



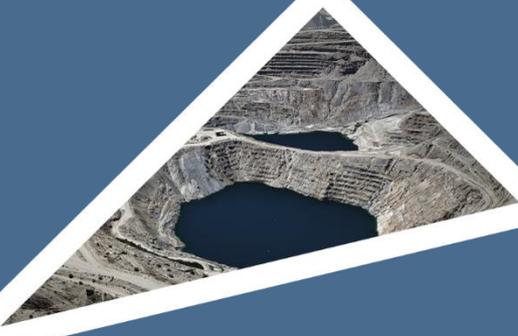
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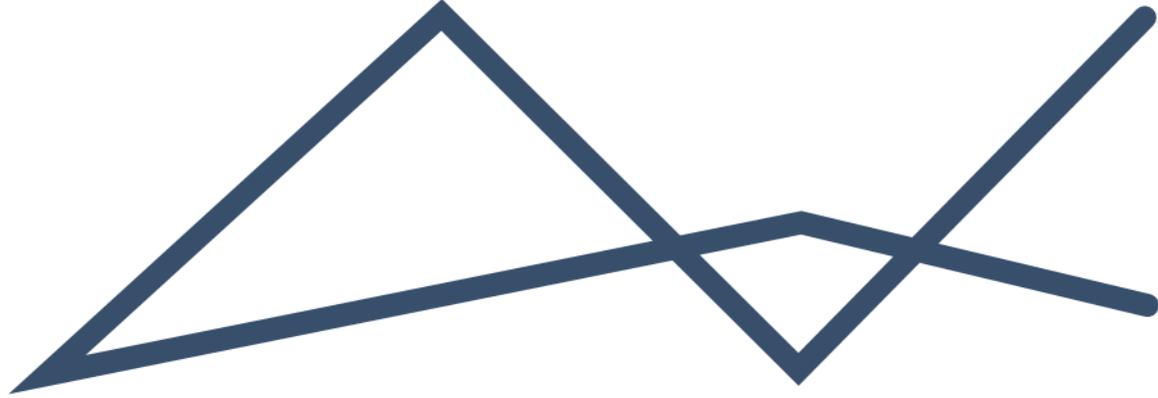
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ENVIRONMENTAL RISK REPORT

ST HELENA 10 SHAFT

FS30/5/1/2/2/86MR





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Table of Contents

1	Introduction	3
2	Legislative Context	3
3	Environmental Risk	4
3.1	Methodology for determination of environmental risk	4
3.2	Screening level environmental assessment (reg 60(a))	8
3.3	Second level risk assessment (Reg 60(b))	8
3.3.1	Groundwater Impacts	9
3.3.2	Surface Water Impacts.....	10
3.3.3	Safety Risk	11
3.3.4	Soils and Land Use Impacts.....	12
3.3.5	Methane / Explosion Risk Impacts.....	14
3.4	Mitigation required for potential significant risks (reg 60(c))	14
3.4.1	Safety Risk	14
3.4.2	Surface Water Mitigation.....	14
3.4.3	Soils and Land Use Mitigation.....	14
3.4.4	Methane Mitigation	14
3.5	Re-evaluation of uncertain risks (reg 60(d))	15
3.6	Status of insignificant risks (reg 60(e)).....	15
3.6.1	Groundwater	15
3.6.2	Soil Contamination.....	15
3.7	Alternative risk prevention or management strategies for potential significant risks (reg60(f))	16
3.8	Management measures for potential significant risks (reg 60(g)).....	16
3.8.1	Soil and Land Use Management	16
3.8.2	Surface Water	16



List of Tables

Table 1: Criteria for Determining Impact Consequence	5
Table 2: Probability Scoring	5
Table 3: Determination of Environmental Risk.....	6
Table 4: Significance Classes	6
Table 5: Criteria for Determining Prioritisation	6
Table 6: Determination of Prioritisation Factor.....	7
Table 7: Final Environmental Significance Rating	8



1 INTRODUCTION

Environmental Impact Management Services (Pty) Ltd (EIMS) was appointed by Harmony Gold Mining Company Limited (Harmony) to undertake draft a Closure Plan as part of a closure application of the Harmony St Helena 10 Shaft. Harmony has embarked on a rehabilitation programme since 2011 and to date, 38 shafts have been rehabilitated and this includes the St Helena 10 shaft which falls under the FS/30/5/1/2/2/86 Mining Right (FS86MR). Demolition work at St Helena 10 was started in 2014 and was completed in early 2017. All concrete bases have been removed from site with only the waste rock dump remaining. The shaft has been filled to surface and a temporary plug has been installed to prevent illegal access to underground working. In terms of the MPRDA, Section 43 (4), an application for a closure certificate must be made to the Regional Manager and must be accompanied by the required information, programmes, plans and reports prescribed in terms of MPRDA and NEMA, as amended. An Environmental Risk Report is required to be submitted as part of the Closure Application.

2 LEGISLATIVE CONTEXT

The risk assessment report is submitted as part of the application for a closure certificate as stipulated in Regulation 57 (1) of the MPRDA. In this regard the closure application requires that the environmental risk report must comply with the requirements of Regulation 60.

Regulation 60: Environmental risk report.

"An application for a closure certificate must be accompanied by an environmental risk report which must include-

- (a) The undertaking of a screening level environmental risk assessment where-*
 - (i) all possible environmental risks are identified, including those which appear to be insignificant;*
 - (ii) the process is based on the input from existing data;*
 - (iii) the issues that are considered are qualitatively ranked as –*
 - (aa) a potential significant risk; and/or*
 - (bb) a uncertain risk; and/or*
 - (cc) an insignificant risk.*
- (b) the undertaking of a second level risk assessment on issues classified as potential significant risks where-*
 - (i) appropriate sampling, data collection and monitoring be carried out;*
 - (ii) more realistic assumptions and actual measurements be made; and*
 - (iii) a more quantitative risk assessment is undertaken, again classifying issues as posing a potential significant risk or insignificant risk.*
- (c) assessing whether issues classified as posing potential significant risks are acceptable without further mitigation;*
- (d) issues classified as uncertain risks be re-evaluated and re-classified as either posing potential significant risks or insignificant risks;*
- (e) documenting the status of insignificant risks and agree with interested and affected persons;*



- (f) *identifying alternative risk prevention or management strategies for potential significant risks which have been identified, quantified and qualified in the second level risk assessment;*
- (g) *agreeing on management measures to be implemented for the potential significant risks which must include-*
- (i) a description of the management measures to be applied;*
 - (ii) a predicted long-term result of the applied management measures;*
 - (iii) the residual and latent impact after successful implementation of the management measures;*
 - (iv) time frames and schedule for the implementation of the management measures;*
 - (v) responsibilities for implementation and long-term maintenance of the management measures;*
 - (vi) financial provision for long-term maintenance; and monitoring programmes to be implemented."*

3 ENVIRONMENTAL RISK

Specialist studies were undertaken to determine the environmental risk. The following studies were undertaken:

- Groundwater;
- Surface Water;
- Land Use and Agricultural Potential; and
- Soil Contamination.

The methodology for determining environmental risk is described in section 3.1 below.

3.1 METHODOLOGY FOR DETERMINATION OF ENVIRONMENTAL RISK

Risks identified during the assessment are ranked qualitatively as either potentially significant, insignificant or as uncertain risks. Any potentially significant risks are then re-evaluated in more detail during the second level risk assessment and re-classified as posing either a potential significant or insignificant risk.

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2010). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER).

The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:



$$C = \frac{(E+D+M+R)}{4} \times N$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 1.

Table 1: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site)
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per Table 2.

Table 2: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),



The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

$$ER = C \times P$$

Table 3: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
Probability						

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 4.

Table 4: Significance Classes

Environmental Risk Score	
Value	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

Impact Prioritisation:

In accordance with the requirements of Regulation 31 (2)(l) of the EIA Regulations (GNR 543), and further to the assessment criteria presented in the Section above it is necessary to assess each potentially significant impact in terms of:

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

In addition, it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision-making process.

In an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 5: Criteria for Determining Prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.



Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 11. The impact priority is therefore determined as follows:

$$\text{Priority} = \text{PR} + \text{CI} + \text{LR}$$

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to Table 6).

Table 6: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33
6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2



In order to determine the final impact significance the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 7: Final Environmental Significance Rating

Environmental Significance Rating	
Value	Description
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥10 <20	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area).

3.2 SCREENING LEVEL ENVIRONMENTAL ASSESSMENT (REG 60(A))

The screening level environmental impact assessment was conducted in order to identify all potential risks. The environmental risks identified are qualitatively ranked as potential significant risks, uncertain risks or insignificant risks in accordance with the requirements of the MPRDA for a risk assessment.

The screening level assessment was based on the following sources of information:

- Desktop assessment of available Google earth satellite imagery; and
- Findings of the site inspection undertaken as part of the final performance assessment for closure.
- Background information supplied by Harmony.

The following risks were identified from screening:

- Groundwater contamination;
- Surface water contamination;
- Soil contamination impacts;
- Agricultural potential and land use impacts; and
- Potential risk of explosion from methane gas in shaft.

3.3 SECOND LEVEL RISK ASSESSMENT (REG 60(B))

The second level risk assessment is undertaken for issues that were identified as potentially significant risks during the screening level environmental assessment. These risks are evaluated utilising the quantitative methodology described in section 3.1 and then re-classified as either insignificant or potential significant risks.



3.3.1 GROUNDWATER IMPACTS

Impact Name	Groundwater: Impacts on groundwater levels				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	1	1
Extent	2	2	Reversibility	1	1
Duration	2	2	Probability	2	2
Environmental Risk (Pre-mitigation)					-3,00
Mitigation Measures					
See Sections 3.4 & 3.6 below.					
Environmental Risk (Post-mitigation)					-3,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change. The 10 Shaft rehabilitation activities do not include any activities that will result in significant changes to groundwater yield (such as groundwater abstraction, groundwater injection, or aquifer dewatering). Minor physical changes to the aquifer flow characteristics may occur in the form of changes in soil conditions due to compaction, importation of soil from other areas, and removal of buildings and paved areas. These may result in modest changes in rainfall infiltration and hence aquifer recharge. This is likely to be insignificant since the changes will occur over a limited surface area and, since groundwater recharge is generally less than 3% of mean annual rainfall, any changes in infiltration will be negligible.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					-4,00

Impact Name	Groundwater: Impacts on groundwater quality				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	1	1
Extent	2	2	Reversibility	5	5
Duration	4	4	Probability	1	1
Environmental Risk (Pre-mitigation)					-3,00
Mitigation Measures					
See Sections 3.4 & 3.6 below.					
Environmental Risk (Post-mitigation)					-3,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change. The WRD is likely to be removed as part of the site clearing and rehabilitation activities. However, the residual impact of 70 years of seepage on the underlying groundwater quality remains.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					



Prioritisation Factor	1,33
Final Significance	-4,00

3.3.2 SURFACE WATER IMPACTS

Impact Name	Hydrological: Pollutants Entering the Surface Water Environment				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	3	1
Extent	3	3	Reversibility	3	3
Duration	4	1	Probability	4	1
Environmental Risk (Pre-mitigation)					-13,00
Mitigation Measures					
<i>See Sections 3.4 & 3.6 below.</i>					
Environmental Risk (Post-mitigation)					-2,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					-2,67

Impact Name	Hydrological: Decrease in Runoff (associated with decrease in smooth surfaces)				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	1	1
Extent	1	1	Reversibility	2	2
Duration	4	4	Probability	5	5
Environmental Risk (Pre-mitigation)					-10,00
Mitigation Measures					
<i>See Sections 3.4 & 3.6 below.</i>					
Environmental Risk (Post-mitigation)					-10,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33



Final Significance	-13,33
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Impact Name	Hydrological: Soil erosion				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	3	1
Extent	3	2	Reversibility	3	2
Duration	3	1	Probability	4	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
<i>See Sections 3.4 & 3.6 below.</i>					
Environmental Risk (Post-mitigation)					-3,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					-4,00

3.3.3 SAFETY RISK

Impact Name	Safety: Risk of Open Shaft causing injury				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	5	5
Extent	1	2	Reversibility	5	3
Duration	5	4	Probability	3	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
<i>See Sections 3.4 & 3.6 below.</i>					
Environmental Risk (Post-mitigation)					-7,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					-9,33



3.3.4 SOILS AND LAND USE IMPACTS

Impact Name	Soil: Loss of land capability after removal of all infrastructure if proposed "Grazing" land capability is not achieved				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	3	2
Extent	2	2	Reversibility	4	3
Duration	3	3	Probability	3	3
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
See Sections 3.4 & 3.6 below.					
Environmental Risk (Post-mitigation)					-7,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					-10,00

Impact Name	Soil: Change in capability - Backfilling of voids				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	3	2
Extent	2	2	Reversibility	4	3
Duration	3	3	Probability	3	3
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
See Sections 3.4 & 3.6 below.					
Environmental Risk (Post-mitigation)					-7,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					-10,00



Impact Name	Soil: Loss of land capability - Reseeding				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	1	Magnitude	1	4
Extent	3	2	Reversibility	2	1
Duration	2	2	Probability	1	3
Environmental Risk (Pre-mitigation)					-2,00
Mitigation Measures					
See Sections 3.4 & 3.6 below.					
Environmental Risk (Post-mitigation)					6,75
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					9,00

Impact Name	Soil: Loss of land capability - ripping of compacted areas				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	1	Magnitude	1	3
Extent	1	2	Reversibility	1	1
Duration	1	2	Probability	1	3
Environmental Risk (Pre-mitigation)					-1,00
Mitigation Measures					
See Sections 3.4 & 3.6 below.					
Environmental Risk (Post-mitigation)					6,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					8,00



3.3.5 METHANE / EXPLOSION RISK IMPACTS

Impact Name	Safety: Impacts of methane - explosion risk				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature	-1	-1	Magnitude	5	4
Extent	2	2	Reversibility	5	4
Duration	5	4	Probability	3	3
Environmental Risk (Pre-mitigation)					-12,75
Mitigation Measures					
<i>See Sections 3.4 & 3.6 below.</i>					
Environmental Risk (Post-mitigation)					-10,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,33
Final Significance					-14,00

3.4 MITIGATION REQUIRED FOR POTENTIAL SIGNIFICANT RISKS (REG 60(C))

Following the second level risk assessment, there were several risks that were ranked as potential significant risks. Mitigation measures for significant risks are discussed in the sections that follow.

3.4.1 SAFETY RISK

The shaft must be correctly sealed with a properly engineered cap to prevent access.

3.4.2 SURFACE WATER MITIGATION

No specific mitigation is required however the management measures identified in Section 3.8 must be implemented.

3.4.3 SOILS AND LAND USE MITIGATION

Remaining infrastructure units on site must be demolished and removed. All hazardous materials should be assessed by a specialist to ensure that suitable recommendations are made for the safe removal thereof, this includes waste material. All shafts should be backfilled according to the DMR specifications and cleared to be safe for rehabilitation thereof to take place. All foundations must be covered by approximately 300mm of topsoil similar to that of the surrounding environment. If no topsoil is available, the area should be ripped to allow vegetation to re-establish itself. The physical properties and chemical properties thereof should be similar to reference conditions and even improved on to ensure sustainable development.

3.4.4 METHANE MITIGATION

. Hourly monitoring of methane levels during backfilling and rehabilitation is required to ensure safety.



3.5 RE-EVALUATION OF UNCERTAIN RISKS (REG 60(D))

No uncertain risks were identified. As such there was no re-evaluation of uncertain risks.

3.6 STATUS OF INSIGNIFICANT RISKS (REG 60(E))

The following section provides the status and recommendations regarding risks identified as being of negligible significance:

3.6.1 GROUNDWATER

No significant impacts on groundwater levels are expected from the decommissioning activities. Therefore, the assessed significance class of the impact is low, no mitigations are required, and the impact with mitigation remains low.

Regarding groundwater quality, the long-term impact of the 10 Shaft Waste Rock Dump (WRD) has been modelled under the assumption that it is a conservative proxy for potentially groundwater contaminating activities associated with the 10 Shaft decommissioning, including hydrocarbon spillages and seepage from the WRD. The model results have indicated that the current groundwater impact from the WRD is indistinguishable from background groundwater quality, which is extensively contaminated by the tailings dam to the immediate east of the St Helena 10 site. Further, removing the WRD source, one outcome of shaft decommissioning activities, results in a low level (as indicated from the modelled distribution of sulphate concentrations) of offsite groundwater impact. This is true for both the inferred groundwater flow directions: west and south. The above model results are assumed to hold valid for hydrocarbon spillages, as these are expected to be low volume and short duration. Therefore, the post-decommissioning distribution of the sulphate contamination from the WRD is indicative of the potential distribution of hydrocarbon-contaminated groundwater. In fact, hydrocarbons are significantly retarded in groundwater due to biodegradation and physical impedance in the aquifer. The impact assessment methodology indicated that the 10 Shaft decommissioning activities would have “low” category impacts on groundwater levels and quality.

Quarterly measurement of groundwater levels and monitoring reports is recommended to ensure no significant residual groundwater impacts. The groundwater monitoring results should be periodically evaluated by an experienced hydrogeologist (who is registered with the South African National Council for Natural Scientific Professions) to provide an opinion on the status of groundwater at the site and the need for further monitoring.

Although no groundwater impacts are expected, it is recommended that the shaft be properly sealed and capped to prevent the vertical migration of any groundwater located in the shaft into the Karoo aquifer. The plug must be constructed in the shaft 3.0 metres below surface. The plugs will be designed by a professional engineer in accordance to the DMR Shaft sealing guidelines.

3.6.2 SOIL CONTAMINATION

The environmental significance rating for contaminated land is classified as low, and no detrimental environmental effects with regards to contaminated land are expected. Copper minimally exceeds the SSV1 Soils Screening Values (land uses protective of the water resources) and protection of ecosystem health values at three of the sampled sites. Copper naturally occurs within the environment at an average amount of 50 parts per million (ppm) but could also occur because of anthropogenic activities such as mining, industries that smelt and refine copper for productional use, combustion of fossil fuels and it is widely used in agricultural practices. Copper can enter the air because of combustion of fossil fuels and it usually ends up in soils as it settles after a rainfall event.

With regards to the minimal exceedance of copper only and the localised distribution of the contaminant at this site no noticeable impact on the environment is expected. No other contaminants were present. When considering the above together with the impact assessment done regarding contaminated land, the impact is unlikely to result in irreplaceable loss of resources. Thus, no rehabilitation recommendations are made with regards to contaminated land.



3.7 ALTERNATIVE RISK PREVENTION OR MANAGEMENT STRATEGIES FOR POTENTIAL SIGNIFICANT RISKS (REG60(F))

Mitigation for significant risks is provided in section 3.4. Management measures for significant risks are provided in Section 3.8 below. No alternative risk prevention strategies were identified.

3.8 MANAGEMENT MEASURES FOR POTENTIAL SIGNIFICANT RISKS (REG 60(G))

Management measures for significant risks are provided below:

3.8.1 SOIL AND LAND USE MANAGEMENT

After the removal of waste material on site, the rehabilitation process should start. A rehabilitation plan has been set-up to ensure that the disturbed area be restored, as far as practically possible, to the conditions prior to the construction and operation of the St Helena Shaft. A fertility assessment should then be undertaken specifically on the currently disturbed/mining (which then will be rehabilitated) area and compared to the reference conditions. The fertility assessment can only be undertaken in the mining area after decommissioning, backfilling and rehabilitation of the project area. Only after these phases will there be a rehabilitated soil form worth sampling. Additionally, fertility can only be tested once all mining activities has ceased and the WRD has been removed from site. By acquiring information about fertility whilst the mining activities still commence means that reference conditions might change, which would account for a vital flaw. The reference land capability should be achieved and similar soil physical and chemical properties to the reference conditions should be achieved during the rehabilitation plan. The land capability of the surrounding environment has been determined to be "Arable." However, given the land potential level, severe limitations for arable land exist due to climate restrictions. Therefore, it is the specialist's opinion that "Grazing" land capability rather be favoured.

3.8.2 SURFACE WATER

The majority of the site's previous surface infrastructure has been removed with subsequent rehabilitation. These rehabilitated areas are considered clean areas for the purposes of this SWMP (assuming adequate rehabilitation), and no storm water infrastructure is proposed for their management. The only dirty area on site is the currently operational waste rock dump and mine shaft (currently being backfilled) for which containment is required with regards to storm water. Two open reservoirs are noted as being present within the area of works (site) according to the 1:50,000 topographical map data, although only the open reservoir to the south remains (as the northern one has been rehabilitated). The southern 'open reservoir' as illustrated in Figure 4-1 in the surface water report, is not formally utilised and is not a reservoir in function, instead functioning as an informal containment area. The existence of this underutilised containment area lends itself to the storm water management of the waste rock dump and mine shaft (currently being backfilled), which are situated immediately to the east.

Current rehabilitation of the site includes the backfilling of the mine shaft and may result in the removal of the waste rock dump. Once all infrastructure has been removed from site and ripping / revegetation has begun , the recommendations in the hydrological report with regards to the SWMP will no longer be applicable as all areas will defined as 'clean' with regards to GN704..

Lastly, a surface water monitoring programme was recommended and details for this are also included in the Closure Plan.