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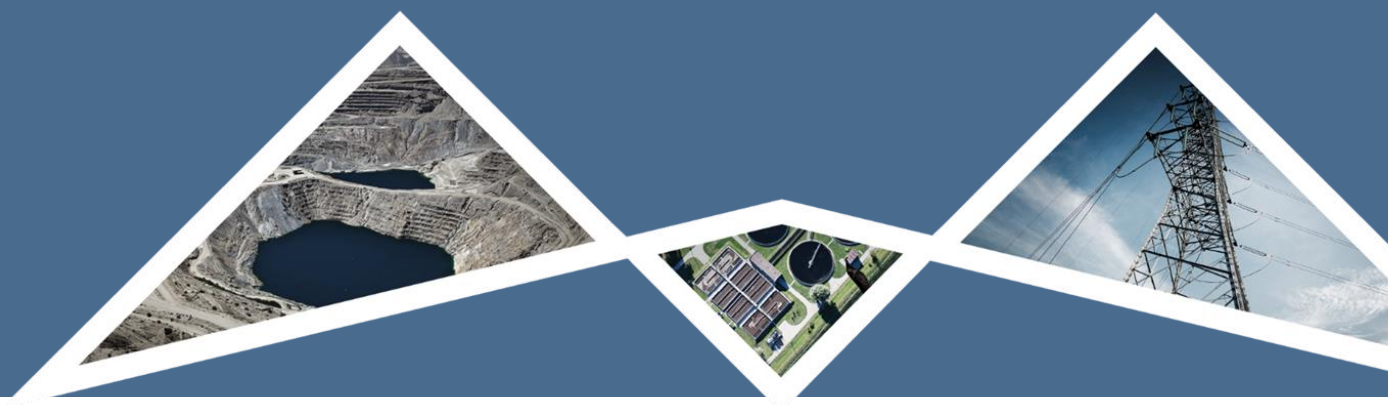
DECOMMISSIONING AND CLOSURE BASIC ASSESSMENT REPORT

HARMONY GOLD MINING COMPANY LIMITED: ST HELENA SHAFT 10

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



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mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

BASIC ASSESSMENT REPORT

And

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATION IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

PREPARED BY:

EIMS | ENVIRONMENTAL IMPACT MANAGEMENT SERVICES

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MINE REFERENCE NUMBER: FS30/5/1/2/2/86MR

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Important Notices

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of Section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of Section 17)1)(c) the Competent Authority must check whether the application has taken into account any minimum requirements applicable in instructions or guidance provided by the Competent Authority to the submission of applications.

It is therefore the instruction that the prescribed reports required in respect of application for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore, please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information requested herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the report, in order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

Objective of the Basic Assessment Process

The objective of the basic assessment process is to, through a consultative process-

a) Determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
b) Identify the alternatives considered, including the activity, location, and technology alternatives;
c) Describe the need and desirability of the proposed alternatives;
d) Through the undertaking of an impact and risk assessment process inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage, and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and the technology alternatives on these aspects to determine:
    i. The nature, significance, consequence, extent, duration, and probability of the impacts occurring to; and
    ii. The degree to which these impacts-
        (aa) Can be reversed;
        (ba) May cause irreplaceable loss of resources; and
        (ca) Can be managed, avoided or mitigated;
e) Through a ranking of the site sensitivities and possible impacts the activity and technology alternatives will impose on the sites and location identified through the life of the activity to –
    i. Identify and motivate a preferred site, activity and technology alternative;
    ii. Identify suitable measures to manage, avoid or mitigate identified impacts; and
    iii. Identify residual risks that need to be managed and monitored.

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List of Abbreviations

BAR	Basic Assessment Report
CR	Critically Endangered
DMR	Department of Mineral Sanitation
EA	Environmental Authorization
EIMS	Environmental Impact Management Services
EMPR	Environmental Management Programme
HL	Habitat Linkage
HR	Habitat Requirements
HS	Habitat Status
I&AP	Interested and Affected Parties
MPRDA	Mineral Petroleum Resources Development Act
MR	Mining Right
N/A	Not Applicable
NT	Not Threatened
PPP	Public Participation Process
SWL	Static Water Level
VU	Vulnerable
WRD	Waste Rock Dump

PART A: SCOPE OF BASIC ASSESSMENT REPORT

1 INTRODUCTION

Harmony Gold Limited has an approved Mining Right (MR) and Environmental Management Programme (EMPR) in terms of the Minerals and Petroleum Resources Development Act (Act 28 of 2002) (MPRDA) for mining of gold at Harmony St Helena Shaft 10 under FS/30/5/1/2/2/86. Harmony Gold has submitted an application for Environmental Authorisation (EA) in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) for the decommissioning and closure on the Remaining Extent of the farm Ongegund 13.

In order to undertake decommissioning and closure activities at St Helena 10 shaft, the applicant is required to submit a Basic assessment Report (BAR). Environmental Impact Management Services (Pty) Ltd. (EIMS) has been appointed by Harmony to compile the BAR (this report) which will in turn be submitted to the DMR for adjudication.

This BAR has been prepared to meet the requirements for a BAR and Environmental Management Programme (EMPR) as stipulated in the 2014 EIA Regulations (as amended) promulgated under the NEMA. The adjudicating authority for this application will be the Department of Mineral Resources (DMR), and this report has been compiled in accordance with the applicable DMR guidelines and reporting template.

The St. Helena Shafts were one of the first gold mining operations established on the outskirts of the town of Welkom in the Free State Province. The Harmony Gold St Helena Shaft 10 is situated south of Welkom, immediately east of the R30, in the Free State Province, South Africa. The St Helena 10 shaft was not formally operational, and no old bearing material was mined from it and decommissioning started in 2015. It falls under the Majhabeng Local Municipality, situated in the Lejweleputswa District Municipality.

The BAR will be made available to Interested and Affected Parties (I&AP's) for comment from a 30 day review period. All comments received from the start of the registration period to have been will be included and submitted to the DMR in the Final Basic Assessment Report.

1.1 REPORT STRUCTURE

This report has been compiled in accordance with the 2014 NEMA EIA Regulations (as amended). The report also includes the requirements from the regulations for the BAR and the EMPR. A summary of the report structure, and the specific sections that correspond to the applicable regulations, is provided in Table 1 below.

Table 1: Report Structure

Environmental Regulation	Description	Section in Report
NEMA Regulation 982 (2014)		
Appendix 1(3)(a):	Details of – (i) The EAP who prepared the report; and (ii) The expertise of the EAP, including a curriculum vitae;	Section 1.2 Section 1.3
Appendix 1(3)(b):	The location of the activity, including: (i) The 21 digit surveyor General code of each cadastral land parcel; (ii) Where available, the physical address and farm name; and (iii) Where the required information in terms (i) and (ii) is not available, the coordinates of the boundary of the property or property or properties;	Section 1.4 Section 1.5
Appendix 1(3)(c):	A plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is – (i) A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; (ii) On land where the property has not been defined, the coordinates within which the activity is to be undertaken;	Section 1.5
Appendix 1(3)(d):	A description of the scope of the proposed activity, including – (i) All listed and specified activities triggered and being applied for; and (ii) A description of the activities to be undertaken including associated structures and infrastructure;	Section 2 Section 2.1 Section 2.2
Appendix 1(3)(e):	A description of the policy and legislative context within which the development is proposed including – (i) An identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks, and instruments that are applicable to this activity and have been considered in the preparation of the report; and (ii) How the proposed activity complies with and responds to the legislation and policy context plans, guidelines, tools frameworks, and instruments;	Section 3
Appendix 1(3)(f):	A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred location;	Section 4

Environmental Regulation	Description	Section in Report	
Appendix 1(3)(g):	A motivation for the preferred site, activity and technology alternative;	Section 5	
Appendix 1(3)(h):	A full description of the process followed to reach the proposed alternative within the site, including:	i	Section 6
	(i) Details of all the alternatives considered;	ii	Section 6.1
	(ii) Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	iii	Section 6.2
	(iii) A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	iv	Section 6.3
	(iv) The environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage, and cultural aspects;	v	Section 6.4
	(v) The impacts and risks identified for each alternative including the nature, significance, consequence, extent, duration, and probability of the impacts, including the degree to which these impacts – (aa) Can be reversed; (bb) May cause irreplaceable loss of resources; and (cc) Can be avoided, managed or mitigated;	vi	Section 6.5
		vii	Section 6.6
	(vi) The methodology used in determining and ranking the nature, significance, consequences, extent duration and probability of potential environmental impacts and risks associated with the alternatives;	viii	Section 6.7
	(vii) Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological social, economic, heritage and cultural aspects;	ix	Section 6.8
		x	Section 6.9
	(viii) The possible mitigation measures that could be applied and level of residual risk;	xi	Section 6.10
	(ix) The outcome of the site selection matrix;		
	(x) If no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and		
	(xi) A concluding statement indicating the preferred alternatives, including preferred location of the activity;		
Appendix 1(3)(i):	A full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity, including –	Section 7	
	(i) A description of all environmental issues and risks that were identified during the environmental impact assessment process; and		

Environmental Regulation	Description	Section in Report
	(ii) An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	
Appendix 1(3)(j):	An assessment of each identified potentially significant impact and risk, including – (i) Cumulative impacts; (ii) The nature, significance and consequence of the impact and risk; (iii) The extent and duration of the impact and risk; (iv) The probability of the impact and risk occurring; (v) The degree to which the impact and risk can be reversed; (vi) The degree to which the impact and risk may cause irreplaceable loss of resources; and (vii) The degree to which the impact and risk can be mitigated;	Section 8
Appendix 1(3)(k):	Where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final report;	Section 9
Appendix 1(3)(l):	An environmental impact statement which contains – (i) A summary of the key findings of the environmental impact assessment; (ii) A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicting any areas that should be avoided, including buffers; and (iii) A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	Section 10
Appendix 1(3)(m):	Based on the assessment, and where applicable, impact management measures from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPR;	Section 11
Appendix 1(3)(n):	Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorization;	Section 12
Appendix 1(3)(o):	A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	Section 13
Appendix 1(3)(p):	A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	Section 14
Appendix 1(3)(q):	Where the proposed activity does not include operational aspects, the period for which the environmental authorization is required, and the date on which the activity will be concluded, and the post construction monitoring requirements finalized;	Section 15

Environmental Regulation	Description	Section in Report
Appendix 1(3)(r):	An undertaking under oath or affirmation by the EAP in relation to: (i) The correctness of the information provided in the reports; (ii) The inclusion of comments and inputs from stakeholders and I&Ps; (iii) The inclusion of inputs and recommendations from the specialist reports where relevant; and (iv) Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties;	Section 16 Section 27
Appendix 1(3)(s):	Where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	Section 17
Appendix 1(3)(t):	Any specific information that may be required by the competent authority; and	Section 18
Appendix 1(3)(u):	Any other matters required in terms of section 24(4)(a) and (b) of the Act.	Section 19
Appendix 4(1)(1)(a):	Details of – (i) The EAP who prepared the EMPR; and (ii) The expertise of that EAP to prepare an EMPR, including a curriculum vitae;	Section 20.1
Appendix 4(1)(1)(b):	A detailed description of the aspects of the activity that are covered by the EMPR as identified by the project description;	Section 20.2
Appendix 4(1)(1)(c):	A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers;	Section 20.3
Appendix 4(1)(1)(d):	A description of the impact management objectives, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified though the environmental impact assessment process for all phases of the development including – (i) Planning and design; (ii) Pre-construction activities; (iii) Construction activities; (iv) Rehabilitation of the environment after construction and where applicable post closure; and (v) Where relevant, operation activities;	Section 21
Appendix 4(1)(1)(e):	A description and identification of impact management outcomes required for the aspects contemplated in paragraph (d);	Section 21.5
Appendix 4(1)(1)(f):	A description of proposed impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (d) and (e) will be achieved, and must, where applicable, include actions to –	Section 0

Environmental Regulation	Description	Section in Report
	(i) Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; (ii) Comply with any prescribed environmental management standards or practices; (iii) Comply with any applicable provisions of the ac regarding closure, where applicable; and (iv) Comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable;	
Appendix 4(1)(1)(g):	The method of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Section 23
Appendix 4(1)(1)(h):	The frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f);	Section 23
Appendix 4(1)(1)(i):	An indication of the persons who will be responsible for the implementation of the impact management actions;	Section 23
Appendix 4(1)(1)(j):	The time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	Section 23
Appendix 4(1)(1)(k):	The mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f);	Section 23
Appendix 4(1)(1)(l):	A program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	Section 24
Appendix 4(1)(1)(m):	An environmental awareness plan describing the manner in which – (i) The applicant intends to inform his or her employees of any environmental risk which may result from their work; and (ii) Risks must be dealt with in order to avoid pollution or the degradation of the environment; and	Section 25
Appendix 4(1)(1)(n):	Any specific information that may be required by the competent authority.	N/A at this stage

1.2 DETAILS OF THE EAP

Name of the Practitioner: John von Mayer

Tel No.: 011 789 7170

Fax No.: 011 787 9059

E-mail Address: john@eims.co.za

1.3 EXPERTISE OF THE EAP

1.3.1 QUALIFICATIONS OF THE EAP

In terms of Regulation 13 of the 2014 EIA Regulations (Government Notice R. 982), an independent Environmental Assessment Practitioner (EAP), must be appointed by the applicant to manage the application. EIMS has been appointed by the Applicant as the EAP and is compliant with the definition of an EAP as defined in Regulations 1 and 13 of the EIA Regulations and Section 1 of the NEMA. This includes, inter alia, the requirement that EIMS is:

1. Objective and independent;
2. Has expertise in conducting EIA's;
3. Comply with the NEMA, the Regulations and all other applicable legislation;
4. Takes into account all relevant factors relating to the application; and
5. Provides full disclosure to the applicant and the relevant environmental authority.

John von Mayer is a registered Professional Natural Scientist who holds a Bachelor of Science Honours degree and has ten years' experience in the environmental field. His main focus is on environmental impact assessments, environmental management programmes, environmental compliance and monitoring, the identification of environmental management solutions and mitigation/risk minimising measures as well as providing technical input for projects in the environmental management field. He has been involved as an EAP in a number of large-scale infrastructure and mining projects and EIAs throughout South Africa.

The declaration of independence of the EAP and the Curriculum Vitae (indicating the experience with environmental impact assessment and relevant application processes) of the consultants that were involved in the BAR process and the compilation of this report are attached as Appendix A.

1.3.2 SUMMARY OF THE EAP'S PAST EXPERIENCE

EIMS is a private and independent environmental management-consulting firm that was founded in 1993. EIMS has in excess of 20 years' experience in conducting EIAs, including many EIA's for mines and mining related projects. Please refer to the EIMS website (www.eims.co.za) for examples of EIA documentation currently available. EIMS has completed Closure Plans and Closure Applications previously for similar projects in various parts of the country. The details of selected project are provided below:

- Closure Plan, Risk Assessment & Performance Assessment for the closure of a mining permit for Royal Bafokeng, North West Province;
- Transnet Borrow Pit Closure: Closure Plan, Risk Assessment and Performance Assessment; Free State Province;
- Eskom Kragbron closure of an existing Asbestos Containing Waste (ACW) disposal site; and
- Closure Application for the Molopo-Evander Exploration Right, Mpumalanga Province.

John has experience in many large EIAs including the following projects:

- Environmental Impact Assessment for the Hopefield Wind Energy Facility, Western Cape Province;
- Environmental Impact Assessment for a Wind Energy Facility near Cookhouse, Eastern Cape Province;
- Environmental Impact Assessment for Vlakvarkfontein Coal Mine, Mpumalanga Province;

- Environmental Impact Assessments for the Amakhala Emoyeni Wind Energy Facilities near Bedford, Eastern Cape Province;
- Environmental Impact Assessment and Management Plan for 200km of Eskom Transmission Lines in Limpopo Province: Mokopane Integration Project;
- Environmental Impact Assessment and Management Plan for Tsitsikamma Community Wind Energy Facility in the Eastern Cape Province; and
- Integrated Environmental Impact Assessment and Management Plan for Tshivhaso Coal Fired power Plant near Lephalale.

1.4 LOCATION OF THE ACTIVITY

The table below indicates the farm portions that fall within the Closing and Decommissioning Area.

Table 2: Locality Details

Farm	**RE of Ongegund**
Application Area (Ha)	~27.2 Ha
Magisterial district	Majhabeng Local Municipality within Lejweleputswa District Municipality
Distance and direction from nearest town	Welkom - 8km North; Odendaalsrus - 14km North; Theunissen - 47km South; Virginia - 19km South-East; Kroonstad - 65km North-East; and Wesselbron - 38km North-West
21 Digit surveyor general code for each farm portion	F03500000000001300000

1.5 LOCALITY MAP

The locality and extent of the St Helena 10 Shaft decommissioning and closure area is presented in Figure 1 below.

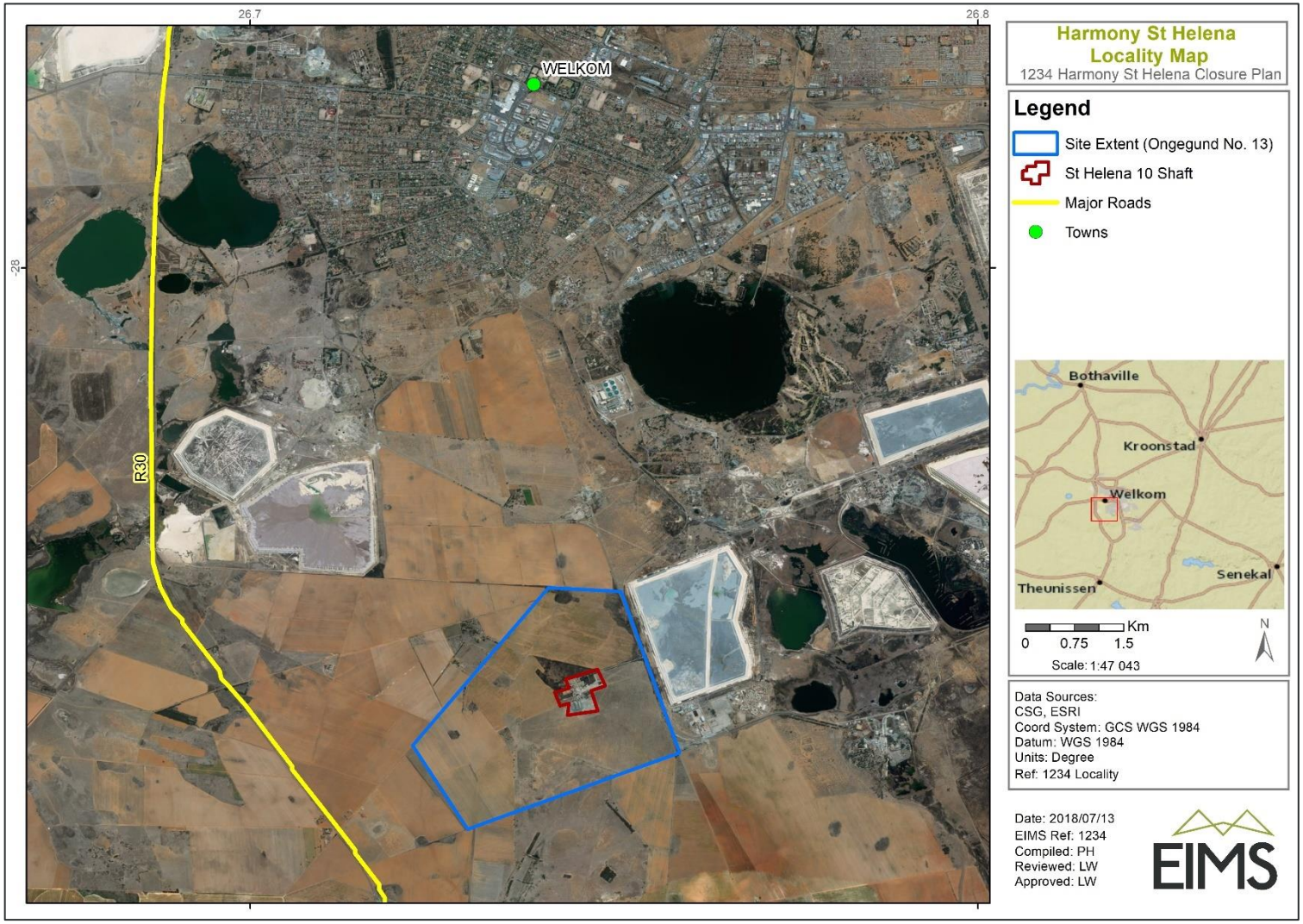

Figure 1: Locality Map indicating the location of the Harmony St Helena Shaft 10.

2 DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

Harmony Gold proposes to decommission and close the St Helena 10 Shaft, which occurs on portion RE of the farm Ongegund 13 within the Lejweleputswa District Municipality. Harmony has an approved MR (FS 30/5/1/2/2/86 MR) and an EMPR in terms of the MPRDA for the gold mining operation at Harmony St Helena Shaft 10. The proposed decommissioning and closure will involve limited, short-term invasive processes on the site. 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.

2.1 LISTED AND SPECIFIED ACTIVITIES

The activities triggered by the closure and decommissioning of St Helena shaft 10 is listed in the table below.

Table 3: Listed and Specified Activities

Name of Activity	Aerial Extent of Activity (Ha or m^2)	Listed Activity	Applicable Listing Notice
Decommissioning and closure activities associated with St Helena Shaft 10	~27.2 Ha	X	GN983 Activity 22

2.2 DESCRIPTION OF THE ACTIVITIES TO BE UNDERTAKEN

Due to the nature of the proposed decommissioning and closure of the Harmony St Helena Shaft 10, the low invasive work that will take place during decommission and closure will be limited and short-term. Even though no new development will be undertaken on the affected portions

The planned short-term invasive activities consist of the following:

- The removal of the remainder Waste Rock Dump (WRD);
- Backfilling of the St Helena 10 Shaft (132m^2);
- Removal of all concrete foundations, oil and water separator(s) and storm water/culverts; and
- Continue the application of the rehabilitation plan.

3 POLICY AND LEGISLATIVE CONTEXT

Table 4 presents the legislation and guidelines applicable to the closure and decommissioning activities associated with St Helena Shaft 10.

Table 4: Policy and Legislative Context

Applicable Legislation and Guidelines	Reference Where Applied (i.e. where in this document has it been explained how the development complies with and responds to the legislation and policy context)	How does this Development Comply with and Respond to the Legislation and Policy Context
National Environmental Management Act (NEMA): **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 (Refer to Appendix E).**	This entire report is prepared as part of the Application for Environmental Authorization under NEMA.	In terms of NEMA an Application for Environmental Authorization subject to a Basic Assessment Process has been applied for.
Mineral and Petroleum Resources Development Act (MPRDA): **43(3) 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, or the person contemplated in subsection (2), as the case may be, must apply for a closure certificate upon-** **(a) the lapsing, abandonment or cancellation of the right or permit in question;** **(b) cessation of the prospecting or mining operation;**	The report is submitted in support of application for Closure in terms of the MPRDA	A closure certificate is being applied for in terms of the MPRDA.

Applicable Legislation and Guidelines	Reference Where Applied (i.e. where in this document has it been explained how the development complies with and responds to the legislation and policy context)	How does this Development Comply with and Respond to the Legislation and Policy Context
(c) the relinquishment of any portion of the prospecting of the land to which a right, permit or permission relate; or **(d) completion of the prescribed closing plan to which a right, permit or permission relate.** **An application for a closure certificate must be made to the Regional Manager in whose region the land in question is situated within 180 days of the occurrence of the lapsing, abandonment, cancellation, cessation, relinquishment or completion contemplated in subsection (3) and must be accompanied by the required information, programmes, plans and reports prescribed in terms of this Act and the National Environmental Management Act, 1998.**		

4 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES

A methane pocket below ground resulted in an explosion, therefore, due to safety reasons the mine would like to decommission and close the St Helena 10 shaft. No formal mining actually occurred at the site due to the methane explosion during the commissioning phase of the shaft. All mining activities at the shaft have ceased. All standing (i.e buildings) infrastructure have already been demolished on site and all concrete bases have been removed. The shaft has been filled to the surface. On completion of closure the rehabilitation phase can be initiated and the land can be returned to a suitable reference land use and capability.

5 MOTIVATION FOR THE OVERALL PREFERRED SITE, ACTIVITIES AND TECHNOLOGY

During decommissioning and closure of the Harmony St Helena 10 Shaft, no alternative sites are applicable i.e. because it is an existing site. No alternative activities are investigated either because closure is the only reasonable option given the safety and environmental concerns. However, alternatives regarding mitigating the safety risk of underground methane pockets are discussed in detail in Section 6.1.4.

6 FULL DESCRIPTION OF THE PROCESS FOLLOWED TO REACH THE PROPOSED PREFERRED ALTERNATIVES WITHIN THE SITE

6.1 DETAILS OF DEVELOPMENT FOOTPRINT ALTERNATIVES

There will be no development footprint due to the low and short-term invasive nature of the project. The closure of the existing St Helena Shaft 10 is the primary driver in determining the location of the proposed activity. As such no assessment of alternative development footprint scenarios was conducted.

6.1.1 PROPERTY

Due to decommissioning and closure activities specifically relating to Harmony St Helena Shaft 10, no alternative property other than Ongegund 13 can be considered.

6.1.2 TYPE OF ACTIVITY

The only available option for the Harmony St Helena 10 shaft, considering the safety concerns around the underground methane pockets, is decommissioning and closure. On completion of closure the rehabilitation phase can be initiated.

Additional activity alternatives considered:

- The alternative options for the removal of rubble (as a by-product of decommissioning) are to (a) partially bury, crush and reuse it for other operations, or (b) use it to back fill the shaft. All options are considered acceptable from an environmental perspective.
- Alternative options for rehabilitation / removal of the waste rock dump are to use the waste rock for backfilling the shaft, to reuse it in other operations (if it is not contaminated eg. road maintenance) or to leave it at its current location and reshape it to its surrounding topography. The Acid-base accounting (ABA) results indicate that the sample from the 10 Shaft waste rock dump is not acid generating and can be used to backfill the shaft. If the waste rock dump is fully utilised by contractors then the area covered by the dump will be made available for future use and no residual land use impacts will occur. The waste rock can be used for various purposes in the construction industry or for rock cladding on tailings. Additionally it can be used to backfill the shaft. All these options are considered equally acceptable from an environmental perspective.

6.1.3 DESIGN OR LAYOUT

The invasive activities that are planned are rated as minimal and over a short period of time. As such there are no design or layout alternatives to consider.

6.1.4 TECHNOLOGY ALTERNATIVES

The following technology alternatives can be considered during the decommissioning, closure and rehabilitation of the St Helena 10 Shaft:

The St Helena 10 shaft has however been filled to surface making Capture and Extraction of methane a non-feasible option, therefore the only suitable option is to install a permanent plug..

Permanent plug:

Before sealing the surface of a shaft, it is filled with boulders (or ay surrounding soil and/or non-contaminated, unused rubble. 3 – 6 metres to the surface is topped with concrete plugs that reinforced with steel rebar. The surface can or be levelled and covered with soil and planted grass. The other option is to add an additional impermeable barrier to provide a more robust plug.

The disadvantage of a permanent plug is the possibility of methane seepage into the adjacent soil beds and groundwater reservoirs as well the increased safety risk linked to the trapped methane. A solution to this will be to build a release valve into the plug that can be opened frequently to release the gas. This option, however, still increases the atmospheric methane levels which in return is potent if inhaled and highly explosive. Installing a methane breather is considered acceptable mitigation in this regard.

6.1.5 OPERATIONAL ASPECTS

No operational activities will be undertaken due to the fact that this is an application for decommissioning and closure. As such there are no operational aspect alternatives to consider

6.1.6 OPTION OF NOT IMPLEMENTING

A no go alternative refers to not implementing decommissioning and closure activities at St Helena Shaft 10 at all. A no-go alternative is not favourable due to the safety and environmental concerns the site holds if proper decommissioning and closure is not implemented. There is also a legal compliance requirement to close the shaft.

The following negative impacts may be expected if decommissioning and closure does not take place:

- The area becomes a safety risk because of open, unattended shaft;
- Soil degradation due to lack of rehabilitation;

- Loss of land use due to unmaintained infrastructure;
- The continued uncontrolled release of methane into the atmosphere;
- Possibility of illegal land occupiers and illegal miners; and
- Increased possibility of groundwater contamination.

6.2 DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOLLOWED

6.2.1 PUBLIC PARTICIPATION METHODOLOGY

The Public Participation Process (PPP) is a requirement of several pieces of South African Legislation and aims to ensure that all relevant Interested and Affected Parties (I&AP's) are consulted, involved and their opinions are taken into account and a record included in the reports submitted to Authorities. The process ensures that all stakeholders are provided this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study.

The legal landowners and other pre-identified key I&AP's were sent an initial notification letter on the 16 July 2018, disseminated via email, fax and registered mail. I&AP's were provided a period of 30 days (from the 19 July 2018 to the 28 August 2018) to register for the proposed project. All registered I&AP's will be further notified of the availability of the BAR for review and comment. All comments received during this period will be included in the Final BAR to be submitted to the Commenting Authority.

6.2.2 IDENTIFICATION OF I&AP'S

An initial I&AP database has been compiled from historic projects in the area and Windeed searches to obtain the contact details of the surrounding landowners. The I&APs referred to in the PPR include:

- Pre-identified and registered landowners and surrounding landowners;
- Pre-identified and registered key stakeholders;
- Regulatory authorities;
- Specialist interest groups; and
- All I&APs who responded to the initial notifications and requested to be registered.

Refer Appendix B for the Key Stakeholder/I&AP Database.

6.2.2.1 LIST OF AUTHORITIES IDENTIFIED AND NOTIFIED

The following, but not limited to, Government Authorities were notified of the proposed project:

- Free State Department of Agriculture, Rural Development;
- Free State Department of Economic and Small Business Development, Tourism and Environmental Affairs;
- Free State Department of Social Development;
- Free State Department of Mineral Resources;
- Free State Department of Public Work and Infrastructure;
- Free State Department of Water and Sanitation;
- National Department of Agriculture, Forestry and Fisheries;
- National Department of Environmental Affairs;
- National Department of Mineral Resources;
- National Department of Rural Development and Land Reform;
- National Department of Water and Sanitation;
- South African Heritage Resource Agency (SAHRA);
- Lejweleputswa District Municipality; and

South African National Roads Agency Limited (SANRAL).

6.2.2.2 LIST OF KEY STAKEHOLDERS IDENTIFIED AND NOTIFIED

The following stakeholders, but not limited to, were notified of the proposed project

- Groundwork;
- Free State Agriculture;
- Endangered Wildlife Trust;
- Wildlife and Environment Society of South Africa (WESSA);
- Eskom;
- Transnet SOC Limited;
- Vaal Water Management Agency;
- Birdlife South Africa; and
- Federation for a Sustainable Environment

6.2.2.3 LIST OF SURFACE RIGHTS/LAND OWNERS IDENTIFIED AND NOTIFIED

The following, landowners and adjacent landowners were identified and notified of the proposed project (refer to Table 5 and Figure 2).

Table 5: Affected and adjacent landowner details

Property	Landowner/Adjacent Landowner	Owner(s)	Company
Farm: The Prairie 93 (3)(4)(5)	Adjacent Landowner		Andre Familie Trust
Farm: Ongegund 13 (0), Farm St Helena 42 (2), Stuirmanspan 92 (1)	Adjacent Landowner	Mr Peter William Steenkamp	Freegold Joint Venture Co. (Pty) Ltd (Harmony)
Farm: St Helena 42 (3)	Adjacent Landowner	Mr Jan Andries Jacobus Bezuidenhout	St Lena Boerdery
Farm: Ongegund 13 (1)	Landowner	Mr Johan Willem Naude	-
Farm: Jonkers Rust 72(0)	Landowner	Mr Nicolaas Johannes van Dyk	-
Farm: Du Preez Leger 324 (1)	Landowner	Mr Andries Bernadus Wessels	-
Farm: Ongegund 13 (0), Farm St Helena 42 (2), Stuirmanspan 92 (1)	Landowner	Mr Frank Abbott	Freegold Joint Venture Co. (Pty) Ltd. (Harmony)

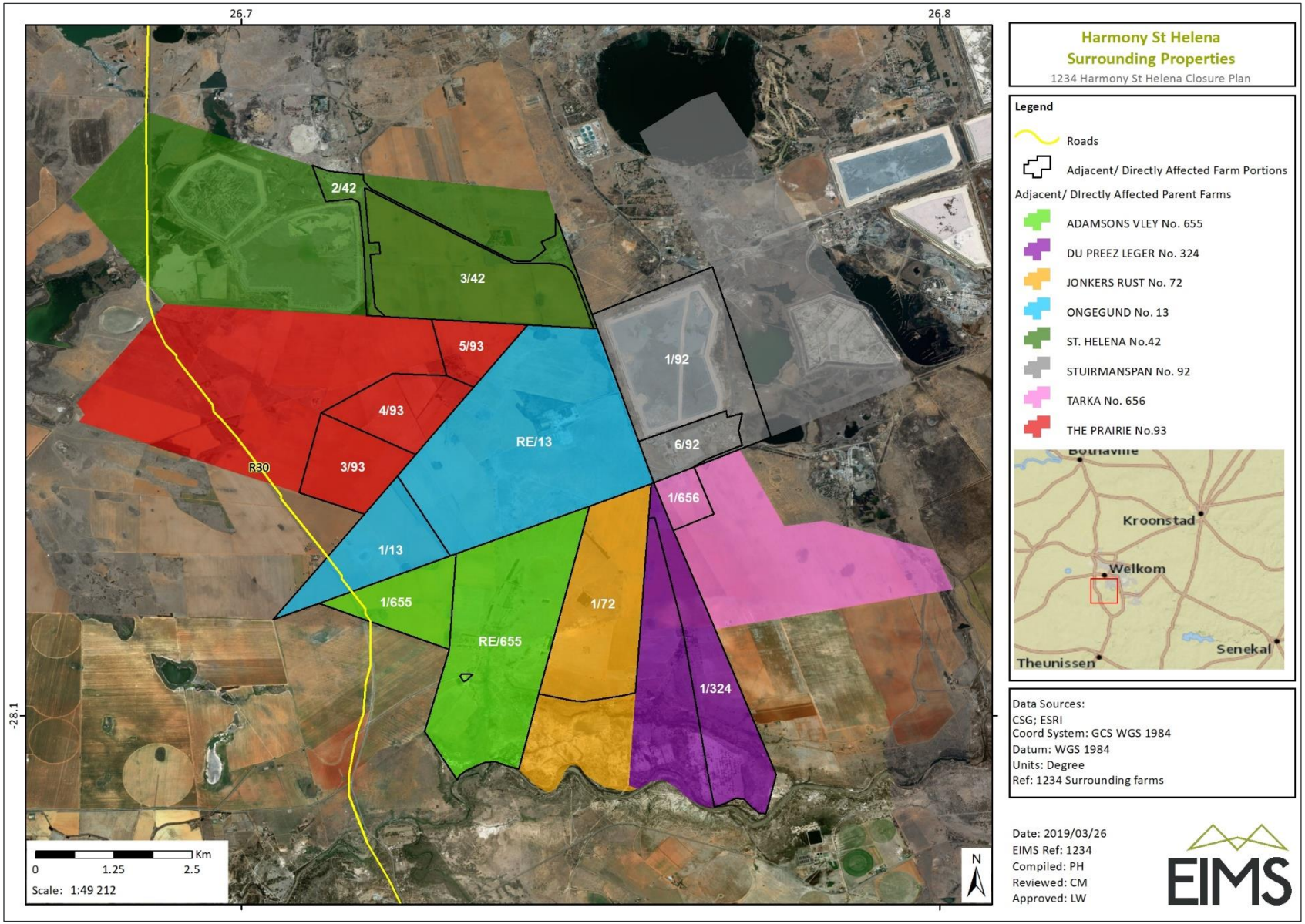

Figure 2: Affected and adjacent properties

6.2.3 NOTIFICATION OF I&AP'S

6.2.3.1 INITIAL NOTIFICATION OF LANDOWNERS AND I&APS

The PPP commenced on the 19th of July 2018 with an initial notification and call to register ending on the 28th of August 2018. Notification during this initial consultation was given in the manner described below.

6.2.3.2 REGISTERED LETTERS, FAXES AND EMAILS

Notification letters (in English and Afrikaans), faxes, and/or emails were distributed to pre-identified I&APs. Please refer to Appendix B for initial notification and proof of initial notification.

The notification documents included the following information:

- List of anticipated activities to be authorised;
- Sufficient detail of the proposed development to enable I&APs to assess/surmise what impact the development will have on them or on the use of their land;
- The purpose of the proposed project;
- Details of the application processes associated with proposed activities;
- Details of the affected properties (including a locality map);
- Details of the South African environmental legislation that must to be adhered to;
- Date by which the I&AP must register and send comments through to EIMS;
- Details of the availability of the scoping report; and
- Contact details of the EAP.

6.2.3.3 NEWSPAPER ADVERTISEMENTS

Advertisements describing the proposed project and BA process were placed in the Vista Newspaper (in English and Afrikaans) with circulation in the vicinity of the study area on the 26th of July 2018. The newspaper adverts included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

Please refer to Appendix B for proof of adverts placed.

6.2.3.4 SITE NOTICE PLACEMENT

Five (5) A1 Correx site notices (in English and Afrikaans) were placed at 5 locations along and within the perimeter of the proposed project study area on the 19th of July 2018. The on-site notices included the following information:

- Project name;
- Applicant name;
- Project location;
- Map of proposed project area;

- Project description;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

Please refer to Appendix B for proof of site notice and site notice distribution.

I&AP's were provided a period of 30 days, from the 19th July 2018 to 28th August 2018, to register as I&AP's for the proposed project. All registered I&AP's were further notified of the availability of the BAR for review and comment. The BAR will be made available for 30 days for review and comment. Comments obtained during the BAR process and the responses of the EAP to date have been included in **Table 6:** Summary of issues raised by I&AP'sTable 6 of this the BAR to be submitted to the DMR. The BAR will be resubmitted to the DMR including all comments received from the I&AP's during the review period.

6.2.3.5 PUBLIC PARTICIPATION OPEN DAYS/MEETINGS

Due to the scale of the BAR process and the low and short-term invasive nature of the decommissioning and closure activities, a public meeting is not deemed necessary for the BAR process.

6.2.4 ISSUES AND RESPONSES

The comments presented in Appendix B are those that have been received and addressed from 19th July 2018 to date and will be updated post the public review period of the BA report. All comments and/or queries received are included in this report and presented in Appendix B for submission to the competent authority, the DMR.

6.3 SUMMARY OF ISSUES RAISED BY I&AP'S

The comments and issues raised through the public participation will be considered and used to inform the compilation of the closure plan (refer to Appendix E) and this BA report. Table 6 will be updated and submitted to the DMR (the competent authority), following the 30-day public review period of the BA report and associated appendices.

Table 6: Summary of issues raised by I&AP's

Interested and Affected Parties Consulted	Date Comments Received	Issues Raised	Response to Issue	Aspect
Ms Boitumelo Melato	2018/08/17	Good day, Kindly take note that the Department of Water and Sanitation would like to be registered as an interested and affected party for this project. The Department's interest is on water and waste water management. Kindly send documentation related to the project on the following address: PO Box 528 BLOEMFONTEIN 9300 For attention: Willem Grobler	Good Afternoon Boitumelo, Thank you for your correspondence regarding the Closure project for the St. Helena Shaft 10. Kindly note that a surface and ground water specialist study will be undertaken for the project. Should you have any further comments or queries please feel free to contact me.	Registration
Mr John Geeringh	2018/07/24	Thanks for the notification, please keep me informed of the process and all related documentation.	Dear John, Thank you for your correspondence regarding the above-mentioned project. Kindly note that you will be informed of the availability of the BA report and associated appendices in due course. Should you have any further comments or queries please do not hesitate to contact me.	Receipt of notification
Ms Selina Molefi	2018/07/27	CV and documents received from Ms Molefi.	Dear Selina, Thank you for your correspondence regarding the Closure Project for the Harmony St. Helena Shaft 10. Kindly note that your CV has been passed onto the mine for their consideration. Should you have any further comments or queries please feel free to contact me.	CV received
Mr Siyabonga Sikade	2018/08/28	Good day, I hereby wish to register as an interested party with regards to the closure application process for the Harmony Mining Right FS/30/5/1/2/2/86. Therefore, would like to be forwarded with detailed information. Hope you find this in order.	Dear Mr Siyabonga, Thank you for your correspondence regarding the Closure Application for the Harmony Mining Right FS/30/5/1/2/2/86. Kindly note that as a registered I&AP you will be provided with an opportunity to review and comment on the Basic Assessment	Registration

Interested and Affected Parties Consulted	Date Comments Received	Issues Raised	Response to Issue	Aspect
			Report and associated appendices once they become available. Should you have any further comments or queries please feel free to contact me.	
Ms Mariette Liefferink	2018/07/24	Noted, with thanks.	No response was required.	
Mr Jsoeu John Sefojane	2018/08/10	Good day Cheyenne Mthukarapan Please attached our response letter. "ENVIRONMENTAL NOTIFICATION REGARDING THE CLOSURE APPLICATION FOR THE HARMONY MINING RIGHT FS/30/5/1/2/2/86 I allude to the above subject and your letter dated 24th July 2018. I hereby would like to register the Free State Department of Agriculture and Rural Development (DARD) as Interested and Affected Party (I&AP) on this project. The particulars of District representative are as follows: Name: Tsoeu John Sefojane. Email: tsoeusefojane@gmail.com Cellphone: 074 580 5505 Our main consent is on protection of valuable arable land surrounding the construction site. Please submit all correspondence in future to the above e-mail address. "	Dear Sir, Thank you for your below correspondence regarding the Closure Project for the St Helena Shaft 10. Please note that various specialist studies have been conducted for inclusion in the BA, including a soil assessment. Should you have any further comments or queries please feel free to contact me.	Arable Land
Mr Richard Roper	2018/08/27	Dear C Muthukarapan, could you please add me to the I&AP list. P.O. Box address was provided.	Dear Sir, Thank you for your correspondence regarding the Closure Project for the St. Helena Shaft 10. Kindly note that you have been added to the project database. As a registered I&AP you will be provided with the opportunity to comment on the Basic Assessment Report and associated appendices once they are made available. Should you have any further comments or queries please feel free to contact me	Registration

6.4 THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE ALTERNATIVES

6.4.1 THE BASELINE ENVIRONMENT

The following description of the baseline environmental is as it is in the current valid EMPr (Shangoni, 2009).

6.4.1.1 TYPE OF ENVIRONMENT AFFECTED BY THE PROPOSED ACTIVITY

6.4.1.1.1 GEOLOGY

The Karoo Sequence is composed of the Volksrust Shale Formation and the under lying sandstones of the Vryheid Formation which contain the Upper and Lower Coal Seams. These beds overlay the tilloids of the Dwyka Formation at the base and the Ecca and Beaufort Groups above. The Dwyka Formation consists 0m-15m thick Tillite, a glacially derived conglomerate set in shale matrix. The Ecca and Beaufort Groups (300m-400m thick) are dominated by shale with thin sandstone units within them.

The Karoo Supergroup is of the order 330 metres thick, overlying the lavas and sediments of the Ventersdorp Super group with a marked unconformity. The Ventersdorp Super group consists of the Platberg Group, 0m-760m thick, is formed by debris flow sediments, with diamictites at the base and shales above. The Kliprivierberg Group lavas (0m-300m thick) are basaltic to andersitic in composition.

In certain areas sill intrusions occurred on the plane of the reef but these are limited. Dolerite dykes and sills are common with intrusions of Kimberlite and dioritic rocks being less common. The dolerite intrusions have altered the Karoo sediments by contact metamorphism. These altered sediments have favourable water bearing characteristics. The dykes seldom have a thickness exceeding five metres, but they may have a length of several kilometres. The sills undulate at various depths with thickness which may exceed 100 metres.

The Free State Goldfield lies some 270km southwest of Johannesburg on the southwest rim of the Witwatersrand Basin. Exploration within the Free State Goldfield dates from the mid-1940s when values within the Basal Reef, the predominant economic reef in the district, were intersected. Structurally, the Free State Goldfield lies within a north-south trending syncline forming an apex in the southwestern corner of the Witwatersrand Basin. The northerly plunging syncline is roughly divided by two major faults into three major blocks: the Odendaalsrus section to the west of the De Bron fault, the Central Horst, between the De Bron and Homestead faults and the Virginia Section east of the Homestead Fault. The Central Horst was uplifted, and the Central Rand Group rocks eroded away prior to Ventersdorp time.

The Central Rand Group in the Free State comprises some 2,000m of sedimentary sequences deposited over successive unconformity surfaces in an expanding depositional area. The lack of major faulting and folding of Central Rand Group age has led to the conclusion that subtle tectonic warping of the basin with granite doming on the margins controlled deposition.

The auriferous horizons are most typically conglomeratic units deposited at the base of each depositional sequence, although they may also occur as scours within a given formation. The principal reefs mined in the Free State are the Basal Reef, the Saaiplaas Reef, the Leader Reef, the 'B' Reef, the 'A' Reef, Elsburg Reefs and the Dreyerkuil Reefs. The Basal Reef is the most extensive, continuous and economically significant reef in the Free State Province, accounting for over one-half of all of the gold produced there to date.

6.4.1.1.2 CLIMATE

St Helena is situated in the Free State Goldfields, which is a semi-arid region with an annual rainfall of between 400 mm and 600 mm. Local thunderstorms and showers are responsible for most of the precipitation during the summer, from October to March and peaking in January. Hail is sometimes associated with the thunderstorms and mainly occurs in the early summer from October to January with its highest frequency in December. More than 79% of the mean Annual Precipitation occurs in the six-month period October to March. Rainfall occurs mainly in thunderstorms and showers, with an annual average of 526mm. The summer rainfall region of the Goldfields is characterised by diurnal convectional heating, which often results in thunderstorms accompanied by lighting, heavy rain, strong winds and sometimes hail. The storms, which may occur on average 40-60 times per year, are highly localized and rainfall can vary markedly over short distances.

The annual average temperature is 17 degrees Celsius with an average maximum of 24°C, and an average minimum of 10°C. The dominant wind direction is North Easterly. The Weather Bureau has supplied information which indicates that

wind speeds of up to 17 m/s can occur (annual frequency of 4 per 100). Generally, however, wind speeds do not exceed 6m/s. The highest wind velocities (on a monthly basis) are generally associated with Westerly and North Westerly winds. The winds are seldom high over the central interior, but gust winds of more than 100 km/h associated with thunderstorms can occur. Moderate to fresh winds (30 - 50 km/h) usually occur with the passing of cold fronts. The area is known locally for dust storms with wind velocities capable of lifting the soil off the lands that have been prepared for summer crop cultivation.

6.4.1.1.3 TOPOGRAPHY

In general terms, the area is described as the Interior Plain of South Africa. According to the terrain morphological division the area is also described as plains and pans. Regionally, the area is flat to relative flat with a slope not exceeding 5%. The area has a low relief with local depressions forming pans. To the south, the Sand River traverses the area from east to west. The characteristic of the area is that of a plain with no distinguishing topographical features. No significant topographical disturbances are expected. The only areas were the topography will be affected is where the Slimes dams, Waste rock dumps and Solid waste disposal sites are situated. The area is very flat with an overall slope to the South West.

6.4.1.1.4 SOIL

According to the land type database (Land Type Survey Staff, 1972 - 2006) the project falls within the Bd20 land type. This land type consists of plinthic catena, upland duplex and margalitic soils which occur rare. Eutrophic, red soils are not widespread throughout the project area.

The geology of this area is characterised by aeolian and colluvial sand which overlies mudstone, sandstone and shale of the Karoo Supergroup. Older Ventersdorp Supergroup basement gneiss and andesite is located to the north (Mucina & Rutherford, 2006).

During the 2018 soil survey, five dominant soil forms were identified, namely an Avalon, Westleigh, Clovelly, Witbank, and Arcadia soil form. The Avalon soil form covers grazing land use areas, the Arcadia soil form covers a small portion of the grazing land use area, whereas the Clovelly soil form covers the agricultural crops and grazing land use area. The Witbank soil form is characterised by disturbed soil, which in this case is characterised by the mining land use area. The Westleigh soil form covers grazing and wetland land use areas.

Soil samples were analysed for standard fertility and textural tests. Results obtained from the lab analysis indicate possible deficiencies in the fertility of the soils in the area. These results would then be regarded as the reference conditions for soil in the vicinity. The textural classes determined during these analyses were that of sandy loam, which indicates high infiltration and a low water/nutrient holding capacity.

6.4.1.1.5 NATURAL VEGETATION

The project area falls within the Vaal-Vet Sandy Grassland vegetation type. This vegetation type is distributed throughout North-West and Free State and stretches from south of Lichtenburg to Klerksdorp, Bothaville, Leeudoringstad as well as Brandfort. The conservation status of this vegetation type is endangered with only 0.3% of it being protected within the Bloemhof Dam, Sandveld, Schoonspruit, Wolwespruit, Soetdoring and Faan Meintjes nature reserves (Mucina & Rutherford, 2006).

6.4.1.1.6 ANIMAL LIFE

The wild life in the general area on, and around the mining area has been severely impacted on by development and surrounding activities. Most of the large mammal species do not occur in the area, although the bio-diversity of the area has been boosted by the creation of artificial wetlands and other habitats associated with the mines and their infrastructure. 214 Species of bird life have been identified that could potentially occur on site. Most commonly identified animals are shown in Table 7.

Table 7: Commonly occurring small mammal species

SCIENTIFIC	COMMON NAME
Atelerix frontalis	**Hedgehog**

SCIENTIFIC	COMMON NAME
Rhinolophus Clivosus	**Geoffroys's horseshoe bat**
Eptesicus capensis	**Cape serotine bat**
Lepus capensis	**Cape Hare**
Lepus saxatilis	**Scrub hare**
Crymptomys hottentotus	**Common mole rat**
Pedetes capensis	**Springhare**
Aethomys namaquensis	**Namaqua rock mouse**
Mus minutoides	**Pygmy mouse**
Mus musculus	**House mouse**
Praomys natalensis	**Multimammate mouse**
Rattus rattus	**House rat**
Rhabdomys pumilio	**Striped mouse**
Tetera brantsii	**Highveld gerbil**
Otomys irroratus	**Vlei rat**
Canis mesomelas	**Black backed jackal**
Vulpes chama	**Cape fox**
Aonyx capensis	**Clawless Otter**
Poecilogale albinucha	**Striped weasel**
Ictonyx striatus	**Striped polecat**
Cynictis penicillata	**Yellow mongoose**
Herpestes sanguineus	**Slender mongoose**

Based on in the EMPr by Shongoni (2009), the Red Data species that may occur in the study area consist of 0 reptilian species, 0 amphibian species, 6 avian species and 7 mammal species. The habitat suitability for Red Data species is low for all species within the study sites investigated for the purposes of this report (except the Reddish-grey Musk Shrew that occurs, keeping in mind that the study took place prior to any mining construction). This is mainly due to the fact that the area is highly disturbed due to mining activities and therefore unlikely to sustain the Red Data species which are likely to occur in the region.

Red Data faunal species that may occur in the area are listed in Table 8. A total of 14 Red Data faunal species may occur in the area.

Table 8: Red Data faunal species that may occur in the study area (Shangoni, 2009).

BIOLOGICAL NAME	COMMON NAME	RED DATA STATUS	HR	HS	HL	PROBABILITY OF OCCURRENCE
Amblysomus septentrionalis	Highveld golden mole	NT	L	H	L	**Low**
Aonyx capensis	Cape clawless otter	LC	L	L	L	**Moderate**
Circus maurus	Black harrier	VU	H	L	L	**Low**
Coracias garrulous	European roller	NT	L	H	L	**Low**
Crocidura cyanea	Reddish-gray musk shrew	DD	L	H	L	**High**
Crocidura fuscomurina	Tiny musk shrew	DD	H	L	L	**Low**
Falco naumanni	Lesser kestrel	VU	L	H	L	**Low**
Falco vespertinus	Red footed falcon	NT	L	H	L	**Low**
Felis nigripes	Black footed cat	VU	L	L	L	**Low**
Geronticus calvus	Southern bald ibis	VU	H	L	L	**Low**
Grus pardisea	Blue crane	VU	H	L	L	**Low**
Gyps africanus	White backed vulture	NT	L	L	L	**Low**
Gyps coprotheres	Cape griffon	VU	L	L	L	**Moderate**
Lutra maculicollis	Speckle throated otter	LC	L	H	L	**Low**
Mystromys albicaudatus	White tailed mouse	EN	L	H	L	**Low**

Red data status: VU=Vulnerable; CR=Critically Endangered; NT=Near Threatened
Habitats: HR=Habitat Requirements; HS=Habitat Status; HL=Habitat Linkage

6.4.1.1.7 SURFACE WATER AND WETLANDS

Figure 3 illustrates the topographical and hydrological setting of the site. The site is positioned on the watershed of three quaternary catchments: C42J, C42K and C43B. An analysis of site topography undertaken in Section 4 as part of the storm water management plan (see Surface Water Study Appendix C1), reveals that the site drains to quaternary C24K (based upon SRTM30 data used). This variation from the quaternary catchments' watersheds dataset is expected since the quaternary catchments for South Africa were derived using a low level of accuracy.

The primary river in the region about the site is the Sand River. A non-perennial river has its headwaters to the south of the site. This non-perennial river captures runoff from the site (which reaches it) and conveys it to the Sand River. A few small farm dams are located on this non-perennial river as indicated by the 1:50,000 topographical map data, with two of these farm dams located within the wider boundary of the site. Non-perennial pans are also located within the wider boundary of the site. During the site visit, both the non-perennial pans and two farm dams were found to be empty.

When considering the site (i.e. the area of works) two open reservoirs are noted according to the 1:50,000 topographical map data. The rehabilitation of the site has, however, removed the northern open reservoir and only the southern open reservoir remains – the location of this reservoir is indicated in the surface water assessment. The National Freshwater Ecosystems Priority Areas (NFEPA, 2011) dataset for South Africa indicates that a wetland is located to the west of the site, outside the shaft area. Figure 3 indicates the hydrology in the area.

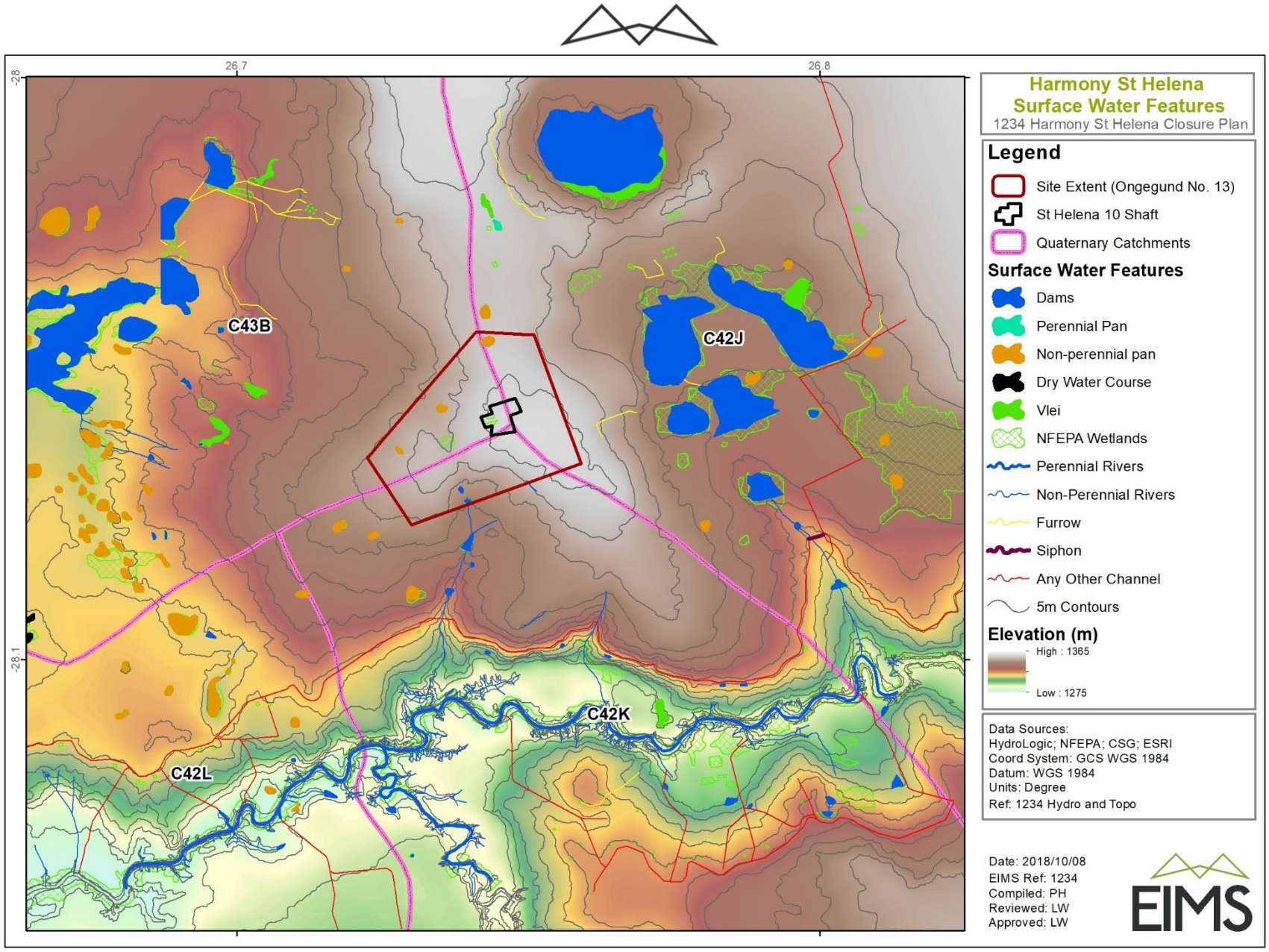

Figure 3: Hydrology and Topography of the region.

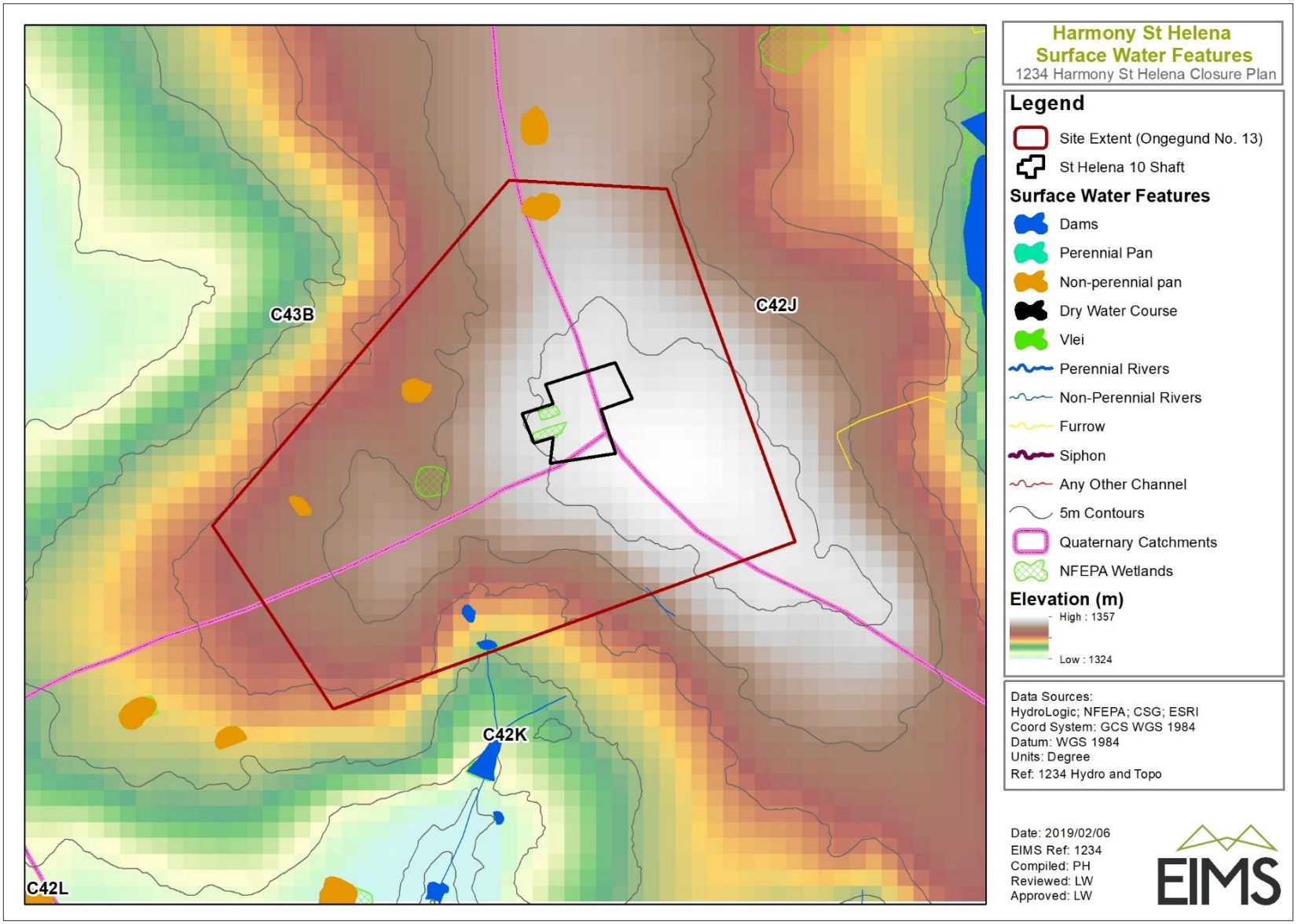

Figure 4: Hydrology and topography of the site area.

6.4.1.1.8 GROUNDWATER

Two main aquifers exist in the area:

- Karoo aquifer, near surface and associate within the weathered and fractured Karoo Supergroup
- Deeper aquifer developed in the fractured and faulted Ventersdorp and Witwatersrand rocks

The deeper aquifer has been dewatered since the 1950s to keep the deep gold mining operations dry. Groundwater levels in the deeper aquifer have declined by hundreds of meters since dewatering was initiated. However, no corresponding drop in water levels in the Karoo aquifer has been reported. Therefore, it appears that no hydraulic connection exists between the Karoo aquifer and the deeper aquifer of the Ventersdorp and Witwatersrand Supergroups.

This assessment considers near-surface impacts on groundwater arising from the St Helena 10 shaft decommissioning operations. Therefore, this assessment considers only the Karoo aquifer. According to the National Aquifer Classification System of Parsons (1995), the Karoo aquifer in the St Helena 10 Shaft assessment area is described as a Minor aquifer system: "These can be fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are both important for local supplies and in supplying base flow for rivers". The primary porosity of the Karoo rocks does not allow significant groundwater flow, except where the porosity has been increased by weathering and/or secondary geological structures (faulting and fracturing). Therefore, the Karoo aquifer comprises the near-surface weathered and fractured Beaufort and Ecca Group rocks. The aquifer is confined to semi-confined. The impermeable shale horizons in the Beaufort and Ecca Groups often restrict the downward infiltration of rainwater into the aquifer. This gives rise to the numerous pans and vleis in the area west of Welkom, including the St Helena 10 Shaft assessment area.

The groundwater quality is generally good due to the dynamic recharge from rainfall. However, the Karoo siltstones were deposited in a marine environment and salinity is known to leach from these rocks. Further, this aquifer is vulnerable to contamination from surface sources including seepage from mine infrastructure such as tailings dams, waste rock dumps, process water pans and evaporation dams. There may be a change in porosity and permeability where the weathered bedrock gives way to less weathered and fractured bedrock. There is often an accumulation of water just above this contact, which gives rise to useable groundwater yields. Borehole yields in this aquifer are generally low due to the low permeability of the soil zone and weathered Karoo rocks.

Other accumulations of groundwater occur in the fractured rocks associated with dolerite dykes and sills. The intrusion of dykes and sills caused the surrounding rock to fracture producing additional storage and conduits for groundwater flow, although not all these fractures are necessarily water bearing. These fracture systems may occasional result in high yielding boreholes, although they are generally not able to sustain excessive pumping and irrigation.

Table 9: Summary of aquifer parameters of the Karoo aquifer

Parameter	Unit	Value	Comment
Recharge	mm/yr	<12	1 – 3% of annual precipitation
Depth to water table	m	<10	
Hydraulic conductivity	m/d	10^{-6}	
Porosity	%	1 – 3	
Aquifer thickness	m	10 – 80	

Groundwater levels typically follow the topography in the region. This implies that flow takes place towards low points in the topography, which are occupied by pans and watercourses.

Harmony has run a groundwater quality monitoring programme in the Welkom area for many years. Limited water quality data (pH, Cl, and SO_4) is available for five boreholes to the north of the 10 Shaft assessment area and six boreholes to the west of the assessment area. There is some variance in the data. However, pH is generally between 7 and 8, while sulphate is generally less than 200 mg/L. There appear to be no trends in the Cl data.

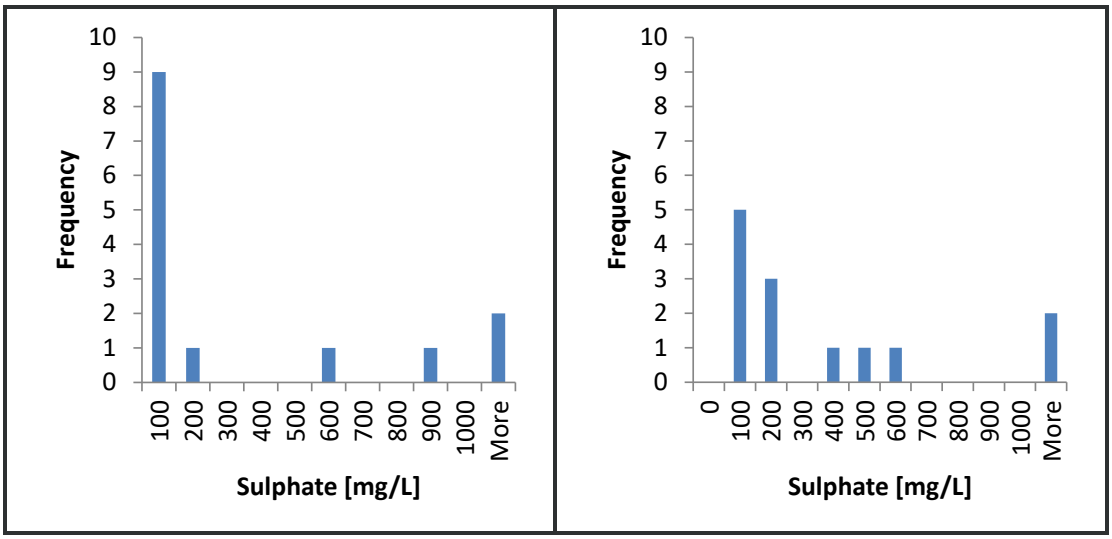

Figure 5: Histograms of SO4 (sulphate) concentrations in Harmony monitoring boreholes west of (left) and north of (right) the 10 Shaft assessment area.

The hydrocensus was conducted on 15 and 16 May 2018. It consisted of measuring groundwater depth in four boreholes, collection of two groundwater samples, and collection of one waste rock sample. During the borehole hydrocensus, only the Static Water Levels (SWL) were measured, but the actual depth of the boreholes are unknown.

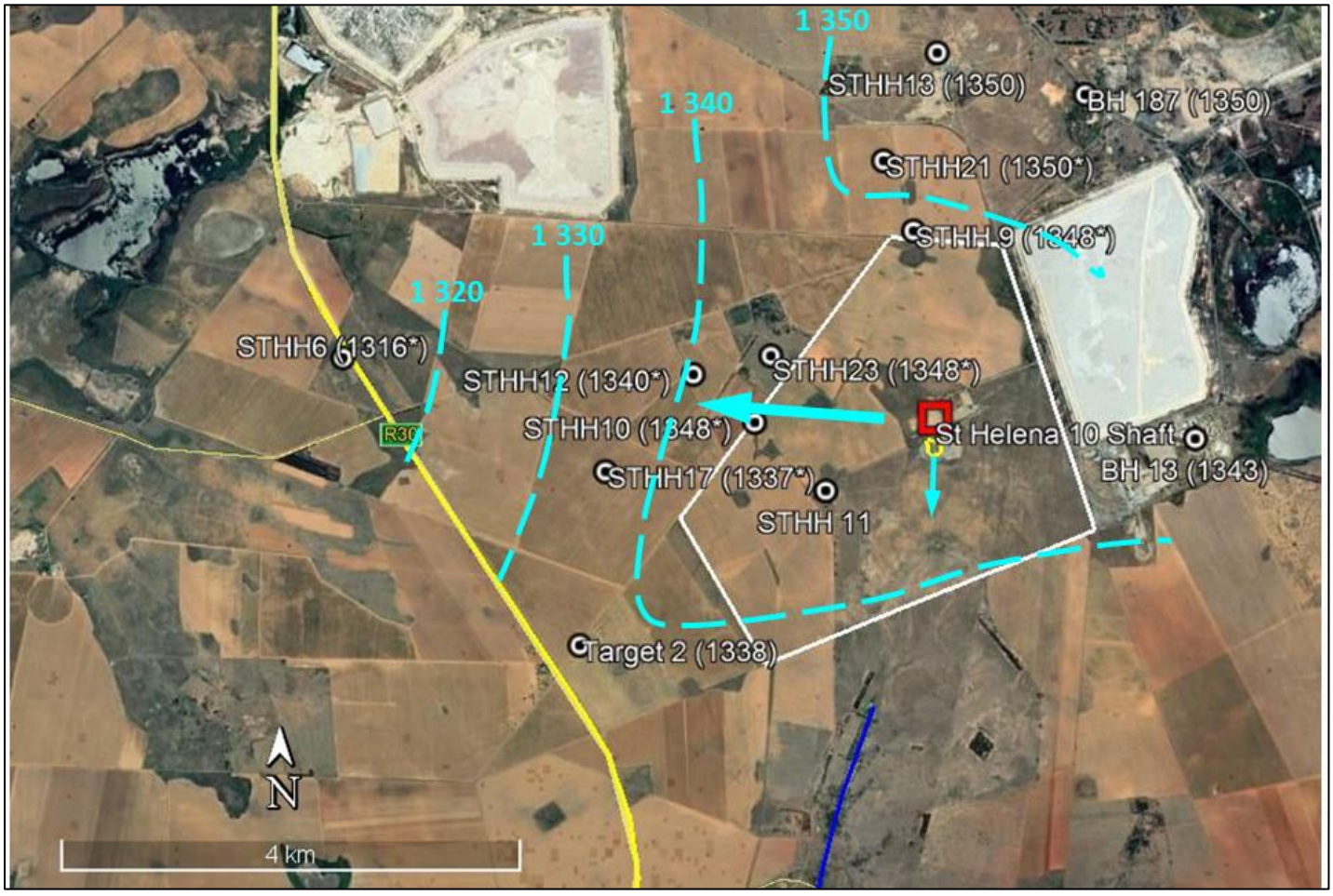

Figure 6: Inferred groundwater elevations at the St Helena 10 Shaft assessment area (turquoise arrows show inferred groundwater flow direction).

Table 10 summarises the groundwater levels used in the groundwater assessment: a combination of levels measured in the hydrocensus and additional information provided from Harmony's groundwater monitoring programme. Borehole elevations were estimated from Google Earth for both hydrocensus and Harmony data to obtain a consistent datum to compare groundwater levels.

Table 10: Groundwater levels used in this study

Borehole ID	Measured GW level (mbgl)	Estimated GW elevation (mamsl)	Comment
STHH 11	no access	none	Hydrocensus data. Water sample collected
STHH 13	10.03	1 350	Hydrocensus data. Water sample collected
Target 2	8.10	1 338	Hydrocensus data.
STHH 9	3.32	1 348	Harmony data
BH 13	4.75	1 343	Hydrocensus data
BH 187	2.99	1 350	Hydrocensus data
STHH 10	3.09	1 348	Harmony data
STHH 12	4.04	1 340	Harmony data
STHH 17	4.26	1 337	Harmony data
STHH 21	7.23	1 350	Harmony data
STHH 23	1.93	1 348	Harmony data
STHH 6	10.15	1 316	Harmony data

Figure 6 shows the distribution of measurements and inferred contours of groundwater elevations around the assessment area. No levels were obtained within the assessment area itself and also indicates the dominant groundwater flow direction is approximately west-northwest with a possible minor flow component to the south. The directions are consistent with the topography, although the inferred hydraulic gradients are generally flatter than the topographic gradients.

Groundwater quality

Based on the two samples analysed, groundwater in the St Helena 10 Shaft area is neutral and saline (Table 11). Nitrate in STHH11 exceeds health-based drinking water guideline for nitrate, presumably contaminated by seepage from the adjacent cattle kraal. Both samples exceed health-based guidelines for selenium (Se). Selenium is associated with fine-grained sediments, such as the Ecca Group rocks which form the shallow Karoo aquifer. It is also associated with pyrite, a common mineral in gold tailings such as the St Helena tailings dam immediately upgradient of the 10 Shaft site. Selenium is found in metal sulphide ores and can be toxic in large amounts.

Table 11: Groundwater analysis results

Aqueous component/ parameter	Units	STHH13	STHH11	SANS 241[A]
pH	pH units	7.9	7.5	
Total Dissolved Solids	mg/L	1 322	914	**1 200**
Total Alkalinity as $CaCO_3$	mg/L as $CaCO_3$	220	252	

Aqueous component/ parameter	Units	STHH13	STHH11	SANS 241[A]
Chloride (Cl)	mg/L	326	248	**300**
Sulphate (SO_4)	mg/L	358	61	**500***
Fluoride (F)	mg/L	<0.2	0.4	**1.5***
Nitrate (NO_3)	mg/L as N	0.2	15	**11***
Ortho Phosphate (PO_4)	mg/L as P	<0.1	<0.1	
Free & Saline Ammonia (NH_3)	mg/L as N	1.1	0.7	**1.5**
Al	mg/L	<0.100	<0.100	**0.3**
As	mg/L	<0.010	<0.010	**0.01***
B	mg/L	0.167	0.086	**2.4***
Ba	mg/L	0.061	0.114	**0.7***
Ca	mg/L	60	120	
Cd	mg/L	<0.010	<0.010	**0.003***
Cr	mg/L	<0.010	<0.010	**0.05***
Cu	mg/L	<0.010	<0.010	**2***
Fe	mg/L	0.430	<0.025	**2***
Hg	mg/L	<0.010	<0.010	**0.006***
K	mg/L	32	10.5	
Mg	mg/L	87	49	
Mn	mg/L	0.193	<0.025	**0.4***
Na	mg/L	194	70	**200**
Ni	mg/L	<0.010	0.035	**0.07**
Sb	mg/L	<0.010	<0.010	**0.02***
Se	mg/L	0.076	0.059	**0.04***
U	mg/L	<0.010	<0.010	**0.03***
Zn	mg/L	0.258	1.30	**5**

Notes:

[A] South African National Standard 241 *Drinking water* (* signifies health-based guideline value)

Sulphate is a robust indicator of the dissolved load that enters groundwater from anthropogenic contaminant sources, especially where pyrite oxidation is significant. This is because sulphate is generally present in easily detectable

concentrations in groundwater and is not significantly affected by geochemical processes under common aquifer conditions.

Sulphate is likely to be one of the least retarded contaminants in groundwater. Therefore, sulphate concentration downstream of a contaminant source is expected to be mainly a function of dilution and it is suitable as an early indicator of groundwater contamination. Other contaminants will have lower concentrations and are expected to travel more slowly in the aquifer. The Acid-base accounting (ABA) results indicate that the sample from the 10 Shaft waste rock dump is not acid generating.

Conceptual Model

Figure 7presents a conceptual model of the groundwater environment in the St Helena 10 Shaft assessment area, based on the information review and hydrocensus results.

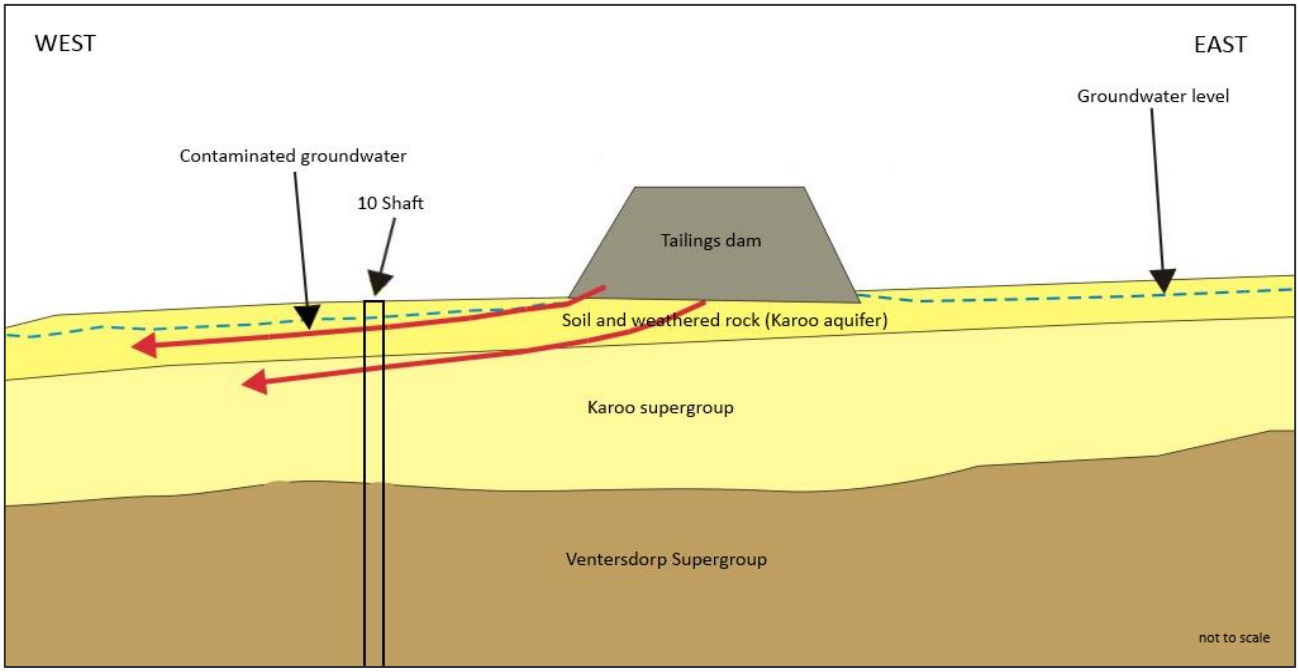

Figure 7: Conceptual model of the St Helena shaft groundwater system.

Key features of the model include the following:

- The aquifer of interest consists of near-surface Karoo rocks;
- The piezometric surface (groundwater table) is shallow (generally <10 m) in the assessment area;
- The general direction (gradient) of groundwater flow is to the west;
- The St Helena tailings dam east (that is, upgradient) of 10 Shaft could potentially contribute to shallow groundwater contamination;
- Groundwater contamination from decommissioning activities at 10 Shaft may include:
    - Spillages of liquid or solid waste from vehicles and machinery used in decommissioning; and
    - Seepage from the WRD.
- The WRD has been (and continues to be) a large, near-constant source of seepage that started years before decommissioning. This is in contrast to spillages of liquid or solid waste, which are likely to have been infrequent, relatively small and of short duration. Therefore, WRD seepage is likely to be a conservative indicator of potential groundwater impacts;
- Any contamination from decommissioning activities at 10 Shaft is likely to be superimposed on the contamination from the upgradient tailings dam.

Recovery of the deeper groundwater level is expected to take several years. Recovery may be further delayed if dewatering is continued at neighbouring mines with active underground operations. Therefore, it is likely that groundwater flow is still towards, rather than away, from the shaft.

6.4.1.1.9 NOISE

Normal background noise levels were encountered, and mining noises are localised. As no impact was expected no monitoring program was instituted. During the closure phase of the mine, no excessive noise will be generated and there are no sensitive receptors in close proximity to the shaft area.

6.4.1.2 DESCRIPTION OF CURRENT LAND USES

Historically, the land uses were rural and agricultural. The construction of the mine has changed the use of land to include residential, industrial and mining. This land use modification is seen as long term, and although it is local, it is seen to have a negative impact on the environment.

The current land use of Ongegund, as defined by the Biodiversity Company (2018), was identified using aerial imagery ground-truthed while out in the field. The possible land use categories are as follow:

- Mining;
- Bare areas;
- Agriculture crops;
- Natural veld;
- Grazing lands
- Forest;
- Plantation;
- Urban;
- Built-up;
- Waterbodies; and
- Wetlands.

The on-site and current surrounding land uses are indicated in **Error! Reference source not found.** and Figure 9.

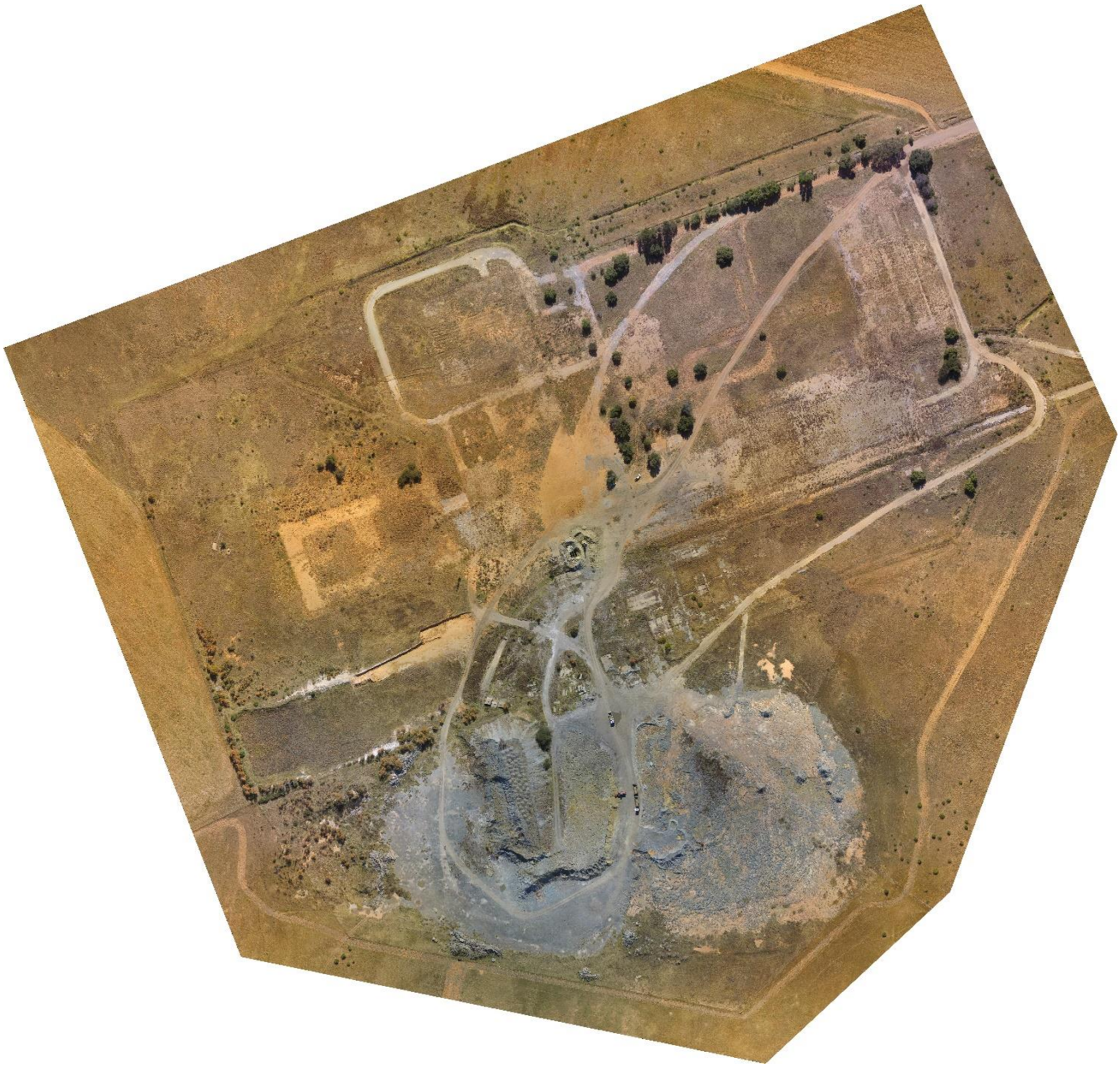

Figure 8: An on-site aerial drone image of the decommissioning and closure area

6.4.1.3 DESCRIPTION OF SPECIFIC ENVIRONMENTAL FEATURES AND INFRASTRUCTURE

The proposed project falls within the Matjhabeng Local Municipality in the Free State. The St Helena 10 Shaft is located approximately 8 km south of Welkom. During the site visit on 19 July 2018, it was found that all surface infrastructure has been demolished. The remaining infrastructure, such as the storm water drainage system and oil and water separators, are no longer in use and will be removed together with the remaining concrete foundations. The WRD and the temporarily plugged shaft are the most prominent features left on site.

6.4.1.4 ENVIRONMENTAL AND CURRENT LAND USE MAP

The following map illustrates the different land-uses in and around the St Helena shaft 10 mining area.

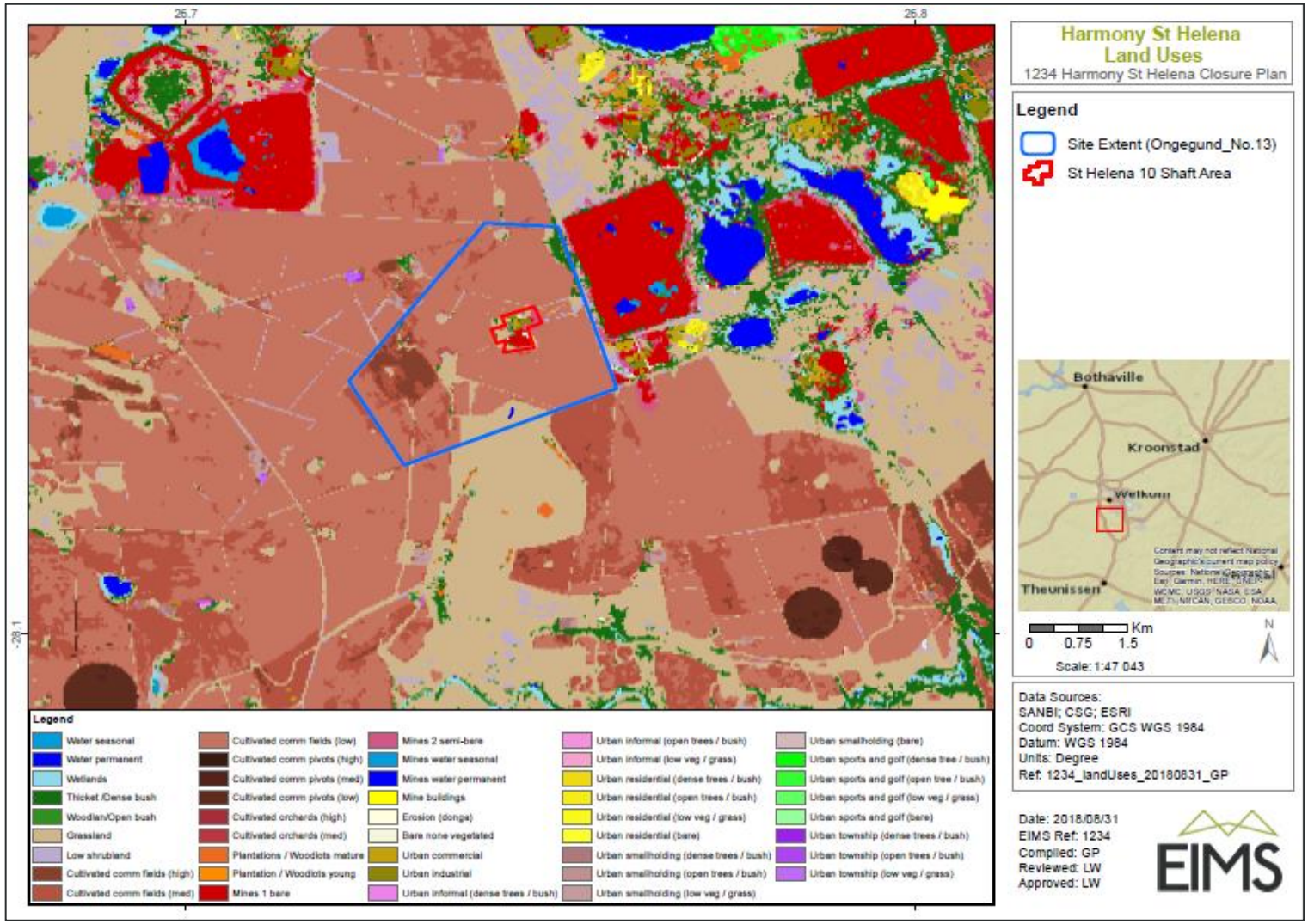

Figure 9: Environmental and Land Use Map of the application area

6.5 IMPACTS AND RISKS IDENTIFIED

The process of identifying potential risks is to list any potential impact that may have a negative effect on the environment as a result of a proposed project (in this case the decommissioning and closure of St Helena Shaft 10). In order to calculate the significance of an impact/risk, probability, duration, extent and magnitude will be used. The pre and post mitigation scores will provide an indication of the extent to which an impact can be mitigated. Seeing as the Harmony already commenced with demolishing activities, the impact and risks identified are only applicable for decommissioning and closure activities still to come. There will therefore be no requirement for access to the farms within the closure area and as such, no physical disturbance and/or changes to the area shall occur.

Following the risk assessment completed as part of the risk report (refer to Appendix E), there were several risks that were ranked as potential significant risks. These include:

- Safety Risks around an unattended open shaft (the shaft has now been filled to surface so this is no longer considered a risk);
- Surface Water Impacts; and
- Land use impacts.

Insignificant risks identified include the following:

- Soil contamination impacts; and
- Groundwater impacts.

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

It should be noted that two radiation hotspots were identified towards the east of the project area in the 2018 radiological assessment. However, since these are related to the existing large tailings facility to the immediate east of the project area the radiation impacts are not considered applicable to the St Helena site area and must rather be addressed as part of the closure of the TSF which is located on a separate mining right. In addition, the safety risk of underground methane release from the shaft and possible mitigation measure are to be investigated. Possible options for St Helena 10 Shaft is a permanent plug, a release valve or flaring. These options are further discussed in Section 19. A letter from an engineer is includes as Appendix C(5) regarding the methane risk.

6.6 THE IMPACT ASSESSMENT METHODOLOGY

The impact significance rating methodology, as provided by EIMS, 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).

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:

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

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 12.

Table 12: Criteria for determination of 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 13.

Table 13: 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 x P

Table 14: 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 15.

Table 15: Significance classes

Environmental Risk Score	
Value	Description
< 10	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥ 10; < 20	Medium (i.e. where the impact could have a significant environmental risk),
≥ 20	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.

In accordance with the requirements of Regulation 31 (2)(l) of the EIA Regulations (GNR 543), and further to the assessment criteria presented 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 16: Criteria for the determination of 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 16. The impact priority is therefore determined as follows:

Priority = PR + CI + 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 17).

Table 17: 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 18: Environmental Significance Rating

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

0	No impact
< 10	Low positive (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥ 10 < 20	Medium positive (i.e. where the impact could influence the decision to develop in the area).
≥ 20	High positive (i.e. where the impact must have an influence on the decision process to develop in the area).

6.7 THE POSITIVE AND NEGATIVE IMPACTS THAT THE PROPOSED ACTIVITY (IN TERMS OF THE INITIAL SITE LAYOUT) AND ALTERNATIVES WILL HAVE THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED

The proposed decommissioning and closure activities to be undertaken are non-invasive and as such no additional alternative layout and activities are proposed. There will be no physical disturbance to the application area and/or interference with landowners or communities.

It should be noted that this report will be made available to I&AP's for review and comment and their comments and concerns will be addressed in the final report to be submitted to the DMR for adjudication. Furthermore, it should be noted that the impact scores themselves will include the results of the aforementioned public response and comment. The results of the public consultation will be used to update the impact scores where applicable upon completion of the public review period.

Please refer to Section 6.6 for the methodology used in determining and ranking the nature, significance, consequence, extent, duration and probability of potential environmental impacts and risks.

The following provides a description and assessment of the potential impacts identified in the impact assessment process. Please refer to Appendix C for the full impact scoring calculations.

The notification of the proposed Harmony St Helena haft 10 Closure is likely to selective interest, particularly in the potential for employment and perceived safety and security risk. However, due to the non-invasive activities for this application no unskilled labour is required and no site access is required. As such, perceptions and expectations must be managed through ongoing, open and transparent communication with affected stakeholders, communities and landowners.

6.8 THE POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK

Potential mitigation measures that can be applied to reduce the impact of the socio-economic perceptions and expectations include:

- Adhere to an open and transparent communication procedure with stakeholders at all times;
- Ensure that accurate information regarding the decommissioning and closure activities to be undertaken, and the resultant lack of requirements for site access and labour is communicated to I&APs;
- Ensure that information is communicated in a manner which is understandable and accessible to I&APs; and
- Enhance project benefits and minimise negative impacts through consultation with stakeholders.

6.9 MOTIVATION WHERE NO ALTERNATIVE SITES WERE CONSIDERED

No site alternatives have been investigated as the application area has been selected as the only preferred site. The closure of the existing St Helena Shaft 10 is the primary driver in determining the location of the proposed activity. As such no assessment of alternative development scenarios could be conducted.

6.10 STATEMENT MOTIVATING THE ALTERNATIVE DEVELOPMENT LOCATION WITHIN THE OVERALL SITE

The closure of the existing St Helena Shaft 10 is the primary driver in determining the location of the proposed activity. As such no assessment of alternative development scenarios could be conducted.

7 FULL DESCRIPTION OF THE PROCESS UNDERTAKEN TO IDENTIFY, ASSESS AND RANK THE IMPACTS AND RISKS THE ACTIVITY WILL IMPOSE ON THE PREFERRED SITE (IN RESPECT OF THE FINAL SITE LAYOUT PLAN) THROUGH THE LIFE OF THE ACTIVITY

The impact assessment process may be summarised as follows:

1. Identification of proposed closure and decommissioning activities including their nature and duration;
2. Screening of activities likely to result in impacts or risks;
3. Utilisation of the above mentioned EIMS methodology to assess and score preliminary impacts and risks identified;
4. Inclusion of I&AP comment regarding impact identification and assessment; and
5. Finalisation of impact identification and scoring.

8 IMPACT ASSESSMENT OF EACH IDENTIFIED POTENTIALLY SIGNIFICANT IMPACT AND RISK

The following table describes each potentially identified impact risk and its' significance rating.

Table 19: Impact Assessment Summary

Name of Activity	Potential Impact	Aspects Affected	Phase	Significance (if not mitigated)	Mitigation Type	Significant (if mitigated)
Removal of all infrastructure and rubble.	Loss of soil and land capability	Soil and land	Decommissioning	Low (-9.00)	• Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Use lighter vehicles (i.e. double cab vehicles) where possible; • Use manual labour instead of heavy machinery where possible; • Rip all dirt roads after final use thereof; • Liaise with future land users to find innovative ways to re-use current foundations instead of decommissioning; • All foundations must be removed. • If no topsoil is available it is considered acceptable that rehabilitation proceed without topsoil. Rehabilitation must be monitored – if after 2 years little to no pioneer species have colonized the site then topsoil will need to be imported to the site in order to ensure proper rehabilitation takes place; • Apply sufficient amounts of top soil where significant erosion has occurred; and • All waste material deemed unsafe to backfill must be removed from site in an environmentally friendly manner.	Low (-7.5)
Backfilling of shaft		Soil	Decommissioning	Low (-9.00)	• Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place;	Low (-7.5)

Name of Activity	Potential Impact	Aspects Affected	Phase	Significance (if not mitigated)	Mitigation Type	Significant (if mitigated)
					• Apply sufficient amounts of top soil where significant erosion has occurred; • Ensure that all waste material to identify whether or not the relevant material is safe to backfill; and • All waste material deemed unsafe to backfill must be removed from site in an environmentally friendly manner.	
Application of lime, fertilizer and other ameliorants		Soil	Rehab and closure	5.00	• Only the designated access routes are to be used to reduce any unnecessary compaction; • The lime requirement for low pH areas as identified in the soil study must be calculated once decommissioning and backfilling of all material (or the removal thereof) has been done. This will include testing the pH post-decommissioning and pre-rehabilitation; • The application of fertiliser, lime and other ameliorants must take place a few weeks before reseeding (if reseeding is to take place); • Relevant ameliorants must be applied to contaminated areas to rectify these imbalances (if required); and • All ameliorants, lime and fertiliser applied to the footprint area must be done according to the reference site conditions.	8.25
Soil rehabilitation		Soil	Rehab and closure	Low (-2.00)	• . If no topsoil is available it is considered acceptable that rehabilitation proceed without topsoil. Rehabilitation must be monitored – if after 2 years little to no pioneer species have colonized the site then topsoil will need to be imported to the site in order to ensure proper rehabilitation takes place,	6.75
Ripping of compacted areas		Soil and land	Rehab and closure	Low (-1.00)	• Ripping of compacted areas must be done. .	6.00

Name of Activity	Potential Impact	Aspects Affected	Phase	Significance (if not mitigated)	Mitigation Type	Significant (if mitigated)
Discontinuing of mining at St Helena 10 Shaft	Change in groundwater levels	Groundwater	Rehab and closure	Low (-3.00)	• Groundwater level monitoring bi-annually	Low (-4.00)
	Alterations in the quality of groundwater	Groundwater	Rehab and closure	Low (-3.00)	• Groundwater quality monitoring bi-annually	Low (-4.00)
Removal or rehab of waste rock dump	Land contamination	Soil and land	Rehab and closure	Low (-3.5)	None required	Low (-4.08)
	Soil erosion	Soil	Rehab and closure	Medium (-12.00)	• Monitoring in line with the 2019 Closure Plan.	Low (-4.00)
	Pollutants entering the surface water environment during removal of the WRD	Surface water	Rehab and closure	Medium (-13.00)	• Bi-annual surface water monitoring reports. Monitoring to take place for ten years post closure.	Low (-2.67)
General rehab / closure activities	Change in runoff	Surface water and groundwater	Rehab and closure	Medium (-10,00)	• Ensure the topography is shaped to mimic the surrounding environment tpo avoid ponding and steep surface.	Medium (-13.33)
	Injury and/or death due to open shaft	Safety	Rehab and closure	Medium (-12.00)	• Shaft to be properly sealed and capped post-closure	Low (-9.33)
	Explosion risk due to methane pockets	Safety	Rehab and closure	Medium (-12.75)	• Hourly monitoring of methane levels during backfilling and rehabilitation to ensure safety.	Medium (14.00)
.					•	

Name of Activity	Potential Impact	Aspects Affected	Phase	Significance (if not mitigated)	Mitigation Type	Significant (if mitigated)
					•	

9 SUMMARY OF SPECIALIST REPORTS

The following specialist studies were undertaken previously for the purposes of the decommissioning and closure of Harmony St Helena Shaft 10.

Table 20: Specialist summary

List of Studies undertaken	Recommendation of Specialist Reports	Specialist Recommendations that have been included in the BAR	Reference to Applicable section of Report where specialist Recommendations have been included

Groundwater Assessment Specialist Study	• Harmony should commission an experienced hydrogeologist (who is registered with the South African National Council for Natural Scientific Professions) to site, drill, and install three (3) monitoring boreholes in the 10 Shaft assessment area. General locations for these boreholes are:
	  ○ one borehole upstream (east) of 10 Shaft, and
	  ○ two boreholes downstream (west and south) of 10 Shaft.
	• The boreholes should be sited by an experienced hydrogeologist using aerial imagery and a site geophysical survey to increase the probability of obtaining useful groundwater intersections in the aquifer.
	• The boreholes should be drilled to a depth of at least 35 m, although final depths should be decided by the appointed hydrogeologist.
	• The boreholes should be screened, constructed, and equipped as long-term monitoring boreholes.
	• The new boreholes should be added to Harmony's routine groundwater monitoring programme.
	• The three new boreholes and the existing borehole STHH 11 should be monitored as follows:
	  ○ Quarterly measurement of groundwater levels
	  ○ Quarterly measurement of groundwater quality
	• Groundwater samples should be collected using the procedure of Weaver et al (1996), including purging prior to sampling, field measurement of alkalinity, field filtering and
		All specialist recommendations have been included.	Sections 8, 10.1 and 25.2

List of Studies undertaken	Recommendation of Specialist Reports	Specialist Recommendations that have been included in the BAR	Reference to Applicable section of Report where specialist Recommendations have been included

	preservation of a sample for metals analysis, and collection of an undisturbed sample for hydrocarbon analysis.
	• Groundwater samples should be analysed for the following:
	  ○ Analytes as indicated in the RAP: pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Sulphate (SO_4) and Chloride (Cl)
	  ○ Major anions: Fluoride (F), Nitrate (NO3)
	  ○ Major cations: Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg)
	  ○ Trace elements of environmental concern:
	  ○ Hydrocarbons: Petroleum range organics (C4-C10), Diesel range organics (C10-C40), Volatile organic hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylene)
	• 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 and opinion on the status of groundwater at the site and the need for further monitoring.		

Surface water Assessment Specialist Study	• If the waste rock dump is to remain on site then the management of stormwater on the site is limited to the waste rock dump and mine shaft undergoing backfilling, for which two dirty diversions and a single PCD are recommended. The PCD has been sized according to the 1:50 RI event and the balance of the wettest months (January) rainfall and evaporation. Lining requirements and the potential to utilise a smaller design event for sizing (e.g. the 1:10 RI event) should be discussed and agreed with the DWS. • During the site visit it was evident that rehabilitation of the site was ongoing, which is assumed to be in accordance with the mines rehabilitation plan. It is unconfirmed as to how	All specialist recommendations have been included.	Sections 8, 10.1 and 25.2

List of Studies undertaken	Recommendation of Specialist Reports	Specialist Recommendations that have been included in the BAR	Reference to Applicable section of Report where specialist Recommendations have been included
	much of the existing waste rock will be used to backfill the shaft or what will be done with the remaining waste rock post backfilling. Modifications to the SWMP will likely be possible once rehabilitation is complete with no requirement for storm water management infrastructure (i.e. diversions and PCD) assuming all areas including the waste rock dump are rehabilitated. • A surface water monitoring programme is recommended although no water quality sampling was possible at the time of the site visit due to it being the dry season. •		
Soils and Land Use Assessment Specialist Study	• All rubble and building material must be removed from site; • Any potential hazardous material within the waste rock should be assessed by a specialist to ensure that suitable recommendations are made for the safe removal thereof, this includes waste material; • 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 (L6), severe limitations for arable land exist due to climate restrictions. Therefore, it is the specialist's opinion that "Grazing" land capability rather be favoured. According to the Chamber of Mines South Africa/Coaltech (2007), a post-mining land capability of "grazing land" can be reached by ensuring the rehabilitated area has a soil profile exceeding a depth of 250mm. The rehabilitated area is extremely compacted at a depth of 100mm. Therefore, the entire rehabilitated area must be ripped to at least 250mm to achieve a grazing post-mining land capability.	All specialist recommendations have been included.	Sections 8, 10.1 and 25.2

List of Studies undertaken	Recommendation of Specialist Reports	Specialist Recommendations that have been included in the BAR	Reference to Applicable section of Report where specialist Recommendations have been included
	• The current stockpile area must be removed, and the shaft must be backfilled and rehabilitated; • After the rehabilitation of this area, samples must be taken to ensure that this area be rehabilitated to the reference conditions.		
Soil Contamination Assessment	• No recommendations are made with regards to contaminated land and no mitigation is required.	N/A – no recommendations made.	NA

10 ENVIRONMENTAL IMPACT STATEMENT

10.1 SUMMARY OF KEY FINDINGS

10.1.1 SURFACE AND GROUNDWATER QUALITY

- Continue surface water monitoring programme after closure and during rehabilitation phase.
    - The surface water monitoring should take place at two suggested locations within a non-perennial river. One is situated inside the mining boundary and the other outside the mining boundary, in a dam. Sampling at these two sites can only take place if there is flowing water in the river. Keeping in mind that no water quality sampling was done during the site visit due to it being the dry season.

10.1.2 GROUNDWATER QUALITY

- Add three additional boreholes to Harmony's routine groundwater monitoring program, these are to be analysed and reported on a quarterly basis.

10.1.3 SOILS AND LAND

- Preserve possible land for future users;
- Identify and remove possible re-usable and re-cyclable items from the project site; and
- Ripping the surrounding areas top-soil to that of "Grazing" land capability by ensuring the rehabilitated area has a soil profile exceeding a depth of 250mm.

10.2 FINAL SITE MAP

Please refer to the composite map included in Section 20.3.

10.3 SUMMARY OF POSITIVE AND NEGATIVE IMPLICATIONS AND RISK

The following positive implication may can be expected by continuing with decommissioning and closure of Harmony St Helena Shaft 10:

- Backfilling the shaft will make the area less of a safety risk to e.g. tripping and falling into an open shaft or methane exposure;
- Continuing with rehabilitation will allow for the area to return to its natural condition (as far as possible);
- Where there is any, re-usable and recycle infrastructure can be removed and used somewhere else;
- Mine closure will allow for the land to be used for other purposes in the future; and
- Any possible environmental contamination can be detected during decommissioning because of the monitoring that will take place.

There are no expected negative impacts on the surrounding environment through decommissioning and closure activities.

11 PROPOSED IMPACT MANAGEMENT OBJECTIVES AND OUTCOMES

The management objective is to minimise the impact of the proposed Decommissioning and Closure for St Helena Shaft 10 in terms of the socio-economic perceptions and expectations of I&AP's. The outcome to be achieved is to lessen the impact through the following measures:

- Adhere to an open and transparent communication procedure with stakeholders at all times;
- Ensure that accurate information regarding the decommissioning and closure activities to be undertaken and the resultant lack of requirements for site access and labour is communicated to I&APs;

- Ensure that information is communicated in a manner which is understandable and accessible to I&APs; and
- Enhance project benefits and minimise negative impacts through consultation with stakeholders.

12 ASPECTS FOR INCLUSION AS CONDITIONS OF AUTHORISATION

Please refer to Section 14.2 for the commitments, which should be included as conditions in the authorisation.

13 DESCRIPTION OF ANY KEY ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

The following assumptions, uncertainties, and gaps in knowledge are applicable to this BAR:

- There will be no invasive work undertaken for the proposed Decommissioning and Closure for St Helena Shaft 10. This report only considers non-invasive decommissioning and closure activities and as such is not adequate to mitigate any invasive activities.

14 REASONED OPINION AS TO WHETHER THE PROPOSED ACTIVITY SHOULD OR SHOULD NOT BE AUTHORISED

14.1 REASONS WHY THE ACTIVITY SHOULD BE AUTHORIZED OR NOT

No invasive work will be undertaken for the proposed Decommissioning and Closure for St Helena Shaft 10. There will therefore, be no impacts on the biophysical and cultural environments. The only impact on the social environment can be mitigated through open communication with the landowners. It is, therefore, the opinion of the EAP that the proposed activity should be authorised.

The activities involved in the decommissioning, closure, rehabilitation and monitoring stages of St Helena 10 Shaft will have a positive impact on the environment, as opposed to just leaving the shaft open and the lack of rehabilitation. These activities also reduce the safety risks involved in an uncovered shaft, as opposed to leaving the site unattended.

14.2 CONDITIONS FOR WHICH THE ENVIRONMENTAL AUTHORIZATION IS REQUIRED

Stakeholder Engagement will continue throughout the decommissioning and closure activities to ensure landowners are kept informed and allowed to raise relevant issues. These issues will then be addressed through a grievance mechanism.

No site access is required due to the non-invasive nature of the decommissioning and closure activities planned.

15 PERIOD FOR WHICH THE ENVIRONMENTAL AUTHORISATION IS REQUIRED

The Environmental Authorisation is required for three years or for the duration of decommissioning and closure.

16 UNDERTAKING

It is confirmed that the undertaking required to meet the requirements of this section is provided at the end of the EMPR (Section B) and is applicable to both the BAR and the EMPR.

17 FINANCIAL PROVISION

This section presents the basis of the calculation of the quantum for financial provisions for closure. The assessment and calculations are based on the 2005 DMR 'Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision' provided by a Mine (DMR Guidelines).

17.1 EXPLAIN HOW THE AFORESAID AMOUNT WAS DERIVED

The quantum for financial provisions for un-scheduled closure has been estimated using the rule-based approach defined in the DMR Guideline. The itemised breakdown upon which this estimated is based on the 2018 Closure Cost Assessment completed by Digby Wells and a summary us included in Table 21.

Table 21: Closure liability summary

Summary - St. Helena #10	
TOTAL (includes rehabilitation)	R 4,937,298
Monitoring Costs (Groundwater)	R 279,100
Monitoring Costs (Vegetation)	R 34,623
Maintenance Costs (Vegetation)	R 31,967
Project Management (12%)	R 592,476
Contingency (10%)	R 493,730
GRAND TOTAL	**R 6,369,194**

Note: No allowance has been made for Value Added Tax (VAT) in the above Digby Wells figures. This issue should be noted where appropriate and for the purposes of which the financial figures are used. The DMR has in the past insisted on its inclusion for the purposes of assessing liabilities but have met with almost uniform resistance by the industry.

17.2 CONFIRM THAT THIS AMOUNT CAN BE PROVIDED FOR FROM OPERATING EXPENDITURE

This section is not applicable for decommission and closure phases. Funds for decommissioning and closure to be provided by DMR.

18 SPECIFIC INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

No additional information has been requested from the competent authority.

18.1 COMPLIANCE WITH THE PROVISIONS OF SECTIONS 24(4)(A) AND (B) READ WITH SECTION 24(3)(A) AND (7) OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (ACT 107 OF 1998) THE BAR REPORT MUST INCLUDE THE:

18.1.1 IMPACT ON THE SOCIO-ECONOMIC CONDITIONS OF ANY DIRECTLY AFFECTED PERSON

The potential impacts on the socio-economic conditions have the potential to include:

- Socio-Economic Perceptions and Expectations of the Community

With the decommissioning and closure of a mine shaft, false perceptions and expectations, particularly surrounding potential employment. There are inevitably more people seeking jobs than the number of jobs available, especially for unskilled labour. Temporary employment is however created during the rehabilitation phase through the tender system that is overseen by the Harmony Asset Management Forum department There can also be a perceived safety and security risk to landowners. However, due to the nature of this project no site access is required. The manner in which false perceptions and expectations is addressed is through consultation and communication to ensure people are fully aware of the lack of any potential employment opportunities and access requirements.

18.1.2 IMPACT ON ANY NATIONAL ESTATE REFERRED TO IN SECTION 3(2) OF THE NATIONAL HERITAGE RESOURCES ACT

No invasive work will be undertaken for the proposed Harmony St Helena Shaft 10 decommissioning and closure. As such no national estates as defined in the NHRA will be affected by the proposed decommissioning and closure activities.

19 OTHER MATTERS REQUIRED IN TERMS OF SECTION 24(4)(A) AND (B) OF THE ACT

. The St Helena 10 shaft has however been filled to surface making Capture and Extraction a non-feasible option. A permanent plug must therefore be installed.

Before sealing the surface of a shaft, it is filled with boulders (or ay surrounding soil and/or non-contaminated, unused rubble. 3 – 6 metres to the surface is topped with concrete plugs that reinforced with steel rebar. The surface can or be levelled and covered with soil and planted grass. The other option is to add an additional impermeable barrier to provide a more robust plug.

The disadvantage of a permanent plug is the possibility of methane seepage into the adjacent soil beds and groundwater reservoirs as well the increased safety risk linked to the trapped methane. A solution to this will be to build a release valve into the plug that can be opened frequently to release the gas. This option, however, still increases the atmospheric methane levels which in return is potent if inhaled and highly explosive.

PART B: ENVIRONMENTAL MANAGEMENT PROGRAMME

20 INTRODUCTION

20.1 DETAILS OF THE EAP

The details and expertise of the EAP are detailed in Section 1 **Error! Reference source not found.**as required.

20.2 DESCRIPTION OF THE ASPECTS OF THE ACTIVITY

Harmony Gold proposes to decommission and close the St Helena 10 Shaft, which occurs on portion RE of the farm Ongegund 13 within the Lejweleputswa District Municipality. Harmony has an approved MR (FS 30/5/1/2/2/86 MR) and an EMPR in terms of the MPRDA for the gold mining operation at Harmony St Helena Shaft 10. The proposed decommissioning and closure will involve no invasive activities on the site. 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 not been filled to surface and a temporary plug has been installed to prevent illegal access to underground working. The various closure and rehabilitation activities include:

- Removal of all infrastructure and rubble;
- Backfilling of shaft;
- Removal or reshaping of waste rock dump;
- Ripping of compacted areas and vegetation.

A composite map of the application area is included in Figure 10.

20.3 COMPOSITE MAP

Figure 10 illustrates a composite map of the St Helena shaft 10 mining and surrounding area.

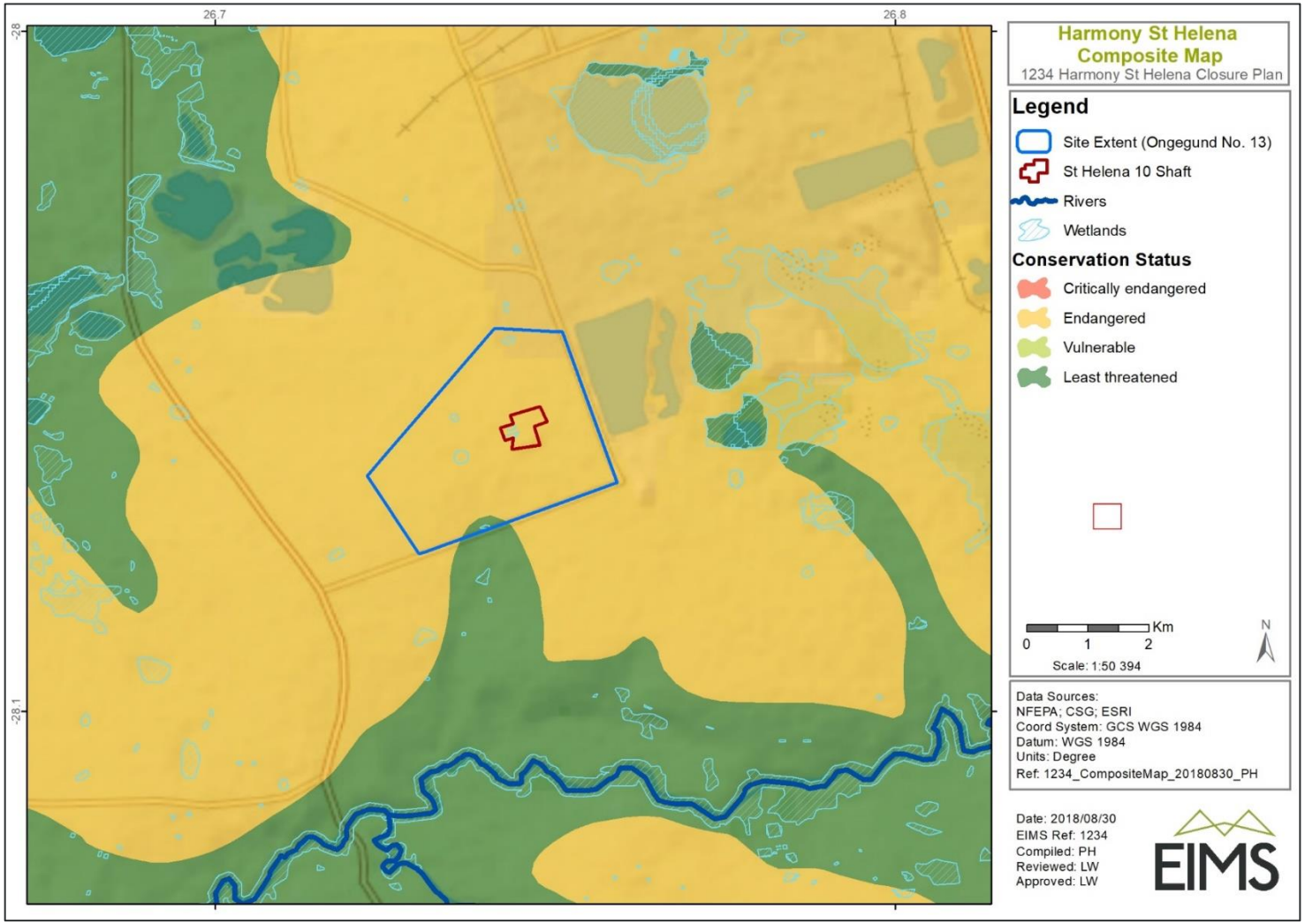

Figure 10: Composite Map of the application area

21 DESCRIPTION OF IMPACT MANAGEMENT OBJECTIVES

21.1 DETERMINATION OF CLOSURE OBJECTIVES

The closure objectives and goals stated and committed to in the approved EMPR (Shangoni 2009).

21.1.1 TOPOGRAPHY

The following objectives were stated with regards to topography in the approved EMPR:

- To reduce the visual impact of the altered topography by a process of reclamation and rehabilitation.
- To dispose of all saleable assets.

21.1.2 SOILS

The following objectives were stated with regards to soils in the approved EMPR:

- To cover mining areas with sufficient soil in order to maintain vegetation.

21.1.3 LAND CAPABILITY

The following objectives were stated in the approved EMPR with regards to land capability:

- To identify alternative use of as much of the infrastructure as possible
- To remove infrastructure not required in situ, and to restore the land where possible to natural vegetation.
- To financially investigate the possibility of re-mining the slimes dams.

21.1.4 LAND USE

The following land use objectives were stated in the approved EMPR:

- Investigate what infrastructure can have alternate uses.
- Remove all un-saleable infrastructures.
- Reinstate mining land to natural vegetation.
- To financially investigate the possibility of re-mining the slimes dams.
- Limit the long-term visual impact of mining activities.

21.1.5 VEGETATION

The following vegetation objectives were stated in the approved EMPR:

- To achieve self-sustaining vegetation on the mining area excluding the slimes dams.

21.1.6 SURFACE WATER

The following surface water objectives were stated in the approved EMPR:

- To ensure that water pollution is contained on the mine property, and that natural watercourses are not affected.
- To eliminate the contamination of surface water thus obviating the need to treat excessive quantities of polluted water.

21.1.7 GROUNDWATER

The following groundwater objectives were stated in the approved EMPR:

- Ensure that individual facilities do not have long term adverse effects in terms of quality on the ground water users.

21.1.8 AIR QUALITY

The following air quality objectives were stated in the approved EMPR:

- Dust emanating from rehabilitated land should not exceed normal levels associated with agricultural and residential areas.

21.2 VOLUMES AND RATE OF WATER USE REQUIRED FOR THE OPERATION

No operational water will be required as the application is for closure.

21.3 HAS A WATER USE LICENCE BEEN APPLIED FOR?

No Water Use License is required.

21.4 IMPACTS TO BE MITIGATED IN THEIR RESPECTIVE PHASES

Table 22 lists all possible impacts related to decommissioning and closure of St Helena Shaft 10 and its mitigation measures.

Table 22: Impacts to be Mitigated

Activities	Phase	Size and Scale of Disturbance	Mitigation Measures	Compliance with Standards	Time Period for Implementation
Removal of all infrastructure and rubble	Decommissioning	From shaft area to disposal site	• Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Use lighter vehicles (i.e. double cab vehicles) where possible; • Use manual labour instead of heavy machinery where possible; • Use as small as possible explosives for decommissioning; • Rip all dirt roads after final use thereof; • Liaise with future land users to find innovative ways to re-use current foundations instead of decommissioning; • Apply sufficient amounts of top soil on historic foundations; • Apply sufficient amounts of top soil where significant erosion has occurred; • Ensure that a specialist inspects all waste material to identify whether or not the relevant material is safe to backfill; and • All waste material deemed unsafe to backfill must be removed from site in an environmentally friendly manner.	Shall adhere to South African legislation pertaining to mine closures, including the MPRDA and NEMA principles.	As soon as possible
Backfilling of shaft		Shaft area only	• Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Apply sufficient amounts of top soil where significant erosion has occurred; • Ensure that a specialist inspects all waste material to identify whether or not the relevant material is safe to backfill; and • All waste material deemed unsafe to backfill must be removed from site in an environmentally friendly manner.	Backfilling in line with DMR guidelines for rehabilitation. Sealing in line with DMR shaft sealing guidelines.	As soon as possible

Activities	Phase	Size and Scale of Disturbance	Mitigation Measures	Compliance with Standards	Time Period for Implementation
			• Hourly monitoring of methane levels and quarterly monitoring of shaft area during backfilling and rehabilitation to ensure safety. • The shaft must be properly sealed and capped in accordance to the DMR Shaft sealing guidelines. • 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 and approved by the Regional Director of Mineral and Energy Affairs in accordance to the DMR Shaft sealing guidelines.		
Application of lime, fertilizer and other ameliorants	Rehab and closure	Area immediately surrounding shaft	• Only the designated access routes are to be used to reduce any unnecessary compaction; • The lime requirement for the degraded area must be calculated once decommissioning and backfilling of all material (or the removal thereof) has been done. This will include testing the pH post-decommissioning and pre-rehabilitation; • If re-seeding is to take place, the application of fertiliser, lime and other ameliorants must take place a few weeks before reseeding; • By applying the wrong type of lime or excessive amounts of lime will further degrade the soil resources; • Testing of inorganic parameters must be completed with the latter mentioned tests to identify possible land contamination; • Relevant ameliorants must be applied to contaminated areas to rectify these imbalances; and • All ameliorants, lime and fertiliser applied to the footprint area must be done according to the reference site conditions.	Shall adhere to South African legislation pertaining to mine closures, including the MPRDA and NEMA principles.	As soon as possible post closure

Activities	Phase	Size and Scale of Disturbance	Mitigation Measures	Compliance with Standards	Time Period for Implementation
Reseeding		Area immediately surrounding shaft	• If no topsoil is available it is considered acceptable that rehabilitation proceed without topsoil. Rehabilitation must be monitored – if after 2 years little to no pioneer species have colonized the site then topsoil will need to be imported to the site in order to ensure proper rehabilitation takes place, • If re-seeding is required, it should take place a few weeks before the anticipated dry season to ensure a successful germination; • Rock armour should be applied to the degraded/eroded areas (especially those characterised by a slope) to support successful reseeding and minimize the risk of seeds washing away via overland flow; • Ripping should be carried out on all compacted areas a few days before reseeding; • Only indigenous grass species should be reseeded; and • Reseeding must take place a few weeks after the application of fertilizer, lime and other ameliorants.	Shall adhere to South African legislation pertaining to mine closures, including the MPRDA and NEMA principles.	As soon as possible post closure
Ripping of compacted areas		Area immediately surrounding shaft	• Ripping of compacted areas must be done by means of manual labour instead of heavy machinery as much as possible.	Shall adhere to South African legislation pertaining to mine closures, including the MPRDA and NEMA principles.	Post closure
Residual radiation caused by mining activities during the operational phase		Area immediately surrounding shaft	• Follow-up radiological monitoring event post-clean-up is required to ensure area is safe.	NNR guidelines for radiation	As soon as possible post-closure

Activities	Phase	Size and Scale of Disturbance	Mitigation Measures	Compliance with Standards	Time Period for Implementation
Removal of all infrastructure and foundations		Downstream surface water and groundwater reservoirs and area immediately surrounding shaft	• Monitoring in line with closure requirements of existing Closure Plan. • Surface and groundwater monitoring.	DWS best practice guidelines	As soon as possible post closure

21.5 IMPACT MANAGEMENT OUTCOMES

The following table lists all impact activities and the outcomes related to managing them.

Table 23: Impact Management Outcomes

Activity	Potential Impact	Aspects Affected	Phase	Mitigation	Standard to be Achieved
Removal of all infrastructure and rubble	Loss of soil and land capability	Soil and land	Decommissioning	• Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Use lighter vehicles (i.e. double cab vehicles) where possible; • Use manual labour instead of heavy machinery where possible; • Use as small as possible explosives for decommissioning; • Rip all dirt roads after final use thereof; • Liaise with future land users to find innovative ways to re-use current foundations instead of decommissioning; • Apply sufficient amounts of top soil on historic foundations; • Apply sufficient amounts of top soil where significant erosion has occurred; • Ensure that a specialist inspects all waste material to identify whether or not the relevant material is safe to backfill; and • All waste material deemed unsafe to backfill must be removed from the site in an environmentally friendly manner.	Shall adhere to South African legislation pertaining to mine closures, including the MDRPA and NEMA principles.
Backfilling of shaft		Soil	Decommissioning	• Only the designated access routes are to be used to reduce any unnecessary compaction;	

Activity	Potential Impact	Aspects Affected	Phase	Mitigation	Standard to be Achieved
				• If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Apply sufficient amounts of top soil where significant erosion has occurred; • Ensure that a specialist inspects all waste material to identify whether or not the relevant material is safe to backfill; and • All waste material deemed unsafe to backfill must be removed from the site in an environmentally friendly manner.	
Application of lime, fertilizer and other ameliorants		Soil	Rehab and closure	• Only the designated access routes are to be used to reduce any unnecessary compaction; • The lime requirement for the degraded area must be calculated once decommissioning and backfilling of all material (or the removal thereof) has been done. This will include testing the pH post-decommissioning and pre-rehabilitation; • By applying the wrong type of lime or excessive amounts of lime will further degrade the soil resources; • Testing of inorganic parameters must be completed with the latter mentioned tests to identify possible land contamination; • Relevant ameliorants must be applied to contaminated areas to rectify these imbalances; and • All ameliorants, lime and fertilizer applied to the footprint area must be done according to the reference site conditions.	
Reseeding		Soil	Rehab and closure	• If no topsoil is available it is considered acceptable that rehabilitation proceed without topsoil. Rehabilitation must be monitored – if after 2 years little to no pioneer species have	

Activity	Potential Impact	Aspects Affected	Phase	Mitigation	Standard to be Achieved
				colonized the site then topsoil will need to be imported to the site in order to ensure proper rehabilitation takes place, • If re-seeding is required, it should take place a few weeks before the anticipated dry season to ensure a successful germination; • Rock armour should be applied to the degraded/eroded areas (especially those characterised by a slope) to support successful reseeding and minimize the risk of seeds washing away via overland flow; • Ripping should be carried out on all compacted areas a few days before reseeding; • Only indigenous grass species should be reseeded; and • Reseeding must take place a few weeks after the application of fertilizer, lime and other ameliorants.	
Ripping of compacted areas		Soil and land	Rehab and closure	• Ripping of compacted areas must be done by means of manual labour instead of heavy machinery as much as possible; and • Reseeding must take place a few days after ripping.	
General closure activities	Change in groundwater levels	Groundwater	Rehab and closure	• Groundwater level monitoring and reporting bi-annually.	
	Alterations in the quality of groundwater	Groundwater	Rehab and closure	• Groundwater quality monitoring and reporting bi-annually.	
	Injury and/or death due to open shaft	Safety	Rehab and closure	• Quarterly monitoring of shaft area during backfilling and rehabilitation to ensure safety	

Activity	Potential Impact	Aspects Affected	Phase	Mitigation	Standard to be Achieved
	Explosion risk during backfilling due to methane pockets	Safety	Rehab and closure	• Hourly monitoring of methane levels during backfilling and rehabilitation to ensure safety.	
	Decrease runoff	Surface water and groundwater	Rehab and closure	• Bi-annual surface water monitoring reports. Monitoring to take place for ten years post closure. • Groundwater quality and level monitoring bi-annually	
Removal of waste rock dump	Land contamination	Soil and land	Rehab and closure	None required	
	Injury and/or death due to open shaft	Safety	Rehab and closure	Quarterly monitoring of shaft area during backfilling and rehabilitation to ensure safety. Installation of plug.	
	Soil erosion	Soil	Rehab and closure	• Monitoring in line with closure requirements of existing Closure Plan.	
	Pollutants entering the surface water environment	Surface water	Rehab and closure	• Bi-annual surface water monitoring reports. Monitoring to take place for ten years post closure.	
Historical mining operations (residual impacts)	Residual radiation	Soil, surface water and groundwater	Rehab and closure	• Follow-up radiological monitoring event post-clean-up is required to ensure area is safe.	
	Change in groundwater levels	Groundwater	Rehab and closure	• Groundwater level monitoring and reporting bi-annually.	
	Alterations in the quality of groundwater	Groundwater	Rehab and closure	• Groundwater quality monitoring and reporting bi-annually.	

21.6 IMPACT MANAGEMENT ACTIONS

Table 24 lists the potential impacts and managing actions.

Table 24: Impact Management Actions

Activity	Potential Impact	Mitigation Type	Time Period Implementation	Compliance with Standards
Removal of all infrastructure and rubble	Loss of soil and land capability	• Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Use lighter vehicles (i.e. double cab vehicles) where possible; • Use manual labour instead of heavy machinery where possible; • Use as small as possible explosives for decommissioning; • Rip all dirt roads after final use thereof; • Liaise with future land users to find innovative ways to re-use current foundations instead of decommissioning; • Apply sufficient amounts of top soil on historic foundations; • Apply sufficient amounts of top soil where significant erosion has occurred; • Ensure that a specialist inspects all waste material to identify whether or not the relevant material is safe to backfill; and • All waste material deemed unsafe to backfill must be removed from site in an environmentally friendly manner.	As soon as possible post closure	Shall adhere to South African legislation pertaining to mine closures, including the Constitution, MDRPA and NEMA principles.
Backfilling of shaft		• Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Apply sufficient amounts of top soil where significant erosion has occurred; • Ensure that a specialist inspects all waste material to identify whether or not the relevant material is safe to backfill; and • All waste material deemed unsafe to backfill must be removed from site in an environmentally friendly manner.	As soon as possible post closure	

Activity	Potential Impact	Mitigation Type	Time Period Implementation	Compliance with Standards
Application of lime, fertilizer and other ameliorants		• Only the designated access routes are to be used to reduce any unnecessary compaction;	As soon as possible during rehabilitation	
Reseeding		• If no topsoil is available it is considered acceptable that rehabilitation proceed without topsoil. Rehabilitation must be monitored – if after 2 years little to no pioneer species have colonized the site then topsoil will need to be imported to the site in order to ensure proper rehabilitation takes place, • If re-seeding is required, it should take place a few weeks before the anticipated dry season to ensure a successful germination; • Rock armour should be applied to the degraded/eroded areas (especially those characterised by a slope) to support successful reseeding and minimize the risk of seeds washing away via overland flow; • Ripping should be carried out on all compacted areas a few days before reseeding; • Only indigenous grass species should be reseeded; and • Reseeding must take place a few weeks after the application of fertilizer, lime and other ameliorants. • Reseeding should take place a few weeks before the anticipated dry season to ensure a successful germination; • Rock armour should be applied to the degraded/eroded areas (especially those characterised by a slope) to support successful reseeding and minimize the risk of seeds washing away via overland flow; • Ripping should be carried out on all compacted areas a few days before reseeding; • Only indigenous grass species should be reseeded; and • Reseeding must take place a few weeks after the application of fertilizer, lime and other ameliorants	As soon as possible during rehabilitation	

Activity	Potential Impact	Mitigation Type	Time Period Implementation	Compliance with Standards
Ripping of compacted areas		• Ripping of compacted areas must be done by means of manual labour instead of heavy machinery as much as possible.	During rehabilitation	
General closure activities	Decrease in runoff	• Bi-annual surface water monitoring reports. Monitoring to take place for ten years post closure. • Groundwater quality and level monitoring and reporting bi-annually	As soon as possible post closure	
	Injury and/or death due to open shaft	• Quarterly monitoring of shaft area during backfilling and rehabilitation to ensure safety.	During backfilling and rehab	
	Explosion risk due to methane pockets	• Hourly monitoring of methane levels during backfilling and rehabilitation to ensure safety.	During backfilling and rehab	
Removal of waste rock dump	Land contamination	• None required	Not applicable	
	Soil erosion	• Monitoring in line with closure requirements of existing Closure Plan	Post closure	
	Pollutants entering the surface water environment	• Bi-annual surface water monitoring reports. Monitoring to take place for ten years post closure.	Ten years post closure	
Historical mining activities	Residual radiation	• Follow-up radiological event post-clean-up required to ensure area is safe.	As soon as possible post closure	
	Change in groundwater levels	• Groundwater level monitoring and reporting bi-annually	Ten years post closure	
	Alterations in the quality of groundwater	• Groundwater quality monitoring and reporting bi-annually	Ten years post closure	

22 FINANCIAL PROVISION

This section presents the basis of the calculation of the quantum for financial provisions for closure. The assessment and calculations are based on the 2005 DMR 'Guideline Document for the Evaluation of the Quantum of Closure-Related Financial Provision' provided by a Mine (DMR Guidelines).

22.1 DESCRIBE THE CLOSURE OBJECTIVES

The specific objectives that Harmony will adopt for rehabilitation and closure are to: • Protect the environment and public health and safety by using safe and responsible closure practices;

- Minimize potential environmental effects, such as surface or ground water impacts;
- Rehabilitate or remove any waste or potentially hazardous substances from site;
- Develop landforms that, within reasonable and practical limitations, are stable and blend with the surrounding terrain;
- Improve water quality consistent with the water quality standards within Harmony's area of responsibility;
- Development of end land use that takes into account the beneficial uses of the site and surrounding areas (where possible);
- Leave a closed mine that does not represent a risk to the health and safety of the community;
- Reduce the requirement for long-term monitoring and maintenance by establishing stable landforms;
- Comply with national regulatory requirements;
- Address relevant stakeholder expectations, concerns and issues;
- To enhance a positive socio-economic impact by achieving a sustainable land use condition or alternatively as agreed upon with the applicable government regulator and affected communities (where possible and practical); and

• Obtain a closure certificate. Various specific closure objectives and goals stated and committed to in the approved EMPR (Shangoni, 2009). These objectives are listed below.

22.1.1 TOPOGRAPHY OBJECTIVES

The following objectives were stated with regards to topography in the approved EMPR:

- To reduce the visual impact of the altered topography by a process of reclamation and rehabilitation.
- To dispose of all saleable assets.

22.1.2 SOILS OBJECTIVES

The following objectives were stated with regards to soils in the approved EMPR:

- To cover mining areas, as far as practically possible, with sufficient soil in order to maintain vegetation.

22.1.3 LAND CAPABILITY OBJECTIVES

The following objectives were stated in the approved EMPR with regards to land capability:

- To identify alternative use of as much of the infrastructure as possible
- To remove infrastructure not required in situ, and to restore the land where possible to natural vegetation.

22.1.4 LAND USE OBJECTIVES

The following land use objectives were stated in the approved EMPR:

- Investigate what infrastructure can have alternate uses.
- Remove all un-saleable infrastructures.

- Reinstate mining land to natural vegetation.
- Limit the long-term visual impact of mining activities.

22.1.5 VEGETATION OBJECTIVES

The following vegetation objectives were stated in the approved EMPR:

- To achieve self-sustaining vegetation on the mining area.

22.1.6 SURFACE WATER OBJECTIVES

The following surface water objectives were stated in the approved EMPR:

- To ensure that water pollution is contained on the mine property, and that natural watercourses are not affected.
- To eliminate the contamination of surface water thus obviating the need to treat excessive quantities of polluted water.

22.1.7 GROUNDWATER OBJECTIVES

The following groundwater objectives were stated in the approved EMPR:

- Ensure that individual facilities do not have long term adverse effects in terms of quality on the ground water users.

22.1.8 AIR QUALITY OBJECTIVES

The following air quality objectives were stated in the approved EMPR:

- Dust emanating from rehabilitated land should not exceed normal levels associated with agricultural and residential areas.

22.2 CONFIRM SPECIFICALLY THAT THE ENVIRONMENTAL OBJECTIVES IN RELATION TO CLOSURE HAVE BEEN CONSULTED WITH LANDOWNER AND INTERSTED AND AFFECTED PARTIES

All identified I&AP's, including directly affected parties, have the opportunity to review and comment on this report. The results of the public consultation shall be included in the final report submitted to the department for adjudication.

22.3 REHABILITAION PLAN

A detailed Closure and Rehabilitation Plan is provided in Table 25. This includes objectives, timeframes and monitoring required for each of the identified potential significant impacts. The full closure plan is included as Appendix E.

Table 25: Closure and Rehabilitation Plan (Closure)

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
Safety (Methane gas)	Ensure shaft is free from methane and that there is no potential for explosions whilst backfilling.	• Hourly monitoring of methane levels during backfilling and rehabilitation to ensure safety.	Hourly monitoring.	During backfilling of shaft.	No deaths or health impacts to workers or public during or post closure.
	Limit safety and environmental risks associated with built up underground methane.	• Install permanent plug with breather as per DMR guidelines.	Not required.	Post-closure.	Extraction of all underground methane.
Safety (Shaft)	Ensure shaft area is safe	• The shaft must be correctly sealed and capped to ensure there is no entry to the shaft and that the shaft does not pose a safety risk to the public.	Not required.	One year after backfilling	Shaft correctly sealed and capped in line with DMR requirements.
Groundwater	Prevention of groundwater contamination	• 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. Alternatively the	None required.	During backfilling of shaft.	Shaft correctly sealed and capped in line with DMR requirements.

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
		underground methane trapped in the shaft will be captured and extracted from the shaft.			
Surface Water	Stormwater Management to prevent potential surface water contamination. Eliminate the contamination of surface water	• During the decommissioning, rehabilitation and closure phases Harmony must ensure vehicles are regularly serviced so that hydrocarbon leaks are limited. Hydrocarbons should be stored off site where possible and handled carefully to limit spillage. • Designate a single location for refuelling and maintenance where possible and keep a spill kit on site to deal with any hydrocarbon leaks. • Remove any soil from the site which has been contaminated by hydrocarbon spillage. • The management of stormwater on the site is limited to the waste rock dump and mine shaft undergoing backfilling. Current rehabilitation of the site includes the backfilling of the mine shaft and may result in the removal of the waste rock dump. Once full site rehabilitation has occurred the recommendations in the hydrological report with regards to the SWMP and PCD will no longer be applicable as all areas will defined as 'clean' with regards to GN704.	None required.	During closure and rehab.	No hydrocarbon spillages during closure.
Soils and Land Use	Removal of infrastructure and replacement of topsoil	• After mining activities has been ceased, decommissioning of all infrastructure components must be implemented. These components mostly include various slabs of concrete that once was part of foundations. • Identify some structures that might be useful to future land users and establish how and why it should be preserved. • Assess whether the remaining infrastructure that should be removed can be re-used or recycled.	None required.	After removal of infrastructure from site	No remaining infrastructure units on site. Rehabilitated areas correctly shaped and profiled.

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
	Proper rehabilitation of soils	• The re-usable items should be removed from site. • All hazardous materials should be assessed by a specialist to ensure that suitable recommendations are made for the safe removal thereof, this include waste material. • All shafts should be backfilled, according to the DMR specifications and the approved Harmony Rehab Plan and cleared to be safe for rehabilitation thereof to take place. • Remaining infrastructure units must be demolished and removed. • If no topsoil is available it is considered acceptable that rehabilitation proceed without topsoil. Rehabilitation must be monitored – if after 2 years little to no pioneer species have colonized the site then topsoil will need to be imported to the site in order to ensure proper rehabilitation takes place, • After the removal of waste material on site, the rehabilitation process should start. A rehabilitation plan (Harmony, 2016) has been set-up to ensure that the disturbed area be restored to the conditions prior to the construction and operation of the St Helena Shaft. • All the rehabilitated areas will be shaped and profiled to be free draining and to emulate the surrounding surface topography. • All infrastructures will be removed and rehabilitated, should no alternative be found for the use of the structures. An alternative use for the brick structures will first be sought i.e. they can either be sold or donated to the post-mining landowner on sale of the land. If an alternative use cannot be found, the building material will be demolished. The rubble will either be removed or buried on site at depth not less than one metre below surface.			

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
		• All fences erected around the mine will be dismantled and either disposed of at a permitted disposal site or sold as scrap (provided that these structures will no longer be required by the post-mining landowner). Fences erected to cordon-off dangerous excavations will remain in place and will be maintained as and when required. • Rip unwanted roads and dispose of base material.			
Vegetation	Suitable revegetation and rehabilitation To cover mining areas with sufficient soil (where available) in order to maintain vegetation Reinstate mining land to natural vegetation. Limit the long-term visual impact of	• For each facility the maintenance on vegetation rehabilitation will be maintained for 18 months after germination. Once rehabilitation has been completed, a three-year period will be allowed to ensure that this vegetation is self-sustaining. • Weed infested areas may need to be scraped prior to re-vegetation to remove the weed seed source. Re-vegetation will be planned for the onset of wet season rain preferably after the spring rains in October. • A weed control plan for access roads and areas disturbed by mining activity based on identifying the type and extent of weed infestation and applying the appropriate control strategies will be developed. • Treatment to stimulate seed germination will be applied where appropriate. • Land surface will be ripped along the contour immediately prior to direct seeding. • Seeding densities will be appropriate to establish rapid vegetative cover in the short term as well as sustainable in the long term. Commercial advice on pasture seeding rates will be used.	Bi-annual inspection of the rate of establishment and distribution of vegetation and take corrective action where required for three years post closure.	During closure and rehab	Sustained unassisted vegetation growth for more than 2 years. No weed infestations.

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
	mining activities. To achieve self-sustaining vegetation on the mining area.				
Dust	Proper control of dust during rehabilitation	• Exposure of un-vegetated areas as a result of demolished infrastructure should be kept to a minimum and rehabilitated as timeously as possible. • Dust control measures should be adopted in critical locations during the rehabilitation process.	None required.	During rehab and closure	At least 70% of bare soil areas covered with vegetation.

Table 26: Closure and Rehabilitation Plan (Post-Closure)

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target

Groundwater	Groundwater monitoring to ensure no significant residual groundwater impacts.
	
	Ensure that individual facilities do not have long term adverse effects in terms of quality on the ground water users.
		• The current monitoring network is not considered sufficient for post-closure groundwater monitoring at St Helena. Harmony should commission an experienced hydrogeologist (who is registered with the South African National Council for Natural Scientific Professions) to site, drill, and install 3 monitoring boreholes in the 10 Shaft assessment area.
		• The boreholes should be sited by an experienced hydrogeologist using aerial imagery and a site geophysical survey to increase the probability of obtaining useful groundwater intersections in the aquifer;
		• The boreholes should be drilled to a depth of at least 35 m, although final depths should be decided by the appointed hydrogeologist;
		• The boreholes should be screened, constructed, and equipped as long-term monitoring boreholes;
		• The new boreholes should be added to Harmony's routine groundwater monitoring programme;
		• The three new boreholes and the existing borehole STHH 11 should be monitored as follows:
		  ○ Quarterly measurement of groundwater levels;
		  ○ Quarterly measurement of groundwater quality; and
		  ○ Groundwater samples should be collected using the procedure of Weaver et al (1996), including purging prior to sampling, field measurement of alkalinity, field filtering and preservation of a sample for metals analysis, and collection of an undisturbed sample for hydrocarbon analysis.
			Quarterly measurement of groundwater levels and monitoring reports for ten years post closure.
			
			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.
				As soon as possible post-closure.	Water samples comply with the relevant water quality limits.

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
		• Groundwater samples should be analysed for the following: ○ Analytes as indicated in the RAP: pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Sulphate (SO4) and Chloride (Cl); ○ Major anions: Fluoride (F), Nitrate (NO3); ○ Major cations: Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg); ○ Trace elements of environmental concern; ○ Hydrocarbons: Petroleum range organics (C4-C10), Diesel range organics (C10-C40), Volatile organic hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylene); and			
Surface Water	To ensure that water pollution is contained on the mine property, and that natural watercourses are not affected.	• The surface water monitoring programme for the site should focus on the two sampling locations identified in the surface water report (Hydrologic, 2018).	Sampling should take place on a quarterly basis. Bi-annual monitoring reports must be compiled. Monitoring to take place for ten years post closure. Parameters that need to be monitored are included in **Error! Reference source not found.** above.	As soon as possible post-closure.	Water samples comply with the relevant water quality limits.
Soils and Land Use	Ensure reference land	• A fertility assessment should be undertaken specifically on the currently disturbed/mining currently occupied by waste rock (which	Fertility assessment to be conducted to compare mining land	The fertility assessment can only be undertaken in the	Land meets reference conditions (grazing land capability)

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
	capability is achieved	then will be rehabilitated) area and compared to the reference conditions. • 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. According to the Chamber of Mines South Africa/Coaltech (2007), a post-mining land capability of "grazing land" can be reached by ensuring the rehabilitated area has a soil profile exceeding a depth of 250mm. However, to account for settling it is recommended that topsoil be replaced to at least 300mm. • A fertility assessment should be undertaken on the disturbed area to indicate how the proposed land capability (grazing) can be achieved.	with reference conditions once rehabilitation is complete.	mining area after decommissioning, backfilling and rehabilitation of the project area. Only after these phases will there be a rehabilitated soil form worth sampling. By acquiring information about fertility whilst the mining activities still commence means that reference conditions might change, which would account for a vital flaw.	
Landform	Site to match surrounding topography To reduce the visual impact of the altered topography by a process of reclamation	• All the rehabilitated areas will be shaped and profiled to be free draining and to emulate the surrounding surface topography. • Maintenance of the land surrounding the rehabilitated outcrop contouring must take place. Pollution of rehabilitated land during life of mine will be addressed and eliminated. Natural drainage patterns will be re-instituted where possible and will not be interfered with.	Annual inspection of landform required. Erosion status of the rehabilitated land should be monitored and zones with excessive erosion should be identified for remedial action. The remedial action should involve reshaping areas to ensure that they are	As soon as possible post closure.	Sustained unassisted vegetation growth for more than 2 years. At least 70% of bare soil areas covered with vegetation.

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
	and rehabilitation.		free-draining and establish vegetation on bare patches.		

22.4 EXPLAIN WHY IT CAN BE CONFIRMED THAT THE REHABILITATION PLAN IS COMPATIBLE WITH THE CLOSURE OBJECTIVES

The closure plan (Appendix E) was drafted in line with the closure objectives from the existing, approved EMP.

22.5 CALCULATE AND STATE THE QUANTUM OF THE FINANCIAL PROVISION REQUIRED TO MANAGE AND REHABILITATE THE ENVIRONMENT IN ACCORDANCE WITH THE APPLICABLE GUIDELINE

The calculations and statement of the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline are outlined in Section 17.1 above as required.

22.6 CONFIRM THAT THE FINANCIAL PROVISION WILL BE PROVIDED AS DETERMINED

The required funds for financial provision have already been provided to the DMR.

23 MECHANISMS FOR MONITORING COMPLIANCE

Successful rehabilitation will be measured against seven key environmental parameters. The purpose of monitoring is to ensure that the objectives of the rehabilitation plan are met and that the rehabilitation process is followed. The physical aspects of rehabilitation should be carefully monitored during the demolition and rehabilitation activities as well as during the progress of the desired final ecosystems. An environmental monitoring record will be kept by Harmony as per the requirements of the 2016 Rehabilitation Action Plan. A progress report will be submitted to DMR three years after closure to provide an update on the rehabilitation.

Table 27: Mechanisms for Monitoring Compliance

Source Activity	Impacts Requiring Monitoring Programmes	Functional Requirements for Monitoring	Roles and Responsibilities	Monitoring and Reporting Frequency and Time Periods for Implementation
Discontinuing of mining and historic mining activities during the operational phase of the shaft	Change in groundwater levels	Existing and additional boreholes will be used for monitoring purposes.	Harmony's Environmental Manager/Officer	Groundwater monitoring in line with specialist requirements included in geohydrological report. Quarterly measurement of groundwater levels and monitoring reports for ten years post closure. Bi-annual monitoring reports.
	Alterations in quality of groundwater	Existing and additional boreholes will be used for monitoring purposes.	Harmony's Environmental Manager/Officer	
	Pollutants entering the surface water environment	Surface water monitoring	Harmony's Environmental Manager/Officer	Monitoring as to the requirements of the hydrological specialist report. Bi-annual monitoring reports must be

Source Activity	Impacts Requiring Monitoring Programmes	Functional Requirements for Monitoring	Roles and Responsibilities	Monitoring and Reporting Frequency and Time Periods for Implementation
				compiled. Monitoring to take place for ten years post closure.
	Residual radiation	None.	Harmony's Radiation Protection Officer	Follow-up radiological monitoring event post-clean-up is required to ensure area is safe.
	Methane levels	None	Harmony's Environmental Manager/Officer	Levels to be monitored during backfilling to ensure area is safe for contractors / workers.

24 INDICATE THE FREQUENCY OF THE SUBMISSION OF THE PERFORMANCE ASSESSMENT/ ENVIRONMENTAL AUDIT REPORT

The continuous submission of performance assessments and/or environmental audit reports are no longer applicable after closure. An environmental monitoring record will be kept by Harmony as per the requirements of the 2016 Rehabilitation Action Plan. A progress report will be submitted to DMR three years after closure to provide an update on the rehabilitation.

25 ENVIRONMENTAL AWARENESS PLAN AND TRAINING

Harmony Gold shall ensure that adequate environmental training takes place. All employees and contractors (working on rehabilitation) shall be given an induction presentation on environmental awareness. Where possible, the presentation needs to be conducted in the language of the employees. The environmental training should, as a minimum, include the following:

- The importance of conformance with all environmental policies;
- The significant environmental impacts, actual or potential, as a result of their work activities;
- The environmental benefits of improved personal performance;
- Their roles and responsibilities in achieving conformance with the environmental policy and procedures, and with the requirement of Harmony Gold environmental management systems, including emergency preparedness and response requirements;
- The mitigation measures required to be implemented when carrying out their work activities;
- The importance of not littering; and
- Details of, and encouragement to, minimise the production of waste and re-use, recover and recycle waste where possible.

25.1 MANNER IN WHICH EMPLOYEES WILL BE INFORMED OF ENVIRONMENTAL RISKS

Mining operations have ceased on the project area, thus there are no permanent employees, but contractors employed for the rehabilitation and removal of alien invasive will be informed by their employer.

25.2 MANNER IN WHICH RISKS WILL BE DEALT WITH TO AVOID POLLUTION OR DEGRADATION

The following recommendations and guidelines are suggested:

- After mining activities has been ceased, decommissioning of all infrastructure components must be implemented. These components mostly include various slabs of concrete that once was part of foundations.
- The preferred options for the waste rock dump removal are either disposal of the waste rock off-site or use of the waste rock for backfilling the shaft or for other construction purposes. Both are considered equally acceptable from an environmental perspective;
- Encourage the establishment of vegetation on the area;
- Monitoring and Maintenance of the area to ensure that there is control of alien species on site;
- Vegetation which has been cleared should be removed from the site and disposed of as waste;
- Land surface will be ripped along the contour immediately prior to direct seeding.
- Loosening of the compacted soil should take place; this may include using rakes or sharp-pointed hoes;
- No machinery or heavy vehicles should be allowed on the area after it has been sown as this may lead to further compaction of the soil;
- The shaft must be correctly sealed and capped to ensure there is no entry to the shaft and that the shaft does not pose a safety risk to the public;
- The two radiation hotspots identified in the 2018 radiological assessment must be cleared up;
- Hourly monitoring of methane levels during backfilling and rehabilitation to ensure safety;
- All the rehabilitated areas will be shaped and profiled to be free draining and to emulate the surrounding surface topography;
- Harmony should commission an experienced hydrogeologist to site, drill, and install 3 monitoring boreholes in the 10 Shaft assessment area and a groundwater monitoring programme should be implemented;
- The surface water monitoring programme for the site should focus on the two sampling locations identified in the surface water report;
- All hazardous materials should be assessed by a specialist to ensure that suitable recommendations are made for the safe removal thereof, this include waste material;
- A grazing land capability should be achieved by ensuring the rehabilitated area has a soil profile exceeding a depth of 250 mm;
- Vegetation monitoring is required to be conducted, If invasive species are found on site then a weed control plan will be developed; and
- Install permanent plug with breather on the shaft to mitigate risks associated with underground methane.

26 SPECIFIC INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

No additional information was requested or is deemed necessary.

27 UNDERTAKING

The EAP herewith confirms:

(a) The correctness of the information provided in the reports;

(b) The comments and inputs from stakeholders and I&AP's will be included in the final BAR;

(c) The inclusion of inputs and recommendations from the specialist reports where relevant; and

(d) That the information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties will correctly be reflected herein.

Signature of the applicant / Signature on behalf of the applicant:

Environmental Impact Management Services (Pty) Ltd

Name of company (if applicable):

20 February 2020

Date:

28 REFERENCES

Digby Wells Environmental. (2017). Closure Cost Assessment Report (FS30/5/1/2/2/86MR)

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