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Ndanganeni Colliery Mine Closure Strategy

Decommissioning, Closure, Rehabilitation and Closure Liability

Middelburg, Mpumalanga Province

31 October 2022

Prepared for:

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Of

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QUALITY MANAGEMENT

Report Title	**Ndanganeni Colliery Decommissioning, Closure, Rehabilitation and Closure Liability Report**		
Project Number	**CIG/ENVSOL/22/PROJ/0058**		
	Draft Report	**Final Report**	**Revision 1**
Date	**26 October 2022**	**31 October 2022**	
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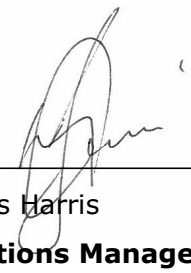
DECLARATION OF INDEPENDENCE

CIGroup Environmental (Pty) Ltd, as the Environmental Solutions specialists, were appointed to conduct a Mine Closure Strategy according to the new GNR 1147 for Ndanganeni Mine near Middelburg in the Mpumalanga Province. CIGroup Environmental does not have a vested interest in the proposed activity proceedings, will not engage in and have no conflicting interest in the undertaking of the activity. CIGroup Environmental has provided all information at their disposal regarding the Closure Strategy, whether such information is favourable to the Client or not.



Jacques Harris
Operations Manager
CIGroup Environmental (Pty) Ltd

31 October 2022
Date

EXECUTIVE SUMMARY

The regulations pertaining to financial provision (GN R1147) under the NEMA set out the requirements for an applicant or holder of a right or permit to determine and make financial provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts of prospecting, exploration, mining, or production operations.

GN R1147 now requires an applicant or holder of a right or permit to compile and annually review the following three documents:

1. A final rehabilitation plan;
2. An annual rehabilitation plan; and
3. An environmental risk assessment report.

This report deals with the final rehabilitation plan and the financial closure liability of the mine.

The following aspects were key to the development of the final decommissioning, closure, and rehabilitation plan of the mine:

- Open pit areas are deep and wide posing a significant safety risk and limits final land use capability; and
- Decant to the Southeast portion of the mine requires a water treatment facility to ensure protection to the environment.

The following table shows that the sudden closure costs calculated for the mine using contractor rates is R62 010 622.62 (excluding VAT) or R71 312 216.02 (including VAT). The breakdown of the costs is provided in **Appendix D**.

Closure Cost

Mine Closure Financial Liability		
Item description		Cost
1	**Surface Infrastructure**	**R6 306 350.75**
1	Dismantling of processing plant and associated structures (including associated conveyors & power lines)	R286 452.33
2(A)	Demolition of steel buildings and structures (including floor slabs)	R0.00
2(B)	Demolition of reinforced concrete buildings and structures	R0.00

3	Rehabilitation of access roads	R4 978 447.29
4(A)	Demolition of electrified railway lines	R0.00
4(B)	Demolition and rehabilitation of non-electrified railway lines	R0.00
5	Demolition of housing and facilities (including floor slabs)	R870 302.42
12	Fencing	R171 148.72
2	**Mining Areas & Waste Sites**	**R22 844 256.36**
6	Opencast rehabilitation (including final voids and ramps)	R22 844 256.36
7	Sealing of shafts, adits and inclines (including concrete cap)	R0.00
3	**Mine Residue Sites**	**R9 504 372.67**
8(A)	Rehabilitation of overburden and spoils	R0.00
8(B)	Rehabilitation of processing waste deposits and evaporation ponds (basic, salt-producing waste)	R0.00
8(C)	Rehabilitation of processing waste deposits and evaporation ponds (acidic, metal-rich waste)	R8 856 681.67
9	Rehabilitation of subsided areas	R0.00
13	Water management (Separating clean and dirty water, managing polluted water and managing the impact on groundwater, including treatment, when required)	R647 691.00
4	**General Rehabilitation**	**R9 248 745.67**
10	General surface rehabilitation, including of all denuded areas	R9 248 745.67
5	**Aftercare & Maintenance**	**R3 344 723.00**
13	Monitoring	R1 420 000.00
14	Maintenance	R1 924 723.00
15	Water Treatment Facility	R0.00
	Sub Total 1	**R51 248 448.45**
	Mobilisation and Project Management (10% of Subtotal 1)	**R5 124 844.85**
	Sub Total 2	**R56 373 293.30**

Contingency (10% of subtotal 2)	R5 637 329.33
Sub Total 3 (Closure Liability for Mine)	R62 010 622.62
VAT (15% of subtotal 3)	R9 301 593.39
Total	R71 312 216.02

The financial contribution of each activity on the financial mine closure liability include:

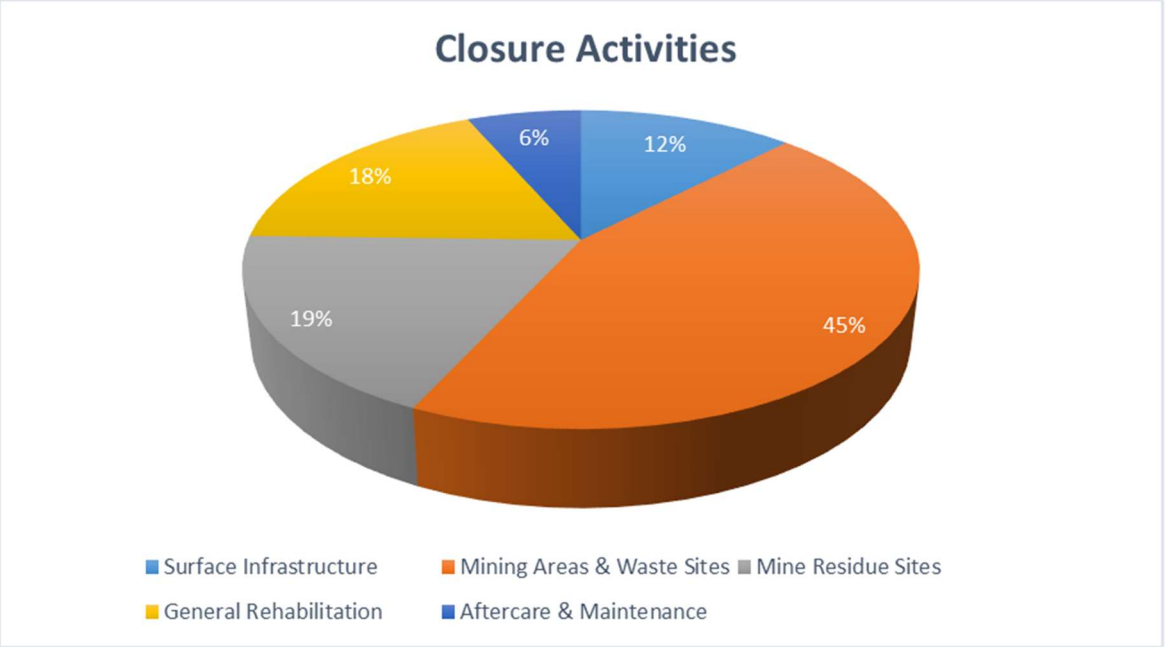


Figure 1.1 Closure activity contribution

The financial contribution to each phase of the financial mine closure liability include:

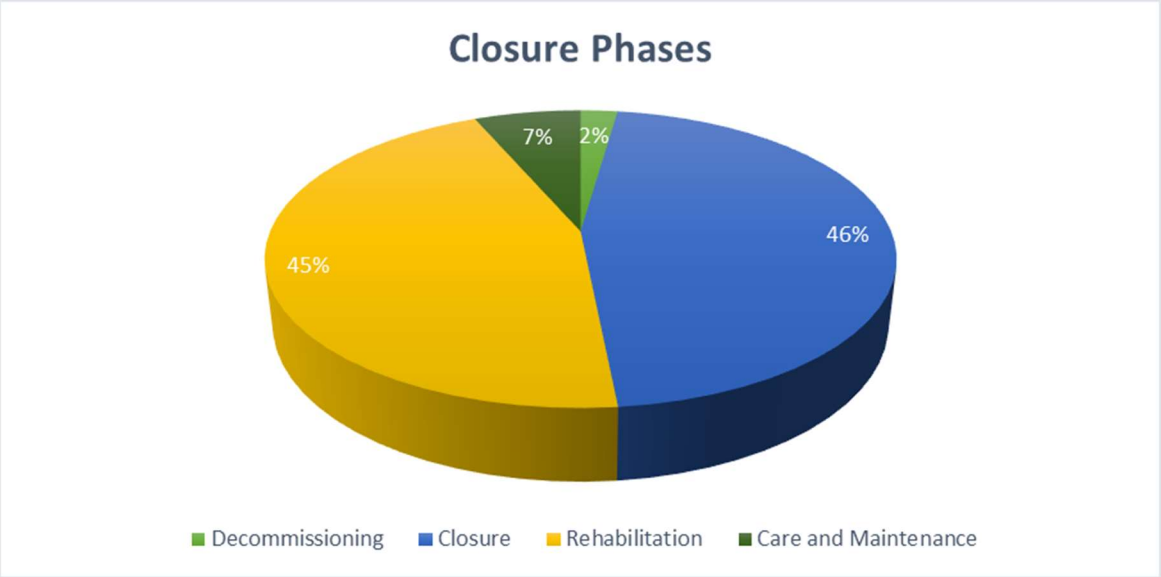


Figure 1.2 Financial Contribution

In conclusion, the major considerations for backfilling the Open Pit/Void are that:

- The safety aspects regarding the people and animals in the surrounding environment; and
- Proper closure of the open pit will reduce or stop any pollution impact on the environment.

From the previous report the large open void has partially been rehabilitated which includes the movement of soil back into the voids. The void surface area has decreased, and the ground disturbance areas have increased. The mine will start with a new mining area, but the author has calculated that only 10% of the total area will constitute a void at the end of the life of mine. The rest of the area will be backfilled as the mine progress to its final closure.

It is recommended that monitoring (Surface water, Groundwater, Fauna, and Flora) is done annually to determine current and future results compared to the baseline status before closure commence.

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1 Introduction

1.1 Background

Ndanganeni Colliery produces approximately 1.45MT ROM annually and has established export and inland coal markets for its sized coal products. Exports are mainly done by utilising the Maputo Mozambique Corridor and customers that exports from South Africa's Richards Bay Coal Terminal (RBCT).

The current mining area comprises over 3 000 hectares in extent, is located on the Remaining Extent of Portion 11 (a Portion of Portion 9) and Portion 17 of the Remaining Extent of the Farm Kopermyn 435 JS and Portions 1, 3, 4, 5, 6, 7 and the Remaining Extent of the Farm Hartogshof 413 JS, Steve Tshwete Local Municipality, Nkangala District Municipality, Mpumalanga Province of South Africa. The site is located approximately 22 km southeast of Middelburg.

Ndanganeni Colliery is a holder of a mining right granted in terms of section 23 of the Mineral and Petroleum Resources Development Act, 2002 ("MPRDA"), in respect of coal, in, on and under the remaining extent of Portion 11 (a portion of Portion 9), Portion 17 the remaining extent of the Farm Kopermyn 435 JS, Portions 1, 3, 4, 5, 6, 7 and the remaining extent of the Farm Hartogshof 413 JS, in the magisterial district of Middelburg, in the Mpumalanga province under Department of Mineral Resources ("DMR") reference number: MP 30/5/1/2/2/299 MR/ 10134 MR ("Kopermyn Mining Right").

Sumo Colliery SA (Pty) Ltd ("Sumo") previously held a mining licence no. 6/2000 issued in terms of section 9(1) of the Minerals Act on 15 September 2000, in respect of coal on Portion 12 and Portion 20 of the Farm Kopermyn 435 JS, in the magisterial district of Middelburg in the Mpumalanga province, measuring 88, 53 hectares in extent (the "Mining Licence"). Portion 23 was created by a subdivision that took place after the Mining Licence was issued in that, in any event, it forms part of the mining boundary authorised in terms of the Mining Licence, where coal washing activities, amongst others, are conducted.

Ndanganeni Colliery has applied to incorporate Portion 23 and 28 of the Farm Kopermyn 435JS into the Kopermyn Mining Right and Kopermyn EMP by way of amendment in terms section 102 of the MPRDA.
The section 102 EMP amendment in this regard has subsequently been granted on the 20th of May 2019 under the reference number MP 30/5/1/2/3/2/1 (10134) EM.

1.2 Locality

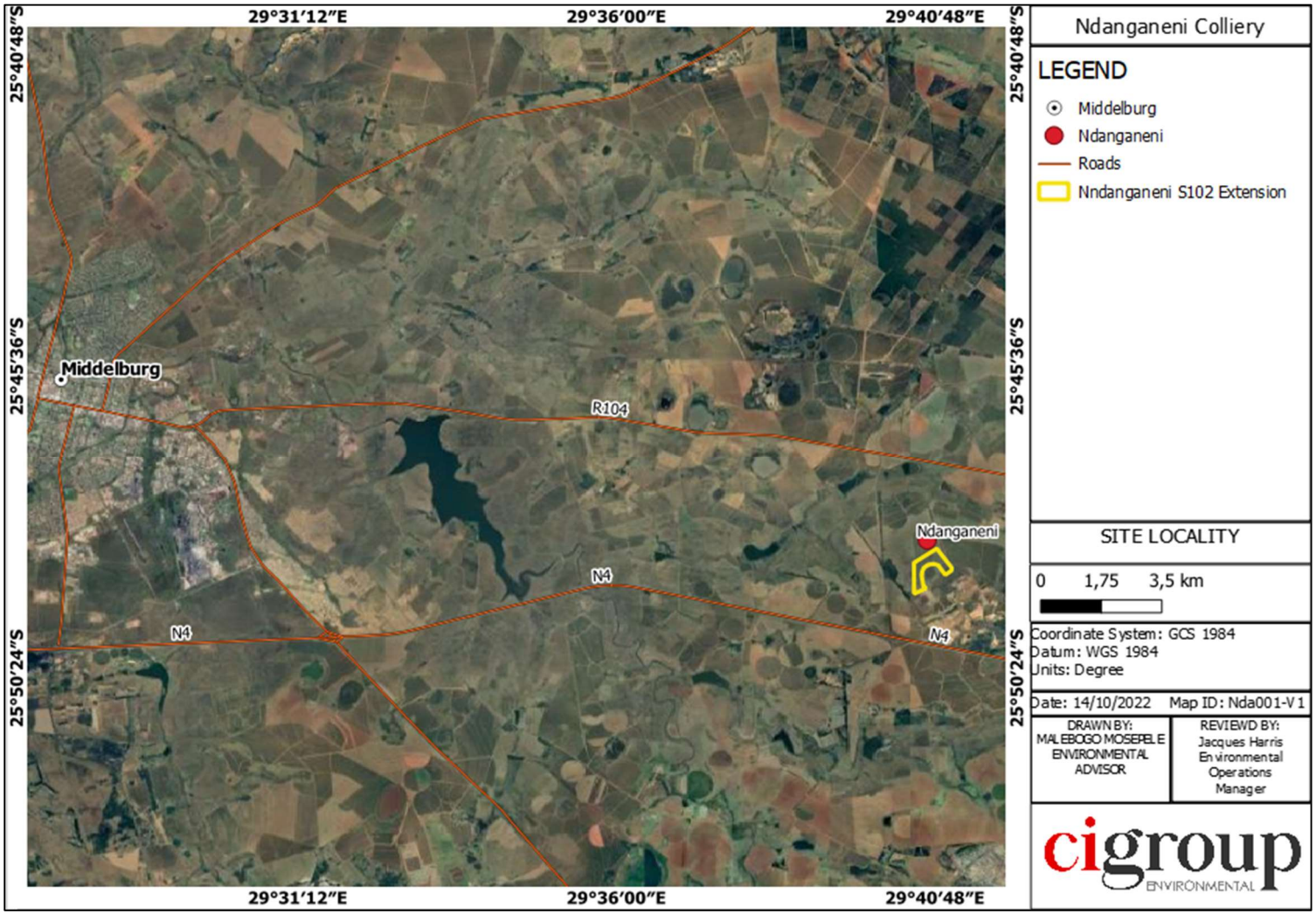

Figure 1.1 Mine Location

1.3 Mine Boundary

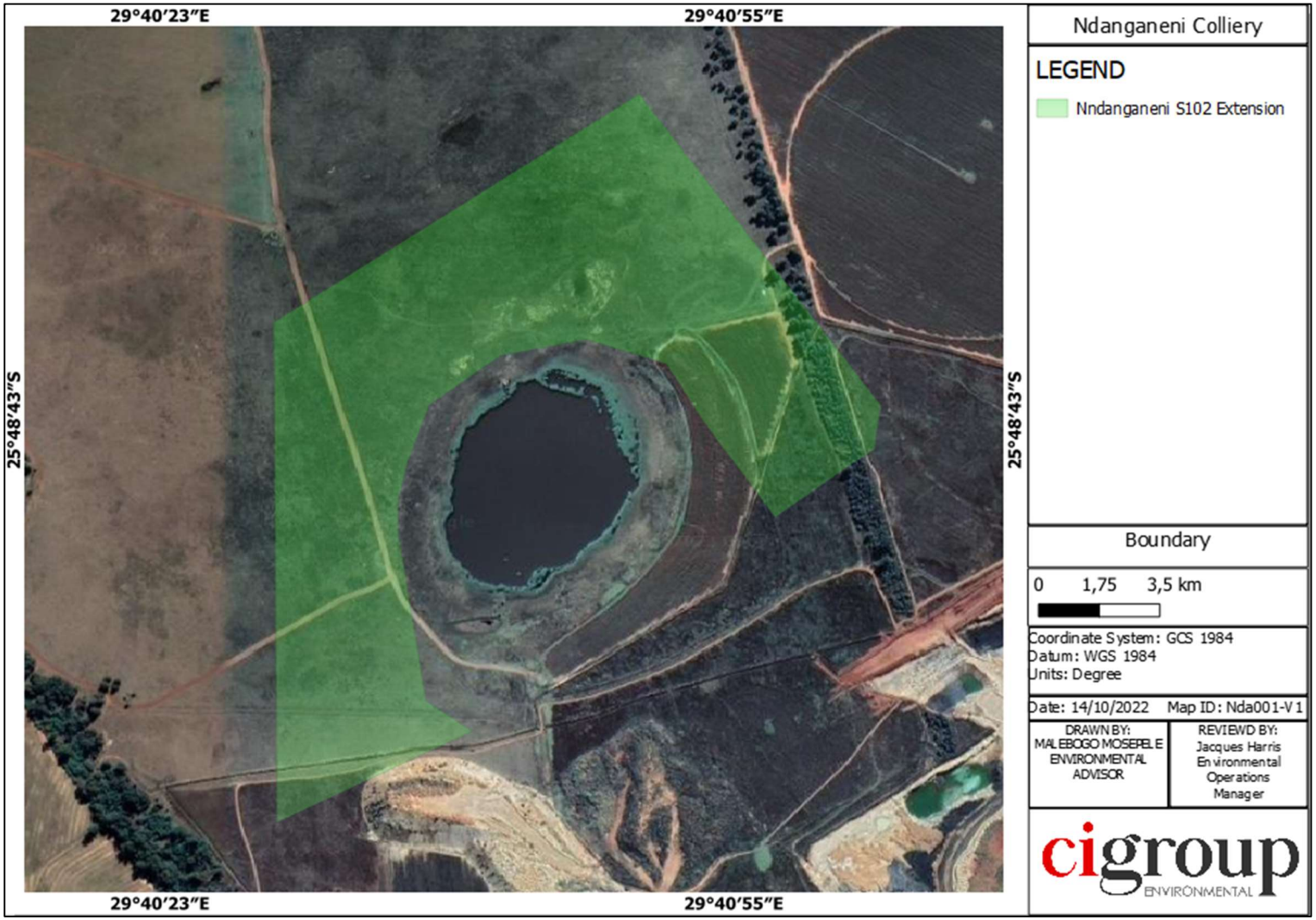

Figure 1.2 Open pit Boundary

1.4 General Mine Plan

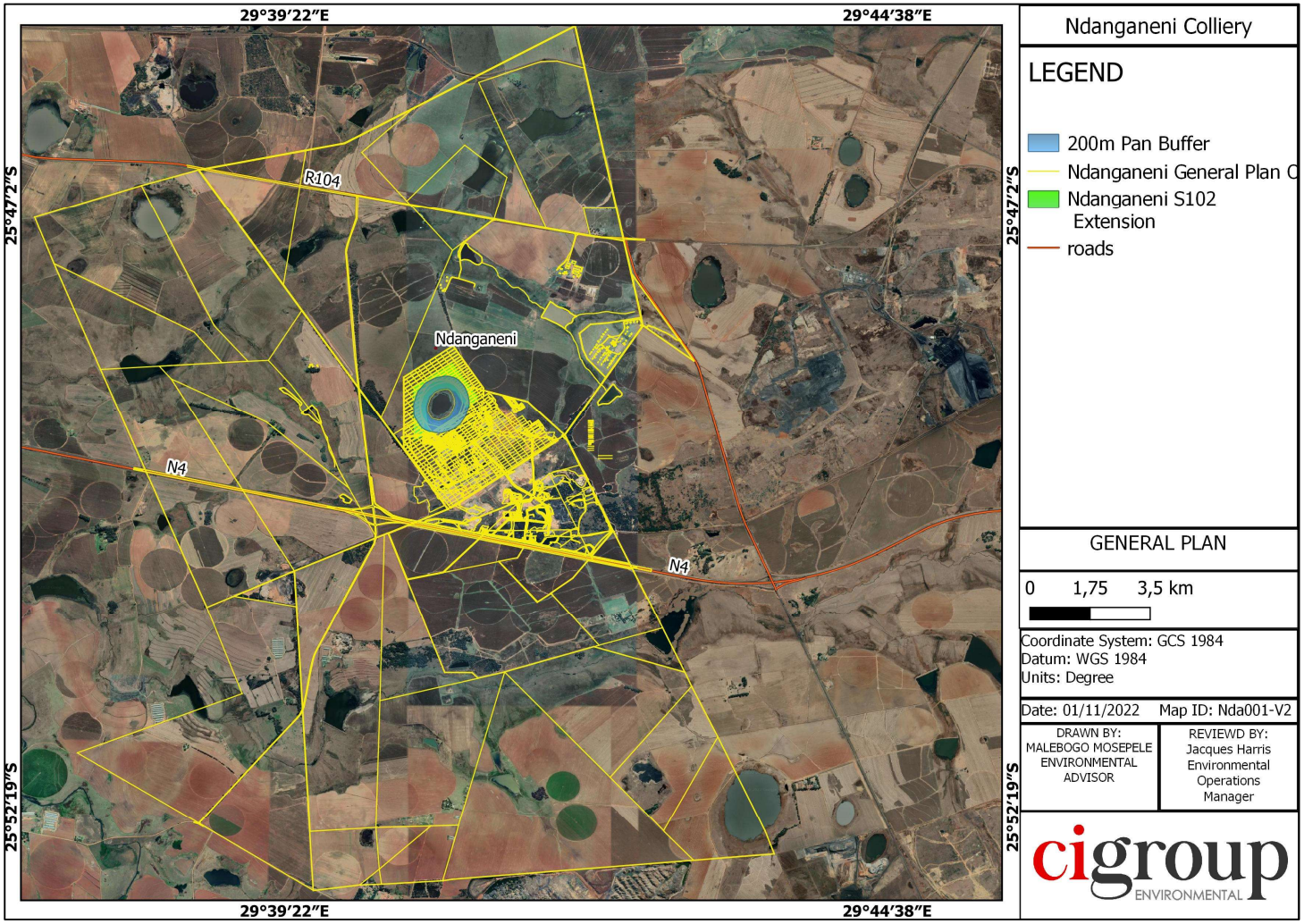

Figure 1.4 General Mine Plan

1.5 Scope of Work

The objective of the final rehabilitation, decommissioning and mine closure plan, which must be measurable and auditable, is to identify a post-mining land use that is feasible through—

(a) providing the vision, objectives, targets, and criteria for final rehabilitation, decommissioning and closure of the project;
(b) outlining the design principles for closure;
(c) explaining the risk assessment approach and outcomes and link closure activities to risk rehabilitation;
(d) detailing the closure actions that clearly indicate the measures that will be taken to mitigate and/or manage identified risks and describes the nature of residual risks that will need to be monitored and managed post closure;
(e) committing to a schedule, budget, roles, and responsibilities for final rehabilitation, decommissioning and closure of each relevant activity or item of infrastructure;
(f) identifying knowledge gaps and how these will be addressed and filled;
(g) detailing the full closure costs for the life of project at increasing levels of accuracy as the project develops and approaches closure in line with the final land use proposed; and
(h) outlining monitoring, auditing, and reporting requirements.

1.6 Document requirements

The following sections is required in the document:

(a) details of the person or persons that prepared the plan;
(b) the context of the project
(c) findings of an environmental risk assessment leading to the most appropriate closure strategy;
(d) design principles;
(e) a proposed final post-mining land use which is appropriate, feasible and possible of implementation;
(f) closure actions;
(g) a schedule of actions for final rehabilitation, decommissioning and closure which will ensure avoidance, rehabilitation, management of impacts including pumping and treatment of extraneous water;
(h) an indication of the organisational capacity that will be put in place to implement the plan;

(i) an indication of gaps in the plan, including an auditable action plan and schedule to address the gaps;

(j) relinquishment criteria for each activity or infrastructure in relation to environmental aspects with auditable indicators;

(k) closure cost estimation procedure, which ensures that identified rehabilitation, decommissioning, closure, and post-closure costs, whether on-going or once-off, are realistically estimated and incorporated into the estimate;

(l) monitoring, auditing, and reporting requirements which relate to the risk assessment, legal requirements, and knowledge gaps as a minimum; and

(m) motivations for any amendments made to the final rehabilitation, decommissioning and mine closure plan, given the monitoring results in the previous auditing period and the identification of gaps.

2 Reference Sections

2.1 Independent Assessor

The details of the specialists responsible for preparing this report are contained in **Table 2.1** below. The CVs of the specialists are contained in **Appendix A**.

Table 2.1: Details of Specialist

Name	Title	Professional Registrations	Years of Experience
Jacques Harris	Environmental Group Manager	*Pri.Sci.Nat* (No: 400363/13)	25

Table 2.2 Specialist Experience

Country	Commodity	Company	Description	Date
Namibia	Zinc	Scorpion Zinc, NamZinc in association with Vendanta	Closure plan and closure cost assessment	2016
Malawi	Uranium	Paladin Energy Ltd	Closure strategy, plan, and financial liability	2018
Botswana	Diamond	GemDiamond	Closure strategy, plan, and financial liability	2019, 2018, 2017, 2016, 2015
Lesotho	Diamond	GemDiamond	Closure strategy, plan, and financial liability	2019, 2018, 2017, 2016, 2015
Mozambique	Coal	ENRC	Closure strategy, plan, and financial liability	2018, 2017
		Zambezi Coal	Closure strategy, plan, and financial liability	2018

South Africa	Quartz	Ferroglobe (Samquartz)	Closure strategy, plan, and financial liability	2019, 2018, 2017, 2016, 2015
	Manganese	Assmang Cato Ridge	Closure strategy, plan, and financial liability	2019, 2017, 2015, 2013, 2011
		ARM	Closure of 8 derelict mines and financial liability	2015
	Vanadium	Vametco	Closure and Rehabilitation Due Diligence	2019
	Platinum	Rustenburg Platinum Mine	Closure strategy, plan and financial liability Final landform design and water management	2016
		Two River Platinum	Closure strategy, plan, and financial liability	2015
		Anglo American, Bokoni Mine	Closure strategy, plan, and financial liability	2016
		Modikwa Platinum	Closure strategy, plan, and financial liability	2015
	Gold	Sibanye Gold, Burnstone	Rehabilitation Strategy and Implementation Plan	2017
		Sibanye Gold, Driefontein	Rehabilitation Strategy and Implementation Plan	2017
		Anglo Gold Ashanti, West Wits	Closure strategy, plan, and financial liability	2015
		CRG	Rehabilitation Strategy and Implementation Plan	2017
	Chrome	DeGrooteboom	Rehabilitation Strategy and Implementation Plan	2017
		Tharisa Chrome Mine	Rehabilitation Strategy and Implementation Plan	2017
		DwarsRivier	Rehabilitation Strategy and Implementation Plan	2016
	Coal	Kangra, Aasvoelkrans, Balgarthan, Bellengue, Leiden, Longridge, Maquassa East, Maquassa West, Mount Ngwibi, Mpisi, Nooitgesiend, Panbuilt, Rooipunt, Savmore North and South, Taaibosh Spruit, Umgala, Utrecht, Zimbutu	Rehabilitation Strategy and Implementation Plan Water Management closure liability	2018, 2017
		Exxaro, Matla, Eloff, Belfast, Eerstelingsfontein. Glisa, Strathrae, Leeuwpan	Rehabilitation Strategy and Implementation Plan	2018, 2017, 2016, 2015, 2014
		Exxaro Coal, Forzando, Dorstfontein East, Dorstfontein North, Tumelo	Rehabilitation Strategy and Implementation Plan	2016, 2015, 2014
		Exxaro, Steincoalspruit	Full closure certificate	2015
		Buffalo Coal	Rehabilitation Strategy and Implementation Plan	2015, 2014
		Aviemore, Wesselsnek, Magdalena		
		Yzermyn	Closure Liability Due Diligence	2018
		Somkele	Rehabilitation Strategy and Implementation Plan	2016

		ZAC	Rehabilitation Strategy and Implementation Plan	2016

2.2 Legal Context

The General Notification 1147 (GN R1147) under NEMA according to the new legislation now requires an applicant or holder of a right or permit to compile and annually review the following three documents:

- A final rehabilitation plan;
- An annual rehabilitation plan; and
- An environmental risk assessment report.

A full set of legal requirements for closure and rehabilitation is found in **Appendix B** of this documentation.

2.3 Environmental Context

The aim of this section is to provide the status of the biophysical and socioeconomic conditions present in and around the mine. The descriptions have been based on available data on the local environmental settings, as well as on specialist studies that have been completed on the mine.
This section is included in **Appendix C** of this documentation.

3 Risk Assessment

3.1 Risks Identified

The most significant identified during the risk assessment include:

- Extreme Risks
    - People will lose employment which will have a negative impact on families and their communities
    - Safety aspects on the mine, relates to people and animals and the possibility of fatalities.
    - Safety risks around the pit lake areas that could cause casualties of animals and people and possible fatalities
    - Suppliers will lose business which will have a negative impact on local business and on a regional scale.
- High Risks
    - Surface water contamination degrading the water bodies downstream of mine resulting in further rehabilitation and a financial risk.

- Groundwater contamination increasing as water rebound influencing downstream surface activities and groundwater supplies and resulting in a financial liability
- Heavy rainfall events causing the erosion of the trenches and berms allowing for polluted water to the enter the environment
- Extreme drought conditions prohibiting the growth of vegetation and resulting in poor rehabilitation
- Migration of mine workers after the mine has closed will negatively affect community structures
- Not able to return quality of soil back to its natural soil quality impacting on the final land-use of the area
- Wetland system downstream of the mine in danger to be impacted by mine closure reducing the quality of the wetland
- Redesign of the areas around the pits to represent the topography of pre-mining conditions could have a financial impact.

3.2 Latent and Residual Risks

According to the Mineral and Petroleum Resources Development Regulations, 2004 (Published under Government Notice R527 in Government Gazette 26275 of 23 April 2004) (GN R527) latent and residual impacts are defined as follows:

"Latent environmental impact means any environmental impact that may result from natural events or disasters after a closure certificate has been issued" (own emphasis);
and
"Residual environmental impact means the environmental impact remaining after a closure certificate has been issued" (own emphasis).

Latent and residual risks are specifically related to post mining impacts that occur at the site once rehabilitation has been completed.

The residual impacts identified for the Ndanganeni mine as required by NEMA General Notification (GN R1147) are described as follows:

- Loss of employment and loss of revenue for the employees, suppliers and surrounding communities has a social impact on the region;
- Leaving an open void because of the type of mining that took place could pose a safety risk to animals and humans;

- Potential ongoing pollution of surface water resources could affect aquatics and quality downstream of the mine; and
- Potential ongoing pollution of groundwater resources could affect quality downstream of mine.

The possible latent impacts identified for the Ndanganeni mine as required by NEMA General Notification (GN R1147) are described as follows:

- Heavy rainfall events (Climate change) causing the erosion of the trenches and berms allowing for polluted water to the enter the environment; and
- Extreme drought conditions (Climate change) can impact the rehabilitation of the mine's surface areas making it difficult to obtain the final land use.

4 DESIGN PRINCIPLES

4.1 ENVIRONMENTAL ASPECTS WHICH MAY REQUIRE PROTECTION OR REMEDIATION

Existing environmental aspects both on the site applied for and in the surrounding area, which may require protection or remediation due to project related components are listed below:

- In-situ soils and land capabilities (not disturbed by project infrastructure);
- Biodiversity (not disturbed by project infrastructure);
- Perennial surface water resources;
- Groundwater resources;
- Visual and landscape quality;
- Societal influences on the site; and
- Surrounding land uses, socio-economic conditions, and economic activity.

These aspects will have an influence on the design principles of the Closure Assessment.

4.2 Closure Vision

The closure vision aims to return the disturbed areas to a stable, non-polluting, and safe state that represents, as close as possible, the pre mining conditions.
The vision include:

- Create a safe, physically stable rehabilitated landscape that limits long-term erosion potential and environmental degradation;

- Sustain the long-term catchment water yield and ensure suitable water quality;
- Rehabilitation of the surface infrastructure where necessary to minimize infiltration into the underground water regime (the philosophy of concentration and containment);
- Rehabilitation to minimise contamination of surface water resources (the philosophy of dilution and dispersion);
- Focus on establishing a functional post-mining landscape that would ensure self-sustaining agricultural practices post mine closure where possible;
- Ensure interconnectivity between the rehabilitated landscapes with surrounding regionally biologically diverse areas;
- Encourage, if and where required, the re-instatement of terrestrial and aquatic wetland biodiversity over time; and
- Create opportunities for alternative post-mining livelihoods by aligning to the regional planning;
- Meet with prevailing environmental legal requirements outlined in this report; and
- Prevent / Minimise negative impacts and risks as identified in this report.

Mining wishes to leave a positive legacy in the area once the mining operations cease.

4.3 Closure Objectives and Targets

To appropriately close the mining area, the mine would annually identify areas of rehabilitation and actively pursue the closure vision. Objectives include:

Topography:	The final elevation will result in the continuation of the pre-mining surface drainage pattern.
Soil, Land Capability and Land Use:	Soil types are replaced in correct sequence, subsoil followed by topsoil, and at appropriate depths. Post-mining land capability is at least like pre-mining which is grazing and some arable lands. Land capability is self-sustaining. Pre-mining land uses can continue.
Surface Water:	No dirty water from the site enters the surrounding surface water systems. Maintain flow in downstream rivers to prevent deterioration of ecological status.

Groundwater:	Possible plumes originating from the mining areas do not impact significantly on the surface water features or surrounding users' boreholes. Groundwater users that are impacted have alternative sustainable water sources of the similar quality and quantity.
Terrestrial (Fauna and Flora):	Vegetation growth and cover on the rehabilitated areas is sustainable. Alien invasive growth is eradicated until the closure certificate is granted. Surrounding animals to return into the rehabilitated areas to maintain the surrounding biodiversity.
Aquatic Ecosystems:	Aquatic ecosystems are maintained as close as possible to that of the pre-mining environment.
Wetlands:	Minimise the disturbance on wetlands. Adjacent wetland conditions are like that of the pre-mining Present Ecological State.
Heritage:	Retain visual and areas of high heritage and archaeological value.

4.4 Research and Assumptions

With the proper closure procedures that will be implemented on site, the author believes that all pollution can be restricted, and no latent risks will become evident in future.

Currently no research is conducted within the boundaries of the site.

5 Final Land use

The proposed final land use would be to return the area to a land use that represents as close as possible the pre mining land use. Prior to mining the area was used for agriculture and a portion of the current mining right is currently being utilised for farming. The farming activities are, at this stage, limited to small scale agriculture (mielies) and livestock (cattle).

The final land use vision would therefore be to encourage small scale subsistence agriculture and livestock grazing once the mining operations cease.

5.1 Possible Closure Alternatives

There are two possible closure alternatives which are detailed in the sections that follow.

5.1.1 Alternative 1

Closure Alternative 1 would be a complete demolition and removal of all mines related infrastructure. In this case all infrastructure would be demolished, removed and where possible sold for scrap. All mine residue sites, mining areas and waste sites would be closed and rehabilitated. The site would be rehabilitated to a point as close as possible to the pre mining conditions. This would include backfilling of all pits and demolition and rehabilitation of all dams and the demolition of all buildings, roads, and other infrastructure.

If this alternative is selected, no infrastructure would be handed over to the surrounding landowners and communities.

5.1.2 Alternative 2

Closure Alternative 2 would see all mine residue sites, mining areas and waste sites closed and rehabilitated. This would include demolition and rehabilitation of all pollution control dams. However, where possible infrastructure that can be handed over to the surrounding community will be considered. To identify what infrastructure is to be handed over, a community engagement process will be run. This process will be the responsibility of Mining Company.

The current infrastructure that could be utilised include:

- Ndanganeni Colliery can negotiate with the adjacent farmer to work towards a final land use which will enhance the capabilities and capacity of the surrounding landscape;
- Roads identified that could assist with the movement within the site; and
- Handing over infrastructure (offices) to the benefit of communities.

For the infrastructure to be handed over, a legal agreement will need to be in place, which removes the mines liability from this infrastructure. Infrastructure for which no legal agreement is in place for the handover will be demolished and removed.

<u>This is the preferred alternative</u>

5.2 Final Land Use Map

The final land use map is depicted in Figure 5.1.

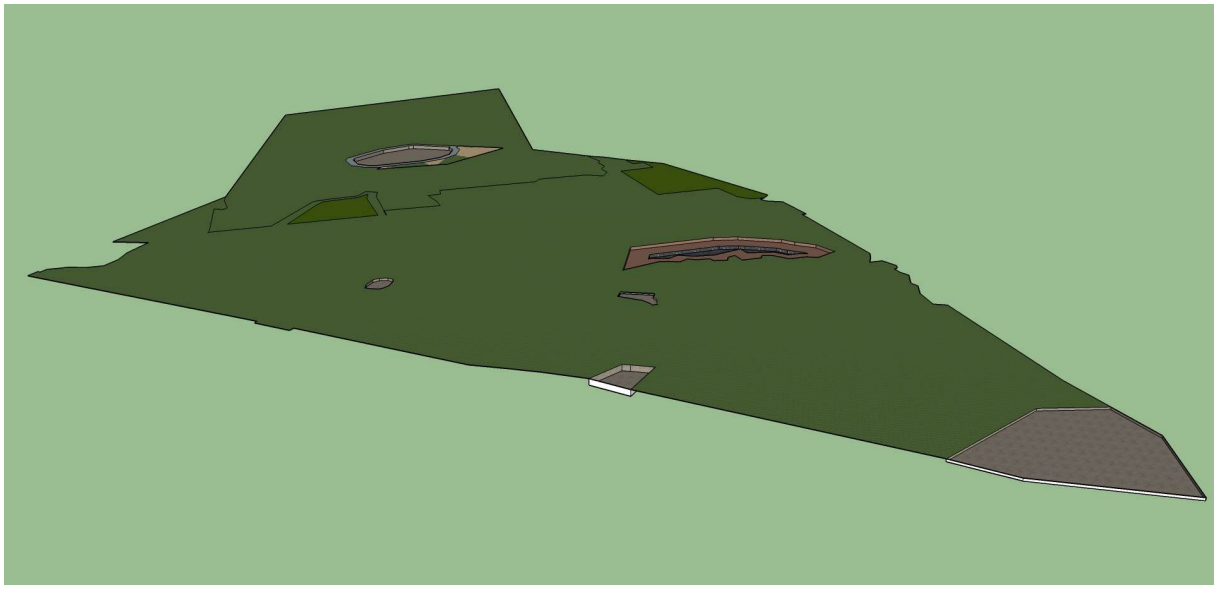

Figure 5.1 Final land use design (Sketchup)

6 CLOSURE AND REHABILLITATION ACTIONS

The following rehabilitation actions will take place when the mine enters its closure and decommissioning phase.

6.1 Preparation Prior to Rehabilitation

The following aspects related to the rehabilitation and site preparation prior to rehabilitation being initiated apply:

- The rehabilitation plan must be followed unless further studies are required;
- The new information such as water quality, will inform the final rehabilitation programme and plan, that will be submitted to the relevant authorities;
- The final rehabilitation programme and plan will be submitted to the interested and affected parties for comment through the Environmental Basic Assessment process;
- Concerns from the interested and affected parties, during the Public Consultation Process, are to be considered by the mine and the rehabilitation specialist;
- Final approval from the Department of Environmental, Forestry and Fisheries will be required to start activities on the mine;
- A rehabilitation team must be appointed to oversee and give guidance during the rehabilitation process;
- The rehabilitation team must draw up a final risk assessment to deal with the rehabilitation processes required for the site;

- A health and safety and environmental officer will guide contractors during the process;
- Rehabilitation should preferably be undertaken before the first rains start to prevent excessive erosion;
- Ensure that demolition and rehabilitation contractors restrict their activities to the areas that need to be rehabilitated; and
- Continuous management and monitoring are required to ensure contractors keep to the final rehabilitation plan and schedule.

6.2 Landform Redesign and Final Topography

Landform redesign is required to include a final topography that coincides with all the surface drainage areas of the site. The aim of the final landform is to ensure that the topography blends into the surrounding landscape.

Key elements of a successful landform design include:

- The comprehensive characterisation of the properties of soils, overburden, and mineral processing wastes to determine their potential erodibility, capacity to support plant growth and potential to have adverse impacts on water quality;
- The segregation and selective placement of those materials to ensure the creation of a favourable medium for plant growth and the protection of water resources; and
- The incorporation of surface water management into the design.

6.2.1 Drainage

The rehabilitation procedures will be planned and carried out to ensure surface runoff patterns. A key objective of the rehabilitation and closure activities will be to ensure, good soil displacement does not occur, and that re-vegetation is effective and contribute to the reduction in financial liability of the process.

Key rehabilitated processes required include:

- Grading and contouring the disturbed surface area as necessary to reduce erosion potential from surface runoff;
- Appling a soil cover where it is considered necessary for vegetation growth;
- Establishing vegetation low maintenance erosion control devices in areas where erosion is a potential concern from the contoured surfaces; and
- Establishing vegetation cover on reclaimed surfaces that is of a similar density and diversity as that which exists in surrounding areas.

These general procedures may be modified, and more detailed methods specified based on knowledge gained in the planned pre-closure site studies, which will be carried out during the final operating period of the mine.

Elements such as drainage paths and contour drains, will be shaped, as much as practical, to keep with natural landforms of the surrounding environment. Contour and catch drains are designed to collect surface runoff from revegetation or disturbed areas. Sedimentation dams are incorporated into the final landform to collect runoff from rehabilitated areas and the dam capacities are designed to allow time for suspended sediment to settle out.

6.2.2 Erosion

The following erosion and sediment controls are used to minimise erosion from rehabilitation:

- Sediment dams;
- Drainage lines to manage clean and sediment basin runoff;
- Erosion controls such as sediment fencing, straw bales;
- Completion of revegetation works (including temporary rehabilitation); and
- Ongoing maintenance of erosion and sediment control structures.

Control of erosion is important, both during mining and rehabilitation. The effects of erosion may require remedial works on sites where soil loss has occurred as well as where the material is deposited as drift, dust, or river sediment. A major objective of most rehabilitation programs is to establish an adequate cover of vegetation to stabilise the site and prevent or control erosion to natural levels. Until a vegetation cover has been established, provision to protect against wind and water erosion will be required.

6.2.2.1 Wind Erosion

A vegetation cover is the best long-term means of protecting against wind erosion. While a vegetation cover is being established, there are three basic methods of controlling wind erosion on disturbed soils. All aim to reduce the wind velocity near the soil surface. They are:

- Protection of the soil surface by natural or manufactured materials or mulch. In most cases, the use of these materials may form an integral part of the revegetation program, the aim of which is to establish a permanent protective cover;

- Maintenance of the soil surface in an erosion resistant condition. This usually means leaving the surface in a coarse condition. Keeping the soil surface damp using sprays or water tankers will increase the aggregation of particles and their resistance to wind erosion; and
- Reduction of wind velocity across the disturbed areas by establishing windbreaks. Windbreaks may be rows of trees or shrubs retained or planted at right angles to the direction of the erosive

6.2.2.2 Water Erosion

Erosion by water is caused mostly by surface runoff from intense rainfall events. Even in arid and semi-arid areas, high intensity low frequency rainfall events can cause rapid runoff and extensive soil erosion.

The important factors influencing runoff include:

- Minimising Area of Disturbance:
  - Clearing of vegetation should be limited to that necessary for the safe operation of the mine. Minimising the area cleared will reduce costs both for clearing and site rehabilitation.
- Restricting Entry of Runoff to the Site:
  - Construction of diversion channels or holding structures such as banks, drains or dams will effectively limit the entry of water on to the site.
- Dam storage:
  - Where dams are constructed for water storage and/or as a measure to limit entry of water to site, ensure the dam is adequately sized and provision is made for safe discharge.
- Encouraging Infiltration:
  - This is often, but not always, most effectively achieved by ripping the disturbed area parallel to the contours.
- Managing Water Leaving the Site:
  - Water must be managed to avoid pollution due to erosion and sediment deposition, either at the point of discharge or further downstream.

6.2.3 Remediation of Contaminated Areas

Traditional remediation techniques such as excavation and remedial groundwater abstraction can be used to avert risk from many types of pollutants. Remediation requires environmental and financial mitigation to assist clients during rehabilitation.

Methods used to remediate contaminated areas include:

- All contaminated soil will be identified, excavated, if possible, to at least 200 mm below the contaminated zone and then treated; and
- Removed soils will be managed as determined by the nature and extent of the contamination.

6.2.4 Acid Mine Drainage

The waste rock dumps are characterised by their physical and geochemical properties. The waste properties, which include acidity and acid generating capability, metal characteristics, infiltration capabilities and nutrient levels, will inform a specific strategy to be used. These characteristics will inform the mine in terms of capability to pollute surrounding water resources, type of vegetation that will be more susceptible to grow and reduce erosion.

For the discard dumps, which ultimately become acid generating, the acid drainage and metal leaching (without acid generation) to drainage water may not become apparent for many years, but once initiated can continue for several years. When produced in high volumes, contaminant leaching and acid generating mine rock can require extensive control and remediation measures to prevent adverse environmental impacts.

The following aspects need to be determined:

- Determine the source underneath footprints of mine residue stockpiles or deposits once removed;
- Determine the extent to which AMD/ARD might take place from groundwater when underground mines a recharged; and
- Implement remedial action for annual and final rehabilitation.

AMD/ARD treatment needs to be considered not only for protection of environmental values of waterways but also for cases where:

- The re-use of mine or process water is required in areas where the available water supply is limited;
- Process or other critical equipment requires protection from corrosion or from fouling by scaling;
- Water in pits or underground workings must be removed to regain access to an ore resource (this is an especially important factor in the context of resource sterilisation);

- Commercial metal recovery is a possibility; and
- Groundwater is contaminated by a plume of AMD/ARD and the plume needs to be remediated.

6.3 Topsoil Stockpiles

Topsoil (or weathered surface material) provides a good microenvironment for seed germination and generally contains seeds, nutrients and microorganisms that are necessary for plant growth. If these are lost, then the system will generally take a longer time to re-establish. Post mining soil reclamation is very difficult or near impossible if the stockpiled topsoil materials are of inferior quality due to mismanagement during storage. Good quantity and quality topsoil are an essential ingredient in the process of soil reclamation.

6.3.1.1 Soil Characteristic

The soil factors most likely to affect the success of rehabilitation are:

- Compaction or the presence of hard layers that restrict root penetration;
- Surface crushing or hard setting;
- Acidity, alkalinity, salinity or sodicity;
- Presence of excess Manganese, Aluminium, or heavy metals;
- Low availability of nutrients (especially nitrogen and phosphorous but can also include other major and minor plant nutrients); and
- Water repellence.

6.3.1.2 Soil replacement

When replacing the soils, the sub-soil layer will be replaced first and lastly the 250mm topsoil in which the seeds will germinate. The risk of replacing soil in this fashion is that it enhances the compaction of the soil, which is one of the critical areas of hard setting. Typical actions of soil replacement include:

- Not all soil must be replaced, and a reserve of soil is required to repair areas that failed during the rehabilitation process;
- Compaction by heavy equipment must be minimised as far as possible;
- Compaction can be limited when soils are dry. Wet soil adds to the compaction;
- When soils are replaced, it must be ripped to full rooting depth; and
- In places where revegetation is difficult the vegetation can be tiled.

6.4 Hydro-seeding / Re-vegetation

The overall objectives for the re-vegetation of reshaped and top-soiled land are to:

- Prevent erosion;
- Restore the land to the agreed land capability;
- Re-establish eco-system processes to ensure that a sustainable land use can be established without requiring fertilizer additions; and
- Restore the biodiversity of the area as far as possible.

A suitably qualified hydro-seeding specialist should be contracted to perform the seeding process;

- A grass mixture utilising endemic grasses should be utilised in the seeding process;
- Analysis of the soils on the site returned deficiencies of nitrogen, phosphorus, and potassium. Depending on the outcome of the soil tests, a standard 3:2:1 (25) ratio N:P:K fertilizer should be added to the soil in a slow-release granular form at a rate of approximately 200 kg/ha before re-vegetation (These results must be verified prior to rehabilitation commencing). It will be necessary to re-evaluate the soil conditions of the site at regular intervals to determine if additional fertiliser applications are required;
- The seed mixture should be incorporated into mulch which includes fertiliser and germination acceleration agents;
- The seed mulch should then be used to fill the Hessian socks;
- The seeded areas should then be irrigated according to the recommendation of the hydro-seeding specialist;
- Weekly monitoring should take place to ascertain the efficacy of the hydro-seeding and to repair any areas where gullies or rills are forming; and
- Note that hydro-seeding is primarily for grasses and smaller shrubs. Larger shrubs and trees will need to be hand-planted.

The following aspects related to the establishment of grass on rehabilitated areas applies:

- Once enough basal cover has been established, the introduction of species representative of the grass vegetation type may commence;
- Introduction of these species should commence through the stages of natural succession, i.e., Pioneer species (grasses, herbaceous species), Secondary species (grasses, small shrubs, and small trees) and Climax state (larger shrubs, large trees);
- This process will also occur naturally as seeds from the neighbouring thatching grass areas are introduced and germinate;

- Certain tree species can be selectively introduced; however, consideration will need to be given to rooting depths and soil stability as well as the ability of the trees to establish on the subject area;
- A test area should be designated to test possible tree species to be introduced for their ability to grow in different substrates. This should commence immediately to allow informed decision-making once rehabilitation commences; and
- The primary goal is to achieve a stable, climax state, representative of the thatching grass and vegetation type where the ecological function of the plant community is tolerant of most environmental conditions it encounters.

6.5 Weeds

The following is relevant:

- Controlling the introduction and spread of weeds is an important consideration in rehabilitation. Weed infestations on rehabilitated areas can be very difficult to control and the emphasis should be on prevention rather than cure;
- Weeds are often vigorous, persistent, and good colonisers. Consequently, they may rapidly invade sites being rehabilitated;
- Weeds in areas adjacent to those disturbed by mining should be controlled to reduce the potential seed load. Be sure the mine site does not become a source of weeds for possible infestation of adjacent properties;
- Care must be taken to ensure that weeds are not introduced to the area in topsoil, hay, mulch, or manure or as contaminants in seed of the desirable species;
- Clean equipment coming on to site from other areas to remove seed or plant pathogens;
- Fertilisers and manures should always be used carefully as they can stimulate weed growth, seed set, and spread. A vigorous cover of the desirable plant species is often an effective impediment to invasion by weed species;
- Early detection of weeds before they are well established can simplify their control;
- Cultivation, hand weeding, burning and herbicides can all be used in attempts to control weed infestations. However, control can be difficult where desirable plants are growing amongst the weeds; and
- Selective grass herbicides can be used for grass weeds in areas revegetated with non-grass species. Herbicides can be applied selectively using wick applicators in some cases, for example, when the weeds are much taller than the desirable species.

6.6 Buildings and Infrastructure

The mine only consists of remnants of infrastructure used during the mining operation. Closure objectives related to buildings and infrastructure should they be removed, include the following:

- Demolish all concrete, brick and/or gravel foundations, slabs, pavements, and roadways;
- Dismantle all fencing for recycling or metal scrapping; and
- The foundations of all buildings that will be removed to a depth of 0.5 m. anything deeper than this can be sealed, buried, and be left in situ.

6.6.1 Building and Paved Footprint Areas

The areas where the mine administration buildings, school, and any other area where a building once stood should be ripped to loosen the soil. Ripping will aid the germination of indigenous seeds and encourage new plants to take root in these previously compacted areas. Any areas that have been compacted which were not direct building footprints should also be ripped.

6.6.2 Topsoil and Vegetate Footprint

The entire footprint area from old buildings is to be laid with topsoil after it has been ripped. Once topsoil is laid to the appropriate depth and specifications of at least 250 mm thick (after compaction), the area must be re-vegetated using grasses, shrubs and trees that are indigenous to the area.

6.7 Access and Haul Roads

The rehabilitation objectives associated with access roads include:

- Demolish all access roads, bridges, culverts, pipes, and railway lines;
- Rip and scarify all roads that have been compacted; and
- Encourage plant growth and natural seeding to revegetate disturbed areas.

Access roads on the mining property have been substantially compacted over the years of mining. Road's areas need to be ripped to loosen the soil and shaped according to the topography of the area. During the shaping process, drainage lines should be considered before revegetation takes place. Riverbanks need to stabilise and monitored post closure. Once access roads have been ripped, these areas need to be laid with topsoil and revegetated.

The rehabilitation of the mines access roads should be done as the last rehabilitation item. This will allow the rehabilitation contractors to make use of these roads during all other rehabilitation activities. Once all other activities have been completed, the access roads should be ripped and rehabilitated from the furthest point from the point of exit to the mine. Should some road services be used by remaining infrastructure, main roads will be kept intact.

6.8 Establishment of natural grass on the Rehabilitated Areas

The following aspects related to the establishment of grass on rehabilitated areas applies:

- Once enough basal cover has been established, the introduction of species representative of the grass vegetation type may commence;
- Introduction of these species should commence through the stages of natural succession, i.e., Pioneer species (grasses, herbaceous species), Secondary species (grasses, small shrubs, and small trees) and Climax state (larger shrubs, large trees);
- This process will also occur naturally as seeds from the neighbouring grass areas are introduced and germinate;
- Certain tree species can be selectively introduced; however, consideration will need to be given to rooting depths and soil stability as well as the ability of the trees to establish on the subject area;
- A test area should be designated to test possible tree species to be introduced for their ability to grow in different substrates. This should commence immediately to allow informed decision-making once rehabilitation commences; and
- The primary goal is to achieve a stable, climax state, representative of the grass and vegetation type where the ecological function of the plant community is tolerant of most environmental conditions it encounters.

6.9 Open Pits

Any remaining pit areas will be backfilled to an extent, and the remaining void left to fill with water.

The environmental objective of this final facility is to make it as safe as possible for humans and animals at closure without filling the pit:

- A berm should be constructed around the outer edges of the pit (if not done so already) to ensure that all human pedestrian access, vehicles driving, or any

animals cannot inadvertently access this area and fall into the pit. This should be done by providing a berm and stockpiling any rubble on the inner slopes. The intention should be to create a berm of at least 1,5 m high. The berm should be sufficiently far from the pit to ensure that any pit instability or sliding does not affect the integrity of the berm and to ensure that cattle cannot cross it;

- Fences should be erected around the pit to prevent access by livestock and larger mammals. It is recognised that these are however not sustainable in the long-term;
- The berm should be at least 10 m from the final pit slope position;
- It is not intended that there should be access to the pit for use of the water by humans or large mammals because there is an expectation that the pit water may become extremely acidic and possibly hazardous. Access roads should be blocked.
- Leave a safe environment for both humans and animals;
- Make all areas stable and sustainable;
- Ensure that the top two sections of the pit have a gentle slope with wide steps to reduce the safety risk of humans and adults falling in the pit;
- To prevent soil and surface/groundwater contamination by managing all water on site to acceptable and agreed standards;
- Preventing water movement out of the mined areas; and
- Comply with local, district and National regulatory requirements.
    - Undertake continuous rehabilitation of the pit areas once rehabilitation is completed;
    - Repair pit instabilities to ensure final pit slopes are stable in the long-term; and
    - Make first and second pit bench, at least, stable in longer term.

6.10 Discard and Waste rock dumps

6.10.1 Stability

The outer layers of the discard dump can be strengthened by using gabions and boulders in panels to reduce erosion. Erosion is controlled by a mature topography characterised by relative stable slope lengths.

6.10.2 Seepage Control

The discard dump is sloped to resemble the natural topography as closely as possible. Enough cap (0.3 to 0.5m thick) need to be introduced to minimise the infiltration of surface water into the dump, preventing seepage, contaminated runoff and ensuring the long-term stability of the dump. The establishment of vegetation on the dump is assisting in

maintaining the cap, ensuring dust control, and allowing the dump to blend with the natural environment as closely as possible.

6.10.3 Safety aspects

Infrastructure and access road will be ripped to reduce access to the facility and the facility will be fenced to prevent movements at the facility. To the edges of the facility signage will be posted to warn intruders of the relative steep slopes of the dump site. Boulders on the edge of the facility could be used as a deterrent for people and animals reducing the safety risk.

6.11 Dirty Water Storage Facilities (DWSF)

The Pollution Control Dams (PCD) will be maintained until it is determined that there is no risk of decant from the underground mining area. Once it has been determined that there is no risk of decant or that the quality of the water is acceptable, both dams will be desilted and be backfilled and sloped to blend with the natural topography. The backfilled area will then be top-soiled and vegetated.

Rehabilitation objectives for the DWSF include the following:

- Remove all dams by flattening dam walls and filling in the open void of dam;
- Return area to previous land-use (small scale subsistence farming/wilderness);
- Re-vegetate dam areas with indigenous vegetation;
- Remove all ancillary structures like pipes, values, pumps etc.; and
- Prevent contamination of water courses on dam decommissioning.

6.11.1 Flatten Dam Walls into Dam Basins

All dams are to be completely flattened and removed. The dam walls and any side supporting walls are to be flattened into the basins of the dam, to fill in the hole left by the dam, and to dispose of the dam and all its material. This material should only be soil, sand and/or gravel which is used to infill the void left by the dam basin. Any plastic liners or non-natural materials should be removed and disposed of appropriately off-site.

6.11.2 Topsoil and Vegetate

Once all ancillary structures have been removed and the walls of each dam have been flattened into their basins, the area must be levelled off, adequately shaped to conform to surrounding topography, lined with topsoil and revegetated appropriately. Topsoil should be used from stockpiles which have been stockpiled at the start of mining operations. If

topsoil cannot be sourced from current stockpiles, then the soil should be brought in from an approved source to rehabilitate these areas.

6.12 Natural Surface and Ground water

Rehabilitation measures should be implemented to protect the natural waterways by:

- Monitoring water quality (Surface and Ground water) regularly and reporting it to the authorities;
- Properly rehabilitating the DWSF to be free-draining and revegetated; and
- Soil erosion control measures, such as protection berms, employed where necessary.

6.12.1 Surface drainage

The aim for restoring surface drainage is to ensure that the mine reinstate the natural contours and drainage lines on the mine site. In restoring these areas, the mine should take cognisance that concentrated flows do not damage rehabilitation areas or threaten their sustainability. Surface rehabilitation also requires reduction of ponding and therefore not drowning vegetation. To achieve this, areas need to be ripped to relieve compaction and promote vegetation growth and infiltration and cross rip to minimise erosion.

6.12.2 Ground water

Consideration should be given to conducting site-specific groundwater sampling to determine:

- Future water quality data and possible pollution plumes;
- Movement of the plume over time;
- Effect of the source terms, once mitigation measures are put in place; and
- Simulated effectiveness of remediation options to halt the movement of the plume, should the modelling indicate further remediation is required.

6.12.3 Wetlands

Wetland Construction is difficult to achieve. These impacts can also be mitigated through the inclusion of engineered water management structure. The impact on the environment is therefore not considered significant by the environmental specialist who undertook the project monitoring assessment. The expectation is that the hydraulics of the wetlands are

unlikely to be significantly impacted on by the future project activities. Closure actions will include:

- Civil works to create the landform required for the wetland;
- Addition of specific wetland soil to improve conditions for vegetation growth;
- The stabilization of any banks or steep areas once soils are included; and
- The establishment of wetland vegetation specific to the regional environment.

6.13 Maintenance of Rehabilitated Areas

All areas must be maintained for a period of three (3) years after formal rehabilitation ceases. During maintenance, the following should be done:

- Clearing of alien and invasive plants to allow indigenous plants to out-compete invasive and take a strong hold in the area;
- Watering of larger trees that were planted during rehabilitation to allow for these trees to establish adequately;
- Patching/fixing of any areas that have eroded since rehabilitation;
- If hydro-seeding was not effective during the first application, a second application of hydro-seed mixture may have to be applied in certain areas. The application of hydro-seed should be at the discretion of the hydro-seeding specialist;
- Maintain water runoff areas to not increase chances of further potential erosion or water ingress into the rehabilitated voids;
- Encourage growth of plants and grasses by cordoning off, fertilising and watering areas that have struggled to take root or re-vegetate;
- Areas of high importance (i.e., slopes and riparian areas) should be more vigorously maintained, fertilized, and watered during maintenance;
- Along the crest of steep gradients', a 1 m high Hessian screen should be placed around the facility to assist with the trapping of seeds and to protect the crest from wind erosion;
- Regular application of fertiliser should take place to ensure efficient establishment of vegetation cover until such time as enough organic matter is being produced by the established grasses to allow for self-sustaining growth;
- The process of unification can be utilised to ensure a constant supply of organic compost (fertiliser). This entails the establishment of a compost heap, where cleared indigenous organic matter is stored and allowed to break down naturally to the point of resembling garden compost;
- Care must be taken to ensure that ONLY indigenous plant matter is utilised for this process, as the presence of alien invaders may cause the establishment of invader plant communities in the rehabilitated areas: and

- With the re-establishment on natural ecological processes, Herpetofauna fauna and flora will slowly return to normal on the mining areas.

6.14 Social Programs and Strategies

6.14.1 Closure Planning

This final rehabilitation, decommissioning and mine closure plan considers the optimal use of mine land and infrastructure during the closure phase of the mining life cycle.

The mine is geared towards mitigating the impact of mine-closure on surrounding communities and specific planning is required regarding the post-mining use of the physical assets of the mine for potential community development purposes. These physical assets include:

- Ndanganeni Colliery can negotiate with the adjacent farmer to work towards a final land use which will enhance the capabilities and capacity of the surrounding landscape. Possibilities include creating a lake after rehabilitation an ensure better drainage;
- Roads identified that could assist with the movement within the site; and
- Handing over infrastructure (offices) to the benefit of communities.

7 SCHEDULE OF ACTIONS

The schedule of actions for rehabilitation, is expected to last for a couple of months.

7.1 Phase: Rehabilitation

During the rehabilitation phase the following actions will take place:

- Transfer of facilities (possibly the access road and dams): Facilities are required to be transferred to new landowners;
- Cleaning up of contaminated areas: all areas that have been contaminated will be remediated;
- Shaping: Areas requiring shaping will be shaped;
- Vegetating: The mine will allow the natural vegetation to be established on all denuded areas and where natural vegetation is not developing, and will ensure vegetation growth through seeding processes as quickly as possible;
- Monitoring: The site will be monitored to ensure the stability of landforms, that vegetation establishes and to monitor for possible latent risks. Once the studies prove the site is non-polluting and has reached equilibrium with the surrounding

environment an application can be made to the relevant government department for the cessation of these activities; and

- Aftercare and maintenance: The monitoring programmes will be used to identify areas that require aftercare and maintenance. The length of this activity is therefore dependant on the continuation of the monitoring programmes.

8 Organisational Capacity

The team responsible for carrying out the rehabilitation actions at the Mine are detailed in Table **8.1**.

Table 8.1: Actions, objectives, and responsible party for rehabilitation activities

Responsibility	Duties
Mine manager	Owning and overseeing the overall rehabilitation
Environmental Manager	Monitoring of the Rehabilitation progress
Rehabilitation Specialist (contractor)	Implementation of rehabilitation measures
Hydro–seeding/revegetation specialist (Contractor)	Seeding where applicable

9 Changes from previous assessment

The large open void has partially been rehabilitated which includes the movement of soil back into the voids. The void surface area has decreased, and the ground disturbance areas have increased. The mine will start with a new mining area, but the author has calculated that only 10% of the total area will constitute a void at the end of the mine. The rest of the area will be backfilled as the mine progress to its final closure.

10 Relinquishing Criteria

10.1 Disturbed areas

All disturbed areas should be ripped, top soiled and allowing natural vegetation to grow and then seeding if natural vegetation is not growing. There should be no evidence of bricks, wood, concrete, or steel on site after the demolition of these facilities.

10.2 Rehabilitation Assessment Sign Off

When the completion criteria have been achieved, the Mining Environmental Manager will undertake the following steps:

- Engage suitably qualified and experienced consultants to complete a final rehabilitation assessment and record findings to ensure all objectives have been met;
- Arrange for a meeting with relevant Government agencies to obtain consensus that the necessary requirements have been fulfilled and that no further work is required; and
- Conduct a basic environment assessment as per the EIA regulations and submit this alongside the application for a closure certificate.

11 CLOSURE COST ASSESSMENT

The required closure costs should the mine undergo sudden closure were calculated using the above closure actions. The methodology, assumptions and costs calculated are detailed as follows.

11.1 Legislative requirement

The final rehabilitation, decommissioning and mine closure plan must be measurable and auditable and must include the closure cost estimation procedure, which ensures that identified rehabilitation, decommissioning, closure, and post-closure costs, whether on-going or once-off, are realistically estimated and incorporated into the estimate, on condition that—

(i) cost estimates for operations, or components of operations that are more than 30 years from closure will be prepared as conceptual estimates with an accuracy of ± 50 per cent. Cost estimates will have an accuracy of ± 70 per cent for operations, or components of operations, 30 or less years (but more than ten years) from closure and ± 80 per cent for operations, or components of operations ten or less years (but more than five years) from closure. Operations with 5 or less years will have an accuracy of ± 90 per cent. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy;

(ii) the closure cost estimation must include—

a. an explanation of the closure cost methodology;
b. auditable calculations of costs per activity or infrastructure;
c. cost assumptions;

(iii) the closure cost estimate must be updated annually during the operation's life to reflect known developments, including changes from the annual review of the

closure strategy assumptions and inputs, scope changes, the effect of a further year's inflation, new regulatory requirements, and any other material developments;

11.2 Methodology

The NEMA regulations require that the closure costs be calculated according to real rates. CIGroup sourced these rates from a third-party contractor specialising in demolition and rehabilitation.

To calculate the closure cost using the third-party contractor rates, each of the closure actions from the report were broken down into specific units (i.e., roads, power lines, buildings, discard dump, Dirty Water Storage Facilities etc.) within specific categories (i.e., Decommissioning, Closure, Rehabilitation and Care and Maintenance).

A bill of quantity was determined for each of the units and applied to the third-party contractor rates to determine a closure cost per unit. The unit costs determined the category costs and the category costs resulted in a preliminary closure cost also called Sub-Total 1. Contractors' costs include a mobilisation and project management fee which represents 12% of the Subtotal 1 and is calculated into a Subtotal 2. A contingency of 10% was included on Subtotal 2 to obtain a Financial Liability Cost in Subtotal 3. Finally, a 15% VAT was added to Subtotal 3 to obtain a subtotal 4. Subtotal 3 is regarded as the Final closure liability of the mine.

11.3 Assumptions

11.3.1 Sudden Closure Assumptions

The following assumptions were made if the mine were to undergo sudden closure:

- Third party contractor rates from a demolition and rehabilitation company were used to calculate the costs;
- The measurements were based on a BOQ developed by the author;
- Volume calculations was done on a Frustum model calculation;
- Void replacement volumes were based on a bulk factor of 25% (Hards) to determine the excess material (dumps) to be rehabilitated;
- Void replacement volumes were based on a compaction factor of 10% (Softs) to determine the excess material (dumps) to be rehabilitated;
- The overburden hards will be used before softs are placed as a second layer;

- Identified topsoil will be used to determine if enough topsoil is available for pit and dumps.
- As there are currently no agreements in place for the handover of infrastructure to a third party, the costs assumed all infrastructure would be demolished;
- Costs were included for groundwater, surface water and biodiversity monitoring for a 3-year period after the closure and rehabilitation efforts cease;
- Costs for the final closure certificate process were included;
- No salvage value was added;
- A 10% mobilisation and project management fee were included for the contractor; and
- A 10% contingency was added to the subtotal to account for any unforeseen shortfalls.

The author estimates a 75% accuracy in the calculations in this report based on the specified BOQ and Master Rates utilised.

11.4 Bill of quantities

The following Bill of Quantities were identified:

Figure 11.1 Mine boundaries (Jacques Harris Sketchup 05/2022)

Table 11.1 Bill of Quantities (BOQ)

Components	Length	Perimeter	Area	Volume	Hectares
FILL					
Void (V7)		3814	126786	633 930	12.7
Pit Lake (V4)		743	20 453	397 879	2.05
Pond/PCD (V8)		386	9 120	45 600	0.91
Pond/PCD (V11)		148	1 465	7 325	0.15
Dam (V2)		295	6 501	2 935	0.65
Dam (V3)		415	9 294	205 673	0.93
Dam (V5)		604	15 648	58 746	1.56
Dam (V9)		621	15 639	78 195	1.56
Dam (V10)		171	1 352	6 760	0.14
Void 12		946	15 174	75 870	1.52
New Void V13		420	44 177	220 883	4.42
Void 14		473	10 573	42 292	1.10
Slurry Pond (V6)		418	9 143	72 511	0.91
Wetland Pan 1		1 374	135 601	271 202	13.56
Wetland Pan 2		650	25 137	50 274	2.51
Heights					
Hards (HD1)		592	16 096	81 811	1.61
Hards (HD2)		744	33 761	355 922	3.38
Hards (HD3)		550	16 790	127 750	1.68
Hards (HD4)		551	17 438	52 227	1.74
Hards (HD5)		1 005	36 599	441 409	3.66
Hards (HD6)		474	16 085	228 511	1.61
Hards (HD8)		583	18 086	54 258	1.81
Subsoil (SS1)		702	21 293	90 413	2.13
Subsoil (SS2)		1 044	57 760	737 017	5.78
Subsoil (SS3)		600	21 030	275 276	2.10
Subsoil (SS4)		991	61 453	234 455	6.15
Subsoil (SS5 + SS6)		1 067	35 212	521 690	3.52
Subsoil (SS7)		508	14 500	43 500	1.45
Ground Cover/Topsoil (TS1)		978	60 180	275 758	6.02
Ground Cover/Topsoil (TS2)		590	21 317	129 180	2.13
Ground Cover/Topsoil (TS3)		656	24 015	139 826	2.40
Ground Cover/Topsoil (TS4)		488	17 233	88 869	1.72
Ground Cover/Topsoil (TS5)		484	14 651	90 027	1.47
Ground discard and dumps (C1)		1 573	53 314	53 314	5.33
Ground discard and dumps (C2)		6 354	359 932	359 932	35.99

Infrastructure					
Plant Infrastructure 1			1 732		0.17
Housing Infrastructure 1			283		0.03
Housing Infrastructure 2			724		0.07
Weighbridge			96		0.01
Housing Infrastructure 4			79		0.01
Housing Infrastructure 5			50		0.01
Housing Infrastructure 6			92		0.01
Housing Infrastructure 7			513		0.05
Housing Infrastructure 8			314		0.03
Housing Infrastructure 9			62		0.01
Housing Infrastructure 10			68		0.01
Housing Infrastructure 11			54		0.01
Roads 1	6 040		43 762		4.38
Roads 2	822		3 721		0.37
Roads 3	1 248		10 039		1.00
Roads 4	3 440		21 553		2.16
Roads 5	2 744		10 592		1.06
Specific areas					
Disturbed area (D1)		1630	43 886		4.39
Disturbed area (D2)		568	14 385		1.44
Disturbed area (D3+D4)		6 729	664 126		66.46
Disturbed area (D5)		1 827	62 322		6.23
New disturbed area		397 589	1 987 943		198.79
Surface					
Total Surface		14 137	5 061 094		506.13
General Surface Rehab			2 647 679		264.77
Care and Maintenance			2 413 415		241.34

11.5 Closure Cost

The calculated closure cost if the mine were to undergo Sudden Closure are summarised in **Table 11.2**.

This table shows that the sudden closure costs calculated for the mine using contractor rates is R144 864 982.31 (excluding VAT) or R166 594 729.66 (including VAT). The breakdown of the costs is provided in **Appendix D**.

Table 11.2 Closure Cost

Mine Closure Financial Liability		
	Item description	**Cost**
1	**Surface Infrastructure**	**R6 306 350.75**
1	Dismantling of processing plant and associated structures (including associated conveyors & power lines)	R286 452.33
2(A)	Demolition of steel buildings and structures (including floor slabs)	R0.00
2(B)	Demolition of reinforced concrete buildings and structures	R0.00
3	Rehabilitation of access roads	R4 978 447.29
4(A)	Demolition of electrified railway lines	R0.00
4(B)	Demolition and rehabilitation of non-electrified railway lines	R0.00
5	Demolition of housing and facilities (including floor slabs)	R870 302.42
12	Fencing	R171 148.72
2	**Mining Areas & Waste Sites**	**R22 844 256.36**
6	Opencast rehabilitation (including final voids and ramps)	R22 844 256.36
7	Sealing of shafts, adits and inclines (including concrete cap)	R0.00
3	**Mine Residue Sites**	**R9 504 372.67**
8(A)	Rehabilitation of overburden and spoils	R0.00
8(B)	Rehabilitation of processing waste deposits and evaporation ponds (basic, salt-producing waste)	R0.00
8(C)	Rehabilitation of processing waste deposits and evaporation ponds (acidic, metal-rich waste)	R8 856 681.67
9	Rehabilitation of subsided areas	R0.00
13	Water management (Separating clean and dirty water, managing polluted water and managing the impact on groundwater, including treatment, when required)	R647 691.00
4	**General Rehabilitation**	**R9 248 745.67**
10	General surface rehabilitation, including of all denuded areas	R9 248 745.67
5	**Aftercare & Maintenance**	**R3 344 723.00**
13	Monitoring	R1 420 000.00
14	Maintenance	R1 924 723.00
15	Water Treatment Facility	R0.00

Sub Total 1	R51 248 448.45
Mobilisation and Project Management (10% of Subtotal 1)	R5 124 844.85
Sub Total 2	R56 373 293.30
Contingency (10% of subtotal 2)	R5 637 329.33
Sub Total 3 (Closure Liability for Mine)	R62 010 622.62
VAT (15% of subtotal 3)	R9 301 593.39
Total	R71 312 216.02

The financial contribution of each activity on the financial mine closure liability include:

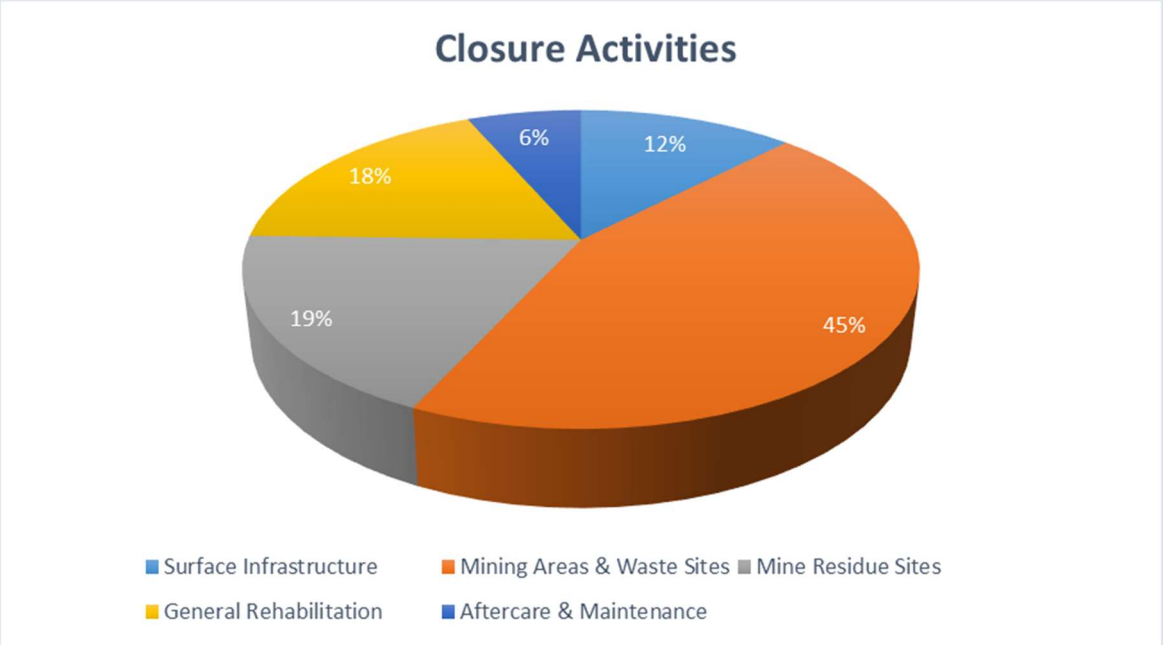

Figure 11.2 Closure activity contribution

The financial contribution to each phase of the financial mine closure liability include:

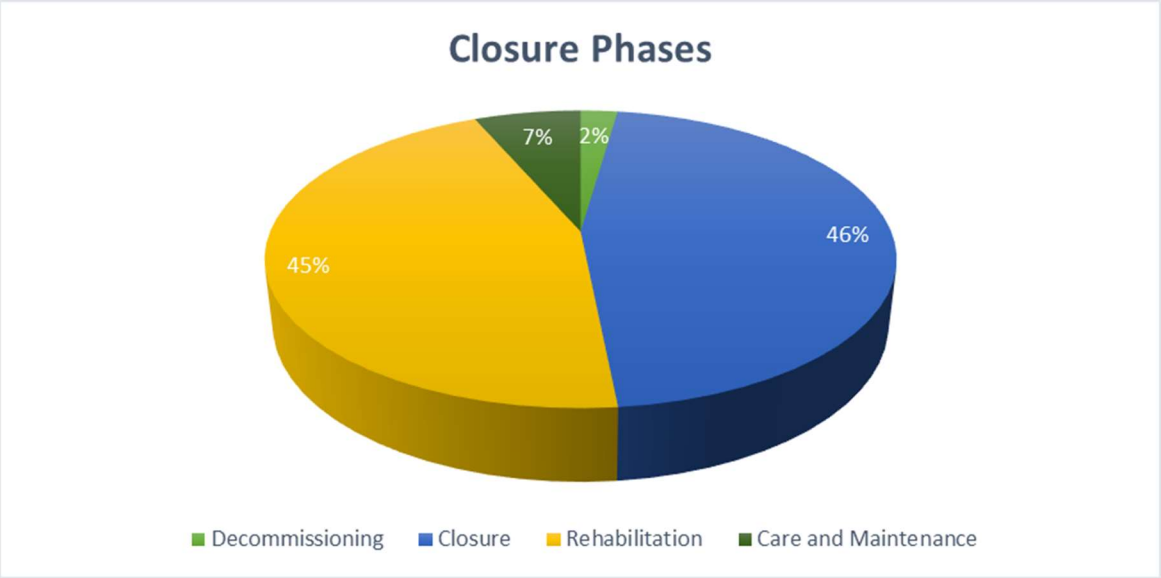

Figure 11.3 Financial Contribution

12 Monitoring

The following monitoring is required to ensure rehabilitation is effective:

- Surface Water;
- Groundwater; and
- Dust.

12.1 Groundwater and Surface Water Localities

Groundwater and surface water sampling localities conducted by EcoElementum are identified in Figure 12.1**Error! Reference source not found.**.

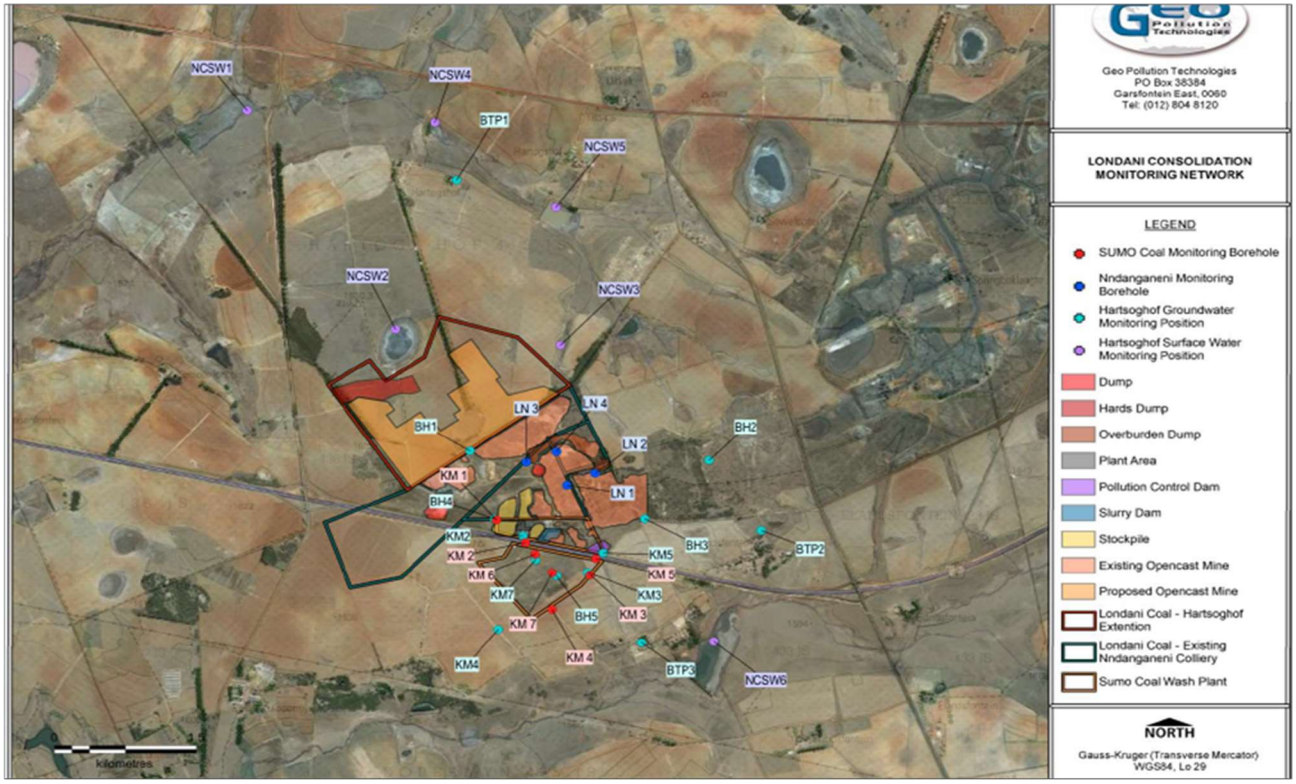

Figure 12.1 Monitoring (Google Earth Image 2018)

Key Qualities that require monitoring include:

- pH;
- TDS;
- Iron;
- Aluminium;
- Zinc;
- Manganese;
- Sodium;
- Fluoride;
- Ammonia; and
- Chloride.

13 Conclusion

The GN R1147 now require that mines annually review and update their:

- Annual rehabilitation, as reflected in an annual rehabilitation plan as per Appendix 3 of GN R1147;
- Final rehabilitation, decommissioning and closure of the prospecting, exploration, mining, or production operations at the end of the life of operations as reflected in a final rehabilitation, decommissioning and mine closure plan as per Appendix 4 of GN R1147; and
- Remediation of latent or residual environmental impacts which may become known in the future, including the pumping and treatment of polluted or extraneous water, as reflected in an environmental risk assessment report as per Appendix 5 of GN R1147.

This plan fulfils the requirements of the final rehabilitation, decommissioning and mine closure plan as per Appendix 4 of GN R1147.

It is important to note that the large open void has partially been rehabilitated which includes the movement of soil back into the voids. The void surface area has decreased, and the ground disturbance areas have increased. The mine will start with a new mining area, but the author has calculated that only 10% of the total area will constitute a void at the end of the mine. The rest of the area will be backfilled as the mine progress to its final closure.

The nature of mining operations means that during the time between the publishing of this report and the final closure of the mine there could be several considerable changes in the available or preferred rehabilitation measures, the desired end land use, the nature of the local and regional socio-economic conditions, changes in legislation and changes in the physical environment. All these factors could lead to large changes in the desired or required rehabilitation measures which could see this document change significantly over time. As such it is vital that this document is a living document which allows for these changes to be made.

Appendix A: Assessor CV

Jacques Muirhead Harris

Address: *51 Brunton Street, Founders View, Edenvale*
E-mail: *jacques.mharris@gmail.com*
Tel: *+(27) 71 684 3414*
Linkedin: *https://za.linkedin.com/in/jacques-harris-687100*

Summary

I am currently the Environmental Operations Manager (SACNASP 400363/13, IRMSA 53533736, SAIOSH 55514187) for CIGroup, with over 25 years' experience in business management processes. I obtained my experience working as a teacher at Linden High School, at a large international manufacturing facility, Saint-Gobain Abrasives (2360 people in RSA), an international consulting firm, WorleyParsons RSA (1500 in RSA), an African Consulting Firm, GCS Pty Ltd (100 Professionals) and currently at CIGroup South Africa.

Through my career I have managed large teams (30 people) and have been involved through all the processes of business. I have been intrinsically involved in setting up Key Performance Indicator (KPI's), and conducting Employment, Retrenchments, Disciplinarians, and the CCMA processes. I have been part of the EXCOM and MANCOM of companies and was part of the Salary Negotiation Team with the Unions (NUMSA and SAEAWU) at Saint-Gobain.

My experience includes procurement activities in terms of procurement contracts, supplier quality assurance audits, BBEEE compliance, raw material storage and product life cycles and financial risk. I have developed ISO 9001, and ISO 14001 systems and managed the OSHAS 18001 systems. I was responsible for Enterprise Risk Management for Saint-Gobain, Project Risk facilitation for WorleyParsons, financial risk modeling for Quatern and responsible for bid and contract risk management for projects. My RND experience include the development of new products for manufacturing through our laboratory services, developing new applications for products, and optimising applications. Operations management in GCS and WorleyParsons included allocating time for procurement for projects, bidding, and contract management, reporting and quality control, budgeting, time management, stakeholder engagement, Human resources, and Scope management.

In Business Development I have marketed products and service in the Mines and Minerals, Power, Oil and Gas, Manufacturing, Government and Financial sectors in South Africa. I have been a manager for Large Account Management Clients (LAMC) with sales and project budgets of up to R30 million, which include companies such as Exxaro, SolarReserve, Government, Columbus Stainless Steel, Investec etc. My sustainability experience includes Carbon, Water and Ecological footprints and offsets and financial implications working towards the climate change objectives of companies.

As a teacher of mathematics and science, education and training has always been important in my working career. In Saint-Gobain I initiated a 2-year course that became the Centre of Excellence of Management studies for Saint Gobain.

Qualification

1992: BSc. Hons Chemistry
1991: HED. Chemistry and Math's
1990: BSc. Chemistry, Biochemistry

Courses and Certificates

1998: Handling Discipline
1998: Assertive Communication Skills
1998: Hands on Managing of IR
1998: Total Workplace Environment
1998: Successful Selling
1998: Training the Trainer
2001: Business / Technical Writing
2002: OSHAS 18001 Auditing Training
2002: Sales Training
2002: Level 2 – RND
2007: Competition Law
2009: Internal Risk Management
2009: Financial Risk Management
2009: Business Development Planning
2011: ISO 9001:2008 ISO lead auditor
2012: Serious about Zero Harm
2013: Risk facilitator training
2013: Global Reporting initiative
2014: Sustainable Design and SEAL Coordinator
2017: Occupational Health and Safety

Skills

Statistical Control and Assurance
Research and Development
Sustainability
Project Management
Project Risk Management
Enterprise Risk Management
Financial Risk Assessment
Financial Modelling
ISO systems (9001, 14001, 45001, 17025, 31001)
Quality Management
Health and Safety
Environmental Management
Societal Management
Energy Balance
Carbon Footprint
Water Footprint
Closure and Rehabilitation

Jacques Muirhead Harris

Registrations

- SACNASP Registration, 400363/13, 2013;
- The Institute of Risk Management South Africa IRMSA 53533736
- SAIOSH Membership Number 55514187
- IOCSA, Chartered Consultant, A00107, 2017;
- Environmental Law Association, ELA, 2016/140/GP, 2015; and
- International Association for Impact Assessment South Africa, IAIA, 3985, 2015

Work Summary

2019 – Present: CIGROUP Pty Ltd **Environmental Operational Manager**

Units: Health and Safety, Environmental Sustainability, Environmental Systems, Environmental Closure and rehabilitation, Risk and Quality.

2018 – 2019: GCS Pty Ltd **Group SHERQ Manager Consulting**

Units: Health and Safety, Environmental Sustainability, Environmental Systems, Environmental Closure and rehabilitation, Risk and Quality.

2014 – 2018: GCS Pty Ltd **Group Environmental Manager**

Units: Pre-Authorizations, Environmental Authorization, Water Authorization, Post-Authorization, Environmental Control Management, Sustainability, Ecology, Health and Safety, Environmental Systems, Closure and Rehabilitations, Business Development

2011 – 2014: WorleyParsons RSA **Environmental Manager**

Units: Environmental and Water Authorizations, Closure and Rehabilitation, Risk Facilitation and Assessment, Financial Risk Modelling.

2009 – 2011: WorleyParsons **Senior Project Manager**

Environmental, Public and Private Partnership, Risk Management and Financial Risk Projects

2008 - 2009: Quatern Advisory **Executive Energy**

Unit Manager, Power, Risk Management and Financial Risk Projects

2003 - 2008: Saint-Gobain **SHERQ and Sustainability Manager**

SHERQ Unit Manager – ISO 9001; ISO 14001, OSHAS 18001, ISO 170125, Enterprise Risk Management; Sustainability GRI reporting for RSA

1999 - 2003: Saint-Gobain **RND Manager**

Research and Development on Products, Services and Client Development

1995 - 1999: Saint-Gobain **Laboratory Manager**

RND and Operations Laboratory and Quality Manager

1993 - 1995: Linden High School **Teacher**

Grade 8 – 12 Math's and Science Teacher

Legislation Experience

MPRDA; NEMA; NEM:AQA; NEM:WA; NRM:BA; NWA; Occupational Health and Safety Act; Mine Health and Safety Act; MFMA; and PFMA

Business Travels

USA (3); UK (2); France (2); Australia (1); Mozambique (1); Namibia (1); and Zambia (1)

System Management Experience

Laboratory Management: ISO 17025
Quality: ISO 9001
Environment: ISO 14001
Health and Safety: ISO 45001
Enterprise Risk Management: ISO 31001
Sustainability: GRI
Project Management: PMBOK
Public and Private Partnerships: PPP
Performance Management.

Computer Literacy

VBA – Good; MS Word – Advanced; MS Excel – Advanced; MS Access – Advanced; MS Project – Advanced; MS Power point – Advanced; Outlook – Good; Eviews – Good; @Risk – advanced; Sketchup – Good; Edraw – Good; and Proman - Advanced

Conference Presentations

2015 – Wits; Environmental Management Systems ISO14001
2015 – Masterclass: Closure liability of mines in South Africa
2016 – IAIA: Closure liability of mines in South Africa
2017 - 8th Annual Construction Risk Conf: Environmental Risk
2018 – GSSA: Climate Change

ACHIEVEMENTS

In 1999 I developed a statistical quality control system that were used until the company closed doors in South Africa. In 2002 I started a Center of Excellence for Management training teaching a total of 125 entrants in becoming supervisors and managers. In 2004 I certified Saint-Gobain in ISO 9001 (SANS accredited) which were held until I left in 2008. In 2006 I obtained a Diamond award for one of 24 best SHERQ facilities from 420 facilities worldwide. I was asked to present the facility and achievements (1million hours without a lost time accident) in Manchester UK. I was the lead in the Risk Assessment Process for St Helena Airport and designed a Disaster Management Plan for an Oil refinery in Vladivostok Russia. Currently I am requested to do a number of presentations on various subjects for the industry.

Jacques Muirhead Harris

I believe that I have the qualification and experience in assisting your company in their future endeavors. I am a hard and dedicated worker loyal to the company I work for (can be seen in the years spent at previous companies). I am focused and precise on the financial and scheduled components of my activities, and work towards satisfying the needs of my clients. Clients are key to the success of any business.

Social

- Project Manager and team member: Study to determine the **socioeconomic benefits of Roads on the economy of South Africa** (RSA Department of Transport (R2mil project))
- Team Member: Chitima **Social Impact Assessment and Resettlement Management Plan** (ERG)
- Team Member: Belfast **Social Impact Assessment, Social and Labor Plan** and Management for Resettlement Implementation.
- Team member: **Social and Labor Plan** for Goeboe Goeboe salt mine.
- Team member: **Social and Labor Plan** for Chrominet Grrenfields project

Environmental Impact Assessment

- Estima Coal Mine (Mozambique) - Power Plant EIA
- Director: Individual Environment, Waste, Water, Electrical and GIS assessments for **Concentrated Solar Plants** in Humansrus, Rooipunt, Arriesfontein.
- Director: Individual Environment, Water, Electrical and GIS assessments for **Photovoltaic Plants** in Southdrift, Humansrus, Rooipunt, Arriesfontein and Farm 198
- Director: Individual Environment, Waste, Water and GIS assessments for **Anaerobic Plants** in Starke, Bonnievale, Keibees and Butt Farming
- Director: Individual Environmental and Water Assessments for **Biomass Gasification Plants** in Ringkink, Lourensford and J&J Sawmills
- Director: Health and Safety, Environment, Water, Waste and GIS **assessments for an Oil Tank farm** in Saldanha Bay (Equator Principles)
- Director: **Environmental and Waste Assessments** for George Mukari Hospital Extension
- **Environmental Management Plan** for uMdloti Wastewater Treatment works
- **Environmental Feasibility** for the construction of a bypass road at Hazyview
- Director: **EIA** for Subenza substation.
- Project Manage: **EIA** for Witsand Desalination Plant.
- Project Manage: **EIA** for Elliotdale Rural Development.

ISO systems and Accreditations

- **Environmental, Health and Safety and Environmental certification and accreditation,** Saint-Gobain Abrasives South Africa
- **Quality control, assurance management and statistical control for products leaving the facility** for Saint-Gobain Abrasives.
- **Environmental, Health and Safety and Environmental implementation**, Quatern, KV3, WorleyParsons and GCS in RSA
- **Disaster Management, Environmental, Health and Safety Management Plan**, Oil Refinery, Vladivostok, Russia
- **Health and Safety, Carbon foot printing as lead auditor on all Cape Town Wastewater Treatment sites** for NIRAS on behalf of the German development Band (KfW) as lender.
- **ISO 9001** development/implementation for Consulting Engineers for CIGroup

Mine Closure and Rehabilitation

- Paladin Energy – Kayelekera Uranium Mine in Malawi
- Exxaro – NBC GNR 1147 Closure and Rehabilitation for 3 mines
- Kangra – GNR1147 Closure and Rehabilitation process on all 18 mines
- Tharissa – Mine closure, Decommissioning, Closure and Closure Liability
- Bokoni Anglo American - Mine closure, Decommissioning, Closure and Closure Liability
- Dwarsrivier (Assore) - Mine closure, Decommissioning, Closure and Closure Liability
- Gem Diamond (Botswana) - Mine closure, Decommissioning, Closure and Closure Liability
- Ladomode – Mine Closure Assessment
- Sibanye Gold – Driefontein and Burnstone Rehabilitation Strategy and Implementation Action Plan
- Pilansburg Platinanum Mine – Mine Closure Design, Rehabilitation and Financial Provision
- Director: Assmang Managnese Cato Ridge Works Conceptual Closure Plan.
- Director: Cronimet Conceptual Closure Plan and closure Liability Assessment.
- African Rainbow Minerals Limited (ARM) Dormant mines closure liability assessments. Drafted a legal opinion on old order mining rights and liabilities ito environmental legislation.

Sustainability

- Project Director to determine the **feasibility of changing gas into electricity** using the Combined Heat and Power Technology for Heritage Hill Development (Project size R256 Million)
- Project Manager Mbombela **Integrated Waste Management Plan**, Municipal Service Plan, and Waste Recycling and Minimisation Plan.
- Gem Diamond (Botswana, Lesotho) – **Energy Balance, Carbon, and Water footprint**
- **Water management for rehabilitation for 18 Kangra mines.**

Corporate

- **Business improvement and Marketing Strategy for Forza Racing** for Quatern Advisory Services.
- **Business risk management Assessment for meridian Wine Merchats for** Quatern Advisory Services.
- **Project Manager to determine the appropriate Tariff for Kouga Municipality** for Quatern Advisory Services.
- **Business risk management plan for Goeboe Goeboe salt mine in the Northern Cape** for Quatern Advisory Services.
- **Risk Facilitator and Risk Manager** for the Siemens Photovoltaic Plant for WorleyParsons.
- **Risk Facilitator and Risk Manager** for the St Helena Airport for WorleyParsons.
- Assisted the client in conducting a full **Environmental Due Diligence and Risk Assessment** of purchasing an Anglo Mine
- Assisting Duetche Bank KfW with a due diligence on funding for Water treatment works in Cape-Town CIgroup

Public and Private Partnership

- **Broadband Financial Risk Modelling** for the Municipality of Cape Town (8 billion Rand Project)
- Project Manager: Eden District Municipality **Landfill PPP** and Risk Management Processes
- Director: **Environmental and Waste Assessments** for George Mukari Hospital Extension
- Team Member: City of Johannesburg **Waste to Electricity Feasibility Study** – Contributed to the Risk and BEE implications of the study
- Team Member: **PPP Strategy and Policy** for the City of Windhoek. Created **access software** for the purpose of running the system.
- Team Member: **Mbombela Integrated Waste Management Plan** with landfill site transport routes, pickers, and additional facilities

Health and Safety

- Director for **Sanral N17 Upgrade Health and Safety Compliance Officer**
- Director for **SANRAL N2 Umtate upgrade**
- Director for **Compliance Officer for Grahamstown Slope Stability study**
- Director for **the City of Johannesburg Orlando Station Upgrade (H&SCO)**
- Director for **Health and Safety Compliance for KwaZakhele Storm Water and Roads construction**
- Director of **Compliance Officer for Nelson Mandela Bay Stadium Health and Safety Audit**
- Director for **N2 Bridge Construction Health and Safety**
- Director for **Health and Safety Compliance Officer for Kwa Nomzamo sewage plant augmentation**
- Director for **Health and Safety Compliance Officer for Derdepoort 189&190 Township Establishment**
- Director for **Compliance Officer on Goedemoed Correctional Services Health and Safety**
- Assisted companies to develop **Mine Health and Safety Files for mines including Anglo American, African Rainbow Minerals, Exxaro, Kangra, Arcelor Mittal, and Samancor.**
- Developed the **Health and Safety Management system for Goeboe Goeboe salt mine.**

Engineering

- **Design, development, and operations of a water treatment facility** for Saint-Gobain Abrasives.
- **Development and operations of a Field instrumentation unit to measure power consumption on Abrasives machines** for Saint-Gobain Abrasives.
- **Maintenance and operations of a ovens and furnaces at Isando operation** for Saint-Gobain Abrasives.
- **Bottling plant feasibility for Ensunc at** Quatern advisory services**.**
- Thubelisha appointed Quatern to provide a **Professional Engineering Audit of Services to verify and quantify installed services, at Delft Symphony, N2 Gateway project, Cape Town.**
- **Pre-feasibility study in generating electricity and heat using gas as a primary source of energy through Micro CHP's** for Quatern Advisory Services
- **Feasibility Assessment for the Visitor Centre for SKA at Carnavon in the Northern Cape SKA** for Quatern advisory services.
- **Assmang Manganese Cato Ridge Work Slag Investigation**. Investigated the use of slag for stabiliser for pipeline
- **Assessment of the contamination of ballast and surrounding areas** for Transnet on South African railway network

Appendix B: Closure legislation

1. Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)

The Constitution of South Africa is the supreme act to which all other acts must speak to. The Constitution sets out the rights for every citizen of South Africa and aims to address past social injustices. With respect to the environment, Section 24 of the constitution states that:

"Everyone has the right:

a) To an environment that is not harmful to their health or well-being;

b) To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

i. Prevent pollution and ecological degradation;

ii. Promote conservation; and

iii. Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development".

The constitution also establishes the idea of the polluter pays principal - simply that the party responsible for pollution of the environment remains responsible for financial reparations of the impacts from their activities.

2. National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA)

The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) provides the framework environmental legislation and establishes an integrated environmental management system for South Africa. It aims to prevent pollution and degradation of South Africa's natural environments while at the same time promoting sustainable economic and social development.

Central to NEMA is the idea of Integrated Environmental Management (IEM). IEM seeks to:

- Promote the integration of the principles of environmental management into the making of all decisions;
- Identify, predict, and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage, the risks and consequences and alternatives and options for mitigation of activities, with a view to minimising

negative impacts, maximising benefits, and promoting compliance with section 2 principles; and

- Ensure that the effects of activities on the environment receive adequate consideration before actions are taken in connection with them.

NEMA also enforces the idea of the polluter pays principle as established in the Constitution. Section 28(1) of the NEMA states:

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

This is central to the idea of mine closure whereby the holder of a mining permit remains responsible for ensuring the mined area is rehabilitated to a state acceptable to all parties and that is not harmful to people or the surrounding environment.

Section 24P of the NEMA also sets out the requirements for financial provision for remediation of environmental damage while Section 24R of the NEMA speaks specifically to environmental authorization on mine closure. Section 24P (5) states the following:

"The requirement to maintain and retain the financial provision contemplated in this section remains in force notwithstanding the issuing of a closure certificate by the Minister responsible for mineral resources in terms of the Mineral and Petroleum Resources Development Act, 2002 to the holder or owner concerned and the Minister responsible for mineral resources may retain such portion of the financial provision as may be required to rehabilitate the closed mining or prospecting operation in respect of latent, residual or any other environmental impacts, including the pumping of polluted or extraneous water, for a prescribed period. responsible for mineral resources in terms of the Mineral and Petroleum Resources Development Act, 2002 to the holder or owner concerned and the Minister responsible for mineral resources may retain such portion of the financial provision as may be required to rehabilitate the closed mining or prospecting operation in respect of latent, residual or any other environmental impacts, including the pumping of polluted or extraneous water, for a prescribed period" (own emphasis).

Furthermore, Section 24R (1) of the NEMA states:

"Every holder, holder of an old order right and owner of works remain responsible for any environmental liability, pollution or ecological degradation, the pumping and treatment of polluted or extraneous water, the management and sustainable closure thereof notwithstanding the issuing of a closure certificate by the Minister responsible for mineral resources in terms of the Mineral and Petroleum Resources Development Act, 2002, to the holder or owner concerned" (own emphasis).

Important to note here is that the NEMA specifically states that the liabilities associated with mining do not end with the issuing of a closure certificate. This is at odds with the MPRDA as illustrated before. Furthermore, the NEMA carries heavier penalties than the MPRDA for transgressions.

2.1. NEMA 2017 Environmental Impact Assessment (EIA) Regulations GN R326

The Department of Environmental Affairs (DEA) has developed a list of activities which are likely to have an impact on the environment. The list of activities was published in 2014 and were separated into three listing notices (GN R983, GN R984 and GN R985) and were amended by the Department in 2017. The amended list of activities was separated into three listing notices (GN R.324, GN R.325 and GN R327).

Any activity which is listed under these notices requires an environmental assessment to be conducted and approved before the activity can proceed. Activities falling under Listing Notice 1 (GN R327) or Listing Notice 3 (GN R324) require a Basic Assessment (BA) to be conducted while any activity falling under Listing Notice 2 (GN R325) requires a full Scoping and Environmental Impact Assessment (S&EIA) process to be conducted.

With the introduction of the 2014 NEMA EIA Regulations (GN R982), as amended by the 2017 NEMA EIA Regulations (GN R326) on 07 April 2017, mine closure is now a listed activity under GN R983 which requires a BA. The listing detailed in **Error! Reference source not found.**.

Table 1.1: Listing Notice GN R327 which triggers a BA.

Activity Number	Activity Description
Activity 22 under GN R324.	The decommissioning of any activity requiring - (i) a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002); or (ii) a prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure. but excluding the decommissioning of an activity relating to the secondary processing of a – a) mineral resource, including the smelting, beneficiation, reduction, refining, calcining, or gasification of the mineral resource; or b) petroleum resource, including the refining of gas, beneficiation, oil, or petroleum products; – in which case activity 31 in this Notice applies.

Therefore, any mine that wishes to apply for a closure certificate is now required to conduct a BA and submit this alongside the application for a closure certificate.

2.2. NEMA 2015 Regulations Pertaining to Financial Provision

The NEMA regulations pertaining to financial provision were previously regulated under the MPRDA, however they have since been retracted from the MPRDA and have now been gazetted under the NEMA.

The regulations pertaining to financial provision (GN R1147) under the NEMA set out the requirements for an applicant or holder of a right or permit to determine and make financial provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts of prospecting, exploration, mining, or production operations.

GN R1147 now requires an applicant or holder of a right or permit to compile and annually review the following three documents:

1. A final rehabilitation plan;
2. An annual rehabilitation plan; and
3. An environmental risk assessment report.

The NEMA regulations require that the financial provision is, at any given time, equal to the sum of the actual costs of implementing the plans and report for a period of at least 10 years forthwith. The calculation of these costs needs to be based on real costs and are no longer calculated according to given rates.

The transitional arrangement under regulation 17(4) states that:
"A financial provision approved in terms of the Mineral and Petroleum Resources Development Regulations, 2004 must be regarded to be the financial provision approved in terms of these Regulations, on condition that a holder that operates in terms of a financial provision approved in terms of the Mineral and Petroleum Resources Development Act, 2002 at the time of the coming into operation of these Regulations, must review and align such approved financial provision with the provisions of these Regulations, after the coming into operation of these Regulations, as set out in sub-regulations (5) to (10), and annually thereafter as set out in regulations 9 and 11, read with the necessary changes" (own emphasis).

Therefore, the previous financial provisions for the Ndanganeni Colliery which were approved as per the Mineral and Petroleum Resources Development Regulations (published under Government Notice R527 in Government Gazette 26275 of 23 April 2004) (GN R527), can be approved of in terms of GN R1147 so long as Ndanganeni Colliery Mining reviews and aligns the previous financial provisions with GN R1147 and continues to do so on an annual basis.

In terms of the time within which the first review and alignment must take place the transitional arrangement under regulation 17(5) further states that:
"A holder must –

(a) within three months of its financial year end following the coming into effect of these Regulations and annually thereafter; or

(b) within 15 months after the coming into effect of these Regulations and annually thereafter;

ensure that a review, assessment and adjustment of the financial provision is conducted in accordance with regulation 11 of these Regulations, read with the necessary changes, and submit an updated financial provision, including the

plans and report contemplated in regulation 11(1), a copy of the independent auditor's reports and proof of payment or arrangements to provide the financial provision for approval by the Minister responsible for mineral resources, which updated financial provision must be included in—

- **i) any audit required in terms of an environmental authorisation issued in terms of the Act; and**
- **ii) any amendment of an environmental management programme to be submitted in terms of the Environmental Impact Assessment Regulations, 2014" (own emphasis).**

This document comprises the final rehabilitation plan for the Ndanganeni Colliery mine and contains all the required information as per Appendix 4 of the NEMA regulations. This plan should be read in conjunction with the Annual Rehabilitation Plan and the Environmental Risk Assessment Report.

3. Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)

The Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) was enacted to make provision for equitable access to and sustainable development of South Africa's mineral and petroleum resources; and to provide for matters connected therewith. The MPRDA recognises that mineral and petroleum resources are non-renewable resources yet are important resources for ensuring the continued economic growth and social upliftment of the people of South Africa. The MPRDA therefore sets out the State's obligation to protect the environment for the benefit of present and future generations, to ensure ecologically sustainable development of mineral and petroleum resources and to promote economic and social development.

As part of the commitments to protect the environment for the benefit of present and future generations and to ensure ecologically sustainable development of mineral and petroleum resources the MPRDA provides that all mining activities need to minimise their impacts on the surrounding environment as much as possible. This includes rehabilitation and mitigation of latent environment impacts of the site post closure of the mine.

Section 43 of the Act enforces the need for every mine to apply for a closure certificate upon completion of the activity. Section 43(1) states that:

"The holder of a prospecting right, mining right, retention permit, mining permit, or previous holder of an old order right or previous owner of works that has

ceased to exist, remains responsible for any environmental liability, pollution, ecological degradation, the pumping and treatment of extraneous water, compliance to the conditions of the environmental authorisation and the management and sustainable closure thereof, <u>until</u> the Minister has issued a closure certificate in terms of this Act to the holder or owner concerned" (<u>own emphasis</u>).

Important to note here is that the MPRDA specifically speaks to the holder of a right or permit. Even if the right or permit has ceased to exist the holder remains responsible for any environmental liability associated with their activities until a closure certificate is granted. As mentioned earlier, this is at odds with the NEMA which states that the liabilities associated with mining activities remain with the holders of the rights or permits notwithstanding the issuing of a closure certificate.

3.1. MPRDA Regulations (GN R537)

The MPRDA Regulations (GN R537 of 23 April 2004) regulate the procedures and criteria for mining related activities as set out in the MPRDA.

The MPRDA Regulations set out the principles for mine closure in Section 56 as follows:
"In accordance with applicable legislative requirements for mine closure, the holder of a prospecting right, mining right, retention permit or mining permit must ensure that -

a) **The closure of a prospecting or mining operation incorporates a process which must start at the commencement of the operation and continue throughout the life of the operation;**
b) **Risks pertaining to environmental impacts must be quantified and managed pro-actively, which includes the gathering of relevant information throughout the life of a prospecting or mining operation;**
c) **The safety and health requirements in terms of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) are complied with;**
d) **Residual and possible latent environmental impacts are identified and quantified;**
e) **The land is rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development; and**
f) **Prospecting or mining operations are closed efficiently and cost effectively".**

The Regulations also set out the procedure for applying for a closure certificate in Section 57 when a mine reaches its LoM.

4. Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA)

The Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA) was enacted to provide for the protection of the health and safety of employees and other persons at mines. The Act seeks to promote a culture of safe and healthy work environments in the South African mining sector. The Act further seeks to regulate employers' and employees' duties to identify hazards; to eliminate, control and minimise the risk to health and safety; to entrench the right to refuse to work in dangerous conditions; and to give effect to the public international law obligations of the Republic relating to mining health and safety.

According to Section 2(2) of the act the MHSA applies to the mine until a closure certificate is awarded as per Section 43 of the MPRDA:

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

This section of the act highlights that the employer of a mine remains liable for any injuries, ill-health, loss of life or damage of any kind occurring at or because of the mine until a mine closure certificate has been awarded. Not only are they liable but they must take reasonable steps to continuously prevent any of these incidents from occurring.

5. National Water Act, 1998 (Act No. 36 of 1998) (NWA)

The National Water Act, 1998 (Act No. 36 of 1998) (NWA) aims to ensure the protection and sustainable use of South Africa's water resources. The three main pillars of the NWA are sustainability, equity, and efficiency. The NWA requires that any activity which might impact on water resources apply for a Section 21 Water Use License (WUL).

The NWA also enforces the idea of the polluter pay principle. Section 19(1) of the NWA states that:

"An owner of land, a person in control of land or a person who occupies or uses the land on which –

a) any activity or process is or was performed or undertaken; or

b) any other situation exists,

which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing, or recurring."

Appendix C: Environmental Aspects

1. Geology

The investigated area falls within the 2628 East Rand 1:250 000 geology series map and is characterised by consolidated sedimentary layers of the Karoo Supergroup. The Karoo Supergroup consists mainly of sandstone, shale and coal beds of the Vryheid Formation of the Ecca Group and is underlain by the Dwyka Formation of the Karoo Supergroup. The Karoo sediments again are underlain at depth by felsitic lavas of the Selons River Formations of the Rooiberg Group. Dolerite intrusions, also previously known as diabase, occur in the form of sills and dykes throughout the area. Deposits of alluvial sand can be found in the low-lying areas around the streams.

The bigger portion of the project area is located within the Witbank Coal Field and a smaller part of project is wither the Ermelo Coal Field. Evander and High Veld Coal fields are located at about 20 km to the southwest of the project area near Bethal. The coal bearing strata are contained within the Vryheid Formation of the Ecca Group. According to historical information, and information collected from the surrounding collieries, it appears that the No.1 coal seam formed in a small, isolated basin in the west (Lemoenfontein Colliery) and a separate larger basin, containing the No. 2 coal seam, in the east. This basin extent and increases to the east and contains the Elandsfontein and Springboklaagte coal reserve, in which Elcoal and Mafube Collieries have been established.

The overburden of the 2 Seam ranges between 7.16 m and 18.66 m with an average of 15.80 m, and the inter-burden between the 2 and 1 Seams ranges from 1.81 m and 11.33 m with an average of 4.48 m.

2. Topography

The topography in the district can be described as gently undulating with slopes lying between 3 and 10°. It is characteristic of the post-African erosion surface back-working into the African surface, which remains preserved in places on the higher lying interfluves. There are wetlands or vleis in the upper part of the valleys and many pans, which vary from insignificant vegetated depressions to large deeply etched features with bare clayey floors, all of which are characteristically present on African surface remnants. Outcropping, resistant sandstone and dolerite ridges flank the flat, marshy valley floors, which also have gentle gradients. The mining area stretches over a wide region and includes various topographical features. Several watersheds, pans, hills, and valleys are incorporated

within the mining area. These topographical features also play a role in how the coal is mined in the region.

3. Climate

Falling in a summer rainfall area, the location is predicted to receive the most precipitation in the summer months of October to March overall. November to January is predicted the highest rainfall months with between 85 mm to 107 mm predicted per month during these months. February, March, and October are predicted to receive 54 mm to 76 mm precipitation. All other months are predicted to receive less than 26 mm precipitation on average during the month.

Wind speed averages around 3.1 m/s. September to December are the windiest months and average wind gust speed ranges between 12 and 14 m/s. Average wind gust speeds for the remainder of the year range between 10 and 12 m/s. Strong winds come predominantly from the northwest and northeast; however, topography does affect wind direction in a specific location. Surface inversions occur during 80% of nights in winter and about 40% of nights in summer to a depth of 100-150 m above the surface. Nocturnal stability regularly occurs close to the ground causing stagnation and slow catabolic drift, particularly in winter. The predominant wind direction is from the northeast.

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella & Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999). The highest precipitation days are predicted during the months of October to March. During these months precipitation is predicted to only occur 13 to 22 days on average. The rest of the year precipitation is predicted to occur less than 6 days per month.

4. Land Capability

Typical soil forms found in the qrea include:

- The Clovelly soils have very shallow to shallow depth and have an apedal structure. The individual particles are coated with free iron oxides and are associated with a moist regime.
- The Hutton soils have very deep weak structured subsoils that generally exceed 1200 mm and are high potential soils.

- The Lichtenburg soils have varying depth but also have several rock outcrops which have compromised the Land Capability of this unit.
- The Avalon soils generally have moderate depth and are underlain by soft plinthite which denotes the presence of a low permeability horizon in the subsurface.
- The Fernwood soils generally have moderate depth and are found in wetlands and pans. The bleached subsoil horizon and topsoil horizon with variegated colours depicts periods of extended saturation with water.

The wetlands and pans form part of the sensitive landscapes on the property. These should be protected and should be left undisturbed and should not be impacted upon

The current land use includes that of the existing opencast operations at Nndanganeni Colliery except for the wetland and pan areas found on site.

5. Land Use

The study area is characterised by mining activities (to the east), cultivated commercial properties, settlements (mainly south), wetland and waterbodies (south, east, on site and west), grasslands, railway line (northwest), the N4 highway (immediately south), grazing land and other agricultural activities.

6. Biodiversity

6.1. Fauna and Avifauna

Unlike flora, fauna are mobile and additional surveys, including nocturnal visits and camera trapping, would result in the confirmation of additional species. The proximity of agricultural, forestry and mining activities near the site has resulted in a significant decline in larger mammals and birds in the general area.

Three species of conservation-important mammals was confirmed by the Virtual Museum records namely: the Endangered Oribi, Near-threatened Southern African Hedgehog and Near-threatened Serval. These species are likely to occur in the vicinity, but not likely on the proposed mining area, as the site has already been disturbed and heavily modified.

A flock of Greater Flamingos (Phoenicopterus roseus) was observed at larger dam (25°48’53”S, 29°40’42”E). The birds seem to be using it as a rest site. Burrows of small mammals (rodents) were also observed at this site. A detailed faunal survey is needed by a faunal specialist/s for further understanding the animal life at the HH study site.

6.2. Flora

The study area is broadly characterised as part of the Grassland Biome. This bioregion consists of 29 vegetation units. Eastern Highveld Grassland is characterised by slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by Highveld grasses (Aristida, Digitaria, Eragrotis, Themeda and Tristachya). The vegetation has small scattered rocky outcrops with sour grasses and some woody species (e.g., Acacia caffra, Celtis africana). Altitude varies from 1520-1780 masl (above sea level) (Mucina and Rutherford, 2006). The altitude at the HH study site varied from 1626-1641 masl.

7. Water

7.1. Surface water

A catchment area is usually bounded by the topographic water-divide. The catchment area is the whole of the land and water surface area contributing to the discharge at a particular stream or cross section, from which every point on a stream channel has a unique catchment of its own, the size of the catchment increasing as the control point moves downstream, reaching its maximum size when the control is at the seacoast. The study area falls within the B12C quaternary catchment. The three (3) sub basins are the Southern Block (No. 2 Seam), Northern Block (No. 2 Seam) and the Western Block (No. 1 Seam). The total surface area for the opencast is 194.67 hectares.

- Quaternary Catchment Area: B12C
- River name: Olifants River
- Management Unit: Upper Olifants

The site falls on the water divide between the Msili River and an unnamed tributary of the Klein Olifants River. Theoretically run-off which gets generated, would leave the site in the form of sheet flow into a northern non-perennial tributary of the Msili River which is situated directly east of the proposed strip-mining area, and towards southern non-perennial tributaries of the unnamed tributary of the Klein Olifants River. Both these River systems flow into a westerly direction to join the Klein-Olifants River on the Farm Erfdeel 446 JS. According to the previously compiled EMPR document (2006), the northern non-perennial tributary of the Msili River has completely been destroyed by the construction of the N4 highway.

7.2. Wetlands

The locality of the various wetland units identified on site is depicted in Figure 25. Unit 1 (Southern Pan) is earmarked for future mining. The Southern Pan has a PES Class C,

indicating a moderately modified wetland system with a moderate EIS rating. The wetland has definite hydrological functional importance with several natural services still intact. Unit 2 is the hillslope seep wetland system that has a PES Class D, indicating largely modified wetland system with a moderate EIS rating. The wetland has some hydrological functional importance with some natural services still intact.). A Farm dam (used for irrigation) also exists on the south-eastern boundary of the study area. The pan had previously been excavated to create storage capacity to supply raw water for centre pivot irrigation purposes. In addition, a berm was created through the centre of the pan to divide the pan in two halves.

7.3. Ground water

Based on information collected during the 2008 and 2015 hydro census it can be concluded that the aquifer system in the study area can be classified as a "Major Aquifer System", since the local population is dependent on groundwater. The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer, in terms of the above, is classified as medium. A Groundwater Quality Management Index of 8 was estimated for the study area from the ratings for the Aquifer System Management Classification. According to this estimate a high-level groundwater protection is required for the aquifer.

8. Air Quality

8.1. Vehicle exhaust gases

Vehicle exhausts contain several pollutants including carbon dioxide (CO2), carbon monoxide (CO), hydrocarbons, oxides of nitrogen (NOx), sulphur and PM10. Tiny amounts of poisonous trace elements such as lead, cadmium and nickel are also present. The quantity of each pollutant emitted depends upon the type and quantity of fuel used, engine size, speed of the vehicle and abatement equipment fitted. Once emitted, the pollutants are diluted and dispersed in the ambient air. Pollutant concentrations in the air can be measured or modelled and then compared with ambient air quality criteria.

8.2. Veldt fires

Veld fires are widespread across the world, occurring in autumn, winter, and early spring. In addition to controlled burning for firebreaks and veld management, many fires are set deliberately for mischievous reasons. Some are accidental, notably those started by motorists throwing cigarettes out of car windows. Emissions from veld fires are like those generated by coal and wood combustion. Whilst veld fire smoke primarily impacts visibility and landscape aesthetic quality, it also contributes to the degradation of regional scale air quality. Dry combustible material is consumed first when a fire starts. Surrounding live,

green material is dried by the large amount of heat that is released when there are veld fires, sometimes this material can also burn. The major pollutants from veld burning are particulate matter, carbon monoxide, and volatile organics. Nitrogen oxides are emitted at rates from 1 to 4 g/kg burned, depending on combustion temperatures. Emissions of sulphur oxides are negligible (USEPA, 1996).

8.3. Agricultural activities

Little information is available with respect to the emissions generated due to the growing of crops. The activities responsible for the release of particulates and gasses to atmosphere would however include:

- Particulate emissions generated due to wind erosion from exposed areas;
- Particulate emissions generated due to the mechanical action of equipment used for tilling and harvesting operations;
- Vehicle entrained dust on paved and unpaved road surfaces;
- Gaseous and particulate emissions due to fertilizer treatment; and
- Gaseous emissions due to the application of herbicides and pesticides.

8.4. Current mining activities within the project area

Mining operations like drilling, blasting, hauling, collection, and transportation are the major sources of emissions and air pollution. Coal left in the ground can catch fire, and mine fires are difficult to control, with some burning for decades or even centuries, creating a major source of air pollution. The use of explosives releases carbon monoxide (CO). Dust and coal particles stirred up during the mining process, as well as soot released during coal transport, contributes to emissions and respiratory problems. Various coal mines exist near the Ndanganeni Colliery site.

8.5. Vehicle use of the gravel road transecting the study area

Dust emissions occur when soil is being crushed by a vehicle, because of the soil moisture level being low. Vehicles used on the roads will generate PM-10 emissions throughout the area and they carry soils onto the paved roads which would increase entrainment PM-10 emissions. The quantity of dust emissions from unpaved roads varies linearly with the volume of traffic.

8.6. Power Stations within the area

The coal fired combustion process in power stations produces large quantities of gaseous and solid waste that are mainly released into the air or disposed of in large ash dumps or sludge and slurry ponds. The gaseous emissions contain a potent mixture of pollutants. Various studies have shown these pollutants to have adverse effects through air pollution

(Pope, III et al., 2009; Dominici et al., 2006; Van Horen, 1996). To add fuel to the fire, so to speak, burning coal produces one and a half times the CO2 emissions of oil combustion and twice the amount of CO2 emissions from natural gas combustion, while producing the same amount of energy (Epstein et al., 2011). This difference holds true for many other pollutants produced during the electricity generation process. With regards to solid waste, ash dumps have been found to contribute to air pollution, particularly in the form a particulate matter (PM) when fly ash from ash dumps is carried into the atmosphere by the wind.

9. Social Context

Mpumalanga province is the second smallest in size after Gauteng measuring 76 495 km2 and covering 6.3% of the land area in the country. This current land area represents a decrease in the land area as the size recorded during census 2001 was 79 487 km2. This decrease is attributed to the allocation of land to the City of Tshwane from the Victor Kanye (previously called Delmas) (Statistics SA, 2012).

Mpumalanga province is divided into four (4) district municipalities (DMs) namely Nkangala, Ehlanzeni and Gert Sibande. Nkangala DM covers 16 892km2 / 188 118 ha in area and is further composed of six local municipalities namely:

- Steve Tshwete
- Victor Khanye
- Emalahleni
- Emakhazeni
- Thembisile Hani
- Dr J S Moroka

According to the draft Spatial Development Framework (2010), Steve Tshwete local municipality is located within Nkangala DM, and measures 3 976 km2 with the municipality office being based in Middelburg. Steve Tshwete is composed of several towns and settlements namely Komati, Blinkpan, Pullen's Hope, Doornkop, Middelburg, Hendrina, Kraanspoort, Koornfontein, Rietkuil, Mhluzi, Kwa Makalane, Lesedi, Kwazamokuhle, Naledi and Presidentsrus.

The town of Pullen's Hope is situated directly to the east of the proposed mine site and is located approximately 40 km south of Middelburg and it is the 4th largest within the municipality. Pullen's Hope is also important because it serves the Hendrina Power Station which is located within its boundaries. Steve Tshwete is in a prime position as it is near the Maputo Development Corridor and the Middelburg/Bethal/Ermelo/Richards Bay

Corridor, and it also hosts the Columbus Steel factory. Additionally, Steve Tshwete is the second most urbanized local municipality at 72.1% after Emalahleni at 86.2% (IDP, 2013-2014).

Appendix D: Closure Costs

Surface Infrastructure

Mine Closure Financial Liability							
Item	**Description**	**Unit**	**BOQ Number**	**Rate Rand**	**Assumptions**	**Cost Rand**	
1	**Dismantling of processing plant and associated structures (including associated conveyors & power lines)**				***Total***	**R**	**286 452.33**
	Mobile Plant structures	**m²**	1 732	R 165.39	*Light Medium Plantstructures*	*R*	*286 452.33*
						R	**-**
2(A)	**Demolition of steel buildings and structures (including floor slabs)**				***Total***	**R**	**-**
						R	*-*
						R	*-*
2(B)	**Demolition of reinforced concrete buildings and structures**				***Total***	**R**	**-**
						R	*-*
						R	*-*
3	**Rehabilitation of access roads**				***Total***	**R**	**4 978 447.29**
	Haul Roads	**m²**	43 762	R 63.94	*Rip compacted roads, profile and vegitate*	*R*	*2 798 050.23*
	Other Roads	**m²**	45 906	R 47.50	*Rip compacted roads, profile and vegitate*	*R*	*2 180 397.06*
4(A)	**Demolition of electrified railway lines**				***Total***	**R**	**-**
						R	*-*
						R	*-*
4(B)	**Demolition and rehabilitation of non-electrified railway lines**				***Total***	**R**	**-**
						R	*-*
						R	*-*
5	**Demolition of housing and facilities (including floor slabs)**				***Total***	**R**	**870 302.42**
	Buildings	**m²**	1 736	R 473.77	*Normal one storey brick buildings*	*R*	*822 461.63*
	Weighbridge	**Item**	1	R 6 911.12	*Dismantling and removal of Weighbridge*	*R*	*6 911.12*
	Temporary Buildings	**m²**	504	R 81.21	*Removal of al temporary buildings*	*R*	*40 929.67*
12	**Fencing**				***Total***	**R**	**171 148.72**
	Fence	**m**	9 934	R 17.23	*Removal of all fencing*	*R*	*171 148.72*
						R	*-*
	Totals					**R**	**6 306 350.75**

Mining areas and Waste sites

Mine Closure Financial Liability							
Item	**Description**	**Unit**	**BOQ**	**Rate**	**Assumptions**	**Cost**	
			Number	**Rand**		**Rand**	
6	**Opencast rehabilitation (including final voids and ramps)**				***Total***	**R**	**22 844 256.36**
	Opencast area	**m³**	873 668	R 21.59	*Backfilling open voids and profilling sides*	*R*	*18 862 230.02*
	Hydroseed rehabilitated pit areas	**m²**	194 148	R 20.51	*Establishment of vegetation*	*R*	*3 982 026.34*
7	**Sealing of shafts, adits and inclines (including concrete cap)**				***Total***	**R**	**-**
						R	*-*
						R	*-*
	Totals					**R**	**22 844 256.36**

Mine Residue sites

Mine Closure Financial Liability							
Item	**Description**	**Unit**	**BOQ Number**	**Rate Rand**	**Assumptions**	**Cost Rand**	
8(A)	**Rehabilitation of overburden and spoils**				***Total***	**R**	**-**
						R	-
8(B)	**Rehabilitation of processing waste deposits and evaporation ponds (basic, salt-producing waste)**				***Total***	**R**	**-**
						R	-
						R	-
8(C)	**Rehabilitation of processing waste deposits and evaporation ponds (acidic, metal-rich waste)**				***Total***	**R**	**8 856 681.67**
	Filling the voids of water bodies	m³	259 097.00	R 21.59	*Backfilling open voids and profilling sides*	*R*	*5 593 826.50*
	Hydroseed rehabilitated voids	m²	57 577	R 20.51	*Establishment of vegetation*	*R*	*1 180 918.93*
	PCD	ha	1.06	R 164 185.35	*Removing liners and infrastructure, levelling and shapping of dam walls*	*R*	*174 036.47*
	Discard Dump	ha	5.33	R 259 075.32	*Reshape discard dump, cover with subsoil and top soil and establish vegetation on the dumps*	*R*	*1 380 871.46*
	Ripping of areas once dumps are removed	ha	35.99	R 14 643.74	Ripping of areas once dumps are removed	*R*	*527 028.31*
9	**Rehabilitation of subsided areas**				***Total***	**R**	**-**
						R	-
						R	-
13	**Water management (Separating clean and dirty water, managing polluted water and managing the impact on groundwater, including treatment, when required)**				***Total***	**R**	**647 691.00**
	Wetland construction	m²	200	R 3 238.46	*Construction of wetland at decant point*	*R*	*647 691.00*
	Totals					**R**	**9 504 372.67**

General Rehabilitation

Mine Closure Financial Liability						
Item	**Description**	**Unit**	**BOQ**	**Rate**	**Assumptions**	**Cost**
			Number	**Rand**		**Rand**
10	**General surface rehabilitation, including of all denuded areas**				**Total**	**R 9 248 745.67**
	Disturbed Areas	ha	423.80	R 16 868.25	*Ripping, Groundcover and Vegetation*	*R 7 148 763.72*
	Ground Discard areas of rehabilitation	ha	41.32	R 50 822.41	*Ripping, Groundcover and Vegetation*	*R 2 099 981.95*
	Totals					**R 9 248 745.67**

Aftercare and Maintenance

Mine Closure Financial Liability						
Item	**Description**	**Unit**	**BOQ Number**	**Rate Rand**	**Assumptions**	**Cost Rand**
5.1	**Monitoring**				***Total***	**R 1 420 000.00**
	Groundwater	year	3	R 70 000.00		*R 210 000.00*
	Surface Water	year	3	R 70 000.00		*R 210 000.00*
	Biodiversity	year	3	R 100 000.00		*R 300 000.00*
	Closure Basic Assessment	Unit	1	R 700 000.00		*R 700 000.00*
						R -
5.2	**Maintenance**					**R 1 924 723.00**
	Care& Maintenance	ha	83	R 23 242.64	***Total***	*R 1 924 723.00*
						R -
5.3	**Topsoil Management**				***Total***	**R -**
	Totals					**R 3 344 723.00**

Appendix E: Declaration of Independence

I, Jacques Harris, declare that –

- I act as the independent external assessor in this assessment;
- I have expertise in conducting Mine Closure Assessments, including knowledge of the Acts, Regulations and any guidelines that have relevance to the permit/license in question;
- I will comply with the Acts, Regulations, and all other applicable legislation;
- I will perform the work relating to the Mine Closure Assessment in an objective manner, even if this results in views and findings that are not favourable to the permit/license holder or site operator;
- I undertake to disclose to the permit/license holder or site operator and the Competent Authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the permit/license by the Competent Authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the Competent Authority, unless access to that information is protected by law, in which case it will be indicated that such information exists and will be provided to the Competent Authority;
- I will perform all obligations as expected from an external assessor in terms of the Regulations; and
- I am aware of what constitutes an offence in terms of the Acts and that a person convicted of an offence in terms of the Acts is liable to the penalties as contemplated in the Acts.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal, or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

Signature of the External Assessor

CIGroup Environmental (Pty) Ltd

Name of Company

31 October 2022

Date

Appendix F: Master Rate declaration (CIGroup uses Product Pricing Information Systems (PPIS) online service https://ppis.cloud/)

PPiS takes that step forward to ensure Contractors, Estimators and Building Professionals have building estimation software at their fingertips to move towards the future. The PPiS product suite is driven to provide professionals operating within the African construction industry with comprehensive building estimation software, giving them the full benefits of time management, cost saving, overall efficiency and embracing technology.

Each product within the PPiS family caters to a specific need for each building professional. To enhance your information search on our products and to understand how the software will benefit your business, please browse through the websites in our online portal for the respective software packages, Costabill, Billcost® and Merkel's®, while also viewing our Training courses.