2019 PRELIMINARY CLOSURE PLAN FOR THE ALTERNATIVE CLOSURE AND REHABILITATION OPTIMISATION PROJECT AT THE TSHIPI BORWA MINE

Prepared for: Tshipi é Ntle Manganese Mining (Pty) Ltd

Tshipi é Ntle
Manganese Mining

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EXECUTIVE SUMMARY

BACKGROUND OF CURRENT OPERATIONS

Tshipi é Ntle Manganese Mining (Pty) Ltd (Tshipi) currently operates the Tshipi Borwa open pit manganese mine located on the farms Mamatwan 331 (mining right and surface use areas) and Moab 700 (surface use area), approximately 18 km south of Hotazel in the Joe Morolong Local Municipality and the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Tshipi currently holds the following authorisations:

- A mining right (NC/30/5/1/2/2/0206MR) issued by the Department of Mineral Resources (DMR);
- An Environmental Management Programme report (EMPr) approved by the DMR;
- An environmental authorisation (NC/30/5/1/2/2/206/000083 EM) issued by the DMR;
- An environmental authorisation ((NC/30/5/1/2/2/206/000130 MR) issued by the DMR; and
- A Water Use Licence (IWUL) (10/D41K/AGJ/1735) issued by the Department of Water and Sanitation (DWS).

PROJECT BACKGROUND

The approved EMPr commits Tshipi to restore the surface to pre-mining state of wilderness and grazing and requires that the open pit is backfilled. Recent optimisation investigations indicate that when considering environmental, socio-economic, technical, commercial and legal factors, completely backfilling the open pit is sub-optimal. An alternative closure and rehabilitation strategy offers:

- The opportunities for enhanced biodiversity habitats with a different backfill approach particularly in terms of topographic variety and access to surface water;
- The opportunities for enhanced land use increase with access to surface water; and
- An alternative closure option will allow for earlier rehabilitation of waste rock dumps.

In addition to the above, completely backfilling the open pit is likely to sterilise an underground resource located to the north of the current approved open pit. The associated loss of employment, procurement, taxes and foreign exchange earnings is significant and will be a material net loss to the region and the country.

Tshipi is therefore proposing to change the current closure commitment to achieve a more sustainable and optimised outcome. In this regard, the proposed project focusses on:

- Concurrent backfill only i.e. in-pit dumping during mining operations only;
- Sloping and rehabilitation of waste rock dumps remaining on surface;
- Access to readily available future water supply; and
- Optimisation of the surface landforms and partially backfilled pit from a biodiversity, rehabilitation, land use and pollution prevention perspective.

SLR Consulting (South Africa) (Pty) Ltd (SLR), an independent firm of environmental consultants, has been appointed by Tshipi to prepare the financial provision for the proposed project.

Preliminary closure plan objectives

The preliminary closure plan objectives include the following:

- To create a functioning ecosystem that supports a sustainable end land use;
- To ensure a suitable pit lake quality;

- Environmental damage is minimised to the extent that it is acceptable to all parties involved;
- Mine closure is achieved efficiently, cost effectively and in compliance with the law; and
- The social impacts resulting from mine closure are managed in such a way that negative socio-economic impacts are minimised.

Legal framework

This preliminary closure plan has been prepared in accordance with GNR 1147 of the National Environmental Management Act (107/1998): Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations, published 20 November 2015 (Financial Provisioning Regulations, 2015). The table below details the requirements of GNR 1147 and also the relevant sections in the report where these requirements are addressed.

GNR 1147 – Appendix 3, 4 and 5		Relevant section in the report
Annual Rehabilitation Report (Appendix 3)		
3(a)-(g)	Content of report	Section 16
Closure Plan (Appendix 1)		
3(a)	Details of the specialists	Section 2
3(b)(i)	Material information	Section 3.1
3(b)(ii)	Environmental and social context	Section 3.2
3(b)(iii)	Stakeholder issues and comments	Section 0
3(b)(iv)	Mining plan and schedule	Section 4
3(c)(i)	Risk assessment methodology	Section 5.1
3(c)(ii)	Identification of indicators	Section 5.2.1
3(c)(iii)	Strategies to manage/mitigate risks	Section 5.2
3(c)(iv)	Reassessment of risks	Section 5.2.2
3(c)(v)	Changes to risk assessment results	Section 5.2.2
3(d)(i)	Legal and governance framework	Section 6.1
3(d)(ii)	Closure vision and objectives	Section 6.2
3(d)(iii)	Evaluation of alternatives	Section 6.3 and 6.4
3(d)(iv)	Motivation for closure option	
3(d)(v)	Motivation for closure period	Section 6.5
3(d)(vi)	Details of ongoing research	Section 6.6
3(d)(vii)	Assumptions made for closure	Section 6.7
3(e)(i)	Post-mining land use	Section 7
3(e)(ii)	Map of post mining land use	Section 8
3(f)(i)	Specific technical solutions	Section 9.1
3(f)(ii)	Threats and uncertainties	Section 9.2

GNR 1147 – Appendix 3, 4 and 5		Relevant section in the report
3(g)(i)&(iii)	Schedule of actions	Section 10
3(g)(ii)	Assumptions and drivers	Sections 6.7
3(h)(i)-(iii)	Organisational capacity and structure	Section 11
3(i)	Indication of gaps	Section 12
3(j)	Relinquishment criteria	Section 13
3(k)(i)	Closure cost estimate & accuracy	Section 15.5
3(k)(ii)	Closure cost estimate methodology	Section 15.1
3(k)(iii)	Annual updates	Section 14.3
3(l)(i)-(iii)	Monitoring, auditing and reporting	Section 14
3(m)	Amendments to the closure plan	Section 14.4
Environmental Risk Assessment (Appendix 5)		
(a)	Details of the specialists	Section 2
(b)(i)	Risk assessment methodology	Section 5.1
(b)(ii)	Latent risk substantiation	Section 5.3
(b)(iii)	Risk drivers	Section 5.3.2
(b)(iv)	Expected timeframe	
(b)(v)	Risk triggers	
(b)(vi)	Risk assessment results	Section 5.3.1
(b)(vii)	Changes to risk assessment results	Section 5.4
(c)(i)	Monitoring to inform management	Section 14
(c)(ii)-(iv)	Alternative mitigation measures following impacts	Section 5.3.3
(d)(i)-(iii)	Cost estimation and accuracy	Section 5.3.3
(e)	Monitoring, auditing and reporting	Section 14

Financial provision

The closure cost liability calculations have been determined for the following periods (as per the 2nd Draft Financial Provision Regulations (Government Gazette 42464, 2019)), namely:

- Current closure cost liability (as at June 2019), R 186,488,203 (excl. VAT).
- The closure cost liability incurred over the next 12 months (i.e. from June 2019 to June 2020), R 15,505,059 (excl. VAT).
- LOM closure cost liability, 25 years from now (as at June 2044), R 316,318,824 (excl. VAT).

The total estimated cost of the post-closure monitoring and inspection activities, has been calculated to be:

- R 17,382,250 (excl. VAT) for the current pit void and mine layout.
- R 20,006,250 (excl. VAT) for the LOM pit void and mine layout.

In accordance with the 2nd Draft Financial Provision Regulations, the amount to be set aside for the current closure and rehabilitation of the Tshipi Borwa Mine (current value (CV) as at June 2019), is calculated to be R 268,680,158 (incl. VAT).

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
amsl	Above mean sea level
BIF	Banded iron formation
DMR	Department of Mineral Resources
DWAF	Department of Water Affairs and Forestry (now DWS)
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
(Original) EMP	Environmental Impact Assessment and Environmental Management Programme for the Proposed Ntsimbintle Manganese Mining Project. May 2009.
EMP 1	Environmental Impact Assessment and Environmental Management Programme Amendment Report for the Tshipi Borwa Mine. October 2017.
EMP 2	Environmental Impact Assessment and Environmental Management Programme Amendment Report for the Tshipi Borwa Mine. September 2018.
GNR	Government Notice Regulation
IAPs	Interested and Affected Parties
LOM	Life of Mine
NEM:WA	National Environmental Management: Waste Act (No. 59 of 2008).
ngl	Natural ground level
SANS	South African National Standards
SLR	SLR Consulting (Pty) Ltd
SMME	Small, medium and micro enterprise
Tshipi	Tshipi é Ntle Manganese Mining (Pty) Ltd
WRD	Waste Rock Dump

1. INTRODUCTION

Tshipi é Ntle Manganese Mining (Pty) Ltd (Tshipi) currently operates the Tshipi Borwa open pit manganese mine located on the farms Mamatwan 331 (mining right and surface use areas) and Moab 700 (surface use area), approximately 18 km south of Hotazel in the Joe Morolong Local Municipality and the John Taolo Gaetsewe District Municipality in the Northern Cape Province. The approved EMPr commits Tshipi to restore the surface to pre-mining state of wilderness and grazing and requires that the open pit is backfilled. Recent optimisation investigations indicate that when considering environmental, socio-economic, technical, commercial and legal factors, completely backfilling the open pit is sub-optimal. An alternative closure and rehabilitation strategy offers:

- The opportunities for enhanced biodiversity habitats with a different backfill approach particularly in terms of topographic variety and access to surface water;
- The opportunities for enhanced land use increase with access to surface water; and
- An alternative closure option will allow for rehabilitation of waste rock dumps concurrent with mining instead of post mining and backfilling.

In addition to the above, completely backfilling the open pit is likely to sterilise an underground resource located to the north of the current approved open pit. The associated loss of employment, procurement, taxes and foreign exchange earnings is significant and will be a material net loss to the region and the country.

Tshipi is therefore proposing to change the current closure commitment to achieve a more sustainable and optimised outcome. In this regard, the proposed project focusses on:

- Concurrent backfill (in-pit dumping) during mining operations only;
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2. SPECIALIST INPUT

2.1 SPECIALISTS THAT PREPARED THE CLOSURE PLAN

The details of the specialists who prepared this preliminary closure plan report are provided in Table 1-1 below.

Table 2-1: Details of specialist

Details	Closure Specialist	Environmental Assessment Practitioner
Name:	Stephen van Niekerk	Natasha Smyth
Tel No.:	011 467 0945	011 467 0945

Details	Closure Specialist	Environmental Assessment Practitioner
Fax No.:	011 467 0978	011 467 0978
E-mail address	svanniekerk@slrconsulting.com	nsmyth@slrconsulting.com

Neither SLR nor any of the specialists involved in the preliminary mine closure plan process have any interest in the Tshipi Borwa Mine other than fair payment for consulting services rendered as part of the preliminary mine closure plan process.

2.2 EXPERTISE OF THE SPECIALISTS

Stephen van Niekerk is a technical director at SLR, holds an MSc Civil Engineering degree, has over 20 years of relevant experience and is registered as a Professional Engineer with the Engineering Council of South Africa (ECSA). Natasha Smyth holds a BSc Honours degree in Geography and Environmental Management and has approximately ten years of relevant experience in the assessment of impacts associated with mining operations.

2.3 DECLARATION OF INDEPENDENCE

I, Natasha Smyth and Steve van Niekerk hereby declare that we are independent consultants, who have no interest or personal gains in this proposed project whatsoever, except receiving fair payment for rendering an independent professional service.

3. CONTEXT OF THE PROJECT

3.1 MATERIAL INFORMATION

Tshipi currently operates the Tshipi Borwa (manganese) Mine located on the farms Mamatwan 331 (mining right and surface use areas) and Moab 700 (surface use area) in accordance with an approved EMPr. Refer to Figure 1 and Figure 2 for the regional and local setting respectively. Key mine infrastructure includes an open pit, haul roads, run-of mine ore tip, a primary crusher, a secondary crushing and screening plant, various stockpiles for crushed and product ore, a train load-out facility, a private siding, offices, workshops, warehouses and ancillary buildings, an access control facility, various access roads, diesel generator house, electrical reticulation, clean and dirty water storage dams, water reticulation pipelines and drains, topsoil stockpiles and waste rock dumps.

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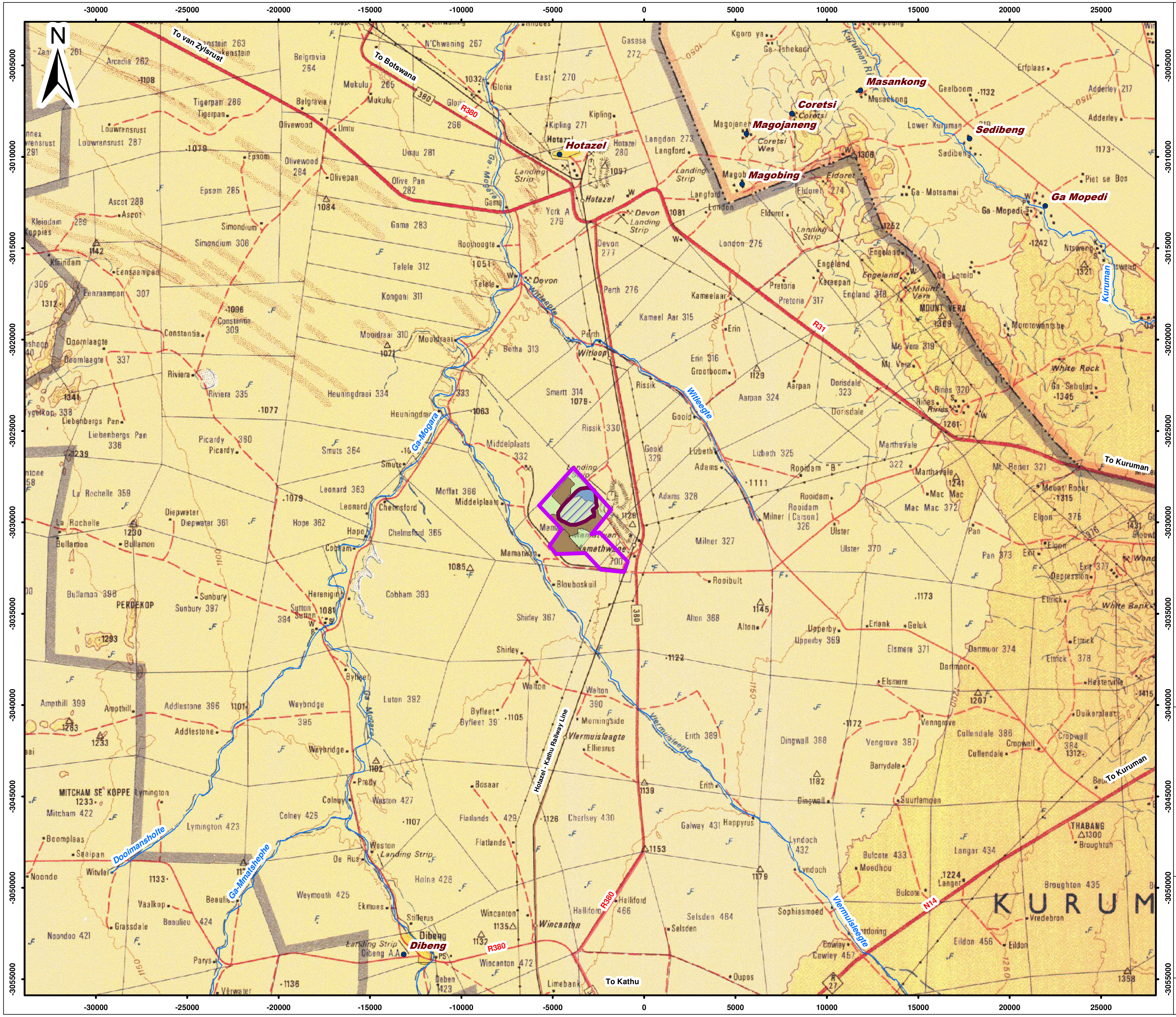
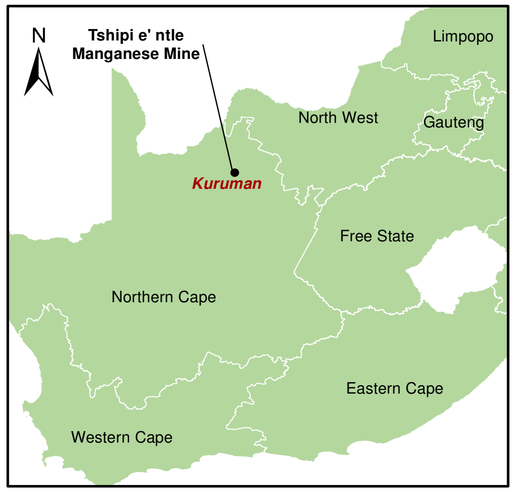
- Optimisation of the surface landforms and partially backfilled pit from a biodiversity, rehabilitation, land use and pollution prevention perspective.

It follows that the proposed closure land use objective is to create a sustainable closure land use which is a combination of natural habitat creation (aquatic and terrestrial) and availability of water for livestock with associated grazing potential.





Legend

- Tshipi Surface Use Area
- Tshipi Mining Right Area
- Open Pit
- Concurrent In-Pit Dumping
- Waste Rock Dumps
- Place Names
- Main Roads
- Power Line
- Rivers and Streams
- 20m Contour Lines

0 2 000 4 000 Meters

Scale: 1:200 000 @ A3

Projection: Transverse Mercator

Datum: WGS1984, Lo23

Tshipi é Ntle Manganese Mining (Pty) Ltd

Figure 1

Regional Setting

SLR

SLR Consulting (Africa) (Pty) Ltd

P O Box 1596, Cramerview, 2060, South Africa

Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

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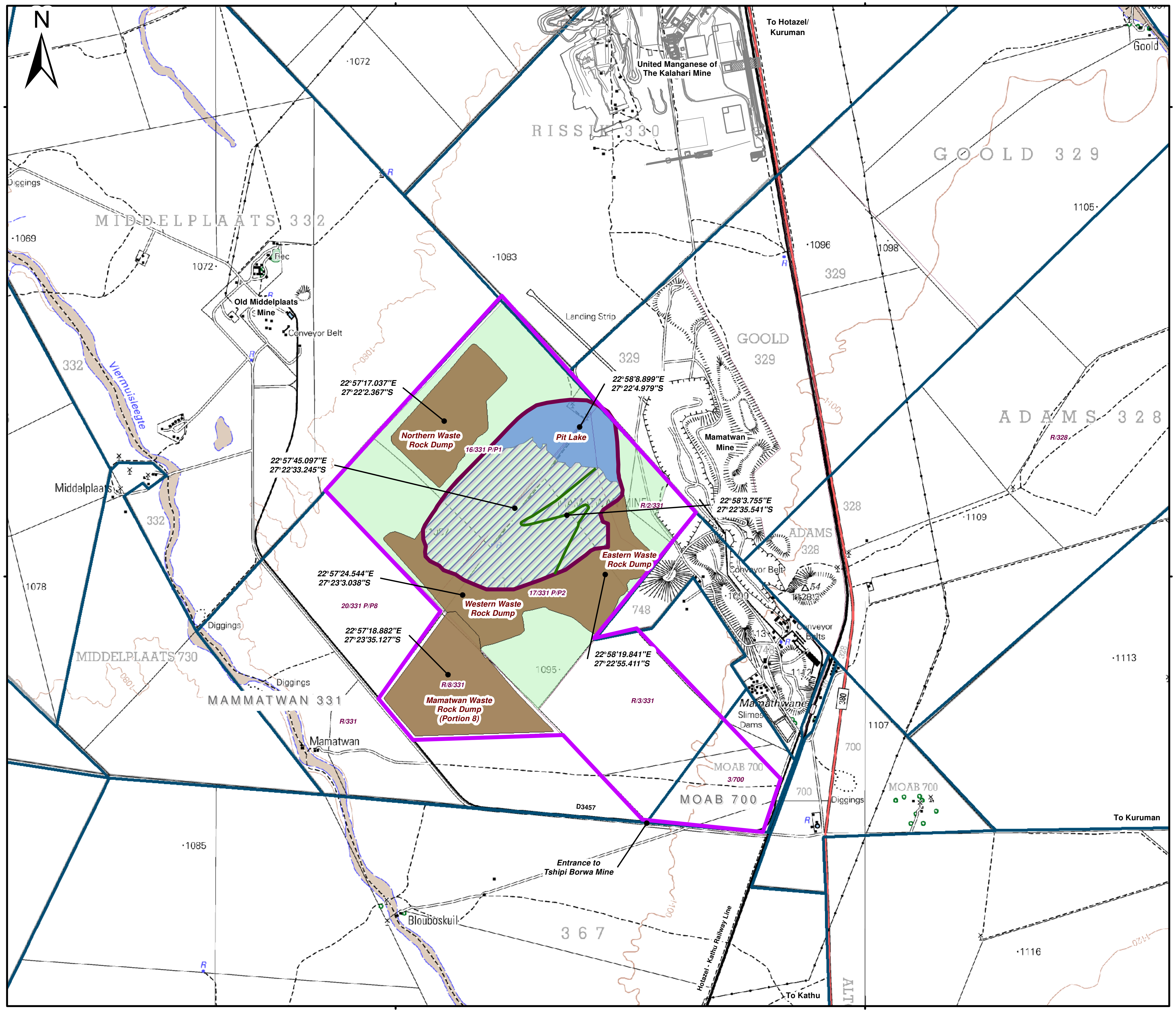


Legend

- Tshipi Surface Use Area
- Tshipi Mining Right Area
- Open Pit
- Concurrent In-Pit Dumping
- Waste Rock Dumps
- Access Road
- Main Roads
- Power Line
- Rivers and Streams
- 20m Contour Lines
- Farm Boundaries
- Farm Portions

0 500 1 000 Meters

Scale: 1:40 000 @ A3

Projection: Transverse Mercator

Datum: WGS1984, Lo23

Tshipi é Ntle Manganese Mining (Pty) Ltd

Figure 2

Local Setting

SLR Consulting (Africa) (Pty) Ltd

P O Box 1596, Cramerview, 2060, South Africa

Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

710.20008.00069 | 2019/08/08

3.2 ENVIRONMENTAL AND SOCIO-ECONOMIC OVERVIEW

The information in this section provides a summary of the environmental and socio-economic baseline situation that is likely to be influenced by the proposed project. Information in this section was sourced from the Basic Assessment Report (BAR) compiled for the proposed project (SLR, August 2019). For further information, refer to Section 7.4 of the BAR (SLR, August 2019).

Table 3-1: Overview of environmental and socio-economic baseline situation

Aspect	Overview
Geology	The manganese ore body is contained within the Hotazel banded iron formation deposit of the Kalahari Manganese Field. Tshipi is exploiting the manganese from the banded iron stones of the Hotazel Formation. The ore is contained within a 30 to 45 m thick mineralised zone which occurs along the entire extent of Tshipi and is made up of three manganese rich zones, namely the Upper Manganese Ore Body (UMO), the Middle Manganese Ore Body (MMO) and the Lower Manganese Ore Body (LMO). The UMO is 10 cm to 15 cm thick and comprises moderate deposits of manganese. The poorly mineralised MMO is approximately 1 m thick and not economically viable. The LMO is highly mineralised and makes up the bulk of the ore body. The ore layer dips gradually to the north-west at approximately five degrees.
Topography	In general the area surrounding the Tshipi Borwa Mine is relatively flat with a gentle slope towards the North West. The elevation varies from 1087 m to 1107 m above mean sea level (mamsl). The Vlermuisleegte River is located approximately 2km west from the Tshipi Borwa Mine boundary. The natural topography of the area surrounding the Tshipi Borwa Mine has been influenced through the presence of isolated farmsteads and mining activities such as the Mamatwan Mine, the old Middelplaats Mine and the United Manganese of Kalahari Mine. The highest topographical features near the Tshipi Borwa Mine are the Mamatwan waste rock dumps located adjacent to the eastern boundary of the Tshipi Borwa Mine (Figure 2). The majority of the natural topography at the Tshipi Borwa Mine has been disturbed as a result of the existing mining infrastructure and activities. The topography of the undisturbed areas at the Tshipi Borwa Mine is relatively flat with a gentle North West slope towards the Vlermuisleegte River
Climate	The project area is characterised by hot to very hot summers and cool to warm winters with rain generally occurring in the form of localised thunderstorms that last for short periods at a time during rainy periods (October to April). The predominant wind directions are from the south east and north east.
Soils and land capability	The soil form (hutton) located at the Tshipi Borwa Mine is well-drained sandy soil, which allows for high infiltration rates and low organic content and is highly erodible. The soil fertility is low due to a deficiency in key nutrients, such as phosphorus. In general, the soil form located in the Tshipi Borwa Mine has limited agricultural and irrigation potential due to low rainfall. Existing infrastructure of the mine has influenced the natural capability of the land.
Surface water	There are no surface water resources within the Tshipi Borwa Mine mining right and surface use area. The closest watercourses to the mine are the Vlermuisleegte (±2km southwest), the Witleegte (± 10km northeast), and the Ga-Mogara (± 6 km west). Both the

Aspect	Overview
	Vlermuisleegte and the Witleegte are tributaries of the Ga-Mogara River, which is a tributary of the Kuruman River. All three watercourses are non-perennial, ephemeral and highly seasonal. Due to the ephemeral nature of Witleegte and Vlermuisleegte Rivers, there is no third party reliance on surface water. No wetlands occur on the mine property.
Biodiversity	The Tshipi Borwa Mine is located in the Kathu Bushveld. Protected species located at the Tshipi Borwa Mine include Camel Thorn (*Vachellia erioloba*) and the Grey Camel Thorn (*Vachellia haematoxylon*) which are protected under the NFA. Areas of moderately high and moderately low sensitivity are associated with the Tshipi Borwa Mine. It is important to note that the natural biodiversity on and surrounding the mine has already been influenced by existing mining activities and infrastructure. In this regard, projected tree species have been removed, with the necessary permits, and areas of moderately high sensitivity have been disturbed as part of clearing activities for the placement of approved mine infrastructure.
Groundwater	Two aquifers are present beneath the project area. This includes a shallow aquifer comprising the Kalahari sands and calcrete and a deeper fractured aquifer comprising Dwyka clay and Mooidraai dolomite formation. Groundwater flows across the mine area in accordance with the topography in a west-north-west direction. Groundwater levels range between 20m to 75m below ground level. The majority of the groundwater in the broader region is used to supply drinking water for cattle and in some instances supply water for domestic use. A groundwater monitoring programme is currently in place at the Tshipi Borwa Mine. Groundwater monitoring results indicate that parameters, Iron (Fe), Selenium (Se), Nitrate (N) and Total Dissolved Solids exceed the DWAF Livestock Drinking Water Standards.
Air quality	Air quality within and surrounding the Tshipi Borwa Mine has already been influenced through the presence of approved infrastructure and activities. In this regard, monitoring results indicate that mining and surrounding activities and infrastructure contribute towards sources of emissions such as dust fallout and PM10 that occasionally exceed relevant NAAQS and NDCR limits.
Noise	Current Tshipi operations contribute towards ambient noise levels; however monitoring results indicate that noise levels do not exceed the IFC guideline limits for residential areas.
Visual	When considering landscape character, scenic quality, visual resource, sense of place and visual receptors, the area to the southwest and west of the Tshipi Borwa Mine surface use area has a high visual value. The areas within the Tshipi Borwa Mine surface use area as well as areas located to the north, northwest and east of the surface use area that have been disturbed have a low visual value. This indicates that mining and infrastructure activities impact on the available visual resources.
Heritage/cultural and palaeontological	No heritage/cultural resources are located at the Tshipi Borwa Mine. There is a low possibility of palaeontological resources occurring in the project area.
Socio –economic	The Tshipi Borwa Mine is located in the John Taolo Gaetsewe District Municipality in the Northern Cape Province. The Northern Cape Province is one of the least populated provinces in South Africa because of its dry and arid environment. The mining industry is the most dominant industry of the Northern Cape economy. Human settlement in the province is concentrated close to centres of economic activity, due to the potential of earning a livelihood there. There is a low conversion factor of school education into tertiary

Aspect	Overview
	education in the region, which limits the availability of highly skilled labour in the area (e.g. for the mining sector). The bulk of the potentially active sectors of the population without tertiary education therefore rely heavily on the limited low-skilled or unskilled labour employment opportunities available in the mining and agriculture sectors.
Land use	Land use within the Tshipi Borwa Mine surface use and mining right area includes mining activities and infrastructure. Land use surrounding the Tshipi Borwa Mine includes a combination of agriculture, isolated residence/ residential areas, infrastructure/servitudes, a solar farm and mining activities.

3.3 STAKEHOLDER ISSUES AND COMMENTS

A summary of the issues and concerns raised by interested and affected parties (IAPs) and commenting authorities as part of the proposed project are provided in Table 2-1 below. It is important to note that the issues and comments tabulated below, relate to closure aspects only. For a full list of issues and comments received as part of the overall project, refer to Section 7.3 of the BAR (SLR, August 2019).

Table 3-2: Summary of issues raised by I&APs and regulatory authorities

Interested and affected party	Date comment received	Issues raised	Response provided
Northern Cape Department of Mineral Resources (DMR)			
Ntsundeni Ravhugoni	Comments raised at the pre-application meeting with the DMR on 02 May 2019	Can the open pit be backfilled after the underground mining is completed? This approach can be considered as an alternative to changing the backfill commitment.	Practically the final void could be backfilled after the deeper resource is mined out however; • Firstly, when considering environmental, socio-economic, technical, commercial and legal factors, completely backfilling the open pit is sub-optimal as a closure solution and an alternative closure and rehabilitation strategy offers; opportunities for enhanced biodiversity habitats and access to surface water; • Secondly, this would imply that the surface waste rock dumps would remain as (un-rehabilitated) temporary dumps until after closure of the underground mine, possibly as long as 70 years from now whereas with concurrent backfill only, rehabilitation of surface waste rock dumps can commence almost immediately; and • Lastly, the underground mine is marginal and if the attributable closure liability is included in the underground mine business plan then the business case may no longer be attractive. i.e. the deeper (underground) resource will be sterilised.
		As part of the alternative investigation, please also comment on the level of Tshipi's responsibility for the four closure options. Our department is of the opinion that with complete backfill, Tshipi's overall responsibility will be less than a closure option where biodiversity habitats are created that need to be maintained and monitored. As an overall comment, we will wait for the final Environmental Impact Assessment (EIA) and EMPr for the details around the specialist findings of the alternative investigation.	It is important to note that there will be a closure phase monitoring and aftercare obligation in both the complete backfill (option 1) and concurrent backfill only (in-pit dumping) (being the preferred option) (option 3) scenarios. In terms of completely backfilling, the long term focus would be groundwater monitoring with shorter term monitoring and aftercare plan aspects focussed on groundwater levels, vegetation/ecosystem establishment, and erosion prevention. In terms of concurrent (in-pit dumping), the long term focus would be on the pit lake where field implementation and monitoring is required to determine how successful the floating wetlands will be as a semi passive treatment solution. Moreover, ongoing monitoring, wetland maintenance/replacement, and establishment of shallow ecosystems may be required in the longer term to maintain the pit lake quality for livestock and ecology use. Alternatively, if the water quality fails at some point then alternative treatment technologies may need to be considered or the use of the pit lake and access thereto may have to change. The shorter term monitoring and aftercare plan aspects focussed on groundwater levels, vegetation/ecosystem establishment, and erosion prevention.

Interested and affected party	Date comment received	Issues raised	Response provided
Ntsundeni Ravhugoni	Comments raised at the pre-application meeting with the DMR on 02 May 2019		Taking the above into consideration, post closure monitoring and aftercare maintenance is more extensive (more aspects that require monitoring) and the duration of the post closure obligations increases from the preferred concurrent (in-pit dumping) alternative when compared to completely backfilling. It is however important to note that the level of responsibility is only one aspect that was considered in the alternatives analysis as outlined in Section 6.3. In this regard when all environmental, social, technical (inclusive of level of responsibility), legal and commercial factors are considered as a whole, the preferred option is concurrent (in-pit dumping). Further to this, not proceeding with the project means that the pit will be completely backfilled and rehabilitated to an end state of grazing/wilderness and as such the economic spin-offs and biodiversity enhancements will not be realised.
Northern Cape Department of Water and Sanitation			
Fhatuwani Magonono	Comments raised at a focussed meeting held on 21 June 2019	An application has recently been submitted to our department for amendments to the existing Integrated Water Use Licence Application for Tshipi. Will the application associated with this proposed project form part of the amendment that is currently with the department for processing, or will a separate application be made?	As part of the proposed project, the waste rock dumps that will remain on surface and backfilling the open pit are water uses in terms of Section 21(g) of the NWA for the disposal of waste in a manner that my detrimentally impact on water resources. These water uses either form part of the existing WUL or are incorporated into the IWUL amendment application that is currently with your department for processing. Even though these facilities/activities are associated with the proposed project, these water uses form part of the current mining operations which require authorisation. It follows, that there is no specific requirement for Tshipi to obtain a water use licence from the Northern Cape DWS in terms of the NWA for the proposed project. After closure the relevant land user would have to review the need for a water use licence depending on the related future use of the water resource. This may include an abstraction licence to use water from the pit lake.
		The Northern Cape Department of Water and Sanitation will need to authorise the use of waste rock to backfill the open pit in terms of Section 21(g) of the National Water Act (No. 36 of 1998).	
		Is the backfilling authorised by the Northern Cape Department of Mineral Resources?	Tshipi is currently required to completely backfill their open pit in accordance with their approved EMPr's (SLR, August 2017 and SLR, April 2019). Prior to the commencement of the proposed project, authorisation will be required from the Northern Cape DMR to change the

Interested and affected party	Date comment received	Issues raised	Response provided
Fhatuwani Magonono	Comments raised at a focussed meeting held on 21 June 2019		approved backfill commitment to concurrent backfilling only (in-pit dumping).
		Why create a pit lake? Why don't you completely rehabilitate the whole pit?	As part of the proposed project, the aim is to create a sustainable closure land use which is a combination of natural habitats creation (aquatic and terrestrial) and livestock watering with associated grazing potential. This can be achieved through access to water within the pit lake. If the pit is completely backfilled, it will not be possible to create a pit lake and the biodiversity enhancements will not be realised. It is important to note, that additional concepts could be considered at some point as potential future additional land uses that may require the use of water within the pit lake. With reference to Section 4.1.5, these include aggregate crushing and screening, aquaponics and intensive grazing. These additional land uses are not specifically assessed as part of the proposed project as these are potential land uses that can be considered.
		What will be the use of that water?	
		The pit lake water will be contaminated because of the waste rock dumps? It will end up infiltrating to the groundwater.	As part of the proposed project, independent hydrologist, geohydrologist and geochemists were appointed to understand the impacts associated with the development of a pit lake. In this regard, specialist investigations have shown that without passive treatment water quality within the pit lake will be suitable for livestock watering purposes for up to 100 years but thereafter some form of floating wetland treatment will be required. Specialists have therefore recommended the use of floating wetlands for the passive treatment of water quality within the pit lake. The predicted modelling results of water quality of the pit lake with the installation of floating wetlands indicate that the water quality is acceptable for livestock watering and the creation of an aquatic habitat for a minimum of 200 years (the modelled period). It is possible for similar water quality to be achieved beyond the modelled period of 200 years and field trials supplemented with additional modelling are recommended for ongoing design refinement. In addition to the above, the impact associated with groundwater contamination was assessed as part of the proposed project. In this regard the pit lake will act as a sink because the pit lake level will settle below the relevant groundwater level. This means that groundwater water will flow towards the pit lake and not from the pit lake outwards. Predicated modelling results indicated that no impacts on any off-site third party boreholes are expected.

Interested and affected party	Date comment received	Issues raised	Response provided
Fhatuwani Magonono	Comments raised at a focussed meeting held on 21 June 2019	Please ensure that post closure monitoring is undertaken?	A post closure monitoring programme has been developed for the proposed project and is outlined in Section 14 of this report. In addition to this, post closure monitoring has been included in the financial provision calculations as outlined in Section 15.5.
		Will the pit spill?	The pit lake level will settle approximately 35m below ground level. It follows that there is no risk of a pit spill.
		Did you conduct a waste classification study?	Waste assessments have been conducted for the Tshipi Borwa Mine as part of previous projects. In this regard, waste assessments were undertaken in accordance with Regulation 5 of GNR 632 of the NEM:WA, which states that waste rock stockpiles need to be classified taking into account Regulation 8 of GNR 634 of 2013, which references the following associated National Norms and Standards: • The National Norms and Standards for the assessment of waste for landfill disposal (GNR 635 of 2013); and • The National Norms and Standards for disposal of waste to landfill (GNR 636 of 2013). A waste assessment was undertaken by Golder Associates (Golder, 2016) for waste rock generated at the Tshipi Borwa Mine. The preliminary results of the waste assessment indicate that waste rock is classified as a Type 1 waste, which requires a Class A liner, which consists of a compacted clay liner, leachate detection, geotextile membranes and geotextile filters. In June 2016, the DHSWS accepted a proposal by the Chamber of Mines of South Africa to follow a risk based approach on a case-by-case basis to allow for representations on alternative barrier systems for Mine Residue Deposits and Stockpiles (29 June 2016). Golder recommended, via a formal motivation letter to the DHSWS, that a Class D liner (stripping topsoil and base preparation) is considered appropriate for the proposed waste rock dumps at the Tshipi Borwa Mine for the following reasons: • A Class A liner is impractical for a waste rock dump on the basis of geotechnical properties given that the liner is likely to fail; • The leachable concentrations of all the constituents are below the LCT0 limit, indicating a low seepage risk;

Interested and affected party	Date comment received	Issues raised	Response provided
Fhatuwani Magonono	Comments raised at a focussed meeting held on 21 June 2019		• The waste rock material will be dry and does not contain waste water; and The waste rock material is non-hazardous and not acid generating.
		The most critical part in terms of this application will be the geohydrological report, which must cover the modelling of the plume and the monitoring boreholes (post closure monitoring) both near and downstream.	Groundwater modelling has been undertaken for Tshipi. This modelling makes provision for a worse case theoretical scenario which includes a completely backfilled open pit with all waste rock dumps remaining on surface. This allows for multiple pollution sources and re-establishment of close to normal groundwater flow. In reality, the proposed closure option will include the partially backfilled pit acting as a hydraulic sink with a draw down cone toward the pit lake in perpetuity. The reason for using the conservative theoretical modelling scenario is the precautionary principle which is relevant because of the importance of understanding groundwater risk in this particular arid region. Details pertaining to the groundwater model are included in the Pit lake report included in Appendix H of the BAR. A detailed discussion of the groundwater impacts and contamination plume modelling results are provided in the BAR. A post closure monitoring programme has been developed for the proposed project and is outlined in Section 14 of this report.
Department of Environmental and Nature Conservation and Department of Environment, Forestry and Fisheries			
Jacoline Mans- DAFF	Comment raised at focus meeting held on 27 June 2019	Will the water from the pit-lake be clean, will it not be contaminated?	As part of the proposed project, independent hydrologist, geohydrologist and geochemists were appointed to understand the impacts associated with the development of a pit lake. In this regard, specialist investigations have shown that without passive treatment water quality within the pit lake will be suitable for livestock watering purposes for up to 100 years for up to 100 years but thereafter some form of floating wetland treatment will be required. Specialists have therefore recommended the use of floating wetlands for the passive treatment of water quality within the pit lake. The predicted modelling results of water quality of the pit lake with the installation of floating wetlands indicate that the water quality is acceptable for livestock watering and the creation of an aquatic habitat for a minimum of 200 years (the modelled period). It is possible for similar water quality to be achieved beyond the modelled period of 200 years and field trials supplemented with additional modelling are recommended for ongoing design refinement.
		In terms of protected trees and plants, how will	The rehabilitation of the waste rock dumps will include shaping to ensure that the areas are

Interested and affected party	Date comment received	Issues raised	Response provided
Jacoline Mans- DAFF	Comment raised at focus meeting held on 27 June 2019	the footprint differ from what's currently authorised? Will your dumps not increase in terms of surface area? Will they not have an impact on currently undisturbed areas?	free draining and the sides will be sloped as required to allow for the optimal re-establishment of vegetation. It is possible that as part of sloping the waste rock dumps, that some current undisturbed areas may be influenced. It is important to note that Tshipi is still committed to implement management actions as outlined in the approved EMPr's (SLR, August 2017 and April 2019). It follows that if any protected trees or plant species need to be removed as part of rehabilitating the waste rock dumps, the necessary tree and/or plant removal permits will be obtained from DAFF and/or DENC. Moreover, refer to Section 4.1.4 for the revegetation plan which aims to re-establish key habitats and related trees.
		So your current waste rock dumps are not rehabilitated?	The current approved EMPr requires that Tshipi backfills the open pit completely. In this scenario, given that waste rock would be backfilled into the open pit, no waste rock dumps that are currently on surface are therefore rehabilitated. Once the waste rock is backfilled into the open pit, surface rehabilitation would commence. As part of the proposed project, some waste rock will remain on surface in perpetuity. It follows that the proposed project will allow for the earlier rehabilitation of waste rock dumps as part of on-going operations, which will improve the state of rehabilitation at closure.
		In terms of alternative land use on the permanent dumps, is it not possible to invite solar plant companies to place their solar panels on the permanent dumps instead of disturbing the natural veld next to the mine?	As part of the proposed project, the aim is to create a sustainable closure land use which is a combination of natural habitats creation (aquatic and terrestrial) and livestock watering with associated grazing potential. Additional concepts could be considered at some point as potential future additional land uses. With reference to Section 4.1.5, provision has been made for the consideration of establishing solar plants on the top of existing waste rock dumps.
		In terms of your existing Environmental Authorisation, was there not something about offsets that Tshipi had to do? Is a biodiversity offset not already a condition in the Environmental Authorisation?	The existing environmental authorisations held by Tshipi do not specifically indicate that a biodiversity offset is required. The approved EMPrs (SLR, August 2017 and April 2019) however indicated that Tshipi is committed to implement an offset when required by DAFF.
Interested and Affected Party			

Interested and affected party	Date comment received	Issues raised	Response provided
Moses Moalani (Care for Nature, NGO)	Comment raised at public meeting held on 26 June 2019	Do you intend on rehabilitating the open pit?	Yes. Rehabilitation of the pit is planned to ensure that a sustainable closure end land use which is a combination of natural habitats creation (aquatic and terrestrial) and livestock watering with associated grazing potential is achieved.
		Is the license for closure only for this portion (open pit)?	The closure licence would be for the entire area that currently falls within the Tshipi surface use area.
		How do you monitor air quality?	A dustfall monitoring network is in place at Tshipi Borwa Mine. In this regard, monitoring results indicate that mining and surrounding activities and infrastructure contribute towards sources of emissions such as dust fallout and PM10 that occasionally exceed relevant NAAQS and NDCR limits.

4. MINE PLAN AND SCHEDULE

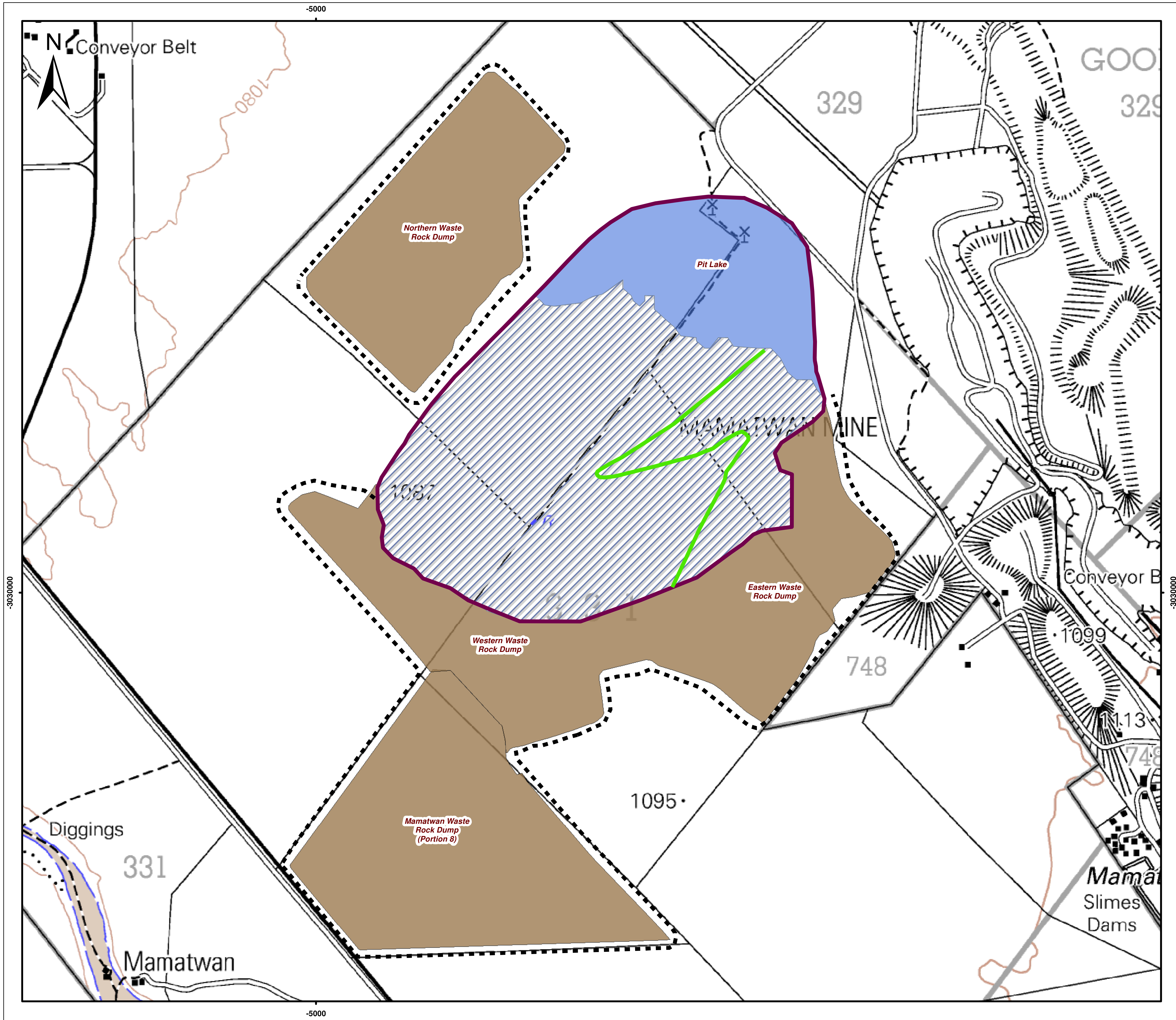
Information in this section was sourced from the BAR (SLR, August 2019) for the proposed project. A summary of the key project components is provided in the section below. For further detail refer to Section 4 of the BAR (SLR, August 2019) for the proposed project.

4.1 OVERVIEW OF KEY PROJECT COMPONENTS

The proposed closure land use objective is to create a sustainable closure land use which is a combination of natural habitat creation (aquatic and terrestrial) and availability of water for livestock with associated grazing potential. Tshipi is therefore proposing to change the current closure commitment to achieve a more sustainable and optimised outcome. In this regard, the proposed project focusses on:

- Concurrent backfill only i.e. in-pit dumping during mining operations only;
- Sloping and rehabilitation of waste rock dumps remaining on surface;
- Access to readily available future water supply; and
- Optimisation of the surface landforms and partially backfilled pit from a biodiversity, rehabilitation, land use and pollution prevention perspective.

A summary of the key proposed project components is discussed below. Refer to Figure 3 below.



Legend

- Open Pit
- Concurrent In-Pit Dumping
- Pit lake
- Waste Rock Dumps
- Access Road
- Toe Paddocks

0 400 800 Meters

Scale: 1:17 500 @ A3

Projection: Transverse Mercator

Datum: WGS1984, Lo23

Tshipi é Ntle Manganese Mining (Pty) Ltd

Figure 3

Site Layout

SLR

SLR Consulting (Africa) (Pty) Ltd

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710.20008.00069

2019/08/08

4.1.1 CONCURRENT BACKFILL (IN-PIT DUMPING)

The proposed project presents an alternative backfill strategy to that of the approved EMPr, which commits Tshipi to completely backfill the open pit. Concurrent backfilling (in-pit dumping) involves backfilling the open pit concurrently with mining operations in a manner that still allows for the provision of a safe working space within the pit for Tshipi personnel and contractors. It is important to note that Tshipi currently undertakes concurrent in-pit dumping and as such the proposed project will allow for the continuation of current practices.

4.1.2 WASTE ROCK DUMPS (SLOPING AND REHABILITATION)

The current approved EMPr (SLR, August 2017) indicates that waste rock will be utilised to completely backfill the open pit, with some waste rock, albeit limited, remaining on surface post closure due the bulking factor. As part of the proposed project, the waste rock dumps will remain in perpetuity. These include the northern waste rock dump, eastern waste rock dump, western waste rock dump and the Mamatwan portion 8 waste rock dump as illustrated in Figure 3. The proposed project also allows for earlier planning and execution of waste rock dump rehabilitation.

At closure these waste rock dumps will be shaped to ensure that the areas are free draining and the sides will be sloped as required to allow for the optimal re-establishment of vegetation. The waste rock dumps will be capped with a topsoil/growth medium material. Revegetation to be done in accordance with the revegetation plan. Rehabilitation success will be determined by monitoring trends in soil nutrient levels, soil microbial levels, vegetation cover and vegetation biodiversity levels and comparing data and temporal trends in the data to numerical targets.

4.1.3 ACCESS TO A FUTURE READILY AVAILABLE WATER SUPPLY (PIT LAKE DEVELOPMENT)

The concurrent backfilling (In-pit dumping) will result in more than half (approximately 75%) of the pit being backfilled with waste rock. Part of the remaining void will over time develop into a pit lake. The section below outlines the characteristics of the pit lake. This section has been informed by the pit lake specialist study undertaken for the proposed project.

Table 4-1: Pit lake development

Aspect	Detail
Access	As part of the proposed project, an access road will be established in order to gain access to the pit lake. This road will remain in perpetuity and will be established from gravel and will be 30m wide.
Hydraulic sink	The pit lake will act as a hydraulic sink. This means that water levels in the pit will remain below surrounding groundwater levels. Hydraulic sinks are normally found in arid climates. Initially, inflows will be high, because the hydraulic gradient driving inflows from the aquifer would be at a maximum due to the water level being at base of the pit. Due to evaporative loses and pit geometry the pit lake is associated with a cone of depression in the water table with the groundwater gradient towards the pit. As evaporation is the only discharge pathway, soluble metals accumulate due to evapoconcentration.
Filling rates and final level	It will take approximately 153 years to reach a steady state level. This steady state level in the pit is 1039 m above mean sea level (AMSL), while the regional groundwater level will be 1045 m AMSL
Pit spilling	The probable maximum precipitation (PMP) is defined as the greatest depth of precipitation for a

Aspect	Detail
	given duration meteorologically possible for a design watershed. The PMP was used to assess the likelihood of a pit spillage occurring during the most extreme rainfall event. Available rainfall records were used for the analysis and include daily rainfall totals dating back to 1931 providing a total record length of 69 years for PMP analysis. This is deemed sufficient for the purpose as a direct estimation can be made from records lengths of greater than 50 years. The PMP at the mine was estimated to be approximately 470 mm for a 24-h rainfall duration. Modelled results indicated a probability of occurrence of 1 in 10 000 years. It follows that there is no risk of a pit spill from a PMP rainfall event.
Water quality	With the installation of floating wetlands the water quality is acceptable for livestock watering and the creation of an aquatic habitat for a minimum of 200 years (the modelled period). It is possible for similar water quality to be achieved beyond the modelled period of 200 years and field trials supplemented with additional modelling are recommended for ongoing design refinement.

4.1.4 OPTIMISATION OF SURFACE LANDFORMS (BIODIVERSITY)

CREATION OF AQUATIC HABITATS

A study was undertaken by Scientific Aquatic Services (SAS, May 2019) to determine the value and applicability of using the end pit lake as a comparative biodiversity support area. The study indicated that this can be achieved with suitable water quality and design of the pit lake to support a sustainable ecosystem. The conceptual design principles that need to be implemented in order to support an aquatic habitat are summarised in Table 4-2 below.

Table 4-2: Pit lake conceptual design principles to support an aquatic habitat

Design aspect	Detail
Pit lake level	The pit-lake should be developed in such a way as to ensure that the lake is as full as possible without decanting. It also requires surrounding habitat and safe access to ensure that the pit lake is ecologically connected to the surrounding area. This will allow fauna which need to utilise the water safer access to the water source.
Creation of shallows	Since the pit lake water level will rise very slowly, an attempt to ensure the continued availability of shallow habitats as the water level rises is deemed essential. This will ensure that productivity and ecological functioning in the pit lake is maintained as it fills. The benches along with the access road must have habitat created along their lengths and the benches sloped to create this continuity as the water level rises. Shallow areas in a pit lake are of particular importance as the shallower areas provide increased habitat and substrate within the euphotic zone of the lake thereby increasing the productivity of the lake. The need to create shallows is considered essential. Any fairly shallow areas can be brought up to the recommended average depth of 0.6-1m for the euphotic zone through strategic backfilling. It is however recommended to improve efficiency and results that areas of less steep gradient within the pit are targeted.
Creation of gravel beds and scree slopes	An important component of all aquatic ecosystems is cover and habitat for aquatic fauna as well as aquatic vegetation. Smooth bedrock faces and bench bases provide very little habitat and cover for aquatic life. It is therefore important that a variety of microhabitats are created to allow for the establishment and success of a variety of aquatic species. This can be achieved through the creation of gravel beds and scree slopes. In this regard the following applies: • Interstitial spaces of varying sizes need to form part of the scree beds in the shallower

Design aspect	Detail
	portions of the pit lake. Interstitial spaces provide aquatic habitats for macro-invertebrates (eg dragon flies and possible fresh water crabs). Juvenile and small fish species, that are introduced, will also be able to utilise the created small interstitial space for cover while bigger, more mature fish can utilise larger interstitial spaces. This measure will greatly enhance the ecology of the system. The creation of refugia should, where possible, be limited to the portions of the pit-lake which fall within the recommended maximum depth of 4m, to ensure their viability for use by aquatic species. • Brushwood reefs should also be constructed, in order to provide shelter for smaller fish species and ambush cover for larger predatory fish, and in general increase biological complexity, productivity and stability. The use of natural materials for the construction of brushwood reefs prevents the leaching of chemicals into the water and provides a surface for the growth of algae, an important food source for a number of fish species.
Introduction of aquatic vegetation	Vegetation growth within the pit lake needs to be established given that fish species such as *Pseudocrenilabrus philander* and *Tilapia sparrmanii*, prefer habitats with submerged and/or emergent vegetation. Aquatic vegetation may take a number of forms, namely; submerged; floating-leaved (attached); free-floating; and rooted emergent.
Construction of floating wetlands	Floating wetlands are an important component of the project design because they: • Provide microhabitats for macroinvertebrates and cover for small fish as a result of roots growing through the wetland base and into the water; • Provide a food source as a result of debris entering the pit lake; • Provide important ecosystem services, particularly in terms of the assimilation of toxicants and excess nutrients; and • Create micro-habitats and niche habitats for fish, aquatic macro-invertebrates and waterfowl.
Introduction of desirable fish species	Fish are unlikely to rapidly colonise the pit lake through natural processes, especially due to the remote location of the pit in relation to natural perennial water bodies in the area. Although fish may be introduced to the system through dispersal by natural agents such as avifauna it is considered likely to occur very slowly, if at all. It is therefore recommended that desirable fish species are introduced. Recommended fish species include: • Straightfin barb • Longbeard barb • Mozambique Tilapia • Largemouth Yellowfish • Smallmouth Yellowfish • Mosquitofish • Orange river mudfish • Southern mouthbrooder • Banded Tilapia Consideration should be given to introducing the threatened fish species *Labeobarbus kimberleyensis* (Largemouth yellowfish) which is considered to be vulnerable by the IUCN and is endemic to the Vaal-Orange river systems. If the proposed pit-lake can support this species this provides value to fish conservation.

CREATION OF TERRESTRIAL HABITATS

A study was undertaken by Scientific Aquatic Services (SAS, May 2019) in order to understand the terrestrial ecological characteristics required to create terrestrial habitats. The study indicated that in order for the pit lake to function effectively as part of the greater terrestrial ecosystem the pit lake and surrounding habitat needs to be recreated and rehabilitated to an acceptable degree. This allows for the natural ecological processes to take over and where species diversity, both fauna and flora can naturally increase and self-manage. This is achieved through topography sloping and profiling and topsoil reinstatement, revegetation and creation of faunal habitats. This is discussed in more detail below.

Topography and Topsoil Reinstatement

Prior to any rehabilitation activities, a clear plan is required in order to recreate the natural topography in line with the surrounding natural environment as far as possible. In addition to this, the correct reinstatement of topsoil is important to promote vegetation growth. In this regard, the revegetation/landscape plan principles are summarised in Table 4-3 below.

Table 4-3: Topography and topsoil plan principles

Aspect	Detail
Ripping	• All hardened surfaces will be ripped/scarified in order to allow for the increased ingress of moisture as well as the development of floral species root systems; and • Soils must not be ripped to unnecessary depths so as to limit erosion and surface soil runoff during high rainfall events.
Topsoil use	• Topsoil is only to be used for rehabilitation activities and is not to be used for any other processes.
Topsoil depth	• Suitably deep soil is required to allow for vegetation re-establishment. This is required to ensuring effective rooting depths are met; and • In addition, topsoil depths can be varied across the rehabilitated areas in conjunction with the design and planned vegetation cover promoting habitat and topographical diversity. The typical range depending on the type of vegetation ranges between 300 to 600mm.
Sides of the waste rock dump - Netting	• The side slopes of waste rock dumps must be secured through the use of netting or matting to protect the soil surface until suitable vegetation cover has established; • The netting material helps protect the soil from wind and water erosion, and the required rehabilitation plant material can be installed by making small incisions for planting; and • The netting is biodegradable and will eventually break down and form a mulch layer.
Sides of the waste rock dump - sloping	• Slopes should ideally be 1V:3H, and where possible a lesser gradient should be aimed for. All re-shaped to resemble the pre-construction landscape where possible; and • Decreasing the numbers of elevated terrain units where possible.This automatically decreases the risk of surface water runoff, erosion and downslope sedimentation. The revegetation success rate is likely to increase as a result of this, as plant recruitment is less effective on sloped areas due to plants natural susceptibility to rain and wind erosion in newly established landscapes.
Accessibility	• The overall topography to the pit lake must not prohibitive to species movement and access, notably to and from the water edge; and • Incremental terraces should be used towards the pit lake. The terraces should vary in size and slope, thereby creating terrain diversity, a more natural landscape effect and better use of the

Aspect	Detail
	area for faunal and floral species. Such terrace design combined with the proposed revegetation/landscape plan can be used to efficiently and effectively utilise the available topsoil by creating areas of both deep and shallow soil structures as required by different plant species (effective rooting depths).

Revegetation

Revegetation is a process undertaken whereby floral species are established in areas that have previously been cleared, in order to restore and reclaim the lost habitat, ideally to a similar condition of that prior to mining conditions. Habitat restoration processes are often slow, taking decades and the final community of plants may not be the most desirable, notably when unmanaged. It follows that a revegetation plan must be in place in order to avoid such a scenario as far as possible. The revegetation plan principles are summarised in Table 4-4 below.

Table 4-4: Revegetation plan principles

Aspect	Detail
Planting of trees and shrubs	• Revegetation should utilise species that are endemic to the area, including plant species that were rescued as part of a floral rescue and relocation plan; • Plants that have already been relocated to other areas are to remain there and not be removed and replanted again for the revegetation purposes; • In the event that rescued plant species were placed in a nursery environment for future rehabilitation activities, it is important to take note of the following guidelines when using these plants for revegetation: ○ In the area where replanting is to occur, dig a hole which is slightly larger and deeper than the plant's root structure; ○ Place the plant in the hole and ensure that it is deep enough that the roots are covered; ○ When placing the plant in the hole, it is recommended that as far as possible to retain the existing soil around the root structure; ○ Replace enough soil in the hole to cover the roots and compact the soil to secure the plant in the hole. If necessary, use more soil and compact again; ○ Make a depression around the plant with a spade such that water will drain towards the plant; ○ Do not plant the plants in straight lines, but rather randomly as in the natural environment; and ○ Ensure that planted areas are sufficiently watered in order to ensure their survival, notably in the early phases of germination, but be careful not to overwater the plants as this could lead to the rotting of the roots as well as erosion of the soil surface.
Collective seeding	• Collect seeds from indigenous plant species on site and surrounding natural habitats; • Avoid collection of unripe and underdeveloped seeds as this will lead to unsuccessful germination of the seeds when replanted; • Collected seeds should be dried and placed in paper bags and stored in cardboard boxes in a cool dry area, keeping in mind that the viability of the seeds will reduce

Aspect	Detail
	with time. It follows that seeds must be collected in the year leading up to the desired re-seeding activity to ensure the maximum viability of the seeds collected; and • Seed collection should be undertaken/overseen by a suitably qualified specialist who is familiar with the various seed types associated with the plant species in the area.
Seeding mix	• An alternative to the manual collection is the use of a seed mix; and • Seed mixes contain a higher species diversity, has been properly collected and stored, is weed free and is likely to have a higher germination rate than that of the collected seeds.
Reseeding timing	• As far as possible reseeding of grass species should occur in the winter months, allowing for seeds to settle into the soil surface and establish prior to the onset of the first rains; • Reseeding should be guided by a rehabilitation specialist who understands the region, the vegetation and rainfall patterns; and • Reseeding methods to consider include, manual hand seeding an area or hydro-seeding. These methods are dictated by the site, topography and accessibility of the areas to be reseeded.
Habitat surrounding the pit lake	• The habitat recreated around the pit lake is, should be similar to Kathu Thornveld vegetation type as far as possible; • Revegetation of the banks and immediate landscape adjacent to the pit lake should be done using grass species and small shrubs that are tolerant to fluctuating water levels, so as to ensure continued bank stability; • Riparian zones may be introduced with guidance of a suitably qualified specialist. It is recommended that tree species such as *Vachellia karoo* and *Ziziphus mucronata* be used in patches along the bank to create stability. Further up the bank slopes species such as *Vachellia hebeclada*, *Grewia flava* and *Vachellia haematoxylon* can be incorporated to create small woodland areas; and • The establishment of *Vachellia erioloba* will take an extended period of time as these are slow growing species. It follows that saplings of *Vachellia erioloba* be obtained from a nursery and used during the rehabilitation process. Saplings should be used as this will ensure a higher survivability rate.
Control of alien and invasive species	• The existing alien and invasive species plan should be updated closer to the time of closure in order to facilitate the control in the context of the closure activities; and • The continued implementation and updating of the alien invasive species plan is imperative as these species in general have a higher recruitment rate than indigenous species, notably in disturbed areas.

Faunal habitat and Pit Lake

Physical relocation of faunal species as part of the proposed project is not a viable option given that it is costly and requires areas to be fenced off in order to control species movement. Natural relocation and faunal dispersal will be relied upon in order to repopulate the rehabilitated areas, provided the habitat is suitable. In order to create an environment that will support the natural relocation of faunal species the following should be noted:

- The quality of the pit lake water needs to be suitable for animal consumption in the long term. This may be achieved through the establishment of floating wetlands;
- The quality of the pit lake water needs to be suitable to support instream aquatic species in order to ensure that the pit lake functions as a complete ecosystem;
- Accessibility to and through the site must not be hindered. This forms part of the revegetation/landscape plan discussed above; and
- The establishment of alien invasive species must be avoided as this will create undesirable habitats.

A suitable habitat will provide a food resource to attract faunal species, which can be supported by the pit lake as a source of water in a water scare environment. The installation of floating wetlands and the creation of reed beds along the edge of the pit provide a suitable habitat for breeding and foraging for avifaunal species and amphibians. The natural introduction of insects provides a food resource to other faunal species but also is a good indicator of the overall health of the ecosystem through species diversity and abundance. The natural introduction of arachnids provides a good indicator of the overall success to the pit lake activities through the rate of recolonization.

4.1.5 FUTURE POTENTIAL ADDITIONAL LAND USES – NOT PART OF THE PROPOSED PROJECT

The preceding section (above) provides the sustainable closure land use plan which is a combination of natural habitat creation (aquatic and terrestrial) and availability of water for livestock watering.

This section provides additional concepts that could be considered as potential future additional land uses, which could be considered at some point in the future.

Aggregate crushing and screening

The proposed project will result in an increase of waste rock dump remaining on surface post closure. Selected waste rock can be used as part of a crushing and screening operation for the production and sale of aggregate post closure. The applicability of this option will however depend on market demands at the time.

Aquaponics

The development of a pit lake provides access to water that can be used to promote alternative land uses post closure. As part of the proposed project a soil study was undertaken by Terra Africa (Terra Africa, May 2019) to identify possible alternative land uses. In this regard, the establishment of aquaponics farming units is an identified possibility subject to water quality and availability. Aquaponics is a combination of hydroponics (crops growing in contained spaces where alternative growing media is used and nutrients are provided in the water) and aquaculture (the production of fish and seafood). This system is water efficient (uses 95% to 99% less water than conventional crop production methods) and nutrients are recycled while the water gets filtered by the crop roots. The system is becoming increasingly popular globally as a method to produce both protein and vegetables while using resources optimally.

Aggregate is a popular growth medium used in aquaponics. The waste rock dump at the mine may prove to be a great source of aggregate. Selected waste rock can be crushed in order to be the optimal size for use in aquaponics.

In addition to aquaponics units, some of the existing infrastructure (buildings) can be converted into plant factories. It is a highly efficient system with regards to water use and the crops grow much faster inside the plant factories than other systems. Artificial light is used inside the buildings to allow plants to grow even during the night.

Intensive grazing

Water from the pit lake could be used for irrigation of pastures since the soil has suitability for irrigation. The pasture produced can be used for intensive grazing of sheep and/or goats or to set up a feedlot for sheep and goats. It follows that the agricultural enterprises on the land may be diversified and create more employment opportunities. Several secondary businesses can also be developed from these production units.

Solar plant

As part of the public participation, a focussed meeting was held with the Northern Cape Department of Agriculture Forestry and Fisheries. One of the suggestions from the department was to include the possibility of establishing solar plants on the top of existing waste rock dumps. This approach eliminates the need for solar operations to remove protected tree species, which would otherwise need to be removed at green field solar development areas. The energy requirements for some of the above-mentioned land uses, such as aquaponics, could come from solar generation.

Use of existing mine buildings for additional land uses

As part of the proposed project, all of the surface infrastructure (except the waste rock dumps) will be removed at closure. There is the possibility of not removing some of the existing infrastructure (eg, buildings), which can be used to support some of the future potential additional land uses discussed above.

4.1.6 DECOMMISSIONING AND CLOSURE PHASE

In broad terms the decommissioning phase will focus on removal of infrastructure and preparation of the site for final rehabilitation and closure. It is anticipated that the decommissioning phase will last for approximately two to five years during which period as many as 20 employees and numerous contractors with their employees will be retained on site for the associated work. Decommissioning activities include:

- Surface infrastructure will be demolished and removed, with the exception of the waste rock dumps and pit access road. Rehabilitation of the waste rock dumps will have started during the operational phase and will be completed during decommissioning;
- All demolition material and waste will be removed from the project area and disposed of appropriately i.e. inert materials into the pit and hazardous waste to an appropriately licensed disposal facility;

- All contaminated soil will either be treated in-situ or removed from the project area and disposed of appropriately; and
- Areas where infrastructure has been removed will be levelled and prepared for rehabilitation in accordance with the topography and topsoil (Section 4.1.4) and revegetation plans (Section 4.1.4).

At the end of the decommissioning phase the site will be ready for closure (the closure phase). The key activities during the closure phase will be:

- Monitoring;
- Aftercare; and
- Maintenance/ adjustment as required.

4.2 LIFE OF MINE

Tshipi has a remaining life of mine of 25 years and has been operational for 7 years.

5. ENVIRONMENTAL RISK ASSESSMENT

5.1 RISK ASSESSMENT METHODOLOGY

The methodology applied to assess the significance of risks is provided in Table 5-1 below.

Table 5-1: Criteria for assessing risks

Note: Part A provides the definition for determining impact consequence (combining severity, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D.

PART A: DEFINITION AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY of environmental risks	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of risks	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of risks	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE					
			SEVERITY = L		
DURATION	Long term	**H**	Medium	Medium	Medium
	Medium term	**M**	Low	Low	Medium
	Short term	**L**	Low	Low	Medium
			SEVERITY = M		
DURATION	Long term	**H**	Medium	High	High
	Medium term	**M**	Medium	Medium	High
	Short term	**L**	Low	Medium	Medium
			SEVERITY = H		
DURATION	Long term	**H**	High	High	High
	Medium term	**M**	Medium	Medium	High
	Short term	**L**	Medium	Medium	High
			L	**M**	**H**
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		

PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	Medium	Medium	High
	Possible/ frequent	**M**	Medium	Medium	High
	Unlikely/ seldom	**L**	Low	Low	Medium
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact.**

5.2 IDENTIFICATION OF STRATEGIES TO MANAGE AND MITIGATE THE IMPACTS AND RISKS

Impacts and risks identified for the proposed project and measures to prevent and/or mitigate the impacts are summarised in Table 5-2 below.

The potential impacts and risks associated with the proposed project can be categorised into those that have low, medium and/or high significance in the unmitigated scenario. All three categories of impacts require a measure of management actions which, if successfully implemented will reduce and or enhance the significance of the impacts. Cumulative impacts and latent impacts are also summarised in the table below. In addition to this, the table also provides a summary of the positive and negative impacts comparing the impact significance rating in both the unmitigated and mitigated scenarios for the current approved commitment (option 1) versus the proposed preferred closure option (option 3).

Strategies to manage and mitigate impacts and risks have been identified, taking into account, the findings of specialist studies (where relevant) and consideration of the project plan. These management and mitigation strategies are aimed at controlling the project activities and process which have the potential to result in environmental degradation if unmanaged. For the detailed discussion on impacts and mitigation, refer to Appendix E of the BAR (SLR, August 2019).

Table 5-2: Impacts and risks identified and associated mitigation measures

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
Geology (mineral resources)	Loss and sterilisation of mineral resources	The approved EMPr's (SLR, August 2017 and April 2019), commits Tshipi to completely backfilling the open pit at closure and as such will sterilise a deeper mineral resource located to the north of the current approved open pit because of the necessity (and associated cost) of establishment of a vertical shaft complex to access the resource that could otherwise be accessed from the highwall of the open pit. This issue is relevant to whomever in future applies to mine the underground resource. In terms of the proposed project, underground resources will be easily accessible and not sterilised. In addition, In the current approved scenario, after complete backfilling, access to selected waste rock resources will be difficult or not possible while in the scenario of the proposed project (concurrent backfill only) there is more opportunity to access selected backfill for crushing, screening and sale as building material. Related management actions focus on efficient planning and execution of concurrent backfilling. No cumulative impact or additional latent impacts have been identified. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). In this regard, this impact related to the difficulty of accessing mine residue resources primarily associated with waste rock backfilled into the open pit during complete backfilling and to a lesser degree from remaining surface residue facilities. It must be noted that at the time of completing the previous assessment, the feasibility of accessing underground resources in the future had not been contemplated and was therefore not included in the previous assessment. The proposed project therefore alters the approved unmitigated and mitigated impact ratings.	High	Low	Medium positive	High positive

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
Topography	Safety to third party and animals	Hazardous infrastructure and excavations include all structures into or off which third parties (persons) and animals (livestock and wild animals) can fall and be harmed. The proposed project will present final rehabilitated areas that are considered hazardous (waste rock dumps) and a partially open pit with a pit lake.). In addition to this, the proposed project allows for the early rehabilitation of waste rock dumps that have reached final form concurrent with mining activities. Related management actions include general site rehabilitation, early rehabilitation of waste rock dumps, making the pit safe and access control. No cumulative impact or additional latent impacts have been identified. This impact was assessed as part of the approved EMPr (SLR, August 2017). The proposed project does not alter the approved impact significance rating.	High	Low	High	Low
Soil and land capability	Loss of soil resources and land capability through contamination	Soil is a valuable resource that supports a variety of ecological functions. Soil is the key to re-establishing post closure land capability. The loss of soil resources has a direct impact on the potential loss of the natural capability of the land. Decommissioning pollution sources include spillages of waste material, dirty water, fuel, lubricants and leaks from vehicles and equipment and run-off from waste rock dumps. Post closure infrastructure includes waste rock dumps remaining on surface that may have the potential to contaminate soil through long term run-off. Related management actions focus on controlling decommissioning activities as per the approved EMPr (pollution prevention) and rehabilitation. No cumulative impact or additional latent impacts have been identified. This impact was assessed as part of the approved EMPr's (SLR, August 2017	High	Low	High	Low

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		and April 2019). The proposed project does not alter the approved impact rating.				
	Loss of soil resources and land capability through physical disturbance	Soil is a valuable resource that supports a variety of ecological functions. Soil is the key to re-establishing post closure land capability. The loss of soil resources has a direct impact on the potential loss of the natural capability of the land. Decommissioning activities and post closure infrastructure such as waste rock dumps remaining on surface have the potential to disturb soils and related land capability through removal, compaction and/or erosion, particularly in the unmitigated scenario. In the case of erosion, the soils will be lost to the area of disturbance. In the case of compaction, the soils functionality will firstly be compromised through a lack of rooting ability and aeration, and secondly the compacted soils are likely to erode because with less inherent functionality there will be little chance for the establishment of vegetation and other matters that naturally protects the soils from erosion. Related management actions focus on controlling decommissioning activities as per the approved EMPr (soil conservation), rehabilitation and post closure monitoring. No cumulative impact or additional latent impacts have been identified. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). The proposed project does not alter the approved impact rating.	High	Low	High	Low
Biodiversity	Physical destruction of biodiversity	Areas of high ecological sensitivity are functioning biodiversity areas with species diversity and associated intrinsic value. In addition, some of these areas host protected species (Grey Camel Thorn and Camel Thorn). The linking areas have value because of the role they play in allowing the migration or movement of flora and fauna between the areas which is a key function for the broader ecosystem. The transformation of land for any	High	Medium	High	High positive

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		purpose, including mining and associated activities, increases the destruction of the site specific biodiversity, the fragmentation of habitats, reduces its intrinsic functionality and reduces the linkage role that undeveloped land fulfils between different areas of biodiversity importance. Decommissioning and post closure activities that result in exposed and un-revegetated areas, un-rehabilitated waste rock dumps and an un-profiled open pit in the unmitigated scenario has the potential to physically destroy biodiversity. With rehabilitation and access to a functional pit lake, aquatic habitats can be created and terrestrial habitats can be enhanced. Related management actions focus on controlling decommissioning activities as per the approved EMPr (limiting vegetation clearing, biodiversity action plan, obtaining tree permits), rehabilitation, pit lake design to support sustainable aquatic systems and post closure terrestrial ecology and post closure monitoring. No cumulative impact or additional latent impacts have been identified. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). With mitigation the significance rating changes with a change to the closure commitment because with access to a functional pit lake, aquatic habitats can be created and terrestrial habitats can be enhanced. The proposed project therefore alters the approved mitigated impact rating.				
	General disturbance of biodiversity	In the absence of rehabilitation, decommissioning activities can generally disturb biodiversity through the presence of exposed areas, contaminated soil, alien invasive species an un-profiled pit and anthropogenic activities which in turn effects the success of rehabilitation. The closure phase may also present contaminated water within the pit lake, that if consumed may be harmful to vertebrates and invertebrates without mitigation. In terms	High	Medium	High	Medium positive

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		of the proposed project, with successful rehabilitation and revegetation, a suitable aquatic habitat (inclusive of suitable water quality within the pit lake) and terrestrial habitat will be created. This will promote the natural relocation of faunal species and reintroduction of floral species into the area, thereby restoring and enhancing biodiversity complexity, diversity, community sensitivity and overall community stability. Related management actions focus on controlling decommissioning activities as per the approved EMPr (rehabilitation, alien and invasive species programme, zero tolerance animal killing policy, veld fire prevention, speed control and pollution preventing) and monitoring. No cumulative impact or additional latent impacts have been identified. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). In terms of the proposed project, with access to a functional pit lake, suitable aquatic and terrestrial habitats can be created and enhanced that in turn will encourage the natural relocation of faunal species and reintroduction of floral species into the area. The proposed project therefore alters the approved mitigated impact rating.				
Surface	Alternation of natural drainage patter	During the closure phase, stormwater management infrastructure to contain dirty water as required by legislation will be required around the perimeter of the waste rock dumps. In this regard the collection of rainfall and runoff will be via toe paddocks. The toe paddocks will remain until such time as the waste rock dumps have been rehabilitated successfully, after which they can be removed. Further to this, natural surface water run-off and rainfall will also be collected in the partially open pit. The collected rain-fall and run-off will therefore be lost to the catchment and can result in the alteration of drainage patterns in a similar manner to what is currently occurring on site and will perpetuate during the	Medium	Low	Medium to Low	Low

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		decommissioning phase. Related management actions focus on rehabilitation to restore natural drainage patterns where possible. No cumulative impact or additional latent impacts have been identified. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). In this regard, with rehabilitation at closure natural drainage patterns would be restored. In terms of the proposed project, the alteration of natural drainage patterns for the partially open pit cannot be mitigated; however it is important to note that the collection of rainfall and run-off in the partially open pit does contribute to the development of the pit lake which can be used for alternative uses. The end ratings remain similar.				
	Contamination of surface water resources	Decommissioning activities that have the potential to pollution surface water resources include sedimentation from erosion, spillages (waste material dirty water, fuel, lubricants and leaks), contaminated soil and run-off from waste rock dumps. Post closure activities that have the potential to pollute surface water resources include contaminated pit lake water, sedimentation from erosion and run-off from waste rock dumps. It is unlikely that contaminates will reach the nearest water course (Vlermuisleegte), given that it is located two km west of the mine and is ephemeral in nature and is therefore associated with long periods of no flow. In terms of the pit lake, in the unmitigated scenario, the water can become contaminated over time. Management actions focus on pollution prevention, rehabilitation, monitoring, establishment of floating wetlands (required to treat pit lake water to meeting DWS livestock watering objectives) and compensation for any water related loss. A potential latent impact could be associated with long terms deterioration	Medium	Low	High	Low

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		of pit lake water quality subject to the success of the ongoing floating wetland treatment. If this latent impact manifests and cannot be mitigated through treatment adaptations then the use of/access to the pit lake will have to be reconsidered. The associated default management measures will be to fence and/or berm off access to the pit lake. No cumulative impacts have been identified. **Further detail is provided in Section 5.3.** This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). The proposed project introduces issues associated with the pit lake which changes the approved impact rating in the unmitigated scenario. There is no difference in the impact ratings in the mitigated scenario.				
Groundwater	Lowering of groundwater levels	Prior to mining the natural depth of the water in surrounding boreholes ranged from 25 to 55 m below ground level. Groundwater level monitoring data currently shows water depths ranging from 41 to 75 m below ground level. At decommissioning (when mining stops), the modelled cone of drawdown developed due to dewatering is predicted to be at a maximum extent of 5.5 km to the east and 8.3 km to the west of the Tshipi Borwa Mine. Third parties within the simulated cone of depression may therefore experience a drop in water levels. When mining and dewatering cease, groundwater levels will start to rebound and the water level in the pit will increase. Over time, as the pit lake level rises inflows will diminish until a steady state level is reached. Due to evaporative loses and pit geometry; the partially filled pit will continue to be a hydraulic sink in perpetuity because the steady state pit lake level will remain approximately 6m below the natural groundwater level which is approximately 35 below ground level. The associated cone of depression hydraulic gradient will be significantly reduced. It follows that groundwater levels at off-site third party boreholes are predicted to rebound to natural groundwater level.	Insignificant			

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		This impact is therefore considered to be insignificant. Related management actions focus on monitoring groundwater levels and compensation for loss of water supply. No cumulative impact or additional latent impacts have been identified. This impact was not assessed as part of the approved EMPr's (SLR, August 2017 and April 2019) given that it was assumed groundwater levels in off-site third party boreholes rebounded to natural ground level at closure. The proposed project does not alter the approved impact rating.				
	Contamination of groundwater resources	The closure phase will present final land forms such as waste rock dumps remaining on surface and the waste rock backfilled into the open pit that may have the potential to pollute water resources through long term seepage and/or run-off. As part of the proposed project, the partially backfilled pit will act as a hydraulic sink and as such the extent of the pollution plume will reduce because the draw down cone will draw some of the pollution plume into the pit. No impact on any off-site third party boreholes is predicted. Related management actions focus on monitoring groundwater quality and compensation for loss of water supply. No additional latent impacts have been identified. Modelling results includes contributions from off-site sources in the context of current water quality. The predicted modelled results therefore are cumulative in nature. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). The proposed project does not change the approved impact rating, however the proposed project minimises the extent of the pollution plume because of the hydraulic sink associated with the partially backfilled pit.	Low	Low	Low	Low

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
Air	Air pollution	The main contaminants associated with the proposed project include: inhalable particulate matter less than 10 microns in size (PM10 and PM2.5), larger total suspended particulates (TSP) that relate to dust fallout, Mn concentration (within waste rock dumps), and gaseous emissions mainly from vehicles and generators. At closure, the main source of windblown dust will be from the exposed land and waste rock dump surfaces. These contaminates have the potential to contribute to the pollution of air. It is however important to note that modelling results indicated that exceedances of the PM10, PM2.5, dust fallout and Mn concentrations are unlikely to be experienced at sensitive receptors. Related management actions focus on monitoring and dust suppression (particularly during the decommissioning phase). No additional latent impacts have been identified. Modelling results includes contributions from off-site sources in the context of current air quality. The predicted modelled results therefore are cumulative in nature. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). The impact was rating remained high for Mn concentrations even with mitigation as modelling predicted that exceedances of the World Health Organisation (WHO) guidelines were expected at some residence near the mine. It is important to note that since the compilation of the previous EIA/EMPrs, the Mn content concentrations within the waste rock dumps at Tshipi have been sampled. The new information demonstrates that there is less Mn content than previously assumed. It follows that for the proposed project, the approved mitigated impact rating has changed.	High	Medium (remained High for Mn)	Low	Low
Noise	Increase in disturbing noise	Noise pollution can create nuisance that will have different impacts on different receptors because some are very sensitive to noise and others	Not applicable	Not applicable	Low	Low

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
	levels	are not. Potential human noise receptors include the isolated residences and farmhouses within 2 km radius of the Tshipi Borwa Mine. Based on the prevailing wind field, disturbing noise levels are expected to be more notable to the east and south during the day and to the north and north-northwest during the night. Post closure activities that may generate disturbing noise levels include intermitted vehicle and materials handling activities associated with post closure monitoring, maintenance and aftercare. Existing operational baseline noise at the Tshipi Borwa mine is below the IFC guideline for residential areas, and as part of on-site monitoring, no audible noise from the mining operations were noted, only noise from cicadas (insects). Related management actions focus on noise attenuation, equipment and vehicle maintenance and limiting traffic to day time hours. No cumulative impact or additional latent impacts have been identified. This impact was not assessed as part of the approved EMPr's (SLR, August 2017 and April 2019) as noise disturbances and noise nuisance activities were limited to all phases prior to closure. The proposed project presents addition monitoring, aftercare and maintenance/adjustment requirements (creating of aquatic habitats) and as such alters the impact rating.				
Visual	Negative visual views	The visual landscape is determined by considering: landscape character, sense of place, scenic quality, sensitivity of the visual resource and sensitive views. In this regard, the visual landscape within the Tshipi Borwa Mine area has been transformed due to the presence of approved mining infrastructure and activities. In general, the visual landscape of the area surrounding the Tshipi Borwa Mine is characterised by flat open areas associated with semi-arid vegetation and an ephemeral river (Vlermuisleegte River), that has been influenced by the presence of	High	Low	High	Low

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		existing mining operations, roads, powerline infrastructure and isolated farmsteads. The proposed project will present visual intrusions (waste rock dumps remaining on surface and a partially open pit) post closure that may be perceived negatively by sensitive receptors, particularly in the unmitigated scenario were rehabilitation activities during decommissioning have not been implemented. It is however important to note that Tshipi is located adjacent to existing mining operations (UMK and Mamatwan), which has resulted in a deteriorated the natural landscape. Related management actions focus on rehabilitation and in particular early rehabilitation of waste rock dumps as part of current mining operations. No latent impacts have been identified. Assessing impacts in the context of surrounding mines provides a cumulative impact assessment perspective. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). The proposed project does not alter the impact rating; however the state of rehabilitation of closure will be improved in the mitigated scenario through the early rehabilitation of the waste rock dumps.				
Traffic	Road disturbance and traffic safety	The proposed project will not generate additional traffic and as such project-related road disturbance and traffic safety impacts are not expected to occur. No cumulative impact or additional latent impacts have been identified.	Insignificant			
Heritage/cultural and palaeontological resources	Loss of heritage/cultural and palaeontological resources	No heritage resources occur at the Tshipi Borwa Mine. In addition, there is a low possibility of palaeontological resources occurring in the area. However, related management actions focus on the steps required in the unlikely event of a chance find.	Insignificant			

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		No cumulative impact or additional latent impacts have been identified.				
Socio-economic	Inward migration	Mining operations tend to bring with them an expectation of employment in all phases prior to closure. This expectation can lead to the influx of job seekers to an area which in turn increases pressure on existing communities, housing, basic service delivery and raises concerns around safety and security. Impacts associated with inward migration were assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). While the rehabilitation plan and closure plan will have been adjusted in order to cater for the proposed project and a change to the closure objective, the proposed project will not present any additional job opportunities as Tshipi will make use of existing contractors and workers as part of rehabilitation activities. It follows that the potential for an increased social risks is considered to be negligible for the proposed project. Related management actions focus on implementing the approved EMPr commitments relating to recruitment, communication and health awareness training. No cumulative impact or additional latent impacts have been identified.	Insignificant			
	Economic impact	Mining has a positive net economic impact on the national, local and regional economy. Direct benefits are derived from wages, taxes and profits. Indirect benefits are derived through the procurement of goods and services, and the increased spending power of employees. In the current approved scenario, the open pit is completely backfilled and the land is reinstated to that of grazing/wilderness. From a net economic perspective, the economy will lose an estimated value of more than R 21.4 billion on a national regional and local level because the completely backfilled pit will prohibit the access to future underground resources. In terms of the proposed project, the national, regional and local economies	Medium to high positive	Medium to high positive	High+	High positive

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		will gain R21.5 billion because the partially backfilled pit allows easy access to underground resources. Related management actions focus on efficient planning and execution of concurrent backfilling only (in-pit dumping) No latent impacts have been identified. This impact was assessed as part of the approved EMPr's (SLR, August 2017 and April 2019). It must be noted that at the time of completing the previous assessment, the feasibility of accessing underground resources in the future had not been contemplated and was therefore not included in the previous assessment and as such the impact rating changes.				
Land use	Change in land use	Mining-related activities have the potential to affect land uses both within the mine area and in the surrounding areas. The key related potential environmental impacts include soil, land capability, biodiversity, water, air, noise, visual, and economic impacts. The approved EMPr's (SLR, August 2017 and April 2019), requires that the surface is reinstated to pre-mining state of wilderness and grazing and requires that the open pit is backfilled at closure. The proposed project is proposing a change to this strategy, where the closure land use objective is to create a sustainable closure land use which is a combination of natural habitat creation (aquatic and terrestrial) and availability of water for livestock with associated grazing potential. Related management measures focus on rehabilitation. No latent impacts have been identified. Depending on the nature and scale of surrounding mining activities at the post closure stage, this could be cumulative impact category. This impact was assessed as part of the approved EMPr's (SLR, August 2017 April 2019). The proposed project presents a change in the closure strategy	High	Low	High	High positive

Aspect	Potential impact	Summary of impact discussion and reference to mitigation measures for the proposed project	Impact significance (approved EMPr) – option 1		Impact significance (proposed project) – option 3	
			Unmitigated	Mitigated	Unmitigated	Mitigated
		and creates and enhances alternative land uses (terrestrial and aquatic habitats) and provides a water resource for livestock watering with associated grazing potential. The proposed project therefore alters the approved mitigated impact rating.				

5.2.1 IDENTIFICATION OF INDICATORS

Three key indicators have been defined which will facilitate evaluation of the ongoing environmental impacts and associated risk to closure (risk triggers). These three key indicators can be evaluated through analysis of ongoing monitoring results. These indicators include:

- Surface water quality.
- Groundwater quality.
- Vegetative cover.

The first indicator, surface water quality, is an important measure of the effectiveness of mitigation activities (particularly for the latent environmental impact of surface water in the open pit and the associated stormwater runoff from the remaining rehabilitated waste rock facilities and mine areas) and for protecting the health and safety of on-site land users, livestock, and wildlife.

Similarly the second indicator, ground water quality, is an important measure of the effectiveness of mitigation activities (particularly for the latent environmental impact of groundwater associated with the open pit and seepage from the remaining waste rock facilities) and for protecting the health and safety of neighbouring and/or down gradient land users, livestock, and wildlife.

The third indicator, vegetative cover, is highly correlated with all the other major environmental parameters of the area, including erosion, dust, physical stability, chemical stability, soil quality and hydrology. Good vegetative cover results in a reduction in the volume of surface runoff, increases soil and slope stability, and leads to the formation of an organic layer. In addition, vegetative growth is visually correlated with successful rehabilitation (and/or protection of the surrounding environment). This is an extremely important indicator because it provides a simple, very effective and relevant measure of the lands' current (and/or future) capability.

Other indicators of rehabilitation success (such as floating wetlands assessment, aquatic biomonitoring, faunal monitoring and air quality monitoring) have also been included in the overall general rehabilitation monitoring programme as described in Section 14.2. In addition to this, the natural introduction of insects is a good indicator of the overall health of the ecosystem through species diversity and abundance. The natural introduction of arachnids provides a good indicator of the overall success to the pit lake activities through the rate of recolonization.

5.2.2 CHANGES TO RISK ASSESSMENT RESULTS

Will the exception of the latent impact associated with the pit lake water quality, as discussed in Section 5.3 below. No changes to the risk assessment are expected and no reassessment of risks is required.

5.3 LATENT IMPACT

5.3.1 LATENT RISK ASSESSMENT RESULTS

There are a number of pollution sources that have the potential to pollute surface water, particularly in the unmitigated scenario. In the decommissioning phase these potential pollution sources are temporary in nature. Although these sources may be temporary, the potential pollution may be long term. The closure phase will present final land forms such as the waste rock dumps that may have the potential to contaminate surface water through long term seepage and/or run-off.

Table 5-3: Impact rating discussion

Criteria	Discussion
Severity/nature	The decommissioning and closure infrastructure and activities present numerous sources of pollution that can contaminate surface water resources. In the unmitigated scenario, potential decommissioning phase pollution sources associated include: • Sedimentation from erosion; • Spillage of waste material, dirty water, fuel, lubricants and leaks from vehicles and equipment • Contaminated soil areas; and • Run-off from waste rock dumps Potential closure phase pollution sources include: • Contaminated pit lake water quality; • Sedimentation from erosion; and • Run-off from waste rock dumps. At elevated concentrations contaminants can exceed the relevant surface water quality limits imposed by DWS and can be harmful to humans and livestock if ingested directly and possibly even indirectly through contaminated vegetation, vertebrates and invertebrates. In the unmitigated scenario this is a high severity. In the mitigated scenario, where decommissioning activities are controlled according to the existing approved EMPr and the closure plan is effectively implemented, the severity reduces to low. It must be noted that this conclusion is drawn in the context of successfully achieving the stated end pit lake quality objective which is suitable for livestock watering and a functional biodiversity system but not for domestic use.
Duration	In the unmitigated scenario the sources of the contamination will extend beyond closure which is a high duration. With management actions, pollution can be prevented and/or managed and as such the impacts can be limited to the pre-closure phase. It must be noted that the pit lake water quality modelling only extended to 200 years post closure.
Spatial scale	In the unmitigated scenario contaminates could migrate off site, which is a medium spatial scale. In the mitigated scenario, all potential surface contamination sources will have been removed or mitigated preventing any possibility of offsite surface water contamination. This is a low spatial scale.
Probability	The probability of the impact occurring relies on a causal chain that comprises three main elements: • Does contamination reach surface water resources; • Will people and livestock utilise this contaminated water; and • Is the contamination level harmful? The first element is that contamination reaches the surface water resources. Due to the distance of the Tshipi Borwa Mine to the closest surface water resource (Vlermuisleegte River), which is located 2 km west of the mine, it is unlikely that pollution sources will reach surface water resources. It should also be noted that the Vlermuisleegte is ephemeral in nature and therefore is associated with long periods of no flow. In the unmitigated scenario, the pit lake will become a surface water resource that is contaminated.

Criteria	Discussion
	The second element is that third parties and/or livestock use this contaminated water for drinking purposes. In the unmitigated scenario this is a definite possibility because one of the stated end uses is grazing and use of the pit lake for livestock watering. The third element in the unmitigated scenario, it is that it likely that some contaminants will be at a level which is harmful to humans and livestock. In the unmitigated scenario, this is possible particularly for the pit lake. As a combination, the unmitigated probability is high, reducing to low with management actions.

Taking the above into consideration in the unmitigated scenario, the significance of this potential impact is high. In the mitigated scenario, the significance is reduced to low.

It is however important to note that a potential latent impact could be associated with long term deterioration of pit lake water quality subject to the success of the ongoing floating wetland water treatment.

Unmitigated and Mitigated – summary of the impact

Severity / nature	Duration	Spatial scale / extent	Consequence	Probability of Occurrence	Significance
Unmitigated					
H	H	M	H	H	H
Mitigated/residual impact					
L	L	L	L	L	L

5.3.2 LATENT RISK DRIVER, TRIGGER AND EXPECTED TIMEFRAME

As part of the proposed project, modelling of the pit lake quality was undertaken (SLR, June 2019). The modelled results indicate that the pit lake has concentrations which do not exceed the relevant water quality standards for livestock for the modelled period of 200 years. This is water quality objective is achieved by using floating wetlands as a semi passive treatment solution. Beyond 200 years it may be possible to maintain the water quality but this requires field implementation, monitoring and adjustment where relevant to mitigate /prevent the potential latent impact.

5.3.3 CHANGES TO RISK ASSESSMENT RESULTS

If this latent impact cannot be mitigated / prevented through treatment adaptations then the use of/access to the pit lake will have to be reconsidered. The associated default management measure will be to fence and/or berm off access to the pit lake. The impact rating will then reduce to medium

5.3.4 FINANCIAL PROVISION FOR LATENT ENVIRONMENTAL IMPACTS

In the event that financial provision for the latent impact (i.e. restricting access to the pit lake) is required, then a provisional amount for the construction of a perimeter fence and/or berm would be of the order of R 4.95 million (incl. VAT). This provisional amount is considered to have an accuracy of ±30% based on the level of detail currently available and the associated assumptions regarding the type of fencing and berm required.

6. CLOSURE DESIGN PRINCIPLES

6.1 LEGAL AND GOVERNANCE FRAMEWORK

The following legislation has been complied with in the drafting of this closure plan:

- *Environmental Impact Assessment Regulations, 2014* (GNR 982 of 4 December 2014) that requires a closure plan to contain the information set out in Appendix 5 of these Regulations (GNR 982, 2014).
- *Mineral and Petroleum Resources Development Amendment Bill, 2013* (Bill 15 of 2013) that require that the holder of a mining right must make the prescribed financial provision for the rehabilitation and management of any negative environmental impacts due to mining activities.
- *Financial Provisioning Regulations, 2015* (GNR 1147 of the National Environmental Management Act (107/1998): Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations, published 20 November 2015.

The calculation of the closure cost liability estimates has been undertaken using the 2nd Draft Financial Provisioning Regulations (Government Gazette 42464, 2019)[1].

6.2 VISION, OBJECTIVES AND TARGETS FOR CLOSURE

The vision, objectives and targets for closure have been developed against the local environmental and socio-economic context of the current mining operations, as well as, regulatory requirements and perceived stakeholder expectations. Stakeholders will continuously be involved in the closure planning process throughout the mine life. The mine will strive to maintain a good working relationship with stakeholders and the local communities in which they operate. Agreements and final approval will be sought from authorities as closure approaches.

6.2.1 VISION FOR CLOSURE

As part of the proposed project the vision for closure is to create a sustainable closure land use which is a combination of natural habitat creation (aquatic and terrestrial) and availability of water for livestock with associated grazing potential.

6.2.2 OBJECTIVES FOR CLOSURE

The proposed closure land use objective is to create a sustainable closure land use that includes the following:

- To create a functioning ecosystem that supports a sustainable end land use;
- To ensure a suitable pit lake quality;
- Environmental damage is minimised to the extent that it is acceptable to all parties involved;

[1] The calculation of the closure liability in the current Financial Provisioning Regulations, 2015 requires mines to provide for their anticipated closure liability 10 years in advance, based on their current mine plans. This requirement is considered too onerous for many mines, especially open pit mines, hence it has been replaced in the draft Financial Provisioning Regulations, 2019 with the requirement to only provide for an escalated anticipated closure liability 12 months in advance.

- Mine closure is achieved efficiently, cost effectively and in compliance with the law; and
- The social impacts resulting from mine closure are managed in such a way that negative socio-economic impacts are minimised.

6.2.3 TARGETS FOR CLOSURE

The closure target outcomes for the Tshipi Borwa Mine site are therefore assumed to be as follows:

- Achieve chemical, physical and biological stability for an indefinite, extended time period over all disturbed landscapes and residual mining infrastructure;
- Protect surrounding surface water, groundwater, soils and other natural resources from loss of utility value or environmental functioning;
- Limit the rate of emissions to the atmosphere of particulate matter and salts to the extent that degradation of the surrounding areas' land capability or environmental functioning does not occur;
- Maximise visual 'harmony' with the surrounding landscape; and
- Create a final land use that has economic, environmental and social benefits for future generations that outweigh the long term aftercare costs associated with the mine.

6.3 ALTERNATIVE CLOSURE OPTIONS

The information in this section provides a summary of the alternatives that were considered for the proposed project. Information in this section was sourced from the BAR compiled for the proposed project (SLR, August 2019). A detailed discussion of the alternatives is provided in Section 7.7 of the BAR (SLR, August 2019).

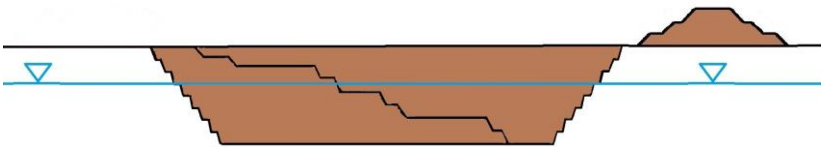
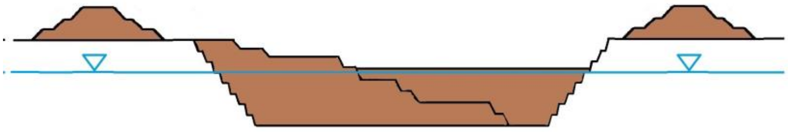
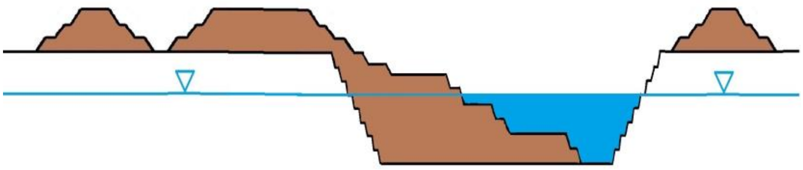
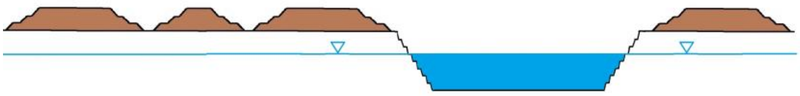
6.3.1 ALTERNATIVES CONSIDERED

The approved EMPr commits Tshipi to restore the surface to pre-mining state of wilderness and grazing and requires that the open pit is completely backfilled. Recent optimisation investigations indicate that when considering environmental, socio-economic, legal, commercial and technical, factors, completely backfilling the open pit is sub-optimal. This section describes alternatives that were considered as part of the proposed project and not proceeding with the proposed project. Project alternatives that were considered included: complete backfill (option 1), partial backfill (option 2), concurrent backfill (in-pit dumping) (option 3) and no backfill (option 4) (Table 6-1).

The alternatives analysis has indicated that **concurrent backfill (in-pit dumping)** is the optimal option from an environmental, socio-economic, technical, legal and commercial perspective. The detailed motivation is provided in Section 6.4 below.

Table 6-1: Project alternatives that were considered

Options considered	Illustration	Detail

Options considered	Illustration	Detail
Complete backfill (option 1)		Backfill of the final pit void post mining to original ground level, before rehabilitation of the surface as per the current approved EMPr
Partial backfill (option 2)		Backfill of the final pit void post mining to a level just above the rebound water-table level, approximately 50m below original ground level, before rehabilitation of the surface.
Concurrent backfill (in-pit dumping) (option 3)		Backfill of the pit void concurrent with mining only, also called in-pit dumping, which results in a partial void and associated pit lake which will be 'made safe' (profiled) before rehabilitation of the surface.
No backfill (option 4)		No backfill of the pit either concurrent with mining or post mining i.e. all waste rock to surface dumps. The pit side-walls and end-walls will only be 'made safe'. The entire pit becomes a pit lake.

6.3.2 THE "NO-GO" ALTERNATIVE

The assessment of this option requires a comparison between the options of proceeding with the proposed project with that of not proceeding with the proposed project. Proceeding with the project attracts potential economic benefits (future underground resources) and promotes the use of alternative land uses post closure with the aim of aligning closure objectives with that of the sustainable end state focus of the 2nd Draft Financial Provision Regulations. Not proceeding with the project means that the pit will be completely backfilled and rehabilitated to an end state of grazing/wilderness and as such the economic spin-offs and biodiversity enhancements will not be realised.

6.4 MOTIVATION FOR PREFERRED CLOSURE OPTION

On 17 May 2019, the Minister of Environmental Affairs published the 2nd draft of the 'Proposed Regulations Pertaining to Financial Provisioning for the Rehabilitation and Remediation of Environmental Damage caused by Reconnaissance, Prospecting, Exploration, Mining or Production Operations' (2nd Draft Financial Provision Regulations) for comment. The 2nd Draft Financial Provisioning Regulations seek to entirely replace the NEMA

Financial Provisioning Regulations, published on 20 November 2015, as amended (Financial Provisioning Regulations, GNR 1147 of 2015).

The 2nd Draft Financial Provision Regulations focusses on facilitating environmentally sustainable end land uses. In this regard, the following applies:

- The 2nd Draft Financial Provision Regulations highlight that the purpose of setting aside a financial provision is to ensure that operations can achieved an approved sustainable end state at closure;
- Companies have the scope to define a credible sustainable end state in the final rehabilitation, decommissioning and mine closure plan. The sustainable end state must reflect local conditions, regulatory complexities, stakeholder expectations, environmental opportunities and technical solutions for the infrastructure and facilities to support the sustainable end state; and
- The mind shift from classic mine closure (returning the land to its pre-mining state) to focussing on a transitional economy promotes the potential for multiple alternative closure opportunities.

The proposed project offers an alternative closure and rehabilitation strategy to the approved current commitment to re-instate the environment to that of grazing and/or wilderness potential in order to align the Tshipi closure objectives with the sustainable end state focus of the 2nd Draft Financial Provision Regulations. It follows that the proposed closure land use objective is to create a sustainable closure land use which is a combination of natural habitat creation (aquatic and terrestrial) and availability of water for livestock with associated grazing potential. With reference to Section 4.1.5, although not part of the proposed project, additional future land uses that could be considered at some point in the future include aggregate crushing and screening, aquaponics, intensive grazing, solar plant installation and the use of existing mine buildings for additional land uses.

A basic alternatives analysis selection matrix was compiled in order to provide a discussion of each of the alternatives considered. Table 6-2 presents the results the options analysis. The ranking system is a simple four score relative ranking system. For each criterion, a score of one is allocated to the best option and a score of four to the worst. The option with the lowest total score is the preferred option. Where specialist input was obtained in order to provide input into the options analysis this has been indicated in the table below.**Results of the alternatives options analysis indicate that there preferred alternative is option 3: concurrent backfilling (In-pit dumping).**

Table 6-2: Alternative analysis matrix

Aspect	Complete backfill – option 1		Partial backfill – option 2		Concurrent backfill only (In-pit dumping) – option 3		No backfill -option 4	
	Detail	Rating	Detail	Rating	Detail	Rating	Detail	Rating
Environmental								
Terrestrial biodiversity*	The advantage of complete backfill is that it best reinstates the natural conditions due to: • Reinstatement of the landscape to grazing/wilderness, • Re-introduction of protected species; and • Re-establishment of a terrestrial habitat for faunal species that were displaced and recreates habitat connectivity. The disadvantage is that this alternative may however: • Create a single habitat, and does not maximising biodiversity potential particularly when the original biodiversity is unlikely to ever be fully reinstated; and • Does not allow for the natural carrying capacity to be truly reinstated to pre-mining levels.	2	The advantage of partial backfill is that this allows for the reinstatement of the natural conditions due to: • Re-introduction of protected species; and • Revegetation and rehabilitation will allow for the provision of terrestrial habitat for faunal species displaced as a result of mining activities. The disadvantage is that this alternative may however: • Result in the remnants of mining activities on surface (eg. waste rock dumps); • Create a single habitat, and does not maximising biodiversity potential particularly when the original biodiversity is unlikely to ever be fully reinstated; • Does not allow for the natural carrying capacity to be truly reinstated to pre-mining levels. • Limitations to habitat connectivity reinstatement; • Require monitoring of indigenous vegetation rehabilitation success.	3	The advantage of concurrent backfill only (In-pit dumping) is that this allows for the partial reinstatement of the natural conditions and provides a water source that allows for: • The creation of a multiple areas of habitat for utilisation through landscape reshaping and soil profiling; • The creation of the pit lake will result in an increased habitat diversity, thereby stimulating an increase in faunal and floral species diversity; • Potential source of drinking water for animals; and • Creation of a new biodiversity hotspot, species breeding grounds and a source from which species could repopulate surrounding habitats (sinks). The disadvantage is that this alternative may however: • Result in the remnants of mining activities on surface (eg. waste rock dumps); • Require an extended timeline until the pit lake is created and functioning versus that of complete backfill habitat creation; and	1	The disadvantage of no backfilling is that this does not provide an opportunity that would benefit the local ecology or environment due to: • Too steep to access the pit lake water for the creation of aquatic habitat • Remnants of mining activities on surface (eg. waste rock dumps) increasing latent footprint of impacts. Most waste rock on surface for this alternative; • No terrestrial habitat enhancement post closure due to lack of access to pit lake water; and • The highest levels of residual impacts to ecology. An example of the above would be the Kimberly Big Hole, which should be avoided.	4
Aquatic biodiversity*	The disadvantage of complete backfill is the lost opportunity to create a surface water feature that could be used to increase aquatic biodiversity.	2	The disadvantage of partial backfill is the lost opportunity to create a surface water feature that could be used to increase aquatic biodiversity.	2	The advantage of concurrent backfill only (In-pit dumping) is that this allows for: • The pit lake be designed in such a way as to have extensive shallow areas and have some productivity which can support a level of biodiversity; • The pit lake can be designed in such a way as to maximise habitat diversity and create areas where fish and other aquatic biota can successfully spawn; and • The opportunity to create a surface water feature that can increase (although artificially) biodiversity and especially aquatic biodiversity in the area.	1	The disadvantage of no backfilling is that this does not provide an opportunity that would benefit the local ecology or environment due to: • The lost opportunity to create a surface water feature that can increase (although artificially) biodiversity and especially aquatic biodiversity in the area since the pit lake will be deep with steep sides and little habitat diversity; and • The water will be well below natural ground level and therefore isolated from the surrounding less affected environment.	4
Soils and land capability*	The disadvantage is that a pit lake will not develop if the open pit is completely backfilled and as such no water will be easily available for the use of agricultural productivity and is therefore considered the least preferred option.	4	The disadvantage is that a pit lake will not develop if the open pit is completely backfilled and as such no water will be easily available for the use of agricultural productivity and is therefore considered the least preferred option.	4	The advantage of concurrent backfill only (In-pit dumping) is that it will have the second-highest volume of water readily available within the open pit that can be utilised for agricultural productivity. The water quality issues are not considered in this	2	The advantage of no backfill is that the most water that will be easily available for use of agriculture productivity, and it is also the option that will provide the highest agricultural productivity per unit area. The water quality issues are not considered in this	1

Aspect	Complete backfill – option 1		Partial backfill – option 2		Concurrent backfill only (In-pit dumping) – option 3		No backfill -option 4	
					category.		category.	
Pit lake*	The advantage of completely backfilling the open pit is that it will take approximately 39 years to fill to the quasi-static water levels which support faster groundwater rebound levels in the cone of depression. The disadvantages of completely backfilling the open pit include: • No pit lake will develop and as such boreholes would need to be drilled to access the water; • The groundwater level will rebound to nature ground water levels, however flow through the backfilled pit means contamination plumes will move to wider groundwater system; • Complete backfill does not allow for a pit lake to form and as such generates a pore water chemistry in the waste rock. This is due to no evaporation undertaken or groundwater flow through and the infill rate is faster than those options which include a pit lake. Therefore this is likely to underestimate the concentration of the chemistry in the pore water. The water is only usable for 25 years without treatment. The parameter that fails the DWS livestock watering limits includes Fe from year 25.	2	The advantage for partially backfilling the open pit is that it will take approximately 36 years to fill to the quasi-static water levels which support faster groundwater rebound levels in the cone of depression. The disadvantages of partially backfilling the open pit include: • No pit lake will develop and as such boreholes would need to be drilled to access the water; • The groundwater level will rebound to nature ground water levels, however flow through the backfilled pit means contamination plumes will move to wider groundwater system; • Partial backfill does not allow for a pit lake to form and as such generates a pore water chemistry in the waste rock. This is due to no evaporation undertaken or groundwater flow through and the infill rate is faster than those options which include a pit lake. Therefore this is likely to underestimate the concentration of the chemistry in the pore water. The water is only usable for 25 years without treatment. The parameter that fails the DWS livestock water limit includes Fe from year 25.	2	The advantage of concurrent backfill only (in-pit dumping) includes: • A pit lake will develop and as such this provides access to future readily available water that can be used to promote alternative land uses; • Less infrastructure will be required to abstract water as boreholes will not be required; • No pit spilling; • The groundwater level in surrounding boreholes will rebound but a cone of depression will remain on site because the open pit will act as a sink. Hydraulic sinks means that the cone of depression captures wider pollution plumes from other mine areas and sources. • In terms of water quality, modelling shows that this water can be used without treatment for the longest period of all for options (approximately 100 years). Moreover, with successfully implemented floating wetlands the water is usable for livestock watering and biodiversity for at least 200 years. The disadvantage of concurrent backfilling only (in-pit dumping) includes: • It will take approximately 153 years to fill to the quasi-static water levels; • Water quality will meet livestock watering limits for 100 years, thereafter treatment will be required, by means of floating wetlands.	1	The advantages of not backfilling the open pit includes: • A pit lake will develop and as such this provides access to future readily available water that can be used to promote alternative land uses; • Less infrastructure will be required to abstract water as boreholes will not be require; • It will take approximately 46 years to fill to the quasi-static water levels; • No pit spilling; • The groundwater level in surrounding boreholes will rebound but a cone of depression will remain on site because the open pit will act as a sink. Hydraulic sinks means that the cone of depression captures wider pollution plumes from other mine areas and sources. The disadvantages of not backfilling the open pit includes: • This closure option, with a pit lake and no infill is the least favoured option from a water chemistry perspective. The main reason is that there is no waste rock in the pit to aid the water precipitate of some of the parameters such as metals. Modelling results show that the water quality will start to deteriorate due to evapo-concentrations from year 50 before treatment is required.	4
Air*	From an advantage and disadvantage perspective there is no difference between the closure alternatives as each options presents final land forms or exposed areas that have the potential to contribute to air pollution.	1	From an advantage and disadvantage perspective there is no difference between the closure alternatives as each options presents final land forms are exposed areas that have the potential to contribute to air pollution.	1	From an advantage and disadvantage perspective there is no difference between the closure alternatives as each options presents final land forms are exposed areas that have the potential to contribute to air pollution.	1	From an advantage and disadvantage perspective there is no difference between the closure alternatives as each option presents final land forms are exposed areas that have the potential to contribute to air pollution.	1
Noise*	From an advantage and disadvantage perspective there is no difference between the closure alternatives	1	From an advantage and disadvantage perspective there is no difference between the closure alternatives	2	From an advantage and disadvantage perspective there is no difference between the closure alternatives	2	From an advantage and disadvantage perspective there is no difference between the closure alternatives	2
Visual*	The approved EMPr's (SLR, August 2017 and April 2019) commits Tshipi to restore the surface to pre-mining state of wilderness and grazing and requires that the open pit is backfilled. This alternative entails a complete backfill of the final pit void post mining before rehabilitation of the surface can take place. However, even with a complete backfill, because of the bulking factor,	3	This alternative will result in waste material being left on the surface, however this alternative allows for some rehabilitation (albeit limited) before the end of mine (i.e. sloping and rehabilitation of waste rock dumps remaining on the surface). This is a slight advantage as during the life of mine some rehabilitation (albeit limited as limited waste rock will remain on surface) can take place allowing for best practice to take place and ensure that this process	2	This alternative will result in waste material being left on the surface, however this alternative allows for progressive rehabilitation before the end of mine (i.e. sloping and rehabilitation of waste rock dumps remaining on the surface). This is an advantage as during the life of mine rehabilitation can already take place allowing for best practice to take place and ensure that this process is well	1	This alternative will result in waste material being left on the surface, however this alternative allows for progressive rehabilitation before the end of mine (i.e. sloping and rehabilitation of waste rock dumps remaining on the surface). This is an advantage as during the life of mine rehabilitation can already take place allowing for best practice to take place and ensure that this process is well managed and will	1

Aspect	Complete backfill – option 1		Partial backfill – option 2		Concurrent backfill only (In-pit dumping) – option 3		No backfill -option 4	
	there will be waste material on the surface that would need to be rehabilitated but only after mining is completed.		is well managed and will achieve the best rehabilitation effects.		managed and will achieve the best rehabilitation effects.		achieve the best rehabilitation effects. The disadvantage of this option is that larger and possibly more dumps will be required post closure.	
Socio-economic								
Economic contribution*	Completely backfilling the open pit will take place over a period of 25.7 years, utilising a conveyor system which will comprise front end loaders moving overburden material onto grizzly feeders that are connected to a movable conveyor system. In this regard the advantage of completely backfilling the open pit is it will stimulate the national, local and regional economy with an approximate amount of R1.21 billion over approximately 25.7 years in operational spending as well as an initial capital investment of R82.9 million. The employment value will constitute R61.7 million (PV) for 25 employment opportunities. However this expenditure will be a net outflow of costs for the company and will be at the expense of tax collection. Once the pit has been rehabilitated, grazing activities may be able to resume. For the fully rehabilitated area this will result in a potential revenue of R1.18m over a period of 55 years (time line life of mine including underground mining). Labour will amount to R2.55 million (PV) for 55 years. Aggregate crushing activities may be able to continue for a limited number of years depending on market demand for all four options. Should the pit be fully backfilled, access to the underground resources will not be feasible because it requires the establishment of a vertical shaft system from surface. Backfilling the pit completely will result in a lost capital investment injection of R1.5 billion (PV) discounted over 24 years. Furthermore a potential revenue boost of R21.2 billion (PV) as well as 246 job opportunities to a value of R5.7 billion (PV) over the life of mine will be lost to loss the local, regional and national economy. From a net economic perspective, the economy will lose an estimated value of more than R 21.4 billion on a national regional and local level.	4	Partial backfilling of the open pit will take place using conveyors over 15.4 years. Partial backfilling the Tshipi open pit will stimulate the national, local and regional economy with an approximate amount of R1.023 billion over approximately 15.4 years in operational spending as well as an initial capital investment of R82.9 million. The employment value will constitute R51.9 million (PV) for 25 employment opportunities over 15.4 years. However this expenditure will be a net outflow of costs for the company and will be at the expense of tax collection. Once the pit has been partially rehabilitated, grazing activities may be able to resume on available land. For the rehabilitated areas this will result in a potential revenue of R1.0m over a period of 55 years. Labour will amount to R2.1million (PV). Aggregate crushing activities may be able to continue for a limited number of years depending on market demand for all four options. Should the pit be partially backfilled, access to the underground resources will not be feasible because it requires the establishment of a vertical shaft system from surface. Partially backfilling the pit will result in a lost capital investment injection of R1.5 billion (PV) discounted over 24 years. Furthermore potential revenue boost of R21.2 billion (PV) as well as 246 job opportunities to a value of R5.7 billion (PV) over the life of mine will be lost to loss the local, regional and national economy. From a net economic perspective, the economy will lose an estimated value of more than R21.7 billion on a national regional and local level.	3	Not undertaking backfilling activities will result in a lost capital investment injection of R82.9 million over a period of 5 years. Furthermore, not backfilling will result in a loss of operational expenditure to the value of R1.21 billion (PV), of which the employment values constitute R61.7 million in present value terms. Not rehabilitating the open pit area, will result in a loss of grazing land due to the pit and waste rock dumps on surface. Only a small portion of land will be available for grazing. For the rehabilitated areas this will result in a potential revenue of R290 593 over a period of 55 years. Labour will amount to R634 236 (PV). Aggregate crushing activities may be able to continue for a limited number of years depending on market demand. Only undertaking in-pit dumping provides access to the underground resources via the un-rehabilitated open pit area. Accessing underground resources via the open pit area will require a life of mine capital investment R1.5 billion (PV) discounted over 24 years. This will result in a revenue boost of R21.2 billion (PV) over the life of mine. The mine will able to provide 246 job opportunities to a value of R5.7 billion (PV) over the life of mine. From a net economic perspective, the national, regional and local economies will gain more than R21.5 billion from the mining of underground resources when partial backfilling is considered.	2	Not undertaking backfilling activities will result in a lost capital investment injection of R 82.9 million over a period of 5 years. Furthermore, not backfilling will result in a loss of operational expenditure to the value of R1.21 billion (PV), of which the employment values constitute R61.7 million in present value terms. Not rehabilitating the open pit area, will result in a loss of grazing land due to the pit and waste rock dumps on surface. Only a small portion of land will be available for grazing. For the rehabilitated areas this will result in a potential revenue of R144 427 over a period of 55 years. Labour will amount to R313 963 (PV). Aggregate crushing activities may be able to continue for a limited number of years depending on market demand. Not backfilling the pit provides access to the underground resources via the unrehabilitated open pit area. Accessing underground resources via the open pit area will require a life of mine capital investment R1.5 billion(PV) discounted over 24 years. This will result in a revenue boost of R21.2 billion (PV) over the life of mine. The mine will able to provide 246 job opportunities to a value of R5.7 billion (PV) over the life of mine. From a net economic perspective, the national, regional and local economies will gain an estimate R21.5 billion from the mining of underground resources when no backfilling is considered.	1
Legal								

Aspect	Complete backfill – option 1		Partial backfill – option 2		Concurrent backfill only (In-pit dumping) – option 3		No backfill -option 4	
Authorisations	No environmental authorisation will be required to be obtained in order to proceed, as this alternative is already authorised in terms of the approved EMPr's (SLR, August 2017 and April 2019).	1	Approval of the BAR is required from the DMR to change the current closure commitment to partial backfilling.	2	Approval of the BAR is required from the DMR to change the current closure commitment to concurrent backfilling only (In-pit dumping).	2	Approval of the BAR is required from the DMR to change the current closure commitment to no backfilling.	2
Technical								
Property and locality	The proposed project will take place within the approved mining right and surface use area. There is no difference between the various alternatives from a property and locality perspective. There is no advantage or disadvantage between the alternatives.	1	The proposed project will take place within the approved mining right and surface use area. There is no difference between the various alternatives from a property and locality perspective. There is no advantage or disadvantage between the alternatives.	1	The proposed project will take place within the approved mining right and surface use area. There is no difference between the various alternatives from a property and locality perspective. There is no advantage or disadvantage between the alternatives.	1	The proposed project will take place within the approved mining right and surface use area. There is no difference between the various alternatives from a property and locality perspective. There is no advantage or disadvantage between the alternatives.	1
Type of activity	The disadvantage of this alternative is that activities post closure will be limited to grazing as there is not access to a pit lake to promote the use of alternative land uses.	4	The disadvantage of this alternative is that activities post closure will be limited to grazing as there is not access to a pit lake to promote the use of alternative land uses.	4	Due to the access to the pit lake, activities that could take place post closure include aquaponics, intensive farming, and recreational fishing. This is supported by a functional pit lake with desired water quality.	1	Due to the access to the pit lake, activities that could take place post closure include aquaponics and intensive farming.	2
Design or layout	No alternatives were considered for the design or the layout of infrastructure and activities post closure.							
Rehabilitation programme	The disadvantage of complete backfill is that no concurrent rehabilitation of waste rock will take place given that the material will be placed back in the pit at closure and only then will the rehabilitation of the pit commence. In follows that rehabilitation will only commence in 2048.	4	Some concurrent rehabilitation of waste rock dumps can commence now, however this is limited to a small area as most of the rehabilitation will only commence after mining has been completed and pit is partially backfilled.	3	The advantage of concurrent backfilling only (in-pit dumping) is that concurrent rehabilitation of waste rock dumps can commence now.	1	The advantage of concurrent backfilling (in-pit dumping) is that concurrent rehabilitation of waste rock dumps can commence now, however the disadvantage is that this alternative also has the biggest dump footprint to rehabilitate.	2
Level of responsibility	Tshipi will be responsible for implementing the closure plan and will include post closure monitoring and aftercare obligations. In this regard the long term focus would be groundwater monitoring with shorter term monitoring and aftercare plan aspects focussed on groundwater levels, vegetation/ecosystem establishment, and erosion prevention. The advantage of this alternative is there will be a limited number of activities post closure that requires monitoring and management.	1	Tshipi will be responsible for implementing the closure plan and will include post closure monitoring and aftercare obligations. In this regard the long term focus would be groundwater monitoring with shorter term monitoring and aftercare plan aspects focussed on groundwater levels, vegetation/ecosystem establishment, and erosion prevention. The advantage of this alternative is there will be a limited number of activities post closure that requires monitoring and management.	1	Tshipi will be responsible for implementing the closure plan and will include post closure monitoring and aftercare obligations. In this regard, the long term focus would be on the pit lake where field implementation and monitoring is required to determine how successful the floating wetlands will be as a semi passive treatment solution. Moreover, ongoing monitoring, wetland maintenance/replacement, and establishment of shallow ecosystems may be required in the longer term to maintain the pit lake quality for livestock and ecology use. Alternatively, if the water quality fails at some point then alternative treatment technologies may need to be considered or the use of the pit lake and access thereto may have to change. The shorter term monitoring and aftercare plan aspects focussed on groundwater levels, vegetation/ecosystem establishment, and erosion prevention. The disadvantage of this alternative is that the post closure monitoring and aftercare maintenance is more extensive (more aspects that require monitoring) and the duration of the post closure obligations increase.	2	Tshipi will be responsible for implementing the closure plan and will include post closure monitoring and aftercare obligations. In this regard, the long term focus would be on the pit lake where field implementation and monitoring is required to determine how successful treatment solutions will be (most likely active treatment solutions). Moreover, ongoing monitoring and treatment may be required in the longer term to maintain the pit lake quality for livestock use. Alternatively, if the water quality fails the use of the pit lake and access thereto may have to change. The shorter term monitoring and aftercare plan aspects focussed on groundwater levels, vegetation/ecosystem establishment, and erosion prevention. The disadvantage of this alternative is that the post closure monitoring and aftercare maintenance is more extensive (more aspects that require monitoring) and the duration of the post closure obligations increase.	3

Aspect	Complete backfill – option 1		Partial backfill – option 2		Concurrent backfill only (In-pit dumping) – option 3		No backfill -option 4	
Commercial								
Operational aspects	The disadvantage of this alternative is the post operations use of a conveyor system to completely backfill the open pit which will cost approximately R1.21 billion over approximately 25.7 years in operational spending as well as an initial capital investment of R82.9 million.	4	The disadvantage of this alternative is the post operations use of a conveyor system to partially backfill the open pit which will cost approximately R1.023 billion over approximately 15.4 years in operational spending as well as an initial capital investment of R82.9 million..	3	The advantage of this option is that there is no post operations cost associated with backfilling the open pit as this is done concurrently with mining. Only pit high walls will need to be made safe by sloping and/or perimeter berms (could mostly be done as part of operations expenditure).	1	The disadvantage of this alternative is the significant cost associated with removing waste rock that has currently been backfilled into the open pit and placing this on the waste rock dumps on surface.	2
Totals		**34**		**32**		**21**		**31**

* Informed by specialist input (copies of the specialist studies are included as appendices to the BAR for the proposed project).

6.5 MOTIVATION FOR CLOSURE AND POST CLOSURE PERIOD

The specialist studies undertaken for the alternative closure and rehabilitation optimisation project recommend a minimum of 10 years monitoring associated with:

- Groundwater quality of the mine site.
- Aquatic biomonitoring in the pit lake.
- Habitat and aquatic macro-invertebrate assessment in the pit lake.
- Floral and faunal monitoring of all the rehabilitated mine areas.
- Air quality associated with the rehabilitated mine areas.

This 10-year post closure monitoring period will be further sub-divided into three years of active maintenance and seven years of passive maintenance (i.e. where maintenance activities have decreased and monitoring frequency declined – where applicable).

The time taken for the pit lake to fill to a quasi-static water level (i.e. mean water level) is estimated to be about 153 years. It has therefore been recommended that the pit lake water quality, as well as, the effectiveness of the floating wetlands be monitored for a minimum period of 25 years (or until suitable trends regarding the pit lake water quality can be established and verified. See further details in Section 14.2.7.

6.6 ONGOING RESEARCH FOR PROPOSED OR ALTERNATIVE CLOSURE OPTIONS

Further research regarding the proposed and/or alternative closure options will be ongoing during the remaining life of mine, for example:

- Investigating underground mining resources.
- Monitoring of trial revegetation programmes to evaluate the effectiveness and sustainability of revegetation efforts; methods to further improve and/or optimise; as well as inform the post closure maintenance and aftercare period. It is important to note that the trail vegetation programme is limited to the rehabilitation of the waste rock dumps during on-going operations.

6.7 CLOSURE PLAN ASSUMPTIONS

The following assumptions are made for the development of the Preliminary Closure Plan at this stage of the mining operations:

- Tshipi will follow and adhere to the commitments made in the EIA and EMP reports, and any amendments there to.
- Tshipi will follow the mine plan and design /layout to minimise the potential for additional disturbed areas.

- The volume of stockpiled topsoil [2] that has been stripped from infrastructure and operational areas will be sufficient for closure activities.
- Groundwater in the deeper BIF aquifer will not be negatively impacted by the mine workings.
- Runoff water quality from rehabilitated areas will be acceptable and will not require any further treatment.
- No allowance for salvage and/or recycling scrap material has been considered in the estimation procedure.
- Inert building and demolition rubble can be safely disposed and buried on site.
- Hazardous material can be safely disposed of offsite at a nearby appropriate facility.
- Reagent, fuel, lubricant and explosive manufacturers/suppliers will accept returned product at the end of the mine life.
- No consideration of the social closure costs has been included in this report.
- No assessment of any socio-economic/shared value/ community based programmes being implemented and whether these would continue post-closure of the operation.
- All costs associated with pre-closure monitoring, auditing and reporting are presumed to be covered under the operations expenditure of the mine, and have not been included in this preliminary closure plan.

Assumptions will be reviewed during the ongoing operations of the mine and any required technical work conducted in order to reduce information gaps and uncertainty prior to mine closure.

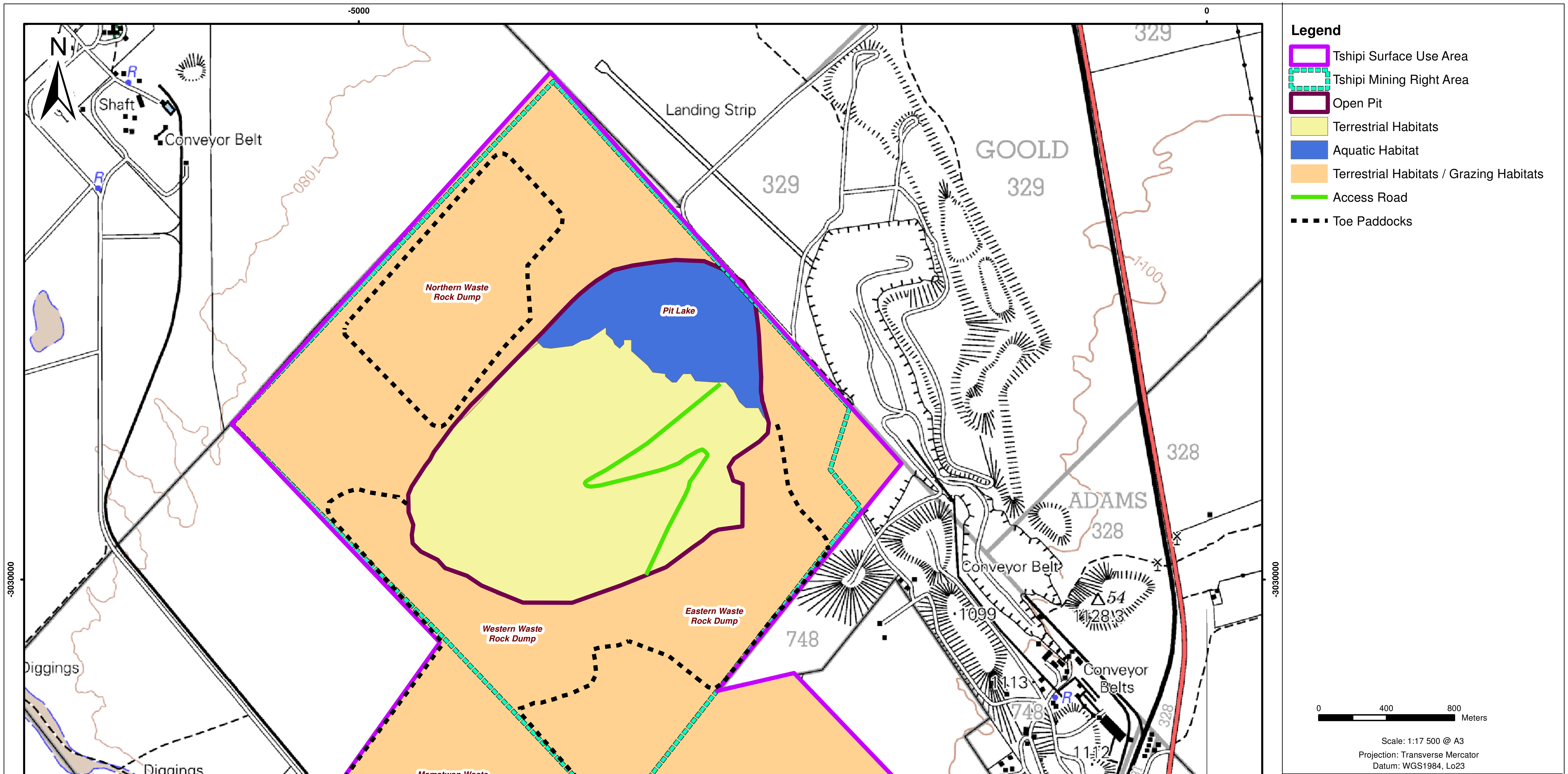
7. POST-CLOSURE LAND USE

The approved EMPr commits Tshipi to restore the surface to pre-mining state of wilderness and grazing and requires that the open pit is backfilled. As part of the proposed project, Tshipi is proposing to change the closure strategy. In this regard, the proposed closure land use objective is to create a sustainable closure land use which is a combination of natural habitat creation (aquatic and terrestrial) and availability of water for livestock with associated grazing potential.

8. MAP OF POST CLOSURE LAND USE

The map of post closure land uses is included in Figure 4.

[2] There are currently two topsoil stockpiles on site. Stockpile near the Northern dump (700,800 m^3) and Stockpile near the railway loop (47,025 m^3).



Tshipi é Ntle Manganese Mining (Pty) Ltd

Figure 4

Map of Post Closure Land Uses

SLR

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2019/08/08

9. DECOMMISSIONING AND CLOSURE ACTIONS

In broad terms the decommissioning phase will focus on removal of infrastructure and preparation of the site for final rehabilitation and closure. It is anticipated that the decommissioning phase will last for 2 to 5 years during which period as many as 20 employees and numerous contractors will be retained on site for the associated work. Decommissioning activities include:

- Surface infrastructure will be demolished and removed, with the exception of the waste rock dumps and pit access road. Sloping and rehabilitation of waste rock dumps remaining on surface to create stable landforms (a significant amount of this work can be done during mining operations as part of concurrent rehabilitation).
- All demolition material and waste will be removed from the project area and disposed of appropriately;
- All contaminated soil will either be treated in-situ or removed from the project area or disposed of appropriately; and
- Areas where infrastructure has been removed will be levelled and prepared for rehabilitation in accordance with the topography and topsoil (Section 0) and revegetation plan Section (0).

At the end of the decommissioning phase the site will be ready for closure (the closure phase). The key activities during the closure phase will be:

- Monitoring;
- Aftercare; and
- Maintenance/ adjustment as required.

Generally accepted closure methods have been used as the basis for determining the closure cost liability. Further details are provided below.

9.1 SPECIFIC TECHNICAL SOLUTIONS

Specific technical solutions related to the preferred closure option for the areas of disturbance are detailed below.

9.1.1 BUILDINGS, PLANT AND MINE INFRASTRUCTURE

Buildings, processing plant and mine infrastructure (conveyors, water supply pipelines etc.) will all be dismantled, and salvageable elements will be sold and removed from site. Inert non-salvageable elements including concrete, plastic liners, brickwork, conveyor belting etc. will be dismantled or broken up and buried on site (either within the overburden/waste rock dumps or within the remaining voids associated with the stormwater control dams). The buried elements must be covered with at least 1m of waste rock and/or soil.

Concrete foundations and underground services (e.g. electrical, water and sewer) will all be removed or buried at least 1m below natural ground surface. Any contaminated soil from the decommissioned areas (that cannot be remediated) will be excavated and disposed of offsite at a nearby appropriate

facility. Contaminated soils will typically include those contaminated by hydrocarbons (i.e. diesel, oil, grease etc.) and non-biodegradable chemicals (i.e. reagents, chemicals, dust suppressants etc.).
All the decommissioned areas will be landscaped and levelled so that natural stormwater flow is restored and that there is no ponding of water (as far as reasonably practical). The decommissioned areas will be covered with 300 mm topsoil/growth medium material (i.e. whatever was initially stripped from the area prior to construction) and revegetated.

9.1.2 PARTIALLY OPEN PIT (RESULT OF CONCURRENT IN-PIT DUMPING)

Tshipi will ensure that the partially open pit will be kept safe. This will commence in the operations phase and will continue through to the closure phase. Actions include:

- Ensuring that the final pit slopes design maintains long term stability performance;
- The top bench slope of the pit (i.e. to roughly 10m below natural ground level) to 18 degrees (1V:3H) is maintained. Sloped area must be top soiled and re-vegetated;
- The 2m high exclusion berm around the high wall side of the pit is maintained;
- Warning signs with images and appropriate languages located along the high wall berm; and
- No access ramps may remain at closure. Access to the pit lake must be via the new haul road that will be constructed to ensure safe by third parties.

9.1.3 WASTE ROCK DUMPS

The remaining WRD’s will be rehabilitated as follows:

- Pushing down steep slopes to allow for the optimal re-establishment of vegetation;
- Shaping to ensure the surface is free draining (i.e. no ponding of water on the top surface post closure);
- Covering the waste rock dumps with topsoil/growth medium material (i.e. whatever was initially stripped from the area prior to construction). The typical range depending on the type of vegetation ranges between 300 to 600mm.
- Revegetating the waste rock dumps in accordance with the topography and topsoil plan included in Table 4-3.

The separation of clean and dirty water systems at the mine will be designed, implemented, and managed in accordance with the provisions of Regulation 704, 4 June 1999 (Regulation 704) for water management on mines. In this regard, runoff from the waste rock dumps will be collected by means of toe paddocks and will be allowed to evaporate. As part of the proposed project, the toe paddocks will remain post closure until such time as the waste rock dumps have been rehabilitated successfully, after which they can be removed. Refer to Figure 3 for the location of the toe paddocks.

Rehabilitation of the waste rock dumps will start during the operational phase and will be completed during decommissioning. Field trials (as part of concurrent rehabilitation efforts) will be undertaken to determine the most successful methods of revegetation that will include the evaluation of: using seedlings, local seed harvesting, commercially available seed mixes, planting aids (e.g. hydrogel, fertilizer), wet (hydroseeding) or dry seeding techniques, water requirements, maintenance and aftercare requirements, and the time taken to meet the criteria for revegetation success. Field trials will also further inform stormwater management infrastructure (e.g. benches, stormwater down chutes) and erosion management measures (e.g. retention berms).

Inert non-salvageable rubble from the decommissioning of facilities may be buried within sections of the overburden/waste rock dumps.

9.1.4 TAILINGS STORAGE FACILITY

The tailings storage facility is not yet operational, so only the removal of the HDPE liner, shaping and levelling of the footprint area, and the establishment of vegetation is currently required. The tailings dam will not be present on site at closure.

9.1.5 ROAD NETWORK

Gravel roads no longer required for post closure use will be ripped and covered with stockpiled topsoil to promote the re-establishment of indigenous vegetation. Major roads no longer required for post closure use will first have the top layer works removed (and carted to a safe disposal facility), and then rehabilitated as per gravel roads.

All concrete lined drainage channels, sumps and culverts (i.e. inert non-salvageable elements) associated with closed roads will be broken up and buried on site (either within the overburden/waste rock dumps or within the remaining voids associated with the stormwater control dams).

9.1.6 FENCING

Fencing no longer required for post closure use will be removed and recycled for scrap. Inert material such as concrete foundations will be buried on site (either within the overburden/waste rock dumps or within the remaining voids associated with the stormwater control dams).

9.1.7 POWERLINES

Powerlines no longer required for post closure use will be removed and recycled for scrap. Inert material such as concrete foundations will be buried on site (either within the overburden/waste rock dumps or within the remaining voids associated with the stormwater control dams).

9.1.8 STORMWATER MANAGEMENT

The existing stormwater management plan will be updated to identify what stormwater management structures are required post closure and which can be decommissioned.

All the decommissioned areas of the mine site will be levelled and shaped so that the areas are free draining and there is no ponding of water. Any remaining slopes will be modified to at least 1V:3H (or flatter) to minimise erosion and long slopes may require energy/flow breakers to curb the velocity of stormwater runoff.

It is currently anticipated that none of the pollution control dams will be required post closure, and hence these facilities and associated infrastructure can be decommissioned (as for concrete foundations, inert liner material etc. as mentioned previously), and the remaining voids potentially used to bury Inert non-salvageable elements from the site decommissioning activities.

Any accumulated silt in the pollution control dams (that is typically classified as hazardous) will need to be safely disposed of at a nearby appropriate facility.

9.1.9 REVEGETATION

Revegetation will be undertaken in line with the revegetation plan outlined in Table 4-4.

9.1.10 MAINTENANCE AND AFTERCARE

All the rehabilitated areas will require some form of aftercare and maintenance to ensure closure success.

These activities will typically include erosion control and filling of erosion gulley's on slopes; fertilising of struggling rehabilitated areas; monitoring of groundwater quality; monitoring of vegetation composition and diversity; control and eradication of alien plants; monitoring slope stability of waste rock dumps, monitoring of dust fallout, creating firebreaks etc.

It is currently anticipated that most of the maintenance and aftercare activities will be undertaken in the first three years following closure (the active maintenance period), and thereafter the frequency of activities is expected to stop (in areas were vegetation is considered self-sustaining) and/or decline (passive maintenance period). The passive maintenance period is a further seven years of monitoring with a reduced frequency (see section 4.5 previously).

9.2 THREATS AND UNCERTAINTIES

The proposed closure land use objective is to create a sustainable closure land use which is a combination of natural habitat creation (aquatic and terrestrial) and availability of water for livestock with associated grazing potential. Threats and uncertainties associated with this objective, include:

- The grazing potential is feasible provided the field quality is maintained by not exceeding the grazing capacity. If grazing capacity is exceeded (i.e. over-grazing) then the closure objectives to prevent contaminated stormwater runoff, dust, land degradation etc. may not be met.
- The effects of climate change on the future local environment are unknown and may present a threat for the preferred post closure land use, as well as, the time taken (i.e. maintenance and aftercare period) to achieve the criteria for revegetation success - see section 13.3 later. A 5-year maintenance and aftercare period, and a 10 to 25-year monitoring period, has currently been costed in this preliminary closure plan.

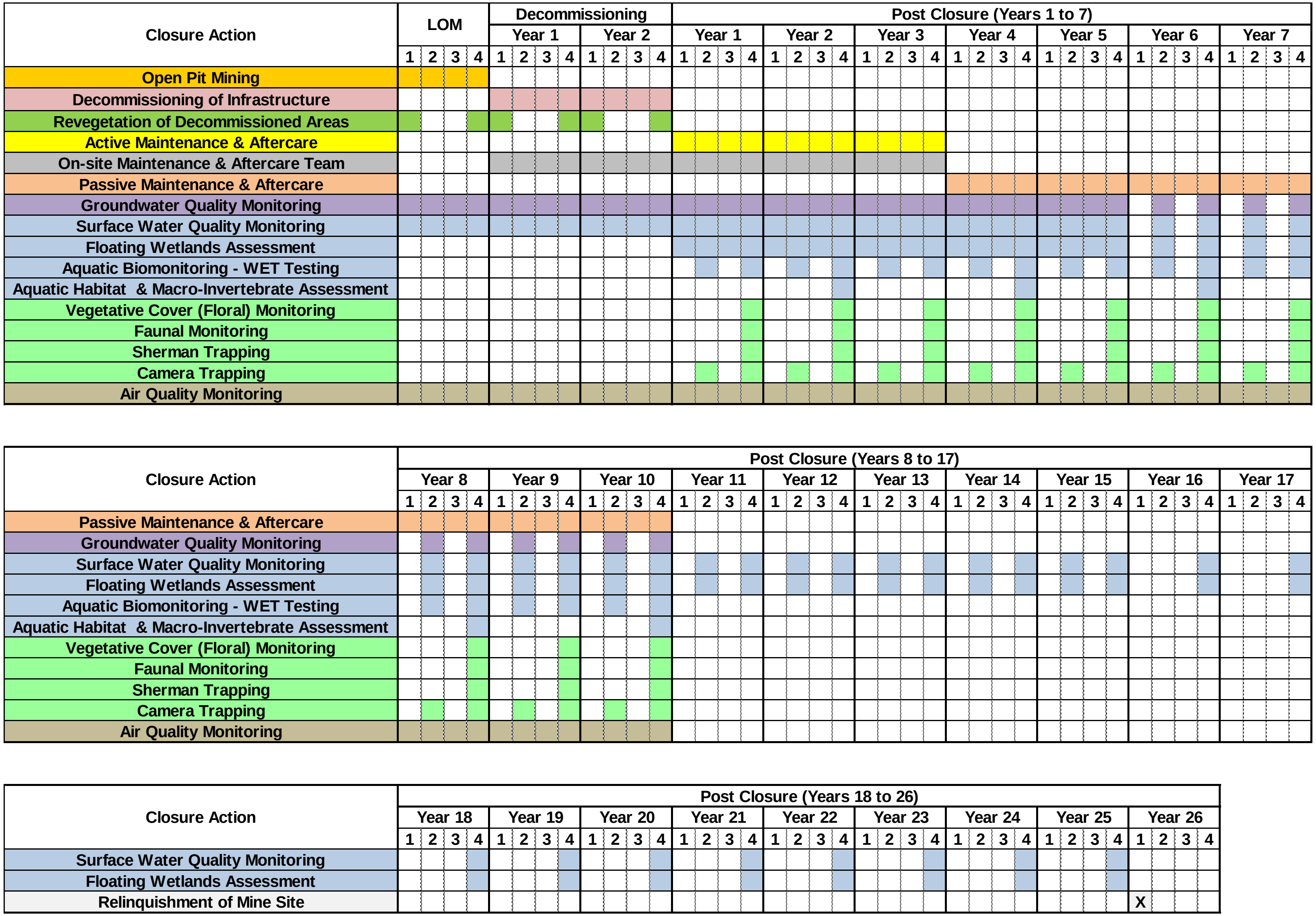
- It is currently assumed that all infrastructure will be demolished and removed from site. This assumption should be confirmed with post closure stakeholders since there may be some post closure use for certain infrastructure (e.g. offices, workshops, roads, water treatment facilities etc.). See section 4.3 previously.

10. SCHEDULE OF CLOSURE ACTIONS

It is estimated that the decommissioning of infrastructure, as well as, the rehabilitation/re-vegetation of the remaining pit area will take roughly 2 years. A significant proportion of the rehabilitation/revegetation of the WRD's will already have been completed as part of concurrent annual rehabilitation as described in Section 16. A preliminary schedule of the decommissioning, rehabilitation and post closure activities as at LOM is shown in Figure 4.

Further details of the post closure monitoring activities are provided in Section 14.2.

Figure 5: Preliminary schedule of decommissioning, rehabilitation and post closure activities at LOM closure



11. ORGANISATIONAL STRUCTURE AND ROLES

Typical key personnel to ensure compliance to the Closure Plan and associated commitments are the operations executive and the environmental manager. As a minimum, these roles as they relate to the implementation of monitoring programmes and management activities include:

- Minimise the areas of possible disturbance by mining activities;
- Inform and commit to follow the annual rehabilitation plan;
- Ensure that the monitoring programmes, audits, and plan updates/reviews are scoped and included in the annual mine budget;
- Identify and appoint appropriately qualified specialists/engineers to undertake the monitoring, auditing and planning work;
- To integrate closure planning into the overall mine operations and mine planning work.
- Appoint specialists in a timeously manner to ensure work can be carried out to acceptable standards;
- Liaise with the relevant structures in terms of the commitments in the Closure Plan;
- Ensure that commitments in the Closure Plan are undertaken and implemented; and
- Establish and maintain good working relations with surrounding communities and landowners.
- Facilitate stakeholder communication, information sharing and grievance mechanism.

12. GAP IDENTIFICATION

Current gaps (and/or known unknowns) associated with the closure plan, that will be addressed during the ongoing operations of the mine include:

- Identify what species of grasses, shrubs and trees will best support the post closure land use of wilderness and/or grazing on the various rehabilitated sites (plant area and WRD's).
- Identify and address (on an ongoing basis) any Category 1 alien invasive plant problem areas on site.
- Compiling a detailed schedule (and costs) of associated mine closure management supporting services for the mine decommissioning and closure period (e.g. mine manpower, external consultants, ongoing maintenance services, mine security, insurances, municipal rates, equipment licences, IT and communications etc.).
- Develop and incorporate socio-economic aspects into the closure plan. Community development initiatives and programmes together with end land use objectives for the mining area form an important part of this study.
- Investigate what work activities of the closure plan can be undertaken during operations as part of the annual rehabilitation planning.
- Establish a closure plan committee that will meet on a regular basis to inform the closure planning process.
- Initiate trials of seed collection and germination (i.e. on site nursery) to inform: (i) the revegetation plan (i.e. suitable plant species and methodology for re-establishing vegetation) and (ii) to provide sufficient plant stock for revegetation purposes.
- Compile a detailed stormwater management plan at closure for the detailed design and quantification of any stormwater infrastructure.

- Assess the long-term geotechnical stability of the pit void and any unstable areas that will need to be addressed as part of ongoing operations.

13. RELINQUISHMENT CRITERIA

Relinquishment criteria will be developed in communication with the regulatory authorities and project stakeholders to define specific end-points that demonstrate the closure objectives have been met. Three key indicators have been defined which will facilitate evaluation of closure objectives having been met at the Tshipi Borwa Mine. These three key indicators can be evaluated through analysis of ongoing monitoring results. The three key indicators are namely:

- Surface water quality
- Groundwater quality, and
- Vegetative cover.

The first indicator, surface water quality, is an important measure of the effectiveness of mitigation activities (particularly for the latent environmental impact of surface water in the open pit and the associated stormwater runoff from the remaining rehabilitated waste rock facilities and mine areas) and for protecting the health and safety of on-site land users, livestock, and wildlife.

Similarly the second indicator, ground water quality, is an important measure of the effectiveness of mitigation activities (particularly for the latent environmental impact of groundwater associated with the open pit and seepage from the remaining waste rock facilities) and for protecting the health and safety of neighbouring and/or down gradient land users, livestock, and wildlife.

The third indicator, vegetative cover, is highly correlated with all the other major environmental parameters of the area, including erosion, dust/air quality, physical stability, chemical stability, soil quality and hydrology. Good vegetative cover results in a reduction in the volume of surface runoff, increases soil and slope stability, and leads to the formation of an organic layer.

In addition, vegetative growth is visually correlated with successful rehabilitation (and/or protection of the surrounding environment). This is an extremely important indicator of rehabilitation success because it provides a simple, very effective and relevant measure of the rehabilitated lands' capability.

Other indicators of rehabilitation success (such as floating wetlands assessment, aquatic biomonitoring, faunal monitoring and air quality monitoring etc.) have also been included in the overall general rehabilitation monitoring programme. In addition to this, the natural introduction of insects is a good indicator of the overall health of the ecosystem through species diversity and abundance. The natural introduction of arachnids provides a good indicator of the overall success to the pit lake activities through the rate of recolonization.

Details of the decommissioning and rehabilitation monitoring programmme designed to provide the data necessary to evaluate rehabilitation success, including monitoring methods and frequency, are provided in the Section 14.2 below.

13.1 SURFACE WATER QUALITY EVALUATION SYSTEM

To utilise surface water quality as an indicator of rehabilitation success the Tshipi Borwa Mine will:

- Confirm the sampling locations for rehabilitation, and post-rehabilitation periods;
- Confirm which water quality analyses are required and the required frequency of sampling;
- Establish a detailed field sampling methodology; and
- Analyze and compare the results of chemical analyses of groundwater samples to the agreed standards to provide proof of compliance, and therefore verification of rehabilitation success, over the agreed monitoring period.

The proposed post closure surface water quality monitoring program for the Tshipi Borwa Mine is described in detail in Section 14, including methods of analysis, monitoring schedule, and definition of rehabilitation success in terms of the monitoring program.

13.2 GROUNDWATER QUALITY EVALUATION SYSTEM

To utilise groundwater quality as an indicator of rehabilitation success the Tshipi Borwa Mine will:

- Confirm the sampling locations for rehabilitation, and post-rehabilitation periods;
- Confirm which water quality analyses are required and the required frequency of sampling;
- Establish a detailed field sampling methodology; and
- Analyze and compare the results of chemical analyses of groundwater samples to the agreed standards to provide proof of compliance, and therefore verification of rehabilitation success, over the agreed monitoring period.

The proposed post closure groundwater quality monitoring program for the Tshipi Borwa Mine is described in detail in Section 14, including methods of analysis, monitoring schedule, and definition of rehabilitation success in terms of the monitoring program.

13.3 VEGETATIVE COVER EVALUATION SYSTEM

The degree to which the vegetation cover is effective at reducing erosion is a function of the height and continuity of the plant canopy, the density of the ground contact cover, and the root density. The vegetation contact cover dissipates the energy from surface water runoff, thereby decreasing erosional forces. An increase in the vegetation cover also results in an increase in both the evapo-transpiration rate and the infiltration rate leading to changes in the water balance.

Wildlife diversity (and/or livestock populations) respond positively to an increase in available habitat and food supply that is brought on by the establishment of vegetative cover.

Additionally, the success of vegetative cover reflects the chemical and physical suitability of soils to develop and maintain a productive ecosystem that will support a post-closure land use of wilderness and/or grazing (provided the field quality is maintained by not exceeding the grazing capacity).
Three parameters will be measured to evaluate vegetative cover on rehabilitated land:

- The percentage of basal cover,
- The tree/shrub (woody species) density,

- Species diversity and abundance,
- Indigenous species composition, and
- The effectiveness of alien and invasive plant control measures.

The percentage basal cover is the parameter which best represents the overall success of revegetation efforts given all relevant considerations. It is proposed that the line point method be utilized to determine the percentage basal cover in representative transects of more than 200 points on representative sections of rehabilitated land.

This method is utilized worldwide and is advantageous because it is simple and reliable, produces valid results, which are easily interpreted, and does not require any expensive equipment. It also gives species composition and basal cover results in one monitoring action. Tree/shrub density will be evaluated by direct field count in the same representative line transects used for the basal cover assessment. Live, rooted woody stems within one meter either side of the line will be counted and expressed as woody plants per ha as well as the species composition.

The vegetative cover monitoring program is described in detail in Section 14.
It is proposed that rehabilitation success for vegetative cover is demonstrated when monitoring of basal cover in rehabilitated areas at the Tshipi Borwa Mine indicates that:

- The percentage of basal cover on rehabilitated areas is greater than or equal to 8%.
- The density of tree/shrub species (expressed as woody plants per ha) on rehabilitated areas is greater than or equal to 80% of the density of tree/shrub species found on corresponding reference plots with a similar land use.
- Species composition is similar to the species composition of nearby reference plots.
- No Category 1 alien invasive plant species occur on site.

A list of vegetative species that are considered appropriate for use in rehabilitation of the mine property will be confirmed during ongoing field trials at the mine site.

14. MONITORING, AUDITING AND REPORTING

14.1 PRE-CLOSURE MONITORING, AUDITING AND REPORTING

The environmental manager will conduct internal management audits against the commitments in the EMP. These audits will be conducted on an on-going basis until final closure. The audit findings will be documented for both record keeping purposes and for informing continual improvement. EMP performance assessment must be undertaken in accordance to the conditions of the environmental authorisation. The site's compliance with the provisions of the EMP and the adequacy of the EMP report relative to the on-site activities will be assessed in the performance assessment.

A monitoring schedule has already been established at the Tshipi Borwa Mine and includes a groundwater and dust monitoring programme. Additional monitoring programmes (e.g. trials for revegetation of disturbed areas) should also be established during the ongoing operations of the mine. Monitoring is the responsibility of the environmental personnel, and is carried out by the environmental officers, who report to the environmental manager.

The closure plan, environmental risk assessment and annual rehabilitation plan will be reviewed (and updated) on an ongoing basis throughout the life of the mine in order to inform the annual financial provision required for closure at LOM, as well as, unforeseen premature closure. The review and update of the closure plan, environmental risk assessment and annual rehabilitation plan will be carried out by external and independent environmental consultants.

Financial provision for closure at LOM, as well as, unforeseen premature closure will be reviewed and updated on an annual basis. The financial provision will be calculated based on the information contained within the closure plan, environmental risk assessment and annual rehabilitation plan. This update will be carried out by external and independent environmental consultants.

The closure plan, environmental risk assessment, annual rehabilitation plan and financial provision will undergo a scientific and engineering audit (i.e. peer review) in accordance with the 2nd Draft Financial Provision Regulations (Government Gazette 42464, 2019). The financial provision amount will also be audited as part of any financial audit (in terms of the Companies Act, 2008).

All costs associated with pre-closure monitoring, auditing and reporting are presumed to be covered under the operations expenditure of the mine, and have not been included in this preliminary closure plan.

14.2 POST-CLOSURE MONITORING, AUDITING AND REPORTING

This section presents a description of criteria to be utilised in the evaluation of rehabilitation success on rehabilitated areas and a suggested monitoring programme to be implemented for this evaluation. The monitoring programme is designed to measure the success of decommissioning and rehabilitation measures in terms of the rehabilitation success indicators defined in the Preliminary Closure Plan.

In accordance with the selected relinquishment criteria (see Section 13), the monitoring programme will focus on the evaluation of:

- Surface water quality of the pit lake.
- Groundwater quality surrounding and/or down gradient of the rehabilitated areas and pit lake.
- Vegetative success on rehabilitated areas in terms of vegetative cover, tree/shrub (woody species) density, species diversity and abundance, indigenous species composition and effectiveness of alien and invasive plant control measures.

To further support and inform the post-closure monitoring programme, the monitoring and evaluation of the following aspects will also be undertaken:

- Effectiveness of the floating wetland(s) within the pit lake.
- Aquatic biomonitoring within the pit lake.

- Faunal monitoring of the rehabilitated areas.
- Air pollution monitoring.
- Erosion levels and the efficacy of erosion control measures (including stormwater drainage channels and diversions).
- Site security, access, fencing and signage erected for public safety.
- Any other unusual conditions noted within the rehabilitated areas.

14.2.1 SURFACE WATER QUALITY MONITORING

Monitoring of surface water quality will be undertaken in the event that surface water flow is present in the Vlermuisleegte River. In this regard, samples should be taken from both upstream and downstream of the Vlermuisleegte River (for a minimum period of 10 years). In addition to this, the sampling of the pit lake water quality for a minimum period of 25 years must also be undertaken. In this regard, quarterly monitoring will be required for the first 5 years, reducing to bi-annually for the next 10 years, and then annually for the last 10 years (provided that the water quality is not showing signs of deterioration (or otherwise) to a concentration outside of what is anticipated.

Refer to Figure 5 for the proposed location of the surface water monitoring points.

Surface Water Quality Analysis

Water quality analyses results should be classified in terms of the SANS 241 (2015) Water Quality Standards and the DWAF Target Quality Range for Livestock Watering (1996), or whichever is applicable at the time. The monitoring results should be assessed by a suitably-qualified professional registered with the South African Council for Natural Scientific Professional (SACNASP). The parameters that need to be analysed are summarised in the table below.

Table 14-1: Recommended Surface Water Quality Analysis Parameters

Parameter to be measured	Location
pH	o Surface water flow in the Vlermuisleegte o Pit lake
Conductivity in mS/m at 25 ° c	o Surface water flow in the Vlermuisleegte o Pit lake
Temperature	o Pit lake
Dissolved oxygen	o Pit lake
Total dissolved solids (TDS) at 180 ° c	o Surface water flow in the Vlermuisleegte
Alkalinity as $CaCO_3$	o Surface water flow in the Vlermuisleegte
Carbonate as CO_3	o Surface water flow in the Vlermuisleegte
Bicarbonate as HCO_3	o Surface water flow in the Vlermuisleegte
Boron as B	o Surface water flow in the Vlermuisleegte
Nitrate as N	o Surface water flow in the Vlermuisleegte o Pit lake

Parameter to be measured	Location
Chloride as Cl	o Surface water flow in the Vlermuisleegte
Sulphate as SO_4	o Surface water flow in the Vlermuisleegte o Pit lake
Phosphate	o Pit lake
Fluoride as F	o Surface water flow in the Vlermuisleegte
Sodium as Na	o Surface water flow in the Vlermuisleegte
Potassium as K	o Surface water flow in the Vlermuisleegte
Calcium as Ca	o Surface water flow in the Vlermuisleegte
Magnesium as Mg	o Surface water flow in the Vlermuisleegte
Manganese as Mn	o Surface water flow in the Vlermuisleegte
Full metal scan - Inter Coupled Plasma Scan (ICP) (via Mass Spectrometry (MS)	o Surface water flow in the Vlermuisleegte o Pit lake

Surface Water Quality Monitoring Schedule - Pit lake

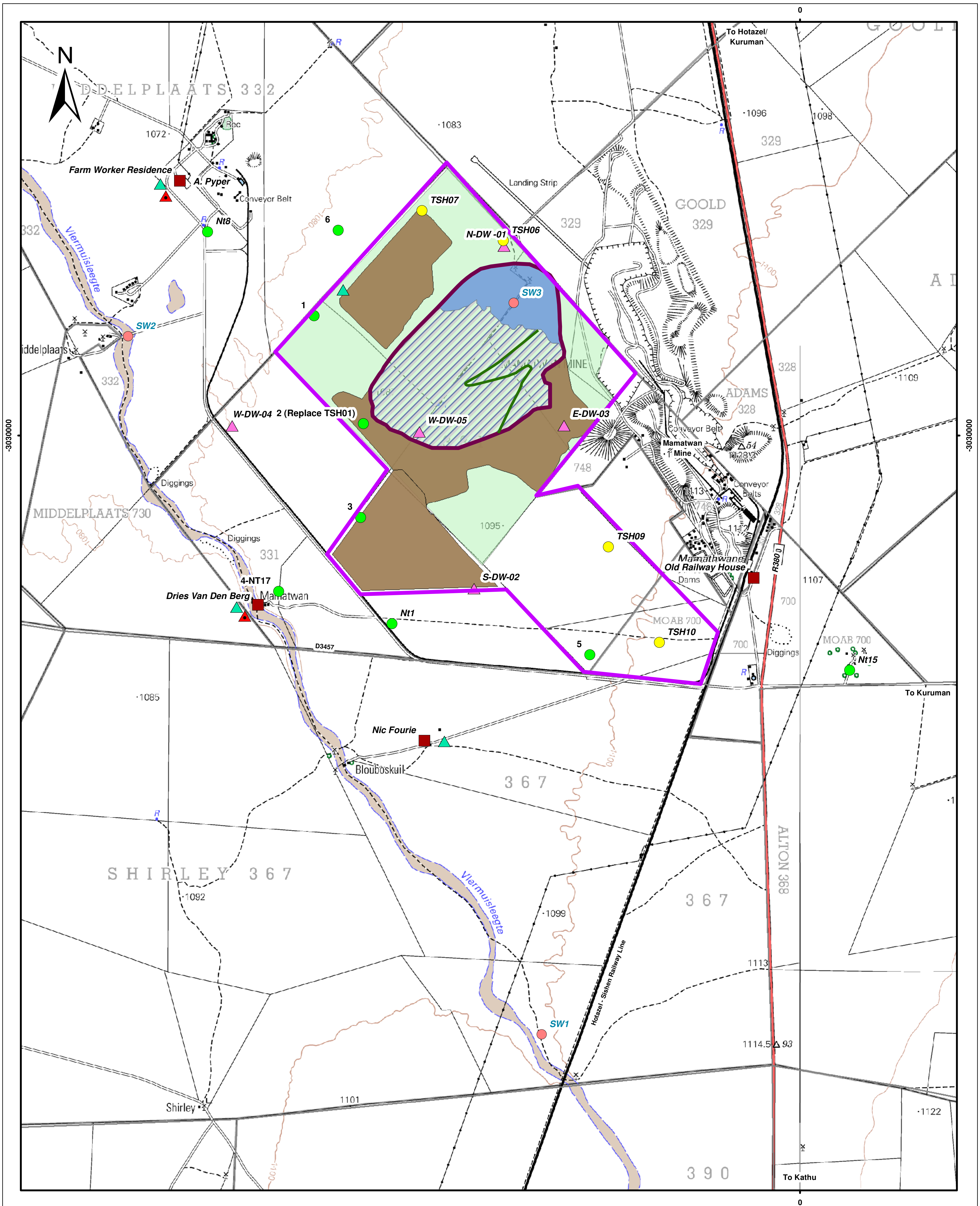
The location (and frequency) of surface water quality monitoring during decommissioning (if possible), rehabilitation and aftercare periods will be based on available access points into the open pit, as well as, the location of the rising water level.

Surface water quality samples will be collected by suitably qualified staff following standard international protocol for collection of environmental samples. Surface water monitoring results will be recorded and included in ongoing monitoring reports. Monitoring reports will need to be submitted to the DWS.

Should statistical analysis of surface water monitoring (pit lake) results for the 25-year monitoring period indicate that agreed standards for the protection of surface water quality will not be met in the open pit, then a study will be commissioned to determine whether the water quality objectives can be met by adjusting the wetland treatment system, or failing that, by applying an alternative treatment method. Additional studies will also consider the potential for harm to the environment and/or post closure land users, the need for remedial measures, and to recommend practicable remedial measures if required.

Rehabilitation Success Criteria for Surface Water Quality Indicators

Rehabilitation success for the surface water quality indicators will be demonstrated when statistical analysis (and trends) of monitoring results for the 25-year monitoring period indicate that future water quality standards for surface water in the open pit lake will not be exceeded.



Legend

- Tshipi Surface Use Area
- Tshipi Mining Right Area
- Access Road
- Open Pit
- Concurrent In-Pit Dumping
- Waste Rock Dumps
- Pit lake

Monitoring

- Surface Water

Air Quality Sampling Points

- Directional
- PM10
- Single

Groundwater Quality Monitoring Points

- Background Monitoring
- Plume Monitoring
- Third Party Ground Water Users

0 500 1 000 Meters

Scale: 1:38 000 @ A3
Projection: Transverse Mercator
Datum: WGS1984, Lo23

Tshipi é Ntle Manganese Mining (Pty) Ltd

Figure 6

Proposed Post Closure Monitoring Locations

SLR

SLR Consulting (Africa) (Pty) Ltd
P O Box 1596, Cramerview, 2060, South Africa
Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

710.20008.00069

2019/08/08

14.2.2 GROUNDWATER QUALITY MONITORING

Post closure groundwater quality monitoring will be undertaken for a minimum period of 10 years. In this regard, monitoring is bi-annually monitoring is required for the first 5 years, reducing to annually for the next 5 years. Refer to Figure 5 for the proposed location of the groundwater monitoring points. It is recommended that after the first 5 years of monitoring is complete, a qualified specialist is contacted to determine the possibility of reducing the number of boreholes that are monitored.

Groundwater Quality Analysis

Water quality analyses results should be classified in terms of the SANS 241 (2015) Water Quality Standards and the DWAF Target Quality Range for Livestock Watering (1996) or whichever is applicable at the time. The monitoring results should be assessed by a suitably-qualified professional registered with the South African Council for Natural Scientific Professional (SACNASP). The parameters that need to be analysed are summarised in the table below.

Table 14-2: Recommended Groundwater Quality Analysis Parameters

Recommended Groundwater Quality Analysis Parameters		
pH	Conductivity in mS/m at 25 ° c	Total dissolved solids (TDS) at 180 ° c
Boron as B	Bicarbonate as HCO_3	Calcium as Ca
Potassium as K	Alkalinity as $CaCO_3$	Magnesium as Mg
Chloride as Cl	Sulphate as SO_4	Manganese as Mn
Fluoride as F	Carbonate as CO_3	Sodium as Na
Nitrate as N	Full metal scan - Inter Coupled Plasma Scan (ICP) (via Mass Spectrometry (MS)	

Groundwater quality monitoring schedule

The locations (and frequency) of groundwater quality monitoring during decommissioning, rehabilitation and aftercare periods will be based on the groundwater monitoring locations (and frequency) at LOM.

Groundwater quality samples will be collected by suitably qualified staff following standard international protocol for collection of environmental samples. Groundwater monitoring results will be recorded and included in ongoing monitoring reports. Monitoring reports will need to be submitted to the DWS on an annual basis.

Should statistical analysis of groundwater monitoring results for the 10-year monitoring period indicate that agreed standards for protection of groundwater quality will not be met for a particular area, then a study will be commissioned to determine the causes of such failure, the potential for harm to the environment and/or post closure land users, the need for remedial measures, and to recommend practicable remedial measures if required.

In such a case, if the indicated groundwater quality emanating from rehabilitated areas is representative of baseline/background (or up gradient) groundwater quality on the rehabilitated areas and in the surrounding region, then previously agreed standards may need to be modified (in agreement with the regulatory Authorities, DWS and DMR).

Rehabilitation Success Criteria for Groundwater Quality Indicators

Rehabilitation success for the groundwater quality indicators will be demonstrated when statistical analysis (and trends) of source term monitoring results for the 10-year monitoring period indicate that agreed water quality standards for groundwater will not be exceeded at monitored locations.

14.2.3 VEGETATIVE COVER (FLORAL) MONITORING

The vegetative cover monitoring programme is designed to verify that rehabilitated areas are successfully developing a productive, self-sustaining ecosystem, which facilitates the post closure land use. Monitoring will take place on an annual basis for a minimum of 10 years.

The success of the vegetative cover is an important aspect in rehabilitation because of its impact on other parameters such as the extent of soil development, soil chemistry and surface erosion (by water and wind). The degree to which the vegetation cover is effective in reducing erosion is a function of the height and continuity of the plant canopy, the density of the ground cover, and the root density. The vegetation cover also dissipates the energy from surface water runoff (and wind), thereby decreasing erosion forces. An increase in the vegetation cover results in an increase in both the evapo-transpiration rate and the infiltration rate leading to changes in the water balance. Finally, wildlife diversity and populations respond positively to an increase in available habitat and food supply that is brought on by the establishment of vegetative cover.

The major potential concerns with vegetative cover on rehabilitated areas are related to the adequacy of ground contact cover, the overall density of tree/shrub (woody) species, species diversity and abundance, indigenous species composition and the effectiveness of alien and invasive plant control measures.

Basal Cover Percentage Analysis

The adequacy of vegetative ground contact cover in providing effective erosion control, habitat establishment and soil building for post closure land uses is related to the percentage basal cover of the site and species composition. Basal cover is a measurement of the contact cover of live rooted vegetation expressed as a percentage of the number of points assessed. A minimum of 200 points per transect is normally required for reliable results and one of the most effective methods of measurement is using the line-point method. This method also allows for measuring species composition and woody plant density at the same time.

Basal cover very seldom exceeds 25% and is correlated to rainfall and species composition. High rainfall can sustain a higher density of plants leading to higher basal cover. Plants with a creeping growth form dominating a site, also tends to lead to higher basal cover. No biomass assessments will be done.

Tree/Shrub Density Analysis

The density of tree and shrub (woody) species on rehabilitated areas provides an indication of the success of efforts in re-establishing a diverse forest/bush environment for post closure land use. A direct count of woody species within belt transects is utilised to determine the density of woody species on rehabilitated areas.

Selected transects used in the rehabilitated areas for analysis of vegetative cover percentage will be utilised for determining woody species density. A count of all rooted, live woody plant within one meter on either side of the line will be done. No biomass assessments will be done.

Species Composition Analysis

The composition of species occurring will be measured by noting species names of the live rooted plant closest to each point in the basal cover assessment. Each species will be listed as to its desirability in the specific veld type. Alien invasive species will be listed where ever they occur on site, and not just in the assessment transects.

The percentage presence of each species will be depicted after each year's monitoring and trends tracked to see if the climax species starts to dominate in the area. A representative presence of climax species on the rehabilitated site, similar to that found in reference sites of the same veld type will indicate rehabilitation success.

Historic Record Sampling in Reference Areas

Representative vegetation reference plots (with similar/identical land uses as per the proposed post closure land use of rehabilitated mine areas in the same veld type) will be marked in areas near rehabilitated sites for determining the degree of achievement of rehabilitation success. This procedure, known as historic record sampling, provides an indication of the cover and diversity found in undisturbed areas.

Vegetative cover and diversity on reference plots will be compared with that on rehabilitated areas. These reference areas will be at least 2500 m^2 in size. Cover and diversity assessments will be done on reference sites at the same time of assessing the rehabilitated sites and will be compared to the results obtained from the rehabilitated sites.

Vegetative Cover Monitoring Schedule

Vegetative cover monitoring will begin one year after completion of revegetation activities and continue annually until rehabilitation success for vegetative cover is achieved. Assessments will be done by trained staff under the supervision of a qualified professional. Vegetative cover monitoring will be completed each year during the seasonal period of peak standing biomass.

Should vegetative cover monitoring after the first year of the aftercare period on any rehabilitated area indicate that the vegetation in that area is not developing in a manner that will lead to achieving vegetative cover success criteria, then necessary remedial measures will be undertaken to enhance vegetative growth in that area to the extent that required standards can be expected to be met.

Rehabilitation Success Criteria for Vegetative Cover Indicators

Rehabilitation success for the vegetative cover will be demonstrated when the following proposed criteria are met:

- The percentage of basal cover on rehabilitated areas is greater than or equal to 8%.
- The density of tree/shrub species (expressed as woody plants per ha) on rehabilitated areas is greater than or equal to 80% of the density of tree/shrub species found on corresponding reference plots with a similar land use.
- Species composition is similar to the species composition of nearby reference plots.
- No Category 1 alien invasive plant species occur on site.

The appropriateness and suitability of these proposed success criteria will be tested and confirmed (and updated if required) as part of ongoing/concurrent mine rehabilitation efforts.

14.2.4 ADDITIONAL MONITORING RECOMMENDATIONS

In addition to the specific monitoring activities described above, the following monitoring activities will also be undertaken.

Floating Wetlands Assessment

Monitoring of the effectiveness of the floating wetland in the pit lake needs to be undertaken by a qualified specialist. Monitoring of the floating wetland is required for a minimum of 25 years because the floating wetland system takes time to establish and the size of the wetland needs to be appropriate to treat the pit lake water to meet DWS livestock watering objectives.

Aquatic Biomonitoring – Whole Effluent Toxicity (WET) Testing

Acute WET tests will be performed in order to qualify and quantify the ability of water in the pit lake to support aquatic life and to assess possible acute effects on aquatic organisms. WET testing should be conducted bi-annually for a minimum of 10 years.

The battery of WET tests must include:

- *Daphnia pulex* (representing aquatic macro-invertebrates);
- *Poecilia reticulata* (representing fish fauna);
- *Vibrio fischeri* (representing bacteria); and
- *Selenastrum capricornutum* (representing algae/aquatic macrophytes).

If a risk of eutrophication is becoming evident, based on physic-chemical data analyses and the results of the *Selenastrum capricornutum* test, further analyses to define the risk of eutrophication should be undertaken by means of determination of Chlorophyll a concentration and algal species identification.

All biomonitoring needs to be undertaken by a suitably qualified specialist. Monitoring reports will need to be submitted to the DWS on an annual basis.

Aquatic Biomonitoring – Habitat and Aquatic Macro-Invertebrate Assessment

An analysis of the aquatic macro-invertebrate community diversity, sensitivity and abundance will take place at an interval of every two years for a minimum period of 10 years. In addition to the aquatic macro-invertebrate community assessment, a visual assessment of habitat conditions should be undertaken. The results should be compared temporarily to determine whether the trajectory of change is acceptable in terms of the desired outcomes.

The monitoring plan will be continually updated and refined for site-specific requirements. All biomonitoring needs to be undertaken by a suitably qualified specialist. Monitoring reports will need to be submitted to the DWS on an annual basis.

Faunal Monitoring

Faunal monitoring will take place on an annual basis for a minimum of 10 years, including annual Sherman trapping to monitor small mammal diversity, and camera trap surveys. Camera trap surveys should be conducted on a bi-annual basis, a winter and a summer trapping survey, for medium to large mammals, as well as cryptic and nocturnal species.

In order to assess the effectiveness of the rehabilitation plans as well as the pit lake it is important that faunal species diversity, abundance and habitat use is assessed. Faunal monitoring will provide valuable insight into the effectiveness of the habitat creation and development, whilst also indicating the rate at which faunal species are recolonising the rehabilitated area. Monitoring will also indicate if the lake is serving its proposed purpose of providing aquatic habitats and breeding zones for faunal species, whilst also forming a useable water resource in the area.

The following points aim to guide the design of the monitoring plan. It must be noted that the monitoring plan will be continually updated and refined for site-specific requirements:

- Permanent monitoring points will be established in areas within the rehabilitated site in various habitat areas and degrees of topography i.e. banks/riparian zone of the pit lake, grassland areas and if applicable areas of increased woody vegetation. These points will be designed to accurately monitor the following parameters:
    - Species diversity (mammal, invertebrate, amphibian, reptile and avifaunal);
    - Species abundance;
    - Faunal community structure including species composition and diversity, which can be compared to year on year results in order to assess trend; and
    - All spoor, scat and signs of faunal species occurrence must be identified and recorded.
- The following criteria will be used with regards to the avifaunal monitoring:
    - Fixed and random points for bird counts to determine species composition and diversity trends. At these points, the observer must record all avifaunal species and total of species observed at the point. A Bird Laser app that can be downloaded onto a smartphone can assist with record keeping, all necessary information can be captured;

    - Proposed avifaunal fixed-point monitoring must be monitored bi-annually (July and February) in order to record summer as well as winter avifaunal species utilising the focus area; and
- The method of monitoring will be designed to be objective and repeatable in order to ensure consistent results.

Air Quality Monitoring

Dust fallout monitoring will be undertaken on a monthly basis for a minimum of 10 years. Dust fallout monitoring will use the ASTM D1739 (1970) method as required, by the South African National Dust Control Regulations (NDCR), with regard to the dustfall unit design, dust collection and analysis.

Post closure dust monitoring will comprise the following:

- Five direction dust fallout buckets;
- Four single dust buckets
- Two PM10 ambient concentration monitoring station.

Monitoring reports will be uploaded onto the National Emissions Inventory System on annual basis.

14.2.5 GENERAL MONITORING

The post-closure monitoring programme will include regular general inspections of rehabilitated areas to assess their condition and to determine any maintenance requirements. These inspections will include:

- Erosion levels and the efficacy of erosion control measures (including stormwater drainage channels and diversions).
- Site security, access, fencing and signage erected for public safety.
- Any other unusual conditions noted within the rehabilitated areas.

General inspections of all rehabilitated areas will be completed at a minimum of quarterly intervals for the aspects defined. Records of all the monitoring and maintenance activities undertaken will be kept.

If the general site condition monitoring activities reveal the requirement for any maintenance or repair of rehabilitated areas, then the necessary works will proceed in a timely fashion to minimise the potential for damage to rehabilitated areas such as soil loss, plant loss and drainage channel disturbance.

Should a condition be identified in any rehabilitated area which has the potential to cause serious environmental damage, or which threatens the health and safety of post closure land users, then the relevant Authorities (DMR, DWS) will be immediately notified of this condition and the remedial measures being undertaken to reduce the potential for harm.

14.2.6 MONITORING AND INSPECTION COSTS

A preliminary post-closure monitoring and reporting programme has been developed as part of this preliminary closure plan. Unit rates for monitoring, analyses and inspection activities were developed based on the costs of similar activities being undertaken by SLR. The total estimated cost of the post-closure monitoring and inspection activities (see tables overleaf), has been calculated to be:

- R 17,382,250 (excl. VAT) for the current pit void and mine layout.
- R 20,006,250 (excl. VAT) for the LOM pit void and mine layout.

This cost makes provision for (including the 2 year decommissioning period):

- 27 years of in-pit surface water monitoring and analysis (quarterly monitoring for first 7 years, bi-annual monitoring for remaining 20 years).
- 12 years of surface water monitoring and analysis at the nearby Vlermuisleegte River – if flowing (quarterly monitoring for first 7 years, bi-annual monitoring for remaining 5 years).
- 12 years of groundwater monitoring and analysis (quarterly monitoring for the first 2 years, bi-annual monitoring for the next 5 years, annual monitoring for remaining 5 years).
- 10 years of floating wetland construction and monitoring.
- 12 years of dust monitoring (quarterly for the first 5 years, bi-annual monitoring for the remaining 7 years).
- Bi-annual (i.e. every six months) biodiversity monitoring/site inspections by external and independent environmental scientists over a period of 12 years.
- Provision for a small on-site maintenance team over a period of 5 years has also been allowed for (for both current and LOM layouts).
- Provision for basic 5 year maintenance expenses.

The post-closure monitoring and inspection costs are considered to have an accuracy of at least ±20% given that much of these monitoring and inspection costs have been derived from the current monitoring and inspection costs at Tshipi.

Table 14-3: Current Post Closure Supervision and Monitoring Costs

Item	Monitoring / Maintenance Activity	no. / year	Cost/activity	Duration (years)	Frequency	Unit	Quantity	Total Cost
1	**WATER QUALITY**							
1.1	*Collection and Laboratory Analysis of Surface and Ground Water Samples*							
1.1.1	Decommissioning and Rehabilitation Phase	4	R 100 000	2	quarterly	Sum	8	R 800 000
1.1.2	Maintenance and Aftercare - Active Phase	4	R 100 000	5	quarterly	Sum	20	R 2 000 000
1.1.3	Maintenance and Aftercare - PassivePhase	2	R 100 000	5	bi-annual	Sum	10	R 1 000 000
1.1.4	Pit water and floating wetlands assessment only	2	R 35 000	15	bi-annual	Sum	30	R 1 050 000
1.2	*Wetland Construction and Replacement*							
1.2.1	Construction over first 10 year period (2.8 ha total)	1	R 245 000	10	ongoing	Sum	10	R 2 450 000
1.2.2	10% Replacement over first 3 year period (0.084 ha total)	1	R 24 500	3	ongoing	Sum	3	R 73 500
1.2.3	5% Replacement over next 7 year period (0.098 ha total)	1	R 12 250	7	ongoing	Sum	7	R 85 750
2	**AIR QUALITY**							
2.1	*Collection and Laboratory Analysis of Dust Samples*							
2.1.1	Decommissioning and Rehabilitation Phase	4	R 40 000	2	quarterly	Sum	8	R 320 000
2.1.2	Maintenance and Aftercare - Active Phase	4	R 40 000	3	quarterly	Sum	12	R 480 000
2.1.3	Maintenance and Aftercare - PassivePhase	2	R 40 000	7	bi-annual	Sum	14	R 560 000
3	**BI-ANNUAL INSPECTIONS**							
3.1	*Inspection of Decommissioning and reclamation works by a local suitably qualified and experienced Environmental Scientist*							
3.1.1	Decommissioning and Rehabilitation Phase	2	R 60 000	2	bi-annual	Sum	4	R 240 000
3.1.2	Maintenance and Aftercare - Active Phase	2	R 60 000	3	bi-annual	Sum	6	R 360 000
3.1.3	Maintenance and Aftercare - PassivePhase	2	R 60 000	7	bi-annual	Sum	14	R 840 000
4	**MANAGEMENT OF MONITORING AND MAINTENANCE**							
4.1	*On-Site Maintenance, Monitoring and Aftercare of the Decommissioning and Reclamation Process by an appropriately qualified and experienced team.*					Years	5	R 3 027 000
		Days/month	**Rate / day**	**Total/month**	**Total/year**			
	- 1 Manager	*1*	*R 11 250*	*R 11 250*	R 135 000			
	- 1 Field Supervisor	*20*	*R 560*	*R 11 200*	R 134 400			
	- 5 Labourers	*100*	*R 280*	*R 28 000*	R 336 000			
					R 605 400			
4.2	Provisional sum for earthmoving equipment, fuel and materials	**Rate / ha**				ha	512	R 4 096 000
	(e.g. fertilizing, re-planting, control of alien vegetation, repair erosion etc.)	R 8 000						
	TOTAL (excl. VAT) for Current Liability as at June 2019							**R 17 382 250**

Table 14-4: LOM Post Closure Supervision and Monitoring Costs

Item	Monitoring / Maintenance Activity	no. / year	Cost/activity	Duration (years)	Frequency	Unit	Quantity	Total Cost
1	**WATER QUALITY**							
1.1	*Collection and Laboratory Analysis of Surface and Ground Water Samples*							
1.1.1	Decommissioning and Rehabilitation Phase	4	R 100 000	2	quarterly	Sum	8	R 800 000
1.1.2	Maintenance and Aftercare - Active Phase	4	R 100 000	5	quarterly	Sum	20	R 2 000 000
1.1.3	Maintenance and Aftercare - PassivePhase	2	R 100 000	5	bi-annual	Sum	10	R 1 000 000
1.1.4	Pit water and floating wetlands assessment only	2	R 35 000	15	bi-annual	Sum	30	R 1 050 000
1.2	*Wetland Construction and Replacement*							
1.2.1	Construction over first 10 year period (2.8 ha total)	1	R 245 000	10	ongoing	Sum	10	R 2 450 000
1.2.2	10% Replacement over first 3 year period (0.084 ha total)	1	R 24 500	3	ongoing	Sum	3	R 73 500
1.2.3	5% Replacement over next 7 year period (0.098 ha total)	1	R 12 250	7	ongoing	Sum	7	R 85 750
2	**AIR QUALITY**							
2.1	*Collection and Laboratory Analysis of Dust Samples*							
2.1.1	Decommissioning and Rehabilitation Phase	4	R 40 000	2	quarterly	Sum	8	R 320 000
2.1.2	Maintenance and Aftercare - Active Phase	4	R 40 000	3	quarterly	Sum	12	R 480 000
2.1.3	Maintenance and Aftercare - PassivePhase	2	R 40 000	7	bi-annual	Sum	14	R 560 000
3	**BI-ANNUAL INSPECTIONS**							
3.1	*Inspection of Decommissioning and reclamation works by a local suitably qualified and experienced Environmental Scientist*							
3.1.1	Decommissioning and Rehabilitation Phase	2	R 60 000	2	bi-annual	Sum	4	R 240 000
3.1.2	Maintenance and Aftercare - Active Phase	2	R 60 000	3	bi-annual	Sum	6	R 360 000
3.1.3	Maintenance and Aftercare - PassivePhase	2	R 60 000	7	bi-annual	Sum	14	R 840 000
4	**MANAGEMENT OF MONITORING AND MAINTENANCE**							
4.1	*On-Site Maintenance, Monitoring and Aftercare of the Decommissioning and Reclamation Process by an appropriately qualified and experienced team.*					Years	5	R 3 027 000
		Days/month	**Rate / day**	**Total/month**	**Total/year**			
	- 1 Manager	*1*	*R 11 250*	*R 11 250*	R 135 000			
	- 1 Field Supervisor	*20*	*R 560*	*R 11 200*	R 134 400			
	- 5 Labourers	*100*	*R 280*	*R 28 000*	R 336 000			
					R 605 400			
4.2	Provisional sum for earthmoving equipment, fuel and materials (e.g. fertilizing, re-planting, control of alien vegetation, repair erosion etc.)	**Rate / ha** R 8 000				ha	840	R 6 720 000
	TOTAL (excl. VAT) for Current Liability as at June 2019							**R 20 006 250**

14.3 ANNUAL UPDATES

This closure plan (including the environmental risk assessment, annual rehabilitation plan and closure cost liability estimates) will be reviewed and updated annually in accordance with the 2nd Draft Financial Provision Regulations (Government Gazette 42464, 2019).

14.4 AMENDMENTS TO CLOSURE PLAN

This is the first draft of the closure plan related to the alternative closure and rehabilitation optimisation project at Tshipi (i.e. pit lake), and there are no amendments to the closure plan.

15. CLOSURE COST LIABILITY ESTIMATION PROCEDURE

15.1 CLOSURE COST LIABILITY METHODOLOGY

The closure cost liability was calculated in accordance with the 2nd Draft Financial Provision Regulations (Government Gazette 42464, 2019), namely:

- A third party will be employed to undertake the decommissioning and rehabilitation work.
- All costs are based on market related figures based on prevailing rates.
- Mine infrastructure asset salvage value has not been taken into account.
- Provisional and general costs and contingencies as per the industry standard are included.

15.2 QUANTITIES

The quantities were calculated from the current mine layout (see Figure 2-1) and proposed LOM layout (see Figure 2-2 and Appendix C).

15.3 UNIT RATES

The closure components for the decommissioning and restoration works to achieve the stated closure objectives are table below. The rates for the closure components have been derived from SLR's database of closure rates.

Table 15-1: Rates used for closure liability calculations

No.	Description of closure component / activity	Unit	Unit Rate (at June 2019)
1	Dismantling of heavy plant structures	m^2	R 1697.74
2	Dismantling of medium plant structures	m^2	R 763.36
3	Dismantling of workshops and shed type structures (5 to 10m high)	m^2	R 238.94
4	Dismantling of suspended conveyors (no cladding)	m	R 672.82
5	Dismantling of steel tanks (upto 5m high)	m^2	R 169.78
6	Demolition of floors, bases and foundations after removal of structures (heavy duty)	m^2	R 741.97
7	Demolition of floors, bases and foundations after removal of structures (medium duty)	m^2	R 270.39

No.	Description of closure component / activity	Unit	Unit Rate (at June 2019)
8	Demolish single storey buildings (incl. removal of foundations)	m^2	R 371.00
9	Remove gravel roads and bury associated layer works	m^2	R 26.41
10	Remove electrified railway lines	m	R 371.00
11	Dismantle security fencing	m	R 33.96
12	Reshaping, profiling of dumps	ha	R 138,963.53
13	Construct 2m high safety berm around pit	m	R 271.60
14	Sloping pit perimeter walls to render area safer	ha	R 105,632.89
15	Remove and dispose HDPE liners	ha	R 76,040.24
16	Shaping, levelling of infrastructural footprint areas (500 mm)	ha	R 69,481.77
17	Shaping, levelling of infrastructural footprint areas (750 mm)	ha	R 104,222.66
18	Place 300mm topsoil and/or growth medium material for revegetation	m^3	R 44.47
19	Establishment of vegetation (general)	ha	R 17,354.73
20	Establishment of vegetation (WRD and TSF's)	ha	R 24,208.58

15.4 TIME, FEE AND CONTINGENCY COSTS

The following time, fee and contingency costs have also been included in the closure cost liability calculations based on SLR's experience with similar projects.

Table 15-2: Time, fee and Contingency costs

No.	Description of closure component / activity	Unit	Rates (at Aug 2018)
21	Contractor P&G's (incl. site establishment and demobilization)	%	20
22	Tender process and procurement	%	6
23	Site supervision of closure works	%	7.5
24	Contingency	%	10

15.5 CLOSURE COST LIABILITY CALCULATIONS

The closure cost liability calculations are provided in Appendix D. The closure cost liability calculations have been determined for the following periods (as per the 2nd Draft Financial Provision Regulations (Government Gazette 42464, 2019)), namely:

- Current closure cost liability (as at June 2019), R 186,488,203 (excl. VAT).
- The closure cost liability incurred over the next 12 months (i.e. from June 2019 to June 2020), R 15,505,059 (excl. VAT).
- LOM closure cost liability, 25 years from now (as at June 2044), R 316,318,824 (excl. VAT).

In accordance with the 2nd Draft Financial Provision Regulations, the amount to be set aside for the current closure and rehabilitation of the Tshipi Borwa Mine (current value (CV) as at June 2019), is calculated to be R 268,680,158 (incl. VAT) as per the table below.

Table 15-3: Current closure liability provision required (CV as at June 2019)[3,4]

Aspect	Calculated Amount
Current Liability as at June 2019	R 186,488,203
Liability incurred over the next 12 months (June 2019 to June 2020)	R 15,505,059
Post closure maintenance and aftercare (see section 11.2 previously)	R 17,382,250
Subtotal 1	**R 219,375,512**
Escalate Subtotal 1 by CPI + 2% (i.e. 6.5%)	R 14,259,408
Subtotal 2	**R 233,634,920**
Add 15% VAT to Subtotal 2	R 35,045,238
Grand Total	**R 268,680,158**

Similarly, the amount to be set aside for the LOM closure and rehabilitation of the Tshipi Borwa Mine (CV as at June 2019), is calculated to be R 411,914,135 (incl. VAT) as per the table below.

Table 15-4:LOM closure liability provision required (CV as at June 2019)

Aspect	Calculated Amount
LOM Liability as at June 2044	R 316,318,824
Liability incurred over the next 12 months (June 2044 to June 2045)	R 0
Post closure maintenance and aftercare (see section 11.2 previously)	R 20,006,250
Subtotal 1	**R 336,325,074**
Escalate Subtotal 1 by CPI + 2% (i.e. 6.5%)	R 21,861,130
Subtotal 2	**R 358,186,204**
Add 15% VAT to Subtotal 2	R 53,727,931
Grand Total	**R 411,914,135**

[3] The calculation of the closure liability in the current Financial Provisioning Regulations, 2015 requires mines to provide for their anticipated closure liability 10 years in advance, based on their current mine plans. This requirement is considered too onerous for many mines, especially open pit mines, hence it has been replaced in the draft Financial Provisioning Regulations, 2019 with the requirement to only provide for an escalated anticipated closure liability 12 months in advance.

[4] For comparative purposes, the amount to be set aside for the current closure and rehabilitation of the Tshipi Borwa Mine (current value (CV) as at June 2019), in accordance with the current 2015 Financial Provisioning Regulations is calculated to be R 361,815,209 (incl. VAT) i.e. significantly more than R 268,680,158 (incl. VAT). See Appendix C for the calculation.

This estimated closure liability calculations are considered to have an accuracy of ±30% based on the unit rates used and the level of detail currently available.

The overall level of confidence in the closure cost liability calculations can be further improved by:

- Confirming the demolition and removal of all infrastructure (including buildings, powerlines, water supply and treatment, access roads etc.).
- Maintaining a database of hazardous materials on site at closure, and the associated method (and hence cost) of safe disposal.
- Obtaining site specific rates for the scheduled closure activities through a formal tender process with a detailed bill of quantities, detailed scope of work with engineered drawings, as well as, contract specifications.

16. ANNUAL REHABILITATION PLANNING

The objective of annual rehabilitation planning is to:

- Review concurrent rehabilitation and remediation activities already implemented.
- Establish rehabilitation and remediation goals and outcomes for the forthcoming 12 months, which contribute to the gradual achievement of the post-mining land use, closure vision and objectives identified in the final rehabilitation, decommissioning and mine closure plan.
- Establish a plan, schedule and budget for rehabilitation for the forthcoming 12 months.
- Identify and address shortcomings experienced in the preceding 12 months of rehabilitation.
- Evaluate and update the cost of rehabilitation for the 12 month period and for closure, for purposes of supplementing the financial provision guarantee or other financial provision instruments.

Annual rehabilitation plans for the forthcoming 12 months will be prepared in future updates of this report.

Annual rehabilitation and remediation activities associated with the annual rehabilitation plan will focus primarily on:

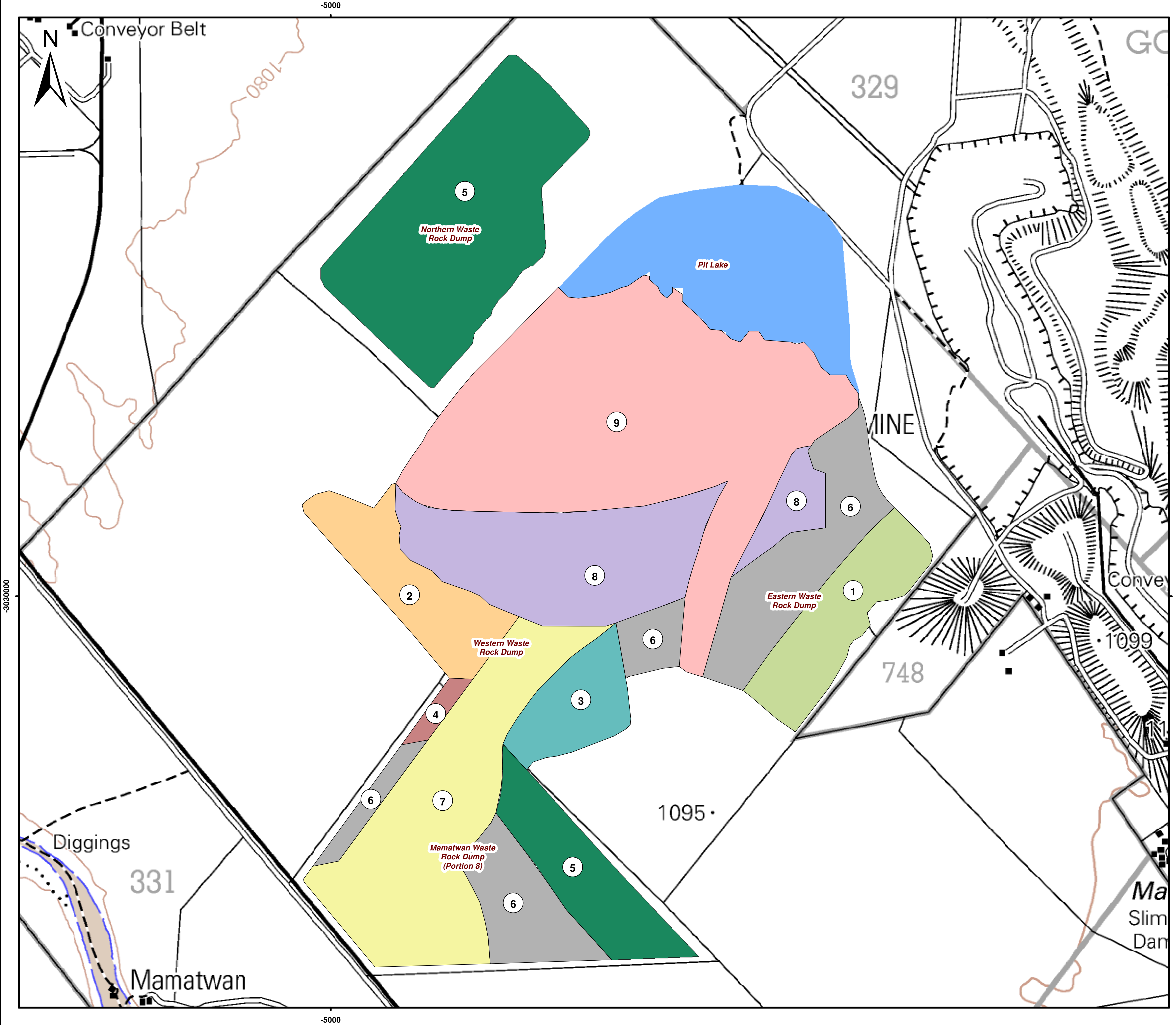
- Clearing of vegetation in accordance with the relevant vegetation management procedures. Destructing and disturbing as little vegetation and biodiversity as possible (i.e. limiting the footprint of the mines operation), and retaining as much natural vegetation as possible.
- Stripping and stockpiling of soil resources in areas designated for development in line with a soil conservation procedure.
- Backfilling of mined out pit areas (i.e. in-pit dumping during operations) in accordance with the mine plan.
- Rehabilitation of overburden dumps (no longer required) that are expected to remain post closure.
- General, hazardous and medical waste collection, storage and disposal.
- Ongoing monitoring of groundwater, surface water and air quality.

A preliminary plan indicating the potential areas of concurrent rehabilitation of the WRD's (based on the latest mining schedule) is shown in Figure 6, and summarised in the table below.

Table 16-1: Potential WRD Areas for Concurrent Rehabilitation

Area Available	Date available for Concurrent Rehabilitation	Location of Area(s)
29.20 ha	2022	• Southern section of Eastern WRD
27.80 ha	2023	• Northern section of Western WRD
19.46 ha	2024	• Southern section of Western WRD
3.26 ha	2025	• North section of Portion 8 WRD
123.80 ha	2030 to 2033	• Northern WRD • Eastern section of Portion 8 WRD
73.76 ha	2034 to 2036	• Northern section of Portion 8 WRD • Central section of Portion 8 WRD • Remainder of Eastern WRD • Area connecting Eastern and Western WRD's
79.88 ha	2037 to 2040	• Remainder of Portion 8 WRD • Remainder of Western WRD
65.34 ha	2041 to 2044	• In-pit dumping areas (mostly top flat surfaces)
148.06 ha *	At LOM (2044+)	• Remainder of in-pit dumping areas (mostly slopes)

* Some of this area may be available before LOM Closure for concurrent rehabilitation.



Areas Available For Concurrent Rehabilitation

- 1 2022 (29.20ha)
- 2 2023 (27.80ha)
- 3 2024 (19.46ha)
- 4 2025 (3.26ha)
- 5 2030 to 2033 (123.80ha)
- 6 2034 to 2036 (73.76ha)
- 7 2037 to 2040 (79.88ha)
- 8 2041 to 2044 (65.34ha)
- 9 At LOM 2044+ (148.06ha)

0 400 800 Meters

Scale: 1:17 500 @ A3
Projection: Transverse Mercator
Datum: WGS1984, Lo23

Tshipi é Ntle Manganese Mining (Pty) Ltd

Figure 7

Areas Available for Concurrent Rehabilitation

SLR

SLR Consulting (Africa) (Pty) Ltd
P O Box 1596, Cramerview, 2060, South Africa
Tel: +27 (11) 467-0945 Fax: +27 (11) 467-0978

710.20008.00069 2019/08/08

17. CONCLUSION

This preliminary closure plan has been generated based on existing information currently available for the Tshipi Borwa Mine, and as documented in the amended EIA and EMP report (EMP 3).

Stephen van Niekerk	**Natasha Smyth**	**Brandon Stobart**
(Report Author)	(Report Author and Project Manager)	(Reviewer)

18. REFERENCES

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GNR 982 of the National Environmental Management Act (107/1998). Environmental Impact Assessment Regulations, 2014. December 2014.

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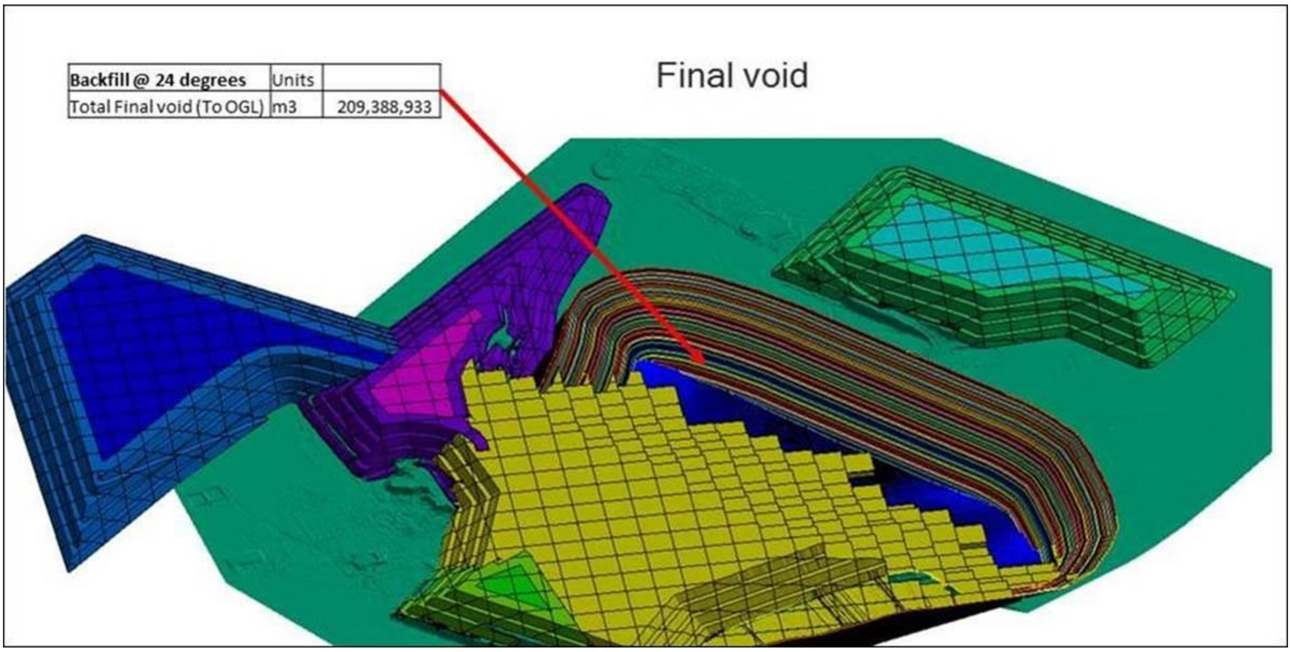
APPENDIX A: LOM MINE PLAN MODEL



APPENDIX B: CLOSURE COST LIABILITY CALCULATIONS

- As per the 2nd Draft Financial Provisioning Regulations (Government Gazette 42464, 2019)

CALCULATION OF THE QUANTUM

Mine: **Tshipi Borwa Mine** — **Current**

Evaluators: **SLR Consulting (Pty) Ltd** — Date: **At June 2019**

No.	Description:	Unit:	Operational Area	A Quantity	B Master rate	E=A*B*C*D Amount (Rands)
1	Dismantling of heavy plant structures	m^2	Crushers, screens, transfer bin and associated plant along conveyor	2 525	R 1 697.74	R 4 286 803.77
2	Dismantling of medium plant structures	m^2	Primary and Product Stockpiles, LocoPlatform	8 270	R 763.36	R 6 312 971.65
3	Dismantling of workshops and shed type structures (5 to 10m high)	m^2	Contractor's Workshops, Warehouse, Powerhouse	9 500	R 238.94	R 2 269 903.11
		m^2	Tyre repair, diesel storage, washbay	2 625	R 238.94	R 627 210.07
		m^2	Diesel farm, magazine	900	R 238.94	R 215 043.45
4	Dismantling of suspended conveyors (no cladding)	m	Suspended conveyors	1 260	R 672.82	R 847 747.94
5	Dismantling of steel tanks (upto 5m high)	m^2	Storage tanks	490	R 169.78	R 83 191.52
6	Demolition of floors, bases and foundations after removal of structures (heavy duty)	m^2	Contractor's Workshops, Warehouse, Powerhouse	9 500	R 741.97	R 7 048 756.73
		m^2	Tyre repair, diesel storage, washbay	2 625	R 741.97	R 1 947 682.78
		m^2	Crushers, screens, transfer bin and associated plant along conveyor	2 525	R 741.97	R 1 873 485.34
7	Demolition of floors, bases and foundations after removal of structures (medium duty)	m^2	Primary and Product Stockpiles, LocoPlatform, temporary slabs	8 870	R 270.39	R 2 398 342.89
		m^2	Diesel farm, magazine	900	R 270.39	R 243 349.33
8	Demolish single storey buildings (incl. removal of foundations)	m^2	Admin officrs, change rooms, laboratory	6 265	R 371.00	R 2 324 300.55
9	Remove gravel roads and bury associated layer works	m^2	Haul roads and heavily trafficked access roads	86 700	R 26.41	R 2 289 929.49
10	Remove electrified railway lines	m	Railway lines	5 800	R 371.00	R 2 151 786.62
11	Dismantle security fencing	m	Magazine, water dams, TSF, waste yard, laydown areas, diesel farm	4 135	R 33.96	R 140 424.27
12	Reshaping, profiling of dumps	ha	Western dump	94.28	R 138 963.53	R 13 101 481.75
		ha	Western dump extension	-	R 138 963.53	R 0.00
		ha	Eastern dump	56.28	R 138 963.53	R 7 820 867.56
		ha	Northern dump	51.21	R 138 963.53	R 7 116 322.45
13	Construct 2m high safety berm around pit	m	Open pit	3 775	R 271.60	R 1 025 272.56
14	Sloping pit permiter walls to render area safer	ha	Open pit	109.33	R 105 632.89	R 11 548 844.24
15	Remove and dispose HDPE liners	ha	TSF and water dams	3.63	R 76 040.24	R 276 026.07
16	Shaping, leveling of infrastructural footprint areas (500 mm)	ha	Truck stop, plant area, lightly trafficed roads, hardstand area	111.42	R 69 481.77	R 7 741 658.34
17	Shaping, leveling of infrastructural footprint areas (750 mm)	ha	TSF, water dams, magazine, crushing area, railway line	24.99	R 104 222.66	R 2 604 524.25
18	Place 300 mm topsoil and/or growth medium material for revegetation	m^3	Use available material from topsoil stockpiles	747 825	R 44.47	R 33 254 530.44
19	Establishment of vegetation (general)	ha	Truck stop, plant area, TSF, magazine, crushing area, railway line, lightly trafficked roads, haul roads, hard stand area and heavy trafficked roads	145.08	R 17 354.73	R 2 517 823.71
20	Establishment of vegetation (WRD and TSF's)	ha	Water dams, Western dump, Eastern dump, Northern dump	203.40	R 24 208.58	R 4 924 025.92
					Subtotal 1 (Sum of items 1 to 15 Above)	R 126 992 306.81
21	Contractor P&G's (incl. site establishment and demobilization)			20% of Subtotal 1		R 25 398 461.36
22	Tender process and procurement			6% of Subtotal 1		R 7 619 538.41
23	Site supervision of closure works			7.5% of Subtotal 1		R 9 524 423.01
					Subtotal 2 (Subtotal 1 plus Time & Fee values)	R 169 534 729.60
24	Contingency			10.0% of Subtotal 2		R 16 953 472.96
					Subtotal 3 (Subtotal 2 plus Contingency value)	R 186 488 202.56
					GRAND TOTAL FOR MINING OPERATIONS (excl. VAT)	**R 186 488 202.56**

CALCULATION OF THE QUANTUM						
Mine:	**Tshipi Borwa Mine**					**Next 12 Months**
Evaluators:	**SLR Consulting (Pty) Ltd**				Date:	**to June 2020**
No.	**Description:**	**Unit:**	**Operational Area**	**A Quantity**	**B Master rate**	**E=A*B*C*D Amount (Rands)**
1	Dismantling of heavy plant structures	m^2	n/a	-	R 1 697.74	R 0.00
2	Dismantling of medium plant structures	m^2	n/a	-	R 763.36	R 0.00
3	Dismantling of workshops and shed type structures (5 to 10m high)	m^2	n/a	-	R 238.94	R 0.00
4	Dismantling of suspended conveyors (no cladding)	m	n/a	-	R 672.82	R 0.00
5	Dismantling of steel tanks (upto 5m high)	m^2	n/a	-	R 169.78	R 0.00
6	Demolition of floors, bases and foundations after removal of structures (heavy duty)	m^2	n/a	-	R 741.97	R 0.00
7	Demolition of floors, bases and foundations after removal of structures (medium duty)	m^2	n/a	-	R 270.39	R 0.00
8	Demolish single storey buildings (incl. removal of foundations)	m^2	n/a	-	R 371.00	R 0.00
9	Remove gravel roads and bury associated layer works	m^2	n/a	-	R 26.41	R 0.00
10	Remove electrified railway lines	m	n/a	-	R 371.00	R 0.00
11	Dismantle security fencing	m	n/a	-	R 33.96	R 0.00
12	Reshaping, profiling of dumps	ha	Western dump	-	R 138 963.53	R 0.00
		ha	Western dump extension	19.00	R 138 963.53	R 2 640 307.10
		ha	Eastern dump	-	R 138 963.53	R 0.00
		ha	Northern dump	5.00	R 138 963.53	R 694 817.66
13	Construct 2m high safety berm around pit	m	Open pit	1 000	R 271.60	R 271 595.38
14	Sloping pit permiter walls to render area safer	ha	Open pit	30.00	R 105 632.89	R 3 168 986.80
15	Remove and dispose HDPE liners	ha	n/a	-	R 76 040.24	R 0.00
16	Shaping, leveling of infrastructural footprint areas (500 mm)	ha	n/a	-	R 69 481.77	R 0.00
17	Shaping, leveling of infrastructural footprint areas (750 mm)	ha	n/a	-	R 104 222.66	R 0.00
18	Place 300 mm topsoil and/or growth medium material for revegetation	m^3	From newly stripped areas	72 000	R 44.47	R 3 201 719.91
19	Establishment of vegetation (general)	ha	n/a	-	R 17 354.73	R 0.00
20	Establishment of vegetation (WRD and TSF's)	ha	Western dump extension, Northern dump	24.00	R 24 208.58	R 581 006.01
					Subtotal 1 (Sum of items 1 to 15 Above)	R 10 558 432.86
21	Contractor P&G's (incl. site establishment and demobilization)			20% of Subtotal 1		R 2 111 686.57
22	Tender process and procurement			6% of Subtotal 1		R 633 505.97
23	Site supervision of closure works			7.5% of Subtotal 1		R 791 882.46
					Subtotal 2 (Subtotal 1 plus Time & Fee values)	R 14 095 507.86
24	Contingency			10.0% of Subtotal 2		R 1 409 550.79
					Subtotal 3 (Subtotal 2 plus Contingency value)	R 15 505 058.65
					GRAND TOTAL FOR MINING OPERATIONS (excl. VAT)	**R 15 505 058.65**

Mine:	Tshipi Borwa Mine					LOM
Evaluators:	SLR Consulting (Pty) Ltd				Date:	At June 2044
No.	**Description:**	**Unit:**	**Operational Area**	**A Quantity**	**B Master rate**	**E=A*B*C*D Amount (Rands)**
1	Dismantling of heavy plant structures	m^2	Crushers, screens, transfer bin and associated plant along conveyor	2 525	R 1 697.74	R 4 286 803.77
2	Dismantling of medium plant structures	m^2	Primary and Product Stockpiles, LocoPlatform	8 270	R 763.36	R 6 312 971.65
3	Dismantling of workshops and shed type structures (5 to 10m high)	m^2	Contractor's Workshops, Warehouse, Powerhouse	9 500	R 238.94	R 2 269 903.11
		m^2	Tyre repair, diesel storage, washbay	2 625	R 238.94	R 627 210.07
		m^2	Diesel farm, magazine	900	R 238.94	R 215 043.45
4	Dismantling of suspended conveyors (no cladding)	m	Suspended conveyors	1 260	R 672.82	R 847 747.94
5	Dismantling of steel tanks (upto 5m high)	m^2	Storage tanks	490	R 169.78	R 83 191.52
6	Demolition of floors, bases and foundations after removal of structures (heavy duty)	m^2	Contractor's Workshops, Warehouse, Powerhouse	9 500	R 741.97	R 7 048 756.73
		m^2	Tyre repair, diesel storage, washbay	2 625	R 741.97	R 1 947 682.78
		m^2	Crushers, screens, transfer bin and associated plant along conveyor	2 525	R 741.97	R 1 873 485.34
7	Demolition of floors, bases and foundations after removal of structures (medium duty)	m^2	Primary and Product Stockpiles, LocoPlatform, temporary slabs	8 870	R 270.39	R 2 398 342.89
		m^2	Diesel farm, magazine	900	R 270.39	R 243 349.33
8	Demolish single storey buildings (incl. removal of foundations)	m^2	Admin officrs, change rooms, laboratory	6 265	R 371.00	R 2 324 300.55
9	Remove gravel roads and bury associated layer works	m^2	Haul roads and heavily trafficked access roads	86 700	R 26.41	R 2 289 929.49
10	Remove electrified railway lines	m	Railway lines	5 800	R 371.00	R 2 151 786.62
11	Dismantle security fencing	m	Magazine, water dams, TSF, waste yard, laydown areas, diesel farm	4 135	R 33.96	R 140 424.27
12	Reshaping, profiling of dumps	ha	Western dump	94.28	R 138 963.53	R 13 101 481.75
		ha	Western dump extension	128.00	R 138 963.53	R 17 787 332.04
		ha	Eastern dump	56.28	R 138 963.53	R 7 820 867.56
		ha	Northern dump	95.00	R 138 963.53	R 13 201 535.50
13	Construct 2m high safety berm around pit	m	Open pit	6 500	R 271.60	R 1 765 369.97
14	Sloping pit permiter walls to render area safer	ha	Open pit	243.00	R 105 632.89	R 25 668 793.10
15	Remove and dispose HDPE liners	ha	TSF and water dams	3.63	R 76 040.24	R 276 026.07
16	Shaping, leveling of infrastructural footprint areas (500 mm)	ha	Truck stop, plant area, lightly trafficed roads, hardstand area	111.42	R 69 481.77	R 7 741 658.34
17	Shaping, leveling of infrastructural footprint areas (750 mm)	ha	TSF, water dams, magazine, crushing area, railway line	24.99	R 104 222.66	R 2 604 524.25
18	Place 300 mm topsoil and/or growth medium material for revegetation	m^3	Use available material from topsoil stockpiles	1 664 205	R 44.47	R 74 004 420.59
19	Establishment of vegetation (general)	ha	Truck stop, plant area, TSF, magazine, crushing area, railway line, lightly trafficked roads, haul roads, hard stand area and heavy trafficked roads	145.08	R 17 354.73	R 2 517 823.71
20	Establishment of vegetation (WRD and TSF's)	ha	Water dams, Western dump, Eastern dump, Northern dump	375.19	R 24 208.58	R 9 082 818.51
		ha	Backfilled open pit areas	197.00	R 24 208.58	R 4 769 090.99
					Subtotal 1 (Sum of items 1 to 15 Above)	R 215 402 671.90
21	Contractor P&G's (incl. site establishment and demobilization)			20% of Subtotal 1		R 43 080 534.38
22	Tender process and procurement			6% of Subtotal 1		R 12 924 160.31
23	Site supervision of closure works			7.5% of Subtotal 1		R 16 155 200.39
					Subtotal 2 (Subtotal 1 plus Time & Fee values)	R 287 562 566.98
24	Contingency			10.0% of Subtotal 2		R 28 756 256.70
					Subtotal 3 (Subtotal 2 plus Contingency value)	R 316 318 823.68
					GRAND TOTAL FOR MINING OPERATIONS (excl. VAT)	**R 316 318 823.68**

APPENDIX C: ALTERNATIVE CLOSURE COST LIABILITY CALCULATION

- As per the current 2015 Financial Provisioning Regulations (GNR 1147)

Mine:	**Tshipi Borwa Mine**					**+ 10 Years**
Evaluators:	**SLR Consulting (Pty) Ltd**				Date:	**At June 2029**
No.	**Description:**	**Unit:**	**Operational Area**	**A Quantity**	**B Master rate**	**E=A*B*C*D Amount (Rands)**
1	Dismantling of heavy plant structures	m^2	Crushers, screens, transfer bin and associated plant along conveyor	2 525	R 1 697.74	R 4 286 803.77
2	Dismantling of medium plant structures	m^2	Primary and Product Stockpiles, LocoPlatform	8 270	R 763.36	R 6 312 971.65
3	Dismantling of workshops and shed type structures (5 to 10m high)	m^2	Contractor's Workshops, Warehouse, Powerhouse	9 500	R 238.94	R 2 269 903.11
		m^2	Tyre repair, diesel storage, washbay	2 625	R 238.94	R 627 210.07
		m^2	Diesel farm, magazine	900	R 238.94	R 215 043.45
4	Dismantling of suspended conveyors (no cladding)	m	Suspended conveyors	1 260	R 672.82	R 847 747.94
5	Dismantling of steel tanks (upto 5m high)	m^2	Storage tanks	490	R 169.78	R 83 191.52
6	Demolition of floors, bases and foundations after removal of structures (heavy duty)	m^2	Contractor's Workshops, Warehouse, Powerhouse	9 500	R 741.97	R 7 048 756.73
		m^2	Tyre repair, diesel storage, washbay	2 625	R 741.97	R 1 947 682.78
		m^2	Crushers, screens, transfer bin and associated plant along conveyor	2 525	R 741.97	R 1 873 485.34
7	Demolition of floors, bases and foundations after removal of structures (medium duty)	m^2	Primary and Product Stockpiles, LocoPlatform, temporary slabs	8 870	R 270.39	R 2 398 342.89
		m^2	Diesel farm, magazine	900	R 270.39	R 243 349.33
8	Demolish single storey buildings (incl. removal of foundations)	m^2	Admin officrs, change rooms, laboratory	6 265	R 371.00	R 2 324 300.55
9	Remove gravel roads and bury associated layer works	m^2	Haul roads and heavily trafficked access roads	86 700	R 26.41	R 2 289 929.49
10	Remove electrified railway lines	m	Railway lines	5 800	R 371.00	R 2 151 786.62
11	Dismantle security fencing	m	Magazine, water dams, TSF, waste yard, laydown areas, diesel farm	4 135	R 33.96	R 140 424.27
12	Reshaping, profiling of dumps	ha	Western dump	94.28	R 138 963.53	R 13 101 481.75
		ha	Western dump extension	116.80	R 138 963.53	R 16 230 940.48
		ha	Eastern dump	56.28	R 138 963.53	R 7 820 867.56
		ha	Northern dump	95.00	R 138 963.53	R 13 201 535.50
13	Construct 2m high safety berm around pit	m	Open pit	5 600	R 271.60	R 1 520 934.13
14	Sloping pit permiter walls to render area safer	ha	Open pit	212.77	R 105 632.89	R 22 475 510.73
15	Remove and dispose HDPE liners	ha	TSF and water dams	3.63	R 76 040.24	R 276 026.07
16	Shaping, leveling of infrastructural footprint areas (500 mm)	ha	Truck stop, plant area, lightly trafficed roads, hardstand area	111.42	R 69 481.77	R 7 741 658.34
17	Shaping, leveling of infrastructural footprint areas (750 mm)	ha	TSF, water dams, magazine, crushing area, railway line	24.99	R 104 222.66	R 2 604 524.25
18	Place 300 mm topsoil and/or growth medium material for revegetation	m^3	Use available material from topsoil stockpiles	1 539 915	R 44.47	R 68 477 451.59
19	Establishment of vegetation (general)	ha	Truck stop, plant area, TSF, magazine, crushing area, railway line, lightly trafficked roads, haul roads, hard stand area and heavy trafficked roads	145.08	R 17 354.73	R 2 517 823.71
20	Establishment of vegetation (WRD and TSF's)	ha	Water dams, Western dump, Eastern dump, Northern dump	363.99	R 24 208.58	R 8 811 682.37
		ha	Backfilled open pit areas	67.19	R 24 208.58	R 1 626 574.74
					Subtotal 1 (Sum of items 1 to 15 Above)	R 201 467 940.76
21	Contractor P&G's (incl. site establishment and demobilization)			20% of Subtotal 1		R 40 293 588.15
22	Tender process and procurement			6% of Subtotal 1		R 12 088 076.45
23	Site supervision of closure works			7.5% of Subtotal 1		R 15 110 095.56
					Subtotal 2 (Subtotal 1 plus Time & Fee values)	R 268 959 700.91
24	Contingency			10.0% of Subtotal 2		R 26 895 970.09
25	Monitoring and maintenance costs			Sum		R 18 766 250.00
					Subtotal 3 (Subtotal 2 plus Contingency and Maintenance values)	R 314 621 921.00
					GRAND TOTAL FOR MINING OPERATIONS (excl. VAT)	**R 314 621 921.00**
					GRAND TOTAL FOR MINING OPERATIONS (incl. VAT)	**R 361 815 209.15**

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