Beeshoek Iron Ore Mine

Residual Risk Assessment Report

Report Purpose

Providing the Client and Regulatory Authority with an understanding of the potential risk for which the licence holder should make provision for (if any).

Report Status

Final

Report Reference

EnviroGistics Ref.: 20201

Departmental Ref.: NC 30/5/1/2/3/2/1/223EM

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3 September 2021

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With more than 19 years' experience in environmental management and the consulting industry, she follows a methodical and practical approach in attending to environmental problems and identifying environmental solutions throughout the planning, initiation, operation and decommissioning or closure of projects.

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Quality Control

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Report Ref. No.	20201
Report Status	Final 3
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20201W	Inclusion of Rehabilitation Specialist input	11 May 2021	20201W2
20201W2	Inclusion of Annual Rehabilitation Costing	11 June 2021	20201FD
20201FD	Change of details of Technical Manager	30 July 2021	20201F
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Specialist team	Comments on report	29 July 2021	Electronic
Client	Final	30 July 2021	Electronic
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1 INTRODUCTION AND TERMS OF REFERENCE

1.1 Introduction

Beeshoek is situated in the Tsantsabane Local Municipality, with neighbouring towns being Postmasburg, located 7km east of the mine and Kathu located 70km north of the mine.

Mining at Beeshoek was established in 1964 with a basic hand sorting operation. In 1975 a full Washing and Screening Plant was installed. Because of increased production, Beeshoek South, a southern extension of the Beeshoek Mine, was commissioned during 1999 on the farms Beesthoek and Olynfontein.

Assmang (Pty) Ltd is the holder of the new order rights in terms of the Mineral and Petroleum Resources Development Act, 2002 (Assmang (Pty) Ltd is the holder of the new order rights in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) in respect of high-grade hematite iron ore deposits at Beeshoek on the farms Beesthoek and Olynfontein. The mining method currently entails an opencast mining operation, which consists of five (5) active opencast pits (Village Pit, HF Pit, BF Pit, East Pit, and BN Pit). Although other opencast pits are dormant at this time, these are continuously assessed in terms of their economic value. The current resources of the Mine are approximately 97.17 million tonnes with a reserve of about 26.18 million tonnes.

Beeshoek can be broadly categorised as follows:

- Northern mining area (North Mine): This area comprises active as well as historical mining areas. A number of small quarries and mine residue dumps of various categories are located within this area. The area also includes the existing iron ore beneficiation plant, tailings storage facility (slimes dam), as well as the North Opencast Pits;
- Main Offices, village (since demolished) and recreational area; and
- Southern mining area (South Mine): This area comprises large opencast pits and associated Waste Rock Dumps (WRDs). The Village Pit and associated WRD are the main activities in this area. This area also includes a crushing and screening area as pre-preparation of the Run of Mine (ROM) iron ore before being routed by overland conveyor to the Iron Ore Beneficiation Plant located at North Mine.

Table 1: Details of Applicant

Applicant	Beeshoek Iron Ore Mine
Postal Address	Private Bag X3002 Postmasburg 8420
Technical Manager (SHEQ)	Ms. Dorianne Odendaal Tel: +27 (0) 53 311 6666 E-mail: dorianne.odendaal@assmang.co.za
Environmental Superintendent	Mr. Msimelelo Silomntu Tel: +27 (0) 53 311 6666 Cell: +27 (0) 63 520 9191 E-mail: msimelelo.silomntu@assmang.co.za
Senior General Manager	Ms. Maryke Burger Telephone No: +27 (0) 53 311 6666 Email: Maryke.Burger@assmang.co.za
Mining Rights Holder	Assmang (Pty) Ltd Private Bag X3002 Northlands 2116 South Africa Contact: Andre Joubert Telephone: +27 (0) 11 770 6800 Facsimile: +27 (0) 11 268 6440 Email: andre.joubert@arm.co.za
Surface Holder	Assmang Limited Private Bag X3002 Northlands 2116 South Africa

Mining Right Ref. No.	(NC) 223MRC

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1.2 Purpose of this Report

The regulations (November 2015 as amended) pertaining to the Financial Provision for Prospecting, Exploration, Mining and Production Operations in terms of the NEMA prescribes the determination and making of Financial Provision for existing rights/ permit holders (Regulation 11 of GN R 1147). Importantly, the provisions in Section 24P of NEMA have been given effect through these newly promulgated regulations.

Accordingly, the following is required to satisfy the requirements for the determination of the Financial Provision and provides the basis to bring Beeshoek's Financial Provision into alignment with the new regulations:

- A detailed review and itemisation of all activities and associated actual costs for the implementation of:
  - Annual rehabilitation, as reflected in an Annual Rehabilitation Plan;
  - Final rehabilitation, decommissioning and closure of the mining operations at the end of the life of the operations, as reflected in a Final Rehabilitation, Decommissioning and Closure Plan; and
  - Remediation of latent or residual environmental impacts which may become known in the future, including the pumping and treatment of extraneous water, again as reflected in a Residual Risk Assessment Report.

According to the Amendments to the 20 November 2015 Financial Provision Regulation (Government Notice 24, published in Government Gazette 42956, dated 17 January 2020)' a holder, or holder of a right or permit who applied for such right or permit prior to the commencement of the 2015 Regulations, shall by no later than 19 June 2021 comply with these Regulations (2015 Financial Provision Regulations. It should be noted that Government Notice No. 371 in Government Gazette No. 44477 of 22 April 2021 was issued for Public Comment for a period of 30 days of the publication of this Notice. This Notice proposed an extension of the transitional provision provided for in regulation 17B of the Financial Provisioning Regulations, 2015. Effect to this notice was issued on 22 April 2021 in Government Notice 44472, with an extension until 19 June 2022 .

To prepare towards compliance to meet the specified timeframes, Assmang (Pty) Ltd initiated the first round of assessing their operations' financial provision requirements in terms of the November 2015 Regulations during the 2016/2017 financial year. A subsequent assessment followed annually thereafter. The purpose of this report is therefore to present the findings of any changes from the 2020 assessment as part of the annual update in **line with the 2015 Financial Provision Regulations**.

The Environmental (Residual) Risk Assessment Report, according to the regulations, must contain information that is necessary to determine the potential financial liability associated with the management of **residual** environmental liabilities post closure, keeping in mind the proposed post-mining end use, once the initial relinquishment criteria have been achieved.

The Environmental Risk Assessment Report must contain information that is necessary to determine the potential financial provision associated with the management of residual environmental risks post closure. The Environmental Risk Assessment Report should address the following key aspects:

- A description of the risk including possible triggers and expected timeframes;
- An assessment of alternatives;
- Costing indicating the quantum of the liability; and
- Monitoring, auditing and reporting requirements

1.3 Objectives

The objective of the risk assessment is outlined in the Financial Provisioning Regulations, 2015. The objectives are to:

- Ensure timeous risk reduction through appropriate interventions;
- Identify and quantify the potential latent or residual environmental risks related to post-closure;
- Detail the approach to managing the risks;
- Quantify the potential liabilities associated with the management of the risks; and
- Outline monitoring, auditing and reporting requirements.

2 ABOUT THE AUTHOR

2.1 The Company

2.1.1.1 The Company

EnviroGistics (Pty) Ltd (EnviroGistics), established in 2015, provides Independent Environmental Planning, Permitting, and Consulting Services to a vast array of clients throughout the mining, construction and development industry. EnviroGistics' independence is ensured with Ms Tanja Bekker being both registered with the South African Council for Natural Scientific Professions (SACNASP), as well as the Interim Certification board for Environmental Assessment Practitioners of South Africa (EAPSA), complying with the highest requirements of the South African Environmental Legislation. The company holds further no equity in any other project. EnviroGistics' operates with the goal of fulfilling its vision and mission, breaking away from a general consulting mould, striving to form an integrate part of a project team. For this reason, clients will be provided with experienced, practical, technically sound, independent, objective and value adding advice, ensuring support on environmental planning, permitting and compliance matters.

EnviroGistics is an independent company and has no vested interest in the outcome of the environmental assessment.

2.1.1.2 Details of the person(s) who prepared the plan

Pieter de Coning: Pieter, trading as EcoCivil Consulting Engineers, has a National Diploma and B-Tech degree in Civil Engineering and is registered as a Professional Civil Technologist (Pr Tech Eng) with over 28 years' experience in various waste, mining, and civil engineering projects.

He started his career at the Department of Water Affairs and Forestry as a Civil Technician in 1991 working in the Design Services department. He joined SKCM Engineers in 1995 where he gained valuable experience in numerous fields of Civil Engineering, namely structural design (concrete and steel), water related design (dams, water reticulation, stormwater), town development, waste related projects (site selection, landfill designs and licensing, feasibility studies). In 2013 he joined WorleyParsons, as a Senior Technologist specialising in environmental engineering and waste related projects but was also involved in civil engineering projects due to his wide-ranging experience. He further gained experience in petrochemical and mining fields of civil engineering as well as solar power generation. He joined GCS Engineering in August 2014 where he headed up the Engineering division until October 2018 before he started EcoCivil in November 2018. At GCS he further gained experience in the mining and waste management fields, water supply and dewatering of mines, management of clean and dirty water, pollution control, closure and rehabilitation of waste and mining facilities, as well as landfill design and feasibility studies.

Pieter also has extensive experience in cost estimation, contract documentation, contract administration, construction supervision and quality control, technical report writing, preparing design drawings and overall project management.

Countries Pieter has worked in includes South Africa, DRC, Botswana, Mozambique, Nigeria, Angola, and Swaziland.

Ferdi Pieterse: Mr. Pieterse has more than 19 years' experience in the Environmental Management field. He has a strong background in providing environmental solutions, having completed numerous projects from concept and pre-feasibility phases to full completion and implementation phases. Ferdi has undertaken and completed projects in different sectors, including tourism, mining, manufacturing, energy and industrial. He also completed a year as an Environmental Manager in the Electricity Generation Industry (Eskom), specifically within the coal, water and gas resource sectors where the focus was on mining environmental management and compliance assurance.

Ferdi's main strengths are focused within the environmental management and sustainable development spheres. Significant experience within the primary, secondary and business economic sectors include strategic planning and advisory, project management and coordination, client interaction and management, capacity building, providing innovative solutions, compliance assurance and reporting, liability valuations, sound advice and objectivity. Ferdi has been extensively involved in projects in Lesotho, Zambia, Angola, Kenya, Namibia, Madagascar and Tanzania.

Ferdi is passionate about creating value and growth for people and projects on the African continent. He thrives on the challenge of integrating his experience and knowledge with new people and project teams and is naturally motivated through the adventure, exploration, learning, engagement and travel which is associated with the developing economies in Africa.

Refer to the Curriculum Vitae of Mr Ferdi Pieterse in Annexure A.

Tanja Bekker Ms. Bekker is registered as a Professional Natural Scientist in the field of Environmental Science with SACNASP Board and is also a registered EAP with EAPASA, a legal requirement stipulated by NEMA. She is further certified as an ISO 14001 Lead Auditor. Her qualifications include BSc. Earth Sciences (Geology and Geography), BSc. Hons. Geography, and MSc. Environmental Management. In addition to these tertiary qualifications, she obtained a Certificate in Project Management, and completed the Management Advancement Programme at Wits Business School.

With more than 19 years' working experience in environmental management and the consulting industry and managing various Large Account Clients, she understands the South African Regulatory System, and can advise clients with due diligence on their environmental regulatory requirements and offer a solution driven service to their project life cycle. She is equipped with exceptional project management and coordination skills, which especially enhances the service she offers clients within the environmental permitting system.

Her key focus is environmental management and compliance, and she has extensive experience in the mining industry. Project Management and Coordination of projects form a critical component of her duties, which include project planning, initiation of projects, client, authority and stakeholder consultation, specialist coordination, budget control, process control, quality control and timeframe management. Her interest lies in a client advisory capacity, being involved during due diligence investigations, pre-project development and assisting the client and engineering team in adding value to develop the project in an environmentally sustainable manner, considering client costs and liabilities, as well as considering the implication of environmental authorisation conditions and requirements on project deliverables. Her involvement in projects has spanned across the project life cycle from Due Diligence Investigations, Pre-Feasibility Investigations, Prospecting Right Applications, Mining Right Applications, Environmental Reporting and implementation and auditing of Environmental Management Plans and Environmental Authorisations.

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Summary of the EAP's Education

B.Sc. Earth Sciences (Geography & Geology) - RAU (University of Johannesburg)
B.Sc. (Hons) Geography - RAU (University of Johannesburg)
M.Sc. Environmental Management - RAU (University of Johannesburg)

Career Enhancing Courses

ISO 14000 Lead Auditors Course (WTH Management)
Certificate in Project Management (University of Pretoria)
Management Advancement Programme (MAP 81) (Wits Business School)

Professional Affiliations

Registered with the Board of Environmental Assessment Practitioners of South Africa
Certified ISO 14001 Environmental Management System Auditor
Registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP)
Member of the South African affiliate of the International Association for Impact Assessment (IAIA)
Member of the Environmental Law Association of South Africa (ELA)

Refer to the Curriculum Vitae of Ms. Tanja Bekker in Annexure A.

2.1.1.3 Registrations, Affiliations & Experience

The following table presents the expertise of the Auditor to carry out the Assessment.

Table 2: Professional Team Registrations, Affiliations and Experience

Name	Position	Project Responsibility	Qualification	Professional Registrations	Experience
Pieter de Coning	Professional Civil Technologist	Cost reviewer	National Diploma in Civil Engineering B-Tech Degree in Civil Engineering	Registered Professional Civil Technologist (Pr Tech Eng) Member of IPET Member of IWMSA, GIGSA	28+ Years
Ferdi Pieterse	Rehabilitation and Closure Cost Assessor	Compliance Assessor	B.Sc. (Honours) Environmental Management (RAU, now University of Johannesburg)	Member of the Environmental Law Association of South Africa	19 Years
Tanja Bekker	EAP	Compliance Assessor	M.Sc. Environmental Management (RAU), now University of Johannesburg)	Registered EAP with the Environmental Assessment Practitioner Association of South Africa (EAPASA Reg No. 306/2019) Registered Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP Reg No. 400198/09) Member of International Association of Impact Assessors (IAIA) Member of the Environmental Law Association of South Africa (ELA)	19 Years

3 PROJECT CONTEXT

3.1 Local Setting

Beeshoek is located in the Northern Cape Province, approximately 7km west of the town of Postmasburg. The mine is situated under the jurisdiction of the Tsantsabane Local Municipality, which is an administrative area in the ZF Mgcawu District Municipality. The mining area is situated on the farms Beesthoek and Olynfontein in the Kuruman Registration Division (RD). Please refer to Figure 1 presenting the local and cadastral setting of the mine, respectively.

The R385 roadway, as well as the Ore Export (OREX) Railway Line traverse the site. The overall area is characterised by intensive mining development. Various servitudes traverse the site, which include roads, telephone lines, and electricity lines.

Beeshoek falls in Quaternary Catchment D73A in the Lower Vaal Water Management Area (WMA) which has a catchment area size of 51 543km^2. The nearest watercourse to the Beeshoek mining area is the Groenwater Spruit, located approximately 5km to the southwest of the mining operations.

Please refer to the following table for the registered name, administrative jurisdiction and summary of location of the land.

Table 3: Property Information

<table>
<tr><td>Farm Name:</td><td>Beeshoek Mine Mining Rights area is located on:

• Beeshoek 448 RD, potion 0 (RE),
• Beeshoek 448 RD, potion 1 and
• Olynfontein 475 RD, portion 2, 3, 4 and 6

The surface rights and also area on which the project areas are located includes:

• Beeshoek 448 RD, potion 0 (RE),
• Beeshoek 448 RD, potion 1 and
• Olynfontein 475 RD, Portion 4.</td></tr>
<tr><td>Magisterial district:</td><td>Hay Registration Division (RD)</td></tr>
<tr><td>Distance and direction from nearest town.</td><td>Beeshoek is located in the Northern Cape Province, approximately 7km west of the town of Postmasburg. The mine traversed by the regional road R385, as well as the OREX Railway Line.</td></tr>
<tr><td>21-digit Surveyor General Code for each farm portion applicable to this application.</td><td>
<table>
<tr><th>Farm Name</th><th>Registration Division</th><th>Portion</th><th>Ownership</th><th>Title Deed</th><th>SG Code</th></tr>
<tr><td>Beesthoek 448</td><td>Hay RD</td><td>0 (RE)</td><td>Assmang Ltd</td><td>T659/1965</td><td>C03100000000044800000</td></tr>
<tr><td>Beesthoek 448</td><td>Hay RD</td><td>1</td><td>Assmang Ltd</td><td>T245/1954</td><td>C03100000000044800001</td></tr>
<tr><td>Olynfontein 475</td><td>Hay RD</td><td>4</td><td>Assmang Ltd</td><td>T4859/1998</td><td>C03100000000047500004</td></tr>
</table>
</td></tr>
</table>

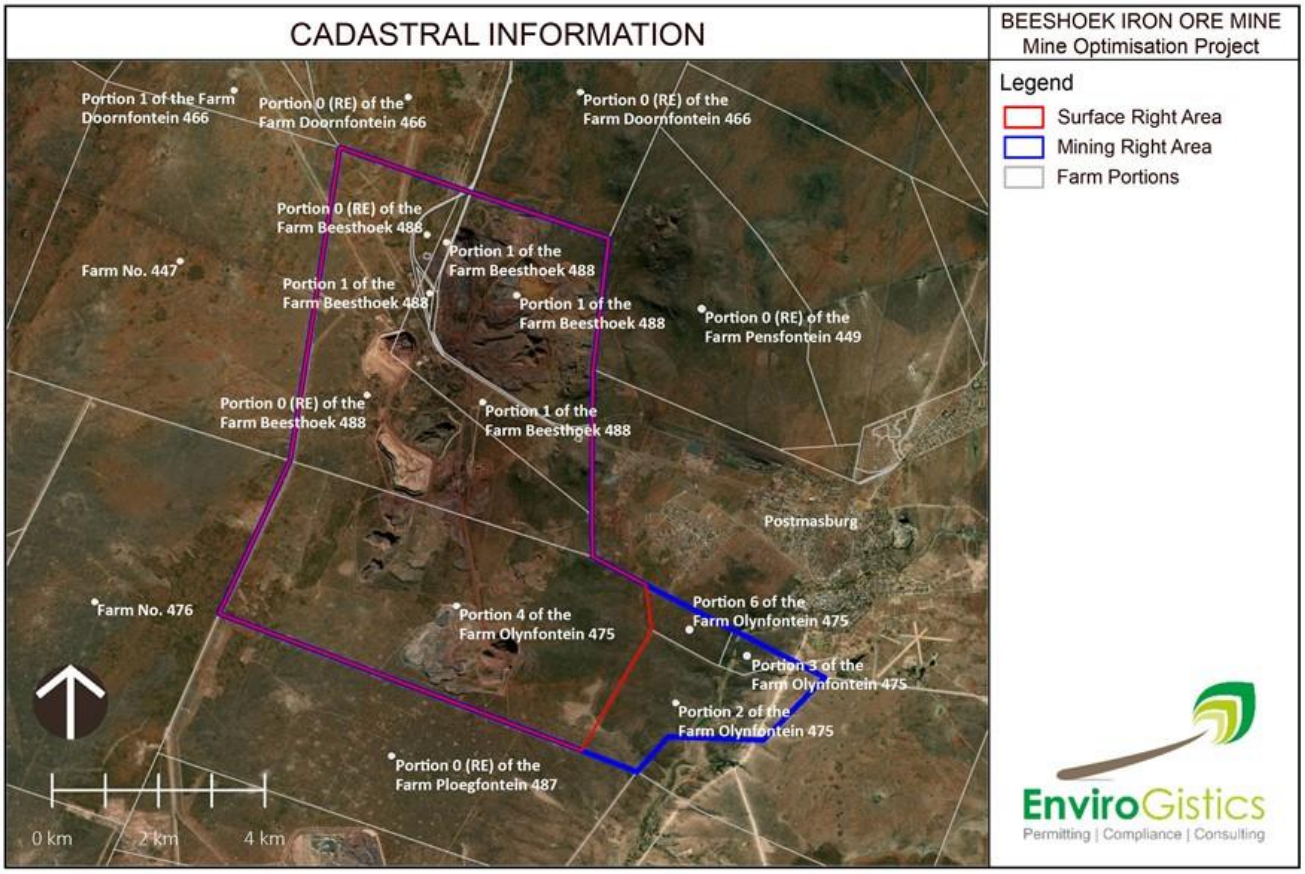

Figure 1: Cadastral Information

3.2 Commercial Context

Beeshoek mines iron ore. The iron ore in the Sishen/ Postmasburg area is preserved within a sequence of the Proterozoic sediment of the Transvaal Supergroup and Olifantshoek Group. Iron ore mined at Beeshoek is mined from the conglomeration type forming part of the Gamagara formation and consists of the mineral's hematite and specularite.

The conglomeratic ore of the Beeshoek-Olynfontein deposits are preserved in a fault-bounded, graben-like structure and deep basin-like structures, found in the area with palaeo-ridges of Wolhaarkop Breccia at varying elevations. These basins are filled with conglomerate and shale of the lower part of the Gamagara Formation and overlie an undulating floor of chert-banded Manganore Iron Formation. The Shale Member forms a laterally continuous blanket deposit that pinches out against palaeo highs. The basin and dome structures of the ore deposits predate the deposition of the Gamagara Formation. However, post-Gamagara deformation also took place and, in some areas, karstic slumping related to the pre-Kalahari or present day erosion, affected the ore deposit.

In recent geological times, the remaining outcrops of the above ore types were exposed to weathering. These outcrops weathered down as slabs and boulders, which were scattered down mountain slopes and into ancient drainage systems. Wind and water eroded impurities from the rock leaving competent high-grade ore behind. In some areas this ore was covered by sand and sediments of the younger Kalahari Formation and vegetation. This is termed as detrital ore.

The geological setting therefore presents for the most feasible mining method as opencast mining. The iron ore deposits on Beesthoek and Olynfontein are relatively shallow, making economic opencast mining viable.

The iron ore is exploited by means of conventional opencast mining techniques (drilling-blasting-load-haul). The drill-blast activities are contracted out, whereas load-haul is done by a combination of owner and contractors' fleets.

The vegetated soil overlying the planned mining area is stripped prior to mining and stockpiled on a dedicated dump to be used for rehabilitation purposes at a later stage. Then bench blocks of 10m height are drilled using drill rigs, which drill 165mm diameter blast holes. Drill patterns can be a staggered or square pattern, with burden and spacing varying from 4m x 5m in waste to 3m x 3m in difficult ore. Blast holes are charged with emulsion explosives and different down-hole charge configurations are used depending on the different rock types to be blasted. This, together with the necessary blasting accessories will achieve optimal fragmentation.

The blasted rock is loaded with front-end loaders and excavators into rigid haul trucks and Articulated Dump Trucks (ADTs). Ore is hauled to the primary crusher and ore stockpiles. Based on the Fe-grade and destined metallurgical processes numerous ore stockpiles exist on Beeshoek.

As an integral part of the mining processes, backfilling of numerous existing pits is employed, where possible, in order to minimise both the final voids left at the end of mining as well as the size of waste dumps. Waste with a potential future use is stockpiled separately in order to be accessible and ready to be processed by the future user.

Beeshoek has scaled down to 3.5 million tonnes per annum until 2028 supplying the local market. In order to maintain production over this period, existing reserves are being exploited from the Village Pit and BN Pit.

The current active Opencast Pits include:

- Village Pit;
- East Pit;
- BN Pit;
- BF Pit; and
- HF Pit.

On-grade material is moved from the on-grade stockpile through to the Washing and Screening Plant situated near the plant, to ultimately produce final product incorporating tertiary crushing of any oversize material from the screening plant.

Off-grade material is moved from the off-grade stockpile through to the Washing and Screening Plant. Any oversized material is crushed in the Tertiary Crushers, and also beneficiated through jigging in the Lumpy or Fines Jig Plants, in order to remove any contaminants.

Another mining method utilised on the mine is the mining of detrital ore, where the deposits of ore are shallow enough to be scooped out of the ground for processing as opposed to employing more extensive opencast mining methods. There are a few of these detrital zones on the mine area which still need to be exploited. According to the 2009 EMP Alignment Report, the mine will mine detrital ore that are available in small pockets that are easy to mine. Detrital mining entails the excavating of loose sedimentary deposited iron ore gravel material with other rock types present due to the sedimentary deposition process within dolomite karsts. The loose material is excavated and loaded, hauled and tipped into a feed bin and then separated into sizing to be fed as contaminated material to the Jig Beneficiation Plant. The fine material on the screening plant is used as rehabilitation material back into the detrital mining area. Dolomite karst depth can vary from 4m to 25m deep in specific areas. The detrital mining strategy and the depth are only determined once excavation start and the quality of iron ore are inspected within a karst deposition area.

3.3 Approved Environmental Management Plans, Programmes and Licenses

The mine is operating with all required environmental authorisations in terms of the:

- National Environmental Management Act, Act No. 107 of 1998 (hereafter referred to as the “NEMA”), also the original approval in terms of the Environment Conservation Act, Act No. 73 of 1989 (hereafter referred to as the “ECA”):
    - Licence 1 (in terms of ECA)
        - Licence Ref.: Permit 12/9/11/P49

        - Purpose: Landfill site.
        - Date: 30 October 2008
    - Licence 2
        - Licence Ref.: Permit 17/2011
        - Purpose: Road Diversion
        - Date: 3 March 2011
    - Licence 3
        - Licence Ref.: Permit 12/2014
        - Purpose: BF Waste Rock Dump (WRD) (now the Village WRD)
        - Date 7 March 2014
    - Licence 4
        - Licence Ref: Permit 20/2015
        - Purpose: WRD Village Haul Road
        - Date: 3 June 2015
    - Licence 5
        - Licence Ref: Permit NC 30/5/1/2/3/2/1/223 MR
        - Purpose: Storm Water Dam North Upgrade
        - Date: 10 March 2017
- MPRDA:
    - Environmental Management Programme (EMP) 1 (pre alignment, and used for information purposes – no longer audited):
        - EMP Report
        - Purpose: Beeshoek Mining Operation
        - Date: August 2004
    - EMP 2:
        - Licence Ref.: NC30/5/1/2/3/2/1/223EM
        - Purpose: EMP Alignment for activities on Beeshoek
        - Date: 7 June 2010
- National Water Act, Act No. 36 of 1998 (hereafter referred to as the "NWA"):
    - Licence Ref.: 10/D73A/ABGJ/2592
    - Purpose: Licence for all Section 21 Water Uses and Government Notice No. 704 (GN704) triggered activities (such as backfilling)
        - Date: 21 August 2018.

3.4 Mine Description

The following table present a list of all approved infrastructure on site which are considered in the development of the Annual and Final Rehabilitation Plans.

Table 4: List of Approved Infrastructure

Infrastructure	Description	Approved in terms of:
Roads		
Access Roads	**Existing Regional Road:** The R385 roadway transects the Beeshoek Mine at both North and South Mines. This road has been diverted in terms of an approved Environmental Authorisation to allow for the development of the Village Opencast Pit. **Existing Regional Road:** Three roads, all originating from the R385, provide access to the mining operation, namely: • Access road to the South Mine; • Access road to the Main Offices; and • Access road to the Plant and North Mine.	Permit 17/2011, 21 April 2011
Haul Roads	**Existing Haul Roads** Due to the long lifespan of the mine, various historic roads are present on site. These have been captured on the surface layout maps of the approved MPRDA EMPs. In addition to this, the mine has constructed a new Haul Road (Village Haul Road) which has an approved NEMA Authorisation.	EMP Report, August 2004 & EMP Alignment Report, July 2009 Permit 20/2015, 19 June 2015
Conveyors		
South Mine Conveyor	**Approved Conveyor at South Mine:** From the South Mine, crushing ore is conveyed via an overland conveyor system to stockpiles at the Plant area on North Mine. A single length conveyor of approximately 2.8km long is present. The conveyor crosses under the R385 and the Transnet Hotazel/ Port Elizabeth (PE) railway line before arriving at the load-off point at the Plant.	EMP Report, August 2004 & EMP Alignment Report, July 2009
North Mine Conveyors	**Approved Conveyors at North Mine:** Several conveyors are present at the North Mine. The approximate combined length of these conveyors is 3.2km. These conveyors convey the ROM from the stockpiles to the crushing facilities and the Plant area. The discard from the Jig Plant is spread via conveyor onto the Discard Dump.	EMP Report, August 2004 & EMP Alignment Report, July 2009
Railway Lines and Associated Infrastructure		
Local Siding	**Existing Siding:** From the Plant, the product is stockpiled at the railway siding within the mining area, where one (1) railway bridge is present. The railway line is non-electrified and has an extent of approximately 11.3km.	EMP Report, August 2004 & EMP Alignment Report, July 2009
Transportation Rail System	**Existing OREX Railway Line & Existing Hotazel/ PE Railway Line:** The final product is transported via rail for local and export purposes. The local rail runs from Beeshoek through Postmasburg towards the harbour of Port Elizabeth (according to information provided from the mine on 12 June 2020, currently to Gauteng), whereas the export rail runs from Beeshoek towards the harbour of Saldanha.	EMP Report, August 2004 & EMP Alignment Report, July 2009

Infrastructure	Description	Approved in terms of:
Power Lines		
Eskom Power Lines	**Existing Eskom Power Lines:** All power within the mining area is supplied by existing Eskom power lines. The mine owns 71,750m of overhead power lines and 9,887m of buried power lines. One (1) substation is present on the mine.	EMP Report, August 2004 & EMP Alignment Report, July 2009
Communication Lines	Communication lines are provided by Telkom, although the mine owns 7,125m of the infrastructure.	EMP Report, August 2004 & EMP Alignment Report, July 2009
Fuel and Lubricant Storage		
Diesel and Lubricant Storage	**Diesel and Lubricant Storage** The operation of the diesel generators and the additional activities on site require the storage of fuel and oil. The mine has a storage capacity of 21 days. All fuel is stored above-ground within designated and appropriately constructed hazardous material storage areas. The following storage areas are present on site: • South Fuel Storage Area (28°18'43.91"S; 23° 0'16.30"E). This area comprises of four (4) 80m³ diesel storage tanks with a combined capacity of 332m³; • North Fuel Storage Area (28°17'2.45"S; 23° 0'0.09"E). This area comprises of five (5) storage tanks: o 1x 83m³ – Diesel Tank o 1x 23m³ – AC10W Hydraulic oil Tank o 1x 23m³ – AC50 Transmission oil Tank o 1x 23m³ – 15W40 CAT engine oil Tank o 1x 23m³ – Waste oil Tank; • Airfield has a Jet 1A fuel storage tanks (28°16'1.19"S; 22°59'27.69"E) with a capacity of 56m³; and • A Portable Long-Distance Diesel tank (which does not require licensing as it is temporary and portable) has been established during 2015 with a capacity of 32m³.	North Mine Tank installation: Aerial photos indicate earth works already commencing on 13 December 2005. South Mine Tank installation: Aerial photos illustrate the presence of these tanks already constructed on 8 April 2006. Airfield Tank installation: Aerial photos indicate presence of the facility on 20 July 2003. Portable Long-Distance Tank installation: 2015. The diesel storage facilities are operated by Total and the Environmental Authorisation for these are held by Total under Permit Number 36/2005 in terms of the ECA.
Solid Waste Management Facilities		
Industrial and Domestic Waste Disposal Sites	**Approved Industrial and Waste Deposal Sites:** Industrial waste is limited to oil, diesel and grease. This waste is removed by licenced Waste Management Companies in bulk back to the manufacturers and suppliers (where waste can be refined or disposed of on licenced landfill sites). Unwanted waste is disposed of by a contractor at an approved industrial waste site. The old oils and hazardous material are stored at the locations as provided under the section above. The mine has a Salvage Yard at North Mine (28°17'11.95"S; 23°59'55.99"E). The mine has an approved landfill site on site to receive the general waste. The location is at 28°16'39.725"S; 22°59'40.088" E.	Permit 12/9/11/P49, 30 October 2010
Contaminated Waste	**Approved Contaminated Waste Storage:** Contaminated waste such as oily rags, oil filters etc. are stored in sealed drums at designated areas in the vicinity of the workshops at the Beneficiation Plant and the two opencast operations. These drums are removed by licensed waste removal services providing for disposal at a licensed site.	-

Infrastructure	Description	Approved in terms of:
	The EMP does not make provision for on-site remediation of contaminated soils, only for *in situ* cleaning using spill kits.	
Tyres	**Tyre Waste Storage:** Old tyres are removed from site by a contracted tyre company for recycling or disposal in an approved manner (28°16'42.17"S; 23°0'9.04"E).	DEA Waste Bureau Registration: WTSREG0043NC
Lubrication Oils	**Approved Lubrication Oil Waste Storage:** Used lubrication oils are removed from site by the fuel and lubrication contractor, for recycling and re-use. This occurs in bulk from tanks designed for this purpose. The areas surrounding the tanks containing the waste oil and the collection point are bunded.	-
Topsoil Stockpiles		
Topsoil Stockpiles	Due to the shallow soil cover at Beeshoek, all topsoil and subsoil has been/ will be stripped (to a minimum of 0.25m or until hard rock is reached) from the: • Opencast pits and • Haul roads. Two topsoil stockpiles are present on site, one at South Mine (28°19'47.37"S; 23° 0'39.49"E) and one at North Mine (28°17'0.71"S; 23° 1'24.02"E).	EMP Report, August 2004 & EMP Alignment Report, July 2009
Mine Residue Deposits		
Overburden and Low-grade ROM Stockpiles	**Approved Mine Residue Deposits:** Various Mine Residue Stockpiles and Deposits exist on site. Due to the historic nature of Beeshoek many of these have been constructed prior to the enactment of the listed NEMA Activities. To assess which of these have been constructed in terms of lawful footprints, surface maps submitted with past environmental authorisation applications were considered. To streamline the layout and naming of these and the ensure effective management, the following Mine Residue Facilities have been grouped together: North Mine: • Quartzite Stockpile; • Shale Stockpile; • Plant Stockpiles and In-Plant Stockpiles; • Plant ROM; • HH WRD; • HL WRD; • BIS ROM; • WRD North; • GF WRD; • Discard Dump; • B Dump ROM; and • North Off-grade ROM. South Mine: • Village WRD; • Village ROM Stockpile; • Village Off-grade ROM;	EMP Report, August 2004 & EMP Alignment Report, July 2009 The most recent Mine Residue Deposit is that of the Village WRD under Permit 12/2014, 7 March 2014

Infrastructure	Description	Approved in terms of:
	▪ West Pit WRD; ▪ South ROM; ▪ South Off-grade ROM; ▪ Contaminated Dump ROM; ▪ Contaminated Dump ROM 2; ▪ BIS ROM; and ▪ East Pit WRD. The heights and footprints of these facilities have not been stipulated in the EMPs and as a result the past submitted maps were used as a source to define the approved footprints. The Village WRD is however approved to not exceed 45m in height.	
Reworking of Mine Residue Stockpiles	The 2004 old order EMP stated: "Rework all contaminated iron ore stockpiles present on the mine site in order to optimise iron ore resource utilisation." Reworking relates to the following dumps: - Dumps labelled on Drawings 5540-001 and 5540-002 as CD-N1 (this is the current WRD North area) and CD-S1 (this is the current Contaminated Dump ROM on South Mine, does not include #2) respectively. In Section 1.7.3 of the new order (aligned) EMP, the Estimated Reserves are discussed. It states that: "Additional iron ore is available in the contaminated dumps (low grade iron ore, which could be blended with high grade or to meet future market needs) on the mine site and these will be reworked to meet the mine's remaining planned life of mine."	EMP Report, August 2004 & EMP Alignment Report, July 2009
Slimes Dam		
Slimes Dam	**Rehabilitated (Old) Slimes Dam:** In order to facilitate the recycling of plant water the Slimes Dams are constructed with waste walls splitting the area into smaller paddocks. Ones each paddock becomes full, it dries out and is covered with a layer of waste approximately 1m in thickness before it is vegetated. The process has resulted in the initial Slimes Dam, situated near the Plant at the North Mine, being rehabilitated and more capacity was required, which resulted in the current Slimes Dam. **Current Slimes Dam:** The slimes generated from the plant processing activities represent approximately 14-16% of ore put through the Plant. Water from the dewatering screen is pumped to a Slimes Dam, which is located on the footprints of an old opencast pit. The mud is allowed to settle, and the clear water is pumped back to the Plant. Ongoing upgrades to ensure efficiency will be undertaken. However, should the footprints or capacity be amendment, the mine will have to apply for a WUL, as well as the associated Environmental Authorisations.	EMP Report, August 2004 & EMP Alignment Report, July 2009
Borrow Pits		
Borrow Pits	No borrow pits are present on site.	
Detrital Mining		
Detrital Area	**Approved Detrital Mining Activities:** One of the mining methods utilised on the mine is the mining of detrital ore, where the deposits of ore are shallow enough to be scooped out of the ground for processing as opposed to employing more extensive opencast mining methods. There are a few of these detrital zones on the mine area which still need to be exploited.	EMP Alignment Report, July 2009

Infrastructure	Description	Approved in terms of:
	As part of the 2009 EMP it was stated that the mine is planning to extend its mining operations within the existing mining area to continue with its mining operation and to ensure that the available mineral reserves are mined optimally. One of the activities approved as part of the EMP was the mining of detrital ore that are available in small pockets that are easy to mine. The area and dimensions of the detrital areas are not indicated in the EMP, but were submitted with the approved Mining Works Programme. The only area demarcated to an extent is to the east of the South Mine Contaminated ROM Stockpiles – this area was present in all mine layouts approved by the Department of Mineral Resources (DMR) since 2009. Any expansions to the detrital mining areas will require amendment to the Environmental Authorisations, due to the size of site clearance which will be in excess of 5ha.	
Opencast Mining		
Opencast Pits	**Approved Opencast Pits:** The iron ore deposits at Beeshoek Mine are relatively shallow, making economic opencast mining viable. The iron ore is exploited by means of conventional opencast mining techniques (drilling, blasting and load-haul). The drill-blast activities are contracted out, whereas load-haul is undertaken by a combination of owner and contractors' fleets. The vegetated soil overlying the mining area is stripped prior to mining and stockpiled on a dedicated dump to be used for rehabilitation purposes at a later stage. Then bench blocks of 10m height are drilled using drill rigs, which drill 165mm diameter blast holes. Drill patterns can be a staggered or square pattern, with burden and spacing varying from 4m x 5m in waste, to 3m x 3m in difficult ore. Blast holes are charged with emulsion explosives and different down-hole charge configurations are used depending on the different rock types to be blasted. This, together with the necessary blasting accessories, achieves optimal fragmentation. Again, as per the constraints with the Mine Residue Stockpiles, the historic natures of the Beeshoek Mine has led to the naming and renaming of opencast pits over time. For the purpose of this document and to identify the footprint areas, the surface plans submitted with the EMPs and subsequent Environmental Authorisation were used in the demarcation of the footprints. The blasted rock is loaded with front-end loaders and excavators into rigid haul trucks and Articulated Dump Trucks (ADTs). Ore is hauled to the Primary Crusher and ore stockpiles. Based on the grade and destined metallurgical processes, numerous iron ore stockpiles exist on Beeshoek. As an integral part of the mining processes, backfilling of numerous existing opencast pits will be employed in order to minimise both the final voids left at the end of mining as well as the size of waste dumps. Waste with a potential future use will be stockpiled separately in order to be accessible and ready to be processed by the future user. The following pits are authorised in terms of the WUL for backfilling purposes: o HH Opencast Pit; o HL Opencast Pit; o BN Opencast Pit; o East Opencast Pit; o GK Opencast Pit; and o West Opencast Pit. Another mining method utilised on Beeshoek Mine is the mining of detrital ore as presented before, where the deposits of ore are shallow enough to be scooped out of the ground for processing as opposed to employing more extensive opencast mining methods. There are a few of these detrital zones on the mine area which still need to be exploited.	EMP Report, August 2004 & EMP Alignment Report, July 2009
Mineral Processing		

Infrastructure	Description	Approved in terms of:
Mineral Processing	The Iron Ore Processing Facility has been designed to process ROM ores from the North and South Mine Opencast Pits. At Beeshoek, there are two lines consisting of a Primary and Secondary Crusher namely South Mine Crushing and North Mine Crushing. These primary plants consist of two stages of crushing, namely one primary crusher and one secondary crusher. At the primary crusher ore is crushed down to -200mm and at the secondary crusher it is further reduced to -80mm. In case of on-grade (ROM) ore feed, the secondary product is fed to the Washing and Screening Plant and contaminated ore or off-grade ore feeds, where beneficiation is needed, is fed to the Jig Plant. From the South Mine Crushing, ore is conveyed via an overland conveyor system to stockpiles at the plant area on North Mine. Following the primary and secondary crushing operations, the crushed ore is conveyed to the processing plant area, which is situated at North Mine. On-grade and off-grade crushed ore is stockpiled separately with dedicated stackers and reclaimed to be fed separately to the dedicated on-grade and off-grade processing plants. On-grade ore requires only screening, while off-grade ore requires further beneficiation, to conform to the market requirements. The plans include the following: • Washing and Screening Plant: The ROM feed is washed and sized into a lumpy fraction (+6mm –32mm), MS product (+6mm – 18mm) and a fines fraction (+0.5mm – 6mm). The primary screens oversize (+32mm) is conveyed to three tertiary crushers in closed circuit with the primary screens. • Preparation Plant: The contaminated/ off-grade ore feed is washed and sized into a lumpy fraction (+8mm –25/32mm) and a fines fraction (+0.5mm – 8mm) prior to conveying to the Jig Plant. The screen oversize is conveyed to a tertiary crusher in closed circuit with the screens. • Beneficiation is achieved by utilising Jig technology. Jigs separate the ore according to the specific density of the particles. Reagents are not utilised in any of the beneficiation processes. A flocculating agent is required to assist in clarifying process water in the water reticulation circuit. This is achieved by utilising a conventional thickener. The clarified water is reticulated in the processing plants. A significant amount of water is recycled in the processing plant, to reduce the magnitude of the clarifying requirement. Thickened pulp from the thickener unit is pumped to the Slimes Dam, designed specifically for this purpose.	EMP Report, August 2004 & EMP Alignment Report, July 2009
Mine Offices	**Approved Mine Offices:** North Mine: Includes offices, administration buildings and the historical portion of the mine village. South Mine: Includes the decommissioned village and recreational area, including a golf course and other recreational sports fields. The 2009 EMP was clear to state that the new Village Opencast Pit will be constructed on the already existing Beeshoek village area. The mine workers living in this village have been relocated by the mine to Postmasburg. The existing surface structures, with the exception of the main offices, recreational facilities, security, training and clinic buildings have been removed and the Village Opencast Pit is in operation.	EMP Report, August 2004 & EMP Alignment Report, July 2009
Laboratory	**Approved Laboratory:** A laboratory has been established at the Plant, which is utilised for the testing and certification of the product being processed and exported from the mine.	Part of Plant infrastructure (EMP 2004)
Change House	**Approved Change House:** Staff facilities for washing, ablutions and the safe keeping of personal belongings have been established at the North and South Mine opencast areas, as well as at the Plant. No sewage treatment plant is located on the mine site. All sewage generated at the mine is collected in several strategically located concrete sumps that are emptied by tanker. The tanker disposes of the collected sewage at the Postmasburg municipal sewage treatment works.	EMP Report, August 2004 & EMP Alignment Report, July 2009

Infrastructure	Description	Approved in terms of:
Clinic/ Training Centre	**Approved Clinic/ Training Centre:** A Medical Centre and a Training Centre have been established at the Main Offices. A Medical and Wellness Centre is located next to Security Offices at the Main Offices in old renovated buildings. A Training Centre is located next to the transport area within old mine workers hostels that were renovated.	Old Renovated Buildings from the 1930s/ early 1940s (visible on the photos from late 1930s/ early 1940s)
Security Building	**Approved Security Building:** Security buildings have been established at both North and South Mines, as well as at the Main Offices area.	Main security – old renovated buildings North Mine – 2004 South Mine – 2015
Plant Control Centre	**Approved Plant Control Centre:** A plant control centre has been established on the Plant for each mine (North and South) to monitor and control the process plant. The centre is equipped with offices, electronics, workshop, a tearoom and ablutions for staff associated with the centre.	North and Wash & Screen – 1973 South – 1998/99 Jig – 2001
Workshops / Stores / Substations	**Approved Workshop, Stores and Substations:** As part of the approved EMP the following was stated: "The existing workshop, administration and related buildings are located within the Northern mining area." The following infrastructure has been established: • South Mechanical and Electrical Workshop; • South Separator and Was Bay Area; • South Primary Crusher Workshop; • North Electrical and Mechanical Workshop area; and • North Separator and Wash Bay area.	South Mechanical and Electrical Workshop - 1998/99 South Separator and Was Bay Area - 1998/99 South Primary Crusher Workshop - 1998/99 North Electrical and Mechanical Workshop area – old renovated buildings North Separator and Wash Bay area – old renovated buildings
Weighbridge	**Approved Weighbridge:** A weighbridge has been established at the Plant area for verifying the weight of loaded and unloaded vehicles etc.	North ''old'' weighbridge – 2012 3x New Road Transport weighbridges – 2015
Explosives Magazine	**Approved Explosives Magazine:** The explosives magazine has been built to Sasol Nitro design with the finished structures having been approved by Sasol Nitro. An exclusion zone of 800m radius within which there will be no buildings, other structures or public access is maintained. This facility is located at the South Mine.	Aerial photos indicate the presence of this facility already on 20 July 2003.
Housing and Recreation		
Housing and Recreation	**Approved Housing and Recreation:** The South Mine includes the decommissioned village and recreational area, including a golf course and other recreational sports fields. The 2009 EMP was clear to state that the new Village Opencast Pit will be constructed on the already existing Beeshoek village area. The mine workers living in this village have been relocated by the mine to Postmasburg. The existing surface structures have to be deconstructed and the footprint area for the new Village Opencast Pit needs to be prepared.	EMP Alignment Report, July 2009
Transport		

Infrastructure	Description	Approved in terms of:
Transportation of Ore on site	**Approved Transportation of ore:** The mined iron ore is transported by truck from the respective operational opencast pits to the respective receiving areas with the North and South Mines. The ore from South Mine is routed by overland conveyor to North Mine for processing.	EMP Alignment Report, July 2009
Transport of Ore off-site	**Approved Transportation of ore:** The final product is transported from the Rapid Loud-Out Facilities, via the OREX rail line to Saldanha (for export), as well as for local markets.	EMP Alignment Report, July 2009
Water Pollution and Storm Water Management Facilities		
Water Pollution and Storm Water Management Facilities - Legalities	Storm water management infrastructure at the mine does and will comply with the requirements of Government Notice Number 704 (GN704), published in terms of the NWA. GN704 requires the following: • All clean water systems must be designed and operated in such a manner that they are always capable of handling the 1:50 year flood event on top of their mean operation level without spilling; • Any water arising from an area, which causes, has caused or is likely to cause pollution of a water resource, including polluted storm water, must be contained within a dirty water system. In order to reduce the volume of polluted water, contaminated areas should be minimised. While clean water should be diverted to natural watercourses, dirty water should be re-used wherever possible, thereby reducing the use of clean water; and • Design, construct, maintain and operate any dam or tailings dam (in the Beeshoek situation, a Paste Disposal Facility) that forms part of a dirty water system to have a minimum freeboard of 0.8m above full supply level. A new Storm Water Dam North has been constructed and is now in use designed with a capacity of 15 000m^3. The mine has evaporation ponds on site, which is used to capture water from the South Mine workshop area. The evaporation ponds are also authorised in terms of the WUL. The EMP does refer to evaporation ponds.	EMP Alignment Report, July 2009 Permit NC 30/5/1/2/3/2/1/223 MR, 10 March 2017
Potable Water Supply		
Potable Water Supply	Potable water for use by the mine is obtained from the dewatering boreholes approved in terms of the WUL of the opencast pit area within the South Mine. Water is also obtained from the Vaal Gamagara Water Supply Scheme. The water is collected in two concrete reservoirs at the entrance to the South Mine where the water is disinfected for further distribution on the mine site.	EMP Alignment Report, July 2009
Disturbance of Watercourses		
None	-	

3.5 Mine Plan and Schedule

According to Mr. Arno Neveling (mine planner), the current Life of Mine as approved in five (5) years.

The mine is committed to ongoing exploration within the Mining Rights Area in order to establish the potential of increasing its reserves (where possible).

The financial provision is based on the current mine plan of five (5) years (defined reserves), although, as presented in the following section, the mining activities may extend to a further 15 years.

The financial provision is determined by the current survey data (date of assessment) and has been projected to end June 2021 in consultation with the Mine Planning, Survey and Engineering Department during the site visit conducted in April 2021.

The current mine development and production rates are based on the following information provided by the mine:

- Average recoveries of the on-grades and off-grades: 84% for Wash & Screening Plant and 28-45% for the Jig Plant. Should the mine optimisation project be approved with the additional WHIMS and Jig Plants it is envisaged to be 85% and 45% (the latter is not considered in this report)
- The current and anticipated Plant capacities for on-grade and off grade: The Washing & Screening Plant capacity is approximately 6.0Mt and Jig plant capacity is 2.45Mt per annum. For Washing and Screening Plant 2020-2021 March the capacity was approximately 2.1Mt and Jig Plant for the same period is 1.84Mt. The plan for the financial year 2021-2022 for Washing and Screening Plant is 2.6Mt and Jig Plant is 1.8Mt.
- The bench cut-off grade of 60% Fe is applied to all pits.

The footprint sizes of the opencast pits will at the present time not extend, and if so, new Environmental Authorisations will be applied for. According to the information provided by the mine all current mining activities are being undertaken within the current pit shells.

In terms of additional waste disposal, the mine will commit to the approved practices of backfilling as far as practically possible to ensure that the approved Mine Residue Deposits do not increase in footprint size and if expansion is required, new Environmental Authorisations will be applied for. Based on the discussions with the Mr. Neveling during April 2021 the only additional mine residue disposal up until end June 2021 will be undertaken on the Village Waste Rock Dump and the Discard Dump with an approximately volume of 3 900 030 tonnes and 265 000 tonnes respectively considered in the financial calculations.

3.5.1 Life of Mine

The Life of Mine, based on the current economies of scale and estimated reserves, is envisaged to be another five (5) yeas (until 2026). A project referred to by the mine as “the Mineral Asset Optimization” is in progress and will potentially have a significant impact on the future Life of Mine of Beeshoek. This project is still in planning phase and has not been formally presented or approved as yet. According to Mr Neveling, the envisaged Life of Mine is approximately 15 years.

The latter is however still subject to refinement as part of the exploration studies.

Closure and rehabilitation will only commence upon the completion of final decommissioning of the mining operations, although ongoing rehabilitation as stated in the Annual Rehabilitation Plans will continue throughout the life of mine.

4 ENVIRONMENTAL CONTEXT

The following section presents key environmental considerations important for the management and implementation of rehabilitation practices.

4.1 Topography

The area in which the mine is located varies in altitude from about 1,400 metres above mean sea level (mamsl) in the hilly area within the North Mine to about 1,300mamsl in the South Mine. Within South Mine, the surface topography is relatively flat varying around 1,310 to 1,300mamsl. A local high point is located east of the mine site at an elevation of 1,481mamsl. The hilly range which includes the local high point to the northeast and east of the mine site forms the water shed between the Groenwater Spruit and the adjacent unnamed catchment in which the mine site is located.

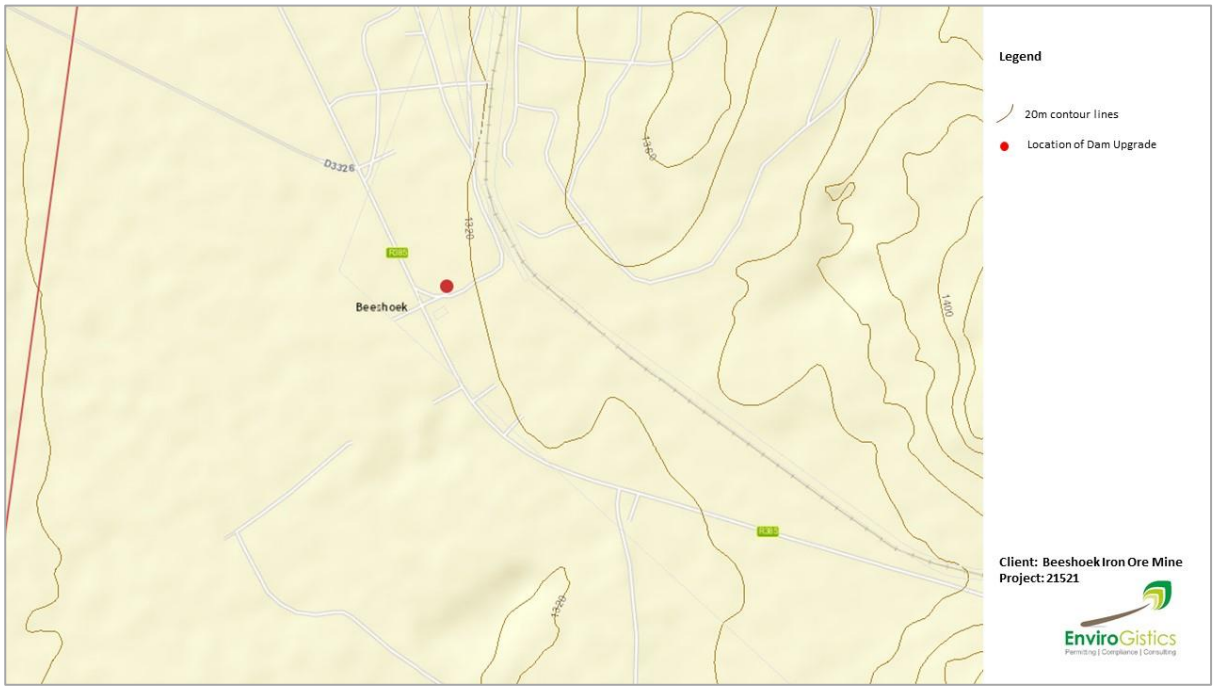

Figure 2: Topographical Setting

4.2 Geology

The Beesthoek-Olynfontein iron ore deposits are situated along the contact between the Gamagara Formation and the underlying Manganore Iron Formation.

The Manganore Iron Formation, being a distorted iron formation, wedged uncomfortably between the Gamagara Formation and the Campbellrand Carbonate Sequence.

According to the approved EMP, four different types of ore are found in the Beeshoek opencast mine namely “Thaba” ore, laminated ore, “detrital” ore and Conglomeritic ore.

The biggest portion of the Beeshoek ore is the Conglomeritic type, which forms the basis of the Gamagara formation. The Conglomerate was deposited in, which seems to be, erosion channels or sinkholes in a north-eastern direction.

The sediments of the Gamagara Formation dip at 10° to the west, with a strike that swings from north to northeast.

The underlying Asbestoshills Formation comprises of laminated iron, banded ironstone and a basal manganiferous chert breccia (Wolhaarkop breccia). The dolomites of the Campbellrand Formation underlie the entire sequence, but nonetheless crops out in the lower lying ground in the east of Beeshoek and over extensive areas of the Doornfontein area to the north.

The contact between the breccia and the underlying dolomite is irregular - sinkholes and solutions cavities are reported to be associated with it. The irregular contact has resulted in considerable thickness variation occurring in the overlying Wolhaarkop breccia. The entire sequence is fully represented in the western portions of the Beeshoek area only, where the dolomite is present at depths of up to and in excess of 15m. See Figure 3 for the geological formation on Beeshoek.

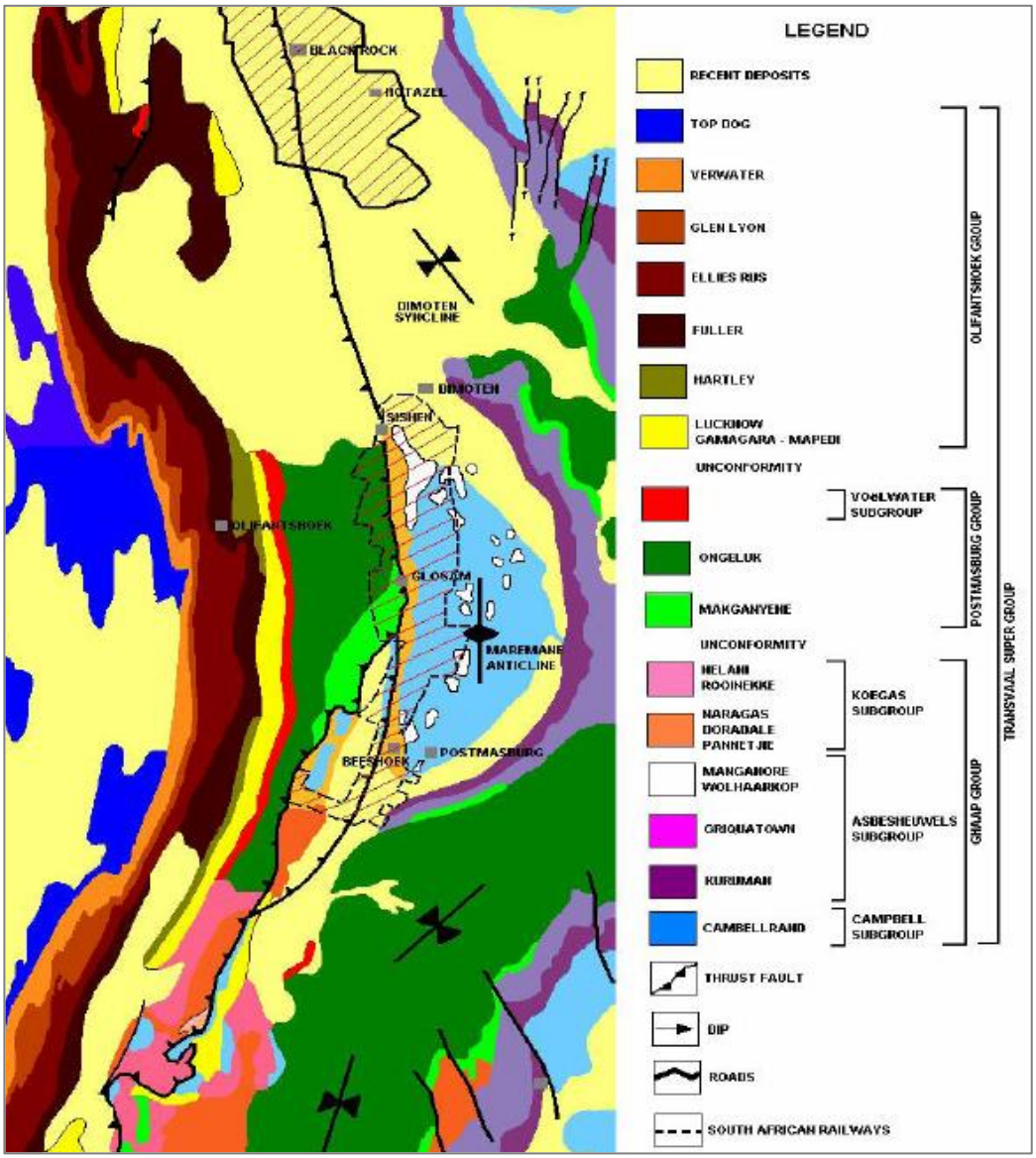

Figure 3: Geological map of Beeshoek

4.3 Soils

The area around the Beeshoek Mine is described as arid Karoo, with sandy, well drained soils and sparse Karoo vegetation. The general area is very flat, with limited rocky hilltops.

The regional soil environment in the Postmasburg area is typified by shallow Mispah and Coega soils on gentle to flat mid-slopes. Both soil forms have medium clay content and a low agricultural potential. The arid climate restricts the growth of vegetation, which usually contributes organic matter to soils further reducing the agricultural potential of the soil.

Typically, the pH levels in the soils range between 7.1 and 8.4. Electrical conductivity, which gives an indication of salinity within the soil, ranges between 31 and 61mS/m and indicates that the soils do not show any signs of salinisation. Low sodium levels indicate that there is no risk of erosion due to dispersion of clay particles by sodium ions. No determinants are present at levels that would inhibit plant growth.

The baseline chemical status of the soils is typical for soils under normal field conditions with no evidence of mining-related contamination. The soils are thus chemically and physically suitable for rehabilitation. However, due to the shallow effective soil depth generally encountered in this area, limited topsoil is available for stripping and stockpiling for rehabilitation purposes.

According to the 2021 Soils and Land Capability Assessment it was concluded that the area is not considered sufficient for viable small-scale commercial farming unless intensive management practices are implemented. For this reason, the final land use as presented in the approved EMPrs of Wilderness land remains relevant.

4.4 Ecological Footprint

Beeshoek Mine is situated within the Savanna Biome and within the Eastern Kalahari Bushveld Bioregion. The mine occurs in three (3) vegetation types, namely the Postmasburg Thornveld (western portion), Kuruman Thornveld (eastern portion) and the Kuruman Mountain Bushveld (eastern boundary) – all three vegetation types are Least Concern ecosystem and currently Poorly Protected.

For the Terrestrial Biodiversity Theme (Online Web Based National Environmental Screening Tool), the Beeshoek Mine is considered to have a very high sensitivity. The trigger sensitivity features include an Ecological Support Areas (ESA), and a Freshwater ecosystem priority area. The Mine is further located in the Griqualand West Centre (GWC) of plant endemism and the Gamagara Corridor.

Based on the latest specialist investigations undertaken for the Mine during 2020/2021, five (5) broad habitat units have been distinguished for the mine:

1. Calcrete Shrubland: This habitat unit is located on shallow calcrete soils derived from the Coega/Knersvlakte soil forms. The vegetation mainly comprised shrubland with sparse grass cover. Species diversities are intermediate and trees generally of low diversity and abundance. Habitat integrity varies throughout this habitat unit, with some areas more encroached by indigenous woody species, and other areas characterised by large intact vegetation;
2. Modified Habitat Unit: This habitat unit includes areas where vegetation is significantly degraded or entirely absent as a result of mining related activities. Two sub-units can be distinguished for this habitat unit, namely Transformed Habitat and Degraded Thornveld;
3. Moisture-driven Habitat: This habitat unit is associated with cryptic wetlands, seasonal depressions, preferential flow paths and a recharge area. This area is mostly located on the South Mine around the west of the Village and East Pit, and south and east of the East Pit and Waste Rock Dump. The Moisture-driven Habitat includes watercourses as delineated within the Freshwater Ecological Assessment undertaken by SAS for 2020/2021, but also includes non-watercourse habitat which is not considered true watercourses as defined in the National Water Act, 1998 (Act No. 36 of 1998) (NWA). Instead, these are low-lying areas where water will preferentially move during rain events, but the floral communities lack wetland indicator vegetation (e.g. vegetation within the centre of the Seasonal Depressions especially differ from that of Cryptic Wetlands). There is also an occurrence of different soil forms between the Watercourse and Non-watercourse habitat;

4. Open Thornveld Habitat Unit: Habitat restricted to the deeper red soils of the Vaalbos and Plooysburg soil forms. Vegetation included an almost continuous grass layer with large tree species such as *Vachillia erioloba* scattered throughout. Habitat integrity also varied through the site; and
5. Rupicolous Habitat Unit: This habitat unit includes areas with shallow red soils of Mispah/Glenrosa soil forms, comprising darker iron-rich stones that either present as lower-lying areas with small pebbles or as prominent rock outcrops on hills. The vegetation communities were generally dominated by encroaching *Senegalia melifera* subsp. *detinens*, but also included a higher species diversity when compared to the other habitat units within the surface rights area.

Based on conservation significance, presence of SCC and the level of habitat degradation, the floral sensitivity of the habitat units indicate that the Modified Habitat Unit is of Low and Moderately Low Sensitivity , the Calcrete Shrubland is of Intermediate Sensitivity, the Watercourses (Cryptic Wetlands and Episodic Drainage lines) of Moderate High Sensitivity, the Non-watercourses (Preferential Flow Paths, Seasonal Depressions and Recharge zone) of Moderately Low and Intermediate Sensitivity, the Open thornveld varied between Intermediate and Moderately Low Sensitivities, and the Rupicolous Habitat varied between Moderately Low and Moderately High Sensitivities.

Please refer to the following figure, which was obtained from the current Environmental Authorisation Process for the Mine Optimisation Project. This figure illustrates the different Habitat Units:

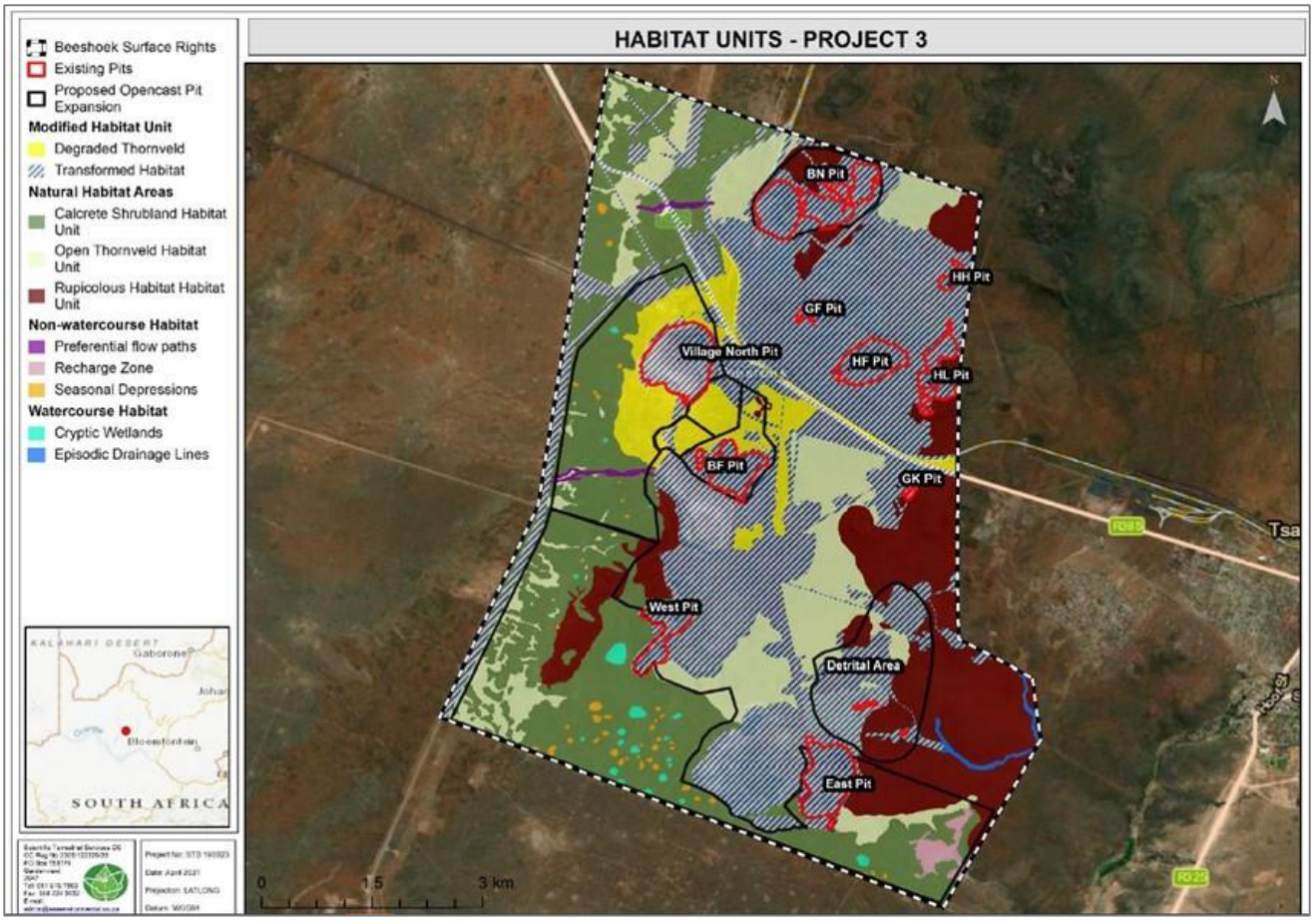

Figure 4: Habitat Units

4.5 Land Use and Capability

The area in which the mine is located is zoned as mining. The surrounding areas are dominated by Iron Ore Mines, and no cultivated agricultural activities occure in the immediate vicinity. This is largely attributable tot eh dominance of rocky outcrops and shallow soils which are not ideal for cultivated agricultural production.

Livestock commercial farming is marginal due to the low grazing capacity for this area (14 hectares per animal). Although the grazing capacity indicated in the existing database is 14ha/LSA, based on the field investigations during 2020/2021 and when considering the veld conditions (i.e. sparsity and palatability of grass) and occurring soils the grazing capacity is anticipated to b lower than indicted. Therefore, the area is not considered sufficient for viable small-scale commercial farming unless intensive management practices are implemented.

4.6 Hydrological Setting

The most important river in the region is the Orange River. The Orange River is perennial with a flow which varies between 50 and 1800 cubic meter per second (m^3/s) depending on the season. The flow of the river is largely controlled by the releases of the dams upstream, like the Bloemhof, Gariep and Vanderkloof dams.

The Hartebees River runs past Kenhardt and flows into the Orange River. This is a river which only flows after heavy rainfall. The Molopo River and its tributary, the Kuruman River, which previously used to flow into the Orange River is situated in the north of the area. A sand dune cut the river off and it can no longer flow through. After a flood a large swamp forms near the confluence of the two rivers.

There are also other small rivers which only flow after heavy rains and are therefore rather inconsistent.

The nearest watercourse to Beeshoek is the Groenwater Spruit, which drains the Beeshoek area in the South.

Water Management Area and Catchment

Beeshoek is located in Water Management Area (WMA) 10: Lower Vaal. The Lower Vaal WMA borders Botswana in the northern parts of the Northern Cape Province and also extends into the North West Province. The major rivers are listed as Molopo, Harts, Dry Harts, Kuruman and Vaal Rivers. A particular characteristic of the Orange/ Vaal WMAs is the extensive inter-catchment transfer of water within WMAs as well as interbasin transfers between these and other adjoining WMAs.

The Lower Vaal WMA is dependent on water releases from the Middle Vaal WMA for meeting the bulk of the water requirements by the urban, mining and industrial sectors within its area of jurisdiction, with local resources mainly used for irrigation and smaller towns.

Water quality in the Lower Vaal is strongly influenced by usage and management practices in the Upper and Middle Vaal WMA.

The Lower Vaal WMA in divided up into three sub-areas:

- **Molopo (where this mine is situated);**
- Harts;
- Vaal River downstream of Bloemhof.

The mine is located in the Quaternary Catchment Area D73A. The site is surrounded by escarpments on the eastern side and a much flatter topography to the West. Most of the water drains towards the south and southwest.

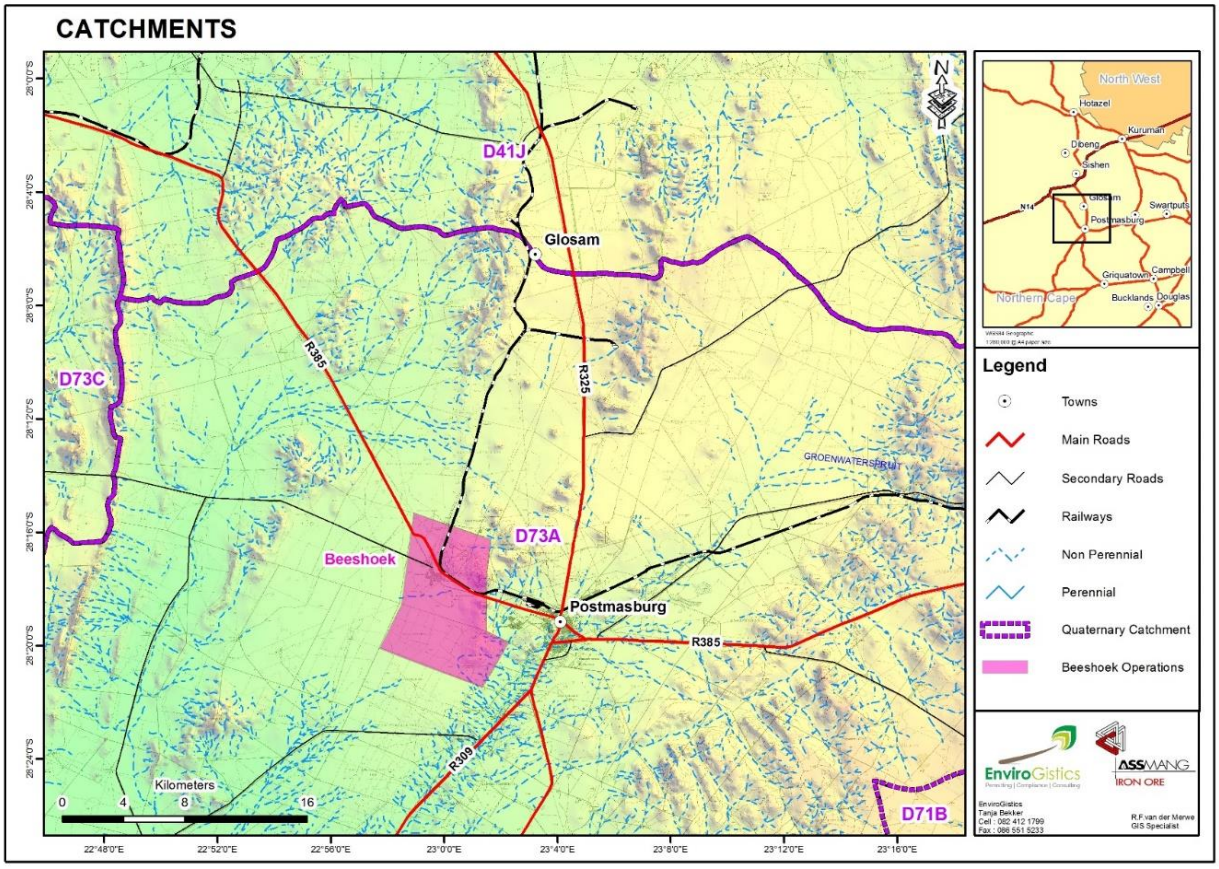

Figure 5: Catchments associated with Beeshoek Mine

The main Natural Catchment area is delineated in a holistic manner from a large to a small scale. A specific Discharge Point (DP) is identified from which the upstream catchment is delineated. No defined watercourses occur on site from which a specific DP could be identified and the DP is limited to the closest discharge point of a given watercourse nearest to the DPs of the mine's boundary. Details are provided in the table below.

4.6.1 Surface Water Settling

Within the region there are no significant dams on the Orange River. There are however various containment dams from which water for irrigation or urban settlement is diverted through canals. Examples of these are Boegoeberg Dam near Groblershoop and the Neusberg Dam near Kakamas. The Rooiberg Dam at Kenhardt is fed by the Hartbees River and is sometimes empty because of the inconsistency of the river flow. In the North of the region is the Leeubos Dam in the Swartbees River.

Although the amount of silt in the Orange River has decreased since the construction of the Gariep Dam, the Boegoeberg Dam was already covered by silt before the building of the Gariep Dam. The quality of the rain water is good in the area since there is no significant air pollution in the area which could result in acid rain.

The nearest watercourse to the Beeshoek, namely the Groenwater Spruit, only flows intermittently, but can thus be used for a temporary supply for animal watering.

This watercourse may also support animal life adapted to these sporadic flow conditions. Farmers in the region mainly obtain water for domestic and stock watering purposes from groundwater, not from surface water sources.

A bulk water supply scheme, namely the Vaal-Gamagara Water Supply Scheme (Sedibeng Water), from the Vaal River to the arid areas of the Gamagara valley near Postmasburg and north thereof was implemented by the

Department of Water Affairs (DWA, now DWS) to supply potable water to these areas and thus to enable the development of the large scale mining operations in areas such as Beeshoek, Lime Acres, Sishen, Mamatwane, Hotazel and Black Rock.

Mainly groundwater from boreholes, as well as water from the Vaal-Gamagara/ Sedibeng Water Supply Scheme, are the main sources of potable water to the Beeshoek mining complex for usage at the Village, the Plant, and workshop and office areas.

4.7 Hydrogeological Setting

According to the 2021 Numerical Model compiled by GPT, groundwater levels range between 5 mbgl in unaffected areas to 180 - 200 mbgl in dewatered areas due to groundwater abstraction for dewatering and water supply.

The effect of dewatering is more pronounced to the south of the mine (south of Olynfontein).

The direction of groundwater flow is south to south easterly from the mining area. A cone of depression has developed within the active mining area with flow directed towards the mining excavation due to the active mining areas.

Generally, the groundwater resources at all the sampling localities are described as being neutral to alkaline (pH levels between 7.8 and 8.0), non-saline to saline (TDS between 445.5 mg/l and 563.8 mg/l), and the hardness can be classified as very hard (> 300mg CaCO3/l). Water hardness at Beeshoek mine is not unlike most other boreholes in the area, resulting from the calcareous/dolomitic underlying geology characteristic of many parts of the Northern Cape.

Metal concentrations were below detection limit or low at all the monitoring boreholes.

Nitrate as N and combined nitrate and nitrite exceed the drinking water limit in the majority of external user boreholes regardless of location. The WUL identified nitrates as a contaminant of concern in relation to mining activity due to the use of N-based emulsions for blasting. Through the analysis of N-isotopes from nitrates, a contamination assessment was conducted in 2019 and it was concluded that mine's contribution to nitrate levels in and around the mine was minimal (<1%).

The latest Numerical Model states that during the operational phase, it is expected that the main impact on the groundwater environment will be dewatering of the surrounding aquifer. Water entering the mining areas will have to be pumped out to enable mining activities. This will cause a lowering in the groundwater table in- and adjacent to the mine.

Mining in this area has been ongoing for many decades, and there are historical impacts on the surrounding aquifer which are impractical to simulate in a numerical model. Thus, current groundwater levels (obtained from various sources) have been used as baseline for this impact assessment, and all dewatering impacts related to the current water levels as a starting point. Considering the impact associated with each mining pit, the following observations were made:

- The area to the south of the mining rights area is characterised by deep groundwater levels (>100 m) associated with large-scale dewatering at the neighbouring Kolomela Mine.
- No drawdown is expected for further mining at East Pit as the declining groundwater levels is predicted to be below the bottom of mining.
- Drawdown at Village pit is predicted to extent to up to 2km from the pit in a mostly westerly direction, for an insignificant drawdown of 5 – 10 metres. Areas of significant drawdown is expected only in in the immediate vicinity of the pit, which could even decline with time as Leeuwfontein mining impacts northward into this area.
- HF Pit is predicted to have a minor impact limited to the immediate surroundings of the pit itself.

- The BN Pit is predicted to have the largest area of impact due to substantial increase in mining depth. Drawdown of groundwater levels will be up to about 100 m but limited to an area of about 1 km around the pit. This is mainly due to different hydraulic characteristics in the area around the pit.
- No groundwater-related impacts are expected on surface water resources.

The model further concludes that After closure and cessation of dewatering/groundwater abstraction, the water table will rise in the mine to reinstate equilibrium with the surrounding groundwater systems. The rebound period also depends on regional activity as large-scale dewatering is occurring at the neighbouring mines as well. Following the closure of the opencasts and the cessation of the dewatering it is assumed to lead to groundwater rebound and potential decanting. However, due to naturally deep-lying groundwater levels, no decant is predicted.

The rise of solute concentrations in groundwater is expected to occur slowly in a south to south-westerly direction, at about 100 metres per year. No adverse effects are predicted on receptor boreholes with regards to increasing solute concentrations in groundwater.

4.8 Sensitive Sites

The endoreic pans that occur with the Sishen/ Postmasburg area can be regarded as sensitive landscapes. A number of these pans occur to the south of Beeshoek. No sensitive landscapes or rivers are located within close vicinity of the mine. However, various areas defined as part of the National Freshwater Ecosystem Protection Areas (NFEPA) database in terms of wetlands are present within the southern portions of the mine. These are associated with the Eastern Kalahari Bushveld Group 3 Depressions.

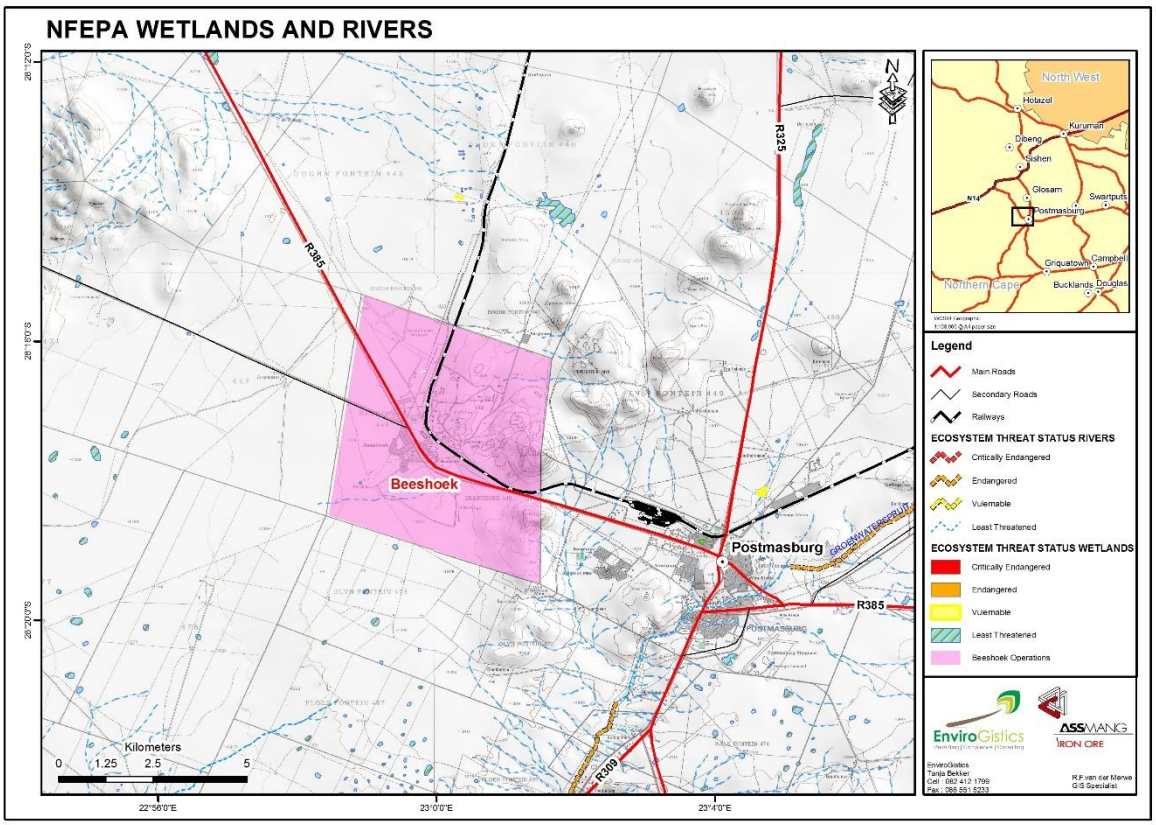

Figure 6: NFEPA Wetlands and Rivers

This was confirmed in the 2021 Freshwater Aquatic Study undertaken by SAS. Cryptic wetlands, seasonal depressions, preferential flow paths and a recharge area are mostly located on the South Mine around the west of

the Village and East Pit, and south and east of the East Pit and Waste Rock Dump. The Moisture-driven Habitat includes watercourses as delineated within the Freshwater Ecological Assessment undertaken by SAS for 2020/2021, but also includes non-watercourse habitat which is not considered true watercourses as defined in the National Water Act, 1998 (Act No. 36 of 1998) (NWA). Instead, these are low-lying areas where water will preferentially move during rain events, but the floral communities lack wetland indicator vegetation (e.g. vegetation within the centre of the Seasonal Depressions especially differ from that of Cryptic Wetlands). The watercourses (Cryptic Wetlands and Episodic Drainage lines) are considered of Moderate High Sensitivity, with the Non-watercourses (Preferential Flow Paths, Seasonal Depressions and Recharge zone) of Moderately Low and Intermediate Sensitivity.

4.9 Cultural and Heritage Setting

The region is known to be rich in archaeological heritage resources. Notable sites in the area are described below.

Rock engravings that have been known at least from 1949 when geologist Mr LJ Nel reported these to the then National Monuments Commission. It was later recorded in some detail by the McGregor Museum. This site is situated in the Gamagara shales a few kilometres southwest of the mine offices. The site consists of some 43 engravings showing up well with a darkish patina on light coloured outcrops of the shale. The engravings consist mainly of a range of geometric images, about thirty in number. Of particular interest is engraved “cups” lines of dots, wavy lines, “grids” “ladders” and concentric circle motifs, which occur primarily on the largest of the shale slabs. Other motifs include six indeterminant mammals and one each of a giraffe, an elephant, a wild dog, an ostrich and a human figure. Moreover, the location of the engravings within the channel of a watercourse and immediately adjacent to the watercourse is significant in terms of the meanings of rock art. It is believed that some of the art was connected with rain-making rituals whilst at least two of the figurative engravings are placed in association with natural hollows in the rock and could be related to concepts of creation and the emergence of animals and humans from waterholes. The giraffe engraving has been “reworked” in recent years. This constitutes vandalism, which is relatively limited at this site. A set of initials was recorded on the large slab in the watercourse. The aforementioned engravings have been relocated to a display area on the mine site.

Also, in the vicinity of Beeshoek is the important Doornfontein prehistoric specularite working. This is the Type Site for Northern Cape “Doornfontein” herder ceramics, now documented at numerous other localities throughout the region. The site’s relevance in terms of local rock engravings relates to the small stones with incisions on them that were found during excavations in the early 1970s. Further related finds might shed light on rock engraving activity contemporary with the workings and occupation of the site. Limited excavations conducted nearly two decades ago yielded an impressive number of bones of domesticated sheep and cattle. The Doornfontein site could be a key on informing on the introduction of pastoralism to southern Africa.

Other similar sites that have been noted include the following:

- Paling M87, 16 km north northwest of Postmasburg;
- Gloucester, 13 km north of Postmasburg; and
- Mount Huxley, about 15 km north of Postmasburg.

4.10 Socio-Economic Setting

The following information is sources from the Social Impact Assessment, draft Scoping Report compiled by Batho Earth, June 2019.

4.10.1 ZF Mgcawu Districts Municipality

The study area falls within the boundaries of the ZF Mgcawu District Municipality and under the jurisdiction of the Tsantsabane Local Municipality.

The ZF Mgcawu District Municipality[1] was formerly known as the Siyanda District Municipality. It lies within the mid-northern section of the Northern Cape Province, bordering with Botswana in the north and Namibia in the west and covers an area of 102 484 km^2.

The ZF Mgcawu District comprises five Local Municipalities namely:

- Dawid Kruiper Local Municipality;
- Kai !Garib Local Municipality;
- !Kheis Local Municipality; and
- Tsantsabane Local Municipality; and
- Kgatelopele Local Municipality.

The main towns that are scattered through the area are Beeshoek, Brandboom, Danielskuil, Eksteenskuil, Groblershoop, Kakamas, Keimoes, Kenhardt, Lime Acres, Mier, Postmasburg, Rietfontein, and Upington. The latter serves as the district municipal capital where the municipal government is located.

Agriculture, mining, and tourism form the key economic drivers in this area. The spatial vision of the ZF Mgcawu District Municipality thus include[2]:

- Tourism: Cultural, wilderness, floristic, river tourism ranging from the Kgalagadi international trans frontier park to the culture of the Riemvasmaak community to river tourism on the Orange River;
- Mining and mining beneficiation;
- Agriculture: riverbank vineyards and expansive stock and game farming in the Kalahari; and
- Renewable energy technology opportunities.

4.10.2 Tsantsabane Local Municipality and Municipal Wards

The Tsantsabane Local Municipality falls under the jurisdiction of the ZF Mgcawu District Municipality formerly known as the Siyanda District Municipality. The extent of the geographical area of the municipality is 18 317 km^2. It is bordered by the John Taolo Gaetsewe and the Pixley-ka-Seme District Municipalities. Furthermore, Tsantsabane Local Municipality is bordered by Siyancuma Local Municipality, //Khara Hais Local Municipality, !Kheis Local Municipality, Gamagara LM and Kgatelopele Local Municipality.

The municipal area falls in the Gamagara Corridor. The NCPSDF (2012: 68) defines the Gamagara Corridor as "comprises the mining belt of the John Taolo Gaetsewe and ZF Mgcawu districts and runs from Lime Acres and Danielskuil to Hotazel in the north. The corridor focuses on the mining of iron and manganese.

Postmasburg is the main town within the Tsantsabane Local Municipality, with various other small rural settlements such as Jenn-Haven, Groenwater and Skeyfontein. Beeshoek is now seen as a mining residential satellite town of Postmasburg. The main routes include the R385 and R31 from Kimberley that runs through Beeshoek, the R309 and the R325 to Kathu.

Economically, Tsantsabane is known for being rich in minerals, and for its mining, agriculture, manufacturing and farming sectors. Tsantsabane has become one of the leading investment areas in the Northern Cape.

The municipality is divided into seven wards, as listed in the table below[3].

The mine falls within Ward 6 and a section of Ward 7 with Wards 1, 2, 3, 4 and 5 in very close proximity.

[1] www.localgovernment.co.za
[2] Tsantsabane Local Municipality. Integrated Development Plan
[3] Tsantsabane Local Municipality. Integrated Development Plan

Table 5: Wards and settlements in the study area

Wards	Affected Settlements in Ward
Ward 1	Part of Postdene and Carnation
Ward 2	Newtown
Ward 3	Groenwater, Jenn Haven, part of Postdene and Kolomela houses
Ward 4	Boichoko
Ward 5	Skeifontein, Soetfontein, Strathmore, Part of Boichoko and Postmasburg Town
Ward 6	White City, Glossom, Maremane, Beeshoek, Stasie
Ward 7	Maranteng, Kanonbult

4.10.3 Strategic Development Framework

The key Municipal priorities as set out in the Tsantsabane Local Municipality IDP include:

- Bulk Infrastructure services;
- Revenue Collection and Enhancement;
- Provision of Sustainable Basic Services (Water, Electricity & Sanitation);
- Local Economic Development and Job Creation;
- Education: access to land for educational purposes;
- Access to land for residential and business erven;
- Library services for rural areas;
- Refurbishment of community halls; and
- Access to health services.

4.10.4 Population Figures

The total population of the Tsantsabane Local Municipality is 39 344 individuals based on the Community Survey of 2016. There is an average 2.1 person population density per km^2 and the number of households totals 11 820. The average household size is 3.5.

4.10.5 Age Groups and Gender

The Tsantsabane Local Municipality population indicates a predominantly young age structure with 34% of the population under 18 years and 62% between 18 and 64 years. The median age is 26 years with the highest percentage (23%) of people falling between 20 and 29 years of age. Those within the working age category (18-64 years) are approximately 10% higher than the rate in the Northern Cape and also slightly higher than the district rate4. These figures indicate the critical need for employment opportunities within the area.

The male population (21 086 individuals) within the municipality are at 54%. The main reason for this situation in the area is attributed to the influx of various workers from outside the province in search of work at the different mining developments and mining being a more male dominant employment industry. The number of males within the study area is thus again approximately 10% higher than the rate within the province and slightly higher than the district rate5.

[4] StatsSA: Community survey 2016
[5] StatsSA: Community survey 2016

4.10.6 Population Stability

Approximately 11% of the population within the Tsantsabane Local Municipality area are from outside the province[6]. The population stability is thus influenced by the in-migration of outsiders to the area, mainly due to the presence of various mining activities and sources of employment within this sector. These outsiders consist of foreigners, as well as individuals from other areas within South Africa.

This in-migration, which is thus mostly attributed to people in search of employment, has further socio-economic consequences such as additional pressure on the Tsantsabane Local Municipality and the business sector to provide employment opportunities, as well as the provision of social infrastructure and services. Residents have further indicated that small businesses are mainly owned by foreigners limiting opportunities for locals in this regard[7].

4.10.7 Education and Skills Levels

The proportion of the adult population with no schooling amounts to 7%, with only 2% having obtained a tertiary level of education. Approximately 36%, however has a matric certificate, which is about 20% higher than the rate in the district and 10% higher than the provincial rate.

The statistics indicate that although a high number of students enroll for primary school, a very low number of students complete Grade 12. Furthermore, only 5% of those who enrolled for Grade 1 endure it into a tertiary level.

With the low number of the population having a tertiary qualification or having completed Grade 12, it can be assumed that the skills levels are also low. This results in a very low probability for employment. Unemployment and low skills remain a major concern within the Tsantsabane Local Municipality area.

Within the TLM, the educational profile of those of 20 years and older is as follows[8]:

Table 6: Educational Profile of Population in Tsantsabane Local Municipality

Educational Profile: Tsantsabane Local Municipality					
No Schooling	**Some primary**	**Completed primary**	**Some secondary**	**Completed secondary**	**Higher**
1 853 (7.3%)	2 326 (9.1%)	1 500 (5.9%)	9 185 (36%)	9 165 (36%)	262 (2.2%)

It must, however, be noted that the education level is further being negatively affected by the urbanisation process, with a lack of sufficient schools for the increase in people coming to Postmasburg and surrounds in search of employment[9]. Learners from all over the TLM area are transported to attend school in Postmasburg. Overcrowding in the classrooms is a serious challenge which hampers the learning experience. There is thus an urgent need for additional school facilities. The challenges in this regard relate to:

- An urgent need for additional school facilities in Newtown (Postmasburg) and Groenwater / Skeyfontein;
- Lack of a Setswana medium school/s;
- Lack of specialised schools focusing on specialized traits i.e. Technical or Agricultural;
- Lack of proper water and sanitation services at schools;
- Not enough classrooms and high learners and teacher ratio; and
- A need for an additional technical high school that will respond/address for the needs of the mining sector.

[6] StatsSA: Community survey 2016
[7] Tsantsabane Local Municipality. Integrated Development Plan
[8] StatsSA: Community survey 2016
[9] Tsantsabane Local Municipality. Integrated Development Plan

4.10.8 Employment and Income

Although various mines operate in the Tsantsabane Local Municipality area, these mines cannot accommodate all the jobseekers. According to the Census of 2011, the employment rate in the municipality is slightly less compared to the district rate, but significantly higher than the provincial rate. The non-economically active people are still of concern as they would thus be dependent on the employed. These figures could have also changed since 2011.

The mining sector, followed by the agricultural sector is the main employment sectors within the local study area. Job creation among the youth remains a challenge with limited sectors available.

The employment profile of persons 15 years and older is as follows:

Table 7: Employment Profile[10]

Employment Profile				
Area	**Employed**	**Unemployed**	**Discouraged work-seeker**	**Other non-economically active**
Tsantsabane Local Municipality	10 760 (45.3%)	3 795 (16%)	419 (1.8%)	8 764 (36.9%)
ZF Mgcawu District	74 449 (47.3%)	17 696 (11.3%)	4 961 (3.2%)	60 210 (38.3%)
Northern Cape Province	282 791 (38.4%)	106 723 (14.5%)	39 913 (5.4%)	306 291 (41.6%)

Although the median average income in the TLM is calculated at R29 400 per annum, approximately 34.1% of the households within the TLM fall within the lower bound income brackets of below R20 000 per year. This figure is lower than that of the Northern Cape Province (41.6%) and the municipal figures (37.2%).

Poverty levels in the study area thus remain high.

4.10.9 Internal Strategic Perspective (ISP)

According to the Lower Vaal Water Management Area: Overview of Water Resources Availability and Utilisation Report (DWAF; 2003), the Gross Geographic Product (GGP) of the Lower Vaal WMA was R9.8bn in 1997. The most important magisterial districts in terms of contribution to GGP in this WMA are shown below:

- Kimberley 29,6%
- Postmasburg 14,8%
- Lichtenburg 9,6%
- Kuruman 8,9%
- Vryburg 8, 3%.

The most important economic activities taking place within the WMA are:

- Mining 23%
- Government 16%
- Trade 15%
- Agriculture 14%

The main agricultural activities identified include livestock and dryland cropping. Livestock includes beef and dairy cattle, goats, non-wooled sheep, pigs and ostriches. Crops grown are mainly maize, but also sunflower, cotton, groundnuts and vegetables. The mining activities in this WMA include mining for diamonds, iron ore, manganese and other minerals such as limestone, dolomite and amphibole asbestos. Kimberlite diamonds are mined at the Finch Mine at Lime Acres, one of the most important diamond producing mines of the De Beers Company. Kimberley is also an important diamond mining area, which is known for its high-quality diamonds. The Sishen Mine, currently

[10] StatsSA: Census 2011

the major supplier of iron ore in the country, is also located in the Lower Vaal WMA. This mine has a mineable depth of 30 metres and was opened in 1953 as part of Iscor's expansion strategy. In 1997, it produced approximately 2 400-million-ton iron ore per year. Other important mining areas includes Kudumane (iron, manganese and asbestos etc.), Ganyesa (diamonds, mica group clay and salt) and Taung (diamonds, limestone, dolomite and salt). Since manufacturing production is far less than mining production, it can be deduced that only a small percentage of beneficiation is done locally. This implies that a large percentage of raw mining products are exported to other areas for beneficiation. Lichtenburg is the largest manufacturing town in the WMA, where manufacturing includes cement and cheese factories. Kimberley is the second largest manufacturing town, but its output is half that of Lichtenburg.

The trade sector is concentrated in wholesale of primary products and related services to the community. Main products of trade in this WMA are:

1. diamonds (for export)
2. food retail related products
3. ostrich-related products.

4.10.10 Strategic Development Framework

According to the IDP, the Spatial Development Framework (SDP) also indicates the impact of development activities on the environment and rate impacts as low, medium and high.

According to the National Biodiversity Strategy (NBS), biodiversity considerations are to be integrated into all other strategies and plans at local government level, such as poverty eradication and developmental programmes. The NBS provides for achieving various biodiversity-related objectives, i.e. reducing the rate of loss of biodiversity by 2010. The goal of the NBS is therefore to conserve and manage biodiversity to ensure sustainable benefits to the people of South Africa, through co-operation and partnerships that build on strengths and opportunities.

According to the National Spatial Biodiversity Assessment (NSBA), Tsantsabane and the broader district were not identified as a priority with regards to biodiversity conservation. However, it continues to be important to address the issue, since biodiversity makes a substantial contribution to the livelihoods of rural communities in the form of housing, fuel, food and medicines. The results of the NSBA also highlight that many people have become alienated from nature, through apartheid policies and processes like urbanisation. Hence, much more needs to be done to make conservation more inclusive and relevant to people's lives.

With all the development happening in the area, the demands for water have increased as in the rest of the semi-arid Northern Cape Province.

The area is rich in minerals which has historically been the mainstay of the area's economy. Iron and manganese mining are an important activity in the economy of the area. Haematite deposits in the form of ferriginised banded ironstone occur as a cake or capping to the Gamagara hills which lies between Postmasburg and Sishen. The ore is very pure and typically consist of 95% ferric oxide. There are significant undeveloped mineral resources left in the area that could contribute to future economic growth in the area, depending on the future viability of exploiting the minerals. Large areas of unrehabilitated and poorly rehabilitated mining activities (current and closed) have a significant negative effect on the scenic environment in the area, especially in the mountainous areas.

4.10.11 Environmental Management Framework

According to the IDP, the Environmental Management Framework (EMF) further indicates strategies focusing on the alleviation of potential key development/ environmental friction areas by providing direction in respect of how these friction areas should be dealt with. The following strategies have been compiled and in future the Tsantsabane Local Municipality will align its own environmental planning to these:

- Strategy for the protection and conservation of high quality natural vegetation;

- Protection of sensitive environmental features on large properties;
- Protection of sensitive environmental features on large properties across the district; and
- Strategy for the protection of sensitive environmental features, surrounded or abutted by small properties.

These aspects are important to consider in the future development of the mine, its EMPs, Social and Labour Plans and Closure Plans.

4.10.12 Internal Strategic Perspective

According to the "Lower Vaal WMA: Overview of Water Resources Availability and Utilisation" Report, the Gross Domestic Product (GDP) of the Lower Vaal WMA was R9,8bn in 1997. The most important magisterial districts in terms of contribution to GDP in this WMA are listed below:

- Kimberley 29,6%;
- Postmasburg 14,8%;
- Lichtenburg 9,6%;
- Kuruman 8,9%; and
- Vryburg 8,3%.

The most important economic activities of the WMA are:

- Mining 23%;
- Government 16%;
- Trade 15%; and
- Agriculture 14%.

The main agricultural activities identified include livestock and dryland cropping. Livestock includes beef and dairy cattle, goats, non-wooled sheep, pigs and ostriches. Crops grown are mainly maize, but also sunflower, cotton, groundnuts and vegetables. The mining activities in this WMA include mining for diamonds, iron ore, manganese and other minerals such as limestone, dolomite and amphibole asbestos. Kimberlite diamonds are mined at the Finsch Mine at Lime Acres, one of the most important diamond producing mines of the De Beers Company. Kimberley is also an important diamond mining area, which is known for its high quality diamonds. The Sishen Mine, currently the major supplier of iron ore in the country, is also located in the Lower Vaal WMA. This mine has a mineable depth of 30 metres and was opened in 1953 as part of Iscor's expansion strategy. In 1997, it produced approximately 2,400 million ton iron ore per year. An increase in mining and transportation activities can be expected with the construction of the Sishen-Coega railway line that will link Sishen with the Coega initiative near PE. Other important mining areas includes Kudumane (iron, manganese and asbestos etc.), Ganyesa (diamonds, mica group clay and salt) and Taung (diamonds, limestone, dolomite and salt). Since manufacturing production is far less than mining production, it can be deduced that only a small percentage of beneficiation is done locally. This implies that a large percentage of raw mining products are exported to other areas for beneficiation. Lichtenburg is the largest manufacturing town in the WMA, where manufacturing includes cement and cheese factories. Kimberley is the second largest manufacturing town, but its output is half that of Lichtenburg.

The trade sector is concentrated in wholesale of primary products and related services to the community. Main products of trade in this WMA are:

- Diamonds (for export);
- Food retail related products; and
- Ostrich-related products.

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5 RISK ASSESSMENT CONSIDERATIONS

5.1 Mine Closure Overview

Successful mine closure depends on the setting in which the mine is located, continual reviewing and validating and finally meeting closure goals that align with the EMP objectives, company and stakeholder requirements (in this case commitments made in approved EMPs and conditions as stipulated in the Environmental Authorisations and WUL). There should be no to minimal residual risk to the environment, and the community should realise benefits that will continue to exist without further involvement from the company.

The vision of mine closure should be to ensure that a process is established to guide all decisions and actions during a mine's life such that:

- Future public health and safety are not compromised;
- Environmental resources are not subject to physical and chemical deterioration;
- The post-mining use of the site is beneficial and sustainable in the long-term and meets the required final land use;
- Any adverse socio-economic impacts are minimised or eliminated; and
- The opportunity is taken to maximise socio-economic benefits.

It is important that the Closure Plan be revised as the mine production progresses; this will ensure that the mine operation take advances in technology and rehabilitation methods into consideration. This is specifically important based on outcomes of ongoing updates of the IWWMP and specialist studies, such as Hydrogeological Models and the latest Deep Dolomitic Studies.

5.2 Legal Considerations

The following table presents the legal considerations in terms of mine closure.

Table 8: Mine Closure Legal Considerations

Applicable legislation and guidelines	Details
Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)	Section 24 of the Constitution states that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that –
	a) Prevent pollution and ecological degradation;
	b) Promote conservation; and
	c) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.
Mineral and Petroleum Resource Development Act. 2002 (Act No. 28 of 2002) (MPRDA)	The MPRDA sets out the requirements relating to the development of the nation's mineral and petroleum resources. It also aims to ensure the promotion of economic and social development through exploration and mining related activities; Section 41 (1) of the MPRDA has been repealed and in terms of Section 24P in the NEMA as amended which provides that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts. The financial provision must guarantee the availability of sufficient funds to undertake the- a) Rehabilitation of the adverse environmental impacts of the listed or specified activities;

Applicable legislation and guidelines	Details
	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; and/or f) Remediation of any other negative environmental impacts. In addition to Section 24P, the Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations were promulgated on the 20 November 2015 (GN R 1147 published in GG 39425). Regulation 11 of the Financial Provision Regulations requires a holder of a Mining Right to determine the quantum of the financial provision through detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for: a) Annual rehabilitation, as reflected in Annual Rehabilitation Plans; b) Final rehabilitation, decommissioning and closure of the mining operations as per the Rehabilitation and Closure Plans which includes the findings of the Environmental Risk Assessment; and c) Remediation of latent or residual environmental impacts as identified in the Environmental Risk Assessment Report.
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA)	The NEMA, as amended, was set in place in accordance with Section 24 of the Constitution of the Republic of South Africa. Certain environmental principles under NEMA have to be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.*
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA)	NEMBA regulates the management and conservation of the biodiversity of South Africa within the framework provided under NEMA. This Act also regulates the protection of species and ecosystems that require national protection and also takes into account the management of alien and invasive species. This Act works in accordance to the framework set under NEMA. The following regulations which have been promulgated in terms of the NEMBA are also of relevance: • Alien and Invasive Species Lists, 2016 published under GN R.599 in GG 37886 of 1 August 2014; • National Environmental Management: Biodiversity Act, 2004: Threatened and Protected Species Regulations; and • National list of Ecosystems that are Threatened and in need of Protection under Section 52(1) (a) of the Biodiversity Act (GG 34809, GN R.1002, 9 December 2011).
National Water Act, 1998 (Act No. 36 of 1998) (NWA)	The NWA provides for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, and that a person can only be entitled to use water if the use is permissible under the NWA.
	CARA states that the degradation of the agricultural potential of soil is illegal; and

Applicable legislation and guidelines	Details
The Conservation of Agricultural Resources, 1983 (Act No. 43 of 1983) (CARA)	CARA requires that protection of land against soil erosion and the prevention of water logging and salinisation of soils means of suitable soil conservation works to be constructed and maintained.
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA)	According to the NEM:AQA the Department of Environmental Affairs (DEA), the provincial environmental departments and local authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement of various aspects of NEM:AQA. A fundamental aspect of the new approach to the air quality regulation, as reflected in the NEM:AQA is the establishment of National Ambient Air Quality Standards (NAAQS) (GN R 1210 of 2009). These standards provide the goals for air quality management plans and also provide the benchmark by which the effectiveness of these management plans is measured.
National Environmental Management Waste Act, 2008	Previously, the MPRDA required all mine residue to be deposited in "approved demarcated" areas. These areas were to be included in the EMP which was required in terms of the now repealed Section 39 of the MPRDA. These provisions were repealed with effect from 8 December 2014, and new provisions were inserted in Section 43A of the NEM:WA. Approved EMPs, however, remain legally binding, and approved residue stockpiles and deposits need not be re-approved. As from 2 September 2014, Mine Residue Stockpiles and Deposits, as defined in MPRDA, are no longer excluded from the ambit of the NEM:WA[11]. The key implications of this change are briefly as follows: i. Mine Residue Stockpiles and/ or Deposits must be managed in accordance with the Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits, 2015 (GN R 632).

According to the Financial Provision Regulations, 2015, an applicant must determine the financial provision through a detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for-

(a) annual rehabilitation, as reflected in an annual rehabilitation plan (this report);

(b) final rehabilitation, decommissioning and closure of the prospecting, exploration, mining or production operations at the end of the life of operations, as reflected in a final rehabilitation, decommissioning and mine closure plan; and

(c) remediation of latent or residual environmental impacts which may become known in the future, including the pumping and treatment of polluted or extraneous water, as reflected in an environmental risk assessment report.

Current specialist investigations and past Environmental Impact Assessments, during which detailed Risk Assessments were conducted by competent Specialists, have as yet not identified any known Residual Risk. Studies have indicated that all identified impacts can be addressed by ongoing management measures implemented by the mine.

Here it is very important to understand the requirements of the Regulations. The content of the final rehabilitation, decommissioning a mine closure plan, as well as that of the Environmental Risk Assessment Report, states that the (c) findings of an environmental risk assessment leading to the most appropriate closure strategy.

[11] Section 4, NEM:WA, as amended.

Annexure 5 of the Regulations, stipulates the minimum content of an Environmental Risk Report and specifically states that the Environmental Risk Assessment Report will form a component of the Environmental Management Programme to be submitted in terms of section 24N of the Act and the Environmental Impact Assessment Regulations, 2014 and will be subjected to the same requirements of the environmental management programme with regards opportunities for stakeholder review and comment as well as auditing. The Regulations are promulgated for both new Environmental Authorisations, but also for the review of already conducted studies.

For the purposes of this mine, such risk assessment has been completed as part of the approved EMPrs' as well as the Environmental Authorisations. Ongoing specialist investigations, such as the Contamination Study, Waste Classification Studies, and Numerical Groundwater Models are undertaken to assess whether there are any changes to the identified risks and whether additional management measures are required. The report should state the -

(b) details of the assessment process used to identify and quantify the latent risks ((this is presented in Section 5.4 and 5.6 of the Beeshoek Residual Risk Report, detailing all documentation considered, including-

(i) a description of the risk assessment methodology inclusive of risk identification and quantification (this is presented din Section 5.5 of the Beeshoek Residual Risk Report, in which the rating methodologies used in the previous risk studies were utilised;

(ii) substantiation why each risk is latent, including why the risk was not or could not be mitigated during concurrent rehabilitation and remediation or during the implementation of the final rehabilitation, decommission and closure plan (this is presented in Section 5.6 and 5.7 of the Beeshoek Residual Risk Report, and also presented in the following section of this Annual Rehabilitation Report;

The main and most important purpose of the Risk Assessment, therefore, is the need to identify whether there are risks that were not or could not be mitigated during the concurrent rehabilitation and remediation or during the implementation of the final rehabilitation, decommissioning or closure plans.

5.3 Residual vs. Latent Risks

For this discussion the following should be clarified:

A residual risk as per the Oxford Dictionary is: "Remaining after the greater part or quantity has gone." The 2015 Financial Provision Regulations defines residual environmental impacts as "any environmental impact or risk that may result or manifest after actions for final rehabilitation, decommissioning and closure have been implemented.

A latent risk as per the Oxford Dictionary is "(of a quality or state) existing but not yet developed or manifest; hidden or concealed."

Based on the specialist studies conducted as part of the past Environmental Authorisation Processes, which includes multi-disciplinary specialist studies, as well as subsequent reviews of these studies (such as the Numerical Groundwater Model updates), it is concluded that no quantitative residual risks have been identified. This pertains to the fact that no specific quantitative risk has been identified which can be costed for the purposes of long term management post mine closure -i.e. when all closure measures have been implemented and still specific impacts remain. For example, where decant has been identified as part of a mine's operational layout and plan, the decant can be quantified, and the treatment options thereof stipulated or where a groundwater pollution plume has been identified as part of a numerical model a specific measures are determined to retract or manage the movement of this plume, such as scavenger boreholes. For the purposes of Beeshoek Mine, no residual risks have been identified.

Latent risks on the other hand are regarded as those risks which are unknown/hidden and for which further studies and/or investigations are required. These are typically associated with ineffective rehabilitation due to premature closure (the risk is present, however management measures are in place throughout the operational phase of the mine to address these), or the loss of employment due to premature closure, or instability due to the underlying strata/geology, such as dolomites (investigations are undertaken on a regular basis to determine where

infrastructure must be place or where risk of subsidence are present and as a result these are incorporated within the mine planning and layout. However, in the event of poor stormwater management or dewatering from other sources, residual to the mine activities, subsidence may occur. This is however a latent risk and not a residual risk – this is a "what if", which must be investigated and understood and incorporated as part of the ongoing layout development of the mine.

Latent Environmental Impacts may be expected for the post-closure scenario, should the recommended operational, ongoing rehabilitation and rehabilitation as part of decommissioning and closure not be successful. This is however unlikely and managed through ongoing studies and investigations. These risks are therefore subjected to further studies as identified in the Beeshoek Residual Risk Report or as part of ongoing incorporation of measures as presented in the Social and Labour Plans. These relates specifically to:

- Stability (due to the presence of the dolomites in the area);
- Management of the impact on the loss of employment once the mine closes; and
- The impacts on premature closure.

Ongoing updates of the groundwater reports and reassessment of the deep dolomitic studies due to the incorporation of conditions listed in these reports may be suitable to better understand the environment and also manage specific areas of concern to manage and/or avoid any potential unknown residual risks.

For this reason, these financial reports are updated annually with the latest available specialist study outcomes.

5.4 Closure Design Principles

Mine closure is an ongoing programme designed to restore the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to a state acceptable to the regulators and to post mining land users. The activities associated with mine closure are designed to prevent or minimise adverse long term environmental impacts, and to create a self-sustaining natural ecosystem or alternate land use based on an agreed set of objectives. The objective of mine closure is to obtain legal (government) and community agreement that the condition of the closed operation meets the requirements of those entities, as a result of which the companies' legal liability is terminated.

Rehabilitation can be divided into two (2) different streams, namely concurrent rehabilitation and final rehabilitation. Concurrent rehabilitation must continue to be carried out along with mining. Concurrent rehabilitation activities should decrease the final closure costs that the mine will carry at the time of closure. This concurrent rehabilitation must be carried out within the context of the approved EMPs and is contained in the Annual Rehabilitation Plan. Final rehabilitation will be carried out once the mine goes into its decommissioning and closure phase and is presented in the mines' Final Rehabilitation Plan.

The primary concerns for decommissioning and rehabilitation are to ensure public safety and health, and environmentally stable conditions compatible with the surrounding environment, and consequently minimize the environmental impacts caused by mining. The overall objective is to have socially, economically, and environmentally sustainable development. The objectives of mine closure as set out in the Department of Minerals (DMR) policies are:

- Safety and health of animals and humans must be safeguarded;
- Environmental damage and residual impacts must be minimized to a level acceptable to all parties, i.e. avoidance of future pollution;
- Land must be rehabilitated to as close to natural state as possible, i.e. creation of a stable land surface;
- Physical and chemical stability of remaining structures must be such that they are not affected by natural elements;
- Mines are closed effectively and cost efficiently; and
- Mines are not abandoned, but closed in terms of policy.

Residual risks are those risks which will remain even beyond the completion of final rehabilitation and risk the mine obtaining final closure.

The mines latest EMPr has a detailed closure plan which was considered in this assessment.

The following table presents the rehabilitation requirements in terms of:

- General Rehabilitation Requirements; and
- Activity/Structure specific Rehabilitation Requirements.

5.4.1.1 General Surface Rehabilitation'

Brick buildings and infrastructure serving as offices, workshops, roads, railways, powerlines etc. can be put to beneficial use upon closure of a mine, and thus should not be removed if there is an adequate use for these buildings post-closure. This "adequate use" should be determined before final closure and rehabilitation measures are formally implemented and should be agreed with in writing with the DMR.

If, any agreement is reached with the community and or any other organization to take over the occupation of one (1) or more buildings and/or infrastructure, then a formal agreement to that extent needs to be entered into and signed by all parties concerned. The DMR also needs to be alerted to this fact, and adequate legal arrangements need to be made in this regard. If various parties cannot reach agreement on the adequate use for these buildings, then these buildings too need to be demolished. All temporary buildings (pre-fabricated buildings) should be removed and their footprints rehabilitated.

Unless the area or activity is otherwise stipulated in the sections below or could be sold/repurposed in terms of the discussion above, all infrastructures will require general surface rehabilitation. The requisite requirements for general surface rehabilitation are presented in the following table.

Table 9: Rehabilitation Recommendations

	Requirement	Target	Responsible Person	Timeframes
	General Surface Rehabilitation			
A	**Planning**			
A1	The closure plan will be reviewed during the life of the mine (closure, operational and decommissioning phases) as part of the NEMA Regulations for financial provision.	Legal closure review compliance.	Environmental Specialist	Annually during operational phase.
A2	Notify the DMR of intended cessation of mining activities and rehabilitation in accordance with the NEMA.	Notification	Environmental Department	Five years prior to closure
A3	Apply for the necessary Environmental Authorisation for the decommissioning of activities in terms of the NEMA, NEM:WA and NWA.	Environmental Authorisation.	Environmental Department	At least 2 years prior to intended decommissioning.
A4	Appoint a project manager to oversee the process	Appointment of suitably qualified project manager.	Mine Manager	Prior to the commencement of closure planning and implementation.
A5	Where still present, asbestos roofs and materials containing asbestos must be identified and removed by a person competent to do so. Asbestos waste must be disposed of to an appropriately licenced facility.	Disposal of waste in terms of Asbestos regulations and the NEM:WA.	Engineering Manager and Environmental Department.	Demolition phase
A6	Identify any protected species that may require permitting prior to disturbing.	Biodiversity Permits	Environmental Specialist	Prior to commencement of rehabilitation.
A7	A storm water management plan (clean and dirty water separation) for the purposes of rehabilitating towards the final land use should be developed.	Free draining environment	Hydrologist/Engineer	Prior to commencement of rehabilitation.
A8	If any archaeological artefacts of potential significance are identified at any stage, work must cease and SAHRA must be notified for instruction on how to proceed.	Protection of artefacts	Environmental Specialist	Ongoing
B	**Removal of Surface Infrastructure and Structures**			
B1	Photographs of the infrastructure, before, during and after rehabilitation will be taken at selected fixed points and kept on record for the Manager (Group Environmental Department) and the DMR purpose	Documentation of rehabilitation process.	Environmental Department	Ongoing
B2	All temporary buildings (pre-fabricated buildings) should be removed and their footprints rehabilitated.	Surface rights area cleared up of all mining related infrastructure and structures.	Project Manager	Ongoing
B3	All fixed assets that can be profitably removed will be removed for salvage or resale (the salvage and resale value have however not been incorporated into the closure cost estimate as per the legislative requirements)	Surface rights area cleared up of all mining related infrastructure and structures.	Project Manager	Ongoing
B4	All surface structures, infrastructure and 'hard surfaces' (inter alia, redundant surfaced roads, parking and paved areas) are to be demolished and removed from the disturbed mine footprint; unless an alternative/continued use for any such items is agreed upon, in writing, with the Department of Mineral Resources (DMR).	Surface rights area cleared up of all mining related infrastructure and structures.	Project Manager	Ongoing
B5	Any item that has no salvage value to the mine but could be of value to individuals will be treated as waste, unless otherwise defined in terms of the NEM:WA	Surface rights area cleared up of all mining related infrastructure and structures.	Project Manager	Ongoing
B6	All structures will be demolished, terracing removed and foundations demolished to 1m below the original ground level	No remaining sub-surface structures that may impede further phases of rehabilitation or vegetation establishment.	Project Manager	Ongoing
B7	Dismantle and remove redundant fencing for salvage	Surface rights area cleared up of all mining related infrastructure and structures.	Project Manager	Ongoing
B8	Water pollution control structures will remain until the completion of all demolition and associated rehabilitation activities where after these will be rehabilitated.	Free draining environment	Hydrologist/Engineer	Prior to commencement of rehabilitation.
B9	The soils beneath any structures used for the bulk storage of hazardous substances (i.e. bulk fuel and oil storage facilities, oil-water separators/sumps), must be made subject to a hydrocarbon contamination screening exercise undertaken by a suitably qualified, independent, professional.	Documented proof of contamination assessments on record. Compliance with any further	Project Manager	Ongoing

	Requirement	Target	Responsible Person	Timeframes
		recommendations from appointed specialist prior to further rehabilitation of contaminated site(s).		
C	**Soil Preparation**			
C1	Where sites have been alienated of vegetation or where soils have been compacted or covered with concretes, these sites will be ripped and ploughed.	No topsoil replacement on compacted soil horizons.	Project Manager	Ongoing
C2	The topsoil and subsoils with the appropriate seedbed as stripped during the construction and operational phases will be placed over these areas to a depth as specified by a qualified specialist. The topsoil shall be appropriately ameliorated to allow vegetation to grow rapidly if required – it should be noted that the mine will encourage self-succession of vegetation, if this does not take place effectively a revegetation project will be implemented	Replacement of fertile topsoil.	Environmental Scientist	Ongoing
C3	On-going alien and invasive floral species control is required through all phases of rehabilitation.	No establishment of weeds or invasive species.	Environmental Scientist	Ongoing inspections.
C4	Pre-mining topography should be reasonably restored through shaping and landscaping, such that the topography of rehabilitated areas will ultimately be commensurate with that of adjacent, non-disturbed areas.	No evidence of significant alteration.	Project Manager	Ongoing
C5	The areas will be landscaped to be free draining in line with the approved storm water management plan.	Area to be fee draining	Project Manager	Ongoing
C6	If a reasonable assessment indicates that the re-establishment of vegetation is unacceptable slow, the soil need to be analysed and any deleterious effects must be corrected and the area be seeded with a seed mix to specification	Successful vegetation establishment	Ecologist	Ongoing inspections.
C7	Appropriate erosion control measures (i.e. contour banks) must be taken where required	No evidence of significant alteration.	Project Manager	Ongoing
C8	Care should be taken in choosing a method/machinery to implement C4 and C5 above, such that ripped soils are not compacted through efforts to appropriately shape the disturbed sites.	No topsoil replacement on compacted soil horizons.	Project Manager	Ongoing
C9	Access to rehabilitated areas should be restricted to vehicles/machinery specifically required for the implementation of the closure plan.	No unauthorised access.	Project Manager	Ongoing
D	**Soil and Vegetation replacement**			
D1	A topsoil/gravel mixture should be replaced over all rehabilitated area. Where topsoil is insufficient, subsoil must be treated in accordance with the specification of a soil specialist.	Replacement of fertile topsoil.	Environmental Scientist	Ongoing
D2	Topsoil should be screened, as necessary, to remove any foreign objects, rocks, etc., prior to the replacement thereof.	Replacement of topsoil that is fit for purpose.	Project Manager	Ongoing
D3	Any areas with slope ≥ 3° should be inspected weekly for signs of topsoil erosion following the replacement thereof, and appropriate action taken to curb any problematic areas.	No evidence of significant alteration.	Project Manager	Ongoing
D4	Self-succession should be encouraged. One rainy season will be allowed for self-succession to take place.	Successful vegetation establishment	Ecologist	Ongoing inspections.
D5	If a reasonable assessment indicates that the re-establishment of vegetation is unacceptable slow, the soil need to be analysed and any deleterious effects must be corrected and the area be seeded with a seed mix to specification. Should self-succession of vegetation not take place, the mine will implement a vegetation strategy to establish vegetation on these disturbed areas. Appropriate erosion control measures (i.e. contour banks) must be taken where required.	Successful vegetation establishment	Ecologist	Ongoing inspections.
D6	No grazing on rehabilitated areas is to occur within three years of reseeding completion.	Documentation of rehabilitation process.	Project Manager	Three years from re-seeding.
E	**Disposal of Material**			
E1	Waste will be classified in terms of the NEM:WA to determine the required waste disposal strategies.	Classification of waste in terms of the NEM:WA	Environmental Specialist	Prior to the commencement of closure planning and implementation.

	Requirement	Target	Responsible Person	Timeframes
E2	Rubble will be disposed of at a suitable site which will be rehabilitated once it serves its purpose. As per the 2009 EMP, the objective was made that the rubble shall be dumped in the waste landfill site on the mine with approval by the relevant authorities. This activity should also comply with the relevant NEM:WA requirements	Safe disposal certificates.	Environmental Department	Ongoing
E3	All types of waste shall be removed entirely from the area and appropriately dealt with in respect of the general waste handling procedure	Safe disposal certificates.	Environmental Department	Ongoing
E4	Inert ceramics such as bricks, concrete, gravel etc. will be used as backfill or disposed of in a permitted waste disposal site according to the approved EMP, 2009	Disposal of waste in terms of the NEM:WA.	Environmental Department	Ongoing
E5	Inert waste, which is more than 1m underground, such as pipes will be left in place	Disposal of waste in terms of the NEM:WA.	Environmental Department	Ongoing
E6	Inert ceramic and buried waste with a salvage value to individuals such as scrap metal, building materials, etc. will be removed and disposed of at a proper facility	Disposal of waste in terms of the NEM:WA.	Environmental Department	Ongoing
F	**Ongoing monitoring and maintenance**			
F1	All rehabilitated areas will be fenced off up until the area is regarded as stable	No unauthorised access.	Project Manager	Ongoing
F2	All illegal invader plants and weeds shall be dealt with as required in terms of the relevant legislation	No establishment of weeds or invasive species.	Environmental Scientist	Ongoing inspections.
F3	External, independent, 'Mine Rehabilitation' compliance audits must be undertaken by a competent auditor for all areas where rehabilitation is being implemented at the mine at least quarterly. Audit to at least document compliance with this plan, as well as any other relevant provisions of the EMP revision approval by the DMR.	Compliance with closure plan	External Auditor	Quarterly
F4	The mine should undertake monthly internal compliance audits for all areas where rehabilitation is being implemented at the Mine.	Compliance with closure plan	Environmental Department	Monthly
F5	Monitoring and maintenance of all natural physical, chemical and biological processes for which a closure condition has been specified must be monitored for three (3) years after closure or as long as required by the relevant authorities. Such processes include erosion of the rehabilitated surfaces, surface water drainage, air quality, surface water quality, groundwater quality, vegetative re-growth, weed encroachment and colonisation by animals	Compliance with closure plan with at least 90% sustainable establishment of vegetation.	Environmental Department	Ongoing
	Specific Infrastructure Requirements			
G	**Product Stockpiles**			
G1	All material will be removed from the footprint area: • Where possible the product will be sold; • If the product cannot be sold, the material will be backfilled into the past opencast voids.	Optimal use of economically viable resources.	Mine Manager and Geologist.	Ongoing
G2	General Surface rehabilitation in terms of Part C and Part D will be implemented.	Successful implementation of General Rehabilitation Requirements.	Environmental Department	Ongoing
H	**Mine Residue Stockpiles**			
H1	Where possible Mine Residue Stockpiles, as indicated in the approved EMP will be reworked.	Optimal use of economically viable resources. Implementation of the waste reduction hierarchy.	Project Manager, Environmental Department.	Ongoing
H2	The slopes of the waste rock dumps will be shaped to be stable and that the structure blends into the surrounding environment. An overall gradient of 16 degrees should be achieved for the mine residue and waste rock dumps to an overall gradient of 16o and the associated gradient between benches of degrees. Slope modification will be achieved by means of either shaping existing waste rock dumps to predetermined side slopes and associated bench configurations or adding waste rock shells with the required outer slopes and associated	Ultimate compliance to the final land use requirements - free draining suitable for grazing land (The properties adjacent to Beeshoek Iron Ore Mine have a very low grazing capacity (3ha per sheep and goat unit).	Project Manager, Civil Engineer	Ongoing, at least 2 years after final deposition of waste on site.

	Requirement	Target	Responsible Person	Timeframes
	benches onto existing waste rock dumps with waste material as it is produced.			
H3	Engineering design drawings for shaping and closure of the Mine Residue facilities, as developed by a competent civil engineer, must be submitted to the DWS and DMR for written approval prior to commencing with the closure thereof.	Ultimate compliance to the final land use requirements	Project Manager, Civil Engineer	Once-Off
H4	Clean and dirty water systems will be implemented to remain as long terms structures to ensure that the area is free draining as far as practically possible	Free draining environment	Hydrologist/Engineer	Prior to commencement of rehabilitation.
H5	Terraces and berms will be implemented to encourage the self-succession of vegetation and the reduced potential for erosion	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
H6	Should self-succession not establish the mine will cover the remaining waste rock dumps with the necessary topsoil and subsoil mixture, with the associated seedbed	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
H7	The re-vegetation process will be monitored and encouraged until the area is regarded as stable	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
H8	The waste rock dump will be fenced off until the vegetation is stable and the rehabilitation is regarded to be finalised	No unauthorised access.	Project Manager	Ongoing
I	**Slimes Dam**			
I1	The slopes of the slimes dams will be shaped to be stable and that the structure blends into the surrounding environment	Ultimate compliance to the final land use requirements - free draining suitable for grazing land (The properties adjacent to Beeshoek Iron Ore Mine have a very low grazing capacity (3ha per sheep and goat unit).	Project Manager, Civil Engineer	Ongoing, at least 2 years after final deposition of waste on site.
I2	Clean and dirty water systems will be implemented to remain as long terms structures to ensure that the area is free draining as far as practically possible	No evidence of significant alteration.	Project Manager	Ongoing
I3	Terraces and berms will be implemented to encourage the self-succession of vegetation and the reduced potential for erosion	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
I4	Should self-succession not establish the mine will cover the remaining waste rock dumps with the necessary topsoil and subsoil mixture, with the associated seedbed	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
I5	The re-vegetation process will be monitored and encouraged until the area is regarded as stable	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
I6	The dam will be fenced off until the vegetation is stable and the rehabilitation is regarded to be finalised	No unauthorised access.	Project Manager	Ongoing
J	**Opencast Pits and Detrital Mining Areas**			
J1	The opencast pits will be backfilled as part of the operational phase. The aim and objective of the final land use will be to limit any open voids. However, should it be found that opencast pit voids remain at the end of the mining operations, the following points will be initiated.	Ultimate compliance to the final land use requirements - free draining suitable for grazing land (The properties adjacent to Beeshoek Iron Ore Mine have a very low grazing capacity (3ha per sheep and goat unit).	Project Manager, Civil Engineer	Ongoing, at least 2 years after final deposition of waste on site.
J2	The area will be made safe by the establishment of enviro-berms around the perimeter of the remaining voids in order to make the area safe and limit access	No unauthorised access.	Project Manager	Ongoing
J3	The enviro-berms will be covered with indigenous thorny vegetation	No unauthorised access.	Project Manager	Ongoing

	Requirement	Target	Responsible Person	Timeframes
J4	The outside slopes will be landscaped to be free draining	Ultimate compliance to the final land use requirements	Project Manager, Civil Engineer	Ongoing
J5	The surrounding topography of the area will be designed in such a manner as to allow storm water to run around the facility.	Free draining environment	Hydrologist/Engineer	Prior to commencement of rehabilitation.
J6	The topsoil and subsoils with the appropriate seedbed as stripped during the construction and operational phases will be placed over these areas to a depth as specified by a qualified specialist. The topsoil shall be appropriately ameliorated to allow vegetation to grow rapidly if required – it should be noted that the mine will encourage self-succession of vegetation, if this does not take place effectively a revegetation project will be implemented	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
J7	If a reasonable assessment indicates that the re-establishment of vegetation is unacceptable slow, the soil need to be analysed and any deleterious effects must be corrected and the area be seeded with a seed mix to specification	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
J8	Appropriate erosion control measures (i.e. contour banks) must be taken where required	Slope stability and effective plant establishment with no signs of erosion.	Project Manager, Environmental Department.	Ongoing
J9	All rehabilitated areas will be fenced off up until the area is regarded as stable	No unauthorised access.	Project Manager	Ongoing
J10	All illegal invader plants and weeds shall be dealt with as required in terms of the relevant legislation	No establishment of weeds or invasive species.	Environmental Scientist	Ongoing inspections.
K	**Clean and dirty water systems**			
K1	Clean and dirty water systems will be implemented to remain as long terms structures to ensure that the area is free draining as far as practically possible	Protection of water integrity.	Project Manager	Ongoing
	The soils and sediment, contained in the dams, must be made subject to a hydrocarbon contamination screening and waste classification exercise undertaken by a suitably qualified, independent, professional.	Documented proof of contamination assessments on record. Compliance with any further recommendations from appointed specialist prior to further rehabilitation of contaminated site(s).	Project Manager	Ongoing
K2	Silt and sediment contained in these facilities should be disposed of onto the licensed Slimes Dam if classification proves allowed. If the material is regarded as hazardous with a contamination potential, lawful disposal of such material should be undertaken at a licensed facility.	Lawful disposal of waste.	Project Manager	Ongoing
K3	Proceed with general surface rehabilitation Part B-F.	Successful implementation of General Rehabilitation Requirements.	Environmental Department	Ongoing
L	**General Landfill**			
L1	The landfill on site should be backfilled during the life of mine. If space remains, then inert waste from demolition must be used to backfill the landfill to the height of the surrounding land profile.	Free draining environment	Hydrologist/Engineer	Prior to commencement of rehabilitation.
L2	The natural recharge over the landfill site should be reduced by the compaction of the area and vegetation of the site.	Free draining environment	Hydrologist/Engineer	Prior to commencement of rehabilitation.
	A storm water management system will be designed and implemented around the facility to reduce runoff over this system.	Reduce recharge.	Civil Engineer.	Prior to the commencement of closure planning and implementation.
L3	Engineering design drawings for capping and closure of the aforementioned facilities, as developed by a competent civil engineer, must be submitted to the DWS and DMR for written approval prior to commencing with the closure thereof.	Ultimate compliance to the final land use requirements	Project Manager, Civil Engineer	Once-Off

5.4.1.2 Mine Residue *Deposits*

Mine residue deposits i.e. Slimes Dam, present potential point sources of groundwater pollution and continued visual intrusion following closure of a mine. These facilities will, unless otherwise recovered, remain on surface at mine closure and require specific actions at closure, or concurrent to operation, to mitigate the potential long-term impacts thereof on groundwater quality (if determined by a groundwater investigation) and the visual and aesthetic character of the landscape. It should be noted that the Mine Residue Deposits have been classified as Type 3 waste. Based on the study undertaken during 2015/2016, these facilities should not have a significant impact on the groundwater resources. However, the required mitigation at closure will differ from the greater closure and rehabilitation provisions for general surface rehabilitation. These facilities will also need to be effectively fenced-off from the remainder of the site in order to prevent any potential injury, or loss of life, that could result through indiscriminate access thereto until final closure status is achieved. The unique closure and rehabilitation of such facilities is discussed in Table 9.

5.4.1.3 Opencast Voids

The opencast pits at Beeshoek will be backfilled as part of the ongoing rehabilitation practices throughout the operational phase as per to the approved WUL. However, due to the removal of material and processing of material, voids may remain at the end of life of mine. Where such voids remain, the closure requirements will differ from the greater closure and rehabilitation provisions for general surface rehabilitation. These facilities will also need to be effectively fenced-off from the remainder of the site in order to prevent any potential injury, or loss of life, that could result through indiscriminate access thereto until final closure status is achieved. The unique closure and rehabilitation of such facilities is discussed in Table 9.

5.4.1.4 *Clean and Dirty Water* Systems

In order to protect the integrity of soil resource, and avoid potential pollution, the clean and dirty water systems will remain until successful closure. The material contained in these facilities may have contamination pollution and will require specific rehabilitation requirements as discuss in Table 9.

5.4.1.5 *General* Landfill

The general landfill site at Beeshoek is used for the disposal of general and garden waste. No hazardous waste is allowed to be disposed of at this facility. Although the facility is not considered as a significant contribution to potential contaminate, the unique closure and rehabilitation of such facilities is discussed in Table 9.

5.5 Details of the assessment process used to identify and quantify the Residual Risk

In order to determine whether any potential latent impacts are present, the available EMPs, WULs and specialist studies were assessed.

Table 10: Environmental Reports Considered

Licence Reference	Date
Landfill Site: Permit 12/9/11/P4	30 October 2008
IVU.07.160	July 2009
NC30/5/1/2/3/2/1/223EM	7 June 2010
Road Deviation NEMA Permit 17/2011 Ref No: NC/SIY/TSA/BEESHOEK1/10/2010	3 May 2011
BF Waste Rock Dump Expansion EMPr	September 2013
Village Haul Road EMPr	November 2014
BF Waste Rock Dump Expansion NEMA Permit 12/2014 Ref No: NC/BA/11/SIY/TSH/POS/ASS/2013	7 March 2014
Village WRD Haul Road NEMA Authorisation Permit 20/2015 Ref: NC/BA/28/ZFM/TSA/POS3/2014	3 June 2015
Storm Water Dam North EMPr	20 June 2016
Storm Water Dam North Environmental Authorisation: Reference NC 30/5/1/2/3/2/1 (223) MR	10 March 2017

Licence Reference	Date
WUL Ref: 10/D73A/ABGJ/2592	21 August 2018
Contamination Assessment at Beeshoek in terms of Nitrate, Barium and Manganese as Contaminants.(GPT)	May 2019
Baseline Risk Assessment of Waste Facilities (GPT)	August 2019
Deep Dolomitic Study (SRK)	May 2020
Hydrogeological Impact Assessment	January 2021
Biodiversity Assessment as part of the EIA and Authorisation Process for the proposed expansion and upgrade for activities. (SAS)	April 2021
Soil, Land Use, Land Capability and Agricultural Potential Assessment (SAS)	April 2021
Freshwater Ecological Assessment (SAS)	April 2021

It should be noted that this project and the closure assessment only make provision for the on-site activities within the mining rights area, and not those undertaken as part of the Corporate Sustainable Investment (CSI) projects, located in Kuruman and the surrounding areas.

Additional resources considered to determine whether residual risks or latent risks, previously not identified, would result as part of the mining operations, even with the implementation of the closure measures as stipulated in the EMPs, are the latest Numerical Model, 2021, as well as the latest IWWMP, 2020, and the Deep Dolomitic Study, 2020.

5.6 Risk Assessment Methodology

The Risk Assessment is the overall process of risk identification, risk analysis and risk evaluation. A baseline risk assessment was completed as part of the financial provision update.

The following methodology was adopted in this process:

- A general discussion of potential hazardous and "drying forces which was then used to determine the potential "things that could go wrong" during mine closure;
- The boundaries of the project were defined to the current site infrastructure;
- For each of the areas, the following was identified;
- Potential unwanted events were identified;
- Current controls for each unwanted event;
- The severity/significance should the event occure, as well as the probability of it occurring;
- Based on this the level of risk was estimated;
- For the high and extremely intolerable events additional management measures were recommended to reduce the level of risk.

Table 11: Risk Levels

Colour	Descriptor	Action	Sign-Off
	Extremely Intolerable	Immediate Action	General Manager
	Highly Intolerable	Short term action required	Senior Management
	ALARP (As low as reasonably predictable)	Heightened Action	Section Manager
	Maintain	Ensure levels of control	Supervisor

The six risk types have been outlined and included in the risk matrix. There are in order of priority:

- Norms and Standards;
- Effect on Work Image (Reputation);
- Effect on Environment;
- Effect on Social and Ecosystem processes;
- Public Reaction; and
- Legal Implications.

A qualitative Severity and Likelihood Matrix was used during the risk estimation as shown in the following table.

The severity and likelihood definitions are provided in this table. Once the severity and likelihood of the unwanted events had been rated, the risk rank was determined using the risk matrix. The matrix is not a simple multiplication tool, risk rank is skewed sot that the emphasis is placed on the high severity events, rather than on high likelihood events.

5.7 Risk Indicator Drivers

Indicators, which are most sensitive to potential risk, are defined during the EIA phases associated with the development of projects. These EIAs focus on aspects within the biophysical and social spheres.

Based on the information in the EMPs, all potential drivers of risks can be mitigated as part of concurrent, as well as ongoing mitigation. Where risks remain, these can be mitigated as part of the Closure Plan – such as revegetation and the monitoring of vegetation establishment for a period of 3 years post-closure.

Based on the approved EMPs, no residual impacts of significance are listed. However, in order to ensure that the outcomes of the EMPs remain consistent with the initial studies, this report also considered the following:

- Latest Deep Dolomitic Study;
- Latest Waste Classification Outcomes;
- Latest IWWMP Outcomes; and
- Latest Groundwater Monitoring Outcomes.

The following studies were considered to determine what potential risk indicator drivers are present on site:

5.7.1 EMP Specific Risk Identification

Rehabilitation activities identified have been undertaken based on the following:

- Meeting the conditions of the approved Environmental Authorisations, Water Use Licences, as well as Waste Management Licences.

In this case it is important that the closure management conditions of the approvals on site is similar, as all Environmental and Water Processes are undertaken in parallel with the same specialist supporting documentation. The current Water Use Licence focusses on the operational management of activities. The WUL specifically requires that the mine shall make full financial provision for all investigations, designs, construction, operation and maintenance for water treatment plant should it become a requirement as a long term water management strategy – for this latter reason, ongoing numerical models are undertaken. To date no such need has arisen.

The compilation of the various EMPrs and WULS were undertaken using a quantitative risk assessment approach. None of the approved documents, which also included multi-disciplinary specialist studies, undertaken have identified any long term or residual risks for consideration in the Closure Plans.

However, considering the above, typical risks unknown could be the reaction of stakeholders once closure is planned. Specifically in employee income and future as well as the confirmation and agreement of final land use opportunities.

5.7.2 Mine Residue Deposit Legal Risk

The transitional arrangements of the NEMA Regulations for the planning and management of Residue Deposits and Residue Stockpiles are very important. Under the transitional arrangements it is stated that an EMP approved in terms of the MPRDA shall be deemed to have been approved and issued in terms of the NEM:WA. The Minister may however direct any holder of a mining right if he or she is of the opinion that the residue stockpile or residue deposit in question is likely to result in significant pollution, degradation or damage to the environment, to take such action to upgrade the EMP to address any deficiency in the EMP. A further very important component of the

transitional arrangements is the fact that under Section 6 it is stated that an EMP submitted in terms of the MPRDA and which is pending when this Notice take effect (8 December 2014), must despite the repeal of the MPRDA, be dispensed with in terms of the MPRDA. The aforementioned statement will then again give effect to the transitional arrangement stating that an EMP approved in terms of the MPRDA shall be deemed to have been approved and issued in terms of the NEM:WA. At the present time the legal status of the Mine Residue Deposits is considered a potential operational risk to the mine, purely based on proper delineation on design specifications. The mine has initiated a process of assessing each of the facilities based on the required design parameters. For this reason, these areas are not considered residual or latent risks, which requires quantification and costing beyond closure.

5.7.3 Rehabilitation Material Availability

The assumption has been made that vegetation growth is possible without having to apply a layer of topsoil. The closure valuation allows for self-succession without the addition of topsoil. The EMPs allow for a revegetation project should self-succession of vegetation not be successful. This will be done through the addition of a topsoil/ subsoil mixture with associated seed bank, and if re-establishment of vegetation using this method is found to be unacceptably slow, soil analysis and amelioration will be undertaken and the area be seeded with a seed mix to specification.

5.7.4 Waste Classification Outcomes in terms of Pollution Potential

The following section provides a systematic presentation of the steps followed by the mine to determine whether the Mine Residue Deposits on site have any potential latent or residual risk:

5.7.4.1 Initial Assessments (2015/2016)

During 2015 and 2016, Waste Classification was undertaken on 20 samples from Beeshoek. The aim of the tests was to classify the material in terms of the waste classification guidelines set by the Department of Environmental Affairs (DEA) and published in the Government Gazette during August 2013. The guidelines which gave effect to this study were:

- GN R. 634 (GN634) of NEM:WA: Waste Classification and Management Regulations;
- GN R. 635 (GN635) of NEM:WA: National Norms and Standards for the Assessment of Waste for Landfill Disposal; and
- GN R. 636 (GN636) of NEM:WA: National Norms and Standards for Disposal of Waste to Landfill.

The sample material was submitted to SGS in Johannesburg South Africa, which is a South African National Accreditation System (SANAS) accredited laboratory, for the analyses. Tests the samples were subjected to include:

- Total Concentration (TC); and
- Leachable Concentration (LC).

<u>Total concentration test results</u>

The test results for the TC show that hexavalent chromium (Slimes Dam, contaminated dump, West Pit and Village waste material), barium (all sampled waste material), copper (BN, West and East waste material), manganese (all waste material except BIS, West and Village waste material), vanadium (Historic waste material) and lead (Discard, HL, Slimes, BN, Historic, Contaminated dump, BIS, TITR and East Pit waste material) exceed the TCT0 guidelines in some of the samples. Arsenic exceed the TCT0 guidelines in all the samples. All the samples comply with the TCT1 guidelines.

It should be noted that all elements that exceed the TCT0 guideline values still comply with the TCT1 guideline values.

Discussion of leach test analysis results as part of the 2015 study

There are a number of facilities where leachate from the facility towards the aquifers would not cause the groundwater quality to deteriorate to a level where it does not comply with the LCT0 guideline values (assuming that the barium concentration in the natural groundwater complies with the LCT0 guidelines in the first place – no information on this is available). These include:

- Contaminated Dump;
- BIS;
- West Pit WRD; and
- Village Pit WRD.

There are several facilities where the LC exceeds the LCT0 guideline values only slightly. It would be reasonable to assume that dilution with groundwater in the underlying and surrounding aquifers will reduce the LC to below the LCT0 guideline value, again assuming that the barium concentration in the natural groundwater complies with the LCT0 guidelines in the first place – no information on this is available. These include:

- Discard (Barium concentration of 0.755mg/L compared to LCT0 guideline of 0.7mg/L);
- Old Slimes Dam (Barium concentration of 0.82mg/L compared to LCT0 guideline of 0.7mg/L);
- North Pit detrital (TITR) (Barium concentration of 0.78mg/L compared to LCT0 guideline of 0.7mg/L);
- East Pit (Barium concentration of 0.77mg/L compared to LCT0 guideline of 0.7mg/L); and
- HL Dump (Manganese concentration of 0.57mg/L compared to LCT0 guideline of 0.5mg/L).

Facilities where additional studies must be performed to determine whether dilution of the leachate with groundwater will yield a combined groundwater quality compliant with LCT0 are:

- Slimes Dam;
- BN WRD; and
- Historic Dump A.

These additional studies to be done would include:

- Determining the natural groundwater quality in the area in terms of barium and manganese concentrations (study was subsequently completed in 2019); and
- Possibly a basic groundwater contaminant model to determine the cumulative impact of leachate from the facilities on the underlying and surrounding aquifers should the natural barium and manganese concentrations in the groundwater be below LCT0 guideline values (study was subsequently completed in 2019).

Waste classification based on TC and LC test analyses

Based on the test results, the material from all the different sites is classified as Type 3 Waste following the GN635 classification system.

This classification is mostly based on the results of the total concentration testing results where there are several elements that exceed the TCT0 guidelines for all the samples. There are several facilities which will not be impacted, or may not be impacted when taking into consideration dilution with natural groundwater based on the leach concentration results.

5.7.4.2 Waste Classification Clarification Study, 2017

A Waste Characterization and Groundwater Monitoring Network Audit was undertaken by GPT, April 2017, following the 2015 study.

Based on the study, groundwater quality analysis, solid waste analyses and liquid waste analyses, it was deduced that the chemical signatures of the three (3) mediums (leach, groundwater and waste rock) are quite similar.

Additionally, it was found that the constituents found to exceed the relevant screening levels for each of the three mediums are also similar. Also, most of the sources are located within the dewatered area, directing any contaminants towards the active mining areas.

The 2017 study concluded that groundwater monitoring in terms of chemistry is not recommended for expansion as the effects of sources on the groundwater environment are likely to be negligible and are unlikely to be observed in samples as the chemical signatures of the different mediums are so similar.

The report also stated the following: "The available hydrogeochemical data (incl. solid waste, liquid waste and groundwater) were analysed using IBM.s SPSS v. 20. The corresponding chemical constituents between each of the samples were defined as chemical fingerprints, which could be correlated and cross-correlated with each other in an attempt to identify the similarities between the waste samples and background water quality. All the chemical compositions of the solid waste and liquid waste samples show a significant correlation (á = 0.01 or 0.05) with that of at least one background groundwater sample. This illustrates that contamination from these sources is likely to have the same geochemical signature as the local groundwater. This shows that contamination to the aquifer from the identified sources is unlikely."

5.7.4.3 Follow up risk study, 2019

A Contamination Assessment was undertaken at the mine in terms of Nitrate, Barium and Manganese as Contaminants of Concern. This arose from the 2015/2016 Waste Classification Study, and the request for further studies became a key condition in the WUL, Annexure IV, Condition 3.18.

The study found that:

- A cone of depression has developed within the active mining area with flow directed towards the mining excavation due to mine dewatering (this was also found in the 2016 Numerical Model undertaken by GPT- Updated Numerical Modelling of the predicted groundwater drawdown resulting from mining of the Village Pit of the Beeshoek Mine, June 2016).
- None of the targeted constituents exceed the prescribed 2018 WUL limits.
- Nitrate as N concentrations exceed the SANS241-1:2015 standard limit in, BN Pit, WG74 and WG34.
- Barium (Ba) and Manganese (Mn) concentrations are within SANS 241-1:2015 recommended limits in all samples.
- All samples have a Ca^{2+}/Mg^{2+}-HCO_3^- hydrochemical signature typical of unpolluted groundwater enriched in Calcium (Ca) and Magnesium (Mg) due to the presence of dolomite [$CaMg(CO_3)_2$] in the area which can influence the carbonate concentration in the groundwater by dissolution.
- The $\delta_{18}O$ and δ_2H analytical results of all samples were plotted on a δ_2H vs $\delta_{18}O$ chart relative to the Global Meteoric Water Line (GMWL). The samples deviate from the GMWL due to depletion in isotopes. Depletion in $\delta_{18}O$ and δ_2H are indicative of evaporation losses in the pit water (BN Pit) and recharge following evaporation and mixing in groundwater.
- The $\delta_{15}N$ (from NO_3) and $\delta_{18}O$ values for all samples were plotted against each other on a Kendall plot. The isotopic signatures of the samples are typical of NO_3 values derived from a mixture of soil, agricultural, and , and septic waste sources, with contribution from N-based explosives in the mining area.
- The use of N-based explosives for mine blasting is likely to contribute to elevated nitrate levels in groundwater as most explosives contain between 70 . 90% ammonium nitrate. Nitrates are highly soluble in water. The occurrence of nitrate in groundwater and the pit water indicates that nitrate is naturally occurring (outside of the mining area) with contribution from N-based explosives in the mining area.
- Nitrate occurrence may be attributed to nitrogen cycling in the environment and the use of N-based explosives (for mine blasting). This study indicates that the nitrate circulation in water is complicated involving multiple sources and the occurrence of nitrate is natural with contribution from mining-related blasting using N-based explosives.
- In the mining environment, the leaching of blasting residue from waste rock, tailings and mine water impoundment are also potential sources of nitrate in groundwater. The contribution of N-based-explosives to nitrate concentration in groundwater is negligible compared to background values.

- Based on the scope and findings of this investigation within the mining area and immediate surroundings, Ba and Mn were not regarded as contaminants of concern in groundwater.

The conclusion of the study stated that due to the limited contribution of explosives regarding elevated nitrate concentration (less than 1mg/l), as well as the fact that groundwater flow eventually ends up in the dewatered zone, no active remediation is required. As part of the groundwater management plan, focus should be on the management of the water balance of the mine to ensure minimal infiltration of surface water enriched in nitrates. The conclusion again, was that no residual or latent groundwater pollution risk was identified on site.

5.7.4.4 Risk to Water Quality

Based on the outcomes of the studies stipulated in the preceding section, no impact on groundwater is foreseen from the mining activities as determined by various specialist studies described hereafter. The groundwater system is therefore well placed to provide potable and process water for the mining operations. No water treatment or additional groundwater management is required.

5.7.5 Opencast Dewatering Impacts

The following is abstracted from the GPT, 2021 Numerical Model. Mining in this area has been ongoing for many decades, and there are historical impacts on the surrounding aquifer which are impractical to simulate in a numerical model. Thus, current groundwater levels (obtained from various sources) have been used as baseline for this impact assessment, and all dewatering impacts related to the current water levels as a starting point. Considering the impact associated with each mining pit, the following observations were made:

- The area to the south of the mining rights area is characterised by deep groundwater levels (>100 m) associated with large-scale dewatering at the neighbouring Kolomela Mine.
- No drawdown is expected for further mining at East Pit as the declining groundwater levels is predicted to be below the bottom of mining.
- Drawdown at Village pit is predicted to extent to up to 2km from the pit in a mostly westerly direction, for an insignificant drawdown of 5 – 10 metres. Areas of significant drawdown is expected only in in the immediate vicinity of the pit, which could even decline with time as Leeuwfontein mining impacts northward into this area.
- HF Pit is predicted to have a minor impact limited to the immediate surroundings of the pit itself.
- The BN Pit is predicted to have the largest area of impact due to substantial increase in mining depth. Drawdown of groundwater levels will be up to about 100 m but limited to an area of about 1 km around the pit. This is mainly due to different hydraulic characteristics in the area around the pit.
- No groundwater-related impacts are expected on surface water resources.

After closure and cessation of dewatering/groundwater abstraction, the water table will rise in the mine to reinstate equilibrium with the surrounding groundwater systems. The rebound period also depends on regional activity as large-scale dewatering is occurring at the neighbouring mines as well. Following the closure of the opencasts and the cessation of the dewatering it is assumed to lead to groundwater rebound and potential decanting. However, due to naturally deep-lying groundwater levels, no decant is predicted.

The rise of solute concentrations in groundwater is expected to occur slowly in a south to south-westerly direction, at about 100 metres per year. No adverse effects are predicted on receptor boreholes with regards to increasing solute concentrations in groundwater.

5.7.6 Sinkhole Development

SRK Consulting (SRK) was appointed by the mine to conduct a deep dolomite study. The Ghaap Plateau dolomite formations occur at depth and into the north east of the mine property where it outcrops in the Maremane Anticline.

The dolomite formation in general and the Ghaap dolomites in the case in particular, are a primary aquifer and an important groundwater reserve especially in the arid western regions of South Arica where the mine is located. The effects of groundwater abstraction on the stability of karst terrane (or dolomite) are well documented. SANS 1936 provides standards for development on dolomite ground where dolomite formations occur within 100m of surface. In these instances, a dolomite stability assessment is required to be conducted to assess the probability of dolomite hazards affecting surface infrastructure and casing risks to the public, personnel, or property of affected parties.

The SRK study focused on the following:

- Exposed karst cave in the vicinity to the BN pit – I 2016 a large cavity manifested in a pit adjacent to the BN pit in the mining area north of the property;
- Current operational and disused pits – the variable depth to bedrock is evidence where pinnacles of dolomite as exposed in the pit face showing recent infill between successive pinnacles;
- Detrital mining area – in the lower lying areas detrital iron ore deposits are blanketed under a horizon of windblown Kalahari sand;
- Subsidence in the south eastern area of the mine property7: A doline was inspected which as occurred in the south eastern area of the site. This area has been fenced off to make it safe and prevent unauthorised entry. The report states that it is probable that this incident is related to groundwater lowering from dewatering from the neighbouring mine.
- The current Slimes Dam in the north of the mine site was inspected at the embankment wall against which supernatant water has ponded on the norther side of the facility.

Surface deformations, both naturally occurring and induced by mining activities, pose as a risk to assets, health and the environment in a karst environment. The mine is underlain by dolomite both near surface and at depth. The buried karst terrane is notorious for the development of subsidences and sinkholes. The Satellite Application Centre of the CSIR has monitored the Beeshoek Mining Rights area and has provided surface deformation reports for the licence areas of interest on 12 and 24 day intervals from August 2017 and June 2019. The reports show the occurrence of the following surface deformation observations as follows:

- 20 August 2017 – southwestern side of the railway line immediately north of the railway bridge -21mm subsidence;
- 18 December 2017 – Village Pit Waste Rock Dump – 8mm subsidence;
- 30 December 2017 – Village Pit Waste Rock Dump – further 130mm subsidence;
- 11 January 2018 – Village Pit Waste Rock Dump – further 42mm subsidence;
- 12 March 2018 – northern main rock dump - 55mm subsidence;
- 16 June 2018 – two zones at crest of eastern pit wall of the BF pit – 22mm and 29mm subsidence respectively;
- 28 June 2018 – north-eastern crest of East Pit – 33mm subsidence;
- 19 November 2018 – further deformation at the south western side of the railway line immediately north of the railway bridge – 18mm subsidence;
- 6 May 2019 – three zones in East Pit Waste Rock Dump – 10mm subsidence;
- 6 May 2019 – Village Pit Waste Rock Dump – further 140mm subsidence;
- 18 May 2019 – 5 zones on the East Pit and Waste Rock Dump – max 22mm subsidence;
- 18 May 2019 – 2 zones in Village Pit Waste Rock Dump – further 136mm subsidence;
- 30 May 2019 – northern basic of the Slimes Dam – 110mm subsidence;
- 30 May 2019 – Village Pit Waste Rock Dump – further <10mm subsidence;
- 11 June 2019 – two zones in the central and southern basin of the Slimes Dam – 28mm subsidence.

A number of the deformation records relate to the rock dumps, and these are unlikely to be dolomite related, but rather consolidation settlement of loosely packed spoil. Deformation associated with pit slope crests are also more likely to be response to stress relief on the pit walls.

The subsidence in the vicinity of the railway line, where subsidence was noted on 20 August 2017 and 19 November 2018 is possibly also attributable to karst terrane dewatering consequences.

The settlements noted in the basin of the Slimes Dam on 30 May 2019 and 11 June 2019 is significant and may indicate localised subsidence in the basin response to water ingress.

5.7.6.1 Dolomite impact on pits

The presence of cavities below the base of Wolhaarkop breccia has been shown to occur on the site. One such large cavern is present as exposed in the BN Pit annex. While this may be a once off occurrence, tis cannot be assumed to be the case with any certainty. The occurrence of this is difficult to predict as they occur within the bedrock at the base of the Wohaarkop chert breccia where solution cavities may be present. Although they are likely to be rare occurrences, the do pose a significant risk to mining activities.

5.7.6.2 Dolomite impact on infrastructure

The impact of dolomite related instability on infrastructure is likely to be the highest risk where dolomite bedrock is shallow or underlies a blanketing layer or layers of unconsolidated soils and deposits. This is particularly relevant where water-bearing services are involved, and the risk of leakage is always possible. Concentrations of surface water such as from stormwater or from unlined impoundments such as tailings storge facilities that are unlined pose a risk.

Infrastructure such as roads, bridges and pipelines will be a risk due to the presence of a blanketing layer of recent soils which overlie buried karst ground at depth. Leaking services and other concertation of water in the vicinity of infrastructure such as stormwater ponding result in water ingress into the ground causing subsurface erosion into receiving cavities in the dolomite bedrock.

A geotechnical investigation of the Beeshoek Slimes embankment wall in a report titled “Beeshoek Iron Ore Mine Tailings Storage Facility – Geotechnical Investigations – SRK Report No. 547755” shows seepage to be occurring through the wall of the embankment. The CSIR InSAR deformation reports show two instances of subsidences within the basin of the Slimes Dam, which is underlain by dolomite at a shallow depth. The relationship between these observations and the risk to stability of the basin and embankments must be established by further investigation.

5.8 Presence of long-term Risks and Ongoing Management Activities

This section presents a repeat of Section 5.4, but is important to illustrate the conclusion of the potential either Residual or Latent Risks identified.

Based on the specialist studies conducted as part of the past Environmental Authorisation Processes, which includes multi-disciplinary specialist studies, as well as subsequent reviews of these studies (such as the Numerical Groundwater Model updates), it is concluded that no quantitative residual risks have been identified. This pertains to the fact that no specific quantitative risk has been identified which can be costed for the purposes of long term management post mine closure -i.e. when all closure measures have been implemented and still specific impacts remain. For example, where decant has been identified as part of a mine’s operational layout and plan, the decant can be quantified, and the treatment options thereof stipulated or where a groundwater pollution plume has been identified as part of a numerical model a specific measures are determined to retract or manage the movement of this plume, such as scavenger boreholes. For the purposes of Beeshoek Mine, no residual risks have been identified.

Latent risks on the other hand are regarded as those risks which are unknown/hidden and for which further studies and/or investigations are required. These are typically associated with ineffective rehabilitation due to premature closure (the risk is present, however management measures are in place throughout the operational phase of the mine to address these), or the loss of employment due to premature closure, or instability due to the underlying strata/geology, such as dolomites (investigations are undertaken on a regular basis to determine where

infrastructure must be place or where risk of subsidence are present and as a result these are incorporated within the mine planning and layout. However, in the event of poor stormwater management or dewatering from other sources, residual to the mine activities, subsidence may occur. This is however a latent risk and not a residual risk – this is a "what if", which must be investigated and understood and incorporated as part of the ongoing layout development of the mine.

Latent Environmental Impacts may be expected for the post-closure scenario, should the recommended operational, ongoing rehabilitation and rehabilitation as part of decommissioning and closure not be successful. This is however unlikely and managed through ongoing studies and investigations. These risks are therefore subjected to further studies as identified in the Beeshoek Residual Risk Report or as part of ongoing incorporation of measures as presented in the Social and Labour Plans. These relates specifically to:

- Stability (due to the presence of the dolomites in the area);
- Management of the impact on the loss of employment once the mine closes; and
- The impacts on premature closure.

Ongoing updates of the groundwater reports and reassessment of the deep dolomitic studies due to the incorporation of conditions listed in these reports may be suitable to better understand the environment and also manage specific areas of concern to manage and/or avoid any potential unknown residual risks.

5.9 Realised Risks

As presented in the preceding sections, no residual risks have been identified at this time of the operational phase at Beeshoek Mine. However, latent risks are present. These are regarded as potential unwanted events for and during mine closure were identified and discussed. Ten unwanted events were identified for the mine.

These unwanted events were ranked for risk based on the maximum reasonable severity should they occur and the likelihood of that specific severity/consequence occurring (please refer to the following table presenting the risk matrix used). This analysis was firstly done assuming that no controls are in place (i.e. the raw latent risk) and secondly considering current controls were in place and effective (i.e. residual risk).

Table 12: Risk Estimation Matrix

Environmental Risk Matrix								Norms and Standards	Effect on Work Image	Effect on Environment	Effect on Social and Ecosystem Processes	Public Reaction	Legal Implication
Severity	A	High Intolerable	High Intolerable	Extremely Intolerable	Extremely Intolerable	Extremely Intolerable	Extremely Intolerable	Consistently outside of the norm or standard	Reputation impacted with majority of key stakeholders.	Irreversible changes to abundance/biomass in affected area. Loss of ecological functioning with little prospect of recovery.	Major, potential for irreversible change to valued flora and fauna, ecosystem processes and structure, including ecosystem services.	Severe national pressure to cease business. Serious public or media outcry (International coverage)	Referral to the National Prosecuting Authority. Potential investigation by authority with prosecution and fines.
	B	ALARP	High Intolerable	High Intolerable	Extremely Intolerable	Extremely Intolerable	Extremely Intolerable	Largely deviating from the norm or standard	Reputation impacted with significant number of key stakeholders	Substantial reduction of abundance/biomass in affected area. Eventual recovery of ecological systems possible, but not necessary to same pre-impact conditions	Major, potential for unacceptable, longer term change to valued flora and fauna, ecosystem processes and structure, including ecosystem services.	Severe local and national public or press reaction.	Withdrawal of permit.
	C	ALARP	ALARP	High Intolerable	High Intolerable	Extremely Intolerable	Extremely Intolerable	Frequent and significant deviate from the norm or standard	Reputation impacted with some stakeholders	Reduction of abundance/biomass in affected area. Limited impact to local biodiversity without significant loss of pre-0impact functioning.	Moderate, potential for unacceptable, short term change to valued flora and fauna, ecosystem processes and structure, including ecosystem Minor local public or media reaction. Services.	Local public or press reaction.	Notification of intent to issue a directive.
	D	Maintain	Maintain	ALARP	ALARP	High Intolerable	High Intolerable	Occasional and minor deviation from the norm or standard	Reputation impacted with small number of people.	Minima reduction f abundance/biomass in affected area. Limited impact to local biodiversity without significant loss of pre-impact functioning.	Moderate, potential for acceptable, longer term change to valued flora and fauna, ecosystem processes and structure, including ecosystem services.	Minor local public or media reaction.	Departmental enquiry and correspondence.
	E	Maintain	Maintain	Maintain	ALARP	ALARP	ALARP	Rare and minimal deviation from the norm or standard	No discernible impact on reputation	Reduction of the abundance/biomass of flora and fauna in affected area. No permanent change to biodiversity or exposed ecological system.	Minor, potential for acceptable, short term change to valued flora and fauna ecosystem processes and structure, including ecosystem services.	Little or no reaction Public concern restricted to local complaints.	Complaints from the public and/or regulator.
	F	Maintain	Maintain	Maintain	Maintain	Maintain	Maintain	Consistently within the norm or standard	No discernible impact on reputation	Possible incidental impacts to flora and fauna in locally affected area. NO ecological consequences.	Minor, potential for incidental and/or transient changes to valued flora and fauna, ecosystem processes and structure, including ecosystem services.	None	No legal implications.
		G	H	I	J	K	L						
		Highly unlikely	Rare	Low likelihood/Unlikely	Probable/Possible	Can happen/Likely	Regular/Almost Certain						
	Percentage (%)	<0.1%	0.1-0.4%	5-14%	15-49%	50-74%	75-100%						
	Description	Practically impossible, not foreseen to occur	Conceivable under exceptional circumstances	Only remotely possible (has	Unusual but possible (can happen)	Quite possible	Is the most likely and expected to happen (has and						

				happened somewhere)			foreseen it to happen again)	
		Once in more than 10 000 years	Once in 1 000 years	Once in 100 years	Once every 10 years	Once every year	More than once a year	

5.9.1 Risk Assessment Results

A discussion on the key potential unwanted environmental risks or results are presented in Section 4.1. For the purpose of the risk assessment the following is assumed:

1. All infrastructure will be removed by the mine – i.e. no built infrastructure will remain;
2. The shaping, ripping and revegetation (self-succession) of the post mining area as costed will be successful and this will be monitored for a period of three (3) years post closure to ensure success and correct areas of concern;
3. Considering successful shaping, ripping and revegetation, no residual impacts are foreseen on any watercourses (i.e. cryptic wetlands or river systems);
4. Opencast pits will be backfilled and where backfilling is not possible, enviroberms will be placed to allow for the safety of the area;
5. The post mining land use will be wilderness, as the land capability studies indicate that successful farming such as livestock commercial farming is marginal due to the low grazing capacity for this area (14 hectares per animal);
6. After closure and cessation of dewatering/groundwater abstraction, the water table will rise in the mine to reinstate equilibrium with the surrounding groundwater systems. The rebound period also depends on regional activity as large-scale dewatering is occurring at the neighbouring mines as well. Following the closure of the opencasts and the cessation of the dewatering it is assumed to lead to groundwater rebound and potential decanting. However, due to naturally deep-lying groundwater levels, no decant is predicted.
7. In terms of a residual impact on groundwater quality, the 2017 and subsequent groundwater studies indicated that contamination to the aquifer from the identified sources (Slimes and Mine Residue Deposits) is unlikely.
8. In terms of a potential failure of the Slimes Dam, no significant risk is likely at this time, as the facility is located within an old quarry. The 2020 Dolomitic study further indicated that the risk of subsidence at the Slimes Dam is based on seep from the facility. With the rehabilitation strategy in place, to cover and shape the facility no further residual risk associated with this facility is anticipated.

Based on the above the current management measures and closure plan proposed and approved in the existing EMPrs should address all potential impacts, with the exception of potential latent risks – i.e. risks which may occur in the future but cannot be reasonably quantified at this stage. These risks are presented below and the necessary control measures are recommended to remediate such risks.

Ten unwanted events were identified. With the implementation of management measures, one (1) of the unwanted events were ranked as highly intolerable, five (5) ranked as ALARP and four (4) as maintain (please refer to the table below).

The risks identified includes:

1. Mine potentially not rehabilitated and closed properly, which could lead to access and security concerns which could lead to establishment of informal settlements. This could also lead to injury or fatalities dur to unauthorised and unrestricted access to mining areas not properly rehabilitated.

2. Mine potentially not rehabilitated and closed properly, which could lead to the occurrence of sinkhole development due to lack of rehabilitation and storm water control around Mine Residue Stockpile slopes and the Slimes Dam.
3. Potential inadequate budget to adequately rehabilitated the environment. This could result in not achieving the final land use plan (rating considering ongoing rehabilitation is currently undertaken).
4. Potential negative effect of future closure on the employees and their future income, which could lead to employees and community income source lost.
5. Potential surface subsidence at opencast pit voids, which could have a negative impact on surface rehabilitation due to the collapse of Opencast Walls – impact on rehabilitation landscape and storm water management.
6. Potential surface subsidence around Mine Residue Slopes. This could have a negative impact no surface rehabilitation due to the collapse of surface infrastructure (MRD) and pooling of surface water – injury to humans and/or animals.
7. Potential surface subsidence on the general environment, resulting in a negative impact on surface rehabilitation due to the collapse of surface infrastructure due to pooling of surface water – injury to humans and/or animals, damage to local infrastructure.
8. Potential dissatisfaction of communities with future land use resulting in protests and disruption of the closure process.
9. Potential unforeseen waste disposal at closure, resulting in unforeseen economic and environmental cost – changes in legislation can also contribute.
10. Potential changes in future legislation. This could include more stringent closure requirements with an unforeseen cost implication.

Table 13: Potential Extremely and Highly Intolerable Risk

Hazard	Consequence(s)	Primary Risk Category	Severity	Likelihood	Raw Risk Rank	Control Measures	Severity	Likelihood	Residual Risk
Mine potentially not rehabilitated and closed properly.	Access and security concerns which could lead to establishment of informal settlements. Injury or fatalities dur to unauthorised and unrestricted access to mining areas not properly rehabilitated.	Health and Safety	A	I	Extremely Intolerable	1. The annual rehabilitation plan should be planned with all departments (Environmental, Engineering and Mining Planning) to ensure that ongoing backfilling and rehabilitation can be implemented on site as part of the operational plan of the mine. Thereby annually having the opportunity to reduce opencast pit voids and historic Mine Residue Deposits and/or disturbed areas (such as on North Mine). 2. The closure management plan to be understood and strictly be followed. 3. The financial provision costing calculated should be available for rehabilitation as stipulated in the	A	H	Highly Intolerable.

Hazard	Consequence(s)	Primary Risk Category	Severity	Likelihood	Raw Risk Rank	Control Measures	Severity	Likelihood	Residual Risk
						Financial Provision Regulations, 2015 (as amended).			
Mine potentially not rehabilitated and closed properly.	Occurrence of sinkhole development due to lack of rehabilitation and storm water control around Mine Residue Stockpile slopes and the Slimes Dam.	Natural Environment	C	J	Highly Intolerable	4. There is evidence that dewatering has had some effect on surface instability on the property. It is recommended that a study be conducted to explore techniques that will aid the identification of potential problem areas. Such techniques include inter alia a geophysical methods such as a gravity survey to identify low gravity anomalies that will aid identifying voids in bedrock. There is a suggestion from a dewatering borehole near the western pit that a similar cavity may exist at depth in this area too. Investigation of known or suspected features will give a good opportunity to test if such geophysical methods will indicate cavernous conditions and can be used in future to identify these ground conditions in advance so that they can be mitigated. The eastern doline can be investigated in a similar fashion to confirm ground conditions that lead to the surface deformation events. 5. In mining of the Manganore Formation, the presence of cavities at the base of the Wolhaarkop Formation can be identified by targeted gravity surveys in future operational area and drilling advance of mining operations. 6. Risks associated with the Slimes Dam from seepage through embankments and seepage through the basin need to be better understood. Investigation by gravity surveying and targeted drilling need to be explored to understand and quantity the risks. 7. The rehabilitation of the Slimes Dam will involve the shaping of this facility to ensure that water does not accumulate	A	H	ALARP

Hazard	Consequence(s)	Primary Risk Category	Severity	Likelihood	Raw Risk Rank	Control Measures	Severity	Likelihood	Residual Risk
						on this facility and also to reduce the recharge through this system. 8. Small scale surface mapping of which areas of the mine site are underlain or have inferred underlying dolomite will be necessary, if there are not already available, to characterise risk. In this instance, wet services, such as water supply and slurry pipelines delivering slimes to the Slimes Dam and storm water accumulation and ponding should be monitored during the operational phase especially where they traverse ground where dolomite bedrock dolomite outcrops or occurs beneath a blanketing horizon of recent soils or deposits.			
Potential inadequate budget to adequately rehabilitated the environment.	Not achieving the final land use plan (rating considering ongoing rehabilitation is currently undertaken).	Legal Implication (financial)	A	K	Extremely Intolerable	Please refer to control measure #3.	D	I	ALARP
Potential negative effect of future closure on the employees and their future income.	Employees and community income source lost	Social Processes	B	J	Extremely Intolerable	9. The Social and Labour Plan is updated annually and the mine will continue in consultation with the municipality, DMRE and communities regarding closure objectives. The Social and Labour Plan legally commits to skills development and also investment in local employment or economic initiatives. For this reason no additional control measure is required.	E	I	Maintain
Potential surface subsidence at opencast pit voids.	Negative impact on surface rehabilitation due to the collapse of Opencast Walls – impact on rehabilitation landscape and storm water management	Natural Environment	C	J	Highly Intolerable	Please refer to control measure # 4 and #5. 10. The main option should remain to conduct ongoing backfilling of voids as part of the operational process. 11. There is a suggestion from a dewatering borehole near the western pit that a similar cavity may exist at depth in this area too. Investigation of	E	J	ALARP

Hazard	Consequence(s)	Primary Risk Category	Severity	Likelihood	Raw Risk Rank	Control Measures	Severity	Likelihood	Residual Risk
						known or suspected features will give a good opportunity to test if such geophysical methods will indicate cavernous conditions and can be used in future to identify these ground conditions in advance so that they can be mitigated. The eastern doline can be investigated in a similar fashion to confirm ground conditions that lead to the surface deformation events.			
Potential surface subsidence around Mine Residue Slopes	Negative impact no surface rehabilitation due to the collapse of surface infrastructure (MRD) and pooling of surface water – injury to humans and/or animals.	Natural Environment	C	J	Highly Intolerable	12. Storm water accumulation and ponding should be monitored especially where they traverse ground where dolomite bedrock dolomite outcrops or occurs beneath a blanketing horizon of recent soils or deposits. This will specifically be managed by the correct engineering design of Mine Residue Deposits and to ensure that no water ponding takes place. Specific low points will be designed in a manner to ensure that water is formally channelled from slopes.	D	H	Maintain
Potential surface subsidence on the general environment.	Negative impact on surface rehabilitation due to the collapse of surface infrastructure due to pooling of surface water – injury to humans and/or animals, damage to local infrastructure.	Social and Ecosystem Processes	C	J	Highly Intolerable	Please refer to control measure # 8 and #12.	C	H	ALARP
Potential dissatisfaction of communities with future land use.	Protests and disruption of the closure process	Social Processes	C	J	Highly Intolerable	Please refer to control measure # 9.	D	J	ALARP
Potential unforeseen waste disposal at closure	Unforeseen economic and environmental cost – changes in legislation can also contribute	National Environment Financial	C	J	Highly Intolerable	13. The financial provision cost estimation is providing for the removal of wastes, bitumen, as well as asbestos. The costing is also making provision for contingencies. For this reason, no additional control measure required is foreseen.	D	H	Maintain

Hazard	Consequence(s)	Primary Risk Category	Severity	Likelihood	Raw Risk Rank	Control Measures	Severity	Likelihood	Residual Risk
Potential changes in future legislation.	Closure requirements more stringent with an unforeseen cost implication	Financial	C	J	Highly Intolerable	14. The mine has an external Legal Advisor who assist in ensuring that the mine considers all current legislation. This is assessed annual through directors liability audits, annual audits and legal audits. 15. The requirement to annually assess the financial provision further assist in mitigating this potential risk. 16. For this reason no further control measure required is foreseen.	E	I	Maintain

For the highest ranked events (highly intolerable and ALARP), additional "controls" should be put in place to reduce the level of risk. Deadlines for ensuring that the additional controls are put in place as well as accountabilities for doing so, should be defined. Recommendations have been included in the table before, and further monitoring recommendations are presented in Section 7.

5.10 Closure Objectives

The following section is obtained from the approved EMP and stipulates the closure objectives for the mine.

5.10.1 Closure Objectives

The main environmental closure objectives as stipulated in the approved EMP can be summarised as follows:

- To ensure an effective surface runoff control system in order to deal with the separation of clean and dirty water environment;
- Rehabilitate areas as soon as possible;
- The sustainable and safe rehabilitation of all activities, in order to address all environmental impacts as far as practical according to the EMP;
- The sustainable rehabilitation of all activities and the mining area as a whole in order to ensure a sustainable endues for the majority of the activity sites/ areas;
- Return of land to its pre-mining state where possible (wilderness land);
- Make all areas safe for both humans and animals;
- Ensure that all areas remaining upon closure are stable, which will prevent dust and water erosion;
- Minimise the impact on the local community;
- Minimise the impact on the surrounding economic environmental and other mining activities;
- Maintenance requirements for rehabilitated activity areas/ sites need to be established and documented within the capability of the subsequent land user;
- Financial provision for post-closure maintenance cost of rehabilitation activity areas/ sites will at all times be appropriate to provide for premature closure in terms of the MPRDA; and
- Final rehabilitation of all infrastructure shall be completed within a period as specified in the appropriate closure document and rehabilitation activities will comply with the specifications as per the appropriate closure document. Should the mine, due to unforeseen circumstances, need to deviate from the Closure Plan, approval from the Department of Minerals and Energy (DME, now the Department of Mineral Resources and Energy - DMRE) and relevant State Departments will be obtained.

5.10.2 Infrastructure Areas (buildings, footprint areas and internal roads)

The rehabilitation of the surface infrastructure will include the following and will be completed within a period as specified in the appropriate closure document:

- Removal of infrastructure
    - Photographs of the infrastructure, before, during and after rehabilitation will be taken at selected fixed points and kept on record for the Manager (Group Environmental Department) and DMR purposes;
    - All fixed assets that can be profitably removed will be removed for salvage or resale (the salvage and resale value have however not been incorporated into the closure cost estimate as per the legislative requirements);
    - All structures will be demolished, terracing removed and foundations demolished to 1m below the original ground level;
    - Dismantle and remove redundant fencing for salvage; and

- Demolish all concrete foundations to 1m below the original ground level.

- Rehabilitation of surfaces previously occupied by infrastructure
  - The areas will be landscaped to be free draining;
  - Where sites have been alienated of vegetation or where soils have been compacted or covered with concrete, these sites will be ripped and ploughed. The topsoil and subsoils with the appropriate seed bank as stripped during the construction and operational phases will be placed over these areas to a depth as specified by a qualified specialist, where required. The topsoil shall be appropriately ameliorated to allow vegetation to grow rapidly if required – it should be noted that the mine will encourage self-succession of vegetation, if this does not take place effectively, a revegetation project will be implemented;
  - If a reasonable assessment indicates that the re-establishment of vegetation is unacceptably slow, the soil needs to be analysed and any deleterious effects must be corrected, and the area be seeded with a seed mix to specification;
  - Appropriate erosion control measures (i.e. contour banks) must be taken where required;
  - All rehabilitated areas will be fenced off until the area is regarded as stable; and
  - All alien and invasive plant species shall be dealt with as required in terms of the relevant legislation.

- Disposal of material
  - Rubble will be disposed of at a suitable site which will be rehabilitated once it serves its purpose. This shall be dumped in the waste landfill site on the mine with approval from the relevant authorities;
  - All types of waste shall be removed entirely from the area and appropriately dealt with in respect of the general waste handling procedure;
  - All foreign matter shall be removed from the site;
  - Inert ceramics such as bricks, concrete, gravel etc. will be used as backfill or disposed of in a permitted waste disposal site;
  - Inert waste, which is located more than 1m underground, such as pipes will be left in place; and
  - Inert ceramic and buried waste with a salvage value to individuals such as scrap metal, building materials, etc. will be removed and disposed of at a proper licensed facility.

5.10.3 Product Stockpile Areas

The following closure objectives are relevant to the product footprint areas at the mine:

- All material will be removed from the footprint area:
  - Where possible the product will be sold; and
  - If the product cannot be sold, the material will be backfilled into the opencast voids.
- The footprint areas will be topsoiled (where required) and ripped;
- One rainy season will be allowed for self-succession to take place
  - If a reasonable assessment indicates that the re-establishment of vegetation is unacceptable slow, the soil needs to be analysed and any deleterious effects must be corrected and the area be seeded with a seed mix to specification;
  - Should self-succession of vegetation not take place, the mine will implement a vegetation strategy to establish vegetation on these disturbed areas; and
  - Appropriate erosion control measures (i.e. contour banks) must be implemented where required.
- All rehabilitated areas will be fenced off until the area is regarded as stable; and
- All alien and invasive plant species and weeds shall be dealt with as required in terms of the relevant legislation.

5.10.4 Waste Rock Dumps (WRDs)

The WRDs present will be rehabilitated:

- The slopes of the WRDs will be shaped to be stable and that the structure blends into the surrounding environment (According to the EMP Alignment the general slope of the waste rock dumps are approximately 40 degrees. – for the Village WRD approval it is stated that at closure the side slopes will have been constructed at an angle of no steeper than 1:3);
- Clean and dirty water systems will be implemented to remain as long terms structures to ensure that the area is free draining as far as practically possible;
- Terraces and berms will be implemented to encourage the self-succession of vegetation and the reduced potential for erosion;
- Should self-succession not establish the mine will cover the remaining WRDs with the necessary topsoil and subsoil mixture, with the associated seed bed;
- The re-vegetation process will be monitored and encouraged until the area is regarded as table; and
- The WRDs will be fenced off until the vegetation is stable and the rehabilitation is regarded to be finalised.

5.10.5 Fine Residue Dump

The following closure objectives are relevant to the fines stockpiles/ dumps, similar to that of the product footprint areas:

- All material will be removed from the footprint area
    - Where possible the product will be sold;
    - If the product cannot be sold, the material will be backfilled into the opencast voids.
- The footprint areas will be topsoiled and ripped;
- One rainy season will be allowed for self-succession to take place
    - If a reasonable assessment indicates that the re-establishment of vegetation is unacceptable slow, the soil needs to be analysed and any deleterious effects must be corrected and the area be seeded with a seed mix to specification;
    - Should self-succession of vegetation not take place, the mine will implement a vegetation strategy to establish vegetation on these disturbed areas
    - Appropriate erosion control measures (i.e. contour banks) must be taken where required;
- All rehabilitated areas will be fenced off up until the area is regarded as stable; and
- All alien and invasive plant species and weeds shall be dealt with as required in terms of the relevant legislation.

5.10.6 Slimes Dams

The slimes dams have no residual environmental impacts associated with it due to the composition of the material deposited on them. There is however management measures that will be included as part of the closure condition:

- The slopes of the slimes dams will be shaped to be stable and that the structure blends into the surrounding environment;
- Clean and dirty water systems will be implemented to remain as long term structures to ensure that the area is free draining as far as practically possible;
- Terraces and berms will be implemented to encourage the self-succession of vegetation and the reduced potential for erosion;
- Should self-succession not establish the mine will cover the remaining slimes dam with the necessary topsoil and subsoil mixture, with the associated seed bank;
- The revegetation process will be monitored and encouraged until the area is regarded as stable; and

- The dams will be fenced off until the vegetation is stable and the rehabilitation is regarded to be finalised.

5.10.7 Opencast Pit Voids

It is the aim of the mine to backfill the opencast pit voids with existing material on site. Should it be found that opencast pit voids remain at the end of the mining operations, the following will be enforced:

- The area will be made safe by the establishment of enviro berms around the perimeter of the remaining voids in order to make the area safe and limit access; and
- The enviro berms will be covered with indigenous thorny vegetation.

Should it be found that there is sufficient material available to backfill the voids completely, the following measures will be implemented:

- The areas will be landscaped to be free draining;
- The topsoil and subsoils with the appropriate seed bank as stripped during the construction and operational phases will be placed over these areas to a depth as specified by a qualified specialist. The topsoil shall be appropriately ameliorated to allow vegetation to grow rapidly if required – it should be noted that the mine will encourage self-succession of vegetation, if this does not take place effectively a revegetation strategy will be developed and implemented;
- If a reasonable assessment indicates that the re-establishment of vegetation is unacceptably slow, the soil needs to be analysed and any deleterious effects must be corrected, and the area be seeded with an indigenous seed mixture to specification;
- Appropriate erosion control measures (i.e. contour banks) must be taken where required;
- All rehabilitated areas will be fenced off until the area is regarded as stable; and
- All alien and invasive plant species and weeds shall be dealt with as required in terms of the relevant legislation.

5.10.8 Water Pollution Control Structures

Water pollution control structures will remain until the completion of all demolition and associated rehabilitation activities where after these will be rehabilitated.

5.10.9 Maintenance

The aim of the maintenance measures is to ensure that the area affected by the mining operations are rehabilitated according to the Closure Plan. The objective is for the area to be rehabilitated sustainability (ensuring self-succession of vegetation and the associated return of natural wildlife, as well as the improvement of the natural watercourses if any).

The following maintenance measures will be implemented as part of the closure and post-closure process:

- All natural physical, chemical and biological processes for which a closure condition has been specified must be monitored for three (3) years after closure or as long as required by the relevant authorities. Such processes include erosion of the rehabilitated surfaces, surface water drainage and quality, surface water quality, groundwater quality, air quality, vegetative regrowth, alien and invasive species encroachment and colonisation by indigenous fauna;
- Measures must be implemented to kerb environmental impacts and to ensure that they do not worsen/ cumulate over time;
- The Closure Plan will be reviewed annually during the life of the mine (closure, operational and decommissioning phases) as per the requirements of the Financial Provision Regulations; and

- All rehabilitated areas will be monitored and maintained until such time as required to enable the mine to apply for closure of these different areas.

6 MONITORING AND PROPOSED CONTROL MEAURES OF RESIDUAL RISKS

The following key risk drivers have been identified to be managed in terms of potential latent risks:

1. Mine potentially not rehabilitated and closed properly, this goes hand in hand with the potential inadequate budget to adequately rehabilitated the environment. This could result in not achieving the final land use plan (rating considering ongoing rehabilitation is currently undertaken).
2. Potential negative effect of future closure on the employees and their future income, which could lead to employees and community income source lost.
3. Management in terms of the Deep Dolomitic Study to manage potential surface
4. Potential dissatisfaction of communities with future land use resulting in protests and disruption of the closure process.
5. Potential unforeseen waste disposal at closure. This also goes hand in hand with potential changes in future legislation.

6.1 General Environmental Management and Control

The following table presents the audit/ monitoring schedule:

Table 14: Monitoring Schedule

Audit	Regulatory Requirement	External Responsibility	Internal Responsibility
MPRDA and NEMA ROD Performance Assessments	Once every year	To be appointed	SHEQ Department (Mr. Msimelelo Silomntu)
NWA Performance Assessment	Once every year	To be appointed	SHEQ Department (Mr. Msimelelo Silomntu)
Closure Cost Assessment	Once every year	To be appointed	SHEQ Department (Mr. Msimelelo Silomntu)
Annual Rehabilitation Plan	Once every year	To be appointed	SHEQ Department (Mr. Msimelelo Silomntu)
NEM:WA Performance Assessment	Once every two years	To be appointed	SHEQ Department (Mr. Msimelelo Silomntu)
Internal Assessment of Annual Plan	Every second month	-	SHEQ Department (Mr. Msimelelo Silomntu)
Annual Update of the Social and Labour Plant	Once every year	-	HR Department

In addition to this, the mine is also undertaking biennial Environmental Legal Compliance and Directors Liability Audits.

The following table presents the reporting requirements:

Table 15: Performance Reporting Requirements

Audit	Regulatory Requirement	Timeframe in which to submit	Regulatory Authority	Comment
MPRDA and NEMA Performance Assessments	Once every year	30 days after finalisation	DMRE	These reports should be presented to Stakeholders during a feedback forum in the event that the findings of the audits detect that the approved measures are no longer suitable to address the
NWA Performance Assessment	Once every year	30 days after finalisation	DWS	

Audit	Regulatory Requirement	Timeframe in which to submit	Regulatory Authority	Comment
Closure Cost Assessment	Once every year	Once audited by external financial auditors	DMRE	activities of the mine and that stakeholders may be negatively impacted as a result. or Upon instruction of the DMR.
Annual Rehabilitation Plan	Once every year	Once audited by external financial auditors	DMRE	
NEM:WA Performance Assessment	Once every two years	30 days after finalisation	DMRE	
Internal Assessment of Annual Plan	Every second month	Upon Departmental Request	DMRE	
Annual Update of the Social and Labour Plant	Once every year	Annually	DMRE	-
Annual Update of the Financial Provision	Once every year	Annually	DMRE	Guarantee to be submitted within two months of the financial auditor report approval.
Annual Legal Audit	N/A	Annual	Internally	The mine has an external Legal Advisor who assist in ensuring that the mine considers all current legislation. This is assessed annual through directors liability audits, annual audits and legal audits.

6.2 Deep Dolomitic Management

The following monitoring and control measures should be implemented:

1. There is evidence that dewatering has had some effect on surface instability on the property. It is recommended that a study be conducted to explore techniques that will aid the identification of potential problem areas. Such techniques include inter alia a geophysical methods such as a gravity survey to identify low gravity anomalies that will aid identifying voids in bedrock. There is a suggestion from a dewatering borehole near the western pit that a similar cavity may exist at depth in this area too. Investigation of known or suspected features will give a good opportunity to test if such geophysical methods will indicate cavernous conditions and can be used in future to identify these ground conditions in advance so that they can be mitigated. The eastern doline can be investigated in a similar fashion to confirm ground conditions that lead to the surface deformation events.
2. In mining of the Manganore Formation, the presence of cavities at the base of the Wolhaarkop Formation can be identified by targeted gravity surveys in future operational area and drilling advance of mining operations. Risks associated with the Slimes Dam from seepage through embankments and seepage through the basin need to be better understood. Investigation by gravity surveying and targeted drilling need to be explored to understand and quantity the risks.
3. The rehabilitation of the Slimes Dam will involve the shaping of this facility to ensure that water does not accumulate on this facility and also to reduce the recharge through this system.
4. Small scale surface mapping of which areas of the mine site are underlain or have inferred underlying dolomite will be necessary, if there are not already available, to characterise risk. In this instance, wet services, such as water supply and slurry pipelines delivering slimes to the Slimes Dam and storm water accumulation and ponding should be monitored during the operational phase especially where they traverse ground where dolomite bedrock dolomite outcrops or occurs beneath a blanketing horizon of recent soils or deposits.
5. The main option should remain to conduct ongoing backfilling of voids as part of the operational process.
6. There is a suggestion from a dewatering borehole near the western pit that a similar cavity may exist at depth in this area too. Investigation of known or suspected features will give a good opportunity to test if

such geophysical methods will indicate cavernous conditions and can be used in future to identify these ground conditions in advance so that they can be mitigated. The eastern doline can be investigated in a similar fashion to confirm ground conditions that lead to the surface deformation events.

7. Sorm water accumulation and ponding should be monitored especially where they traverse ground where dolomite bedrock dolomite outcrops or occurs beneath a blanketing horizon of recent soils or deposits. This will specifically be managed by the correct engineering design of Mine Residue Deposits and to ensure that no water ponding takes place. Specific low points will be designed in a manner to ensure that water is formally channelled from slopes.

The following commitments have been made by the mine for the next financial year:

- Gravimetric Geophysical surveys - Known and/or suspected sub-surface features will be covered by the Geophysical survey currently underway. This will provide a good opportunity to confirm the efficacy of the gravimetric geophysical method to indicate cavernous conditions and reaffirm its continued future use to identify these ground conditions in advance;
- West Pit Exploration drilling;
- Small scale surface mapping of which areas of the mine site are underlain or have inferred underlying dolomite is being undertaken - water accumulation and ponding will also be monitored as part of this procedure.

6.3 Post Closure Monitoring

Post closure monitoring, maintenance and aftercare is scheduled for a period of three (3) years post completion of said rehabilitation, decommissioning and closure actions.

Table 16: Post Closure Monitoring

Item	Monitoring Component	Timeframe
1	Surface Water Quality Monitoring	R 750 000,00
2	Groundwater Quality Monitoring	
3	Air Quality Monitoring ($PM_{2.5}$ & PM_{10})	R 240 000,00
4	Vegetation establishment & Distribution Monitoring	R 120 000,00
5	Land Stability Monitoring	R 343 850,00
6	Dust suppression	R 3 734 611,20
7	Social & Labour Plan Commitments	R 26 000 000,00

7 CLOSURE ENVIRONMENTAL MANAGEMENT PLAN

Please refer to Section 5.3 for the summary of rehabilitation and closure actions.

The monitoring plan as it relates to the realised risks, the legal requirements and knowledge gaps in terms of respective biophysical and social parameters are extensive and is detailed in the individual monitoring sections contained in the EMPs and other licences and permits.

At the end of the active decommissioning stage when infrastructure is removed, earthworks are completed and ecosystems are becoming established, decommissioning moves to a passive care stage for a period of time until it is demonstrated that completion criteria are achieved. The post-decommissioning monitoring programme should be similar to monitoring undertaken during the progressive rehabilitation but geared to focus on those aspects of the site that either relate to a potential on-going pollution hazard or provide an indicator for the success of rehabilitation.

Monitoring in terms of water, air, vegetation and land stability have been included into the final rehabilitation costing.

It is estimated that the final rehabilitation, decommissioning and closure actions, based on the current mine plan, would take approximately two (2) years to implement from date of commencement.

7.1 Rehabilitation Plan Summary

This rehabilitation plan has taken into consideration all possible areas that need to be rehabilitated on the mine site either at closure, or as part of concurrent rehabilitation. The result of rehabilitation should be to return the entire project area to as close to its previous pre-mining state as is possible and practical.

All acceptable options for waste minimisation in terms of recycling and reuse should be considered before final disposal of any waste rock material, product or ROM, building materials, steel structures, electrical equipment or any associated equipment that could be reused, recycled or appropriately scrapped. When considering the latter, the license holder must consider the necessary licensing requirements in terms of the relevant waste legislation.

The rehabilitation plan is a working document and should be reassessed annually as part of the Closure and Rehabilitation Regulations as presented in the NEMA. The process of concurrent and ongoing rehabilitation may result in the realisation of alternative practices or potential obstacles. In this event, the plan will require updating.

Maintenance and monitoring will be required for at least a period of three years or until the end land use is achieved.

This maintenance should be undertaken in such a manner to ensure that all rehabilitated areas, re-vegetated areas and alien invasive control is undertaken effectively. Rehabilitation of disturbed areas, as far as is practical, should proceed concurrently with the remainder of the operational period. Disturbed areas should be rehabilitated as quickly as possible. The requirements for such are similar for concurrent and closure rehabilitation.

In order to address potential latent risks, such as land stability and the management of Socio-Economic considerations, additional focus have been placed in the Annual Rehabilitation Plan on land stability and Social and Labour Plan monitoring and auditing.

Please refer to Section 5.3 for the summary of rehabilitation and closure actions.

7.2 Ongoing Research

The NEMA Regulations promulgated to regulate the Financial Provision have resulted in mining operations having to reconsider the implementation of ongoing rehabilitation into the operational plans of the mine. Ongoing research into rehabilitation at the Beeshoek Mine will involve the following:

- Implement the recommendations of the 2020 Deep Dolomitic Study;
- Undertaking of an Impact Prediction Model as part of the groundwater model to determine any changes in the 2009 EMP assessments in terms of the impact of Mine Residue Stockpiles/ Deposits on the groundwater resources, if any; and
- Strategic plans on how the mine can more efficiently mine opencast resources to optimise the potential for ongoing backfilling as approved in the EMP.
- Ongoing investigation on the success of measures to manage the underlying dolomitic landforms and potential latent stability risks.

7.3 Closure & Post Closure Timeframes

It is estimated that the final rehabilitation, decommissioning and closure actions, based on the current mine plan, would take approximately two (2) years to implement from date of commencement.

Post closure monitoring, maintenance and aftercare is scheduled for a period of three (3) years post completion of said rehabilitation, decommissioning and closure actions.

7.4 Post-Closure Land Use Objectives

The approved 2009 EMP states that: “Mining areas could be rehabilitated to a wilderness final state with a final land capability of about 60% of the original land capability.” These rehabilitated mining areas could also be handed over to the local municipality for other beneficial uses.

Please refer to the figures overleaf for the Post Mining Land Use Maps.

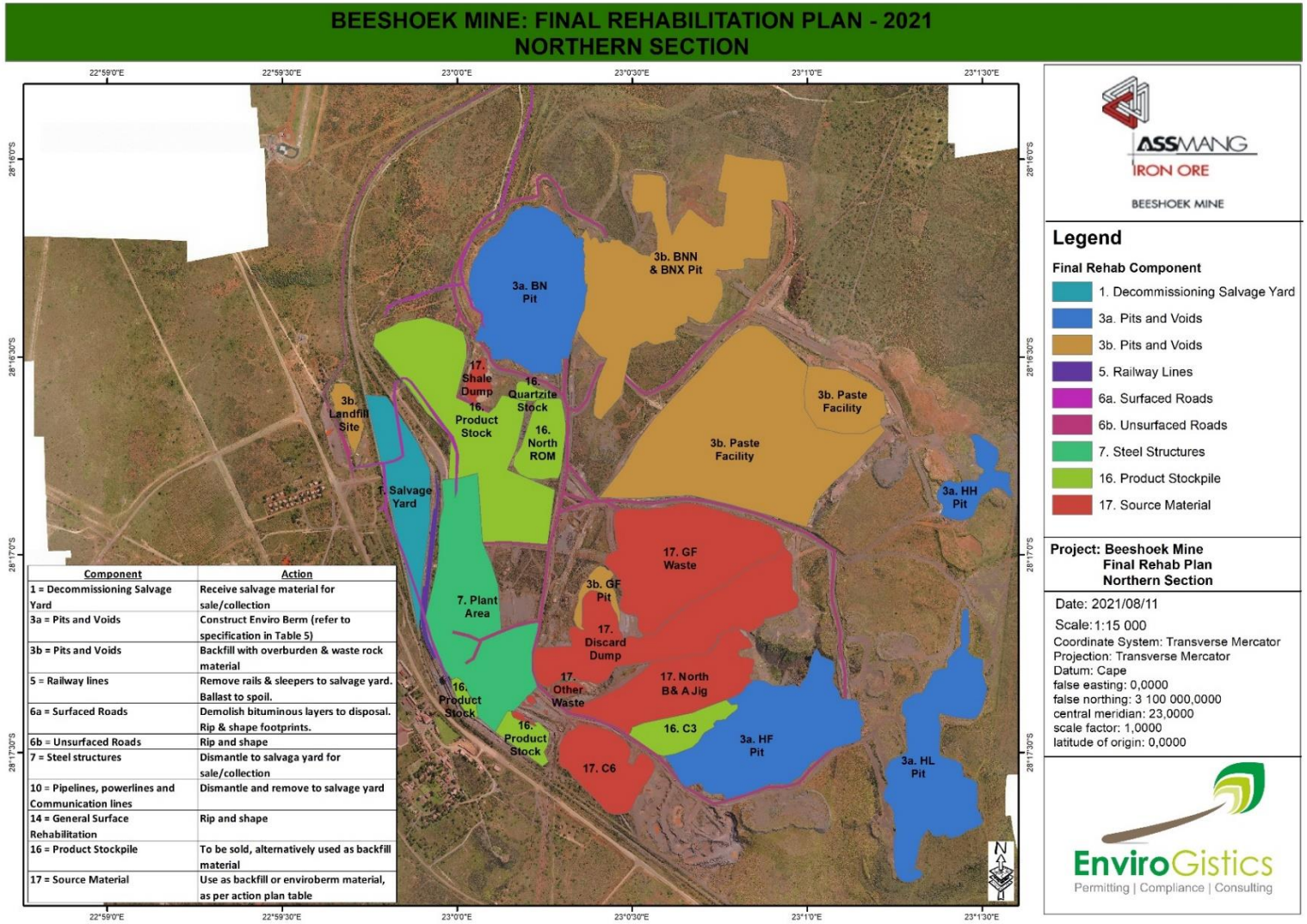

Figure 7: Rehabilitation Progression – North Mine

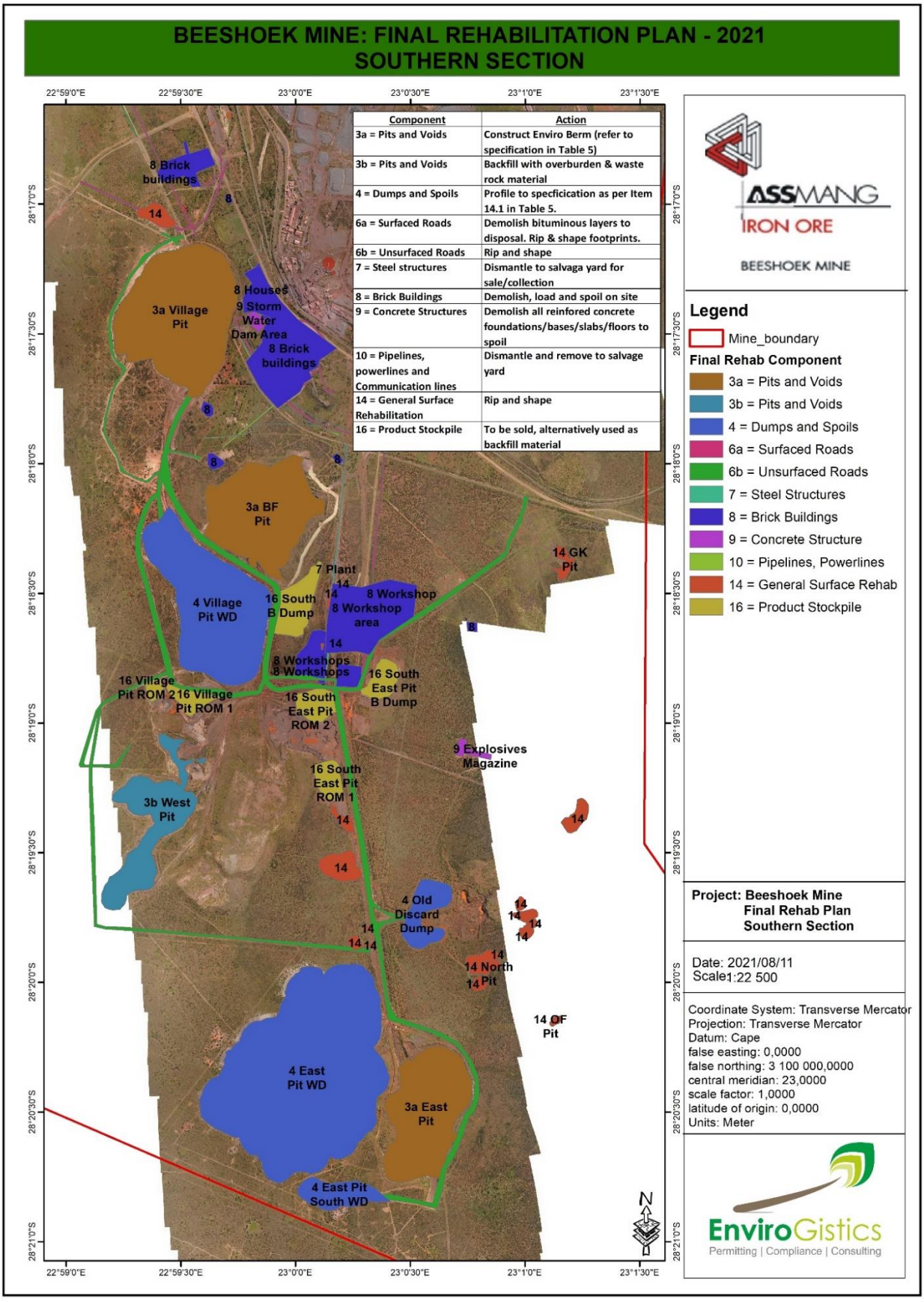

Figure 8: Rehabilitation Progression – South Mine

8 COSTING OF RESIDUAL RISK

No costing is required for the management of residual risks. Ongoing operational costs in terms of the undertaking of numerical models and implementation of the Deep Dolomitic Study should be undertaken to ensure that this finding remains true.

The Rehabilitation Fund makes provision for monitoring for a period of 3 years post closure.

Table 17: Post Closure Monitoring

Item	Monitoring Component	Requirement	Timeframe	Cost
1	Surface Water Quality Monitoring	Area must be free draining – no surface water system exists.	Annually	R 750 000,00
2	Groundwater Quality Monitoring	Sample and monitor groundwater levels in the vicinity of the mine.	Annually	
3	Air Quality Monitoring ($PM_{2.5}$ & PM_{10})	Continuous $PM_{2.5}$ and PM_{10} monitoring. Monitoring must meet the South African National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) Dust Control Regulations (2013).	Annually	R 240 000,00
4	Vegetation establishment & Distribution Monitoring	Invasive Species Monitoring • Visually inspect areas where invasive species have been previously eradicated and areas prone to invasive species; and • Undertake surveys on relevant sites where bush encroachment has previously been identified to determine the status quo of invasive vegetation. Vegetation Establishment • Determine whether re-established vegetation communities are achieving a stable self-sustaining community dominated by species typical of the climax-species present in the adjacent areas: o Inspect rehabilitated areas to assess vegetation establishment and provide for early detection of erosion in recently planted/seeded areas (monthly); o Undertake fixed point photography at specific points at the rehabilitated sites to obtain a long term directly comparable method of determining changes in the landscape; and o Conduct evaluation of rehabilitated areas by means of field inspections. During these assessments measurement of growth performance and species abundance will be carried out to determine: o Plant basal cover and species abundance in the grassed areas. Estimates of vegetation canopy and ground cover as well as height; o Distribution, growth and survival of woody species; o Dominant plant species (woody and herbaceous); o Presence of exotic invasive species, and degree of encroachment; o Notes regarding erosion; and Species composition and richness.	Annually	R 120 000,00
5	Land Stability Monitoring	Topography: • Conduct a visual assessment to determine areas of potential erosion; and • Undertake regular digital surveys of rehabilitated areas to confirm that final topography is aligned with landform designs. • Erosion: • Conduct a visual assessment to determine areas of potential erosion; and	Annually	R 343 850,00

Item	Monitoring Component	Requirement	Timeframe	Cost
		• Undertake field investigations, fixed point photography to document the significance of the erosion occurring on site Land Stability: • Ensure that no water ponding is taking place on site – i.e. ensure area is free flowing; Ensure the achievement of self-succession on Mine Residue Deposits and opencast pits and rehabilitated areas to ensure the stability of slopes.		
6	Dust suppression	Dust monitoring using the ASTM Method. Monitoring must meet the South African National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) Dust Control Regulations (2013).	Annually	R 3 734 611,20
7	Social & Labour Plan Commitments	Stakeholder engagement	Annually	R 26 000 000,00

9 THREATS, OPPORTUNITIES AND UNCERTAINTIES

The following has been identified, with respect to threats, opportunities and uncertainties to the compilation of this plan and to define any additional work that is needed in order to reduce the level of uncertainty:

- Consider the inclusion of ongoing backfilling, as approved for in the WUL, 2018, to reduce the volumes of mine residue placed on Mine Residue Deposits – this will reduce the volumes of opencast pit rehabilitation as well as the volumes of Mine Residue Deposits to rehabilitee upon mine closure. This will further have a significant cost reduction on the year on year financial provision specifically relating to opencast pit and Mine Residue Deposit rehabilitation;
- Identification of historically mined areas, such as on North Mine for the purposes of ongoing rehabilitation and landscaping to reduce areas for final rehabilitation year on year.
- Update the numerical or analytical groundwater model for the project site with closure in mind - The water sampling results should inform the groundwater model, to refine the model and more accurately predict post closure impacts based on actual data obtained during the operational phase;
- Ongoing surface water and groundwater quality monitoring during the operational LoM in order to determine trends overtime and to monitor changes in water quality overtime to determine if the mine is impacting on water quality and/or quantity within the vicinity of the mine;
- Ongoing engagement with communities and stakeholders surrounding the area, with respect to the closure vision of the mine and tacking these issues into account when closure is considered;
- Skill development training for employees and engagement with employees to ensure that when closure is reached and downscaling and retrenchment of staff occurs that all are aware of the process and that people have the required skills in order to find alternative employment; and
- Adopting closure recommendations as identified in the respective specialist reports, with particular emphasis on surface stability aspects.

10 CONCLUSION

Mine closure is an ongoing programme designed to restore the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to a state acceptable to the regulators and to post mining land users. The activities associated with mine closure are designed to prevent or minimise adverse long-term environmental impacts, and to create a self-sustaining natural ecosystem or alternate land use based on an agreed set of objectives. The objective of mine closure is to obtain legal (government) and community agreement that the condition of the closed operation meets the requirements of those entities, at which point the companies' legal liability is terminated.

Based on the outcomes of the Risk Assessment, no quantitative residual risks were identified, however, ten unwanted events which could lead to hidden latent risks were identified. With the implementation of management measures, one (1) of the unwanted events were ranked as highly intolerable, five (5) ranked as ALARP and four (4) as maintain (please refer to the table below).

The following key risk drivers have been identified to be managed in terms of potential latent risks:

1. Mine potentially not rehabilitated and closed properly, this goes hand in hand with the potential inadequate budget to adequately rehabilitated the environment. This could result in not achieving the final land use plan (rating considering ongoing rehabilitation is currently undertaken).
2. Potential negative effect of future closure on the employees and their future income, which could lead to employees and community income source lost.
3. Management in terms of the Deep Dolomitic Study to manage potential surface

4. Potential dissatisfaction of communities with future land use resulting in protests and disruption of the closure process.
5. Potential unforeseen waste disposal at closure. This also goes hand in hand with potential changes in future legislation.

The following is recommended to assist the mine in successfully carrying out the rehabilitation and closure at the operation:

- Concurrent rehabilitation should take place when and where possible in line with the Annual Rehabilitation Plan;
- There should be a constant interaction and communication with local stakeholders and local farmers, so that their requirements can be taken into consideration in the rehabilitation process;
- Regular groundwater monitoring should take place to determine possible changes in groundwater flow and groundwater quality;
- Recommendation of the Deep Dolomitic Study, 2020 should be undertaken;
- Invasive and alien plant species should be removed on an ongoing basis; and
- Monitoring and maintenance of the rehabilitated areas should take place on an annual basis for at least three (3) years post-closure.

11 REFERENCES

- Storm Water Solutions (Pty) Ltd: Storm Water Assessment, May 2016
- GPT: Critical Evaluation of the Groundwater Quality monitoring Network at Beeshoek Mine and Development of Groundwater Related EMPs, April 2016
- GPT: Waste Characterisation and groundwater Monitoring Network Audit, April 2017
- GPT: Updated Numerical Modelling of the Predicted Groundwater Drawdown Resulting from Mining of the Village Pit of the Beeshoek Mine, June 2016
- EnviroGistics (Pty) Ltd: Beeshoek Iron Ore Mine Water Use Licence Amendment, June 2017
- EnviroGistics (Pty) Ltd: Beeshoek Iron Ore Mine Integrated Water and Waste Management Plan Update, 14 October 2017
- SRK: Deep Dolomitic Study, 2020
- EnviroGistics: ARM Ferrous Mine Residue Investigations, June 2016

Annexure A: CVs of Author