees have been successfully redeployed or re-skilled;
- Legal compliance has been achieved;
- Authorities will be satisfied with the extent of rehabilitation and closure criteria; and
- The DMR will be satisfied to issue a closure certificate with limited / no significant conditions attached.

Detailed closure objectives include:

Physical Objectives	Biophysical Objectives	Social objectives
All the rehabilitated land is safe and useable, excluding the open pits and potentially the pit-facing slopes of the WRD's, which will be wilderness.	Minimise all negative impacts on the bio-physical environment as far as possible.	Ensure that issues will be addressed and managed so that the main objective and acceptable closure plan can be attained
All rubble from plant decommissioning and related areas do not cause long term degradation or become a safety hazard	That rehabilitated areas can be utilized in a sustainable manner.	Stakeholder engagement is undertaken and their views must be considered during closure planning
All waste dumps be closed and rehabilitated as per the legislative framework	Ground- and surface water will not be polluted once the mine is closed. (e.g. slimes dams);	Permanent employees will be re-deployed and re-skilled to minimise job losses as far as possible.
Land be physically and chemical stable	To ensure legal compliance in terms of biophysical closure	To stimulate the economy of the area by implementing viable projects that will enable some of the employees to be redeployed within that sector
The safety zone of the open pit is established and suitable measures taken to prohibit access		That rehabilitation work as well as other related work with regards to closure is not outsourced but that ex-employees can form part of this process, as far as possible, ensuring job continuation after closure
		That mine owned houses are sold to individuals
		That employees are generally satisfied with re-deployment, re-skilling and alternative employment opportunities

Figure 1 below illustrates the post closure land use inside and outside of the mine's boundaries.

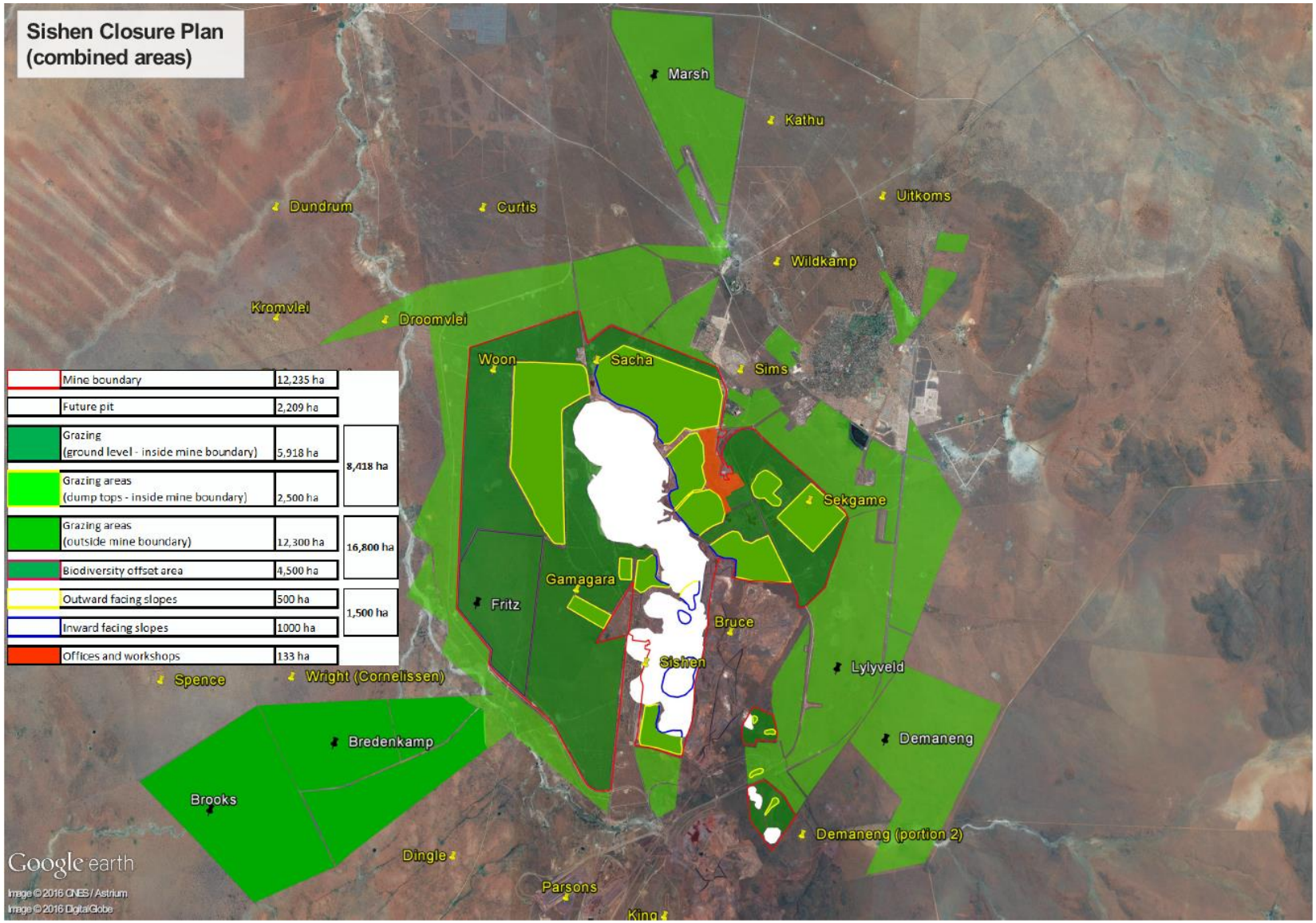


Figure 1:Closure land use map

Closure cost: An assessment was conducted of all the infrastructure and activities currently taking place on site, which fall within the area of responsibility of Sishen Mine. The infrastructure was classified in accordance with the tariffs list. The surface areas of the infrastructure were calculated to determine the volume or surface requiring rehabilitation or demolition. The existing list, which included sizes and volumes, was used as the basis for the update. No new measurements were performed to verify existing sizes and volumes. The sizes and volumes of new structures and areas were included and was derived from a combination of measurements and information provided by the mine and VBKOM.

Previously the closure quantum was calculated on a preliminary basis at R2,369,745,999 as at 30 November 2015, excluding VAT. The reviewed 2015 quantum (Premature), as at 31 December 2016, was calculated at **R 2,263,687,349**, excluding VAT. A summary of the premature closure cost is included in the table below.

Main reasons for the change in closure cost are:

- Escalation of the demolition and rehabilitation rates from the 2015 rate to 2016 with 6.1%, in line with the Consumer Price Index (CPI) as calculated by the South African Reserve Bank (SARB).
- Life of Mine was changed from 2030 to 2031.
- The cost for the backfilling of the Western Waste Rock Dumps (WWRD) was removed and changed to slope redesign for rehabilitation.

Table 1: Premature closure cost estimate

	Closure cost
1 Rehabilitation / Restoration provision Total	R 1,332,201,065
2 Decommission provision (Sishen excl. SEP)	R 273,939,908
3 Decommission provision (Total only SEP)	R 40,986,355
4 Contingencies and consultants' fees	R 616,560,020
GRAND TOTAL - SISHEN & SEP	**R 2,263,687,349**

Closure risk profile: The risks envisaged can be managed to ensure an acceptable end land use. Where a level of uncertainty exists, these risks have been rated as high. The tables below contain a summary of the pre- and post-mitigation risks.

Table 2: Summary of premature closure risks

Risk category	**Premature closure impact rating (pre-mitigation)**							**Total**
	Health	**Safety**	**Environment**	**Financial**	**Reputation**	**Social**	**Legal**	**Max rating**
Insignificant risks	7	3	4	19	11	18	11	**3**
Uncertain risks	15	29	47	55	47	43	51	**66**
Potential significant risks	7	9	55	29	30	17	26	**72**
Total risk frequency	**29**	**41**	**106**	**103**	**88**	**78**	**88**	**141**

Table 3: Summary of post-mitigation risks

Risk category	LOM closure impact rating (post-mitigation)							Total
	Health	Safety	Environment	Financial	Reputation	Social	Legal	Max rating
Insignificant risks	19	22	39	61	46	47	45	**52**
Uncertain risks	10	14	48	36	38	27	36	**69**
Potential significant risks	0	5	19	6	4	4	7	**20**
Total risk frequency	**29**	**41**	**106**	**103**	**88**	**78**	**88**	**141**

The potential significant post-mitigation risks relate to:

- Erosion,
- Loss of land capability / agricultural land,
- Accumulated waste on site,
- Fire,
- Loss of biodiversity,
- Uncontrolled access to site (safety concern),
- Surface– and groundwater impacts,
- Inadequate post-closure management / unsustainable farming, and
- Inadequate closure planning.

Initial regulatory engagement for the closure process will be conducted as part of the public participation process of the Sishen Mine Expansion Project: Environmental Impact Assessment process. During the public participation meeting, the following should be communicated:

- The closure vision and associated objectives;
- The proposed final land use; and
- Plans with regards to the future use of infrastructure and equipment.

A closure gap analysis was conducted per the Anglo American Mine Closure Toolbox (AAMCT) gap analysis tool. The results show that this closure plan is still at Preliminary stage, however, since Life of Mine is 2031, the closure plan should be updated to a Draft Closure Plan. An action plan was compiled, that identifies steps and responsibilities towards closing the gaps and reaching Draft status.

APPLICANT AND ENVIRONMENTAL ASSESSMENT PRACTITIONER

Details of the applicant

Name of Mine	Sishen Iron Ore Mine
Applicant	Sishen Iron Ore Company (Pty) Ltd (SIOC), Trading as Sishen Iron Ore Mine
Postal Address	Sishen Iron Ore Mine PO Box 9679 Centurion 0046
Responsible Person	Werner Voigt
Telephone Number	(053) 739 2821
Facsimile Number	053 739 2058
Cell Phone Number	083 417 8306
E-Mail Address	werner.voigt@angloamerican.com
Company Registration No.	2000 011 085 07

Details of the EAP

Name of the Practitioner: Shangoni Management Services: Jan Nel / Emma Fourie
Tel No.: (012) 807 7036
Fax No.: (012) 807 1014
E-mail address: jan@shangoni.co.za / emma@shangoni.co.za

Expertise of the EAP

Name	Qualifications	Summary of experience
Jan Nel	M.Sc. Environmental Management (UFS)	Jan Nel has been actively involved for the past 16 years in environmental management within the mining industry, providing assistance with EMP Compliance, Environmental Impact Assessments (EIA), Financial Provision Calculations, Closure Plans, Rehabilitation Plans, Environmental Management Programme Reports (EMP) and EMP Performance Assessments. Jan is the Technical Director: Rehabilitation and Closure at Shangoni.
Emma Fourie	B.Sc. (Hons): Geography and Environmental Management	Emma obtained a B.Sc. Hons degree in Environmental Management from the University of North West (Potchefstroom). She gained international exposure

Name	Qualifications	Summary of experience
		through participation in Finnish and Russian environmental management courses and conferences in 2010. Emma compiles Closure Plans, Rehabilitation Plans and Financial Provision calculations and reports. She also has experience in EIA, EMP compilation and EMP Performance Assessments.

DEFINITIONS

Concurrent rehabilitation	Rehabilitation that occurs during the process of mining as the ore body is mined out in parts of a mine
Environment	The surroundings (bio-physical, social and economic) within which humans exist and that are made up of: the land, water and atmosphere of the earth; micro-organisms, plant and animal life; any part or combination of (i) and (ii) and the interrelationships among and between them; and the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing.
Environmental Aspects	Elements of an organisation's activities, products or services that can interact with the environment.
Environmental Degradation	Refers to pollution, disturbance, resource depletion, loss of biodiversity, and other kinds of environmental damage usually refers to damage occurring accidentally or intentionally as a result of human activities.
Environmental Impacts	Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.
Environmental Impact Assessment	A study of the environmental consequences of a proposed course of action.
Financial Provision	The insurance, bank guarantee, trust fund or cash that applicants for an environmental authorisation must provide in terms of this Act guaranteeing the availability of sufficient funds to undertake the- (a) rehabilitation of the adverse environmental impacts of the listed or specified activities; (b) rehabilitation of the impacts of the prospecting, exploration, mining or production activities, including the pumping and treatment of polluted or extraneous water; (c) decommissioning and closure of the operations; (d) remediation of latent or residual environmental impacts which become known in the future; (e) removal of building structures and other objects; or (f) remediation of any other negative environmental impacts.
Integrated Development Plan (IDP)	A plan aimed at the integrated development and management of a municipal area as contemplated in the Municipal Structures Act (Act 117 of 1998).
Interested and affected parties (IAPs)	A person or an association of persons with a direct interest in a proposed development or existing operation, or who may be affected by such a proposed development or existing operation.
Land use	The various ways in which land may be employed or occupied.
Local community	The communities that live within the same local municipality as that in which the mine is located

Local Economic Development (LED)	The process by which public, business and nongovernmental sector partners work collectively to create better conditions for economic growth and employment generation
Local municipality	A local municipality that shares municipal executive and legislative authority in its area with a district municipality within whose area it falls and which is described in section 155 (1) of the Constitution as a category B municipality.
Mine Closure	This entails the process of decommissioning and rehabilitation at the end of a mine's life leading to the issue of a closure certificate in terms of section 24R of NEMA.
Mine closure certificate	The holder of a prospecting right, mining right, retention permit or mining permit must apply to the Regional Manager for a closure certificate within 180 days of the occurrence of closure. No closure certificate will be issued unless the Chief Inspector and the Department of Water Affairs and Forestry have confirmed in writing that the provisions relating to health and safety and management of potential pollution to water resources have been addressed
Mitigate	Practical measures that are implemented to reduce or avoid negative effects or enhance positive effects of a development action.
Pollution Prevention	Any activity that reduces or eliminates pollutants prior to recycling, treatment, control or disposal.
Portable skills	Technical skills that can be used in a variety of production and operational settings such as welding, plumbing, computer skills, etc. Although the term "portable skills" apply to both generic and technical, the term "portable skills" will be used in this regard to identify technical skills that are transferable across contexts.
Public Participation Process	A process of involving the public in order to identify needs and address concerns, in order to contribute to more informed decision-making relating to a proposed project, programme or development.
Rehabilitation	The process of reshaping and re-vegetating land to restore it to a stable condition with a land-use that is appropriate for the particular location and is not associated with any pollution issues such as water pollution
Rehabilitation plan	Plan describing and detailing the concrete actions that are required to adequately mitigate environmental impacts and achieve rehabilitation outcomes.
Restoration	Restoring full ecosystem services, sustainably
Reparation	Repair the site to a new sustainable land use
Revegetation	Re-establish vegetation cover
Reshaping	Reshape the topography to serve a landscape function
Significance	A subjective judgement of the importance of an impact to an interested or affected party
Sustainable development	The integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that mineral and petroleum resources development serves present and future generations.
Technical skills (or "top-up" skills)	Enhance the workers' occupational performance and which are transferable within the Mining Sector such as skills in rock breaking, production, machine

	maintenance, health and safety, etc. For further reference the term “Sector Transferable Skills” will be used.
Topography	Topography, a term in geography, refers to the "lay of the land” or the physio-geographic characteristics of land in terms of elevation, slope and orientation.
Vegetation	All of the plants growing in and characterising a specific area or region; the combination of different plant communities found there.
Waste land	Abandoned sterile land (unsafe)

ABBREVIATIONS

AAMCT	Anglo American Mine Closure Toolbox
BAP	Biodiversity action plan
CPI	Consumer price index
DEA	Department of Environmental Affairs
DoL	Department of Labour
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
GWCE	Griqualand West Centre of Endemism
GN	Government Notice
I&AP	Interested and Affected Party
IWULA	Integrated Water Use License Application
IWWMP	Integrated Water and Waste Management Plan
LOM	Life of Mine
mamsl	meters above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MHSA	Mine Health and Safety Act
MPRDA	Mineral and Petroleum Resource Development Act
MRA	Mining Right Area
NEMA	National Environmental Management Act, Act 107 of 1998 as amended
NGDB	National Groundwater Database
PES	Present Ecological Status
PM_{10}	Particulate matter with a diameter of a 10µm
PPP	Public Participation Process
RAS	Rives Analysis System
R	Regulation
SABS	South African Bureau of Standards
SANS	South African National Standards
SEAT	Socio-economic assessment toolbox
SLP	Social labour plan
SOER	State of the Environment Report
TDS	Total Dissolved Solids

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1. INTRODUCTION

1.1 Overview and objectives

Shangoni Management Services (Pty) Ltd was appointed by Sishen Iron Ore Company to review and reformat the 2012 closure plan to meet the requirements of the Department of Mineral Resources (DMR) and produce a closure plan for its mining activities at Sishen Mine. The project entails compiling a plan in line with the requirements as stipulated in the Anglo American Closure Toolbox standard. The final product is required to meet the requirements of the NEMA Financial Provision Regulations, 2015. The Preliminary closure plan developed in 2009 was used as the basis for the development of this updated closure plan.

The historical mining phases and proposed phases after cessation are defined below. This closure plan attempts to address the decommissioning, closure and post closure phases.

- Operational phase - 1953 –2031: Mining operations were still active, deposition of slimes and waste rock executed according to mining plan, rehabilitation and demolition of unused structures as per concurrent rehabilitation schedule.
- Decommissioning phase – (2032-2037): Disposal of or demolition of infrastructure, re-vegetation, sloping, remediation of contaminated soil, and finalising agreements with users of infrastructure.
- Closure phase – (2037-2047): This phase will formally commence once all restoration and rehabilitation has been completed in line with the closure plan and rehabilitation schedule. It will also involve managing the mining area to ensure continued achievement of the closure objectives.
- Post closure phase – (2048): Once all the relevant government departments are in agreement with the achievement of the closure objectives and closure success criteria, a closure certificate will be issued to Sishen mine.

The mine and environmental components that may be affected after cessation are contained in Table 4. It is the purpose of this closure plan to identify end use options and management measures for the components, informed by the closure risk assessment (Section 6).

Table 4: Mine components

Physical	Biophysical
1. Mineral waste	**5. Receiving environments**
Tailings facilities	Air quality
Pollution control dams	Visual / Topography
Waste rock dumps	Ground water
Stockpiles	Surface water
Ore dumps	Biodiversity
Open pits	Topsoil / Growth medium
Burrow pits	Vegetation (indigenous)

Physical	Biophysical
2. Non-mineral waste	Vegetation (alien invasive)
Dirty water control dams	Drought
Domestic waste site	Fire
Hazardous waste site	**6. Land use**
Polluted areas (soils)	Biodiversity important areas
Building rubble	Active farms (game / livestock)
Metal waste	Recreational areas
Tyre waste	Disturbed open areas
Radio-active waste	Undisturbed open areas
	Sterilised land
3. Built infrastructure	Cultural, Archaeological, Paleontological, Meteorite significant areas
Processing plant areas	
Workshop areas	
Office areas	
Electrical substations	
Fuelling stations and depots	
Explosives magazine	
Mine towns / housing / schools	
4. Surface infrastructure	
Roads	
Conveyors	
Railways	
Electrical power lines	
Telephone lines	
Pipelines	
Weirs, canals, berms	
Fences	
Off-site infrastructure	

1.2 Mine background

Sishen Mine is an established open pit operation, which is a wholly owned subsidiary of Kumba Iron Ore managed by Anglo American plc. Sishen Mine is located in the Northern Cape Province of South Africa, about 280 km north-west of Kimberley and close to the town of Kathu. The town of Dingleton is located on the western side of the mine. The locality of the mine is indicated in Figure 2.

Sishen mine is one of the largest open pit mines producing iron ore in the world. Mining at Sishen is carried out as part of Anglo American's Kumba Iron ore operation. The mine accounts for the majority of Kumba's iron ore production, with the bulk of the iron ore being exported to the international market. The ore from the opencast pit is transported to the beneficiation plant where it is crushed, screened and beneficiated through dense media separation and Jig technology.

Sishen Mine was established in 1954 primarily to provide ore for consumption at domestic steel mills. From 1953 to 1975, SIOM supplied only the South African Steel industry with hematite ore. Further exploration programmes led to a significant increase in the resource base, increased production, and also created the world's fourth largest supplier of iron ore.

The first ore from the mine was exported in 1976 via the Sishen-Saldanha Iron Ore Export Channel (IOEC) to the Saldanha port. More than 900 million tonnes (mt) of iron ore has been produced over the 60 years of the mine's operation. The life of Sishen mine is currently estimated to be 2031 (LOM Plan, November 2015).

ISCOR Ltd, the South African Iron and Steel Industrial Corporation was founded in 1928 as a state-owned entity. In 1989, ISCOR was privatised and listed on the JSE. Kumba Resources was formed when a major restructuring of the business took place in 2001. Later Anglo American acquired a majority stake in Kumba Resources. Kumba Resources re-organised and Kumba Iron Ore and Exxaro were born. The iron mining assets were retained by Kumba Iron Ore. A subsidiary company of Kumba Iron Ore, the Sishen Iron Ore Company (SIOC), is the registered owner of the prospecting and mining permits.

The majority of the mine’s employees come from the neighbouring settlements of Kathu, Sesheng, Mapoteng, Dingleton, and also further afield from places such as Kuruman, Vryburg, and Upington. Sishen Mine has a policy of employing local people, although necessary expertise may be sourced from further away and outside the province.

Sishen Mine falls under the jurisdiction of the Kgalagadi District Municipality (Kgalagadi DM). The Kgalagadi DM is divided into four local municipalities, namely, Gamagara Local Municipality (Gamagara LM), Ga-Segonyana Local Municipality, Moshaweng Local Municipality, and the District Management Area (DMA). Kumba Iron Ore falls under the jurisdiction of the Gamagara Local Municipality. The Kgalagadi DM is a trans-boundary (North West/Northern Cape Province) district municipality, situated on South Africa’s border with Botswana. The Siyanda District Municipality is situated to its west and south, and the North West Province to its east.

Most of the Sishen Iron Ore Company (SIOC) property at Sishen Mine lies at approximately 1200 m above sea level. The N14 National Road passes to the south and east of the site. The farm portions which make up the Mining Right Area (MRA) area, are located to the south and south-west of the existing Sishen Mine (Sishen Complex EMPR Final, 2011).

The current regional land use includes livestock farming, tourism, and cultivated produce along the Gamagara River. The local land use in surrounding Sishen comprises of low density livestock grazing.

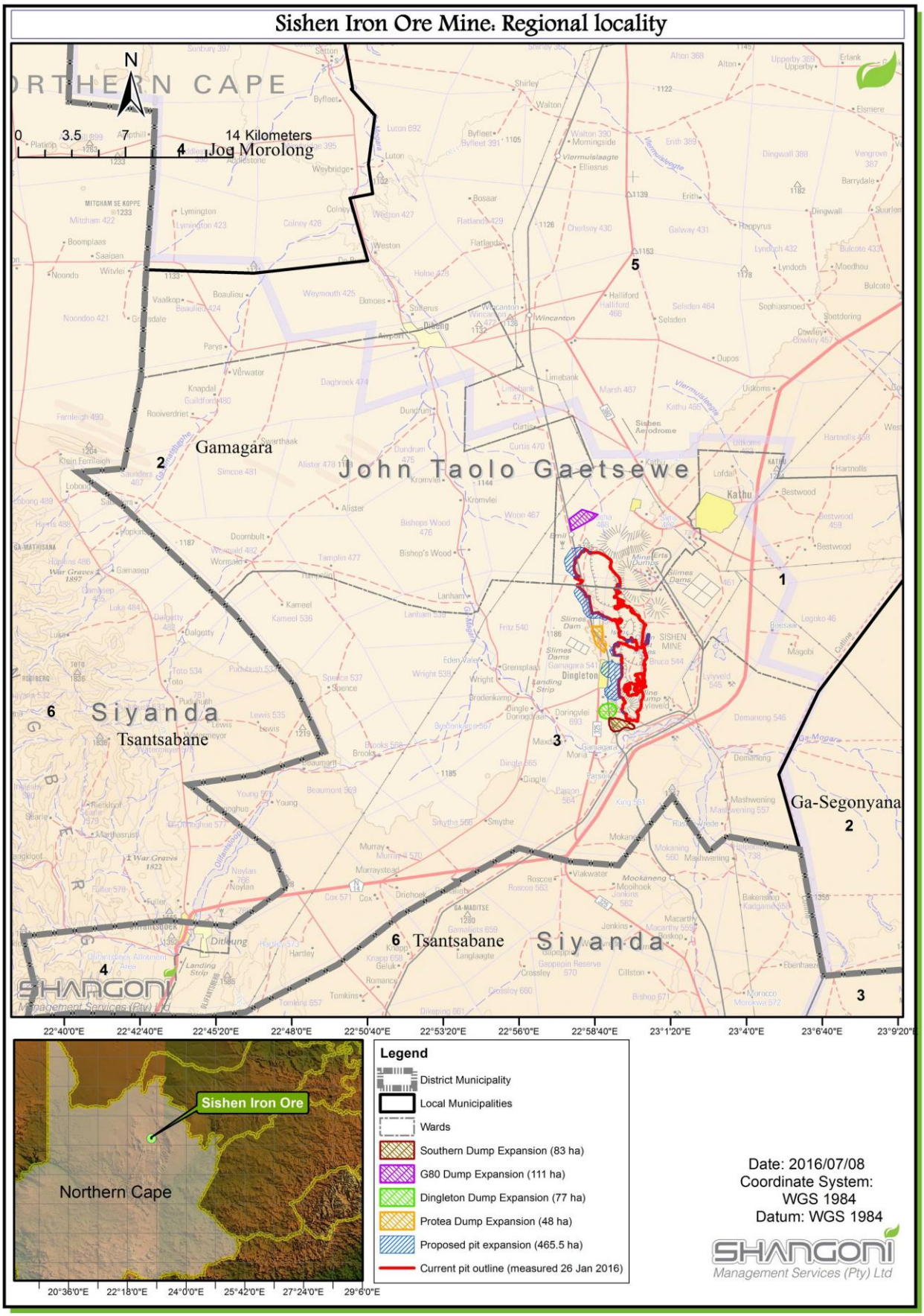

Figure 2: Regional setting of Sishen Mine

1.3 Closure plan development to date

Closure cost rehabilitation investigations commenced in the 1980's at Sishen Mine, and a closure trust fund was established in 1991. In 2001, an environmental closure risk assessment at a screening level was conducted (Sishen Closure Costing, 2001, Pulles, Howard & de Lange Inc. and SRK Consulting (Pty) Ltd). At that stage a closure cost estimate was made for both the immediate as well as the LOM closure scenarios and included in the 2002 EMPR. This estimate was escalated annually by the mine for the period 2002 to 2007 to calculate the liability for mine closure based on the two scenarios. In 2008 an updated Closure Plan was compiled by African EPA (Preliminary Mine Closure Plan – Physical Components, 2008). This report dealt specifically with the assessment of infrastructure and dump rehabilitation costs. In 2009 a further update of the Closure Plan was compiled by Lidwala Environmental (Preliminary Mine Closure Plan, 2009). This report focussed on the bio-physical and social aspects of mine closure and also served to integrate the 2008 report by African EPA with the outcomes of the work done by Lidwala Environmental.

The Preliminary Mine Closure Plan of 2009 compiled by Lidwala Environmental was submitted to DMR as part of the EMPR Consolidation in February 2014 (pending approval).

Sishen Mine's original closure costing of 2001 (Pulles, Howard & de Lange and SRK Consulting) was therefore updated in 2008 (African EPA) and 2009 (Lidwala Environmental). A further update of the closure costing followed in 2012 when Onno Fortuin Consulting compiled a more detailed costing model. These costs have been incorporated in the annual update of the closure provision as submitted annually to DMR.

Between the period 2008 to date the closure provision has also been updated for projects for which individual EMPR's have been approved by the DMR (e.g. Lylyveld South – 2010, Western Waste Rock Stockpiles – 2012 and new HME Filling Station – 2014).

This Closure Plan therefore represents and integration of all previous Closure Plans compiled for Sishen Mine and similarly the closure cost presented herein reflects the updated closure cost as at end 2016.

1.4 Approach and methodology

The process followed to develop this updated Closure Plan for Sishen Mine was based on the relevant requirements of the Mineral and Petroleum Resources Development Act No. 28 of 2002 (MPRDA) and associated regulations as mentioned in Section 2 of this document. Appendix 4 of the Financial Provision Regulations (GN. No. R. 1147 in terms of the National Environmental Management Act (NEMA)), were also taken into account during development of this Preliminary Closure Plan. In addition,

guidance was taken from the Anglo American (AAplc) Mine Closure Toolbox. The approach prescribed by the Mine Closure Toolbox is shown in Figure 3. The process entailed the following:

1. Tool 1: Strategic planning for mine closure

Through this Tool basic expectations were identified, baselines of social, environmental and economic knowledge were gathered and a specific post-closure vision was identified through focused engagement, acknowledging that this is likely to change over the life of the mine.

2. Tool 2: Rapid assessment of the status of a mine's existing closure plan

This Tool identifies knowledge gaps in the mine's existing closure plan and defines what level of detail the closure plan should contain relative to the remaining time to closure.

3. Tool 3: Filling the gaps in the closure plan

Through this Tool the approach, technology and resources required to close the gaps are determined and scheduled.

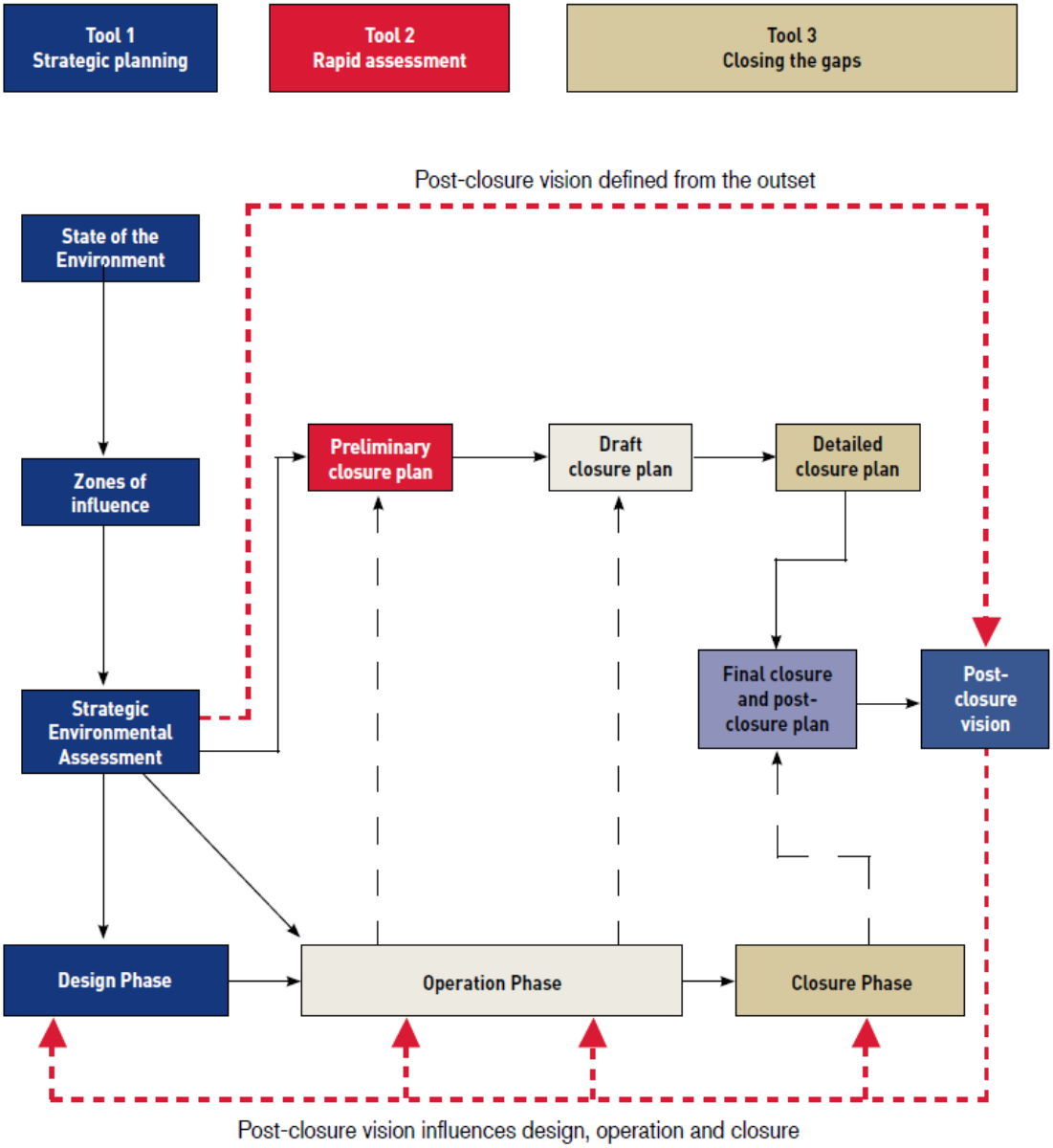

Figure 3: AAPlc MCT approach in developing a mine closure plan

1.5 Structure of this Preliminary Mine Closure Plan

Appendix 4 of the Financial Provision Regulations, 2015 under the NEMA, 1998, lists aspects that must be included in Closure Plans. Table 5 indicates the sections where information has been provided as part of this Closure Plan:

Table 5: Contents of a Closure Plan in terms of Appendix 4 of the NEMA Financial Provision Regulations, 2015

(a) details of— (i) the person or persons that prepared the plan; (ii) the professional registrations and experience of the preparers;	Provided above

(b) the context of the project, including— (i) material information and issues that have guided the development of the plan;	Section 1 – Introduction and project background Section 2 – Closure legislating and other requirements
(ii) an overview of— (aa) the environmental context, including but not limited to air quality, quantity and quality of surface and groundwater, land, soils and biodiversity; and (bb) the social context that may influence closure activities and post-mining land use or be influenced by closure activities and post-mining land use;	Section 3 – Description of Sishen Mine Section 4 – State of Environment
(iii) stakeholder issues and comments that have informed the plan;	Section 8.8 – Social closure cost assessment
(iv) the mine plan and schedule for the full approved operations, and must include— (aa) appropriate description of the mine plan; (bb) drawings and figures to indicate how the mine develops; (cc) what areas are disturbed; and (dd) how infrastructure and structures (including ponds, residue stockpiles etc.) develops during operations;	Section 3 – Description of Sishen Mine
(c) findings of an environmental risk assessment leading to the most appropriate closure strategy, including— (i) a description of the risk assessment methodology including risk identification and quantification, to be undertaken for all areas of infrastructure or activity or aspects for which a holder of a right or permit has a responsibility to mitigate an impact or risk at closure; (ii) an identification of indicators that are most sensitive to potential risks and the monitoring of such risks with a view to informing rehabilitation and remediation activities; (iii) an identification of conceptual closure strategies to avoid, manage and mitigate the impacts and risks; (iv) a reassessment of the risks to determine whether, after the implementation of the closure strategy, the residual risk has been avoided and / or how it has resulted in avoidance, rehabilitation and management of impacts and whether this is acceptable to the mining operation and stakeholders; and (v) an explanation of changes to the risk assessment results, as applicable in annual updates to the plan;	Section 6 – Closure risk assessment and criteria
(d) design principles, including— (i) the legal and governance framework and interpretation of these requirements for the closure design principles; (ii) closure vision, objectives and targets, which objectives and targets must reflect the local environmental and socio-economic context and reflect regulatory and corporate requirements and stakeholder expectations;	Section 5 – Closure vision, objectives and final land use

(iii) a description and evaluation of alternative closure and post closure options where these exist that are practicable within the socioeconomic and environmental opportunities and constraints in which the operation is located; (iv) a motivation for the preferred closure action within the context of the risks and impacts that are being mitigated; (v) a definition and motivation of the closure and post closure period, taking cognisance of the probable need to implement post closure monitoring and maintenance for a period sufficient to demonstrate that relinquishment criteria have been achieved; (vi) details associated with any on-going research on closure options; (vii) a detailed description of the assumptions made to develop closure actions in the absence of detailed knowledge on site conditions, potential impacts, material availability, stakeholder requirements and other factors for which information is lacking;	
(e) a proposed final post-mining land use which is appropriate, feasible and possible of implementation, including— (i) descriptions of appropriate and feasible final post-mining land use for the overall project and per infrastructure or activity and a description of the methodology used to identify final post-mining land use, including the requirements of the operations stakeholders; (ii) a map of the proposed final post-mining land use;	Section 5 – Closure vision, objectives and final land use
(f) closure actions, including— (i) the development and documenting of a description of specific technical solutions related to infrastructure and facilities for the preferred closure option or options, which must include all areas, infrastructure, activities and aspects both within the mine lease area and off of the mine lease area associated with mining for which the mine has the responsibility to implement closure actions; (ii) the development and maintenance of a list and assessment of threats and opportunities and any uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty;	Section 13 – Closure implementation plan
(g) a schedule of actions for final rehabilitation, decommissioning and closure which will ensure avoidance, rehabilitation, management of impacts including pumping and treatment of extraneous water — (i) linked to the mine works programme, if greenfields, or to the current mine plan, if brownfields; (ii) including assumptions and schedule drivers; and (iii) including a spatial map or schedule, showing planned spatial progression throughout operations;	Section 13 – Closure implementation plan

(h) an indication of the organisational capacity that will be put in place to implement the plan, including— (i) organisational structure as it pertains to the plan; (ii) responsibilities; (iii) training and capacity building that may be required to build closure competence;	Section 13 – Closure implementation plan
(i) an indication of gaps in the plan, including an auditable action plan and schedule to address the gaps;	Section 12 - Gap analysis / opportunities / recommendations
(j) relinquishment criteria for each activity or infrastructure in relation to environmental aspects with auditable indicators;	Section 7 – Closure success criteria
(k) closure cost estimation procedure, which ensures that identified rehabilitation, decommissioning, closure and post-closure costs, whether on-going or once-off, are realistically estimated and incorporated into the estimate, on condition that— (i) cost estimates for operations, or components of operations that are more than 30 years from closure will be prepared as conceptual estimates with an accuracy of ± 50 percent. Cost estimates will have an accuracy of ± 70 percent for operations, or components of operations, 30 or less years (but more than ten years) from closure and ± 80 percent for operations, or components of operations ten or less years (but more than five years) from closure. Operations with 5 or less years will have an accuracy of ± 90 percent. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy; (ii) the closure cost estimation must include— (aa) an explanation of the closure cost methodology; (bb) auditable calculations of costs per activity or infrastructure; (cc) cost assumptions; (iii) the closure cost estimate must be updated annually during the operation's life to reflect known developments, including changes from the annual review of the closure strategy assumptions and inputs, scope changes, the effect of a further year's inflation, new regulatory requirements and any other material developments; and	Section 8 – Closure cost assessment
(l) monitoring, auditing and reporting requirements which relate to the risk assessment, legal requirements and knowledge gaps as a minimum and must include— (i) a schedule outlining internal, external and legislated audits of the plan for the year, including— (aa) the person responsible for undertaking the audit(s); (bb) the planned date of audit and frequency of audit;	Section 10 – Closure monitoring and maintenance

(cc) an explanation of the approach that will be taken to address and close out audit results and schedule; (ii) a schedule of reporting requirements providing an outline of internal and external reporting, including disclosure of updates of the plan to stakeholders; (iii) a monitoring plan which outlines— (aa) parameters to be monitored, frequency of monitoring and period of monitoring; (bb) an explanation of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities; and	
(m) motivations for any amendments made to the final rehabilitation, decommissioning and mine closure plan, given the monitoring results in the previous auditing period and the identification of gaps as per 2(i).	Section 12.5 – Updating requirements of this plan

2. CLOSURE REQUIREMENTS

The South African constitutional and common law require mines to conduct their "operational and closure activities with due diligence and care for the rights of others". The constitutional right to an environment which is not harmful to his/her health and well-being supersedes all other legislation (Swart 2003). This section aims to summarise the main legislation regarding mine closure.

2.1 Legal Requirements

The following statutory acts are applicable to mine closure:

- The National Environmental Management Act (NEMA) (Act 107 of 1998);
- The Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002);
- The National Water Act (NWA) (Act 36 of 1998);
- The Mine Health and Safety Act (MHSA) (No. 29 of 1996);
- Labour Relations Act (66) of 1995 as amended, (LRA);
- Basic Conditions of Employment Act (BCEA) of 1997; and
- The Mineral and Petroleum Resources Development Act (MPRDA), 2002 through the Mining Charter as outlined in Regulation 46(d) of the Social and Labour Plan (SLP).

The controlling legislation is NEMA and its regulations in which the closure process is prescribed. However, many compliance requirements originate from the MPRDA and the National Water Act. The Environmental Conservation Act has limited application to mines and is applicable mainly in terms of disposal of hazardous wastes. The interaction between various Acts of parliament that deal with the environment is varied and complex, as is the range of environmental issues that are regulated. This discussion is limited to those aspects considered most directly related to this closure cost assessment and is by no means a complete summary of all applicable environmental legislation nor is it a compliance register.

The mine closure principles that will govern the process of closure are derived from the mine closure policy of the Department of Mineral Resources (DMR, 1998) namely:

- The safety and health of humans and animals are safeguarded from hazards resulting from mining operations.
- Environmental damage or residual environmental impacts are minimised to such an extent that it is acceptable to all involved parties.
- The land is rehabilitated to, as far as is practicable, its natural state, or to a predetermined and agreed standard or land use which conforms to the concept of sustainable development.
- The physical and chemical stability of the remaining structures should be such that risk to the environment is not increased by naturally occurring forces to the extent that such increased risk cannot be contended with by the installed measures.

- The optimal exploitation and utilisation of South Africa's mineral resources are not adversely affected.
- Mines are closed efficiently and cost effectively.
- Mines are not abandoned but closed in accordance with this policy.

2.1.1 The National Environmental Management Act (NEMA)

Mine closure is addressed in the National Environmental Management Act (Act No. 107 of 1998) as amended in 2009, in Section 24R, in the following terms:

24R (1) Every holder, holder of an old order right and owner of works remain responsible for any environmental liability, pollution or ecological degradation, the pumping and treatment of extraneous water, the management and sustainable closure thereof until the Minister of Minerals and Energy has issued a closure certificate in terms of the Mineral and Petroleum Resources Development Act, 2002, to the holder or owner concerned.

(2) When the Minister of Minerals and Energy issues a closure certificate, he or she must return such portion of the financial provision contemplated in section 24P as the Minister may deem appropriate to the holder concerned, but may retain a portion of such financial provision for any latent and or residual environmental impact that may become known in the future.

(3) Every holder, holder of an old order right or owner of works must plan, manage and implement such procedures and requirements in respect of the closure of a mine as may be prescribed.

(4) The Minister may, in consultation with the Minister of Minerals and Energy and by notice in the Gazette, identify areas where mines are interconnected or their impacts are integrated to such an extent that the interconnection results in a cumulative impact.

(5) The Minister may, by notice in the Gazette, publish strategies in order to facilitate mine closure where mines are interconnected, have an integrated impact or pose a cumulative impact.

Duty of care and remediation of environmental damage is addressed in Section 28 of the Act, where it is stated that:

(1) Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.

Section 32 and 33 of the Act discusses judicial matters, whereby citizens are responsible for enforcing environmental laws. Private prosecution also applies if a person is aware of a breach of the Act.

Decommissioning of a mine is a listed activity in terms of activity 22 of the Environmental Impact Assessment Regulations Listing Notice 1 of 2014. The activity is listed as follows:
The decommissioning of any activity requiring -
(i) a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002); or
(ii) a prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure.

The NEMA Financial Provisioning Regulations, 2015 (as amended 2016), came into effect on the 20th of November 2015. The purpose of these regulations is to regulate the determination and making of financial provision for the costs associated with the undertaking of management, rehabilitation and remediation of environmental impacts from prospecting, exploration, mining or production operations through the lifespan of such operations and latent or residual impacts that may become known in the future.

2.1.2 The Mineral and Petroleum Resources Development Act

This act describes the legal framework for mine closure planning.

In terms of section 43(1) of the MPRDA, the holder of a prospecting right, mining right, retention permit or mining permit remains responsible for any environmental liability, pollution or ecological degradation, and the management thereof, until the Minister has issued a closure certificate to the holder concerned.

An application for a closure certificate must be made to the Regional Manager in whose region the land in question is situated within 180 days of the occurrence of the lapsing, abandonment, cancellation, cessation, relinquishment or completion contemplated in section 43(3) and must be accompanied by the prescribed environmental risk report. The environmental risk assessment (ERA) process to be followed during the development of the mine closure report is prescribed in Regulation 60 of the regulations published under the new MPRDA (GN 527, 23 April 2004).

Section 43(5) of the Act also stipulates that no closure certificate may be issued unless the Chief Inspector and the Department of Water Affairs and Forestry have confirmed in writing that the provisions pertaining to health and safety and management of potential pollution to water resources have been addressed.

The removal of buildings, structures and other objects is addressed in Section 44 of the Act in the following terms:

(1) When a prospecting right, mining right, retention permit or mining permit lapses, is cancelled or is abandoned or when any prospecting or mining operation comes to an end, the holder of any such right or permit may not demolish or remove any building, structure or object—

(a) which may not be demolished or removed in terms of any other law;

(b) which has been identified in writing by the Minister for purposes of this section; or

(c) which is to be retained in terms of an agreement between the holder and the owner or occupier of the land, which agreement has been approved by the Minister in writing.

(2) The provision of subsection (1) does not apply to bona fide mining equipment, which may be removed.

The following regulations regarding closure have been published under the MPRDA:

Principals for mine closure under Regulation 56 stipulates that the holder of a prospecting right, mining right, retention permit or mining permit must ensure that the closure process is incorporated throughout Life of Mine, environmental risks and impacts, including residual and latent risks, must be quantified and adequately managed. Furthermore, safety and health requirements should be met according to the Mine Health and Safety Act of 1996, disturbed land should be rehabilitated for sustainable use and all operations have to be closed cost effectively and efficiently.

An application for a closure certificate should be accompanied by the following, according to Regulation 57:

- A Closure plan as contemplated in Regulation 62;
- An environmental risk report according to Regulation 60; and
- A final EMP performance assessment.

2.1.3 National Water Act (NWA)

The NWA controls the use of water in South Africa. It should be noted that government is the custodian of all water resources in South Africa. Mining activities which lead to the pollution of a water resource require permitting, and it is unlawful to pollute water without a water use permit which makes provision for this (pollution of water is regarded as a water use) and without following the conditions which are applicable to the specific water use and which should be included in such a permit. The regulations on the use of water for mining and related activities aimed at the protection of water resources were published in the Government Notice No. 704 on June 1999. (Government Gazette No. 20119). A guideline document - Operational Guideline No. M6.1 - has been developed to aid the implementation of these regulations.

With regard to the issue of mine closure, the interpretation of the NWA is still somewhat unclear insofar as the NWA does not make provision for the transfer of liability associated with water pollution to the State. However, as Section 43(5) of the MPRDA ensures that mine closure requires the written approval from DWA, it can be assumed that such an endorsement of mine closure will entail some acceptance

of post-closure liability by DWA. It can also be expected, however, that such approval from DWA will only be forthcoming if strict procedural requirements have been met.

2.1.4 Mine Health and Safety Act

The Mine Health and Safety Act (No. 29 of 1996) provides for the health and safety of employees and other persons at mines. Mine closure is addressed in the following regulations:

2(2) The employer of a mine that is not being worked, but in respect of which a closure certificate in terms of the Minerals and Petroleum Resources and Development Act has not been issued, must take reasonable steps to continuously prevent injuries, ill-health, loss of life or damage of any kind from occurring at or because of the mine.

2.2 Corporate requirements

2.2.1 Policies

The Good Citizenship Business Principles of Anglo American is the principle document and a guiding policy document that Sishen prescribes to. The policies applicable to Sishen include the Anglo American Biodiversity Policy, the Anglo American Corporate Safety Health and Environmental Policy, and the Sishen Safety Health and Environmental (SHE) Policy. The SHE policy is in line with the requirements of ISO 14001 and OSHAS 18001 management systems.

2.2.2 The Anglo Environment Way

Anglo American has developed the Anglo Environment Way (AEW) to meet commitments towards the protection and management of environmental impacts at its operations. The Anglo American Plc. Executive Committee has endorsed and committed to the implementation of the AEW as the governing framework for the management of environmental impacts. The AEW is based on the commitment to Anglo American's "Good Citizenship: Our Business Principles", which should be complied with by all divisions and managed operations of the company.

2.2.3 The Anglo American Mine Closure Toolbox Kit

Anglo American has launched its Mine Closure Toolbox in an effort to ensure that it leaves a positive environmental, social and economic legacy. The tool is designed for use in conjunction with the SEAT and other tools developed to support sustainable development planning, risk assessment and project evaluation. Use of the toolbox will help operations to comply with the requirements of the Anglo Mine Closure Performance Standard, which is a part of the AEW.

The toolbox facilitates an iterative and detailed approach to mine closure, ensuring that the full spectrum of opportunities, risks and liabilities is identified. It further ensures that closure plans are fully accounted and provided for, both in the case of LoM closure as well as premature closure. Three separate tools

make up the closure toolbox, namely strategic planning, gap analysis and the identification of required actions to address the identified gaps. The physical, biophysical and socio-economic components of mine closure should be addressed in an integrated manner to ensure confidence in the closure plan. This report applied the Toolbox framework on updating the Sishen Closure plan.

2.2.4 Anglo Socio-Economic Impact Assessment Toolbox (SEAT)

The SEAT process is an evaluation process to determine the socio-economic status of a zone of influence of an operation. It intends to produce benefits for all Kumba operations through an improved understanding of the concerns and priorities of the communities of which they are a part of. Social Closure Impacts are an important aspect of closure management for Anglo American, and the SEAT process is integrated into the Anglo Closure Toolbox towards improving the management of social and economic impacts at operations.

3. DESCRIPTION OF SISHEN MINE

3.1 History

Sishen Mine is a wholly owned subsidiary of Kumba Iron Ore. The mine was established in 1954 primarily providing ore for consumption at domestic steel mills. Further exploration programmes led to a significant increase in the resource base, increased production and also created the world's fourth largest supplier of iron ore. The Sishen Expansion Project (SEP) will extend the mine's life by a further ten years. The Sishen South Project – a new mine south of Kathu and close to Postmasburg – will be operated independently. Most of the mine's employees come from the neighbouring settlements of Kathu, Sesheng, Mapoteng, Dingleton and also further afield from places such as Kuruman, Vryburg and Upington. Sishen Mine has a policy of employing local people although where necessary expertise may be sourced from further away and outside the province.

3.2 Regional setting

Sishen Mine is located in the Northern Cape Province of South Africa, about 230 km north-east of the town of Upington and 280 km north-west of Kimberley. Kathu is situated approximately 8 km north-east of the Sishen Mine and the town of Dingleton is located in the Sishen Mine. Many of the Sishen Mine's labourers are housed in hostels and family units at Sesheng, approximately 5 km north of the mine.

Sishen Mine was established in 1953 and over the past 57 years, comprehensive surface infrastructure has been developed to service the needs of the local population and operations at the mine and neighbouring areas. The primary access to the area is via the north-south running N14 provincial tar road east of the mine. Sishen Mine also has its own airstrip with daily chartered flights during the working week. Iron ore is railed 861 km to the Saldanha export harbour on the west coast of South Africa.

3.3 Local municipality and magisterial district

The site falls within the jurisdiction of the Gamagara Local Municipality (which is under the jurisdiction of the John Taolo Gaetsewe District Municipality) in the Northern Cape Province. The Gamagara Local Municipality is situated in the north-eastern part of the Northern Cape Province, and includes the towns of Kathu, Dingleton and Deben.

3.4 Mining rights

3.4.1 Current mining area

Sishen Iron Ore Company (SIOC) the holder of the mining right relating to this EMPR (Sishen Mining Right) is majority held by Kumba Iron Ore Limited. SIOC produces iron ore at Sishen Mine in the

Northern Cape province and at Thabazimbi Mine in the Limpopo province, and is a supplier of seaborne iron ore, exporting 73% of its 41 million tons per annum production from the Sishen Mine to more than thirty global customers, mainly in Asia and Europe.

The extent of the Sishen mining right area is indicated on Figure 4.

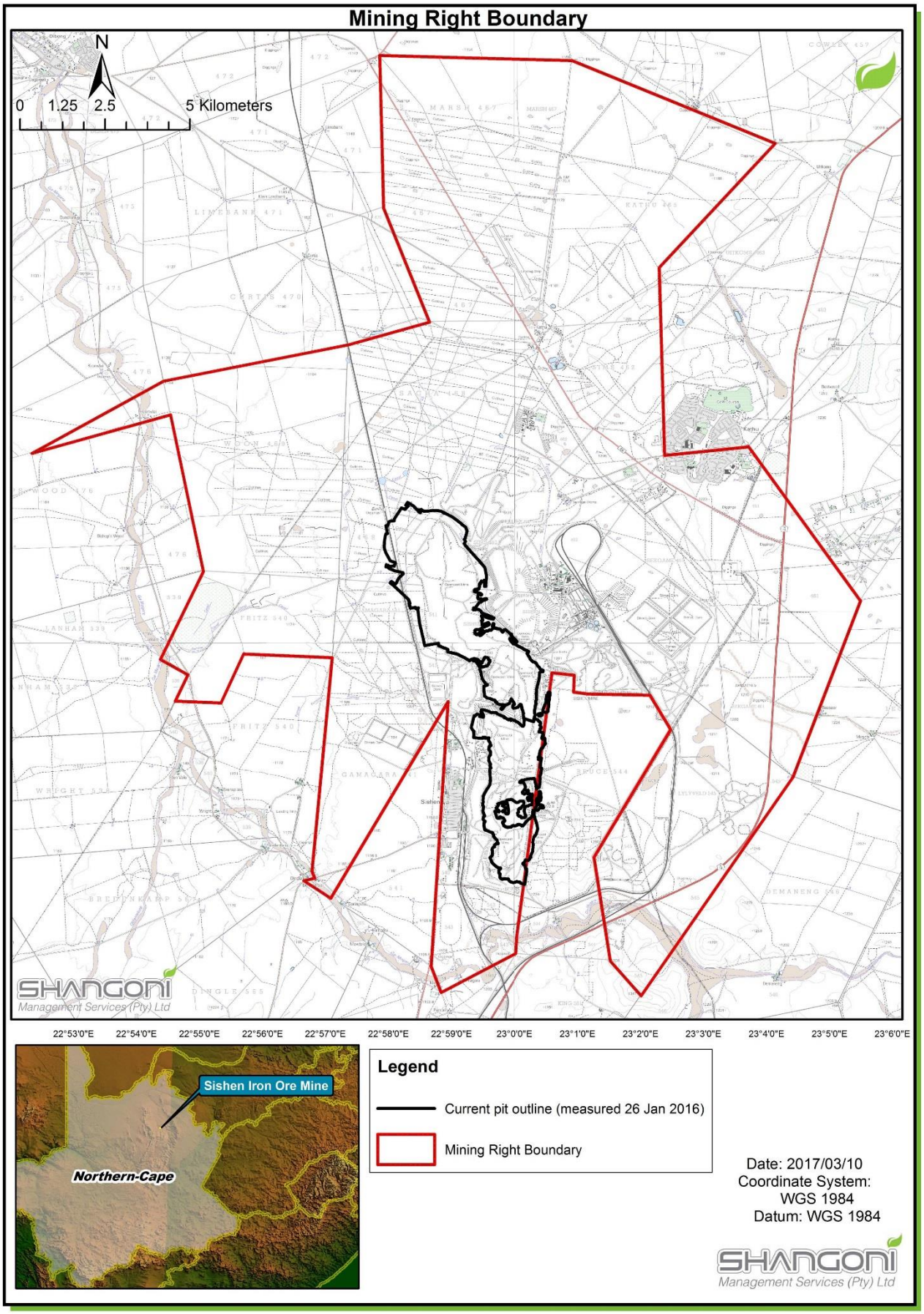

Figure 4: Sishen Mining Right boundary

3.4.2 Proposed mining right area expansion

Sishen Mine has applied for 5 prospecting rights areas to be included into the Sishen Mining right. These properties are located to the south of the current mining rights area and are indicated in Table 6.

Table 6: New areas to be included in the Mining Rights area

Portion	Owner
Surface Rights Holder(S): Sishen 543	
Dingleton Erven 416	Prov Regering V Noord Kaap
Dingleton Erven 417	Prov Regering V Noord Kaap
Dingleton Erven 418	Transnet Ltd
Dingleton Erven 419	Transnet Ltd
Dingleton Erven 420	Transnet Ltd
Dingleton Erven 421	Transnet Ltd
Dingleton Erven 422	Transnet Ltd
Dingleton Erven 423	Fernando Disengomoka
Dingleton Erven 424	Telkom Sa Ltd
Dingleton Erven 426	Gamagara Municipality
Dingleton Erven 493	Gamagara Municipality
Dingleton Erven 548	Gamagara Municipality
Dingleton Erven 549	Speelman Fredrik Jan
Dingleton Erven 550	Nedere Gereform Sendingkerk
Dingleton Erven 551	Gamagara Municipality
Dingleton Erven 569	Gamagara Municipality
Dingleton Erven 679	Christen Gemeentes Dingleton
Dingleton Erven 681	Gamagara Municipality
Surface Rights Holder(S): Gamagara 541	
Gamagara 541 2/	Sishen Iron Ore Company Ltd
Gamagara 541 7/	Poolman George Philipus
Gamagara 541 11/	Transnet Ltd
Gamagara 541 13/	Transnet Ltd
Surface Rights Holder(S): Sishen 543	
Sishen 543 Re/19/	Gamagara Municipality
Sishen 543 24/	Moria Boerdery Cc
Sishen 543 25/	Keyser Jan Jacobus
Surface Rights Holder(S): Parsons 564	
Parsons 564 2/	Assmang Ltd
Parsons 564 6/	Transnet Ltd

Portion	Owner
Surface Rights Holder(S): Fritz 540	
Fritz 540 Re/	Sishen Iron Ore Company Pty Ltd
Fritz 540 Re/2/	Sishen Iron Ore Company Pty Ltd
Fritz 540 4/	Sishen Iron Ore Company Pty Ltd

3.5 Motivation for mining

From 1953 to 1975, Sishen Iron Ore Mine supplied only the South African Steel industry with hematite ore. On completion of the Saldanha rail line and port facilities, production was increased and the first ore was exported in 1976. Sishen currently produces five different ore products, which are sold to all major steel mills across the globe. Stringent physical and chemical specifications are required to compete on the export market and Sishen employs state of the art grade control processes to ensure customer satisfaction. During 2009, 4 Mt of iron ore products from Sishen Mine were consumed by the Arcelor Mittal Steel mills in South Africa (11%), and the rest exported to steel mills in China (58%), Europe (11%) Japan and Korea (20%). (Mining Works Programme, 2014).

The benefits of the Sishen mine include:

- Anglo American Kumba Iron Ore (Kumba) is a major supplier of iron ore to steel mills around the world.
- Kumba aims to make a positive difference in the communities where its mines are located and in labour sending areas by using its skills and resources to conduct business in a way that benefits both communities and Kumba.
- Kumba is cognisant of the important role it plays in these areas and leverages its influence to assist government in uplifting the standard of living of host communities.

3.6 Resources and mine planning

The information in this section was sourced from the Life of Mine Plan Report, dated December 2015.

Mine design

The practical final pit design is based on the optimal pit shell from the approved 2014 Whittle Optimisation. Through a Strategic redesign programme the pushbacks were optimised for practicality (width), ore exposure and flexibility (available face positions) considering the available pit space. The new pit shell resulted in a decrease in reserve of around 87 Mt but a significant reduction in waste of around 780 Mt.

Life of Mine Planning

The Life of Mine Plan for each Mining Right Area is used in the Business Unit Strategy and Mining Right Area Extraction Strategy as inputs for context and direction and be used to inform the Short-Term Mine Business Planning process. It also includes the development of final dump layouts as part of the closure

design for the operation. Planning will ensure the overall practicality of the proposed sequence and designs on an annual perspective. Long Term Plans are generally updated annually to provide the basis for the yearend Reserve Statement and annual BU valuations.

Waste stripping and ore production schedule

Waste is mined according to the revised pushback strategy and pit space limits, and aims to maintain the required levels of exposed ore in the pit.

Figures 5 to 8 below indicate LOM planning as per the 2015 LOM Plan Report.

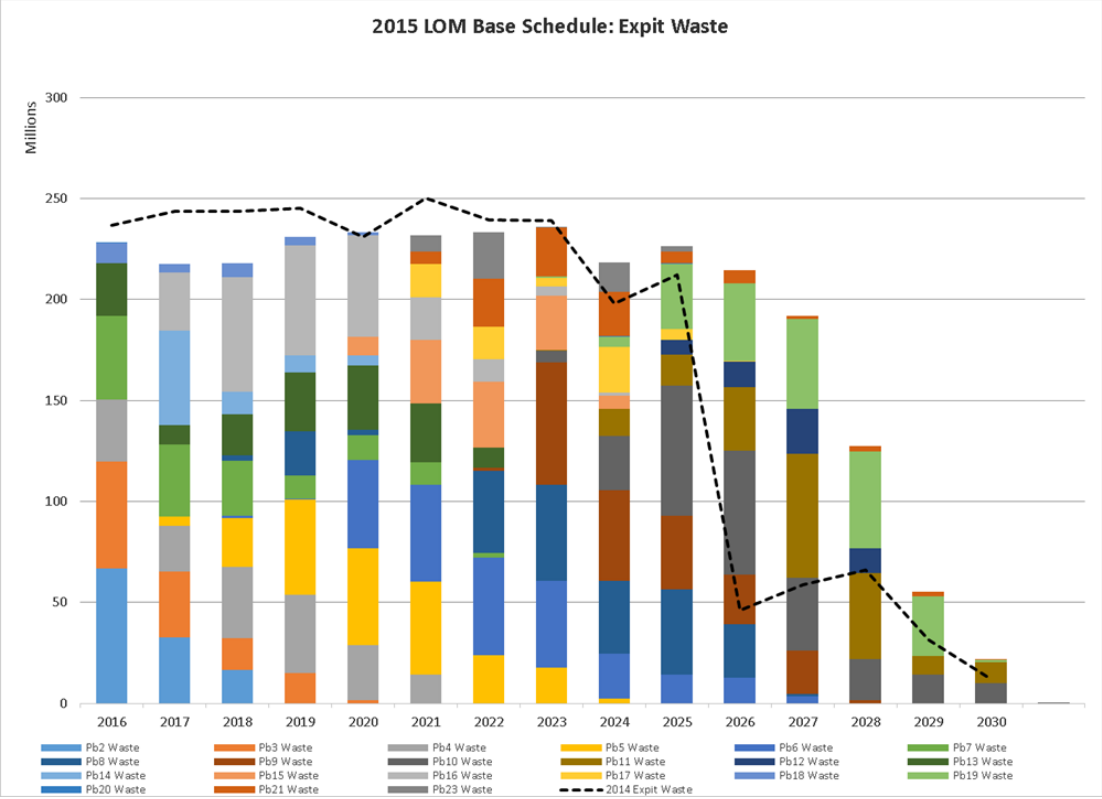

Figure 5: 2015 LoM Ex-pit waste mined

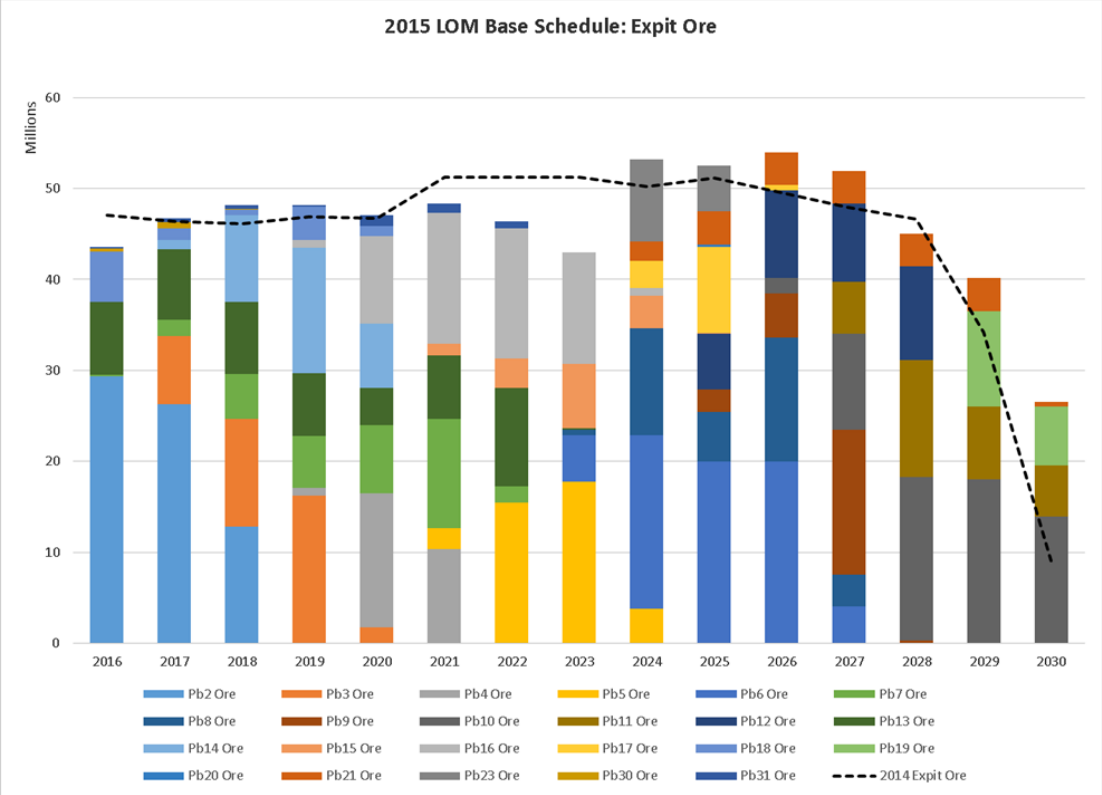

Figure 6: 2015 LoM Ex-pit ore mined

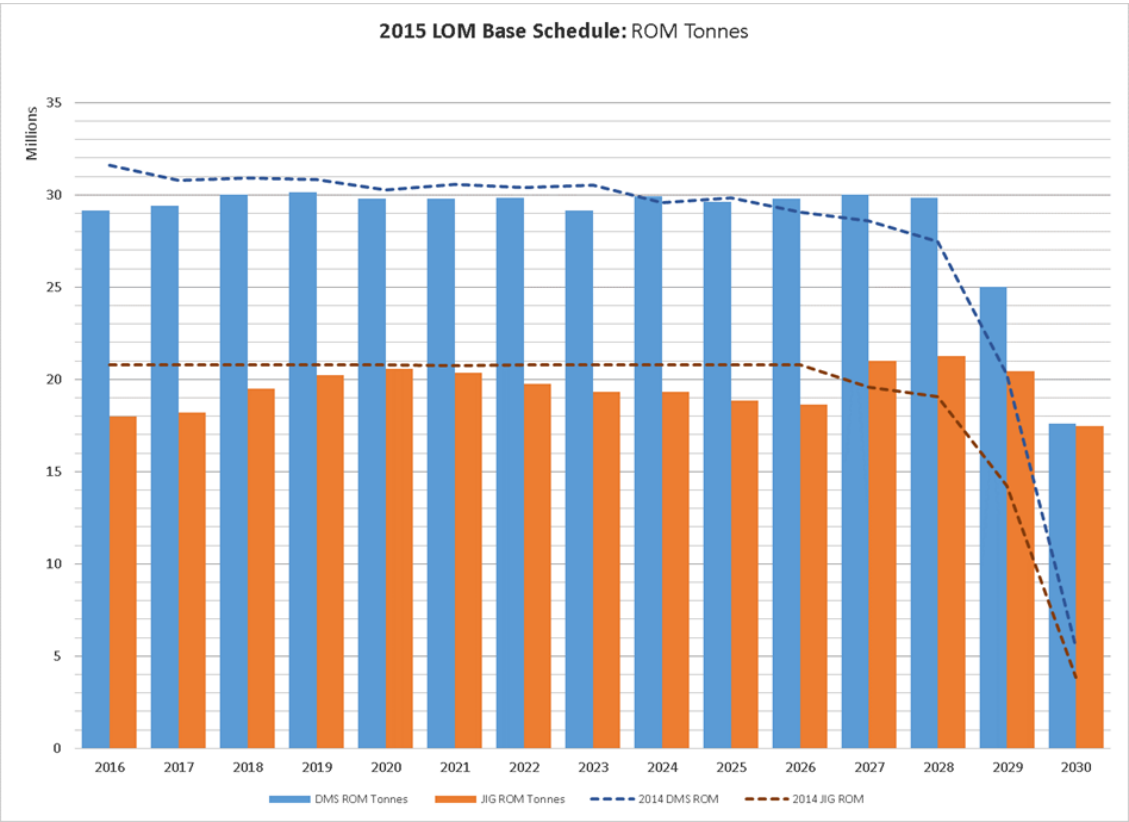

Figure 7: 2015 LoM Ore treated

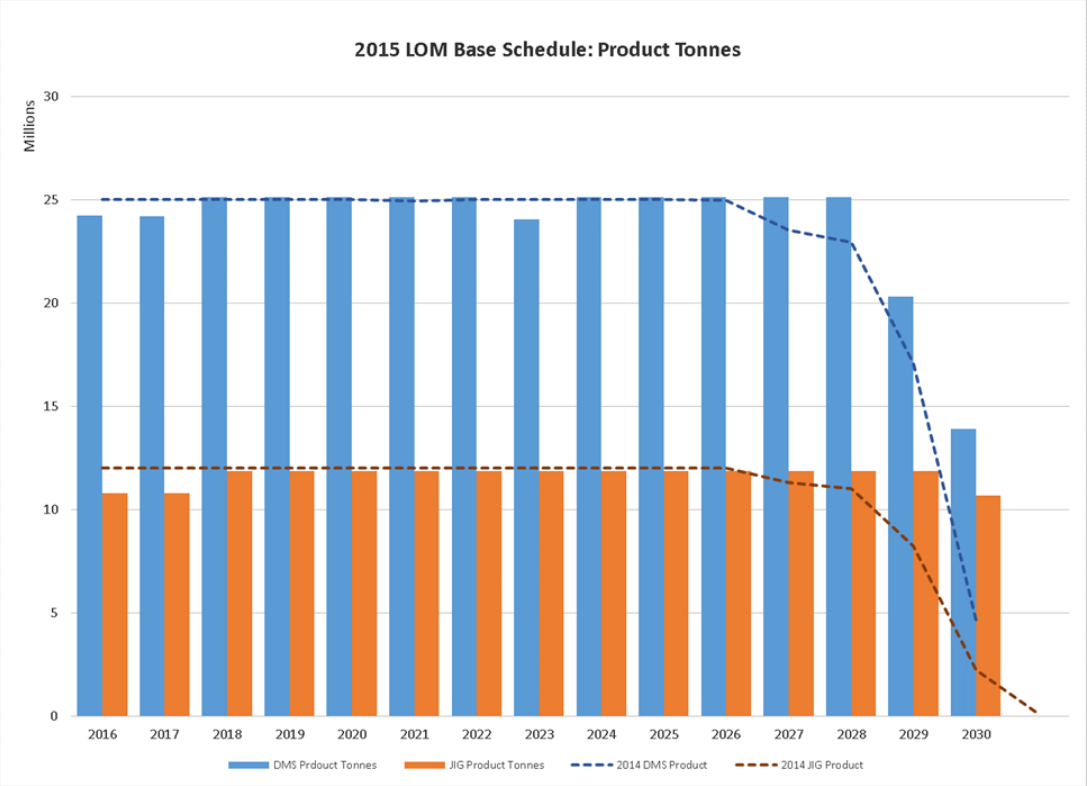

Figure 8: 2015 LoM product tonnes per plant

As illustrated in the figures above, LoM is 2031.

3.7 Mining operations

3.7.1 Iron ore mining operations

Mining started in outcrop and shallow ore areas along the north to south strike of the ore body and is generally progressing in a westerly direction along the dip of the ore body, with the mine pit becoming increasingly deeper towards the west.

Four types of hard iron ore, namely massive, laminated, conglomerated and brecciate iron ore are mined. Blast hole drilling is a continuous process and blasting is done once a day, typically in the early afternoons between 12h00 and 14h00, at each of the active mining areas within the mine pit.

With the mine pits' continued progression in a westerly direction, it is moving increasingly closer to surface infrastructure such as the Postmasburg-Hotazel railway line (for which the Sishen Western Expansion project (SWEP) included the re-alignment of this railway line to make sure future mining can take place), Vaal-Gamagara water pipeline, and Eskom power lines, as well as to the buildings and houses associated with Dingleton Town. The Dingleton Relocation process is however underway to allow for the expansion of the future pit. In 2014 the DMR approved the inclusion of the Railway Properties into the Sishen mine right.

In 2007, Sishen Mine and Khumani Mine received DMR approval to mine the boundary pillar between the Sishen and Khumani mine pits (Refer to Figure 10). Once the boundary pillar has been mined, the Sishen and Khumani mine pits will be joined into one. The reserves within the Sishen Mine portion of the boundary pillar are estimated at approximately 27.6 Mt.

In 2011 the Lylyveld satellite opencast development was approved by DMR. This project will supplement the existing Sishen mining operations and will consist mainly of truck and shovel operations. The resource is estimated at approximately 10 million tonnes, which would ensure a Life of Mine (LOM) of approximately 11 years at a mining rate of 1 million tonnes /annum (RoM). The opencast pit is located to the south of the N14 highway and is located next to an existing pit where mining has taken place in the past. The ore will be mined, transported and stockpiled at the pit entrance. The ore will be hauled by roads to the existing Sishen Iron Ore mine using 30 t road haulers where the ore will be crushed.

SIOC submitted an application for a mining right over the Sishen Mine Complex Properties in 2010 which application was supported by an EMPR (Submitted July 2011), this submission was in line with the SIOC strategy to further optimise the extraction of iron ore at the Sishen Mine. Since then it has been suggested by the DMR that SIOC apply in terms of Sec 102 of the MPRDA to extend the Sishen Mining Right by the inclusion of the Sishen Mine Complex Properties and should this application be granted, the pending Section 22 mining right application referred to above will be withdrawn. The Sishen mine Complex comprises the 3 satellite pits discussed below as well as waste rock dumps (Refer to Figure 9).

Vliegveld West Satellite Pit (Sishen 543 Prospecting Right Area - 1021/2007 PR)

The Vliegveld West satellite pit is situated south of the Dingleton town and is part of the current mining right area. It extends onto the Sishen 543 prospecting right area and has a reserve of 14.7 Mt with an average JIG beneficiated Fe grade of 65.8%. Vliegveld West is mined from 2020 onwards in the life-of-operation schedule.

The Doornvlei Satellite Pit (Gamagara 541 Prospecting Right Area - 319/2006 PR)

Doornvlei is situated west of the Dingleton town and has an additional resource of 37.7 Mt with a high average DMS Beneficiated Fe grade of 66.3%. Doornvlei plays an important role to enhance the product grade in the life-of-operation schedule.

Parsons Satellite Pit (Sishen 543 Prospecting Right Areas - 1021/2007 PR and Parsons 564 - 320/2006 PR)

The Parsons Satellite pit is planned south of the current Sishen pit and has a speculative resource, categorised as a 15.4 Mt deposit, with an average in-situ Fe grade of 64%. The importance of the Parsons Satellite pit is that it can significantly contribute to the production schedule toward the end of the life-of-operation and may develop into a significant production area in the future. The geological confidence in the Parsons deposit needs to be improved by exploration and in-fill drilling.

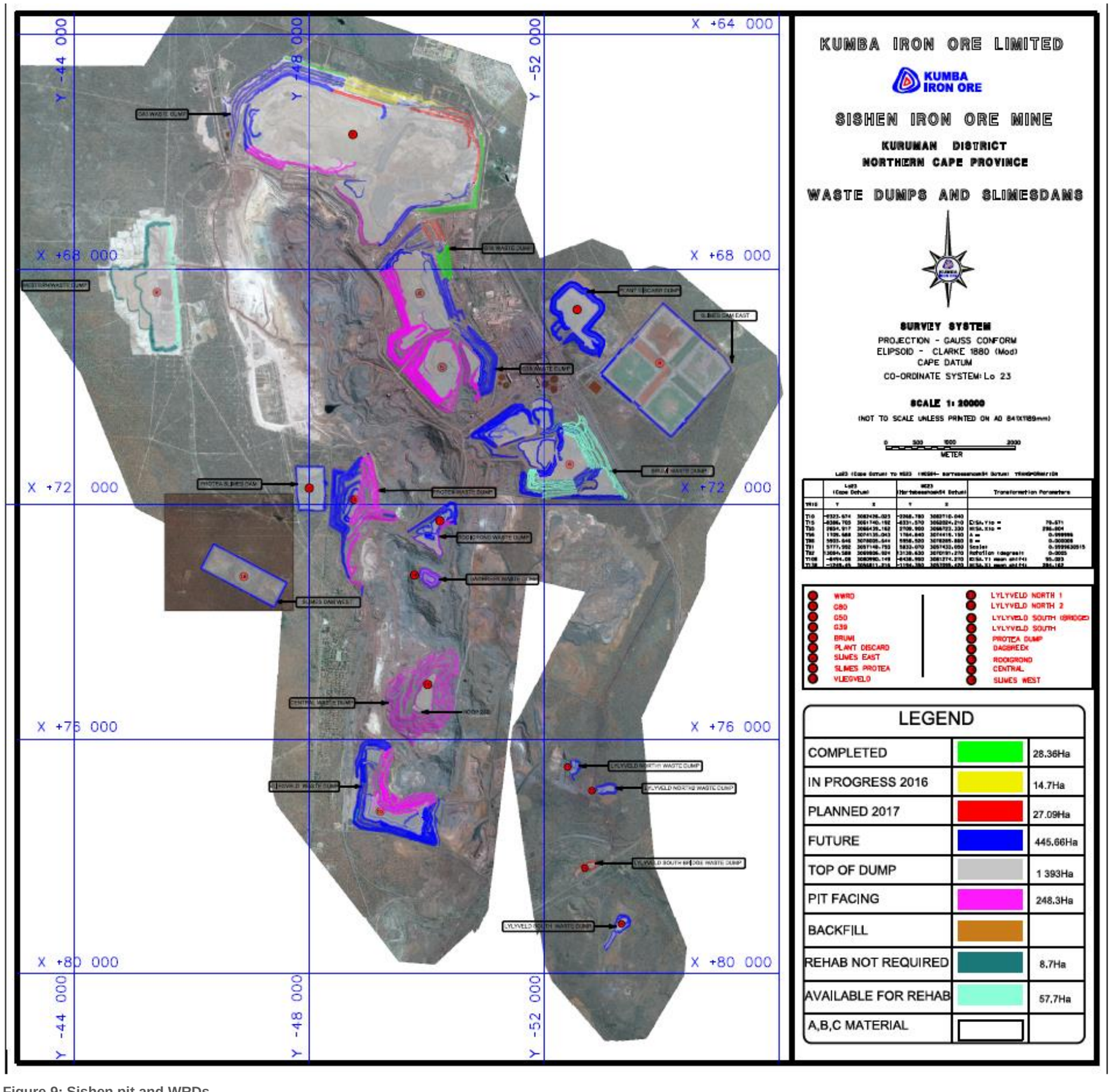

Figure 9: Sishen pit and WRDs

Figure 10: Sishen - Khumani boundary pillar mining areas

3.7.2 Quartzite Mining Operations

The clastic sequence of the Gamagara Subgroup contains a prominent light-cream to dark-purple coloured quartzite, termed the Marthaspoort Formation. The quartzite unit can be up to 40 m thick. The colour of the quartzite varies in conjunction with iron impurities within the matrix of the well-rounded silica grains. The light-cream coloured quartzite has a quartz-rich matrix, is fine-grained and has a massive texture. It is this light-cream coloured quartzite that is sought for crushing material.

Quartzite is crushed in various sizes for railway foundation ballast or crushed stone for mixing into building cement to produce various strength concrete bases.

3.8 Mining process

3.8.1 Description of Mining Method

Sishen Mine is a conventional open pit mining operation applying a pushback deployment strategy. The distinctive mining areas are North Mine (G80 and G50), Middle Mine, Dagbreek, Vliegveld, Far South and Lyleveld. Material is drilled, blasted, loaded by electric and diesel (rope and hydraulic) shovels and hauled by trucks to either the primary crusher, high-grade or low-grade stockpiles or waste dumps. Benches are 12.5 m high. The mining equipment fleet is a combined owner and contractor fleet. Sishen Mine has a reserve of 672.3 Mt at a strip ration of 4.0. The LOM is 15 years (2031), with

an ex-pit ore mining rate of 45 – 50 Mt per annum (Mtpa) and steady ex-pit waste mining rate of 23 Mtpa from 2019 onwards (2015 LOM Planning Report).

3.8.2 Mineral Resource Management

The mining operation is supported by a Mineral Resource Management function which includes:

- Exploration and Resource Estimation
- Mine Surveying
- Pit Design
- Mine Planning
  - Pit Optimization
  - Life of Mine Planning
  - Long Term Planning
  - Medium Term Planning
  - Short Term Planning
- Production Geology
- Quality Control
- Reconciliation.
- Geotechnical Services
  - Slope Design and Monitoring
  - Geo-hydrological services e.g. Pit Dewatering

These services are provided within Kumba Iron Ore. It also includes external consultants and an auditing process that involves Competent Persons from within the bigger Anglo American Group and outside the organisation.

3.9 Beneficiation

Sishen Iron Ore Mine is similar to many international iron ore producers and uses blending techniques and various metallurgical processes to beneficiate the ROM ore. It employs two different plants to beneficiate two different feed grades of ore, the Dense Medium Separation (DMS) for higher grade and JIG plant for the lower grade ore. The fine product from the two plants is blended to form a single product while the lumpy products are handled separately.

Figure 11: DMS and JIG plant

3.10 Key mining related activities

3.11.1 Mineral Deposits

Mineralogical wastes produced at Sishen Mine consist of:

- Mining waste rock
- Low grade and off grade ore bearing material
- Slimes (fine fraction of waste from the processing plant)
- Process discard (course faction of waste from the processing plant).

Mineralogical waste produced at Sishen Mine is inert, non-acid forming, and other than suspended solids, does not result in contamination of water resources (EMPr, 2014). Mining waste rock is hauled from the seven mining areas.

Deposition of material is by end-tipping resulting in the creation of slopes at the natural angle of repose (~37 degrees). These slopes are potentially unstable and difficult to rehabilitate as they are dangerous to access and traverse, water runoff from the slopes leads to erosion, and it is problematic for vegetation to become established. Low rainfall limits vegetation growth, further hampering rehabilitation efforts. At present DMR approved rehabilitation to be conducted on deposited material at the slope angle of 24°.

Material on the mine waste deposits is tipped in a series of benches with a bench width of 28 m. Originally, these benches were 20 m wide; however, the width was increased to 28 m. The bench width allows for reshaping to 24 degrees.

Low grade and off grade ore bearing material is hauled from the mine pit to a number of stockpiles around the mine pit or directly from the mine pit to the Jig Plant. The Jig Plant also receives feedstock from the low grade ore stockpiles.

Process discard, the courser faction of process waste is conveyed from the processing plants to the process discard deposit. The current approved design height is 90 m. The side slopes of the process discard deposit are at ~37 degrees, with no benches.

All waste rock deposits are managed according to Sishen Iron Ore Code of Practice on mine residue deposits.

Slimes dams

Slimes, which represents the fine fraction of waste from the processing plant with particle sizes smaller than 0.2 mm, are sent from the processing plant thickener dams to the slimes dams (see Figure 12) via a slurry pipeline.

Evaporation water losses at the slimes dams have also been reduced through improved management of the slimes dams. This includes reduced pond sizes (open water surface from which water evaporates) and the recovery of water from the slimes has been increased through the establishment of a return water dam as part of the SEP1 development.

Three distinct slimes dam complexes are located in the mine site, as follows:

- The main slimes dam area located to the east of the DMS plant (“North Slimes”). This complex has a footprint are of about 324 ha. This complex is currently operational and the primary area receiving slimes from the beneficiation plant.
- Slimes dam area located to the west of the historical South Beneficiation plant with a footprint covering about 67 hectares (“South Slimes”).
- Slimes dam area located to the west of the Protea Mine residue dump, having a footprint area of about 32 ha. This area is defunct and historically served the South Beneficiation plant.

The main slimes dam complex consists of 4 separate compartments with a 100 m wide cross area between them (Figure 12).

The four slimes dams are separated from each other by a ~100 m wide empty space in the shape of a cross between the four dams. The dams were redesigned as part of the SEP1 development and approved by the DMR as part of the SEP1 EMP Amendment. The redesign allows for utilisation of the cross area between the four original dams, which would combine the four dams into one, as well as increasing the design height to 35 m. The side slopes of the slimes dams are at ~26 degrees.

Figure 12: Operational Slimes Dam Complex

The North Slimes Dams and return water dam were lined through compaction of in-situ soil and clay underlying an HDPE liner. The water recovered from the penstock system at the slimes dams is pumped to the mine's return water dam after reduction of suspended material in a silt trap, and then back to the process water circuit for re-use at the DMS plant.

Sishen Mine committed to optimised management of the slimes dam to reduce evaporation losses and increase the recovery of water from the slimes dam11. The increased recovery of water from the slimes facility is in line with objectives to increase the re-use of contaminated water in the process water circuit, and thereby reducing the use of raw water from the extraction boreholes, which water can be supplied to the Vaal–Gamagara Water Supply Scheme.

Waste Rock Disposal areas

There are numerous waste rock dump disposal and storage pile areas on the mine. Mineral residue sites include backfill areas, mine waste rock dumps, tailings dumps and slimes dams (Figure 4).

Protea Waste Rock Dump

The Protea Waste Rock Dump extension is needed since the current dumps have run out of space and the waste then needs to be dumped further away leading to longer hauling distances for waste arising from the south mine. Extension on the north-western side of the Protea Waste Dump will also assist in re-benching of the outer slope to facilitate rehabilitation.

The G80 Waste Rock Dump

The G80 Waste Rock Dump is the most northern waste dump on Sishen Mine. The G80 Waste Rock Dump will be extended as the current waste rock dumps will have insufficient capacity to accommodate the waste rock from the pit extension project. Extension on the north-western side of the Protea Waste Dump will also assist in re-benching of the outer slope to facilitate rehabilitation.

Western Waste Rock Dumps

As the mining operation progresses down the western dip of the ore bodies of the mine, the pits become deeper and the stripping of overburden increases. The increased waste stripping will have a significant impact on the mining fleet expansion and requirements for additional areas for waste rock dumps. Construction of the dumps is in process.

The two new waste rock dumps will be developed, as approved by the DMR, on the farms Remaining Extent, Portion 1, Portion 3 and Portion 4 of the Farm Gamagara 541; Portion 1 of the farm Fritz 540; Remaining Extent of the farm Woon 469; Remaining Extent of Portion 2 and Remaining Extent of Portion 3 of the farm Sacha 468.

3.11.2 Access roads

Main entrance to the Sishen Mine is obtained along a secondary road off the Kuruman/Postmasburg arterial road (R325). The mine is located approximately 8 km south of Kathu, which has a number of secondary and other roads that service the houses and small industry located there.

Various other roads, of which majority are dust roads, provide access to the mining area, mine infrastructure and buildings, as well as other excavated areas and facilities such as the slimes dams and rock dumps.

3.11.3 Haul roads

Ore and waste rock is hauled by large haul trucks with load capacities of between 100 and 320 tons. Pit and haul roads are generally 25 – 56 m wide and safety berms are built by tipping of waste rock on the cliff side of these roads. Vehicle-entrained dust emissions from unpaved haul roads represent a significant source of dust. Sishen Mine uses chemical stabilisation, in conjunction with wet suppression, for dust suppression on haul roads.

3.11.4 Railway lines

The Sishen-Saldanha railway line originates at the north mine complex and serves to transport iron ore north through the Emil Station and Limebank. The line extends for 861km to Saldanha Bay where the majority of the iron ore is exported. The remainder of the ore leaving Sishen Mine is delivered to ArcelorMittal SA in Vanderbijlpark, approximately 689km from Sishen Mine and Newcastle, approximately 998km from Sishen Mine.

In 2009 a study was conducted to relocate parts of the Postmansburg- Hotazel railway line to allow for future expansion of the mine to the west. This included a 19 km section of the Postmasburg-Hotazel Transnet freight railway line (Postmasburg-Hotazel railway line). The line was relocated from the point where the railway line enters the Sishen Mine property boundary in the south to the point of exit on the

northern boundary. The Sishen Railway Properties (Approved 2014) allows the inclusion of the properties associated with the previous railway line into the Sishen Mining Right area.

3.11.5 Internal Railway Lines and Loadout stations

After processing and blending of ore to client specification at the product stockpiles, the product is loaded onto rail via a number of load-out stations and a marshalling yard, and dispatched and railed to Saldanha for the international export sales markets or inland to the domestic customers

Figure 13: Loadout facilities and product stockpile

3.11.6 Topsoil stripping and Stockpiling

All available topsoil will be stripped advancing the footprint areas of mine waste rock dumps, slimes dams, discard dumps, excavation and blasting. Topsoil is also stripped prior to the development of new physical infrastructure and services. The stripped soils are stockpiled for eventual use in rehabilitation but due to the nature of the soils that occur over most parts of the mining area and the fact that topsoil stripping only started in 1982, there is a general topsoil deficit at Sishen Mine.

Closure and rehabilitation objectives and end land use planning at Sishen Mine are constrained by this topsoil deficit. Sishen Mine has therefore embarked on an extensive rehabilitation trial programme to determine sustainable and cost effective measures to rehabilitate the extensive mining waste deposits, slimes dams and process discard deposits. The option of utilising process discard as a growth medium is also being investigated.

3.11.7 Water use and management

A water balance model for the dewatering and process water use has been developed, reviewed and is regularly updated as illustrated in Figure 14. In addition to this water balance diagram, Figure 15 gives the schematic layout of Sishen borehole and pipe layout.

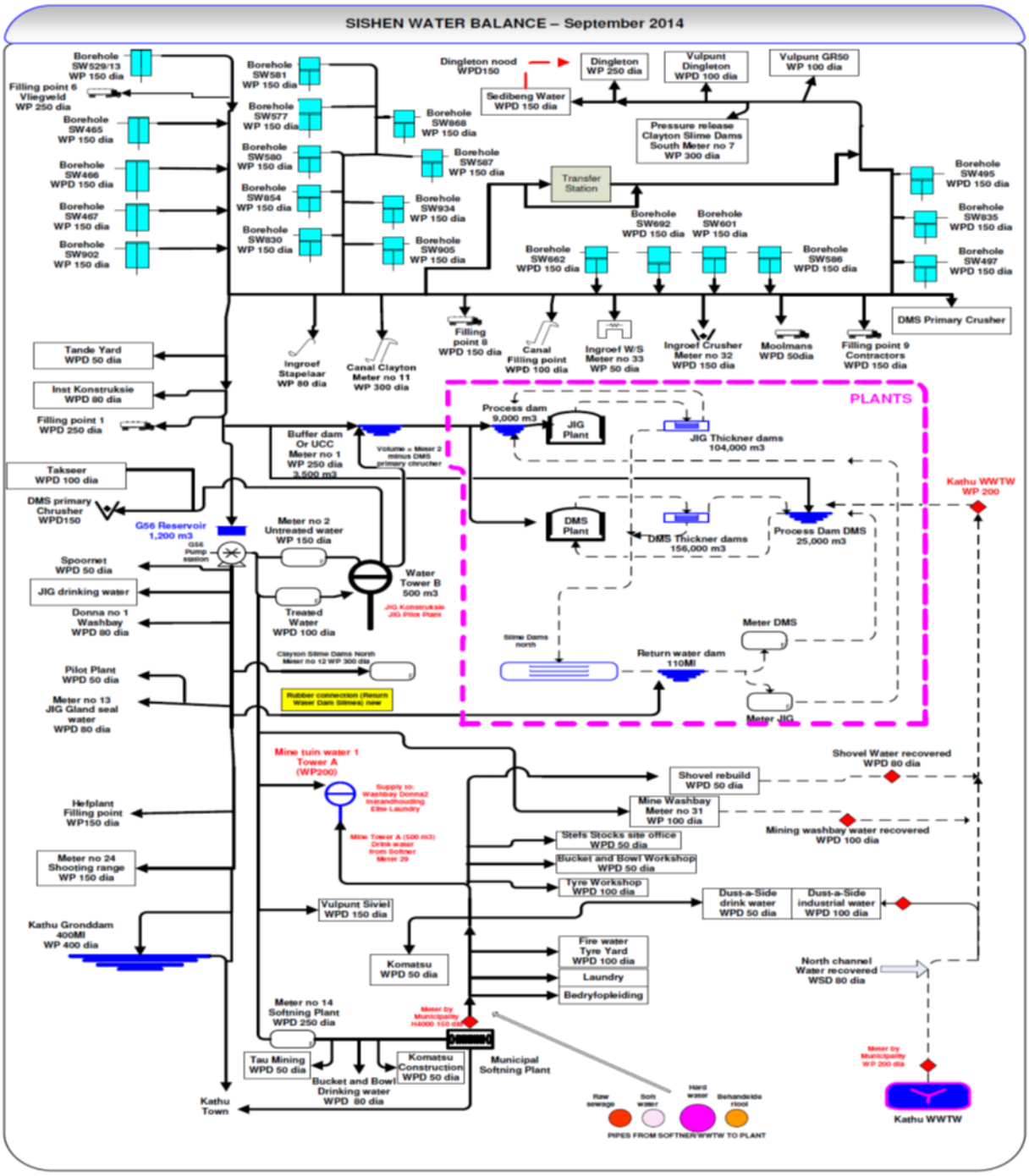

Figure 14: Water balance model for the dewatering and process water use updated in September 2014

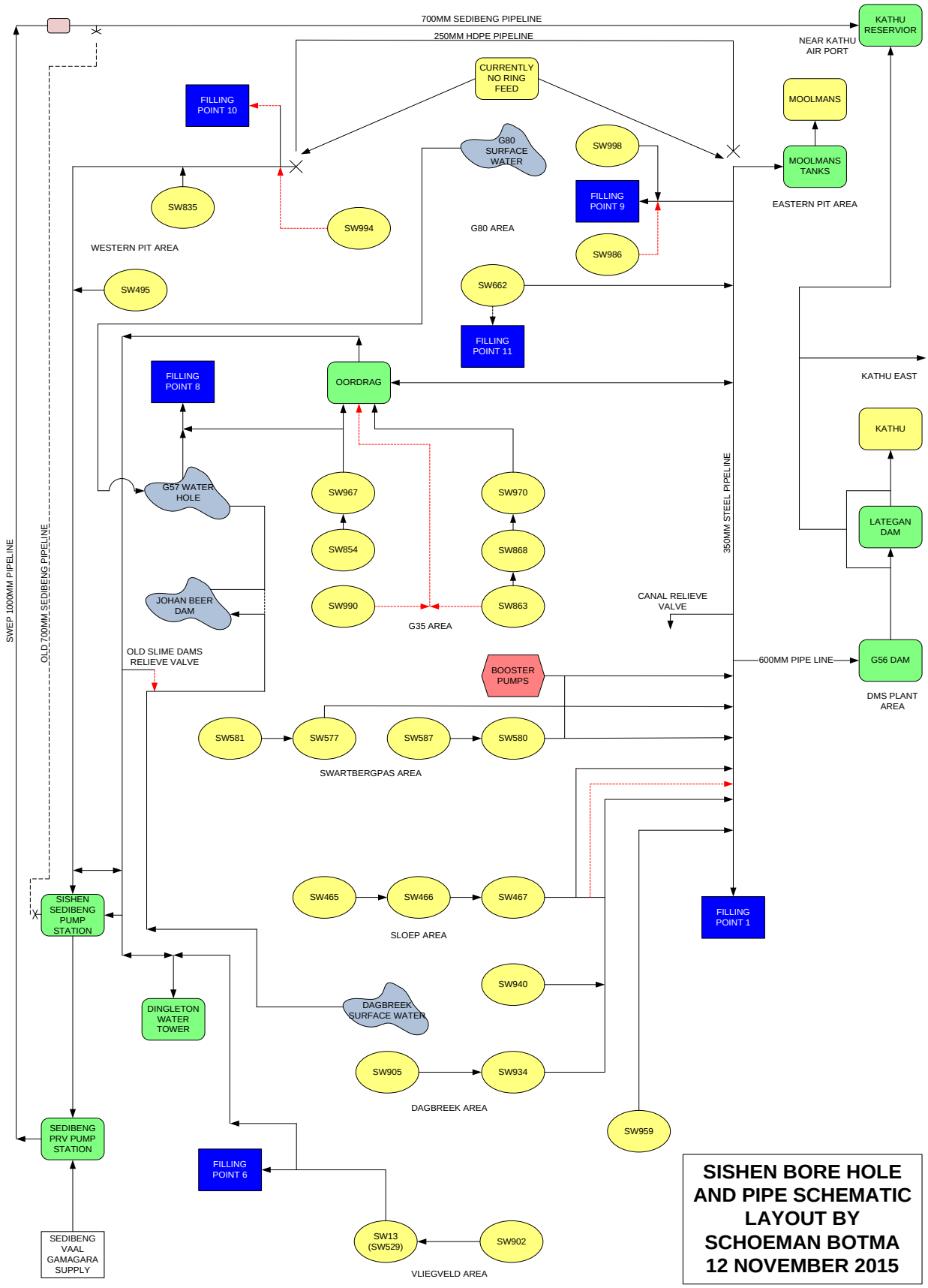

Figure 15: Schematic layout of Sishen borehole and pipe layout

With regard to water abstraction, use and disposal, water usage monitoring data from 2009 to December 2015 was used for compiling the 2015 IWWMP. On the basis of this data, some conclusions can be drawn with regard to the current water balance for the mine: There are effectively two water balances in operation:

- abstraction from the Kathu aquifer for water supply to training and recreation facilities, and is associated with infrastructure in Kathu/Sesheng;
- dewatering of the Sishen compartments, the use of this water in the beneficiation process and the supply of surplus groundwater to the Gamagara Local Municipality and to Sedibeng Water which operates the Vaal Gamagara pipeline.

Figure 16 below was generated by Sishen Mine from the Monthly water balance report.

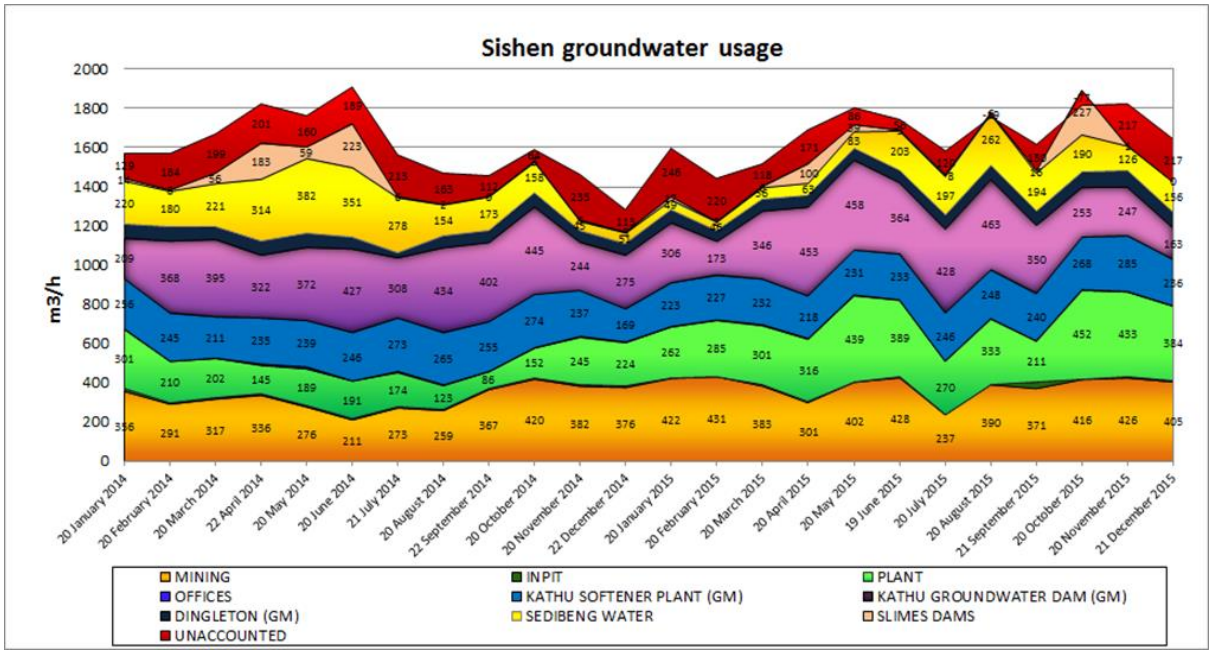

Figure 16: Sishen Iron Ore Mine Groundwater Supply

The information provided in this section is based on annual amounts calculated from water balance data supplied by Sishen Mine for 2015. Sishen Mine provides water to the Gamagara Municipality by means of the following:

- Provision of water to the Municipality via the Softener Plant (2,096,670 m^3 in 2015);
- Discharge of excess dewatering water to Lategan Dam ("Gronddam") - 2,905,700 m^3; and
- Provision of water to Dingleton (591,145 m^3).

Sishen supplies approximately 1,218,100 m^3 (2015 volume) of water removed from underground to Sedibeng Water via the disposal in the Gamagara pipeline.

Of the approximately 14,523,463 m^3 of water abstracted from the underground compartments in 2015, approximately 7,711,8486 m^3 was used on the mine in mining, in pit, plant operations, offices and slimes

dam south according to the data provided in 2015 (this includes unaccounted for water, which is assumed to have been used on the mine).

Water for these facilities is obtained from both municipality owned and Sishen mine boreholes, which are all located on the Kathu aquifer in the town of Kathu, approximately 7km away from the mine.

Since 2010 the abstraction and use of this water is depicted as on Figure 17 below.

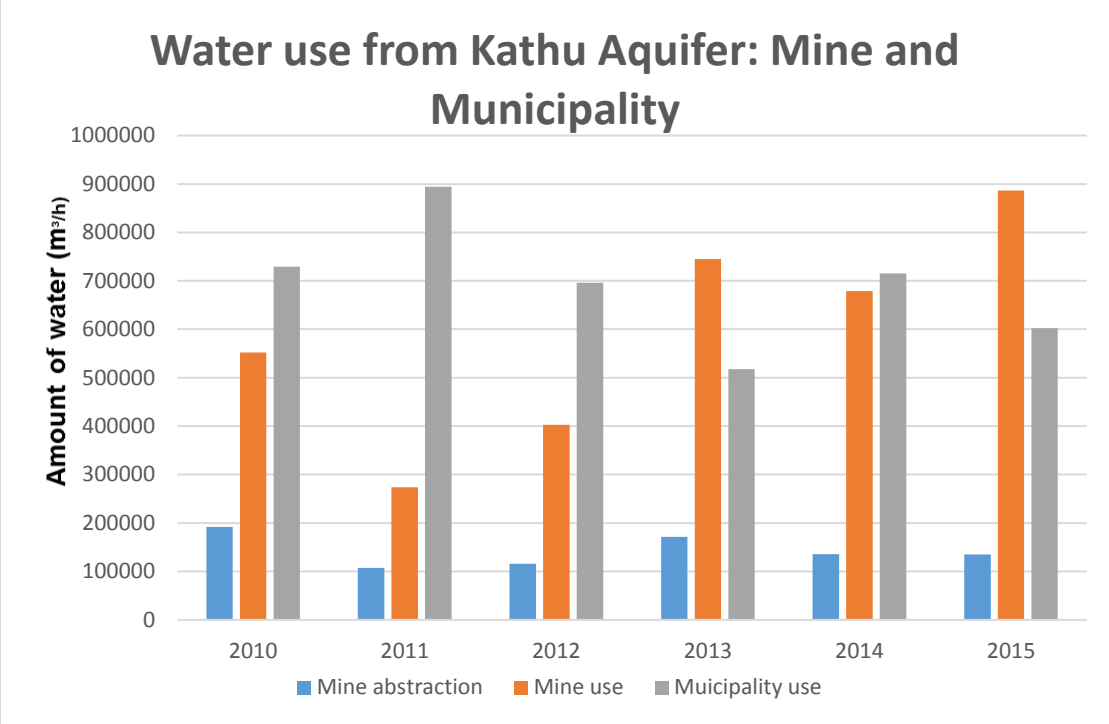

Figure 17: Water Use from Kathu Aquifer: Mine and Municipality

Water is supplied to the municipality for further purification (mainly softening and disinfection) to potable water standards for drinking water supply to the towns (Dingleton, Kathu and Sesheng) that provides accommodation to the mine employees and their families. Some water is discharged into the environment via the stormwater channels. The remainder of the water from extraction boreholes is distributed to other mines in the area, including Hotazel and Olifantshoek, via the Vaal-Gamagara pipeline, which is operated by Sedibeng Water. Figure 18 illustrates the abstraction rates for 2015.

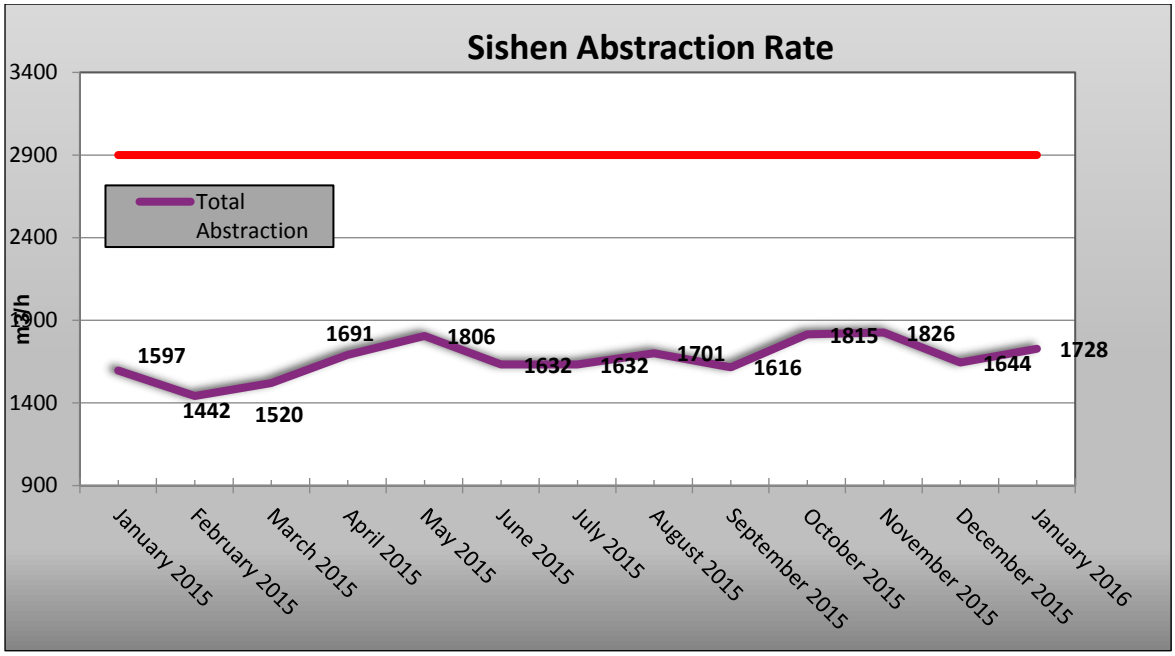

Figure 18: Sishen Abstraction Rate

The water use data for the period 2010 to 2015 provide valuable insight into the current water balance for the mine for the use of dewatering water, as outlined in **Table 7** below.

Table 7: Dewatering and water use 2010-2015

Volume m^3	Year	2010	2011	2012	2013	2014	2015	Average
Abstraction	South	8 377 199	8 555 902	7 943 830	7 850 620	7 775 185	8 708 371	
	North	2 013 940	2 281 605	1 748 890	1 850 280	2 872 052	3 194 401	
	West	1 601 280	1 921 410	2 106 344	2 730 129	1 604 260	962 495	
	TOTAL	**11 992 419**	**12 758 917**	**11 799 064**	**12 431 029**	**12 251 497**	**12 865 267**	**12 349 698.83**
Reclaimed water	Kathu sewage	1 408 160	1 550 710	1 369 320	1 409 630	1 445 530	1 321 370	
	Softened water	49 056	40 930	186 390	35 976	32 978	35 976	
	TOTAL	**1 457 216**	**1 591 640**	**1 555 710**	**1 445 606**	**1 478 508**	**1 357 346**	**1 481 004.33**
Total input		**13 449 635**	**14 350 557**	**13 354 774**	**13 876 635**	**13 730 005**	**14 222 613**	
	Offices	160 032	42 567	19 810	16 300	27 980	16 740	
	Plant	3 016 837	2 044 309	2 104 154	2 168 286	1 469 691	2 715 184	
	Mining	1 388 991	1 911 379	1 550 526	2 361 801.00	2 571 905	3 147 227	
	In pit Use	125 663	171 636	172 290	152 624	56 252	60 384	
	TOTAL	**4 691 523**	**4 169 891**	**3 846 780**	**4 699 011**	**4 125 828**	**5 939 535**	**4 578 761.33**
Other use	Rifle range	36 270	-	-	16 300	27 980	-	
Total Mining Use		**4 727 793**	**4 169 891**	**3 846 780**	**4 715 311**	**4 153 808**	**5 939 535**	
On-site Discharge	North Slimes	10 900	-	-	100	-	-	
	Stormwater Canal	25 500	49 942	7 127	780	55	-	
	South Slimes	54 855	498 428	78 600	53 470	417 680	134 450	
	TOTAL	**91 255**	**548 370**	**85 727**	**54 350**	**417 735**	**134 450**	**221 981.17**
Total Use & Discharge		**4 819 048**	**4 718 261**	**3 932 507**	**4 769 661**	**4 571 543**	**6 073 985**	
Water Provided: Softening & Municipal Use	Softening	1 722 520	1 566 730	1 944 410	2 083 320	2 006 120	2 096 670	
	Dingleton	543 920	494 030	619 540	678 260	509 864	548 114	
	Kathu Municipality	1 722 520	1 566 730	1 944 410	2 083 320	2 006 120	2 096 670	
	Kathu Grond dam	2 656 020	3 396 300	2 682 100	2 462 800	2 862 800	2 905 700	
	TOTAL	**6 644 980**	**7 023 790**	**7 190 460**	**7 307 700**	**7 384 904**	**7 647 154**	**7 199 831.33**
Water Provided	Vaal-Gamagara Pipeline	963 500	2 122 500	1 950 000	1 277 200	1 811 700	13 008	
Total Provided		**7 608 480**	**9 146 290**	**9 140 460**	**8 584 900**	**9 196 604**	**7 660 162**	**8 556 149.33**
Balance	Abstracted & Reclaimed	13 449 635	14 350 557	13 354 774	13 876 635	13 730 005	14 222 613	13 830 703.17
	Used & Discharged	4 819 048	4 718 261	3 932 507	4 769 661	4 571 543	6 073 985	4 814 168
	Provided	7 608 480	9 146 290	9 140 460	8 584 900	9 196 604	7 660 162	8 556 149
	Difference (unaccounted)	1 022 107	486 006	281 807	522 074	-38 142	488 466	460 386

3.11.8 Polluted water management

Sishen Mine makes use of the following pollution control dams;

- Plant crusher pollution control dams
- Aldag refuelling station pollution control dams
- Mining maintenance primary and secondary equipment (diesel workshop pollution control dams)
- Sishen infrastructure pollution control dams

This contains dirty water pumped from the wash floors from workshops, crushing plants, car wash bays, heavy equipment wash bays and re-fuelling station. Theses pollution control dams are designed and operated using DWS minimum requirement for pollution control dams (Magalela Associates, 2012). Active treatment of polluted water is achieved by pollution control systems described above. These facilities separate the oil and other contaminants in the wash and storm water. These include settling pits and oil separators.

Wash water mixed with oil and sludge that is washed from equipment and vehicles is collected in a concrete canal that discharges into settling pits. Here the dense or heavier material settles. Oil will float on the water and skimmed into oil separator tanks. Currently the precipitated mud (mix of sludge and coarse oil particles) that collects in the settling pond for evaporation and is being moved to the mines bioremediation facility after the water has been evaporated. New Bioremediation facility at Aldag is described in Section 3.11.15 (Magalela Associates, 2012).

3.11.9 Storm water management

Storm water management at Sishen Mine is a challenge, since the mine comprises large mining areas with even bigger catchment areas. The result is that large volumes of storm water are directly and indirectly impacting the mining operations. Figure 19 below shows the bigger clean water sub-catchment area that impacts upon Sishen Mine.

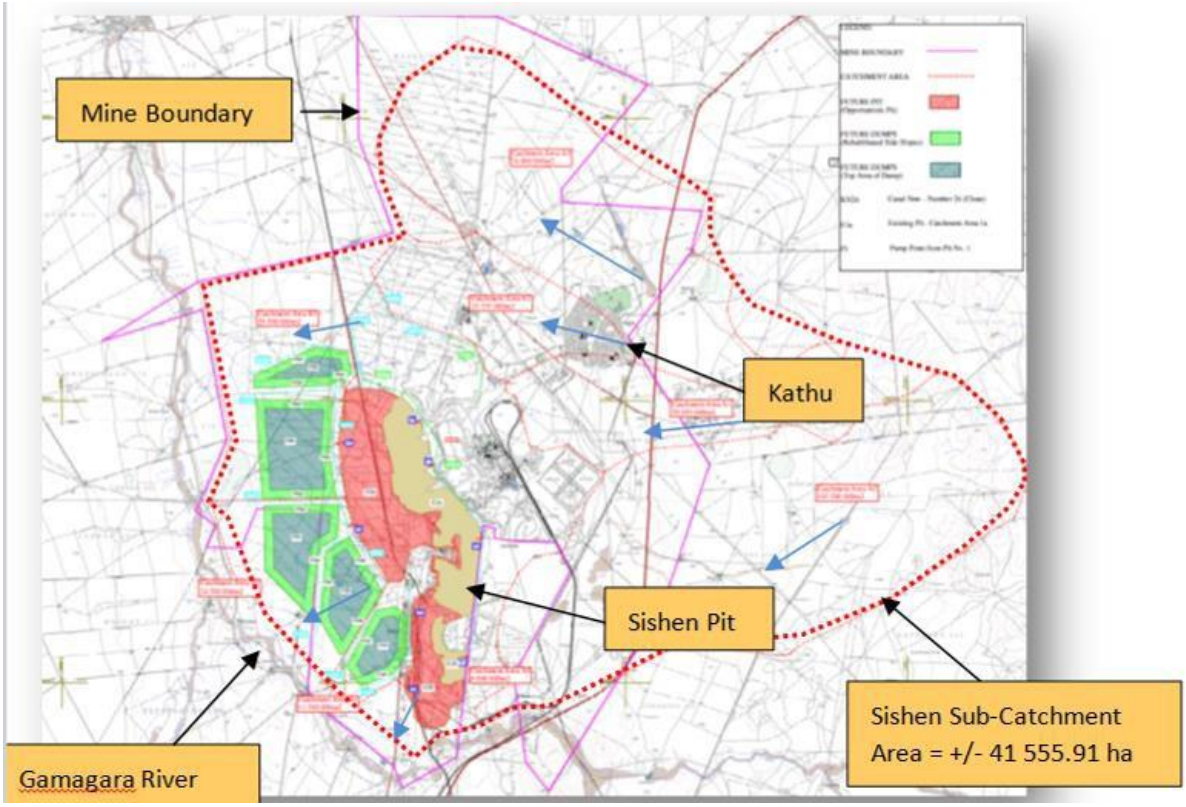

Figure 19: Catchment area

The total sub-catchment comprises approximately 41,555 ha. Most of this water is clean water and gravitates to the Gamagara River towards the west of the mine as shown by the flow direction arrows (blue).

Storm water is diverted around mining infrastructure. Storm water collecting inside the pit surface is pumped into the western storm water channel and water quality is monitored at the outlet of the channel. The Eastern Drainage Canal and the Western Drainage Canal, which follows the natural (very flat) drainage gradients, both discharges into the environment along the northern boundary of the mining area. A new storm water dam is being constructed on the north-eastern side of the mine, this will collect water from the eastern storm water channel. The water collected will be returned to the plant, thereby preventing any outflow to the surrounding environment.

The construction of a storm water channel on the north-western side of the mine will also commence in 2017. This will collect water from the western storm water channel, which will also be returned back to the plant. The storm water management structures (existing and proposed) are shown in Figure 20 below.

Currently the dirty water is contained and handled per area of the mine. Decentralised pollution control measures have been installed separately at some of the bigger workshop areas so that the dirty water drainage from these workshop areas is isolated with an associated silt trap, oil separator and return water system.

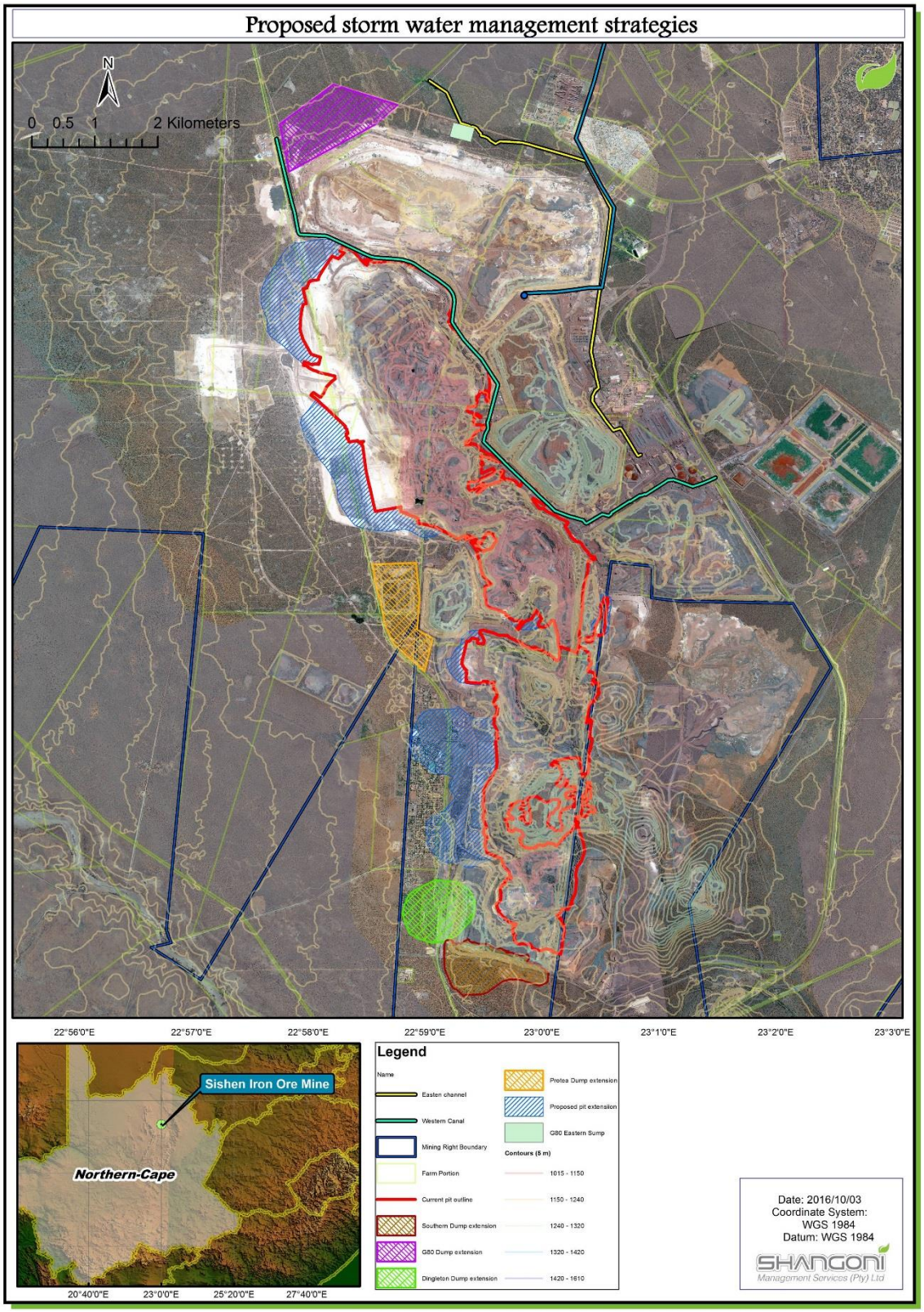

Figure 20: Storm water management structures

3.11.10 Powerlines

Electricity to the mine is supplied by Eskom via the Ferrum substation located to the north-east of the mine pit, between Sishen Mine and the town of Kathu. Originating from the Ferrum substation, a network of 11 kV to 66 kV powerlines and substations deliver power to various areas on the mine, including the processing plants, offices and workshops, mining operations and dewatering borehole pumps.

3.11.11 Workshops and Offices

Various offices and workshops are located in the vicinity of the processing plants and main entrance to the mine.

The key infrastructural components include the following:

- Heavy mining equipment (HME) assembly area and associated bulk services;
- Diesel workshop and associated bulk services;
- Tyre workshop and associated bulk services;
- Central workshop's heavy services crane capacities;
- Shovel and Bucket Mechanical Repairs and welding workshop;
- Front End Loader (FEL) workshop extensions into the existing electrical workshop;
- Upgrading of tyre workshop for future drill maintenance requirements;
- Increase of existing diesel workshop's crane capacities to accommodate for future heavier HME components;
- Plate and welding workshop expansion into existing diesel workshop bays;
- Original Equipment Manufacturer (OEM) workshops and associated bulk services;
- New electrical workshops and associated bulk services;
- Covered parking lots for cranes and low beds;
- Warehouses and OEM stores and associated bulk services;
- Upgrading of existing Aldag filling and tyre station (diesel, lubricants, tyre air inflation points, gharries);
- Diesel and lubricant storage facilities and associated bulk services at Aldag Service Station;
- Washing facilities (wash bays) for heavy mining-, secondary-, support-, PPE and LDV equipment as and where required;
- Civil infrastructure associated with the above infrastructure, such as offices, area lightening, potable water, storm water, roads for HME and light vehicles in mine premises (internal to mine site and external), process water, radiator water, sewerage, roof cover and parking areas;
- Electrical power systems, network for both infrastructure and new additional HME pantograph systems and;
- Workshops and wash bays for mining contractors

3.11.12 Refuelling Station and Diesel Storage

All existing and planned fuel storage tanks are bunded to minimise the risk of hazardous spills as to comply with the NEMA requirements. In 2011 Sishen received authorisation for diesel tanks with a capacity of 6X1.5ML from DENC, these were commissioned in 2013 (Figure 21). Service stations facilities at the mine include the Aldag Filling station and Moberg Total Depot (Figure 22).

The Aldag Filling Station has an 83 000 litre diesel tank and this has been authorised to be upgraded to a 500 000 l Diesel tank and is used by HME vehicles. Aldag receives diesel from the Moberg depot. Moberg is used for light delivery vehicle filling.

The new filling station EMPr amendment has been submitted early 2014 for the development of a new Vertical Diesel Storage Tanks No. 5 & 6 and New HME Filling Station. The diesel storage facilities have the combined capacity of holding 3000m^3 of diesel and a Heavy Mining Equipment (HME) filling facility including all related infrastructure for these facilities (Figure 22). These facilities were approved by DMR and already constructed and started operating in 2016.

Figure 21: Diesel Tanks 3 & 4

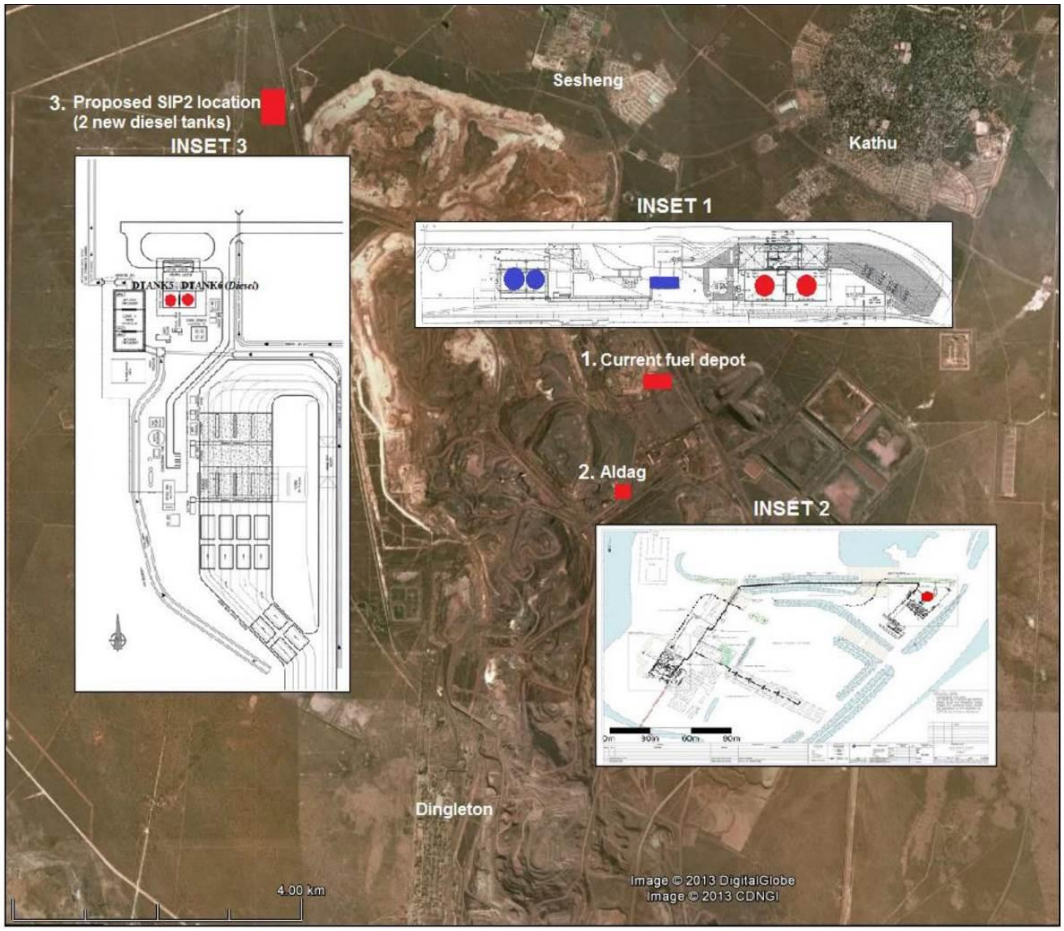

Figure 22: Location and Layout of the Refuelling stations

3.11.13 High Energy Fuel Plant

The mine manufactured high energy explosive fuels at the High Energy Fuel (HEF) plant, which is located to the south of the slimes dam complex. The HEF plant is however no longer in operation (since 2016). All explosives are supplied by a third party.

3.11.14 Hazardous substances Storage and Handling

The storage and handling of hazardous substances is managed in accordance with the procedures and work instruction of the Sishen Mine's Waste Management System.

3.11.15 Waste Management

Sishen Mine is an ISO 14001 certified company and all operational departments, section and their associated activities, substances, products and services are managed in accordance with the ISO14001:2004 standard requirements. Procedures and work instructions have been developed and are being implemented to manage the storage, handling, transportation and disposal of wastes on the mine.

General and Hazardous Waste

SIOM has been issued with Two (2) Waste Management Licence as detailed below:

- Waste Management Licence (WML) in July 2013 for Sishen Mine (Licence number: 129/11/L229/8), by the Department of Environmental Affairs (DEA).
  Details of the WML are as follows:
  Licence Number: 129/11/L229/8
  Licence holder: Sishen Iron Ore Company (Pty) Ltd
  Waste management activities:

  Category A

  (1) The storage, including the temporary storage of general waste at a facility that has the capacity to store in excess of 100 m^3 of general waste at any one time, excluding the storage of waste in storage lagoon.

  (2) The storage, including the temporary storage of hazardous waste at a facility that has the capacity to store in excess of 35m^3 of hazardous waste at any one time, excluding the storage of waste in lagoons.

  (4) The storage of waste tyre in storage area exceeding 500m^2.

  (5) The sorting, shredding, grinding or bailing of general waste at a facility that has the capacity to process in the excess of one ton of general waste per day.

  (7) The recycling or re-use of general waste of more than 10 ton per month.

  (18) The construction of facilities for activities listed in Category A Schedule (not in isolation to association activity).

  (19) The expansion of facilities of or changes to existing facilities for any process r activity, which requires an amendment of an existing permit or licence or a new permit or licence in terms of legislation governing the release of pollution, effluent or waste

  Category B

  (4) The re-use and recycling of hazardous waste.

- Waste Management Licence (WML) in 2014 for Sishen Mine (Licence number: NC/JTG/SISH7/2014), by the Department of Environmental Affairs (DEA).
  Details of the WML are as follows:
  Licence Number: NC/JTG/SISH7/2014
  Licence holder: Kumba Iron Ore, Sishen Mine
  Waste management activities:

  Category B

  (8) The disposal of general waste to land covering an area in excess of 200m^2 and with a total capacity not exceeding 25 000 tons.

The Sishen Mine Landfill Site is located on the farm Sekgame 461. The landfill site is fenced in with access control (locked access gate and security office. Further, the landfill site is also enclosed within the Sishen Iron Ore Mine (SIOM) boundary area. Waste is sorted at the landfill takes place prior to the covering and compacting of the landfill site (weekly basis) to recover as much recyclable material as possible.

Tyre storage yard

Used tyres generated from the mine's haul truck fleet are currently stored in a fenced-off waste tyre storage facility. This site is located towards the southern portion of the mine. A new tyre storage facility was constructed.

Soil storage and treatment and the Bioremediation plant at Aldag

In 2011, a waste permit was granted by DENC for the storage and re-use of treated soils (2011/L2/2/SISH) arising from the Aldag bioremediation plant (Figure 23 and Figure 24). This facility is used to store and treat contaminated soils. The design of the facility was approved by DWS. The facility includes a series of HDPE liners which serve to prevent groundwater contamination. The facility is also equipped with a leakage detection layer that would indicate if any damage is caused to the protection layer. Run-off water from the site is captured and removed.

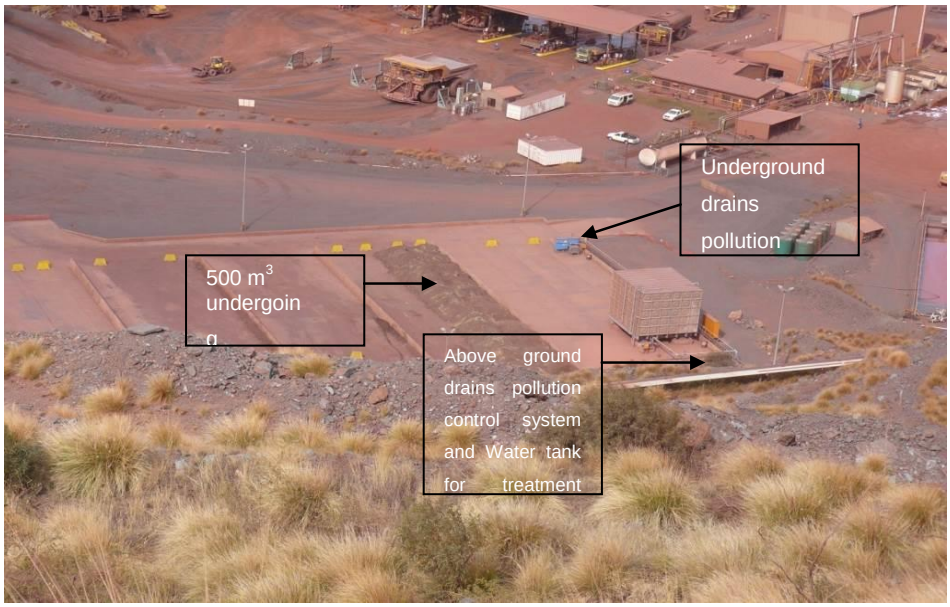

Figure 23: Sishen Bioremediation Site at Aldag

Figure 24: Sishen Bioremediation Site at Aldag- on site

3.11.16 Explosives Magazine

Management, handling and usage of the explosive equipment is conducted in accordance to the Sishen mine procedure and work instruction developed in accordance with the ISO14001.

3.11.17 Radioactive sources

Some of the instrumentation in the processing plants is radioactive. These instruments are managed by an operator licensed to handle radioactive sources. At the end of the life of the equipment, the radioactive sources are disposed of by the Nuclear Energy Corporation of South Africa. The financial provisions for rehabilitation and closure include the costs for disposal of the radioactive sources.

3.11.18 Sewage treatment

The majority of sewerage effluent produced at Sishen Mine (~80%) is piped to the Gamagara municipal sewage treatment works. The remaining sewage effluent is collected in a series of conservancy tanks, from where it is pumped out by tanker truck (honey sucker) for disposal at the Gamagara municipal sewage treatment works. Treated sewage effluent is piped back to the mine for use as process water. Sishen Mine has recently enlarged the capacity of feed pipes from the sewage treatment plant, thus increasing volumes of water being recycled.

There are two centralised sewage systems owned and operated by the local authority. The first lies north of the mining area and serves Kathu, Sesheng and the main mine complex (north mine). The second sewage plant, of which decommissioning will commence in 2017, served Dingleton and the old south plant complex.

3.11.19 Crushers, mobile and semi-mobile crushers

A small portion of the iron ore mined at Sishen is crushed from time to time using a series of mobile and semi-mobile crushers, also involving primary, secondary and tertiary crushing stages. The crushed material is either hauled directly to temporary stockpiles or the product stockpiles for rail transportation or it is sent to the processing plant.

The position and number of mobile and semi-mobile crushers in operation at Sishen Mine may change from time to time with changes in demand for iron ore and quartzite. The management of impacts associated with these crushers is covered in the EMP commitments and will apply to all current and future mobile and semi-mobile crushers.

4. STATE OF ENVIRONMENT

4.1 Introduction / general observations

A summary of the state of the mining environment at Sishen Mine is provided in this section. This has been extracted from the Mine's EMPR Consolidation (2014). This description will be used as a baseline for future closure plan amendments / updates.

4.2 Geology

Regional Geological Setting

At Sishen Iron Ore Mine, high-grade hematite ore is extracted from specific stratigraphic units belonging to the Palaeo-Proterozoic (~ 2400 million years (Ma)) Transvaal and (~ 2070 Ma) Olifantshoek Supergroups, respectively.

The Superior-type banded iron-formations (BIF's) of the Transvaal Supergroup lithologies were deposited in two related basins, one in an extensive continental shelf environment and the other in an intra-continental sea, both situated on the Kaapvaal craton.

The basin, preserved along the western margin of the Kaapvaal craton, is referred to as the Griqualand West basin and hosts the largest known resources of high-grade hematite ore on the Southern African continent.

The mine is situated in the Postmasburg-Sishen sub-region, where iron ore and associated lithologies of the Transvaal (locally termed Griqualand West Sequence) and Olifantshoek Supergroups crop out intermittently along a 60 km arcuate belt. The iron ore outcrops define an important regional anticlinal structure known as the Maremane Dome.

The Sishen Iron Ore Mine is located at the northern end of the Maremane anticline, with the Beeshoek Mine and new Kolomela Mine, at the southern end.

4.3 Climate

Rainfall

The mean annual precipitation (MAP) of the Sishen Mine is 374 mm/a. Figure 26 shows the MAP as measured at from 1963 to 2011.

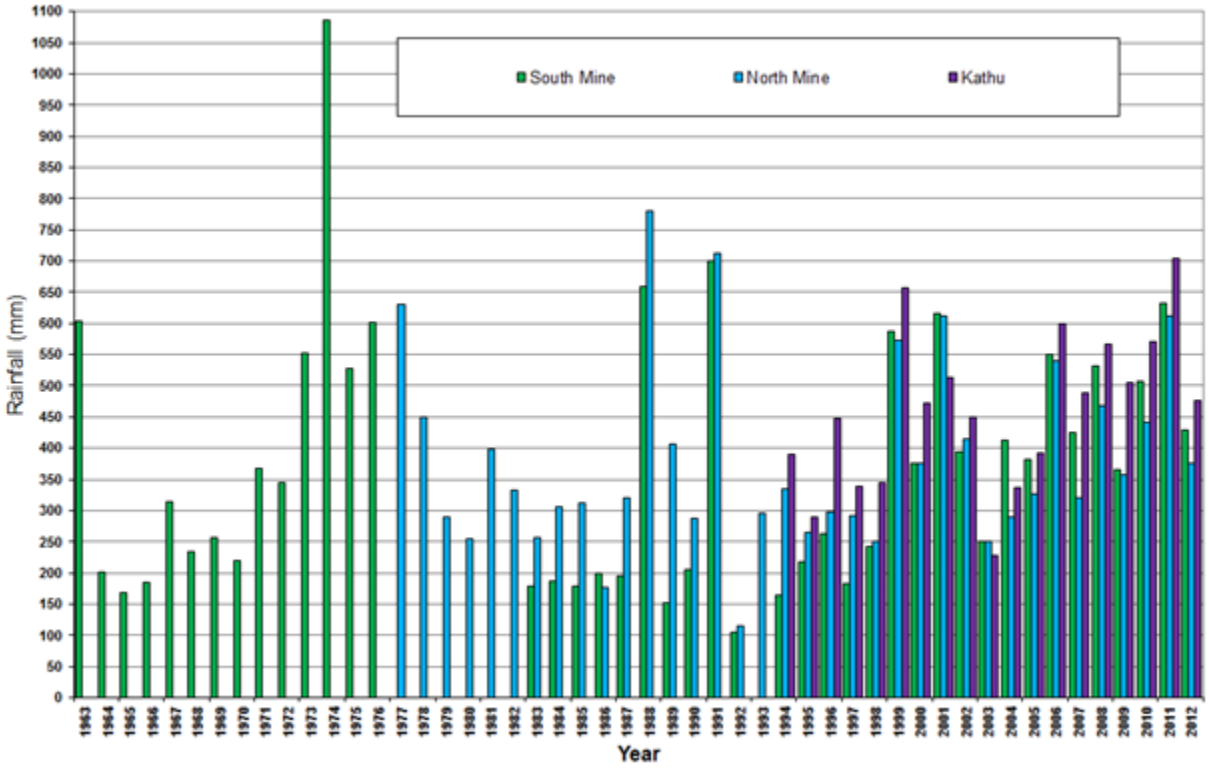

Figure 25: Annual rainfall for Sishen mine and Kathu

Temperature

The mean annual temperature at the Sishen Mine is 19^{O}C. The average annual maximum temperature is 26,7^{O}C and minimum temperature is 11,8^{O}C. January is the warmest month with an average maximum temperature of 32,9^{O}C and July is the coldest month with an average minimum temperature of 3,1^{O}C.

Evaporation

The average annual evaporation rate in the region is 2,026 mm per year, which is more than 5 times greater than the mean annual precipitation, which is 374 mm per year.

Wind direction and speed

At Sishen mine the prevailing wind direction is from the northwest and the southeast. The strongest winds are from northwest. During the day the prevailing winds are from the northwest with limited airflow from the southeast. Daytime airflow is characterised by higher occurrence of strong winds of more than 5 m/s. There is an increase in the number of calm conditions during the night; from 7.2% (daytime) to 12.6% during the night. The wind velocity also decreases significantly and the airflow changes to be predominantly from the southeast during the night.

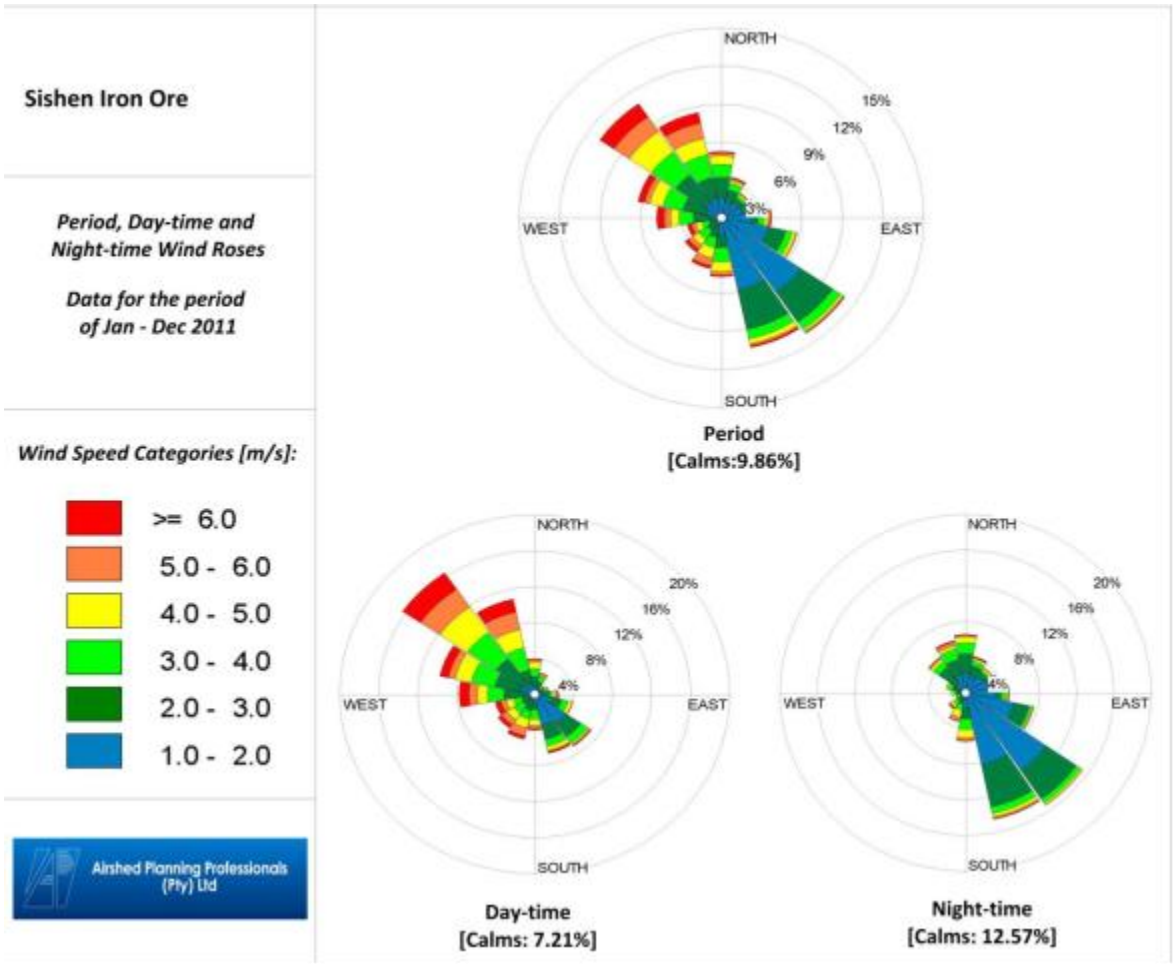

Figure 26: Wind directions recorded at Sishen Mine

Extreme weather conditions

Thundershowers occur irregularly in the summer months, from October to March. Frost occurs in the winter months, from May to August. Excessively high temperatures, above 45°C, typically occur in the months of December and January and are often correlated with an excessively low humidity volume. Fog and snow are unlikely to occur at Sishen.

4.4 Topography and visual environment

The natural topography of the MRA is generally flat with some isolated undulating areas. The average altitude of the flat plains is at 1200 metres above mean sea level. There are a number of hills, stretching up to 1350 metres above mean sea level, to the southeast of the Sishen mining areas, close to the N14 road. The Langberg is located approximately 35 km southwest of Sishen Mine. The general slope of the land, specifically the Sishen mining area, is in a westerly and south-westerly direction towards the ephemeral Gamagara River.

According to the Environmental Potential Atlas of South Africa (ENPAT, 2000) the project area is classified as being “Level Plains with some relief”. The area has however been altered by existing tailings disposal facilities, waste rock dumps and the open pit.

4.5 Soil and land use

During a 2003 soil and land use survey conducted by Potchefstroom University (now North West University), it was found that in the Sishen area assessed, the regional soil environment is typified by shallow soils on rocky ridges and sandy freely drained soils on gentle to flat mid slopes where Mispah, Glenrosa, Namib and Coega soils are found. The dominant soils encountered were predominantly Coega (100–200 mm), Mispah (100-200 mm) and Namib soils (300-1200 mm).

Agricultural potential is very low due to shallow sandy soils and climatic constraints. Dry land production potential is estimated to be 13 ha per large stock unit. Specific limitations applicable to the area include shallow soils, unfavourable climate, low water-holding capacity, stony soils and rock outcrops and erosion hazards.

Land use trends posing a threat to the environment

Although mining is a major creator of employment, mining activities at their best have major impacts on the environment, especially open-cast mining where high technology earthmoving equipment is used. The Gamagara Municipal Area is, by virtue of its semi-arid nature, environmentally very sensitive, and even with rehabilitation done according to best practice standards, re-vegetation of the mined area and mine residue dump footprints is extremely slow. A major problem is that such areas either become sterilised or infested by alien invasive plant species.

Currently the land users in the Gamagara area are predominantly agriculture and mining. The single largest factor that has guided the development of the Gamagara area is Sishen Iron Ore mining development. Not only does the mine provide jobs to thousands of people, it is also the reason why the town of Kathu was planned and developed in the first place.

4.6 Surface water

There are no perennial rivers in the area. The Gamagara River is located on the southern border of the site. The river is ephemeral having no dry-weather flow due to the semi-arid nature of this area. There is no flowing or standing water. It only flows for varying distances every decade or so after heavy rains in its catchment (Synergistics, 2009).

The mine is located within the Lower Vaal Water Management Area (WMA), in the D41J Quaternary Catchment drained by Gamagara River (Refer to Figure 28). Seasonal fluctuations in rainfall occur. Rain falls mainly during summer and autumn seasons with a maximum of only 60 mm per month.

Non-perennial pans occur to the North, East and West of the mine. Artificial wetland vegetation within the mine area occurs in the canals that drain water to the north and west of the site. Further information on the pans is given in Section 4.9 of this document.

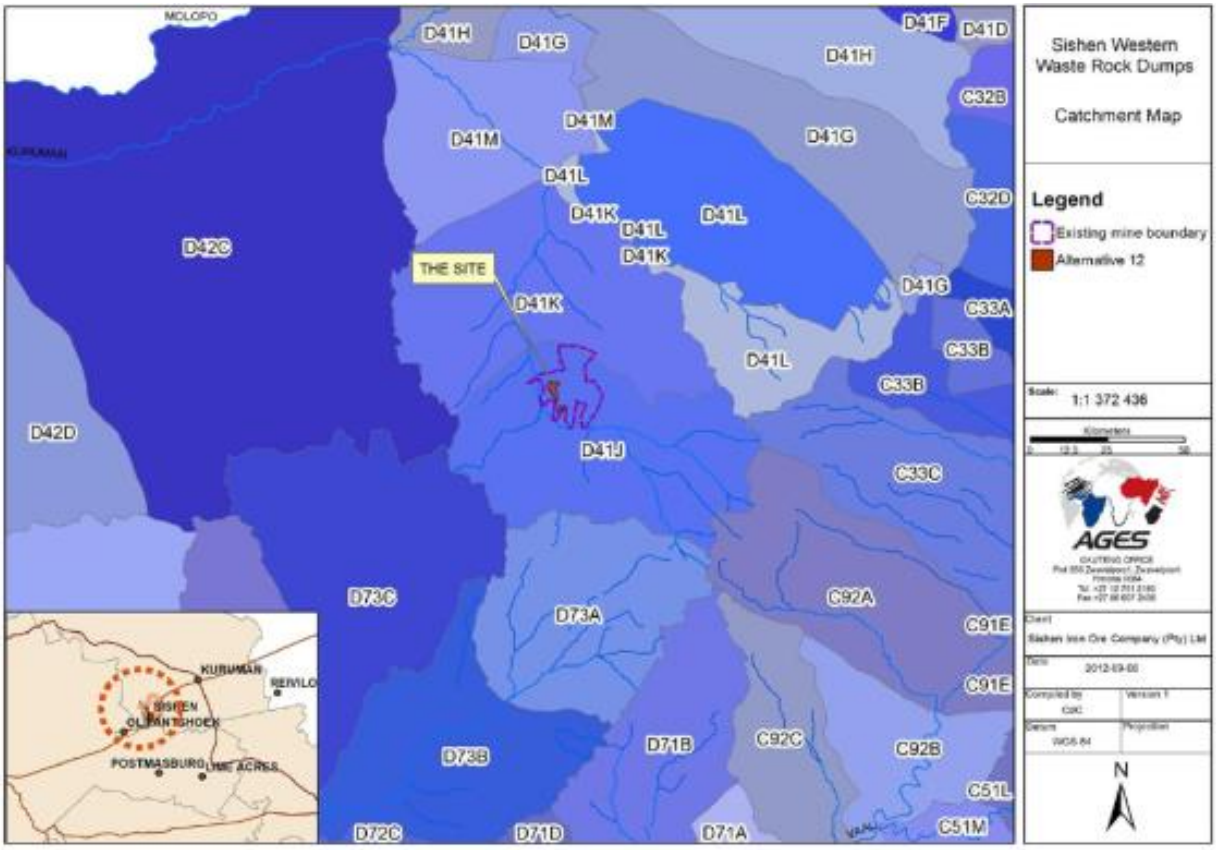

Figure 27: Regional catchment area

Storm water is diverted around mining infrastructure. Storm water collecting inside the pit surface is then pumped into the western storm water channel and water quality is being monitored at the outlet of the channel. The Drainage Canal and the Western Storm water drainage canal, which follows the natural (very flat) drainage gradients, before both discharges into the environment along the northern boundary of the mining area (Refer to Section 3.11 for more information on the storm water in and around the Mine). As mentioned in Section 3.11, new storm water dams are being constructed to prevent water flowing out of the mine.

4.7 Geohydrology

Sishen's activities have impacted on water resources in two ways, these being firstly the direct dewatering zone of impact and secondly the indirect impact of restricted surface water flow in the Gamagara River as result of swallets that formed in the river. These two impacts are described below.

4.7.1 Dewatering zone of impact

The geohydrology in the Sishen area is complex with geological influences of permeable formations such as the banded iron formations (BIFs) and dolomites that are intruded by almost impermeable dykes (Meyer, 2009). Regional fault zones cut through these successions and form conduits for groundwater flow (Parsons, 1991 and AGES, 2012).

The complexity is further evident from the presence of numerous dyke intrusions, faults, thrust faults, doming and associated folding and turning of strata. These geological structural elements largely control the movement of groundwater in the area, irrespective of whether it is natural flow or inferred flow due to pumping and large scale abstraction (Meyer, 2009).

Two lateral aquifer systems are present in the Sishen Mining area, as described in Meyer, 2009. These two systems are briefly discussed below.

Primary aquifers

The Gamagara Primary aquifer is young, and occurs in the mostly unconsolidated alluvium of the Gamagara River Valley, while the Kalahari Primary aquifer occurs in the semi-consolidated to consolidated sediments of the Kalahari Sands, with the gravel layer constituting the main water bearing unit. Water strikes in the shallow primary aquifers generally occur at depths ranging between 0 and 66 m though occasionally they occur as deep as 100 m below the ground (Meyer, 2009). The calcrete varies between 5 m and 50 m in thickness and the clay layer varies between 0m and 50m. The clay layer is important as it disconnects the shallow calcrete aquifer from the deep aquifer with a distinct shallow water level (AGES, 2012). Generally, borehole yields are low, in most cases below 2 ℓ/s, though there have been cases of yields of up to 8 ℓ/s in the pebble zone. The uppermost aquifer-unit is located in fractured and weathered calcrete and is considered unconfined. The second aquifer is found in a pebble layer that is consolidated by a calcrete matrix and may have primary porosity. A persistent clay layer in these deposits is suspected to prevent the downward movement of the groundwater in the primary aquifers towards the deeper secondary aquifer.

A special case of the aquifers is formed by the Kalahari formations and alluvial material along the Gamagara River, The Gamagara aquifer. This aquifer is limited to a zone along the river and is expected to be of a perched nature. This shallow/perched aquifer zone is considered to potentially support aquifer dependent eco-systems (ADEs) along the river (AGES, 2012).

Secondary aquifer

The Secondary Aquifer is a karst-type aquifer that is formed by the dissolution of limestone and dolomite to form fissures and underground caverns hosting large volumes of groundwater. In the Sishen Mine area this type of aquifer is represented by the various fractured and tectonically affected hard rock formations ranging from the Dwyka Group to the dolomite of the Campbell Rand Subgroup (Meyer, 2009). Significant water strikes range in depth from 70 to 200 m below the ground level. Borehole yields

vary widely from as low as 0.1 ℓ/s to as high as 100 ℓ/s. The extraction and dewatering boreholes of the Sishen mine area extract water from the secondary aquifers.

The secondary aquifer is the main source of ground water and occurs in the pre-Kalahari formations. These include:

- Dolomite - The main groundwater supply channel is the Breccia (chert breccia/manganese marker) near the upper dolomite contact.
- Banded ironstone - The banded ironstone possesses a well-defined jointing system. Brecciation occurs along the fault zones, resulting in a high rate of ground water supply.
- Gamagara strata - The Gamagara strata occur in a belt running north-south. Folding and well-defined jointing ensure a good supply of ground water from the south.
- Ongeluk lava - The lava separates the primary and secondary aquifers west of the mine. Ground water does not generally occur in the Ongeluk lava, as it is relatively impermeable.

The Diabase dykes have had a major impact on ground water occurrence and flow, and compartmentalised the karst-type secondary aquifer into a number of distinct ground water compartments that vary between confined and unconfined. The following significant compartments have been identified:

- Northern Compartment
- Khai Apple Compartment
- Kathu Compartment
- Western Compartment
- Southern Compartment

Mine dewatering

At the time of commencement of mining, it was assumed that little groundwater existed on the farm Sishen. Groundwater has been subtracted from boreholes near the Gamagara River and the Khai Appel area for the mining processes and for water supply for the town of Sishen, today known as Dingleton.

In 1976 the first dewatering boreholes were commissioned and dewatering was done uninterrupted ever since. The dewatering rate averaged 1450 m^3/h during 2011.

Various studies starting in 2002 have taken place to determine the dewatering zone. The studies include the following:

- Report 1: December 2002 Assessment of Groundwater conditions in the vicinity of the Sishen Mine;
- Report 2: November 2003 Phase II Groundwater studies: Summary Report; and
- Report 3: Sishen Phase III report by Golder Associates, November 2004.

In 2009 Sishen Mine appointed Mr. Reynie Meyer to develop a conceptual model to define the total dewatering zone of impact for Sishen Mine. Mr. Meyer evaluated all previous studies/reports and finalized the conceptual model report in July 2009 (Development of a Conceptual Geohydrological Model, an Evaluation of the Effect of Dewatering and the Design of a Monitoring Protocol, Sishen Iron Ore Mine). Based on this report a dewatering zone was identified. This dewatering zone of impact is updated annually with monitoring data. The dewatering zone of impact is shown in Figure 29.

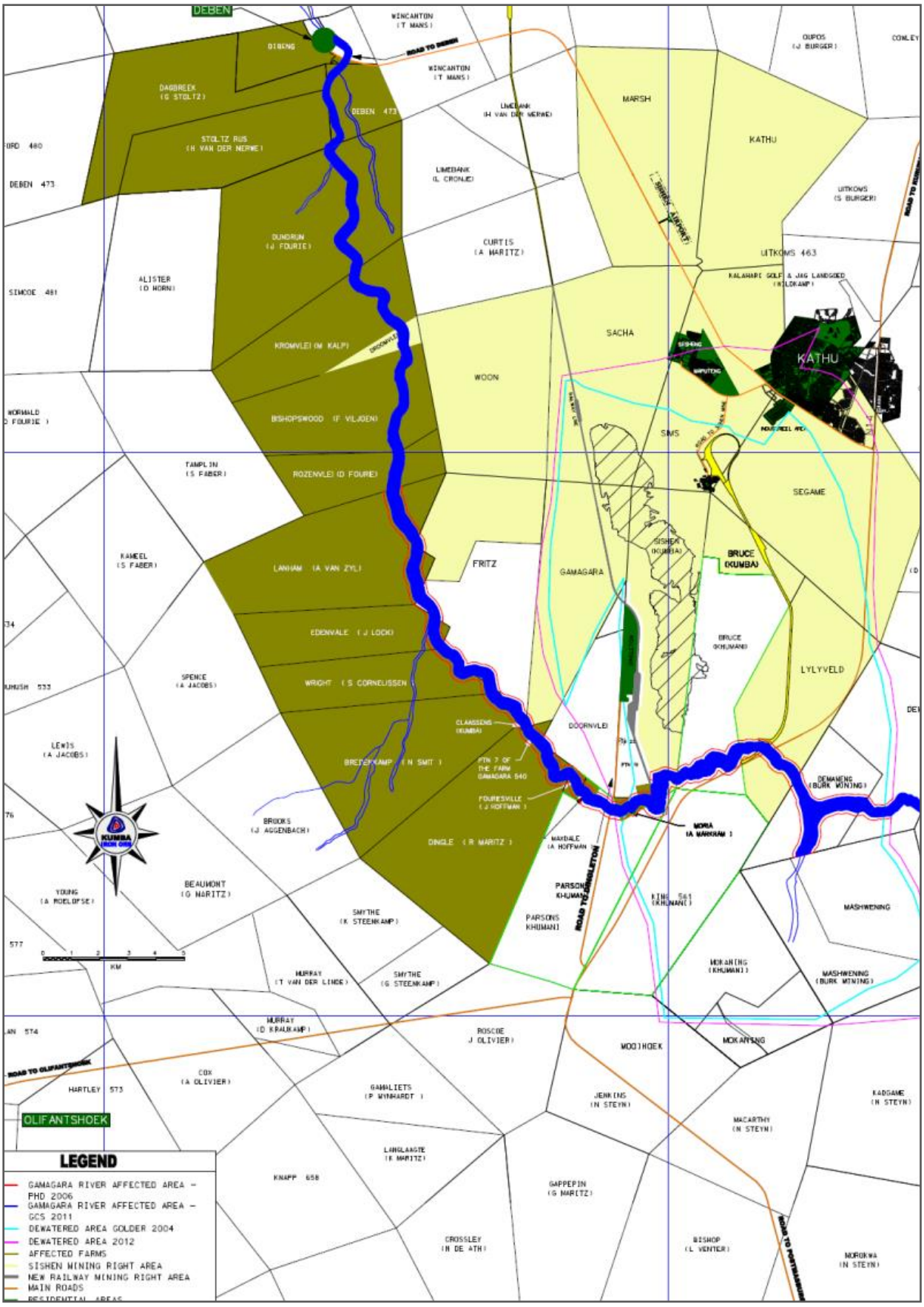

Figure 28: Dewatering zone of influence

Swallet formation and Gamagara River impact

A detailed study on swallet formation was done by Pulles Howard & De Lange in 2006. The study was undertaken after an erosional feature appeared along a section in the Gamagara River approximately 3 km downstream of the proposed Lylyveld South Satellite Pit (**Error! Reference source not found.**). This occurred during the February 2006 flood in the Gamagara River. During this event the material "eroded" from the river channel was not transported further downstream, but was transferred vertically along a highly brecciated and permeable fault zone to deeper levels and possibly accumulated in palaeo-karst like features.

The study confirmed the area of impact to be at least 12 km downstream of the swallets up to the farm Lanham. A follow-up study was done by Groundwater Consulting Services (GCS) in 2011 to confirm the impact of mining on the Gamagara River. The GCS study resulted in a shift in the dewatering area of impact and the boundary moved north to the farm Dagbreek. Affected farmers who are impacted by Sishen's dewatering activities are compensated by means of water provision and grazing subsidies. A project has been initiated to consider long-term impact management options for the swallet area. The details of the project will be communicated to all relevant stakeholders in 2017.

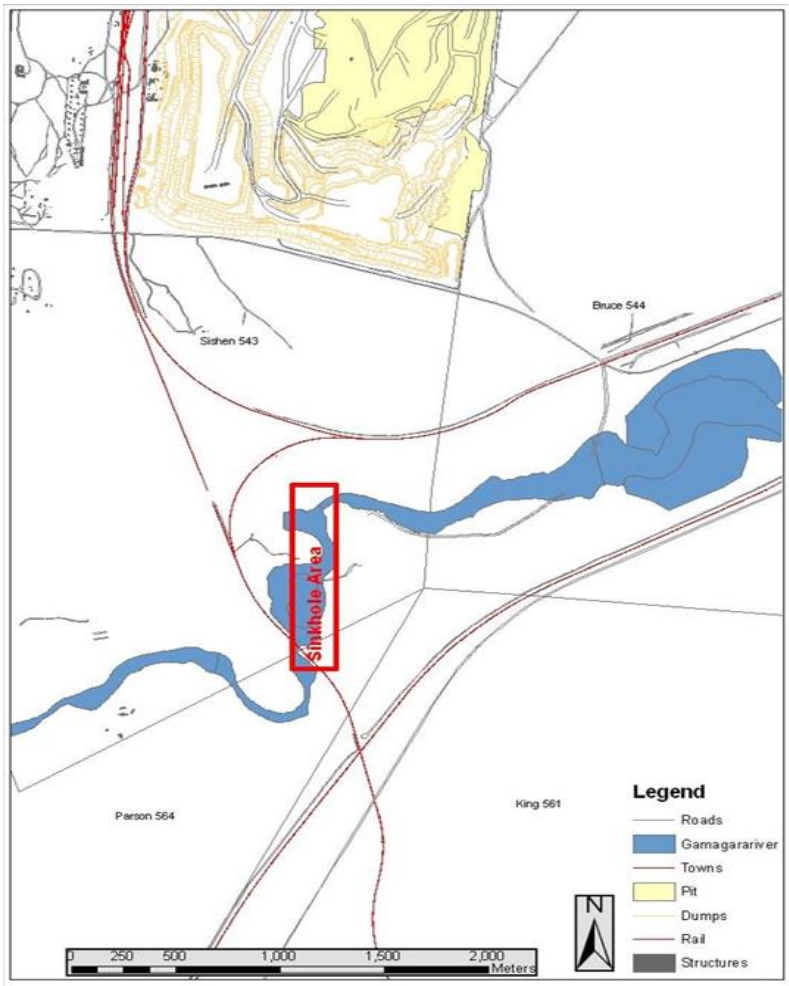

Figure 29: Locality of sinkhole

4.8 Water quality

As part of the Sishen Mine Water Monitoring Program surface and ground water resources are monitored on a monthly basis for resource quality. Water monitoring reports are compiled on a monthly, quarterly and annual basis. Water quality concerns with regard to closure include:

- Hydrocarbon contamination at the Moberg diesel storage depot, Aldag filling station, Loadout Station workshop and the Haul truck workshop; and
- Nitrate contamination around the HEF Plant and Ammonium Nitrate Store.

Remediation projects are underway to clean-up the contaminated areas.

4.9 Biodiversity

Sishen Mine lies within the Eastern Kalahari Bushveld Bioregion of the Savanna biome which is the largest biome in Southern Africa. The Savanna Biome is characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs).

4.9.1 Flora

Regional vegetation types

There are three distinctive vegetation types, as defined by Mucina and Rutherford (2006), that occur on the land that Kumba owns around Sishen:

- Kuruman Thornveld
- Kuruman Mountain Bushveld
- Kathu Bushveld, which is the predominant vegetation type.

In addition to these three vegetation types, there are isolated patches of Southern Kalahari Salt Pans vegetation, associated with a number of the endorheic pans at the site. These areas are characterised by low grassland and a mixture of dwarf shrubs. They are generally exposed for most of the year and carry shallow pools for a short time only after good rains. The vegetation of these pans is subject to natural degradation/regeneration cycles controlled by the concentration of grazing animals (antelopes in particular).

Kuruman Thornveld occurs on flats from the vicinity of Postmasburg and Danielskuil in the south, extending via Kuruman to Tsineng and Dewar in the north. It occurs on flat rocky plains and some sloping hills with a well-developed shrub layer and well developed tree stratum dominated by *Acacia erlioloba.*

Invasive plants

Seventeen species controlled under Regulation 15 and Regulation 16 (R. 280 of 2001) of the Conservation of Agricultural Resources Act (No. 43 of 1993), were recorded within the study area. Ten

of these species were recorded within the mining area, of which five species were found restricted to the mine area and were not recorded on any of the surrounding properties.

Table 8: Declared alien/invasive species in the MRA and/or surrounding farms

Species		Category	Occurrence in Mining Area	Occurrence on Surrounding Farms
Argemone mexicana	Yellow Flowered Mexican Poppy	1	Definite	Not known
Argemone ochroleuca	White Flowered Mexican Poppy	1	Definite	Definite
Atriplex nummularia	Old Man Salt Bush	2	Definite	Not known
Cestrum laevigatum	Inkberry	1	Definite	Not known
Cortaderia selloana	Pampas Grass	1	Definite	Definite
Datura ferox	Large Thorn Apple	2	Probable	Definite – uncommon
Eucalyptus cf. *camuldulensis*	Red River Gum	2	Probable	Definite planted around buildings
Melia azedarach	Seringa	3	Probable	Definite – planted
Nicotiana glauca	Wild Tobacco	1	Definite	Definite
Nerium oleander	Oleander	1	Definite	Not known
Opuntia cf. *ficus indica*	Prickly Pear	1	Probable	Definite
Pennisetum setaceum	Fountain Grass	1	Definite	Definite
Prosopis cf. *glandulosa*	Mesquite	2	Definite	Definite
Ricinus communis	Castor Oil Plant	2	Probable	Definite – uncommon
Rorippa nasturtium-aquaticum	Watercress	2	Definite	Not known
Senna didymobotyra	Peanut Butter Cassia	3	Definite	Not known
Tamarix ramocissima	Tamarisk	1	Probable	Definite
Xanthium spinosum	Spiny Cocklebur	1	Probable	Definite

Wetlands / Salt pans

Two Hydro-Geomorphic (HGM) units were identified and represent wetlands according to the National Wetland Classification System (SANBI, 2009). These HGM units are classified as follows:

- Depressions:
    - Endorheic depressions without channelled inflow;
    - Exorheic depressions without channelled inflow
- Channel wetlands:
    - Natural channels;
    - Artificial channels

Wetland zone identification was done according to soil types, topography of the landscape and vegetation. The wetland map (Figure 31) indicates the location of the HGM unit in the larger project area.

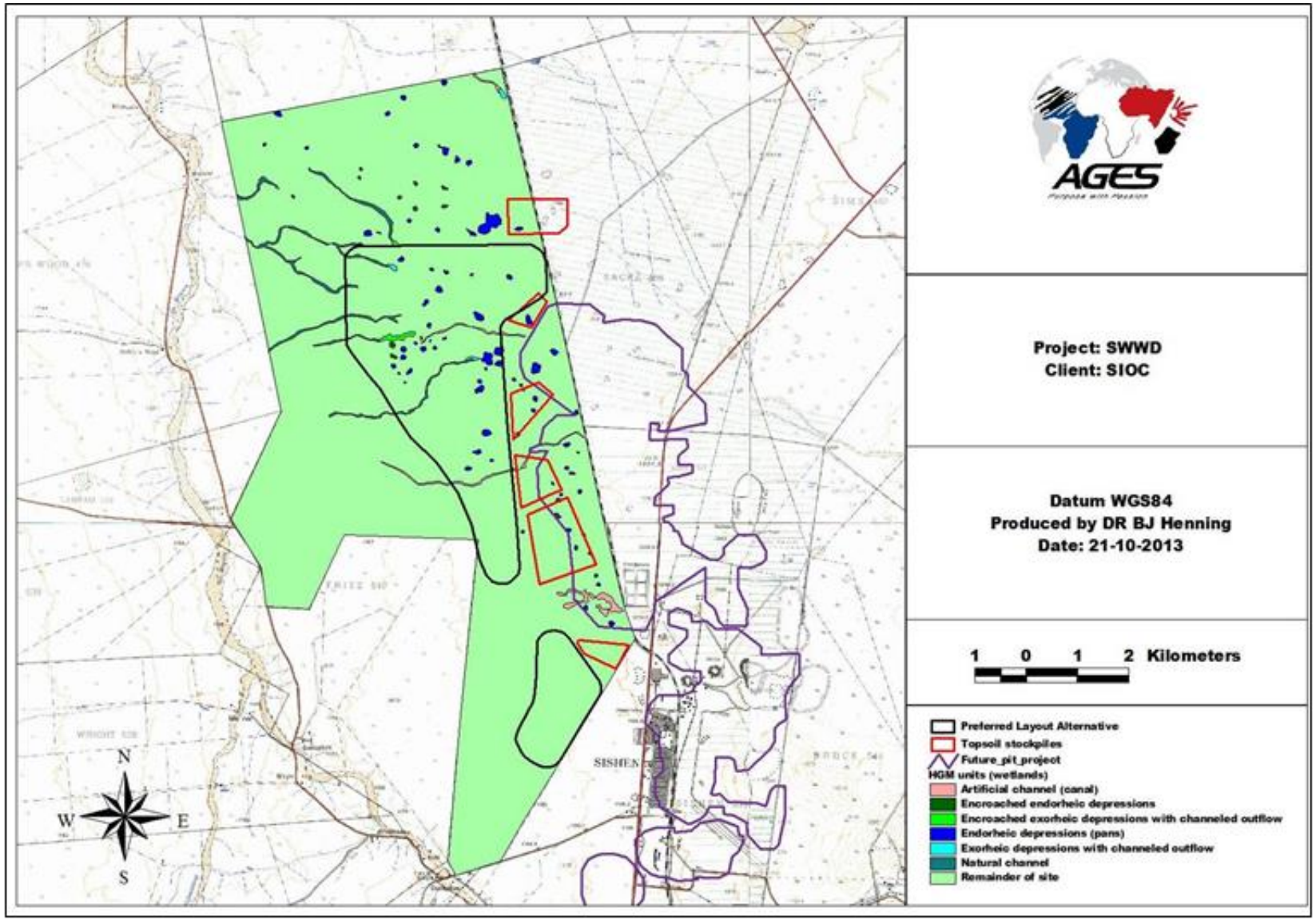

Figure 30: Wetlands identified in the MRA

4.9.2 Fauna

A wide range of fauna species could possibly occur in the area. The regional species diversity account for 56 fauna species The species diversity, within a 10km radius zone of influence from the development, account for 37 species, some of which are listed below.

The actual occurrence on the site itself is much less considering that it is adjacent to waste rock dumps, an operational mine and fragmented by public tar and gravel roads as well as power line servitudes.

Listed mammals which may occur at the site include the Brown Hyaena (*Hyaena brunnea*) (Near Threatened), Black-footed Cat (*Felis nigripes)* (Vulnerable), Honey Badger (*Mellivora capensis*) (Endangered), South African hedgehog (*Atelerix frontalis*) (Near Threatened) and Ground Pangolin (*Smutsia temminckii*) (Vulnerable). However, due to the fragmentation of the landscape and the relatively high human density in the area, it is not likely that many of these species would actually occur at the site on a regular basis. It is probably only the Black-footed cat and South African Hedgehog which could be present at the site.

Avifauna species for the area include 156 bird species. Bird activity on the site was however low. The only listed species that could frequent the area is the Marshall Eagle and Kori bustard.

Listed reptile species could all occur on site, specifically because of the rocky nature of the whole extent of the site. Most amphibians are protected, a total of 11 listed amphibian species could be found on site, but would require a more intensive investigation. All species listed could possibly be in the zone of influence of the project, primarily because of the diverse habitats on site.

The only amphibian species of conservation concern which is known from the area is the Giant Bullfrog *(Pyxicephalus adspersus*) which breeds in temporary pans. There are no pans in the vicinity of the development area and it is not likely that the Giant Bullfrog occurs at the site or would be significantly impacted by the development.

4.10 Air Quality

The information contained in this section of the report was abstracted from the following sources:

- Environmental Impact Report (EIR): Sishen Iron Ore Mine Complex: Mining Right Application: Phase 1; and
- EMPR Amendment and Consolidation: Sishen Iron Ore Mine.
- Air Quality Impact Assessment Rev1.

Baseline dust fallout and PM_{10} emissions for the mine are already exceeding the SA limit values and therefore it is to be expected that the impact on the air quality will be a cumulative impact, which will be in non-compliance against the SA ambient standards at all residential areas.

Sishen Mine, however, operates an ambient monitoring (PM10) and dust fallout (deposition) network. Air quality has been identified as a priority by the mine, and high quality PM_{10} monitors have been commissioned in Sesheng, Kathu and Dingleton in order to measure real-time PM_{10} levels.

Since July 2011 Sishen Mine monitors the ambient PM10 levels at the three residential areas, Dingleton, Sesheng and Kathu by means of Beta Attenuation Mass (BAM) monitors. The focus of the results presented here is for the three sensitive receptor areas around the mine, namely Dingleton, Sesheng and Kathu.

- The average concentration measured at Dingleton in 2011 was 69.79µg/m_3, in 2012 this decreased to 64.34 µg/m_3 and in 2013 to 63.09 µg/m_3.
- The average concentration measured at Sesheng in 2011 was 74.31µg/m_3, in 2012 this decreased to 48.02 µg/m_3 and in 2013 increased again to 56 µg/m_3.
- The average concentration measured at Kathu in 2011 was 48.02µg/m3, in 2012 this decreased to 32.76 µg/m_3 and in 2013 increased again to 26.97 µg/m_3.

Sishen Mine has a comprehensive dust management program in place to ensure dust levels are kept as low as possible. Dust fallout monitoring is taking place at various locations on and around the mine. Dust-A-Side (DAS) is used on all major haul roads and chemical dust suppression will be implemented shortly on secondary haul roads (i.e. those that are not treated with DAS). Several initiatives have been identified and commenced with in the process plant to reduce dust emissions, specifically water and chemical spray systems at transfer points which will have a positive impact on the already elevated baseline concentrations.

Sishen has obtained an Air emissions licence (AEL) for the diesel storage tanks on site. An amendment to the AEL was granted by DENC for the addition of Tanks 5 & 6 at the Nooitgedacht (HME) Fillings station facility to the west of the mine.

The opencast mining operations typically comprise the following sources and associated air quality pollutants:

- Routine emissions
    - Land clearing operations, building and scraping and
    - Stockpiling (particulate matter);
    - Materials handling operations (truck loading and unloading, tipping, stockpiling)
    - In pit operations (dozing, scraping and excavating)
    - Vehicle entrainment on paved and unpaved (haul) roads

  - Crushing and screening; and
  - Wind-blown dust (tailings dam, waste dump, stockpiles).
- Upset emissions
  - Drilling operations; and
  - Blasting.

The main findings from the dust fallout modelling indicated very high dust deposition levels at all sites in and near the mining operations.

- The SANS alert threshold of 2,400 mg/m²/day requiring immediate action and remediation was exceeded on the mine with exceedances of the industrial action limit of 1,200 mg/m²/day for areas on the mine but not close to activities. Other sites also recorded levels in exceedance of this threshold included Dingleton North and Slimes Dam North.
- Dust fallout at the residential areas of Sesheng, Dingleton South, Kathu and Lylyveld farm exceed the residential limit of 600 mg/m²/day and also the industrial limit of 1,200 mg/m²/day with the exception of Kathu.

An updated air dispersion model will be completed in 2017.

4.11 Asbestos

Asbestos occurs in two areas:
The first area is Dingleton, along the old railway line and in Dingleton itself. The Dingleton settlement resettlement project team is managing the clean-up of this area. A registered asbestos removal contractor has been appointed for the clean-up which has already commenced at the time of writing this Closure plan.

The second area with asbestos is inside the mine, starting at the area where the old railway enters Sishen Mine (on northern side of Dingleton) all the way up to where the line exits the mine in the north. Sishen has barricaded the entire line and is in the process of appointing a contractor to start the clean-up.

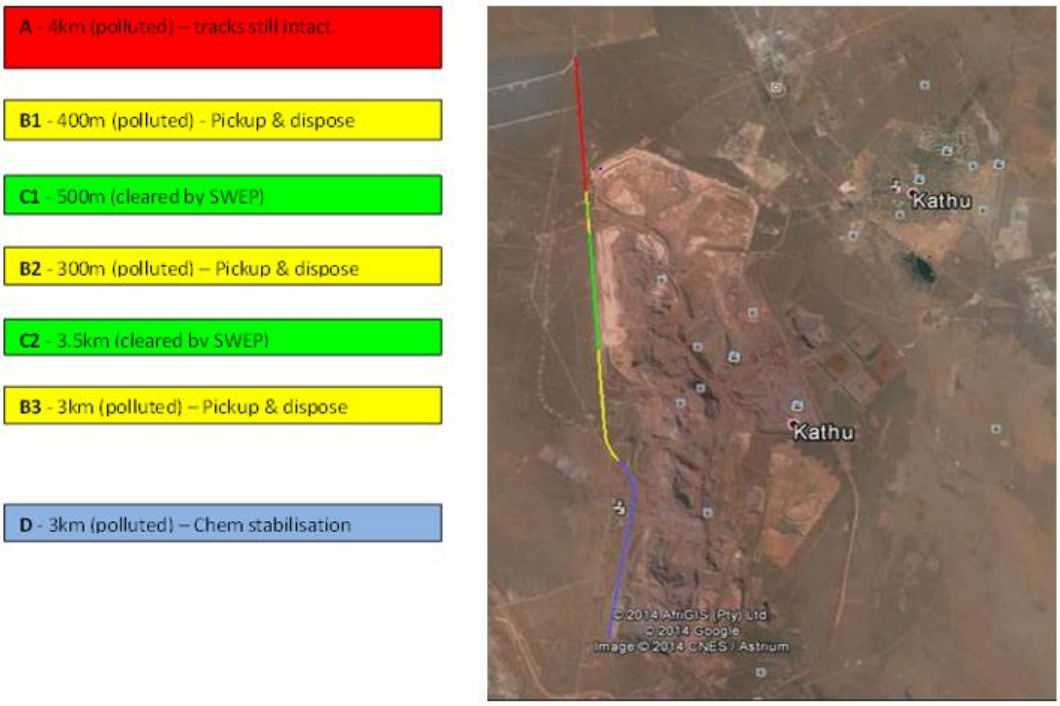

Figure 31: Areas where existing asbestos contamination is to be mitigated

Figure 32 indicates the areas to be cleaned. The above-mentioned clean-up projects will remove the asbestos risk.

4.12 Visual

The visual environment of the area around Sishen Mine is characterised by open, undulating to flat sandy plains, with a series of hills orientated in a north-south axis, including the Kuruman and Langberg mountain ranges, forming a backdrop for the otherwise flat plains. Mining activities since 1950 have altered this landscape through the deposition of waste rock and slimes, and the construction of the mine and slimes dams.

The semi-arid open nature of the landscape renders it particularly sensitive to visual intrusion. Due to the relative flatness of the landscape, views in the area are being dominated by the mine dumps that can be seen from great distances.

Areas frequented by tourists are generally regarded as more sensitive than agricultural areas in terms of visual impacts. However, there are no established guest farms/guest houses on any of the private farms immediately adjacent to the mine (NEWLA 2011 and Endemic Vision, 2011).

4.13 Sites of archaeological and cultural interest

The information contained in this section of the report was abstracted from the following sources:

- Environmental Impact Report (EIR): Sishen Iron Ore Mine Complex: Mining Right Application: Phase 1;
- EMPR Amendment and Consolidation: Sishen Iron Ore Mine; and
- 2015_12_15_SishenFarSouthPitScoping_V1.

It is essential that cognisance be taken of the larger archaeological landscape of the Northern Cape Province and the Kathu region in order to avoid the destruction of previously undetected heritage sites. Water sources such as pans, drainage lines and rivers should also be regarded as potentially sensitive in terms of possible Stone Age deposits.

Heritage evaluation in terms of the National Heritage Resources Act is not conducted yet. Even though many structures are older than 60 years at closure, the heritage valuation has not made to determine if the infrastructure will be retained. Heritage evaluation has to be conducted for closure planning.

A large number of archaeological and historical studies have been conducted in the Kathu area. These studies all infer a rich and diverse archaeological landscape around the town, but the Northern Cape Province at large encompasses a significant heritage legacy, mostly dominated by Stone Age occurrences.

The Northern Cape Province has a rich cultural heritage of numerous historical, archaeological, cultural, and natural heritage sites. Thirty-one key archaeological heritage sites and features were identified in the Northern Cape. Four of these are located within the Kgalagadi District.

There are two main driving forces behind the development and maintenance of these sites, namely, heritage and tourism. It is therefore important to maintain these sites in order to conserve them for heritage purposes, as well as for the possible attraction of local and international tourists which can boost the tourism industry and in turn the economy of the region.

The Stone Age surface scatters along the Gamagara River are of limited scientific value due to the mixing of artefacts caused by the erosion of the river banks and no significant impact on these resources is foreseen with any of the projects. Previous studies conducted in the larger Sishen area, coupled with isolated finds in 2010 by AGES suggests a rich and diverse archaeological landscape and cognisance should be taken of archaeological material that might be present in surface and sub-surface deposits. Such material might include:

- Formal Earlier Stone Age stone tools such as handaxes, choppers and cleavers.
- Formal Middle Stone Age stone tools such as points, blades and scrapers.
- Formal Later Stone Age stone tools such asmicrolithic blades, points and scrapers.
- Lithic residues and debris such as stone cores and flakes.

4.14 Noise

The information contained in this section of the report was abstracted from the following sources:

- Environmental Impact Report (EIR): Sishen Iron Ore Mine Complex: Mining Right Application: Phase 1;
- EMPR Amendment and Consolidation: Sishen Iron Ore Mine; and
- S2_SIO_Far-South_EIA Noise Study: Scoping Baseline Report 10 Nov. 2015.

In a 2009 survey conducted for the SWEP EIA, ambient noise levels in the farming area west of the Sishen Mine were found to be low, with little influence from Sishen mining operations and railway lines. Night-time ambient levels were in the order of 35 dBA, considered to be characteristic of Rural Districts. The low ambient levels at the time were ascribed to the distance of these farms from the railway lines and from the mine (> 6 km for most of the area surveyed). Traffic on local and distant roads and noise from mining activity in the larger surroundings had negligible effect on the night-time ambient levels observed and measured in the SWEP survey. No trains could be heard at night. For all practical purposes, the night-time level, including those locations where higher than average levels were recorded (e.g. Smit, Cornelissen), was caused primarily by insects and in some areas by frogs.

In the meantime, prior to the current survey, Sishen mining activities expanded and intensified, resulting in a greater contribution to ambient levels. More significantly, however, is the subsequent relocation of the railway line and the noise introduced by operation of the Postmasburg-Hotazel western bypass railway line in particular. Noise measurements in the current survey for the Far South study indicate that train noise is now impacting notably on some of the farm houses to the south-west. This confirms predictions made in the SWEP noise study, which indicated that the 40 dBA noise footprint of railway noise was expected to encroach on some of the houses along the Gamagara river.

Surveys conducted during the course of the past two years showed that, notwithstanding the considerable scale of mining activity, the noise impact of Sishen Mine in most of the areas to the north, east and south of the mine is still relatively low. There are two main reasons for this:

- Considerable distances have until now been maintained between Sishen and the nearest residents - north, east and south of Sishen; and
- Probably not intended for that purpose, the large discard dumps in and around the central mining area do act as effective noise screens between noise-sensitive areas and Sishen open pit operations and processing plants.

The mine does however have a more significant effect on the residents of Dingleton and in the future, is expected to have a growing impact on the nearest farms south-west of the mine. Some of these farms, in view of potential future expansions currently under consideration, lie in the proximity of the

mine's axis of growth. It is for this reason that the noise survey focused on Dingleton and the area west of the mine.

This and previous surveys show that ambient noise in most areas around the mine is still within acceptable levels. Dingleton is already experiencing elevated noise levels. Ambient noise levels on the nearest farms west of the mine are not currently affected significantly but are susceptible to and likely to be affected by noise from any new development in the proposed MRA area.

Ambient noise levels on the nearest farms west of the mine are not currently affected significantly but are susceptible to and likely to be affected by noise from any new development in the proposed MRA.

Noise in the decommissioning phase will be of a similar nature, but at a lower intensity and of shorter duration compared to noise in the operational phase. Decommissioning noise will be inaudible in noise-sensitive areas and the noise impact will be negligible. No residual noise impacts will remain after decommissioning of the mine.

4.15 Socio-economic structure

Population

The growth rate in the Northern Cape Province is lower than the national average. The John Taolo Gaetsewe District Municipality (JTGDM) shows a decline in population size since 2001 and this can most likely be ascribed to the closure of some of the asbestos mines in the district as well as the prevalence of HIV/AIDS (although it is well below the national prevalence rate). Negative growth is estimated for the area between 2005 and 2015 for both high and low growth scenarios (Kgalagadi District Municipality, 2007). The population in the Gamagara area has increased by almost 20% since 2001 and as the Sishen Mine is the largest employer in the area, the increase is in all likelihood due to an increase in mining activities (Ptersa, 2011).

In 2011, the Gamagara area had an average household size of 3.85, the highest of the three levels (provincial, district and local) under investigation. The household sizes on provincial and district level have also decreased slightly.

The population distribution of the Gamagara area shows greater similarities with the Northern Cape Province than with the JTGDM. 40% of the population of the Northern Cape Province belong to the coloured population and almost 50% to the black population group. In the JTGDM just over 80% belong to the black population group. This can be ascribed to the large presence of tribal land in the district. In Gamagara the black population makes up just over 55% of the population with only about 28% of the population belonging to the coloured population. Gamagara has proportionately the most people from the white population with about 14% of the population being white. This is most likely due to the presence of the Sishen Mine as the largest employer in the area. Technical expertise and tertiary

education is required for many jobs in mining operations. People from the white population group had a historical advantage in acquiring the technical skills and tertiary education required for some of the jobs (Figure 33).

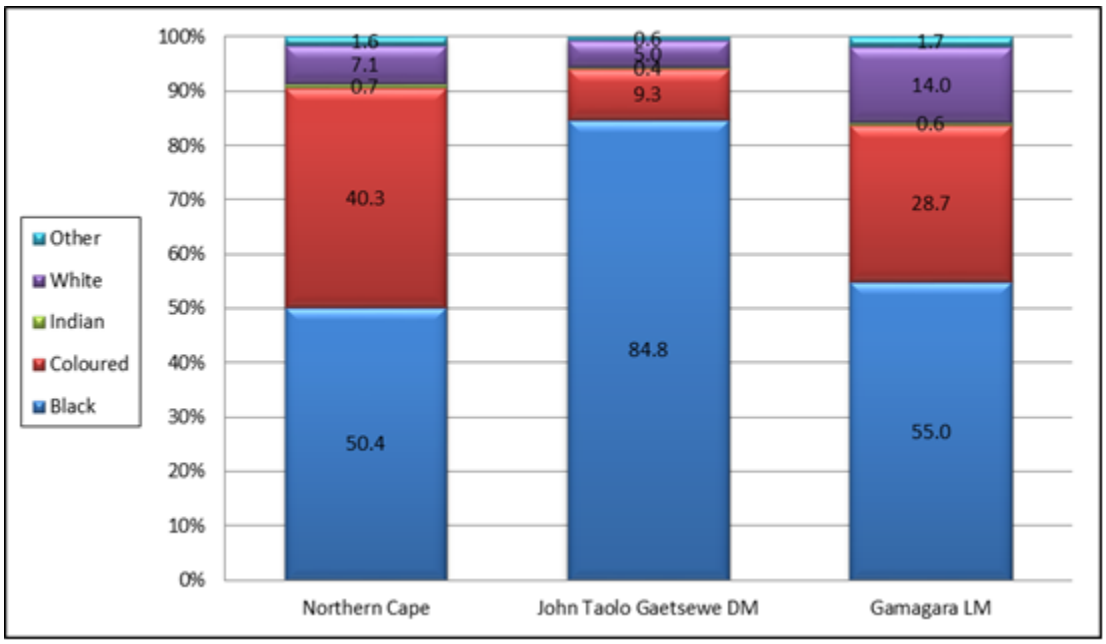

Figure 32: Population distribution

Age

The average age in Gamagara (28.87 years) is much higher than that of the district but just slightly lower than the average age of the province. The average age in the JTGDM is much lower than on provincial or local level. This can most likely be ascribed to the large tribal areas in the district where many people from economically active age migrate to other areas in search for work in order to support their families, while children and older people stay behind (Figure 34).

The age distribution profile of Gamagara is very similar to that of the Northern Cape Province with about 25% of the population being younger than 15 years and 72% of economically active age (aged between 15 and 64 years). In the JTGDM a smaller proportion of people from economically active age (592%) than in the other areas has to take care of children who make up almost a third of that population. This put more strain on those who are economically active.

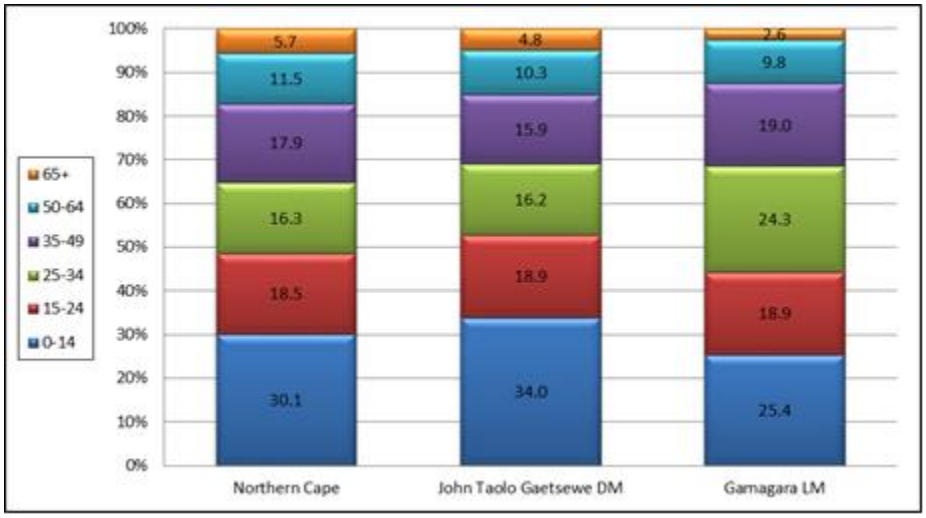

Figure 33: Age distribution

The large proportion of people below the age of 15 years in the district indicates a greater future demand for employment and infrastructure. More work seekers can migrate from the rural areas to the more urbanised areas in the district such as Kuruman and Kathu in search of job opportunities.

Gender

On provincial level the gender distribution is more or less equal (Figure 35), but in the JTGDM there are much more females than males. This is due to the large portions of tribal land in the district where many males have migrated to other areas in search of employment.

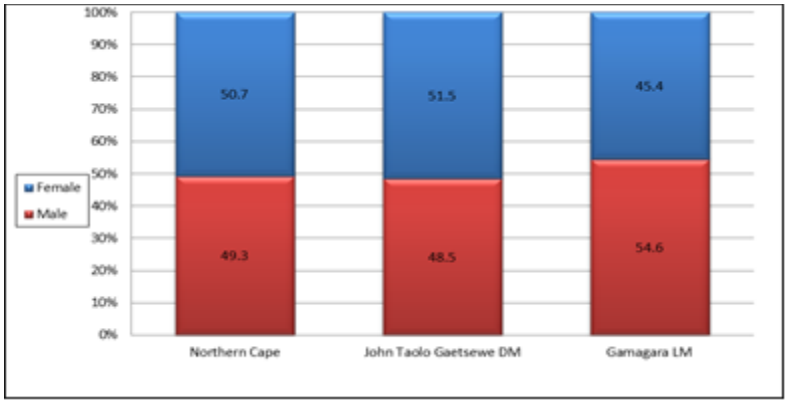

Figure 34: Gender distribution

In the Gamagara area there are more males than females, which can be ascribed to the extensive mining activities in the area. Traditionally mine workers tend to be male.

Language

The Census 2011 data for language was used to get an indication of the language distribution in the area. The language distribution of the Gamagara area is very similar to that of the Northern Cape

Province, with Afrikaans being the home language of more than 50% of the people and Setswana the home language of about a 30% of the people.

More than 70% of the people in the JTGDM district have Setswana as home language, indicating that this district is culturally very different from the other areas under discussion. The district borders Botswana and the greatest part of the population in the district live in tribal areas where mainly Setswana is spoken. All the tribal land in the Northern Cape is situated in the JTFDM.

Education

The education profile for people 20 years or older in the Gamagara area is very similar to that of the Northern Cape with the exception that Gamagara has a greater proportion people with tertiary education and less people who stopped their education at Grade 12. This can be ascribed to the nature of skills required by the Sishen mine as the largest employer in the area. Educational facilities in the area include a training college and six schools (Kgalagadi District Municipality, 2007).

Education Deprivation is one of the domains of multiple deprivations that were used to calculate the Provincial Indices of Multiple Deprivation (Noble et al, 2006). There is a close link between educational attainment, the type of work an individual is engaged in and the associated earnings potential. The level of education achieved by an individual determines current income and savings potential, as well as future opportunities for individuals and their dependants. This does not bode well for the JTGDM, as the education levels in the area are generally low.

Income

More than 60% of the people of economically active age (aged between 15 and 65 years) in the JTGDM district have no personal income. The absence of personal income can be linked to historical educational deprivation (Noble et al, 2006). The Gamagara area is more affluent than the district or the province with more people earning in the higher income categories.

Economic development

The following information is obtained from the Economic Study conducted as part of the Western Waste Rock Residue Stockpiles study (2012) by Urban Econ.

The importance of mining and mineral processing, in particular iron ore and manganese, driving economic development along with the agricultural, manufacturing, and tourism activities and is recognised by various provincial policies. The District Municipality's strategic documents further highlight the integral nature of the mining sector's development in ensuring sustainable livelihoods of the local communities and improving their standard of living. The SIOM itself is seen as a cornerstone of further expansion of the mining sector in the area. However, the strategic document calls for the greater management of negative impacts associated with the mining activities, such as road congestion, road condition deterioration, and air pollution. A great emphasis is also made on the need to diversify

the local economies to reduce the dependency on the mining activities' volatile nature and increase the sustainability of local communities, as well as on the need to perform more stringent environmental management and land use management. Overall, it can be concluded that the proposed project is in line with the local, provincial, and national developmental priorities; however, issues regarding negative impacts associated with mining activities will need to be taken into account (Urban-Econ, 2012).

Sishen Mine is one of the largest contributors to the economy of the Northern Cape. Sishen Mine's Social and Labour Plan was compiled with the Local Economic Development (LED) strategies and Integrated Development Plans (IDP) of the Gamagara Local Municipality and the Kgalagadi District Municipality as a guide. The Social and Labour Plan outlines Sishen Mine's commitment to contributing to the socio-economic development of its employees and the surrounding communities.

Unemployment remains one of the major challenges in some of these areas. The level of unemployment in communities around the mine differs due to skill and education levels. Kathu and Sesheng, both located closest to the mine, have the highest number of employed persons per household; Deben and Mapoteng have the highest number of households with at least one person unemployed compared with other towns.

Health

In communities around the mine, the prevalence of HIV and AIDS and other diseases is high. This is especially noticeable in informal settlements and poorer rural communities. In this regard, the mine is committed to addressing these issues by developing and implementing a comprehensive HIV and AIDS programme.

Despite the effort that all tiers of government have put in place in terms of investing in primary and secondary health care facilities, access to these facilities by poorer communities remains a hurdle.

Tourism

Tourism in the vicinity of Sishen Mine consists mainly of a variety of guesthouses catering largely for business. There are various guest / game farms in the area that offer hunting. However, there are no established guest farms / houses on any of the private farms directly adjacent to the mine.

Activities immediately adjacent to site

There are a number of privately-owned farms located to the west of the site. Based on the survey conducted during March 2012 (Urban Econ), the dominant activity on the farms is cattle grazing with an average grazing capacity of 9ha per animal. According to the District's Spatial Development Framework 2012 (SDF), the average grazing capacity of the land in the area is estimated to be even lower and range between 14 and 17 ha per animal.

In addition to cattle grazing, some farmers carry stock of sheep (about 30% of farms) and game (about 60% of farms). Game farming, though, is not the commercial business on the farms, except for one farm, and does not comprise the primary income generating activity. Game kept on the farms largely includes antelope which roam in the same territory as cattle. It is used for biltong hunting by farmers themselves as well as small numbers of domestic biltong hunters.

Semi-arid climate and subsequent climate change effects are considered to be one of the greatest factors affecting the potential of the agricultural activities in the municipality, including the area next to the SIOM. The problem though is exacerbated by the decreasing levels of underground water table, due to the fact that its extraction by various users is not appropriately replenished by precipitations and transfers from other catchments (JTG DM, 2012).

5. CLOSURE VISION, OBJECTIVES AND FINAL LAND USE

5.1 Closure vision

The Sishen closure vision is to make sure that the Sishen zone of influence is a sustainable, safe, stable, non-polluting, and healthy environment with predominately grazing potential supporting small scale socio-economic enterprises.

The following principles were defined in support of the closure vision and applied in the development of closure success criteria:

- Identified risk (Safety, Health, Environment and social) will be mitigated to acceptable levels;
- Rehabilitation objectives need to be achieved;
- Post closure remnants must confirm to the concept of sustainability; and
- Contribute to local economic development and manage direct socio-economic impact.

5.2 Final land use

Potential socio-economic opportunities in the area were identified during a Rapid SEA workshop, taking all the identified strengths, weaknesses, opportunities, and threats into account, so as to indicate possible post closure land uses.

In order to fulfil the above vision, the post-closure land use options for the mine include the following:

- The farming areas (the current undisturbed areas owned by Sishen Mine) are to be utilized for game and/or cattle production which is also the current use of the land;
- The mining infrastructure area must be reverted back to grazing and incorporating it into the bigger farming area;
- The mine residue sites (waste rock, plant discard, and slimes) and pit area must be made safe, and stable and should be utilized as waste land;
- There can be possible utilisation of the industrial infrastructure on the mine with a sustainable post closure use;
- Investigate and utilize the potential of part of Kathu as a possible future retirement village;
- Small scale socio-economic business development can take place in the area;
- The areas on top of the waste dumps could be utilised for the establishment of a solar energy facility.

Land use opportunities that could translate into the above listed uses have been identified and are listed below:

- The re-processing of residual material for making bricks and tiles. There is also a possibility of re-mining the existing pit by smaller mines;
- There is a potential for light industries using the existing infrastructure of the mine;
- There is a potential for game and cattle farming;
- The housing units built for the mineworkers can be converted into a retirement village in Kathu;
- An agreement could be put in place with the DWS for the re-utilisation of the water supply system on the mine after closure;
- Some of the existing infrastructure on the mine can be used as a central maintenance and mining support system for neighbouring mines;
- The mine can be used as a centre for skills development, training, and education for the area;
- The mine can be used as a central loading and distribution centre for material utilizing the existing rail system and loading terminal;
- Small scale specialist tourism can be promoted in terms of golf, gliding, and bird watching;
- Small business initiatives can be opened in the area.

In terms of post-closure land use, the following uses have been defined for the mining right area:

- The mined open pit must be made safe and stable, with wilderness as final land use;
- Game and cattle farming in disturbed and undisturbed open areas;
- Safe, stable, and unpolluted mineral residue areas (grazing not included);
- Certain waste dumps could be utilised for the establishment of solar energy facilities, if feasible;
- Industrial activity post closure in the mining area, where appropriate;
- The establishment of a possible retirement village in Kathu; and
- Small-scale, socio-economic business opportunities that can be implemented sustainably.

All level gradient areas will be rehabilitated to accommodate small livestock farming. The open pit will remain and access barriers be put in place. Grazing to be implemented on top of waste dumps, with an alternative of the establishment of solar energy facilities. Waste dump slopes to be rehabilitated to wilderness status as far as possible.

Post mining land use will initially entail the removal of most of the infrastructure and rehabilitation the area to a state that will facilitate grazing or other facilities as noted above.

Table 9 indicates interim closure criteria (actions to be taken as part of mine closure to mitigate identified closure risks) and the proposed end uses for the different domains.

Waste dumps, tailings and slimes dams will be rehabilitated as far as possible to a stable condition to facilitate low density grazing on dump tops or to be used for solar energy facilities. It is anticipated that the final pit voids will get filled with water, the details of which are still to be determined

Table 9: Interim closure criteria and proposed end land uses

Area	Interim criteria	End use
Open pit	Open pit will be made safe (prevent access) and stable as far as possible	Wilderness
All remaining disturbed and undisturbed areas	Implement game and cattle farming on level gradient areas	Grazing
		Small scale specialist tourism can be promoted such as gliding and bird watching;
Mineral residue areas (waste rock, plant discard, and slimes)	Mineral residue areas will be made safe, stable, and non-polluting	Wilderness or wasteland
		Wilderness
		Implement grazing on top of waste dumps, alternatively establish solar energy facilities if feasible
Mining area – existing infrastructure	Leave some buildings intact to be used for Industrial or other activities. Redundant infrastructure to be removed	Small-scale, socio-economic business opportunities
		Central maintenance and mining support system for neighbouring mines
		Use as a centre for skills development, training, and education for the area
		Use as a central loading and distribution centre for material utilizing the existing rail system and loading terminal;
Kathu – housing units for the mineworkers	Establish a retirement village or sell houses to employees or other interested parties	Retirement village
Current farming areas (the current undisturbed areas owned by Sishen Mine)	Implement game and/or cattle production combined with conservation and tourism activities	Grazing, conservation
Water supply system	Re-utilisation of the water supply system (DWS agreement)	Water supply

The figures below illustrate the proposed final land uses, inside the mining area (Figure 36) and outside the mining area (Figure 37).

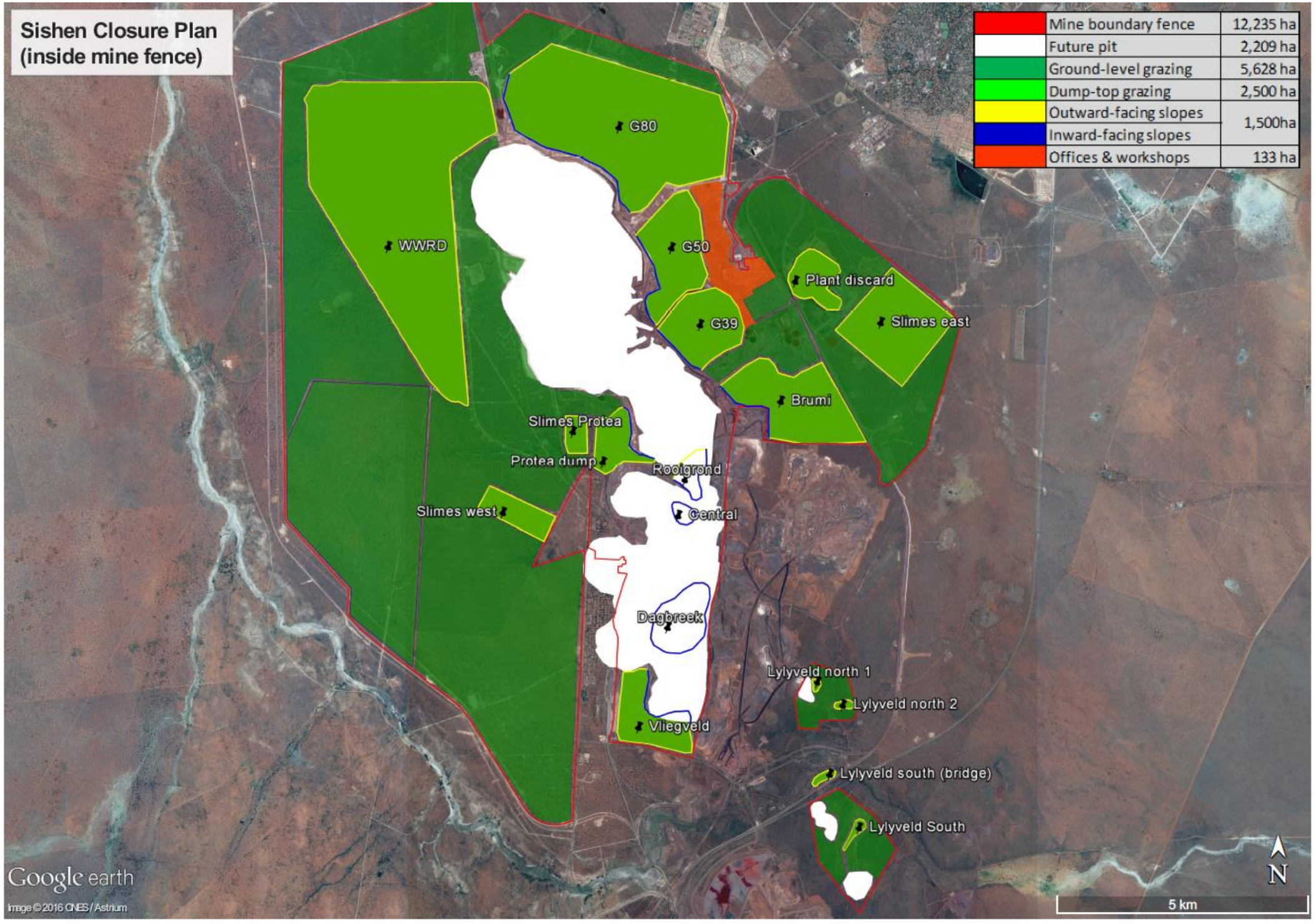

Figure 35: Final land use inside mining area

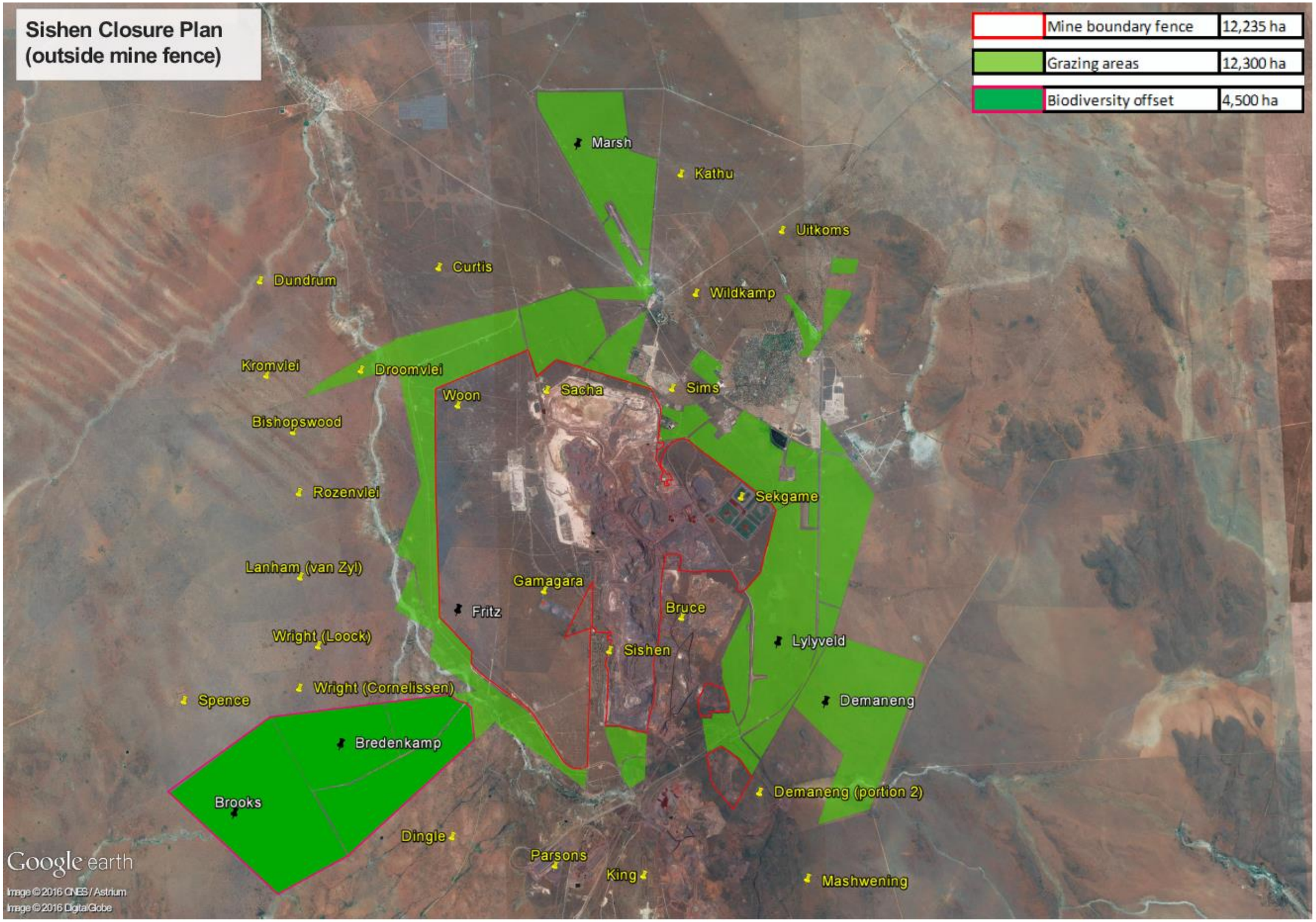

Figure 36: Final land use outside mining area

5.3 Closure objectives

The overarching goals for closure are described below, and give effect to physical, biophysical, and social closure objectives tabled below:

- A walk-away closure with limited / no significant long-term liabilities that require management;
- Rehabilitation is of high quality and sustainable into the predictable future;
- Proposed post-closure land uses are sustainable;
- Stakeholder engagement is undertaken and their views have been taken into account in closure planning;
- Permanent Sishen employees have been successfully redeployed or re-skilled;
- Legal compliance has been achieved;
- Authorities will be satisfied with the extent of rehabilitation and closure criteria; and
- The DMR will be satisfied to issue a closure certificate with limited / no significant conditions attached.

From the overarching goals the following objectives are applicable to Sishen Mine:

Table 10: Detailed closure objectives

Physical Objectives	Biophysical Objectives	Social objectives
All the rehabilitated land is safe and useable, excluding the open pits and potentially the pit-facing slopes of the WRD's, which will be wilderness.	Minimise all negative impacts on the bio-physical environment as far as possible.	Ensure that issues will be addressed and managed so that the main objective and acceptable closure plan can be attained
All rubble from plant decommissioning and related areas do not cause long term degradation or become a safety hazard	That rehabilitated areas can be utilized in a sustainable manner.	Stakeholder engagement is undertaken and their views must be considered during closure planning
All waste dumps be closed and rehabilitated as per the legislative framework	Ground- and surface water will not be polluted once the mine is closed. (e.g. slimes dams);	Permanent employees will be re-deployed and re-skilled to minimise job losses as far as possible.
Land be physically and chemical stable	To ensure legal compliance in terms of biophysical closure	To stimulate the economy of the area by implementing viable projects that will enable some of the employees to be redeployed within that sector
The safety zone of the open pit is established and suitable measures taken to prohibit access		That rehabilitation work as well as other related work with regards to closure is not outsourced but that ex-employees can form part of this process, as far as possible,

Physical Objectives	Biophysical Objectives	Social objectives
		ensuring job continuation after closure
		That mine owned houses are sold to individuals
		That employees are generally satisfied with re-deployment, re-skilling and alternative employment opportunities

Objectives translated into ISO 14 001

The ISO 14001 EMS system should be used as an internal system to ensure closure objectives are integrated into the day-to-day operations of the mine. The Closure Vision and SHE policy is aligned to ensure coherence in the management commitments and its management systems (Figure 38). The closure mitigation sheet produced from the closure risk assessment translates into recommendations and monitoring to provide increased information to understand risks or to reduce the risks. The mitigation measures / key recommendations are set out as environmental projects or programs that can be implemented via ISO 14001, and in return, be monitored for continuous improvement.

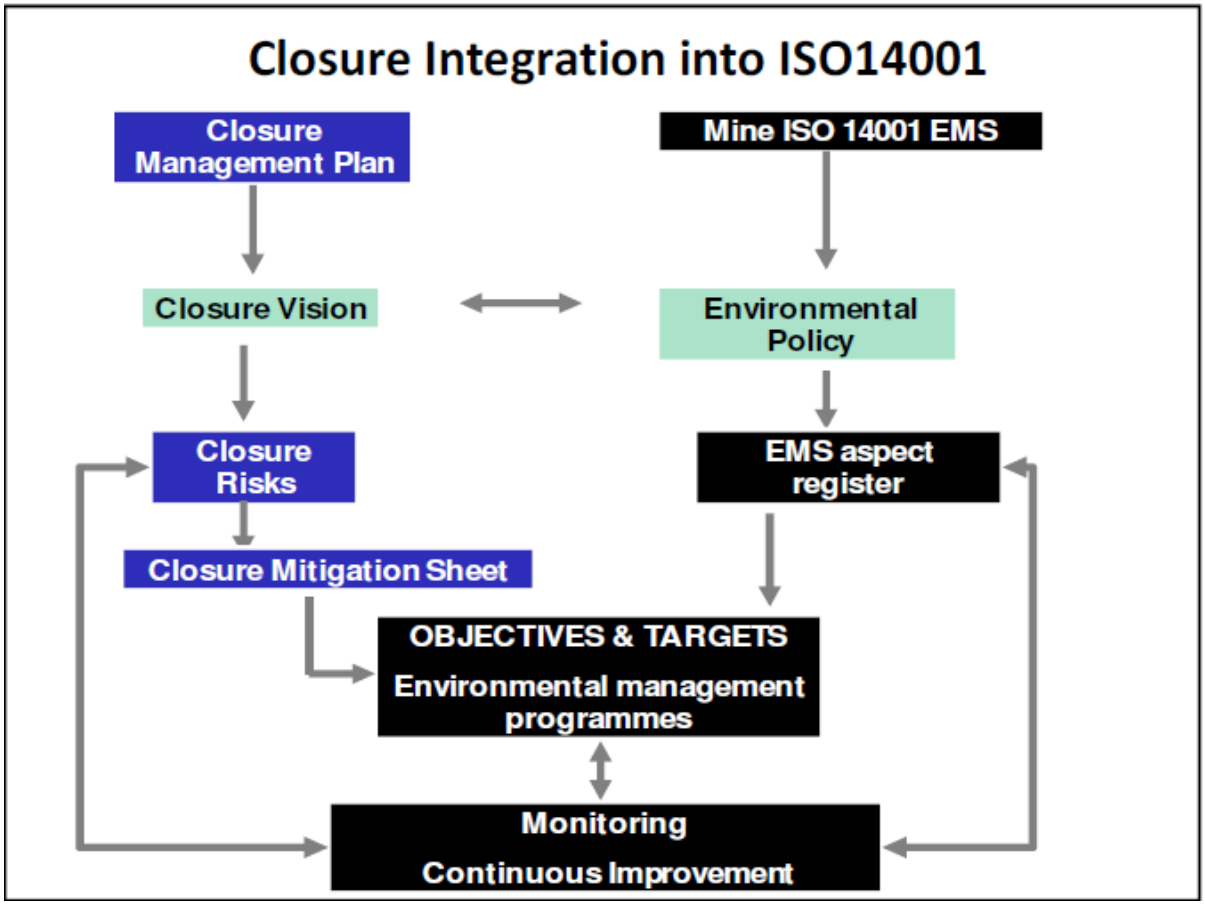

Figure 37: Integrating closure with ISO 14 001

Objectives integrated into LOM planning

To ensure closure objectives are integrated into the company's LOM plans, the following is recommended:

- The LOM Plan protocol should be updated to address the key issues highlighted through this closure planning process.
- The environmental department of the mine is a required signatory to the LOM Plan.
- The concurrent rehabilitation plan (3-year plan) should also be included as a part of the LOM plan.
- Coherence between the mining plan, waste deposition plan, and rehabilitation plan should be vetted by appropriate managers before official approval of the plan.

6. CLOSURE RISK ASSESSMENT AND CRITERIA

6.1 Introduction

The aim of this risk assessment is to give the necessary confidence to the mine and regulatory authority that the mine has accurately predicted its long-term closure impacts and made the necessary resources and financial provisions available to address these impacts.

The objective of the environmental risk assessment is to–

a) ensure timeous risk reduction through appropriate interventions;
b) identify and quantify the potential latent environmental risks related to post closure;
c) detail the approach to managing the risks;
d) quantify the potential liabilities associated with the management of the risks; and
e) outline monitoring, auditing and reporting requirements.

From a regulatory point of view, the authorities will know what liabilities they are accepting when granting closure – albeit after an appropriate monitoring period to demonstrate the accuracy of impact predictions. In the event a closure certificate is granted, it is imperative that there will be limited risk of identifying further unknown problems after closure has been granted.

6.2 Approach and methodology

6.2.1 Scope of the risk assessment

The risk assessment is limited to the mining lease area and the selected off-site infrastructure. The risk assessment considers four areas: physical, biophysical, social, and general closure items (Table 11). Applicable items in each area are selected as appropriate to each operation. The external influences include, but are not limited to the parties that are affected or interested in the closure of the mine; and biophysical influences such as climate, ground, and surface water entering the mine lease area.

Table 11: Scope of risk assessment

Physical	Biophysical
1. Mineral waste	**4. Receiving environments**
1.1 Tailings facilities	4.1 Biodiversity
1.2 Plant discard	4.2 Groundwater
1.3 Pollution control dams	4.3 Surface water
1.4 Waste rock dumps	4.4 Land use / Land capability
1.5 Stockpiles (ore)	
1.6 Open pits	
2. Non-mineral waste	**Social items**
2.1 Domestic waste site	5.1 Employees and dependants
2.2 Hazardous waste site & bioremediation facility	5.2 Affected parties
2.3 Polluted areas (soils)	5.3 Interested parties
2.4 Building rubble	5.4 Regulators
2.5 Metal waste	5.5 Economic
2.6 Tyre waste	5.6 Health
2.7 Radio-active waste	
3. Built infrastructure	**General issues**
3.1 Processing plant areas, workshops & offices, electrical sub-stations, Fuelling stations, Explosives magazine	6.1 Monitoring
3.2 Mine towns / housing / schools / off-site infrastructure	6.2 Maintenance
3.3 Roads	6.3 Detailed designs
3.4 Conveyors	6.4 Project Management
3.5 Railways	6.5 Closure costing
3.6 Powerlines, telephone lines, pipelines, fences	6.6 Preliminary & General
3.7 Weirs, canals & berms	

6.2.2 Assumptions

Detailed operational risks associated with the mine, for example safety baseline risk assessments, were excluded from the scope as it was being assessed via the normal operational risk processes and applicable primarily to operational phase activities.

Specific assumptions of each area assessed are listed as part of the risk mitigation plan, refer to the risk assessment in Table 17 (summary) & Appendix 1 (complete). This approach was taken because a risk would be reduced by either a key assumption of the risk or the mitigation strategy (closure criteria) implemented.

6.2.3 Risk assessment approach

A three-tiered risk assessment approach was followed, as described below:

- Level 1
  The existing closure risk assessment from previous processes used as the initial screening risk assessment.
- Level 2
  Refined risk assessment that includes an assessment of premature and post-closure risk ratings. Semi-qualitative with existing data. New data required is noted. Where a level 3 risk assessment has been conducted, this work is referenced and guides the risk rating.
- Level 3
  In-depth analysis of the level 2 risk assessment. This is a specialist study with specific risk analysis tools, data extrapolation and modelling applied to address a risk highlighted during the level 2 risk assessment.

The Anglo American Integrated Risk Management System (IRM) applies a heat map (5x5 matrix) to assess risks according to seven (7) types - health, safety, environmental, legal, financial, reputation, and community risks. The risk areas and risk rating heat map (5x5 matrix) of this system are applied as is. Risk ratings are high, significant, medium, and low. Where uncertainty remains, a risk is rated as medium–significant, as a conservative approach is followed until the risk is fully known. The heat map (Table 12) considers specific descriptions of each area in terms of likelihood and consequence (Appendix 1).

Table 12: IRM heat map

Event Risk Rating/Priority (1)					
Consequence / Likelihood	1 Minor	2 Low	3 Medium	4 High	5 Major
5 Almost Certain	Medium (11)	Significant (16)	Significant (20)	High (23)	High (25)
4 Likely	Medium (7)	Medium (12)	Significant (17)	High (21)	High (24)
3 Possible	Low (4)	Medium (8)	Significant (13)	Significant (18)	High (22)
2 Unlikely	Low (2)	Low (5)	Medium (9)	Significant (14)	Significant (19)
1 Rare	Low (1)	Low (3)	Medium (6)	Medium (10)	Significant (15)

The risk rating obtained with the Anglo system was used to undertake a screening level risk assessment of post-closure risks as required by Section 60 of the MPRDA (i.e. qualitative identification of significant, uncertain an insignificant risks). Post-closure risks rated as high with the Anglo American rating system is regarded as potentially significant in terms of the MPRDA rating system, post-closure risks rated as significant or medium are regarded as uncertain and closure risks rated as low are regarded as insignificant. The comparison between the Anglo American and MPRDA risk values is illustrated in Table 13.

Table 13: Correlation between MPRDA and Anglo risk values

Anglo IRM rating	MPRDA qualitative rating
High	**Potential significant**
Significant	Uncertain
Medium	
Low	Insignificant

6.3 Closure criteria

Closure criteria are the agreed tasks/measures involved in mitigating identified closure risks. The criteria therefore present the actions that will be taken as part of mine closure and involves activities such as removal of infrastructure, erecting fencing, installing drainage structures, reshaping, topsoiling, ripping, seeding and planting, maintenance and monitoring. The closure criteria are used as the basis for estimating the closure cost.

The closure criteria for Sishen Mine have been set for the different domains shown in Table 14. These criteria are constantly being refined throughout the life of the mine. With each refinement, more data becomes available and greater understanding of the risk and cost requirements become apparent. In return, the refined closure criteria impact the closure costs.

The closure criteria are summarised in Table 14 and set out in detail in the Closure Risk Assessment (Appendix 1). The closure criteria are detailed for each item evaluated in the risk assessment, and describes the actions to be taken to address closure risks. The assumptions applicable to the respective items, the closure cost approach and methods applied to determine costs applicable to the criteria are also provided in Appendix 1.

Table 14: Closure criteria

Domain	Closure criteria
Tailings facilities	Slope, infill, revegetate Storm water management Reduce ground water impact
Plant discard dump	Source for topsoil / growth medium Sloping, revegetate Storm water management

Domain	Closure criteria
Pollution control dams	Complete removal, infilling, levelling of areas. Free drainage post closure
Waste rock dumps, Ore dumps & stockpiles	Access control Sloping, topsoil & revegetate Storm water management
Open pits	Stabilise, access control, storm water management Bird habitats
Dirty water control dams	Demolish, revegetate Storm water management
Domestic waste site	Revegetate Storm water management
Hazardous waste site	Removal Storm water management Revegetation
Polluted areas (soils)	Removal, Revegetation Storm water management
Metal waste	Remove & salvage
Tyre waste	Removal
Radio-active waste	Removal
Infrastructure Areas - Retained Structures (ongoing rehabilitation work, mine town, housing, schools, airport, third party business)	Stable infrastructure, sell, lease, donate
Infrastructure Areas - Demolished Structures (No sustainable further use)	Demolish, building rubble and hazardous waste disposal, vegetate
Roads	Rip, vegetate, storm water management
Railways	Remove, revegetate
Fences	Remove, remains at certain areas
Off-site infrastructure	Transfer (Lease, sell or donate)

6.4 Risk Assessment Results

6.4.1 Detail risk assessment results

The detailed risk assessment is tabulated in the Risk Assessment Table (Appendix 1). The table includes a description of the risks (unwanted events and consequences), the risk rating with and without mitigation, the proposed closure criteria / mitigation measures to address the identified risks as well as assumptions and notes relating to the risk rating and closure criteria. The table also identifies additional actions / information requirements to improve the risk assessment accuracy where required.

6.4.2 Summary of premature closure risks

Sishen's premature closure risk is high due to two reasons: the mine was developed under a less stringent environmental legal regime that did not require careful closure management; and because there is a significant backlog with regards to concurrent rehabilitation. Table 15 below indicates the number of insignificant, uncertain and significant risks per risk type (e.g. environment, health, safety, etc.), while Table 16 indicates significant risk management areas as per the risk assessment scope. Table 17 contains the potential significant risks (pre-mitigation).

Table 15: Summary of premature closure risks

Risk category	Premature closure impact rating (pre-mitigation)							Total
	Health	Safety	Environment	Financial	Reputation	Social	Legal	Max rating
Insignificant risks	7	3	4	19	11	18	11	**3**
Uncertain risks	15	29	47	55	47	43	51	**66**
Potential significant risks	7	9	55	29	30	17	26	**72**
Total risk frequency	**29**	**41**	**106**	**103**	**88**	**78**	**88**	**141**

Table 16: Significant risk management areas

Physical	Biophysical
1. Mineral waste	**4. Receiving environments**
1.1 Tailings facilities	4.1 Biodiversity
1.2 Plant discard	4.2 Groundwater
1.3 Pollution control dams	4.3 Surface water
1.4 Waste rock dumps	4.4 Land use / Land capability
1.5 Stockpiles (ore)	
1.6 Open pits	
2. Non-mineral waste	**Social items**
2.1 Domestic waste site	5.1 Employees and dependants
2.2 Hazardous waste site & bioremediation facility	5.2 Affected parties
2.3 Polluted areas (soils)	5.3 Interested parties
2.4 Building rubble	5.4 Regulators
2.5 Metal waste	5.5 Economic
2.6 Tyre waste	5.6 Health
2.7 Radio-active waste	
3. Built infrastructure	**General issues**
3.1 Processing plant areas, workshops & offices, electrical sub-stations, Fuelling stations, Explosives magazine	6.1 Monitoring
3.2 Mine towns / housing / schools / off-site infrastructure	6.2 Maintenance
3.3 Roads	6.3 Detailed designs
3.4 Conveyors	6.4 Project Management
3.5 Railways	6.5 Closure costing
3.6 Powerlines, telephone lines, pipelines, fences	6.6 Preliminary & General
3.7 Weirs, canals & berms	

Table 17: Potential significant risks (pre- and post-mitigation)

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
PHYSICAL CLOSURE						
1. MINERAL WASTE						
1.1 Tailings facilities						
1.1 (C) Groundwater contamination	Possible health impact of ground water dependent users, environmental resource degradation as a result of elevated metals or salts within the tailings, legal penalties in terms of NWA, reputation damage of Kumba seen as major polluter		21	i) Same criteria as for 1.1 (B), including groundwater monitoring ii) All oil spills from operational phase to be cleaned up before rehabilitation	Additional actions: i) Develop post-closure groundwater contamination model to determine post-closure risk	7
1.1 (H) Loss of agricultural land	Reduced land use capability, Loss of alternative economic gains post closure.		21	i) Same criteria as for 1.1(B), including vegetation monitoring	Assumption / notes: i) Return to agricultural land capability is expected to be possible to a certain degree for the tailings facility	17
1.1 (I) Dam leakage	Polluted surface water, Contaminated soils, Drainage and pollution to groundwater, Erosion Polluted drinking water for animals and persons Legal non-compliance to NWA and NEMA Financial clean-up and remediation costs Social and Reputational damage to direct neighbouring properties sharing same surface water		21	i) Monitor rehabilitated areas against success criteria, including leakage detection	Assumption / notes: i) Dam leakage unlikely after rehabilitation and closure with storm water measures in place	1
1.2 Plant discard						
1.2 (G) Visual and aesthetic degradation	Landscape alteration Impact on tourism, sense of place, land-use value Non-compliance to NEMA because of safety risks of remediating long slopes Impact on Municipal Spatial Development Framework / Integrated Development Plans		21	i) Same criteria as for 1.2(B), including vegetation monitoring	Additional actions: Develop stable post-closure landform (consider reshaping of top edges to create a natural profile and break straight lines)	18
1.2 (H) Loss of agricultural land	Reduced land use capability, Loss of alternative economic gains post closure.		21	i) Same criteria as for 1.2(B), including vegetation monitoring	Additional actions: i) Develop end use alternatives and proven rehabilitation prescription for discard dump	21
1.4 Waste rock dumps						
1.4 (A) Uncontrolled access	Illegal access to possible unsafe areas. Impact on rehabilitated areas by people or livestock. Safety incidents.		21	i) Current site fencing and signage to be retained post-closure ii) Redundant infrastructure will be removed	Assumptions / notes: i) Site currently fenced and access control in place	1
1.4 (E) Erosion	Erosion furrows Deposit waste at toe of dump - footprint extension Loss of rehabilitation work Regulation 704 possible noncompliance Storm water damage - repair required DWA concern and reputation damage		21	i) Same criteria as for 1.4(B), including surface erosion monitoring		7

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
1.4 (G) Visual and aesthetic degradation	Landscape alteration Impact on tourism, sense of place, land-use value Non-compliance to NEMA because of safety risks of remediating long slopes Impact on Municipal Spatial Development Framework / Integrated Development Plans		25	i) Same criteria as for 1.4(B), including vegetation monitoring		22
1.4 (H) Loss of agricultural land	Loss of previous land capability (grazing - waste)		25	i) Same criteria as for 1.4(B), including vegetation monitoring		22
1.5 Stockpiles (ore)						
1.5 (C) Groundwater contamination	Possible health impacts of groundwater dependent users, Environmental resource degradation. Legal penalties in terms of NWA, Reputation damage of Kumba seen as major polluter.		23	(i) All oil spills from operational phase to be cleaned up before rehabilitation. (ii) Runoff water considered clean after vegetation cover.	Assumptions: (i) Same as Waste rock dumps	11
1.5 (D) Surface water contamination	Siltation from Stockpiles Dirty water run-off ITO regulation 704		23	(i) Rehabilitation of affected drainage lines and floodplains (ii) post closure landscape to replicate original as far as possible. Free flow drainage.		11
1.5 (J) Soil contamination	Polluted soils on site affected waste volumes, remedial costs, environmental quality for future land use. Polluted soils also has human and animal health impact		23	(i) Bioremediation plant remains until all contaminated soils from demolition works are treated and reintroduced into natural system as safe.		7
1.6 Open pits						
1.6 (A) Access	Safety incidents, Polluted water intake by animals or people		21	(i) Building rubble and non-hazardous waste to be buried in pit. (ii) Access control signage.	Assumptions: (i) Pit stability when recharge takes place needs to be re-assessed and criteria updated if required. (ii) The assumption that the pit side slopes is stable is being queried and additional investigations are underway. Risk Reward analyses. (iii) It is assumed that a portion of the pit volume will be backfilled before closure and that this will be achieved from dump rock material excavated in the latter years. (EMPR requirement)	18
1.6 (K) Dewatering of groundwater due to pumping or evaporation			21	(i) Ground water pumping to cease and pit recharged post closure.		20
1.6 (C) Reduced groundwater quality	Salinization of water and high mineral / dissolved solid content resulting in reduced water use capability. Financial impact only applicable if water purification is required - with current results this is not required		21	(i) Ground water pumping to cease and pit recharged post closure.		18
1.6 (L) Impact on groundwater level and quantity			21	(i) Ground water pumping to cease and pit recharged post closure		20
1.6 (B) Instability & failure	Failure resulting in unsafe areas, extended footprint, loss of natural habitat and rehabilitation work. Reputation damage as Kumba is linked to failure. Financial clean-up and remediation costs		21	(i) The top bench will be cut back to 1v:3h slope to a minimum of 3m below the natural ground surface and a 2m high berm with 1m deep trench on the outside constructed around the pit. This will serve as safety measure for humans and animals as well as to prevent clean surface runoff water from entering the pit. (i) All access roads into the pit will be rehabilitated and trenches will be cut into the top bench of the pit access road to prevent vehicles from entering the pit. (i) The geological evaluation indicated that cut-back line of 34 degree slope from the pit floor-level is required as a guideline and it should be confirmed at risk assessment review. Average 40 metre buffer should		21
1.6 (H) Loss of agricultural land	Loss of previous land capability (grazing - pit)		25			25

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
				be kept between pit boundary and waste dump toe line. End February 2013 current mine pit dewatering simulation with geohydrological model will be completed. Incorporate pit construction guideline.		
1.6(D) Surface water (Quality catchment runoff)	Affected surface water entering natural systems. Legal non-compliance to regulation 704. Environmental resource impact, extended impact footprint. Reputation damage linked to non-compliance. Remediation and management costs.	Hydrology report, Golder and Associates, 2003	21	(i) Dirty water containment and management according to storm water master plan		20
1.6 (M) Surface water (Quantity Catchment Runoff)	Water influx result in pit stability risks. Pit safety affected. Because water remains in pit, legal requirements are met ito regulation 704 - not pumped out		21	(i) The open pit will remain after closure and allowed to fill up with water over time. Rubble material may be disposed of inside the pit if it is found that this will not be detrimental to the environment in the long term.		21
2. NON-MINERAL WASTE						
2.1 Domestic waste site						
2.1 (C) Groundwater contamination	Polluted ground water. Affecting possible third party use. Degradation of environmental resource.	IWULA 2009	23	(i) All contaminated areas removed. (ii) Seepage to groundwater should be eliminated. (iii) Soil samples to prove possible residual impacts.	<u>Assumptions:</u> (i) Could have premature closure liability but not a LOM liability should dump advancement over facility be acceptable. (ii) Rehabilitation costs to rehabilitate dump over domestic site applies and is calculated under dumps.	1
2.1 (D) Surface water contamination	Siltation from Domestic Waste Site Dirty water run-off ITO regulation 704		23	i) Same criteria as for 2.1 (C), including soil sampling		1
2.1 (N) Change of land use - sterilisation of land	Environmental degradation of natural resource Reduced land use capability and food production Reduced sense of place ito farming and tourism Financial compensation is to recover loss of land use (rehab or offset) Kumba reputation associated with mining legacy in natural veldt		23	(i) Reshaping (ii) Topsoil capping of 300 mm. (iii) Planting and seeding of trees and grasses. Fertiliser application. (iv) Weed control.		23
2.1 (B) Instability and subsidence of waste material	Unstable area with subsidence with possible safety risk. Unsuitable for certain land use - any future construction (roads, infrastructure)		23	(i) Complete removal, infilling levelling of areas. (ii) Free drainage post closure. (iii) Reshape area in line with surrounding landscape. (iv)Rip final levelling.		9
2.2 Hazardous waste site & bioremediation facility						
2.2 (C) Groundwater pollution	Reduced natural resource quality Impact on Ground water dependent users Human and animal health impact from using affected ground water Financial remedial costs Kumba reputation associated with ground water pollution Farming community affected		23	i) Same criteria as for 2.1 (C), including soil sampling	<u>Assumptions:</u> (i) Similar as built infrastructure costing approach	20

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
2.2 (D) Surface water pollution	Regulation 704 non-compliance, Extension affected area where surface water flow. Secondary impact - soil contamination and change in chemical structure. Migration of affected material to other areas - increased footprint Clean-up costs		23	i) Same criteria as for 2.1 (C), including soil sampling		19
2.2 (J) Soil contamination	Polluted soils on site affected waste volumes, remedial costs, environmental quality for future land use. Polluted soils also have human and animal health impact		23	(i) Consider remediation of possible contaminated soils at bioremediation plant (operating costs) (ii) Additional soil samples required throughout process (3 per annum). (iii) Remediate soil to be used for growth medium		20
2.3 Polluted areas (soils)						
2.3 (C) Groundwater contamination	Possible health impacts of ground water dependent users, Environmental resource degradation. Legal penalties in terms of NWA, Reputation damage of Kumba seen as major polluter		23	(i) Area to be sampled for possible soil conditions that could seep to ground water. (ii) Ground water monitoring in place and to continue post closure.	Assumptions: (i) Quantities assessed, locations identified and action plans developed. Additional actions: (i) The impacts on soils from the railway lines, storm water channels and wider area still needs to be assessed. (i) Residual impacts to be determined.	20
2.3 (D) Surface water contamination	Siltation from Domestic Waste Site Dirty water run-off ITO regulation 704		23	(i) Storm water master plan. (ii) Operational storm water system to remain until area is rehabilitated and safe for free flow storm water		20
2.3 (J) Polluted, affected or changed soil	Loss of soil quality Natural resource loss (topsoil) Hazardous materials on site Regulation 704 compliance		23	(i) Bioremediation plant remains until all contaminated soils from demolition works are treated and reintroduced into natural system as safe.		20
2.4 Building rubble						
2.4 (O) Accumulated building rubble waste on site	Landscape alteration. Unsafe areas for human or animal access. Reduced sense of place. Permanent change of land use. Removal costs		21	(i) Removal, on-site burial or selling.	Assumptions: (i) It is currently assumed that rubble material will not cause significant groundwater contamination, however, this will have to be investigated in future and the report updated accordingly; (ii) Inert ceramics such as bricks, concrete, gravel etc. will be disposed of onsite - input filling. (iii) Any item that has no salvage value to the mine but could be of value to individuals will be treated as waste and dumped in the open pit; (iv) Only non-hazardous waste will be dumped on site (permission/exemption will be obtained from DEA) (v) Only uncontaminated material will be disposed of onsite Additional actions: (i) Investigate possibility of groundwater contamination	8
2.5 Metal waste						
2.5 (O) Accumulated metal waste on site	Heavy metal release into soils and water over time. Reduced infrastructure / resale value over time. Landscape alteration. Unsafe areas for human or animal access. Reduced sense of place. Permanent change of land use. Removal costs		21	(i) Removal and selling.	Assumptions: (i) Metal waste to be salvaged as far as possible. (ii) Any item that has no salvage value to the mine but could be of value to individuals will be treated as waste and dumped in the open pit.	1
2.6 Tyre waste						
2.6 (O) Accumulated tyre waste on site	Fire hazard. Landscape alteration. Unsafe areas for human or animal access. Reduced sense of place. Permanent change of land use. Removal costs		22	(i) Final collection and removal of all stacked and loose tyres over Sishen property. (ii) Final disposal site to be confirmed, but is expected to be offsite. (iii) Tyre cutting and re-use being investigated (this option will reduce costs if agreed)	Assumptions: (i) CPI adjusted Demolition and Salvage rates 2011 apply. Average of three quotes	25

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
2.6 (P) Fire	Excessive air pollution. Safety hazard. Increased pollution on site. Increased soil impact		22	(i) Same criteria as 2.6 (K)		22
2.7 Radio-active waste						
2.7 (O) Accumulated radio-active waste on site	Health risk. Increasing instability of radioactive elements. Extended hazard zone created. Unsafe areas for human or animal access. Permanent change of land use. Removal costs		21	(i) Removal by qualified company. (ii) Verify levels before removal and disposal at hazardous site if needed.	Assumptions: (i) CPI adjusted Demolition and Salvage rates 2011 apply. Average of three quotes	9
2.7 (Q) Exposure to radio activity	Health and safety risk of hazardous materials on site. Reduced land capability. Extended impact on fauna and flora.		21	(i) Same criteria as 2.7 (K)		9
3. BUILT INFRASTRUCTURE						
3.1 Processing plant areas, workshops & offices, electrical sub-stations, Fuelling stations, Explosives magazine						
3.1 (C) Groundwater contamination	Environmental resource degradation on the long term. Legal penalties in terms of NWA, Reputation damage.		21	(i) Ground water monitoring LOM to determine possible change in impacts for rehabilitation (ii) Area to be sampled for possible soil conditions that could seep to ground water. (iii) Ground water monitoring in place and to continue post closure.	Assumptions: (i) Inventory items have unique reference number and figures.	9
3.1 (J) Polluted, affected or changed soils	Loss of soil quality Natural resource loss (topsoil) Remediation or disposal costs		21	(i) Contaminated soil needs to be moved to remediation site. Removed below ground level and filled / reshaped if necessary. (ii) All surface sources of potential pollution will be removed before and during closure;		8
3.1 (F) Reduced air quality	Dust covering natural vegetation interfering with natural and rehabilitation vegetation growth Nuisance to people and animals Health impact from airborne dust particles Air quality impact		21	(i) Dust suppression during demolition activities		5
3.1 (D) Surface water contamination	Regulation 704 noncompliance. Extended affected footprint. Surface water contamination / deterioration affecting ground water on long term.		21	(i) Storm water master plan (ii) Rehabilitation of affected drainage lines and floodplains - post closure landscape to replicate original as far as possible. Free flow drainage		9
3.1 (R) Wasted infrastructure. Loss of possible re-use opportunity	Infrastructure becomes waste liability with increased handling / disposal costs. Safety & Pollution related liabilities of infrastructure remain until area is proven safe and clean.		21	(i) All structures will be demolished and terracing and foundations removed to a minimum of 500mm below the final rehabilitated ground level. (ii) All electrical office equipment should be considered for re-sale or salvage and general waste to domestic waste site (iii) Demolish, remove, fence after completion. Hazardous materials to be disposed at hazardous waste site. (iv) All electrical office equipment should be considered for re-sale or salvage and general waste to domestic waste site (v) Remove electricity supply lines to mining related operations (from the main substation to the plant, mini-substations, transformers). (vi) Oil spills removed to hazardous waste site or bioremediation site. ID transformers with PCB's and hazardous materials - remove to registered hazardous site		7
3.2 Mine towns / housing / schools / off-site infrastructure						
3.2 (R) Wasted infrastructure. Loss of possible re-use opportunity	Infrastructure becomes waste liability with increased handling / disposal costs. Safety & Pollution related liabilities of infrastructure remain until area is proven safe and clean.		23	(i) Same criteria as 3.2 (S) above		5

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
3.5 Railways						
3.5 (C) Groundwater contamination	Possible health impacts of ground water dependent users, Environmental resource degradation. Legal penalties in terms of NWA, Reputation damage of Kumba seen as major polluter.		21	(i) All to be removed and materials resold where possible.	Assumptions: (i) Price per meter for ballast, sleeper and two rails.	5
3.5 (D) Surface water contamination	Affected surface water entering natural systems. Legal noncompliance to regulation 704. Environmental resource impact, extended impact footprint. Reputation damage linked to noncompliance.		21	(i) All to be removed and materials resold where possible.		5
3.5 (J) Polluted, affected or changed soil	Loss of soil quality Natural resource loss (topsoil) Hazardous materials on site Regulation 704 compliance		21	(i) All to be removed and materials resold where possible.		5
BIOPHYSICAL CLOSURE / REHABILITATION						
4.1 Biodiversity						
4.1.4 Permanent Loss of sensitive species	Reduced ecological functioning. Loss of biodiversity, landscape resilience, land use value. Where species are protected this may have a legal impact.		25	1. Voluntary offsets areas identified and in place 2.Biodiversity action plans in place and be implemented	Assumptions: (i) Dump expansions planned into Camelthorn forests & some pans.	25
4.1.5 Insufficient topsoil for rehabilitation	Inadequate rehabilitation success Lack of growth medium Increased financial costs to obtain topsoil Possibility of not achieving sustainable vegetation growth		25	1. Directly place topsoil where possible. 2. Ensure topsoil stockpiles are constructed to standard and protected. 3. Optimise utilisation of topsoil. 4. Use thinner topsoil coverage (150 mm) on the top of dumps. 5. Use compost or plant discard as a topsoil substitute. 6. Apply alternative growth mediums that replace the role of topsoil	Assumptions: (i) Waste rock top platform will only be ripped and grass seed placed, receive crest vegetation and no active rehab in centre of dump. (ii) Slope facing the pit does not have significant dust pollution to external parties. (iii) Pit facing slopes are unsafe for rehabilitation and will not be vegetated. (iv) All local available material shortfall will be made up with discard material.	18
4.1.6 Reduced topsoil quality	Reduction in soil fertility and integrity to support vegetation growth		25	1. Directly place topsoil where possible. 2. Ensure topsoil stockpiles are constructed to standard and protected. 3. Optimise utilisation of topsoil through adding fertilising components where necessary		18
4.1.7 Alien vegetation encroachment	Noncompliance to CARA legislation Environmental degradation - reduced ecosystem functioning		21	1. Seeding and planting of native grasses, trees and shrubs. Fertiliser application. 2. Implement alien invasive management plan (Control of weeds). 3. Monitoring and maintenance (success criteria 60% of existing grazing capacity).	Additional actions: (i) A detailed alien invasive management plan for the whole mine is required as part of rehab maintenance program. (ii) Upon closure, final evaluation of the *Acacia melifera* bush encroachment status and impact on grazing capacity should be done and action plan implemented accordingly.	13
4.1 (A) Uncontrolled access	Loss of rehabilitation. Trampling, erosion, plant removal. Restoration costs		22	1. Maintain security during closure phase. 2. Incorporate rehabilitated areas into farming enterprises with associated fencing and security.		22
4.2 Groundwater						
4.2.13 Calcification of groundwater aquiver network	Permanent loss of aquifers. Isolation of aquiver. Reduced of quantity / quality of ground water resource for users. Permanent impact on surrounding		21	1. Install necessary monitoring.	Assumptions: (i) There are various specialist studies taking place. (ii) Assume ground water levels will return to pre-mining. (iii) Ground water issues include dewatering, ground water amelioration, ground water recharge management measures.	21

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
	private landowners. Reputation damage of water resource impact. No breach of the water use license.				(iv) Addressing sinkhole formation during rehab and closure. (v) Dewatering risk - compensating farmers through the provision of piped water within the de-watered zone and the purchase of farms impacted upon post closure (slow recharge rate). Additional actions: (i) The residual impacts on the groundwater table needs to be assessed. (ii) Need to evaluated data and status	
4.2 (L) Reduced groundwater levels	Ground water aquiver depletion / reduction. Draw down cone development affecting quality of water from surface water influx. Third party water users affected. Reduced resource use. Altered resource. Supplying dewatered zone of influence with water and purchasing properties if required.	IWULA 2009	25	1. Install necessary monitoring. 2. Model final pit water level.	Assumptions: (i) Groundwater removed from Sishen extraction boreholes is further purified by softening and disinfection before being supplied for domestic water use	21
4.2 (L) Change in groundwater flow directions	Change in ground water / topography relationships - quantity and quality of water from surface water influx. Third party water users affected. Reduced resource use. Altered resource. Supplying dewatered zone of influence with water and purchasing properties if required.	IWULA 2009	25	(i) Same criteria as 4.2 (L) above	Assumptions: (i) Ground water flow alteration seen as high risk in IWULA	21
4.2.14 Sinkhole development	Unsafe areas. Sterilisation of land for other land uses. Remediation costs. Disruption of surface flows, which has occurred as a result of sink holes may however have impacts on surface vegetation, which may lead to vegetation changes and impacts along the Gamagara River. Such sink holes may also pose a risk in terms of public safety. Disturbance of near-surface aquifers may also lead to impacts on vegetation.	Kumba Land Strategy, MSA, 2009	21	1. Dolomite (subsidence) risk management task team plan. 2. Surface subsidence management procedure. 3. Areas are identified, isolated, and backfilled.	Assumptions: (i) Disruption of surface flows, which has occurred as a result of sink holes may however have impacts on surface vegetation, which may lead to vegetation changes and impacts along the Gamagara River. Such sink holes may also pose a risk in terms of public safety. Disturbance of near-surface aquifers may also lead to impacts on vegetation.	20
4.3 Surface water						
4.3.15 Disturbance of river catchments.	Reduced ecological functioning. Loss of biodiversity corridor areas - fragmentation.	IWULA 2009	21	1. Temporary diversion structures are removed and original flow path reinstated 2. Permanent diversion structures engineered for 100 year ARI 3. Quarterly flora and fauna monitoring in undisturbed areas to assess impacts	Assumptions: (i) The main impacts on surface water will be from the Pit water. (ii) The municipal sewage water will not be used post closure. (iii) The natural flow of surface water will be impaired by pit. (iv) Impacts evaluated and concept storm water plan completed. (v) Water reuse strategies underway. (vi) Surface water management measures - where natural surface water systems are impacted. (vii) Surface water management include river diversions and corrections. Additional actions: (i) The potential post closure evaporation from pits needs to be addressed. (ii) On-site verification of impacts and remediation required for closure of surface water sensitive areas.	21
4.3.16 Contaminated water run-off from Mine Dumps	Regulation 704 non-compliance, Extension affected area where surface water flow. Siltation of natural veldt. Secondary impact - soil contamination and change in chemical structure. Migration of affected material to other areas - increased footprint Clean-up costs		21			11
4.4 Land Use / Land Capability						
4.4.14 Sinkholes in Gamagara River	Safety and land-use impact		23		Assumptions: (i) HQ is currently busy with a project to restore the river or alternatively mitigate the impact thereof. The solution is still uncertain and stakeholder engagement will commence 2017	23

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
4.4.19 Inadequate post-closure management	Loss of biodiversity important areas identified and set aside by Kumba in EMP for current mining right. Reputation impact as poor custodian of biodiversity resource. EMP and NEMA non-compliance. Financial penalties and remediation / offset planning		22	1. Develop a rehabilitation strategy include vegetation management plan 2. Fire and weed management plans within biodiversity action plan 3. Implement maintenance as required. 4. Implement management plan.	Assumptions: (i) Game farm sold as economic unit in itself.	22
4.4.20 Unsustainable farming	Permanent liability to Kumba, Financial associated costs and liabilities, Environmental loss of original important area for future use		22	1. Develop a rehabilitation strategy include vegetation management plan 2. Fire and weed management plans within biodiversity action plan 3. Implement maintenance as required. 4. Implement management plan.	Assumptions: (i) Game farm sold as economic unit in itself.	22
SOCIAL CLOSURE						
5.1 Employees and dependants						
	(c) Employee law suits based on health conditions		22	1. Annual health checks of employees. 2. Health Improvement Plans set up to mitigate and detect any health risks to employees. 3. Premature studies conducted to detect health risks and exposure put employees on preventative programmes.		8
5.2 Affected parties						
	(a) Economic viability of immediate local communities impacted by mine closure		25	1. Community development strategies aligned with government's agenda for economic growth and development. 2. Enterprise development and procurements benefits maximized to establish sustainable local business. 3. Alignment in delivering community strategies for SED to maximize the cost of beneficiaries during life of operation. 4. Make social provision for mine and post mine closure for future and ongoing socio-economic benefit delivery.		14
	(b) Downscaling of mine related and mine dependent businesses in local areas surrounding mine to drive benefits of secondary economic activity		23	1. Develop social and economic development clauses and enforce through commercial contracts for socio-economic contribution to mitigate impact of closure. 2. Community development strategies aligned with government's agenda for economic growth and development. 3. Enterprise development and procurements benefits maximized to establish sustainable local business. 4. Alignment in delivering community strategies for SED to maximize the cost of beneficiaries during life of operation. 5. Make social provision for mine and post mine closure for future and ongoing socio-economic befit delivery.		13
	(c) Unrealistic expectations of directly affected parties during and after mine closure lead to reputational damage		23	1. Social Management systems and mechanisms in place to mitigate impact during life of operation. 2. Community and media strategies with messaging to mitigate perception. 3. Stakeholder perception studies to put mitigating measure in place. 4. Measure the socio-economic impacts every three years during life of operations to develop and update strategies and plans.		14
5.3 Interested parties						
	(c) Socio-political risks are high due to political interest in mining industry and mining legacies in relation to inequalities		21	1. Same criteria as 5.2 (d) 2. Make social provision for mine and post mine closure for future and ongoing socio-economic benefit delivery. 3. Robust government and stakeholder relations through managing reputation and issues proactively during operation to minimize impact with mine closure and post mine closure. 4. Ensure full compliance to all regulations.		13
5.5 Economic						
	(b) Under estimation of preliminary and general costs		21	1. Realistic P&G % used		5

Unwanted event	Consequence	Reference	Max Risk rating	Closure criteria	Assumptions / notes / additional actions	Max Risk rating
	(e) Deteriorating iron ore price reduces Sishen mine's resources for socio-economic benefit delivery where dependency by IAPs has been created		25	1. Same criteria as 5.3 (c)		18
	(f) Inadequate strategies and financial provision to respond to negative economic impacts resulting in spike in poverty and social ills		22	1. Establish social fund and develop SLPs that aligns to developmental needs and deliver maximum benefit increasing cost of each unit spent. 2. Same criteria as 5.3 (c)		18
GENERAL ISSUES						
6.2. Maintenance - Inadequate maintenance of rehabilitated areas and associated infrastructure	Loss of rehabilitation. Infrastructure failure. Stability and safety issues. Restoration costs as well as new rehabilitation areas to cost and rehabilitate		25	(i) Maintenance of rehabilitated areas e.g. alien vegetation control, erosion control	Assumptions: (i) Percentage of total storm water and rehabilitation costs over decreasing sliding scale.	11
6.3. Detailed designs - Inadequate detailed design	Rehabilitation structural failure. Safety and Stability issues. High cost implication to correct and rebuilt dumps. Erosion and Flooding of rehabilitation areas.		25	(i) Detailed designs secured	Assumptions: (i) Agreed percentage of total costs.	1
6.4. Project management - Increased closure liability over time	Inadequate closure provision. Increasing closure costs with correlated decreased available capital for mine operations. This will affect the Life of Mine period because the rehabilitation costs and resources required towards the end of the life of mine will be beyond the capability of the mine.		25	(i) Internal project manager appointed. (ii)No additional costs - incorporated into operational budgets. (iii) Post closure project management as percentage of total costs.	Assumptions: (i) Inadequate closure provision. (ii) Increasing closure costs with correlated decreased available capital for mine operations. This will affect the Life of Mine period because the rehabilitation costs and resources required towards the end of the life of mine will be beyond the capability of the mine.	8
6.5.1. Closure costing - Inaccurate closure cost calculations	High percentage cost fluctuations in future. Inaccurate reflection of closure liability estimate. Inaccurate fund provision. Actual rehabilitation costs exceed budgeted projections due to inaccurate costing.		25	(i) External cost calculations provided at least every 3 years for the life of mine with updates every year (escalation)	Assumptions: (i) High percentage cost fluctuations in future. Inaccurate reflection of closure liability estimate. Inaccurate fund provision. (ii) Actual rehabilitation costs exceed budgeted projections due to inaccurate costing (iii) Knowledge gaps remain that can influence closure costs (iv) Closure & success criteria not finalised	25
6.5.2. Closure costing - Inadequate mine plans (as-built)	Increased time and cost to work out closure liability costs. Possibility of inaccurate calculations.		25	(i) Same criteria as 6.5.1	Assumptions: (i) Increased time and cost to work out closure liability costs. Possibility of inaccurate calculations.	25

6.4.3 Residual and Latent impacts (post-closure risks)

Residual impacts are defined as those environmental impacts that remain after the issuing of a closure certificate. All management actions are launched to limit the potential for residual environmental impacts. Various actions such as rehabilitation of the areas, assessing appropriate land uses and identifying practical closure objectives all work towards minimising this risk.

Latent impacts are defined as impacts that result after closure. These impacts are in other words impacts that were not foreseen prior to closure. The mine has embarked on managing the potential impacts that have been identified as part of the EIA and impact and aspect identification process (ISO 14 001 system).

The closure risk assessment was conducted to qualify and quantify potential residual risks. Potential areas where latent risks could arise have also been identified. The potential residual impacts were identified during the risk assessment process conducted by Endemic Vision as part of the Preliminary Closure Plan, 2012. It should be noted that only high risks (in terms of Anglo American standards) or potential significant risks (in terms of DMR) are listed in the table below.

Table 18: Residual risks

Unwanted event	Consequence	Risk rating
PHYSICAL CLOSURE		
1. MINERAL WASTE		
1.2 Plant discard		
1.2 (H) Loss of agricultural land	Reduced land use capability, Loss of alternative economic gains post closure.	21
1.4 Waste rock dumps		
1.4 (G) Visual and aesthetic degradation	Landscape alteration Impact on tourism, sense of place, land-use value Non-compliance to NEMA because of safety risks of remediating long slopes Impact on Municipal Spatial Development Framework / Integrated Development Plans	22
1.4 (H) Loss of agricultural land	Loss of previous land capability (grazing - waste)	22
1.6 Open pits		
1.6 (B) Instability & failure	Failure resulting in unsafe areas, extended footprint, loss of natural habitat and rehabilitation work. Reputation damage as Kumba is linked to failure. Financial clean-up and remediation costs	21
1.6 (H) Loss of agricultural land	Loss of previous land capability (grazing - pit)	25
1.6 (M) Surface water (Quantity Catchment Runoff)	Water influx result in pit stability risks. Pit safety affected. Because water remains in pit, legal requirements are met ito regulation 704 - not pumped out	21
2. NON-MINERAL WASTE		
2.1 Domestic waste site		
2.1 (N) Change of land use - sterilisation of land	Environmental degradation of natural resource Reduced land use capability and food production Reduced sense of place ito farming and tourism Financial compensation is to recover loss of land use (rehab or offset) Kumba reputation associated with mining legacy in natural veldt	23

Unwanted event	Consequence	Risk rating
2.6 Tyre waste		
2.6 (O) Accumulated tyre waste on site	Fire hazard. Landscape alteration. Unsafe areas for human or animal access. Reduced sense of place. Permanent change of land use. Removal costs	25
2.6 (P) Fire	Excessive air pollution. Safety hazard. Increased pollution on site. Increased soil impact	22
BIOPHYSICAL CLOSURE / REHABILITATION		
4.1 Biodiversity		
4.1.4 Permanent Loss of sensitive species	Reduced ecological functioning. Loss of biodiversity, landscape resilience, land use value. Where species are protected this may have a legal impact.	25
4.1 (A) Uncontrolled access	Loss of rehabilitation. Trampling, erosion, plant removal. Restoration costs	22
4.2 Groundwater		
4.2.13 Calcification of groundwater aquiver network	Permanent loss of aquifers. Isolation of aquiver. Reduced of quantity / quality of ground water resource for users. Permanent impact on surrounding private landowners. Reputation damage of water resource impact. No breach of the water use license.	21
4.2 (L) Reduced groundwater levels	Ground water aquiver depletion / reduction. Draw down cone development affecting quality of water from surface water influx. Third party water users affected. Reduced resource use. Altered resource. Supplying dewatered zone of influence with water and purchasing properties if required.	21
4.2 (L) Change in groundwater flow directions	Change in ground water / topography relationships - quantity and quality of water from surface water influx. Third party water users affected. Reduced resource use. Altered resource. Supplying dewatered zone of influence with water and purchasing properties if required.	21
4.3 Surface water		
4.3.15 Disturbance of river catchments.	Reduced ecological functioning. Loss of biodiversity corridor areas - fragmentation.	21
4.4 Land Use / Land Capability		
4.4.14 Sinkholes in Gamagara River	Safety and land-use impact	23
4.4.19 Inadequate post-closure management	Loss of biodiversity important areas identified and set aside by Kumba in EMP for current mining right. Reputation impact as poor custodian of biodiversity resource. EMP and NEMA non-compliance. Financial penalties and remediation / offset planning	22
4.4.20 Unsustainable farming	Permanent liability to Kumba, Financial associated costs and liabilities, Environmental loss of original important area for future use	22
GENERAL ISSUES		
6.5.1. Closure costing - Inaccurate closure cost calculations	High percentage cost fluctuations in future. Inaccurate reflection of closure liability estimate. Inaccurate fund provision. Actual rehabilitation costs exceed budgeted projections due to inaccurate costing.	25
6.5.2. Closure costing - Inadequate mine plans (as-built)	Increased time and cost to work out closure liability costs. Possibility of inaccurate calculations.	25

Plant Discard Dump Residual Risks

Instability and failure due to rain events, gravity over time, and erosion remains a high risk as the dump is high, constructed with relatively fine material at very steep angles without benches or safe access (ramps) to rehabilitate. Dump failure resulting in unsafe areas, extended footprint, loss of natural habitat, and rehabilitation work is likely if the dump is not reduced to a manageable size. It will also cause

reputation damage of Kumba as a company being linked to dump failure, more so, given the fact that the dump is directly visible from public roads and Kathu. Financial clean-up and remediation costs to remediate such failures are considered high in proportion with the closure liability of Sishen Mine.

Considering the limited ability to vegetate the discard dump, the height of the dump, and its fine material, current dust fallout is expected to remain a post closure risk. It is also expected that the dust fallout will be visible and have reputation / community impacts. Closure air dispersion modelling should be done to confirm the risk.

Since the area is unsafe to rehabilitate, and has no benches to access higher lying areas, any possible restoration of agricultural capability on the footprint of the discard dump is lost. The loss of previous land capability (grazing) is a permanent and certain loss.

This dump is visible from more than one angle by local and transitional community members. The visual impacts include landscape alteration, impact on tourism, sense of place, and land-use value. It is also foreseen that the dump in its current state contradict the tourism planning of the Municipal Spatial Development Framework / Integrated Development Plans.

Waste Rock Dumps Residual Impacts

The residual impact from the waste rock dumps is the loss of land capability. The slope angle approved for rehabilitation is 24 degrees. This slope angle is considered steep and limits the post closure land use and closure objectives of using the waste rock dumps for grazing post closure. The risks of rehabilitation destruction post closure are extremely high because the dumps could be used for grazing at such angles. Visual impact is also considered and is mitigated as far as possible, but it is not a high residual impact.

Open Pits

It is certain that erosion will take place within the pit post closure and that land use potential and landscape alteration will be permanently impacted post closure.

Tyre Waste

The accumulated tyre waste on site as well as the resultant fire risk from this waste area is a risk for which a sure solution must still be confirmed.

Ground Water

Four ground water risks remain post closure that need further investigation and quantification, namely the calcification of ground water aquiver network; reduced ground water levels (remaining post closure for an uncertain time); change in ground water flow directions after mining is complete; and possible sink hole development. These risks all have extended impacts beyond the direct boundaries of the mine.

Surface Water

There is only one surface water issue currently and that is the river diversion at the Lylyveld dump. A regulation 704 exemption to divert and impact on the Gamagara River is in place. It must be confirmed if this exemption is applicable post closure as the current understanding is that the diversion needs to be corrected post closure.

Biodiversity

The new dump expansion project indicates the permanent loss of certain sensitive habitats in terms of pans and Camel Thorn forest. These items will not be recovered post closure.

Closure Costing

Constant pressure to ensure efficient (lower) costs result in calculating costs with broad assumptions. This result in a lower, but inaccurate closure liability figure for Sishen Mine with catastrophic financial, planning, implementation, and reputation damage. Consequentially it will result in high percentage cost fluctuations in future; inaccurate reflection of closure liability estimates; and inaccurate fund provision. Actual rehabilitation costs will exceed budgeted projections and become a cash flow burden not adequately planned for.

7. CLOSURE SUCCESS CRITERIA

Success criteria are the agreed standards that must be met to facilitate lease relinquishment. They include physical, biophysical and socio-economic parameters and are generally defined through engagement with regulators and other external stakeholders.

Each closure principle needs to be assessed at multiple time categories. Table 19 contains the determined time categories and its relation to the principles that have been defined in determination of success criteria.

Table 19: Time categories related to closure success criteria

Time category	Risk mitigation	Rehabilitation objectives	Sustainability	Local economy
Planning - Identification and approval or acceptance of closure plan	Yes	Yes	Yes	Yes
Rehabilitation process - Implementation of closure plan	Yes	Yes	Yes	Yes
Early development (0-4-year rehab) - Biodiversity starting to establish, business established	Yes	Yes	No	Yes
Established rehabilitation and closure certificate (> 4-year old rehabilitation) - Growth of biodiversity and business	No	No	Yes	No

The tables below contain the success criteria for the different phases of decommissioning and closure.

Table 20: Planning phase success criteria

Principle	Intent	Domain	Guidelines for Acceptance	Accepted Standard	Potential Corrective Actions
Risk mitigation	Have all risks been identified and documented?	All	Risk assessment (including environmental, social and health/safety) performed in line with Anglo and legal requirements.	DMR accepts risk assessment	Update risk assessment to include additional risks. Conduct additional specialist studies to support risk understanding and rating.
	Will all identified risks be mitigated to an acceptable level? (Risk management plan)	All	Residual and latent risk have been identified and rated in line with Anglo standards and outcome of specialist studies performed during the project. Process has been developed to ensure re-assessment of potential latent impacts during decommissioning phase.	The residual risks have been approved in the closure plan.	Update risk management plan and implement additional mitigatory controls
Rehabilitation objective/Sustainability	Have clear land use objectives been developed for the site?	All - although objectives may vary in different areas.	Land use objectives should be developed with input from relevant stakeholders.	Land use objectives have been approved by the relevant government agency.	Update the land use objectives following additional input from stakeholders.
	Has clear rehabilitation objectives been developed?	All	The rehabilitation objective should align with the rehabilitation strategy and closure plan, and any Anglo American guidelines. The rehabilitation objective should be consistent with the identified land use.	The site specific rehabilitation objective has been endorsed by the relevant government agencies following stakeholder input.	Update the rehabilitation objective following additional input from stakeholders.
	Has a clear rehabilitation plan been developed, covering rehabilitation for each year, including procedures?	All	Rehabilitation plan should align with the Closure plan, LoM plan, EMP and short/medium term mine plan.	Annual rehabilitation plans have been developed and agreed by all relevant internal stakeholders. Plan is implemented as agreed. Sufficient resources are available to complete progressive rehabilitation.	Review areas available and adjust rehabilitation plan accordingly.
	Are the rehabilitation designs appropriate?	All	Rehabilitation designs should be developed to comply with the commitments in the EMP.	The designs are consistent with the conditions and include appropriate aspects such as slope angles, slope lengths, drainage lines, and storm water management structures.	Redesign as required and include suitable structures. Test infrastructure use for feasibility.
Local economy/Sustainability	Are socio economic programmes focussed on sustainable and independent community development projects and on promoting economic growth?	All	The infrastructure use should be in line with the local development needs. Project evaluation criteria supports mitigation of social risk and local economic development	Infrastructure use is feasible. Project evaluated against criteria	Test infrastructure use for feasibility. Re-evaluate project if deemed sustainable

Table 21: Rehabilitation process success criteria

Principle	Criteria and Intent	Domain	Guidelines for acceptance	Accepted standard	Potential Corrective Actions
Rehabilitation Objective/Sustainability	Have the rehabilitation works been undertaken per documented procedures?	WRD's and discard dump	Slope, moonscape, contours or other alternative, storm water management, stabilise, access restriction, grazing or solar energy on surface, wilderness land use on side slopes	Slopes at maximum of 24°. Moonscaping (growth pocket), contouring or other erosion control measure has been completed on the entire slope. Adequate storm water structures for drainage have been constructed. Structures (e.g. berms) to prevent access to pits are in place. Grazing or solar land use requirements agreed on for top surface of dumps Wilderness criteria agreed on for side slopes. Access for animals e.g. cattle and solar energy activities to top of rehabilitated waste rock dump by means of ramps. Road closure with the construction of berms, berm construction around the toe of the waste dumps, berm and trench construction around the toe of the waste dumps or fencing the toe of waste dump. During decommissioning the monitoring of surface water will continue to ensure that the impact of siltation can be assessed if any. Maintenance on the storm water structures will continue during decommissioning. Restricted access to all waste dumps is recommended in the long-term stability evaluation. This can be accomplished by road closure with the construction of berms, berm construction around the toe of the waste dumps, berm and trench construction around the toe of the waste dumps or fencing the toe of waste dump. Where areas are considered to report medium to high risk results, a combination of rock bolting, meshing and/or blasting is recommended to reduce the risk where necessary. Use of discard and weathered lime as growth medium. Define different requirement for different slopes i.e. north eastern slopes - different grass requirements Ensure sufficient availability of topsoil,. Dry land rehabilitation principle to be applied as a result of erratic rainfall. Slope length is reduced as far as possible by splitting the slope with intermittent contour drains and pockets. Increasing resistance to windblown loss of resources before planting by applying wet compost. Re-vegetation of side slopes. Testing of microbial, chemical and erosivity beforehand. Using direct harvesting or recently harvested material where possible. (Consider older stock for areas where topsoil will be placed at greater thickness). It is recommended that *C. ciliaris, D. eriantha* and *E. superba* be used as majority percentage base. Shrub elements are proposed along the slope, contours, and pockets at a density of 5000 trees per hectare or 1 tree for every 2m².	Undertake remedial works to comply with conditions.
		Flat areas (waste rock dumps, disturbed areas)	Ripping, storm water management, grazing on surface	Flat areas have been deep ripped to break the compacted area Adequate storm water structures for drainage has been constructed Grazing criteria had been agreed for surface rehabilitation	

Principle	Criteria and Intent	Domain	Guidelines for acceptance	Accepted standard	Potential Corrective Actions
		Roads (Haul roads, secondary roads, exploration roads)	Rip, storm water management	Part of roads not required are deep ripped to break compacted soil. Adequate storm water structures for drainage have been constructed.	Once decommissioning commences roads will be rehabilitated (Ripped and re-vegetated) if they are not needed as part of the end land use management. Roads will be rehabilitated as per the plan. Most of the roads will remain to give access to the different areas of the property but much reduced in size
		Slimes Dam	Slope stability, vegetation in line with wilderness criteria, storm water management	Interim measures identified prior to commencement of final rehabilitation. Batter slopes are between 20° and 30°. Adequate storm water structures for drainage have been constructed. Invader plants eradication programme is in place	During the decommissioning phase deposition of waste will cease on the tailings facility and concurrent rehabilitation will commence on the last bench and on top of the tailings facility. The containment capability of the slimes dams needs to be removed as part of rehabilitation of the dams During the decommissioning phase monitoring will continue to identify any possible surface water pollution originating from the tailings facilities.
		Pits - Access control and final voids	Access control, stabilize, storm water management	Structures (e.g. berms) to prevent access to pits are in place Adequate storm water structures for drainage have been constructed on the berms. Final voids are left in situ. Stability monitoring in place where required Adequate storm water structures for drainage have been constructed	Once mining has ceased water will gather in the open pit areas. No dewatering will take place and the water will be left to recharge the ground water and to evaporate. Evaporation rates are very high in the area. During decommissioning ground water, will continue to be monitored. Establishment of access control berms outside of 100 year break back zone. Monitoring of effectiveness of control measures and stability of pit as well as size break back zone
		Infrastructure Areas - Retained Structures (ongoing rehabilitation work, Farming, third party business)	Stable infrastructure, sell, lease	Final use for infrastructure has been decided. All infrastructure that is to be retained has been assessed for structural integrity, contamination and suitability. Agreements are in the process of being developed for lease or sell purposes	Current supply chain procedures to be followed with criteria to decide on disposal as indicated in the closure plan. Consideration of sustainable alternative uses. Alternative users may also be interested in purchasing sections once decommissioning commences Inspections, maintenance and monitoring until infrastructure has been disposed of. Liabilities to be identified and disclosed during the disposal (selling / leasing) process.
		Infrastructure Areas - Demolished Structures (No sustainable further use)	Demolish, building rubble and hazardous waste disposal, vegetate	All infrastructure not required is removed and the land remediated and rehabilitated. Hazardous waste was disposed of per procedure. Buried inert material is capped with at least 1 m of clean fill. Discontinuation permits acquired where necessary	Where no further use has been identified for the said infrastructure it will be demolished and the disturbed area re-vegetated. Regular inspections. Security measures to safe guard property until disposed / demolished. Safe disposal of all material as per legal requirements. Discontinuation of site permit.
		Infrastructure Areas - to be sold	Structural stability, sell	Any issues preventing transfer of ownership are addressed. Infrastructure is transferred to third party name. The mine has no further liability	Current supply chain procedures to be followed with criteria to decide on disposal as indicated in the closure plan. Consideration of sustainable alternative uses. Alternative users may also be interested in purchasing sections once decommissioning commences Inspections, maintenance and monitoring until infrastructure has been disposed of. Liabilities to be identified and disclosed during the disposal (selling / leasing) process.
		Infrastructure Areas - Third party owners	Access	Safe access to these areas by third party owner. Infrastructure is safe and not being impacted by mine activities or infrastructures.	Regular inspections. Security measures to safe guard property
		Contaminated Sites (Hydrocarbon)	Remediation, disposal	Contaminated areas are identified through testing and material removed from site and transferred to bioremediation area for treatment. In situ treatment may be considered for some areas. Clean soil is transferred back to area.	Spillages are contained and cleaned accordingly. Contaminated material is disposed in line with the waste management procedure. The size of hydrocarbon spills is limited. Process material spillages have a negligible effect on the soils. Ground water monitoring and soil sampling takes place as per the monitoring procedure requirements. Remediation of contaminated soil would be done (if needed) once demolition of the plant and related structures have taken place. Storm water management, storm water controls e.g. bund walls, roofing, sumps etc. Tyre abatement plan & waste management procedure.
		All - Water management structures	Storm water structures, demolish	Testing indicates that residual hydrocarbon contamination in dams meet agreed standards. Removal of dams no longer required completed. Other dams left in a safe and stable condition to collect clean water for game farm use. Storm water management structures have been established as required.	No leftover spilt or residue materials after shutdown Regular inspections of quantity of water in containment areas All areas need to be free draining as far as possible If no impact to the environment.

Principle	Criteria and Intent	Domain	Guidelines for acceptance	Accepted standard	Potential Corrective Actions
		All - Waste management	All waste removed from site	All waste is removed from areas and disposed of per regulatory requirements and defined in the internal procedure. Alternative use for used tyres have been identified. Used tyres are reworked or have been removed for recycling purposes	The waste management procedure is followed with regards to waste handling, storage and disposal. Disposal contracts to be in place Inspection of hazardous waste inside buildings before demolition
		All - Seeding	Appropriate seed mix	Seed mix used and planted trees meet final agreed land-use.	Apply seed mixture and seeding methodology as identified in Endemic Vision studies.
Risk Mitigation	Are dust levels within legal limits?	All - Air	Acceptable air quality	No exceedances of legal limits for dust.	Vegetation of mineral residue deposits, tailings, open pits, roads, etc. within determined schedule to minimise dust. Dust monitoring
Risk Mitigation	Have the health closure risks been adequately addressed?	All - Health	Acceptable health risk management	Health closure plan is accepted by relevant stakeholders.	Implement measures identified in social closure plan
Local economy	Have the socio economic programmes focussed on sustainable and independent community development projects commenced implementation?	All - Social	Implementation of socio-economic programmes, sustainability	Stakeholder acceptance of project implementation plans.	Implement measures identified in SLP and social closure plan

Table 22: Early development success criteria

Principle	Criteria and Intent	Domain	Guidelines for acceptance	Accepted standard	Monitoring	Potential Corrective Actions
Rehabilitation objectives	Are the pit walls stable and pit areas safe?	Mining Pits	Pit walls should be stable and access to pits should be prevented.	Berms and fences have been constructed beyond the 100 year break back of all pits. Areas are clearly sign-posted. Geotechnical monitoring and modelling indicates that the areas are becoming more stable.	Stability monitoring - 2 years	Move berms and signage, maintain erosion on berms, re-vegetate where necessary on berms repair fences and install signage.
	Is the rehabilitated area stable and not prone to erosion?	All	Surface should be free draining and diversion structures should be established where demolition and rehabilitation has been completed.	Minor erosion only with no bare areas > 0.25 ha. No evidence of areas of ponding and possible gully formation.	Monitoring as per plant ecological study monitoring recommendations	Identify source of erosion and redirect/disperse energy. Areas may require reshaping and reseeding.
	Is water movement controlled within the rehabilitated area?	All	Water drainage structures should direct water off the slopes in a controlled manner.	Water drainage flows naturally without pooling or flooding. Minimal erosion where water flows from drainage structures. Slope length is reduced as far as possible by splitting the slope with intermittent contour drains and pockets.	Surface water monitoring, storm water management measures	Areas of erosion and slumping may require treatment. Reshape, rip and seed areas.
	Is the quality of run-off water acceptable?	All	Surface run-off should not be carrying excessive sediment loads or other contaminants that have been identified as posing a risk to the final land use.	Berms are installed where necessary to reduce sediment loads. No evidence of siltation of nearby natural drainage lines. Contaminant levels do not exceed defined agricultural limits.	Surface water quality monitoring	Install and maintain sediment control structures if required. Ongoing monitoring of contaminants of concern.
	Is the groundwater contaminated?	All	Groundwater is not contaminated by any substances related to mining at the site.	Groundwater monitoring indicates that all potential contaminants are below agreed thresholds related to drinking water standards.	Tailings monitoring - 10 years Water level monitoring - 10 years Stable isotope monitoring - 2 years Quarterly groundwater hydro-chemical monitoring - 10 years	Identify and remove contamination sources, or pump contaminated water and treat.

Principle	Criteria and Intent	Domain	Guidelines for acceptance	Accepted standard	Monitoring	Potential Corrective Actions
	Is water use optimised?	All	Water optimisation mechanisms identified and implemented.	Water optimisation meets requirements in the water use licence.	Management of water consumption in accordance with IWUL and internal requirements Water balance continuation Inspections Resourcing Compliance with WUL requirements Monitoring & licence requirements - 10 years	Review water optimisation strategy to meet licence requirements.
	Have dust generating sources been minimised where possible?	All - Air	Dust sources minimised where practicable.	Dust monitoring indicates decreasing loads at relevant monitoring locations.	Air quality monitoring - 5 years	Identify and remove dust sources where practicable.
	Has vegetation established on slopes?	WRD's	Vegetation has established on shaped slopes which limits visual impact.	Indigenous vegetation cover > 30% as per land use.	Monitoring as per plant ecological study monitoring recommendations	Replanting of shaped areas.
	Has sustainable vegetation established on the slimes dams?	Slimes Dams	Indigenous vegetation has established on the slimes dam rehabilitated surfaces.	Indigenous vegetation cover > 30% as per land use.	Monitoring as per plant ecological study monitoring recommendations	Replanting of shaped areas
	Are invader plant being controlled?	All (excluding undisturbed)	Invader plant species should not be dominating plant cover and indigenous species should be present.	Weed species cover < 50% and native plant cover >25%.	Monitoring as per plant ecological study monitoring recommendations	Appropriate invader plant control techniques are implemented. Re-seed or plant area with indigenous species.
	Is the rehabilitated area sustaining sufficient nutrient cycling?	All	Leaf litter should be accumulating and evidence exists that it is decomposing.	The average scores for litter cover are > 30%.	Monitoring as per plant ecological study monitoring recommendations	Apply fertiliser where appropriate. Re-seed with nitrogen fixing species.
	Is there evidence that indigenous species are becoming established?	All	Monitoring according to year 1 template demonstrates that seeded species are establishing.	More than 50% of planted or seeded species are present when compared to a similarly sized reference ecosystem.	Monitoring as per plant ecological study monitoring recommendations	Direct plant or seed key absent species.
	Is there any evidence that indigenous vegetation present is biased to a particular community stratum?	All	Germinating plants should represent tree, shrub and ground cover.	Germinating species in similar proportions for each stratum. Tree and shrub species should be at least 150 stems/ ha.	Monitoring as per plant ecological study monitoring recommendations	Re-seed or plant key absent species.
	Is there potential fauna habitat present?	All	Potential fauna habitat should be present.	One potential fauna habitat is present every 5 ha.	Monitoring as per plant ecological study monitoring recommendations	Add microhabitats such as rocks, logs or fallen branches.
	Are dust levels within legal limits?	All	Vegetation has established on most areas limiting dust movement off site.	Dust levels are monitored and are below 600 mg/m^2/day for at least 12 months.	Air quality monitoring - 5 years	Re-seed bare areas.
	Is there evidence of contamination?	In-situ Bioremediation site	Contaminated sites should meet all required standards.	Final soil tests following remediation of contaminated sites should meet agreed criteria.	Soil samples	Continue to remove soil until contamination levels meet criteria. Attempt in-situ remediation if appropriate.

Principle	Criteria and Intent	Domain	Guidelines for acceptance	Accepted standard	Monitoring	Potential Corrective Actions
Local economy	Have business enterprises independent of mining been established?	All - Social	Business enterprises independent of mining have been established.	All business development mentoring processes have been completed.	Implement measures identified in SLP and social closure plan (Appendix 4)	Further assistance provided to develop mining independent businesses in local communities.

Table 23: Established rehabilitation and certification

Principle	Criteria and Intent	Domain	Closure criteria	Success criteria	Monitoring	Potential Corrective Actions
Sustainability	Are all waste rock and pit areas safe and stable?	All	Stability measures have all been successful implemented. Access control measures reduce safety risks to an acceptable agreed level.	Monitoring indicates that all areas are stable with an agreed and accepted level of residual risk. Access control measures have been successfully implemented.		Constructing berms, fence maintenance and/or installing signage may be considered as mitigation options.
	Have all safety risks related to mining infrastructure been mitigated to prevent any significant impact to the surrounding communities?	Infrastructure Areas	No residual safety risks remain.	All safety risks related to remaining mining infrastructure has been dealt with and mitigated to an acceptable level.		Remove or mitigate safety risk.
	Is the rehabilitated area stable and not prone to erosion?	All	Rehabilitated areas are stable and not exhibiting significant active erosion.	Minor erosion only with no bare areas > 0.25 ha. No evidence of areas of ponding and possible gully formation.		Identify source of erosion and redirect/disperse energy. Areas may require reshaping and reseeding.
	Is there any evidence that post mine closure infrastructure will require ongoing management?	All	All infrastructure installed as part of the closure plan should not require ongoing management from SIOC.	No remaining infrastructure requires ongoing management from SIOC.		Third parties agree to ongoing management responsibilities for infrastructure.
	Are invader plants being controlled?	All (excluding undisturbed)	Invader plant species should not be dominating plant cover and native species should be present.	Invader plant species cover < 30% and indigenous plant cover >50%.		Appropriate weed control techniques are implemented. Re-seed or plant area with native species.
	Is the rehabilitated area sustaining sufficient nutrient cycling?	All (excluding long slopes)	Leaf litter should be accumulating and evidence exists that it is decomposing.	The average scores for litter cover are > 30%.		Apply fertiliser where appropriate. Re-seed with nitrogen fixing species.
	Is there evidence that indigenous species are becoming established?	All	Monitoring according to year 5 template demonstrates that seeded species are establishing.	More than 50% of planted or seeded species are present when compared to a similarly sized reference ecosystem.		Direct plant or seed key absent species.
	Is there any evidence that indigenous vegetation present is biased to a particular community stratum?	All	Germinating plants should represent tree, shrub and ground cover.	Germinating species in similar proportions for each stratum. Tree and shrub species should be at least 150 stems/ ha.		Re-seed or plant key absent species.
	Is there potential fauna habitat present?	All	Potential fauna habitat should be present.	One potential fauna habitat is present every 5 ha.		Add microhabitats such as rocks, logs or fallen branches.
	Has vegetation established on slopes?	WRD's, discard dump	Vegetation has established on slopes which limits visual impact.	Indigenous vegetation cover > 70%.	Rehabilitation monitoring - 10 years	Aerially re-seed by helicopter.
	Has sustainable vegetation established on the slimes dams?	Slimes Dams	Indigenous vegetation has established on the slimes dam rehabilitated surfaces.	Indigenous vegetation cover > 70%.	Rehabilitation monitoring - 10 years	Replanting of shaped areas
	Are dust levels within legal limits?	All	Vegetation has established on most areas limiting dust movement off site.	Dust levels are monitored and are below 600 mg/m^2/day for at least 12 months.	Air quality monitoring - 5 years	Re-seed bare areas.

Principle	Criteria and Intent	Domain	Closure criteria	Success criteria	Monitoring	Potential Corrective Actions
	Are independent business enterprises functioning effectively?	All - Social	The independent business enterprises are sustainable.	All independent business enterprises function independent from SIOC.		Provide time-framed and strategic assistance to selected enterprises with high probability of success.
	Have all legal requirements been met for the issuing of a closure certificate?	All	Legal requirements in terms of closure need to be met.	Government agrees that all requirements have been met to issue closure certificate		Implement defined and agreed corrective actions and continue engagement with government on requirements.

8. CLOSURE COST ASSESSMENT

8.1 Introduction

This chapter provides information regarding the process followed in determining the financial provision for the mine.

The closure budget consists of the following sections:

- Physical: Infrastructure – Demolition and/or disposal of infrastructure that does not form part of the preferred end land use.
- Bio-physical (including dump rehabilitation) – Identification of dumps, confirmation of toe-line boundaries and LOM footprints, dump modelling to confirm volumes required for dozer shaping and topsoil coverage. Actions to safeguard (making safe and stable) and re-establish the bio-physical to ensure a sustainable landform and mitigate identified risks.
- Social – The management of closure expectations and risks including (but not limited to) downscaling and retrenchment. The social component of the closure costing was not included in the financial provision calculation dated November 2015. Information associated with the social component was obtained from the SLP (2015).

8.2 Physical closure cost assessment

Physical work is defined as the demolition of the infrastructure where infrastructure cannot be transferred to another party. The following activities have been identified on site. The physical cost approach is summarised below.

A detailed infrastructure assessment was done by African EPA when the Preliminary Closure Plan was developed in 2007. This assessment was updated in 2012 by Onno Fortuin Consulting as part of the development of the Closure Plan update. The following is a summary of the closure methodology that was followed for the infrastructure component:

- No allowances have been made for money received from sale of equipment, recyclable materials, structures, vehicles or the hiring out of infrastructure;
- All container offices on the mine will be sold;
- Prior to determining which buildings should be demolished the requirements of section 44 of the Mineral and Petroleum Resource Development Act was considered;
- Concrete structures will be demolished and buried one meter below natural ground adjacent to their current positions as per DMR guideline requirement;
- The mine's general layout plan was sub-divided into various logical closure sub-zones.
- Detailed layout plans were developed for each of the closure zones where the latest mine infrastructure plan was overlain against the aerial photo backdrop for that area.

- The Asset register for the mine was used and buildings and infrastructure so listed were identified on the layout plans.
- Where possible, the unique numbering system used in the asset register was retained and the buildings and infrastructure were numbered in white labels on the layout plans.
- Where the asset register did not have numbers, new yellow labels were added to the layout plans.
- Digital photos were taken during the detailed site assessment and where possible, these photos are linked to the closure cost item as a special hyperlink in the closure cost spreadsheets.
- Similarly, as built plans were obtained from the survey department and in critical areas, these pdf details and layout plans were also linked to the spreadsheet tables.
- Closure base rates were developed for the various closure items so required for the Mine.
- A detailed schedule of quantities was developed for every building and infrastructure item on the mine and was broken down into the components of steel, concrete, brickwork, timer and cladding. The mine infrastructure was broken up into items such as pipelines, railway lines, overhead power lines and telecommunications, roads and conveyors.
- A detailed closure cost assessment was then done for each of the numbered items so identified on the Layout Plans and the quantities so calculated were multiplied with the base rates so compiled for the Mine.
- The closure costs so calculated distinguish between demolition costs, transport costs where applicable and possible salvage values.
- The closure cost assessments for each of the closure zones are grouped together where this is then summarised for premature and LOM closure.
- The closure costing spreadsheets have been annexed to this report (Appendix 3), while a separate A2 Plan Book was compiled for the various layout plans of the closure zones, which is available at the mine.
- New buildings and infrastructure that have been constructed since the 2007 and 2012 reviews were identified via the latest aerial images and added to the infrastructure list.

8.3 Biophysical closure cost assessment

The Bio-physical process is defined as the actions to safe guard and re-establish the bio-physical areas that were disturbed during the mining activities, and this includes levelling of the dumps, seeding of the trees and grass. During the 2007 closure assessment of the dumps, a detailed assessment was done to identify the dumps, to confirm their current toe-line boundaries and to obtain the LOM footprints and volumes to be evaluated in the closure costing. Actual dump modelling was undertaken to confirm the volumes required for dozer shaping with associated topsoil coverage.

A detailed assessment was done in 2007 and 2012 for the rehabilitation of WRDs, the open pit, plant discard dump as well as disposal facilities. The following is a summary of the closure methodology that was followed for the biophysical rehabilitation component:

- The rehabilitation of WRDs will consist of:
  - Slope reduction;
  - Moonscaping and/or contouring; and
  - Planting;
- The pit will not be backfilled (i.e. no waste will be picked up from a waste dump for re-deposition into the pit). The mine does, however, undertake in-pit dumping whereby waste arising from the mining area is directly tipped into mined out areas of the pit. This reduces dump footprint and decreases closure liability.
- The option of only rehabilitating the outward facing slopes of the waste rock dumps was also considered;
- Actual dump rehabilitation modelling was done to determine the volume of material that will be shaped.
- No benches were modelled and it was also assumed that no toe-line limitations exist where normal downward dozing operations could be performed;
- The final closure costing used for the November 2007 assessment was based on 18-degree side slopes. This has subsequently changed where the EMPR commitment was changed when the DMR accepted the rehabilitation shaping at 24-degree side slopes. The updated closure cost assessment conducted in November 2015, is also based on the 24-degree side slopes;
- Allowance has been made for topsoil placing on the shaped dumps. Preliminary calculations have shown that the topsoil stockpiles on the mine will not be sufficient to cover the dumps with a layer of 300 mm topsoil. It was confirmed that the Plant Discard Dump can be used to augment the deficiency in topsoil material and that enough material is available for this for both the pre-mature and LOM closure requirements of the dumps. Testing is however being undertaken to assess the viability of undertaking rehabilitation directly on the waste rock;
- The assumption was made that the topsoil so required (300 mm) for the dumps will be available within a haul distance of 2 km;
- Allowance has been made for the vegetation of the shaped dumps where this involves a lump sum rate per hectare. This is for basic grassing, seeding and planting shrubs on the shaped dumps.
- Allowance has been made for basic water management on the rehabilitated dumps where an additional 15% material movement was allowed for the shaping of the dumps to create benches which will then be used for the water management on the dumps;
- The assessment did not allow for contour drain or chute outlets with clean water drainage canals that will be required to divert the clean water from the rehabilitated dumps;
- The open pit will remain after mine closure and it is assumed that a portion of the pit will be backfilled. A safety berm will be constructed all around the perimeter of the open pit; and
- The slurry dams will be rehabilitated to 24 degrees where the outside walls will be filled with waste rock material.

8.4 Social closure cost assessment

Current social status highlights the requirement to address education, employment issues, and housing concerns. The determination of social closure costing was not done as part of this update of the Closure Plan, as a Social Impact Assessment focussed on closure has not been conducted for Sishen Mine. Subsequently, the content of this section was obtained from the SLP and SEAT reports.

Key social impacts due to mine closure include:

- Loss of employment, with cumulative socio-economic impacts such as increase in crime;
- Increase in pressure on municipal services such as infrastructure and medical services;
- Residents of the local municipalities may move to other towns in search of employment, leading to loss of revenue for the municipality;
- Decreased support of local businesses; and
- Loss of sponsorship for local community development projects.

Social closure criteria are included in the risk assessment. In relation to its practices of good faith by aligning itself with the guidelines set out in the SLP, as well as requirements of the Mining Charter, Sishen Mine will adhere to regulations in terms of the following:

a) Establishment of the Future Forum
   Members of the Forum consists of representation from:
   i. Manager Sustainable Development Sishen Mine
   ii. Employee Relations Manager
   iii. Recognised Organised Labour Representatives
   iv. Local Municipality Representative
b) Mechanisms to save jobs and avoid job losses and a decline in employment
   i. Consultations in terms of Section 189 (1) of the Labour Relations Act (LRA), 1995
c) Mechanisms to provide alternative solutions and procedures for creating job security where job losses cannot be avoided
   i. Consultations
   ii. Communicating possible retrenchments
   iii. Notification to the minister of Mineral Resources
   iv. Implementing Section 189 of the LRA, 1995
   v. Mechanisms to provide alternative solutions and procedures for creating job security where job losses cannot be avoided
d) Mechanisms to ameliorate the social and economic impact on individual, regions and economies where retrenchment or closure of the mine is certain
   i. Assessment and counselling service
   ii. Comprehensive self-employment training programmes and portable skills
   iii. Comprehensive training and re-employment programmes

The above programmes and processes are discussed in detail in the SLP (2014), which is available at the mine.

8.5 Summary of closure costs

The NEMA Financial Provision Regulations (GN. R. No. 1147, 20 November 2015) requires the holder of a mining right to annually review and update the financial provision of the mine. This section serves the purpose of providing the necessary information to support the calculations of the specified closure costs as at 31 December 2016. A detailed assessment was conducted of all the infrastructure and activities currently taking place on site, which fall within the area of responsibility of Sishen Mine.

The closure cost assessment has been reviewed based on all the activities that Sishen mine is responsible for at the mine. The review of the closure cost focused on updating the closure liability done in 2012. Figure 43 and Figure 44 provides a visual cost breakdown of the costs related to the main components of the closure process with all the slopes rehabilitated. Rehabilitation of the pits and dumps contributes to the largest section of the costs related to rehabilitation and closure.

Consumer Price Index (CPI) adjustment was applied to Onno Fortuin Consulting's rates used in 2012, per year to 2016. CPI adjustments were in line with CPI provided by Kumba head office for 2016. CPI adjustment rate was obtained from the SA Reserve Bank for years 2013 to 2016. This is also in line with the Kumba Head office adjustments made in 2013 to 2016.

8.5.1 Rehabilitation / Decommissioning tariffs

The personnel within the DMR Regional Offices are required to review and approve the quantum, that is, the monetary value of the financial provision that has been computed by the holder of a prospecting right, mining right or mining permit during the annual review as being sufficient to cover the environmental liability at that time and at closure of the mine

The mine calculates the tariff for the rehabilitation (leveling, ripping and planting) of the WRDs on an annual basis from actual cost incurred during the year. The calculation of the quantum is based on actual cost obtained from demolition companies by Onno Fortuin in 2012 with a CPI adjustment per year to 2015. The rates are included in the tariffs list. The tariffs were applied to the different volumes determined during the assessment of the physical and biophysical data.

8.5.2 Closure cost summary

Infrastructure and disturbed areas on the mine was identified and incorporated into the financial provision spreadsheet. A list of these infrastructure (e.g. plant, workshops, crunchers, office buildings etc.) and disturbed areas (e.g. WRDs, workshop areas, etc.) can be seen in the detailed budget for the disturbed areas and structures in **Appendix 3**. This information was used to compile a detailed closure

budget and schedule that reflects decommissioning and post closure monitoring and management costs. A summary of the components of the total closure cost estimate based on all slopes rehabilitated is given in Table 24.

Table 24: Summary of the pre-mature closure cost calculations as at December 2016

AREA	TOTAL (Excl. Salvage Value)
NEW INFRASTRUCTURE	R 36,980,028
A OFFICES AND WORKSHOP AREA	R 72,617,986
B MAIN PLANT AREA	R 94,821,840
C SEP PLANT AREA	R 40,986,355
D SOUTH PLANT AND WORKSHOP AREA	R 21,243,859
E OVERLAND INFRASTRUCTURE	R 43,826,718
F PITS AND DUMPS	R 1,332,201,065
G OUTSIDE FARMING AREAS	R 293,766
H SESHENG	
I KATHU (FACULTY TRAINING CENTRE)	R 4,155,711
SUB-TOTAL	**R 1,647,127,329**
CONTINGENCIES FOR UNFORESEEN	R 82,356,366
SUB-TOTAL	**R 1,729,483,695**
ALLOWANCE FOR P&G COSTS	R 259,422,554
ALLOWANCE FOR DETAIL DESIGN FEES	R 59,667,187
ALLOWANCE FOR PROJECT MANAGEMENT FEES	R 39,778,125
MAINTENANCE COSTS (10-Year Period)	R 96,048,892
MONITORING COSTS (10-Year Period)	R 79,286,895
PREMATURE-CLOSURE COST ESTIMATE	**R 2,263,687,349**

The closure cost breakdown below illustrates the impact of the rehabilitation of the open pit and dumps on the total closure cost – at 59% of the total rehabilitation costs.

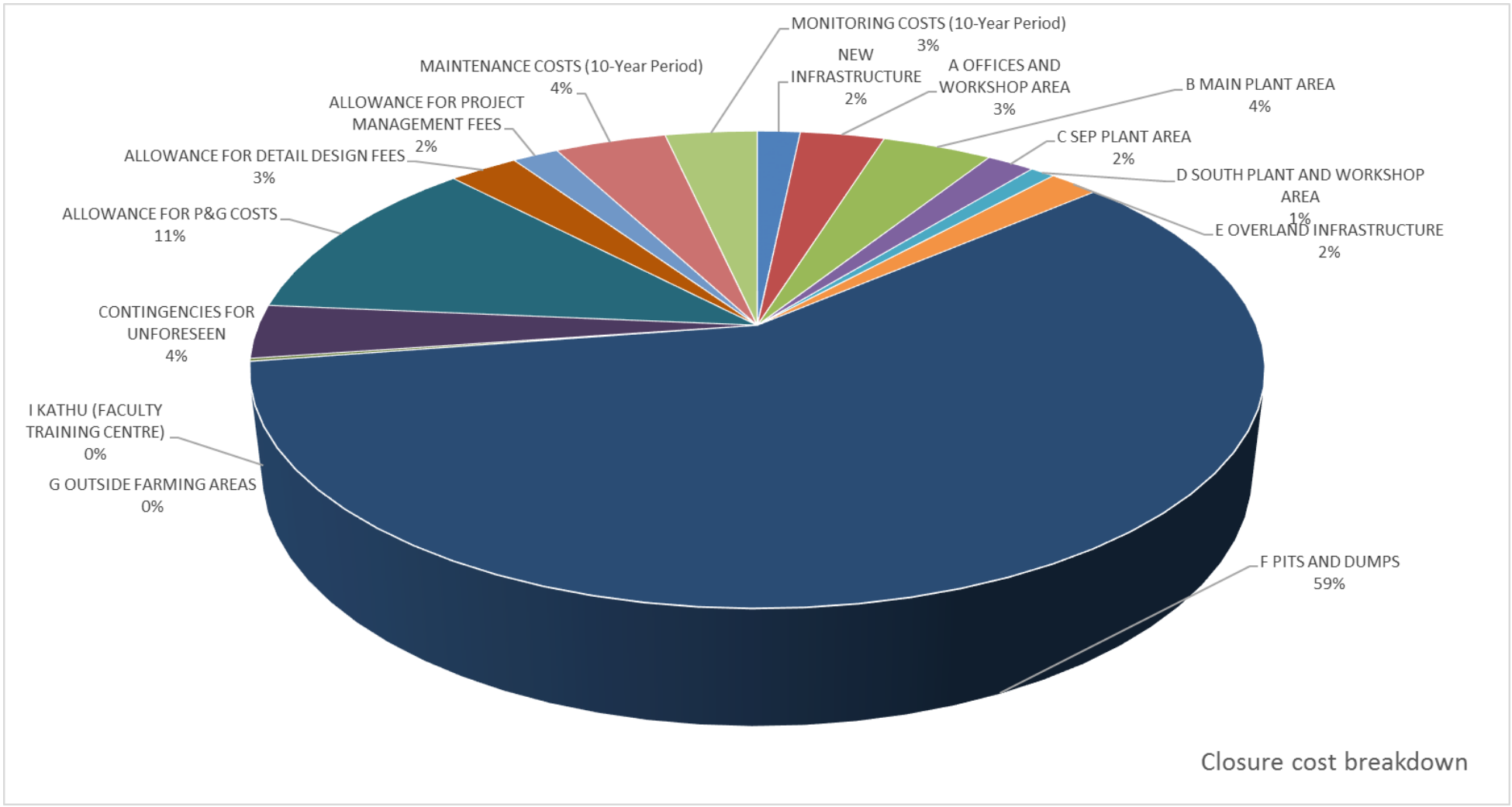

Figure 38: December 2016 closure cost breakdown

9. REHABILITATION PLAN

The information in this section was obtained from the document titled *Sishen Mine Rehabilitation Plan for 2017*.

9.1 Rehabilitation to date

Rehabilitation at Sishen Mine started with trials in 2003 by the University of the North West. These trials evaluated 18 degree, 24 degree and 30-degree slope angles. The trial concluded that rehabilitation can be done successfully at 24 degree slopes and this was approved by DMR. After the initial trials a period passed during which no rehabilitation was undertaken. In 2010 a further trial was undertaken with shade netting at 37-degree slope angles. This trial was not successful. After this, in 2012, Sishen Mine appointed Fountain Civil Engineering (FCE) to rehabilitate the G80 eastern slope (6.6ha) (Figure 40) and awarded FCE a further 3-year contract in April 2014. The target set was 13 hectares of rehabilitated slope per annum. From April 2014 to date FCE fully completed 14 ha of rehabilitation as follows (Figure 40):

- G80 south slope – 7.3ha
- G80 east corner – 2.6ha
- G80 north lower bench – 4.1ha

A further area of approximately 34 ha has been reshaped on the G80 northern slope (top, middle-and bottom slopes). These slopes will be vegetated as part of the 2017 rehabilitation plan.

For the rehabilitation undertaken to date Sishen reshaped the slopes to 24 degree angles and applied a mixture of discard and topsoil as growth medium, in line with the 2002 EMPR. However, due to evolution in the closure plan, experience gained and external inputs received from Anglo experts, the new thinking is to attempt rehabilitation without topsoil directly onto waste rock. The method proposed is known as moonscaping and this has yielded success in Australia. Topsoil is a limited resource at Sishen and is proposed to be used selectively on the top of waste dumps and on benches between slopes.

All rehabilitation efforts at Sishen Mine has therefore to date been restricted to the G80 waste dump and in 2017 the rehabilitation focus will remain on this dump.

9.2 Rehabilitation Plan for 2017

During a workshop on 23 November 2016 the concept of available rehabilitation areas was discussed. In simple terms, available areas mean areas where no further mining or waste rock dumping will take place and where rehabilitation can commence. Some areas are, however, available for low cost

rehabilitation and others for high cost rehabilitation. The G80 waste dump can be used as example as follows (see Figure 40):

- Fully rehabilitated – marked green
- Rehabilitation in progress - marked yellow
- Available for rehab at lower cost – marked red (these areas only require cut-fill dozing, no significant cut-back or reconstruction)
- Available for rehab at higher cost – marked blue (these areas can be reshaped, however, to do so would be costly due to significant earthworks required, where possible alternative means must be explored (e.g. reconstruct the north-west edge to correct bench widths)
- Available for rehab at very high cost – in-pit facing slopes marked purple (due to space limits the rehab of inner slopes will require significant cut-back, the preferred strategy is to retain these slopes as waste land and to use the resources that would have been allocated to these inner slopes for other meaningful rehabilitation or restoration activities, either on or off the mine. This will be discussed with DMR during future engagements

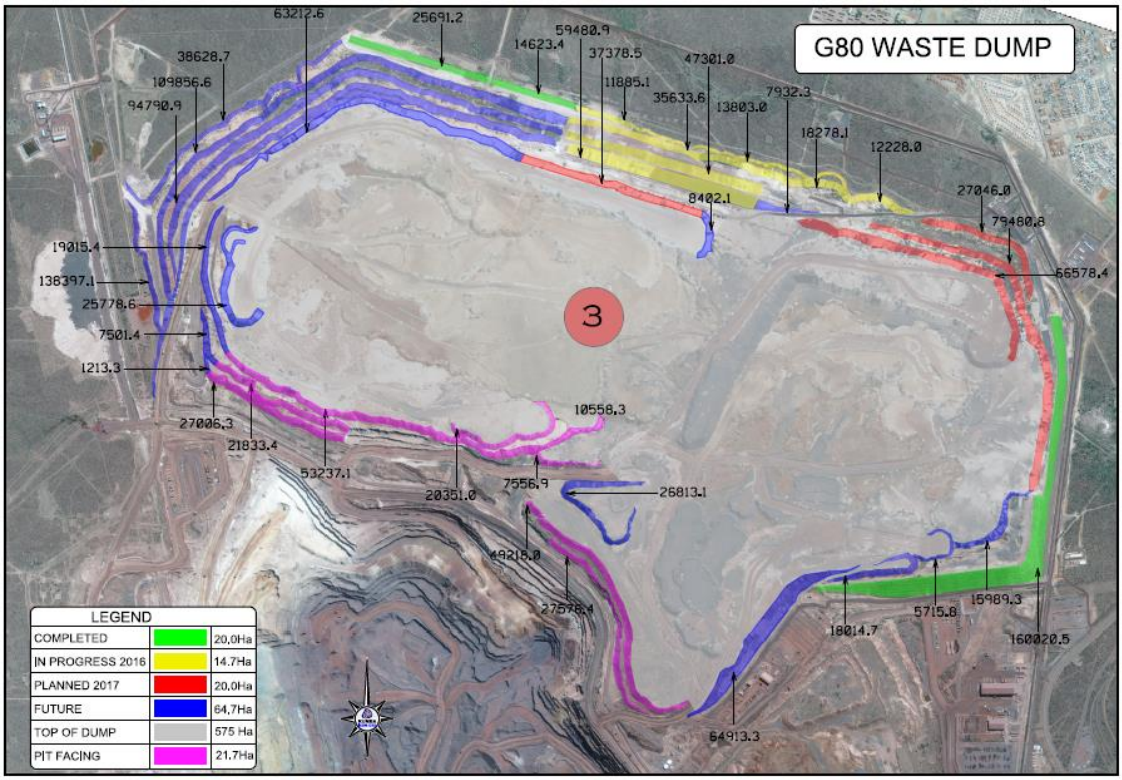

Figure 39: G80 dump slope analysis

Table 25 presents a breakdown of available rehabilitation areas per waste dump. The individual dumps listed in Table 25 can be seen in the attached map Figure 41.

With reference to Table 25, the side slopes that are available for lower-cost rehabilitation adds up to approximately 85 hectares. The biggest areas are located on the G80, Brumi and Western waste dumps. Rehabilitation will focus on these areas for the next two to three years.

The old slimes dams (Protea and Western Slimes) is also available for lower-cost rehabilitation provided that there is no further resource value locked in these dumps. Once this is confirmed rehabilitation of these old facilities can commence.

For 2017, the rehabilitation focus will remain on the G80 waste dump (Figure 40, red areas). These slopes measure 20 ha before reshaping. After reshaping the slope area increases with a factor of 1.5 and the final area will be approximately 30ha. Additional reshaping areas could be achieved depending on factors such as rainfall, dozer availability and contractor performance.

Vegetation work on G80 will be done on the top-, middle- and bottom-slopes of G80 north where reshaping to 24 degrees is already completed. The total area to be vegetated measures approximately 34 hectares. This area will be vegetated with hydro-seeding trucks and different types of organic treatments.

The biophysical work to be done is experimental in nature and the experience gained with the moonscape trials during these few months will be used to guide the future bio-physical work to be implemented on Sishen. The hydro-seeding application is expected to have a positive outcome and will reduce safety risks associated with the vegetation component.

9.3 Rehabilitation Plan for 2018 - 2020

Sishen Mine is currently developing a 3-year rehabilitation plan to guide rehabilitation activities over the next 3 years. A longer-term rehabilitation plan will also be developed based on the LOM Plan and rehabilitation design concepts to be developed for each waste dump during 2017. The DMR will be consulted in this regard.

Table 25: Areas available for rehabilitation per waste dump

No	Dump name	Fully completed (ha)	In progress (ha)	Top of dump area (ha)	Available area (ha) **LOW cost** (only requires cut-fill dozing, no significant cut-back construction)	Notes (LOW cost)	Available area **HIGH cost** (inadequate bench widths or footpring limitations, significant cut-back and reconstruction)	Notes (HIGH cost)	Available area **VERY HIGH** cost (inpit facing slopes - will require high volumes of cut-back rehabilitation)	Notes (Very High cost)	Total Area to be rehabilitated
2	WWRD	0	0	126	8,7	Eastern lower leg available for rehab	0		0		
3	G80	20	25	575	20		64,7	Preferred option is to extend the dump on the north-west	21,7	Motivate to DMR to retain inpit facing slopes	
4	G50	8,36	0	87	3,79	Behind LOM workshops	25,6		35,5	Motivate to DMR to retain inpit facing slopes	
5	G39	0	0	52	0		28,5		42	Motivate to DMR to retain inpit facing slopes	
6	Brumi	0	0	99	42.3	Areas unlikely to be affected by any future activities	58.9		0		
7	Plant discard	0	0	37,4	0		39,1		0		
8	Slimes East	0	0	245	54,5	Need to confirm if rehab can commence during operational phase	0		0		
9	Slimes Protea	0	0	31,4	3,7	Need to confirm if material will be re-used	0		0		
10	Vliegveld	0	0	36	0		35,9		26,7	Motivate to DMR to retain inpit facing slopes	
11	Lylyveld North 1	0	0	2,5	2,3		0		0		
12	Lylyveld North 2	0	0	2,5	2,9		0		0		
13	Lylyveld South bridge	0	0	2,4	3,3		0		0		
14	Lylyveld South	0	0	5,2	3,9		0		0		
15	Protea Dump	0	0	6	0		39,9	Preferred option is to extend the dump to the west	25,3	Motivate to DMR to retain inpit facing slopes	
16	Dagbreek	0	0	2,6	0		0		5,6	Motivate to DMR to retain inpit facing slopes	
17	Rooigrond	0	0	14,1	0		11,9		5,1	Motivate to DMR to retain inpit facing slopes	
18	Central	0	0	13	0		0		80,8	Motivate to DMR to retain inpit facing slopes	
19	Slimes West	0	0	56	14,5	Need to confirm if material will be re-used	0		0		
TOTAL		**28,36**	**25**	**1393,1**	**85,1**	Slimes Dams Protea and Slimes Dams West will add 87.4ha to this value	**372,4**		**242,7**		

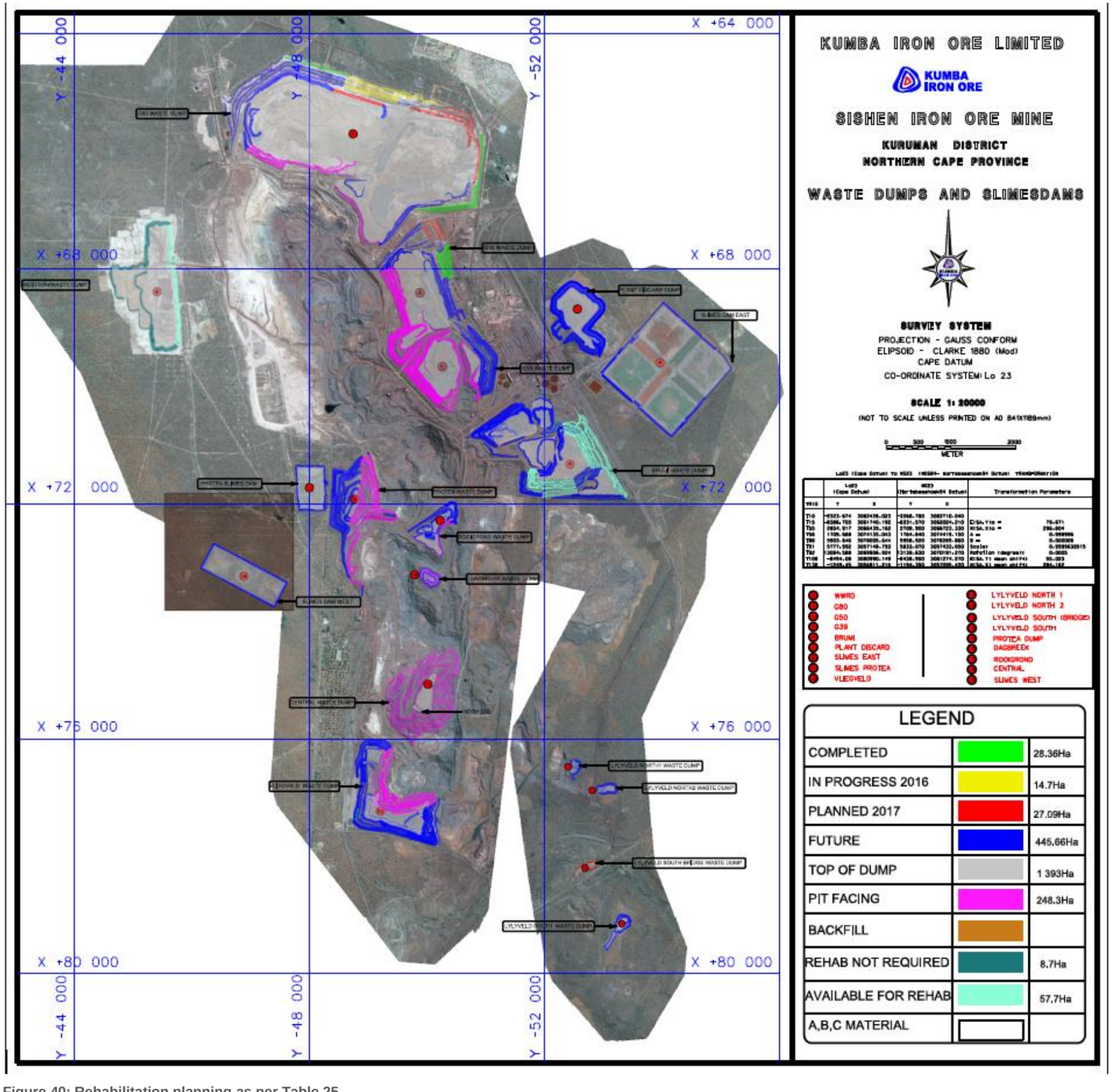

Figure 40: Rehabilitation planning as per Table 25

10. CLOSURE MONITORING AND MAINTENANCE

This chapter provides information with regards to the monitoring of the various environmental characteristics that will provide an indication of compliance to performance requirements, license and permit requirements, Anglo requirements and any other requirements that may be applicable to Kumba Iron ore Sishen mine. The key characteristics are further monitored to ensure that the closure objectives have been achieved and that compliance to the scheduling of rehabilitation planning takes place.

Monitoring is of utmost importance because closure will only be obtained once evidence can be presented to the department of Mineral affairs that the closure objectives have been achieved, that closure plans have been effectively implemented and that rehabilitation is sustained.

The Closure Monitoring and auditing includes the monitoring of the closure plan and its status; the biophysical elements, the social elements and environmental aspects monitored during the LOM (EMS and SEAT) as well as closure plan specific monitoring.

10.1 Monitoring

Sishen Iron Ore Mine monitors the significant aspects and impacts on the environment in accordance with a pre-determined frequency. The results obtained from the environmental monitoring feed into the EMS (ISO 14001). The Monitoring and Measurement Procedure describes the basis of the various monitoring programs conducted throughout the mining area.

The secret to environmental compliance and eventually final closure further lies in pro-active involvement of government agencies and their full support of the rehabilitation program. Constant collaboration with regulating authorities, record keeping by means of statistical programs, and photographic record and database of the rehabilitated areas will give credibility once the stage of closure application is reached.

Where closure is properly integrated into the Environmental Management System of the mine, the internal auditing systems of ISO 14001 is applied to comply with the auditing of the biophysical elements and environmental aspects. The monitoring vehicles that can be used to compliment post rehabilitation / closure monitoring includes:

- Internal audits and external certification audits;
- Management review meetings;
- Review of the aspects and impacts register;
- Monitoring programs required in terms of the aspect register;
- Legal compliance audits and the updating of the legal register;
- Incident and accident reporting and addressing external complaints;

- The monitoring of the social aspects that does not form part of the EMS should be monitored through:
  - Socio Economic Assessment Toolbox (SEAT) management protocol; and
  - Social and labour plan legal reviews (every five (5) years).

The following also add value and should align to the closure plan:

- Environmental Management Program (EMP) Performance assessments (every two (2) years); and
- Sustainable Development indicator monitoring (Anglo American).

The closure plan is monitored through:

- Annual cost escalations to ensure financial status remains relevant;
- Closure Gap analysis applying the Anglo American Closure Toolbox;
- Updating the closure plan and associated plans once every three years;
- Peer Reviews of the closure plan itself; and
- Financial Auditing of closure costs and provisions.

In terms of the updated closure cost assessment (Appendix 3) conducted in November 2015, the monitoring cost as included in the 2012 closure liability report was escalated according to CPI, but not updated as no plan exists yet to determine what monitoring will be done after closure and what the proposed time frame for such monitoring would be. Therefore, the following aspects, currently included in the closure monitoring plan, have not been updated during this assessment:

- Ground water;
- Surface water;
- Rehabilitation monitoring (indigenous vegetation);
- Alien vegetation monitoring;
- Air Quality; and
- Stability.

The closure specific monitoring relates to rehabilitation monitoring as captured in Table 26. According to this procedure, certain monitoring indicators were selected to practically measure the success of the closure and rehabilitation management at the mine. The indicators were selected by means of elimination in order to ensure that key variables are identified to track, check, alert and record changes that affect closure.

The closure monitoring costs have been included in the mine's financial provision (Table 24 in Section 8).

Table 26: Monitoring characteristics and frequencies

Subject monitored	Sub-sections	Specification	Frequency	Monitoring method / equipment used	Records
Ground water	Quality, quantity	Tailings monitoring - 10 years Water level monitoring - 10 years Stable isotope monitoring - 2 years Quarterly groundwater hydro-chemical monitoring - 10 years	Quarterly, until success criteria have been met	All boreholes / as identified in specialist studies	Monitoring reports
Surface water	Storm water containment dams	-	As applicable	-	
	Decommissioning phase monitoring of Gamagara	Siltation monitoring	Quarterly	Surface water monitoring must take place at the surface water monitoring localities specified by the DWA WUL	
	Decommissioning phase monitoring of slimes dams	Water quality	Quarterly		
Rehabilitation monitoring (indigenous vegetation)	Vegetation establishment, basal cover	After five years, ecological index monitoring to ten years.	Bi-annually, for 10 years or until success criteria have been met	-	
Alien vegetation monitoring	Alien vegetation density	Monitoring frequency decreasing according to decreasing density rating.	Every three years, for ten years.	-	
	Percentage of dump slope (north, south, east, and west) covered with alien species	Maintain 10% alien vegetation cover	Bi-annual	Fixed photography monitoring and visual site inspection	
Air quality	PM 10	-	PM10 remote sensing and continual recording	5 Stations	
	Dust fall out monitoring	Dust buckets monthly and then according to dust results frequency and number of dust buckets to reduce over time. First 3 years. Thereafter 12 buckets at quarterly and no buckets after 10 years.	Monthly	24 Dust buckets outside the mine	
Stability	Pit stability monitoring	-	Annually for two years	Satellite monitoring	

Subject monitored	Sub-sections	Specification	Frequency	Monitoring method / equipment used	Records
Infrastructure	Retained Structures (ongoing rehabilitation work, Farming, third party business)	Structural integrity, contamination and suitability	Annually until disposed of	-	

11 STAKEHOLDER ENGAGEMENT PLAN

Sishen's Stakeholder Engagement Plan (SEP) was extracted from the mine's Socio-Economic Assessment (SEAT) Report, dated 2014. This review of the Closure Plan did not include an SEP process.

Sishen mine works hard to build relationships with key stakeholders. Three ongoing SEPs provide a framework for proactively engaging and communicating with stakeholders (i.e. employees, contractors, suppliers, communities, government and other stakeholders).

The three SEP's are:

1. A programme for engagement of communities, local and provincial government.
2. A programme directing trade union and employee engagement.
3. A programme for the engagement of the DMR Regional Office and other regulators such as the northern Cape Department of Environment and Conservation.

Each year, Sishen mine undertakes a stakeholder mapping and analysis exercise to outline stakeholders who are material to its operation - and not managed by Kumba Corporate Office. The table below organises Sishen mine's local stakeholder landscape serviced by its three engagement programmes. Due to the size of the mining operation, its 'age', and the extent of its social management activities, Sishen mine's zone of influence is vast and spans a vibrant and dynamic stakeholder landscape.

Table 27: Sishen Mine stakeholders

Stakeholder category	Stakeholder
Residential communities (People residing within the local area/zone of influence in towns, townships, villages, new developments and informal settlements)	Communities in the Gamagara Local Municipality
	High-density or fast-growing villages/towns in Ga-Segonyana
	Other rural villages in Ga-Segonyana
	Rural villages in Joe Morolong
Affected parties (Stakeholders affected by Sishen Mine, either positively or negatively)	Dingleton community
	Farmers directly impacted by Sishen mining activities
	Complainants (Community members or those who have lodged a complaint or grievance at Sishen mine, not yet resolved)
	Sishen mine employees
	Trade unions
	Contractor employees
	Supplier companies
	Community trainees

Stakeholder category	Stakeholder
	Beneficiaries of health projects
	Beneficiaries of poverty alleviation projects
	Small Business Hub clients
	Beneficiaries of municipal infrastructure projects
	Donation applicants
Interest groups (Stakeholders who, although not affected by the operation, have an interest in or influence over what the operation does)	Ga-Segonyana SMME forum
	JTG District SMME forum
	Kgalagadi Youth Organisation
	Kuruman Community Development forum
	Joe Morolong road forum
	Kuruman Unemployment Community forum
	Gamagara Community Development forum
	Olifantshoek Contractor Unemployment forum
	Tsantsabane Black Business Chamber
	Dingleton Contractors forum
	Jobseekers settling in Gamagara
	Local business
	Commercial farmers in the JTG district
	Local / community based media in Kathu and Kuruman
	Faith based Organisations and church leaders
Development partners in the local area (Stakeholders acting as development agents)	SIOC CDT member trusts, namely JTGDT and Gamagara Development Trust
	Mining companies in the district
	Youth Development Agency, Northern Cape
	National Development Agency
	DBSA
DMR Regional Office (The regulator who is a national competency, but has a regional presence in Kimberley)	Mineral Regulation
	Mine Health and Safety Inspectorate
Local authorities (Authorities with political jurisdiction in the local area)	Gamagara Local Municipality
	JTG District Municipality
	Joe Morolong Local Municipality
	Ga-Segonyana Local Municipality
	Traditional authorities in Ga-Segonyana and Joe Morolong
Provincial Government (Departments in the Northern Cape Province)	Department of Education
	Department of Health
	Department of Social Development
	Department of Finance, Economic Development and Tourism
	Department of Agriculture, Land Reform and Rural Development

Stakeholder category	Stakeholder
	Department of Cooperative Governance, Human Settlements and Traditional Affairs
	Department of Environment and Nature Conservation
	Department of Roads and Public Works
	Department of Transport, Safety and Liaison
Other Government agencies and parastatals	Water authorities
	Parastatals

An SEP does not only identify key stakeholders and analyse their expectations, perceptions and needs. It also sets specific objectives to be achieved through engagement varying from sharing information to consultation, collaboration and joint solution finding. Engagement platforms are categorised by the following main uses:

- Mining sector coordination;
- Collaboration with local authorities;
- Engagement with provincial authorities;
- Engaging interested and affected parties on particular issues;
- Involvement of beneficiaries of projects or programmes funded by Sishen mine;
- Sponsorships offering an opportunity for stakeholder engagement;
- Other engagements (as hoc community information sessions).

An effective, fair and transparent mechanism for recording, handling and resolving complaints and grievances of stakeholders is an important part of Sishen mine's stakeholder engagement framework. The intention is to address stakeholder concerns using tools that are standardised across Anglo American and based on the United Nations Guiding Principles on Business and Human Rights, specifically the guiding principle on access to remedy. Currently, Sishen mine has three complaints and grievance systems: one for environmental matters, one for complaints and enquiries from Dingleton residents, and one for complaints and questions about the Small Business Hub, SLP and CSI projects or any other socio-economic expectations, needs or concerns.

For all three systems, complaints are analysed, reported to the Sishen SLT and considered in the Socio-Economic Assessment report. The same procedure is essentially followed for all three types of complaints; however, there may be differences in the time allowed for resolving complaints, the way complaints are acknowledged and the level of feedback given to stakeholders. To streamline and simplify the process, Sishen mine is moving towards a single complaints and grievance procedure for stakeholders, regardless of the nature of the complaint or query.

12. GAP ANALYSIS

As part of the update of this closure plan to the level of draft as defined by the AAMCT, a gap analysis as per the second tool is required to identify the relevant gaps. The AAMCT's third tool (closing the gaps) requires that an action plan must be linked to the gap analysis and included in the closure plan. The action plan is to include persons responsible for the actions as well as appropriate timelines to complete the actions.

The evaluation model consists of a spreadsheet (Table 28) with the time remaining to scheduled closure along the horizontal axis and the items relating to physical closure, biodiversity, I&AP consultation, social closure and general issues along the vertical axis. The individual cells specify the minimum requirements that should be met for the items along the vertical axis depending on time remaining to scheduled mine closure. The information required for each of the closure items increases in detail and accuracy as the mine moves closer to closure.

The following steps were followed in conducting the gap analysis:

1. The current status of the each of the items on the mine was identified by highlighting the corresponding cell to the *Item Description* column. A short description of the current status was provided.
2. The required status, based on the remaining LOM, was identified.
3. In occurrences where the current status differed from the required status, actions were identified to close the gap. A detailed action plan is included in Section 13 of this report.

Table 28: AAMCT Gap Analysis

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
A. PHYSICAL CLOSURE					
A1. SURFACE CLOSURE					
A1.1 Process Plant Area (including substations)					
The plant area including SEP is about 30 to 50ha, with the redundant plant area being 10ha, the workshops / offices area is 30 - 50ha and the SEP plant 5ha. Slimes dam lines – 30km; Plant power lines – 14km; Overland lines – 50km; Sewage lines – 25km; Overland conveyors (input & SEP 1) – 10km; Additional areas since 2007: Jig Plant, New workshop area, Western Expansion, New filling station	Assumed closure criteria:	Reviewed closure criteria	**Tested closure criteria:** Demolition has been tested and proven elsewhere.	Proven closure criteria	Agreed closure criteria
References: Update Base Rates Nov 2010 - OFC Preliminary Mine Closure Plan – Physical Components 2008 – OFC Integrated Closure Plan 2009 – Lidwala Integrated Rehabilitation Strategy 2011 – OFC Closure Report of Lyleveld South 2010 - Ages	Incomplete cost estimate:	**Class 0 estimate** Actual rates, quantity survey work completed and linked. The new items added at same standard.	Improved Class 0 estimate:	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
A1.2.1 Mine residue sites: Plant Discard					
References: Update Base Rates Nov 2010 - OFC Preliminary Mine Closure Plan – Physical Components 2008 – OFC Integrated Closure Plan 2009 – Lidwala Integrated Rehabilitation Strategy 2011 – OFC Closure Report of Lyleveld South 2010 – Ages Progress Report, Quantifying the extent of rehabilitation of iron ore tailings at the Sishen Iron Ore Mine, January 2008 SRK Report on Slimes Dams Rehabilitation, undated	**Assumed closure criteria:** No topsoil to be imported. In-situ rehabilitation. Updated quantities used. Liability at R 42 million (2016), based on shaping only. **Incomplete cost estimate:** This cost can move by more than 50%.	Reviewed closure criteria	Tested closure criteria:	Proven closure criteria	Agreed closure criteria

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
A1.2.2 Mine residue sites: Tailings					
<u>References:</u> Update Base Rates Nov 2010 - OFC Preliminary Mine Closure Plan – Physical Components 2008 – OFC Integrated Closure Plan 2009 – Lidwala Integrated Rehabilitation Strategy 2011 – OFC Closure Report of Lyleveld South 2010 – Ages Progress Report, Quantifying the extent of rehabilitation of iron ore tailings at the Sishen Iron Ore Mine, January 2008 SRK Report on Slimes Dams Rehabilitation, undated	**<u>Assumed closure criteria:</u>** Growth medium assumed to be discard, to be used on side walls (infilling) and for capping, reshaping to 24 degrees, rock cladding. Storm water infrastructure. Low level of confidence in criteria for capping of facilities (top surface). **<u>Incomplete cost estimate:</u>** This cost can move by more than 50%.	Reviewed closure criteria	Tested closure criteria:	Proven closure criteria	Agreed closure criteria
A1.2.3 Mine residue sites: Waste Rock					
The mine currently has 1 active fine residue complex consisting of 4 compartments (1.8 x 1.8km + return water dam), as well as 2 redundant dam complexes at “South plant” - 20ha. The mine also has a plant discard dump – ha at a height of 70m and mine waste rock dumps (180ha – 120m high) ***Changes since 2012:*** Increase in dump volumes. Western WRDs added. **<u>References:</u>** Draft Soil Enzymatic Report, Sishen Iron Ore Mine, undated Monitoring of long term rehabilitation at Sishen Iron Ore Mine, South Africa, undated Sishen Rehabilitation Trial Evaluation, November 2004 Sishen Water Use license submission (2009)	<u>Assumed closure criteria</u>:	**Reviewed closure criteria** Trials completed and tested on site. Criteria revised based on trials. Immediate closure is based on 24 degree slopes, downward dozing. Storm water master plan and visual impact assessment included.	Tested closure criteria	Proven closure criteria	Agreed closure criteria

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
Progress Report, Quantifying the extent of rehabilitation of iron ore tailings at the Sishen Iron Ore Mine, January 2008					
Rehabilitation monitoring, 2015					
Rehabilitation design for G80 south slope, 2015					
	Incomplete cost estimate:	**Class 0 estimate**	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
		Updated improved rates, modelling and updating of quantities. 2015 volumes are incorporated.			
		Modelling completed (2012). Cost is escalated by 40% to incorporate storm water and benches. Rates used compares to FCE dozing rate used for G80 -Eastern Slope contract - June 2012.			
		Cost estimate can move by 25%			
A1.3 Offsite Surface infrastructure (including railway lines					
The offsite surface infrastructure includes railway lines of approximately 80 – 100km;	Assumed closure criteria:	**Reviewed closure criteria**	Tested closure criteria	Proven closure criteria	Agreed closure criteria
Overland water pipelines 2 x 7km (180km);		Most of the infrastructure is incorporated into the closure liability. Closure criteria reviewed.			
Roads (gravel 60km, Surfaced 10km);					
Storm water channels – 2x5km (West & South);					
Fencing – 60km					
Reference: Base Rate Report	Incomplete cost estimate:	**Class 0 estimate**	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
		Boundaries for demolition defined in latest closure quantum document. To be reviewed annually.			
A1.4 Disposal facilities					
The main waste disposal facilities constitute the Domestic landfill site behind plant discard dump (2ha); Waste tyres and scrap equipment (Yard); Temporary hazardous waste storage.	**Assumed closure criteria:**	Reviewed closure criteria	Tested closure criteria	Proven closure criteria	Agreed closure criteria

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
	Closure of landfill site to be work shopped. Current assumption is to cover it with plant discard. Solution for waste tyres to be determined. Hazardous waste yard assumed to be demolished.				
Reference:	**Incomplete cost estimate:**	Class 0 estimate	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
	Not included, should be included. Could have premature closure liability but not a LOM liability should dump advancement over facility be acceptable. Waste tyre solution to be costed.				
A1.5 Mine towns / housing / schools, etc.					
The mine has got an airport - 20ha, as well as mine owned farms (23000ha). The towns of Kathu / Sesheng township will all be impacted on by mine closure. Clinic is also in municipal area and will not be incorporated in closure costs.	**Assumed closure criteria** High level closure criteria have been defined for closing these facilities. The criteria need to be defined based on the sustainability of these towns post closure. Assumption is that the airport will stay.	Reviewed closure criteria:	Tested closure criteria	Proven closure criteria	Agreed closure criteria
Reference: SEAT, 2014	Incomplete cost estimate:	**Class 0 estimate:** All the towns are proclaimed and excluded from closure cost. Kathu faculty training centre is included. Cost estimate may change once criteria has been defined.	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
A2. MINING AREA CLOSURE					
A2.1 Open pit					
Open pit mining area is 14km long by 2km wide, depth 350m. Width up to 2km. **Reference:** EMP 2002 Update Base Rates Nov 2010 – OFC Preliminary Mine Closure Plan – Physical Components 2008 – OFC Integrated Closure Plan 2009 – Lidwala Integrated Rehabilitation Strategy 2011 – OFC Water use license 2002 Rehabilitation criteria (OFC), 2011	Assumed closure criteria:	Reviewed closure criteria	**Tested closure criteria** Criteria reviewed and tested elsewhere.	Proven closure criteria	Agreed closure criteria
	Incomplete cost estimate	**Class 0 estimate**	Improved Class 0 estimate	Class 1 estimate	

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
		Pit perimeter distance estimates used for rates. (distance x profile x rates) Variation of 35% expected. No fence included in cost estimates. (not sustainable)			Class 2 estimate & Class 3 estimate 1 year from closure
		Pit stability when recharge takes place needs to be re-assessed and criteria updated if required.			
B. BIO-PHYSICAL CLOSURE / REHABILITATION					
B1. Biodiversity					
There are some Red data and protected species in the Sishen area. **Reference:** Biodiversity study done in 2003 - "Kameeldoring woud"; Biodiversity Action Plan – 2008/2009 – does not include post closure impacts	Assumed impacts:	**Assessed impacts:** Specialist studies have been conducted as part of EMPs, impacts have been identified but not focussed on closure.	Confirmed impacts:	Proven mitigation criteria	Agreed mitigation criteria
EIA studies completed for expansion project	**Assumed rehabilitation – method:** No trials conducted on northern slopes, slimes dams and discard dumps.	**Trialled rehabilitation:** Design completed for northern & western slopes, trials to be conducted	**Tested rehabilitation - method:** Southern & eastern slopes rehabilitation tested	Proven rehabilitation - method	Agreed rehabilitation - method
Endemic vision integrated strategy (2011) does include alien vegetation issues.	**Incomplete cost estimate:** Costs associated with offset (incl. sustainability) area not included	**Class 0 estimate:** Rehabilitation costs may change after trials completed	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B2. Protected (Sensitive) habitats / ecosystems:					
Kathu forest is now a proclaimed protected area, there are some pans in the area, the Gamagara River and the Sandveldt area. There are also some Archaeological sites in the area at the airport and on the farm - Marsh.	**Assumed impacts:**	**Assessed impacts:** Specialist studies have been conducted but are not focussed on closure.	Confirmed impacts:	Proven mitigation criteria	Agreed mitigation criteria
Reference:	**Assumed rehabilitation – method:** It is currently assumed that no rehabilitation will be required.	Trialled rehabilitation:	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
	Incomplete cost estimate:	**Class 0 estimate:** Specialist studies focussed on closure may identify additional actions/information to be costed	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B3. Groundwater					
Some specialist studies / Hydro-census done by Golder. **Reference:** AHEE Coetzee, Ian Hunt, Clean stream, F Goussard	Assumed impacts:	**Assessed impacts:** The residual impacts on the groundwater table needs to be assessed. Need to evaluated data and status.	**Confirmed impacts:** Impacts of operation up to closure confirmed	Proven mitigation criteria	Agreed mitigation criteria

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
Moore Spence & Jones study	Assumed rehabilitation method:	**Trialled rehabilitation:** Water treatment not required. Remedial measures currently being implemented at operating costs.	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
Golder Associates Report 2008 – 2011	Incomplete cost estimate:	**Class 0 estimate:** Cost included as per Idwala report.	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B4. Surface water:					
Surface water include sewage and storm water systems	Assumed impacts:	**Assessed impacts:** The main impacts on surface water will be from the Pit water. The municipal sewage water will not be used post closure. The natural flow of surface water will be impaired by pit.	Confirmed impacts	Proven mitigation criteria	Agreed mitigation criteria
		Impacts evaluated for operational phase and concept storm water plan completed. Water re-use strategies underway.			
Reference:	Assumed rehabilitation method:	**Trialled rehabilitation:** Water re-use strategies underway. Regulation 704 compliance being implemented.	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
Master Storm water management plan OFC 2010	**Incomplete cost estimate:** Storm water costs should be included for each dump as outlined in storm water master plan.	Class 0 estimate	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B5. Air quality					
Dust from the waste disposal facilities is the biggest concern at Sishen.	Assumed impacts:	**Assessed impacts:** Dust modelling completed and on-going monitoring takes place. Future dumps excluded. Fair understanding of post closure impacts / residual impacts known. No specialist studies focussed on closure/post closure	Confirmed impacts	Proven mitigation criteria	Agreed mitigation criteria
Reference: Airshed Report	Assumed rehabilitation method:	**Trialled rehabilitation:** Rehabilitation will have a positive effect on air quality	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
Air quality monitoring underway and modelling completed.					
Lidwala report	Incomplete cost estimate	Class 0 estimate:	**Improved Class 0 estimate:** Section 12.3 of Lidwala report sets out costing for air quality monitoring	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B6. Soil					
Hydrocarbon pollution is a key issue at some areas on the mine	**Assumed impacts:** The impacts on soils from the railway lines, storm water channels and wider area still needs to be assessed.	**Assessed impacts:** Quantities assessed, locations identified and action plans developed.	Confirmed impacts	Proven mitigation criteria	Agreed mitigation criteria
Reference:					
Moore Spence & Jones study	Assumed rehabilitation method	**Trialled rehabilitation:** Rehabilitation of soils forms part of the ongoing ground water project, but a specialist study will still be required to determining the potential residual impacts?	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
Golder Associates Report 2008 – 2011	**Incomplete cost estimate:** Contaminated areas not assessed or costed	Class 0 estimate	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B7. Land capability					

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
Gamagara river swallet - sinkhole formation	Assumed impacts:	Assessed impacts:	**Confirmed impacts:** Sinkhole formation confirmed	Proven mitigation criteria	Agreed mitigation criteria
Reference:	**Assumed rehabilitation method:** Restoration / mitigation to be investigated	Trialled rehabilitation:	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
Risk assessment	**Incomplete cost estimate:** Costs associated with restoration or mitigation t be investigated	Class 0 estimate:	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
The area has a low land capability – 16ha per large livestock and 3ha per small live stock.	Assumed impacts:	Assessed impacts:	**Confirmed impacts:** Establishment of offset area to mitigate impact on land capability	Proven mitigation criteria	Agreed mitigation criteria
Reference:	Assumed rehabilitation method:	**Trialled rehabilitation:** It is assumed that the area will be rehabilitated as per land use layout plan	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
EMP Lidwala report	**Incomplete cost estimate:** Costs associated with offset (incl sustainability) area not included	**Class 0 estimate:** Rehabilitation costs may change after trials completed	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B8. Land use					
It is assumed that the future land use will be small scale livestock / game farming. The slopes of the residue/waste disposal facilities will remain as waste land, while the tops will be used for grazing	Assumed impacts:	**Assessed impacts:** The current mine closure plan assumes that stock farming/grazing will be the final land use. This might not be correct for all areas and should the land use differ, so will the closure criteria and costs.	Confirmed impacts	Proven mitigation criteria	Agreed mitigation criteria
Reference:	**Assumed rehabilitation – method:** No trials conducted on northern slopes, slimes dams and discard dumps.	**Trialled rehabilitation:** Design completed for northern & western slopes, trials to be conducted	**Tested rehabilitation - method:** Southern & eastern slopes rehabilitation tested	Proven rehabilitation - method	Agreed rehabilitation - method
EMP	**Incomplete cost estimate:** Costs associated with offset (incl sustainability) area not included	**Class 0 estimate:** Rehabilitation costs may change after trials completed	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B9. Natural resources					
-	Assumed impacts:	**Assessed impacts** Refer to Biodiversity, Surface water and Groundwater discussions above	Confirmed impacts	Proven mitigation criteria	Agreed mitigation criteria
Offset area, water, biodiversity	Assumed rehabilitation method:	**Trialled rehabilitation** Refer to Biodiversity, Surface water and Groundwater discussions above	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
Reference:	Incomplete cost estimate:	Class 0 estimate Refer to Biodiversity, Surface water and Groundwater discussions above	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
B10. Topography / Visual					
The biggest impact on topography/visual are the appearance of the waste rock dumps, discard dump, dust form these facilities, as well as erosion. This could impact on tourism in the area.	Assumed impacts	**Assessed impacts.**	Confirmed impacts	Proven mitigation criteria	Agreed mitigation criteria

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
		A visual impact assessment was done by Stevan Raal and OFC. This report must be reviewed to confirm the post closure impacts and mitigation measure			
Reference:					
Stevan Raal Report	Assumed rehabilitation method:	**Trialled rehabilitation:** Rehabilitation method decided and incorporated into costs. Rehabilitation will have a positive effect on topography and visual aspects	Tested rehabilitation - method	Proven rehabilitation - method	Agreed rehabilitation - method
Visual impact assessment – EndemicVision 2010	Incomplete cost estimate:	**Class 0 estimate:** Rehabilitation method decided and incorporated into costs.	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
C. I&AP CONSULTATION & SOCIAL CLOSURE					
C1. Employees					
Sishen employ approximately 3700 permanent employees, 1500 contract staff and 4000 project labour.	Assumed needs	**Assessed needs:** The mine has a Social & Labour Plan and a re-skilling, retraining programme. The needs of the employees must be reviewed against the post closure land used and the re-skilling and training programme must be adapted to accommodate potential sustainable post closure socio-economic opportunities.	Confirmed needs:	Proven needs	Agreed needs
Reference:	Nothing	**Nothing:** No specific closure consultation has taken place. Specific closure consultation is not required at this stage.	Consult	Involve	Collaborate
Social and Labour plan	**Incomplete cost estimate:** No additional post closure costs have been included to accommodate potential requirements from employees. The current operating cost does include the retrenchment, re-skilling and training cost associate with closure.	Class 0 estimate:	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
C2. Affected Parties					
Affected parties at Sishen are the local farmers, the Gamagara, the local communities (etc.), local and wider business, municipalities and other local mining companies.	Assumed needs:	**Assessed needs:** Socio-economic closure requirements have been assessed during SLP and SEAT process.	Confirmed needs	Proven needs	Agreed needs
Reference:					
Lidwala Report	**Nothing:** No specific consultation on mine closure planning has taken place date. Affected parties must be informed once the Preliminary mine closure plan has been completed.	Inform	Consult	Involve	Collaborate
Check community engagement plan and inform community about closure issues. Use current communication platforms.	**Incomplete cost estimate:** Social closure costs not estimated	Class 0 estimate:	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
C3. Interested Parties					

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
The main interested parties are SARHA, WESSA, Academics (Potchefstroom), McGregor Museum and the Raptor Centre	**Assumed needs:**	**Assessed needs:** Socio-economic closure requirements have been assessed during SLP and SEAT process.	Confirmed needs	Proven needs	Agreed needs
Reference:	**Nothing:** No specific consultation on mine closure planning has taken place date. Interested parties must be informed once the Preliminary mine closure plan has been completed.	Inform	Consult	Involve	Collaborate
EMP	**Incomplete cost estimate:** Social closure costs not estimated	Class 0 estimate:	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
C4. Authorities					
DME, DWAF, DTEC, NC DA, NA DA, Local and provincial authorities,	Assumed needs	**Assessed needs:** The closure needs of government have been asses through the EMP process. Some of the criteria need to be reassessed in consultation with government.	Confirmed needs	Proven needs	Agreed needs
Reference:	Nothing	**Inform:** Ongoing reporting on compliance with EMPR has been taking place, although closure specific consultation has not been done to date. Social closure has not been addressed or discussed with government to date.	Consult	Involve	Collaborate
EMP	**Incomplete cost estimate:** Social closure costs not estimated	Class 0 estimate:	Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
D. GENERAL ISSUES					
D1. Overall cost estimate					
- **Reference:** Base Rates report OFC 2012 (escalated to Nov 2015)	Incomplete Estimate:	**Class 0 Estimate:** The current estimate does not include all potential rehabilitation, socio-economic and closure management costs and can at best be seen as an indication of the potential closure cost.	Improved Class 0 estimate	Class 1 estimate	Class 2 estimate & Class 3 estimate 1 year from closure
D2. Closure programme					
- Provisional Mine closure date – 2031 (Nov 2015) **Reference:** None	**Proposed programme:** No specific mine closure programme is in place to manage the mine closure process.		Linked program	Final detailed program	Final detailed execution program
D3. Overall cash flow					
- **Reference:** None	**Initial cash flow:** Ongoing rehabilitation/hydrocarbon management is in the current operational budget. There is no cash flow linked to the final mine closure plan.		Linked cash flow	Final cash flow	Final cash flow
D4. Financial provision					

TIME REMAINING TO SCHEDULED CLOSURE	More than 25 years	25 – 15 years	15 – 10 years	10 - 5 years	5 – 0 years
ITEM DESCRIPTION	**PRELIMINARY CLOSURE PLAN**		**DRAFT CLOSURE PLAN**	**DETAILED CLOSURE PLAN**	**FINAL CLOSURE PLAN**
- Trust fund **Reference:**	Initial financial provision	**Proposed financial provision:** The current trust fund is standing at R400 million. Short fall is covered by bank guarantees. The closure programme is linked to financial provision but not to cash flow.	Linked financial provision (Class 0):	Linked Financial provision (Class 1)	Financial provision (Class 2)
D5. Overall Integrated Mine Closure Plan					
- **Reference:** Preliminary Mine Closure Plan, 2017 - Shangoni	**Preliminary mine closure plan:** The 2012 Mine Closure Plan compiled by OFC was updated by Shangoni in 2017. As LoM is estimated at 2031 (Nov. 2015) a Preliminary CP is required.		Draft mine closure plan	Detailed mine closure plan	Final mine closure plan

13. CLOSURE ACTION PLAN

This section identifies measures/actions to address the gaps, opportunities and recommendations as identified in the Preliminary Closure Plan, during the operational phase. This plan is still in draft format and will be updated in 2017 in consultation with the DMR.

Table 29: Closure action plan

Action no.	Gap analysis Ref no.	Description (as per gap analysis tool)	Domain	Reference	Action (from gap analysis / risk assessment / previous CP)	Lead	Participants	Due date	Budget
A. PHYSICAL CLOSURE									
A1. SURFACE CLOSURE									
A1.1 Process plant areas									
1	A1.1.1	Process plant area	Process plant	Gap analysis (Shangoni 2016)	(i) Generate integrated surface layout drawing to include in Prelim CP	Land Manager		Update as necessary	
2		Process plant area	Electrical sub-stations	Risk assessment: Electrical sub-stations (Shangoni 2016)	(i) Add temporary lines within mine.	Land Manager		Next financial provision update	
A1.2 Mine residue sites									
3	A1.2.1	Plant discard	Plant discard facility	Risk assessment (1.2 (B)) Plant discard- Instability and failure Risk assessment 1.2 (H) Loss of agricultural land	i) Develop end use alternatives and proven rehabilitation prescription for discard dump ii) Develop stable post-closure landform and storm water design catering for relevant flood event as per legal requirements. Consider reshaping of top edges to create a natural profile and break straight lines iii) Confirm final volume of discard dump based on newest LOM Plan	Land Manager		Before next closure plan update	
4	A1.2.2	Tailings	Tailings facilities	Risk assessment (1.1 B) Action #12 (Sishen CP review)	i) Confirm stability and phreatic zone projection for Sishen ii) Develop end use alternatives and proven rehabilitation prescription for tailings facilities iii) Develop stable post-closure landform and storm water design catering for relevant flood event as per legal requirements iv) Determine if concurrent rehabilitation of side slopes can take place as part of rehabilitation program v) Re-assess topsoil availability and depth of cover for top of dumps	Land Manager		Before next closure plan update	
5	A1.2.3	Waste rock	Waste rock dumps	Risk assessment WRDs 1.4 (B) Instability & failure Opportunities to minimise closure costs	i) Sishen Mine currently proposes that waste dump slopes that are pit-facing be left as wasteland / sterilised land. Sishen Mine will undertake a detailed risk assessment and finalise a motivation to the DMR. ii) Develop proven rehabilitation prescription for waste rock dumps (include detail investigation into feasibility of moonscapes) iii) Develop stable post-closure landform and storm water design catering for relevant flood event as per legal requirements. Include visual impact considerations iv) Re-evaluate topsoil availability and depth of cover for top of dumps and benches v) Consider boreholes on top of dump to ensure water retainment and penetration instead of accumulation and runoff	Land Manager		Before next closure plan update	
6	A1.2.3	Waste rock	Waste rock dumps	Action #22 (Sishen CP review) Opportunities to minimise closure costs	(i) Estimate WRD specific topsoil transport distances and adjust cost estimates required An opportunity identified through this process to reduce closure costs significantly in the face of calculating actual haul distances for growth medium as opposed to assumed (inaccurate) 2 km haul distances, is to declare the pit facing dumps as wilderness area.	Land Manager		Next financial provision update	
7			Waste rock dumps	OFC (2012)	It is recommended that more detailed studies are undertaken to confirm the viability to use a small dragline for possible dump rehabilitation of the older dumps at the Mine.	Land Manager		Concurrent	

Action no.	Gap analysis Ref no.	Description (as per gap analysis tool)	Domain	Reference	Action (from gap analysis / risk assessment / previous CP)	Lead	Participants	Due date	Budget
8		Rehabilitation / Closure criteria		2012 CP - Opportunities to minimise costs	(i) Designing new dumps and current dumps with closure / rehabilitation in mind. (ii) Design any new dumps in such a way to minimise material movement per dump and identify areas where incorrect slopes can be rectified with dumping.	Land Manager		Ongoing	
9		Rehabilitation / Closure criteria		2012 CP - Opportunities to minimise costs	(i) Mega dump design and maximise air space usage of current dumps require a feasibility study to assess the operational implementation of these options against the closure liability threshold level for the mine	Land Manager		Within next 2 years	
10		Rehabilitation / Closure criteria		2012 CP - Opportunities to minimise costs	(i) Determining Ore Dumps (C-Grade dumps) management in line with closure management and liabilities	Land Manager		Ongoing	
11		Rehabilitation / Closure criteria		2012 CP - Biophysical assumptions	Investigate topsoil haul distance	Land Manager		Before next financial provision / closure plan update	
12		Rehabilitation / Closure criteria		2012 CP - Biophysical assumptions	Include contour drain or chute outlets with clean water drainage canals that will be required to divert the clean water from the rehabilitated dumps in the next assessment	Land Manager		Before next financial provision / closure plan update	
A1.3 Offsite infrastructure									
13	A1.3.1	Offsite infrastructure							
A1.4 Disposal facilities									
14	A1.4.1	Disposal facilities	Waste tyres	Gap analysis: Disposal facilities Action #15 (Sishen CP review)	(i) Determine the closure solution for waste tyres and include in the closure liability estimate	Land Manager		Next financial provision update	
A1.5 Mine towns / housing / schools, etc.									
15	A1.5.1	Mine towns / housing / schools, etc.		Gap analysis: Mine towns / housing / schools	(i) Develop / identify closure criteria for mine towns / housing / schools	Land Manager		Next financial provision update	
16				Gap analysis: Mine towns / housing / schools	(i) Determine costing related to mine towns/housing/schools in line with criteria as identified above. Update costing accordingly	Land Manager		Next financial provision update	
A2. MINING AREA CLOSURE									
17	A2.1	Open pit	Open pit	Gap analysis: Open pit	(i) Review open pit perimeter shaping method and costing (ii) Pit stability when recharge takes place needs to be re-assessed and criteria updated if required.	Land Manager		Next financial provision update	
18				Knowledge gap (open pit)	(i) In-pit dumping plans to be finalised for discussion with the DMR.	Land Manager		2017	
B. BIO-PHYSICAL CLOSURE / REHABILITATION									
B1. BIODIVERSITY									
19	B1	Biodiversity	Biodiversity	Gap analysis: Biodiversity	(i) Consolidate information on biodiversity impacts. (ii) During next biodiversity survey / impact assessment, assess closure specific impacts	Land Manager		Before next closure plan update	
20	B1	Biodiversity	Biodiversity	Gap analysis: Biodiversity	(i) Commence with trials on northern & western slopes. (ii) Trials without topsoil to commence (iii) A final set of rehabilitation parameters and criteria needs to be determined	Land Manager		Before next closure plan update	
21	B1	Biodiversity	Biodiversity	Gap analysis: Biodiversity	(i) During next ecosystem / heritage survey / impact assessment, assess closure specific impacts	Land Manager		Before next closure plan update	

Action no.	Gap analysis Ref no.	Description (as per gap analysis tool)	Domain	Reference	Action (from gap analysis / risk assessment / previous CP)	Lead	Participants	Due date	Budget
22	B1	Biodiversity	Biodiversity	Closure risk assessment: Biodiversity	(i) Consider biodiversity targets for farms and sensitive ephemeral pans. (ii) Management costs and liability transfer arrangements required.	Land Manager		Before next closure plan update	
23	B1	Biodiversity	Biodiversity	Closure risk assessment: Biodiversity	(i) A detailed alien invasive management plan for the whole mine is required as part of rehab maintenance program. (ii) Upon closure, final evaluation of the Acacia melifera bush encroachment status and impact on grazing capacity should be done and action plan implemented accordingly.	Land Manager		Before next closure plan update	
24	B1	Biodiversity	Biodiversity	Closure risk assessment: Biodiversity	(i) Consider drought risk in contingencies - rehabilitation failure will have to be redone or followed up.	Land Manager		Before next closure plan update	
25	B1	Biodiversity	Biodiversity	Closure risk assessment: Biodiversity	(i) Consider LOM rehabilitation and post closure management and transfer of responsibilities in a sustainable manner. (ii) Post closure planning in terms of fire management is not in place yet. Although, this is not currently a key priority, it must be addressed for closure.	Land Manager		Before next closure plan update	
26	B1	Biodiversity	Biodiversity	2012 CP - Opportunities to minimise costs	(i) Composting is applied for soil amelioration at great costs to Sishen, hydro seeding VS (ii) Composting, and hand sowing should be trialled for large scale implementation.	Land Manager		Next 5 years	
27	B1	Rehabilitation / Closure criteria	Biodiversity	2012 CP - Opportunities to minimise costs	(i) Use locally produced VS purchased and imported plant specimens	Land Manager		Concurrent	
B2. PROTECTED (SENSITIVE) HABITATS / ECOSYSTEMS									
28									
B3. GROUNDWATER									
29	B3	Groundwater	Groundwater	Gap analysis: Groundwater Risk assessment (Groundwater contamination)	(i) Groundwater modelling during next groundwater study (ii) Detailed investigation of closure groundwater risks and the associated mitigation options	Land Manager		Before next closure plan update	
B4. SURFACE WATER									
30	B4	Surface water	Surface water	Gap analysis: Surface water Risk assessment (Surface water contamination)	(i) Detailed investigation regarding costs associated with possible transfer of infrastructure to Sedibeng water. (ii) The assumption that water supply to Sedibeng and surrounding landowners will be stopped and pit recharged must be investigated. Community expectation management should also be addressed here. The landowners and Sedibeng will have to incorporate adequate planning and management. Liability transfer arrangements and agreements are required for premature and LOM Closure. The conceptual and fine scale planning is required to ensure community expectations are addressed. Once these items are resolved, closure costs should be updated to include the pumping, maintenance, and operational costs to maintain this system according to the time period the agreed plans indicate.	Land Manager		Before next closure plan update	
31	B4	Surface water	Surface water	Gap analysis: Surface water Action #18 (Sishen CP review)	(i) Develop integrated storm water plans for the entire Sishen Mine. (ii) Focus on closure required. (iii) The potential post closure evaporation from pits needs to be addressed.	Land Manager		Before next closure plan update	
32	n/a	n/a	Surface water	Risk assessment: Surface water	(i) The potential post closure evaporation from pits needs to be addressed. (ii) On-site verification of impacts and remediation required for closure of surface water sensitive areas.	Land Manager		Before next closure plan update	
33	n/a	n/a	Surface water	2012 CP - General recommendations	(i) Sishen has exemption to divert 8 river streams in terms of its integrated water use license. This may have to be remedied for closure. Closure risk assessments include water related risks and mitigation plan. Cost estimates are completed for these items. In this regard, the closure plan should also be signed off by Department of Water Affairs.	Land Manager		2017	
B5. AIR QUALITY									

Action no.	Gap analysis Ref no.	Description (as per gap analysis tool)	Domain	Reference	Action (from gap analysis / risk assessment / previous CP)	Lead	Participants	Due date	Budget
34	B5	Dust	Air quality	Risk assessment (Air quality) Gap analysis: Air quality	(i) Confirm possible impact of dust on ecology through current biomonitoring program (ii) Develop post-closure air quality model to determine post-closure risk (iii) Review Air Quality study to identify closure impacts. (iv) Considering the distinction between pit-facing and outfacing waste dump slopes, it must be accurately proven that dust from these slopes will not affect any third party (this can be confirmed with specific monitoring).	Land Manager		Before next closure plan update	
35	B5	Asbestos	Air quality	Gap analysis: Social closure Action #13 (Sishen CP review)	(i) Determine residual levels of asbestos contamination at Dingleton and include remediation costs in the premature closure liability and in operational budgets. (ii) Asbestos items generated from infrastructure demolition in terms of closure should be addressed in the waste license application or amendment to the license has to be made to ensure compliance.	Land Manager		Immediate	
B6. SOIL									
36	B6	Soil	Soil	Gap analysis: Soil Action #19 (CP review) Keys to success Opportunities to minimise closure cost	(i) Develop an integrated topsoil management plan to ensure optimal utilisation of the scarce resource (ii) The option to screen dump material to augment topsoil deficiencies should be investigated.	Land Manager		5 years	
37	B6	Soil	Soil	Risk assessment (Polluted areas) Gap analysis: Soil	(i) Assessment on contaminated soils & costing if required (ii) The impacts on soils from the railway lines, storm water channels and wider area still needs to be assessed. (iii) Residual impacts to be determined.	Land Manager		Before next closure plan update	
B7. LAND CAPABILITY									
38	B7	Gamagara river swallet - sinkhole formation	Land capability	Risk assessment	HQ is currently busy with a project to restore the river or alternatively mitigate the impact thereof. The solution is still uncertain and stakeholder engagement will commence 2017	Land Manager		Before next closure plan update	
39	B7	Land capability	Land capability	Gap analysis: Land capability & Biodiversity	(i) Costing of management of offset area - cost related to transformation to independent reservation	Land Manager		Before next closure plan update	
B8. LAND USE									
40	B8	Lan use	Land use	Gap analysis: Gap analysis: Land use	(i) Map post-mining land-use in more detail to ensure appropriate matching of rehabilitation prescription to post-mining land-use.	Land Manager		Update as necessary	
41	n/a	n/a	Land use	2012 CP - Keys to success Opportunities to minimise closure cost	(i) A key to closure success and a possible flaw in the current design is that the final land use of Waste Rock Dumps is small stock grazing (EMPR, Closure Objectives). Trials need to be conducted, and the final land use commitments re-evaluated. (ii) Investigate the possibility to declare pit-facing dumps as wilderness area	Land Manager		Before next closure plan update	
B9. NATURAL RESOURCES									
42	n/a	Closure monitoring	n/a	Knowledge gap	(i) A definitive gap exists between the monitoring aspects defined in the closure cost assessment conducted in 2012 (as a result of only a CPI update – Only the costing was updated in 2015) and the closure monitoring and maintenance plan also completed in 2012. Gap: The closure monitoring and maintenance plan requires and update.	Land Manager		Before next closure plan update	
B10. TOPOGRAPHY / VISUAL									
43	B10	Topography/Visual	Topography/Visual	Gap analysis: Visual / Topography	(i) Verify whether post closure impact is addressed in VIA	Land Manager		Before next closure plan update	
44	n/a	n/a	Topography/Visual	Risk assessment 1.2 (G) Visual and aesthetic degradation	(i) Develop stable post-closure landform (consider reshaping of top edges to create a natural profile and break straight lines)	Land Manager		Ongoing	
C. I&AP CONSULTATION & SOCIAL CLOSURE									
C1. EMPLOYEES									

Action no.	Gap analysis Ref no.	Description (as per gap analysis tool)	Domain	Reference	Action (from gap analysis / risk assessment / previous CP)	Lead	Participants	Due date	Budget
45									
C2. AFFECTED PARTIES									
46	C2	Affected parties' consultation	Social	Gap analysis: Social closure	(i) Stakeholder engagement & public participation focussed on closure to start in order to identify social closure requirements and calculate social closure costs.	Land Manager		Before next closure plan update	
C3. INTERESTED PARTIES									
47	C3	Affected parties' consultation	Social	Gap analysis: Social closure	(i) Stakeholder engagement & public participation focussed on closure to start in order to identify social closure requirements and calculate social closure costs.	Land Manager		Before next closure plan update	
C4. AUTHORITIES									
48	C4	Stakeholder engagement	Social	Gap analysis: Social closure	Increase DMR confidence in Sishen Mine closure and rehabilitation plan and get approval to rehabilitate the WWRD in-situ. For this purpose submit an updated Closure Plan for DMR approval after engagement sessions with the DMR, where the details of the Closure Plan have been discussed. (i) Stakeholder engagement & public participation focussed on closure to start in order to identify social closure requirements and calculate social closure costs.	Land Manager		Before next closure plan update	
C5. GENERAL (SOCIAL)									
49	n/a	n/a	Social	Gap analysis: Social closure Action #24 2012 CP - Key to success	(i) Stakeholder engagement & public participation focussed on closure to start in order to identify social closure requirements and calculate social closure costs. (ii) Calculation of decommissioning costs should include social costing (iii) Develop social closure criteria and include in the updated closure plan in line with SEAT. (iv) To have a successful closure, the social element of closure needs to be prioritized. Social Closure Risk Assessment, mitigation strategy and cost updating is required	Land Manager		Before next closure plan update	
D. GENERAL ISSUES									
D1. OVERALL COST ESTIMATE									
50	D1	Overall cost estimate	n/a	Gap analysis: Overall cost estimate	(i) Rates to be reviewed and updated. (ii) Social closure cost to be investigated	Land Manager		Next financial provision update	
51	n/a	n/a	n/a	2012 CP - Opportunities to minimise costs	(i) Much better rehabilitation rates could be achieved when longer-term contracts are negotiated with external contractors. . Determine best model and issue new tender in 2017 for the next 3 years	Land Manager		Ongoing	
D2. CLOSURE & REHABILITATION PROGRAMME									
52	D2	Closure programme	n/a	Gap analysis: Closure programme	(i) Annual and 10 year rehabilitation scheduling to be done and linked to financial provision.	Land Manager		Before Feb 2018 (Regs implementation date)	
53	D2	Overall cash flow	n/a	Gap analysis: Overall cash flow Action #21 (Sishen CP review)	(i) Appropriately sequence closure activities for the premature estimate across the remaining LoM to ensure that the NPV is being calculated correctly.	Land Manager		Before next closure plan update	
54	n/a	Rehabilitation	n/a	Knowledge gap	(i) A significant opportunity exists to minimize closure cost by reducing the rehabilitation backlog position of Sishen Mine. The biggest challenge facing Sishen Mine is to rehabilitate 76 years of waste rock dumps before LOM.	Land Manager		Concurrent	
D3. OVERALL CASH FLOW									
55									

Action no.	Gap analysis Ref no.	Description (as per gap analysis tool)	Domain	Reference	Action (from gap analysis / risk assessment / previous CP)	Lead	Participants	Due date	Budget
D4. FINANCIAL PROVISION									
56									
D5. OVERALL CLOSURE PLAN									
57		Zones of influence		Knowledge gap	(i) The zones of influence have not yet been set and defined.	Land Manager		Before next closure plan update	
58		Closure criteria		Action #6 (Sishen CP review)	(i) Update closure criteria to the level of tested as defined in the MCT	Land Manager		Before next closure plan update	
59	n/a	n/a	ICPS	n/a	Re-evaluate Sishen ICPS maturity status	Carl Grant			
60	n/a	n/a	ICPS	n/a	Submit proposal (PID) for assisting Sishen to implement an ICPS	Carl Grant			
61	n/a	n/a	ICPS	n/a	Obtain approval for PID	Werner Voigt			
62	n/a	n/a	ICPS	n/a	Develop implementation plan for ICPS and present to site leadership for approval	Carl / Werner			
63	n/a	n/a	ICPS	n/a	Implement ICPS at Sishen Mine as per ICPS action plan in E1 to E6 below Objective is to achieve a maturity rating of at least competence (level 4) for all relevant sub-processes identified in the ICPS				
D6. OTHER GENERAL ISSUES									
64	n/a	Legal compliance	Cumulative impacts	OFC (2012)	The legal requirement to manage cumulative impacts for closure is applicable to Sishen, situated adjacent to Khumni Mine. Closure discussions and a joint management plan are required.	Werner Voigt		Before next closure plan update	
65	n/a	Legal compliance	n/a	2012 CP - General recommendations	(i) Closure risk assessment addresses significant impacts. A copy of the closure plan should be signed off by DEA to make sure the requirements in terms of NEMA are adequately addressed.	Land Manager		2017	
66	n/a	Heritage / Legal compliance	Heritage	2012 CP - General recommendations	(i) Heritage evaluation in terms of the National Heritage Resources Act is not conducted yet at the main pant area. Even though many structures are older than 60 years at closure, the heritage valuation has not made to determine if the infrastructure will be retained. Heritage evaluation has to be conducted for closure planning.	Land Manager		5 years	
67	n/a	Closure criteria	n/a	2012 CP - General recommendations	(i) Implement the Closure success criteria (planning phase) to ensure closure risks are managed.	Land Manager		Ongoing	

14. CLOSURE MANAGEMENT PLAN

This section describes the proposed decommissioning and closure sequence, including scheduling, cash flow and the organisational structure to manage the process.

14.1 Closure organisational structure

As LOM is 2031, a definite closure organisational structure cannot be identified at this stage. However, two options for the implementation of the decommissioning and rehabilitation actions have been identified, the first being that the process be managed in house, while the second option is to appoint contractors to manage the decommissioning and closure process. The two options are further expanded upon below:

1. In house closure management
   This option will entail a process where existing employees of Sishen Mine will apply for certain positions that will manage the closure process. Only a small portion of the existing workforce will be employed in this manner. The benefit of this option is that the current employees know the mine and are already settled in the area, which will lower the closure costing as it will cut out site establishment fees and other similar items.
2. Closure management through contractors
   This option will entail the appointment of contractors to implement the decommissioning and closure plan actions. The process will be managed by Kumba Head Office, with few Kumba employees on site. The benefit of this option is that the contractors already specialise in in demolition and rehabilitation, which will mean that employees will not require further training towards this end. Preliminary and General costs will however be higher than the costs associated with option 1.

14.2 Decommissioning and closure scheduling

The rehabilitation schedule is incorporated into the financial provision of the mine to ensure sufficient budget for the planned annual actions. It is assumed that the current LOM date for Sishen Mine is 2031. The main activities are:

- Physical – the lease, sell, donation or demolition of buildings and infrastructure not utilised as part of the rehabilitation process, is scheduled for the first five (5) years after cessation.
- Biophysical – sloping, moonscaping, planting and making safe of areas is scheduled to continue from the concurrent rehabilitation that was done during mining, to completed rehabilitation in ten (10) years. Ideally, the rehabilitation backlog will be eliminated prior to cessation of mining. This will ensure a shorter rehabilitation period.

- Transition management – monitoring will continue during the decommissioning and rehabilitation, (two years after all rehabilitation has ceased), after which the DMR may issue a closure certificate or request further monitoring or rehabilitation measures to be taken.

14.3 Updating requirements for this plan

This plan needs to be reviewed annually as required by the Financial Provision Regulations (GN 1147) and updated every three years, except in the case of a significant change. The accompanying support documentation should be updated where significant changes occur and integrated during the review of this document. It is strongly felt that the good concurrent rehabilitation work that commenced at G80 Waste Rock Dump and learnings from this work should be incorporated into the existing rehabilitation strategy and Closure Implementation Plan.