

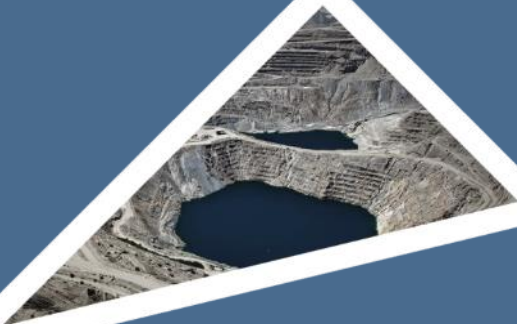


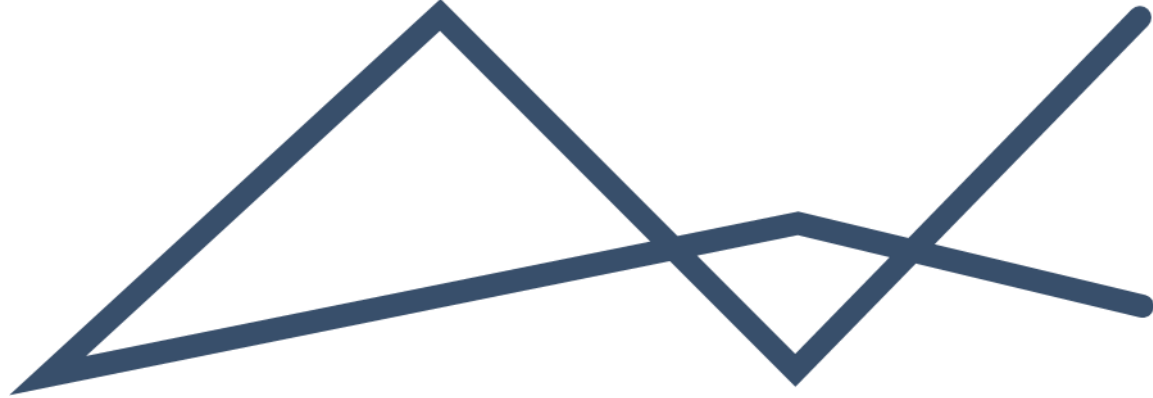
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## CLOSURE PLAN

HARMONY GOLD MINING COMPANY LIMITED: ST HELENA 10 SHAFT  
FS30/5/1/2/2/86MR





#### DOCUMENT DETAILS

EIMS REFERENCE: 1234  
DOCUMENT TITLE: ST HELENA SHAFT 10 (FS30/5/1/2/2/86MR) CLOSURE PLAN

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## Table of Contents

1	Introduction .....	4
2	Legislative context .....	4
3	Details of Applicant and EAP .....	6
4	Project Overview.....	7
4.1	Vegetation.....	7
4.2	Climate .....	7
4.3	Soils .....	8
4.4	Surface Water and Wetlands .....	11
4.5	Groundwater.....	14
5	Results of Risk Report .....	20
6	Mine Closure .....	20
6.1	Rehabilitation already undertaken .....	20
6.2	Closure Requirements.....	20
6.3	Closure Objectives .....	21
6.3.1	Closure Objectives Identified In Rehabilitation Plan .....	21
6.3.2	Closure Objectives Identified In EMPR .....	21
6.4	Post closure Objectives .....	22
6.4.1	Infrastructure Areas .....	22
6.4.2	Mine Facilities and Residue Deposits .....	22
6.5	Residual Impacts (Post Closure Impacts) .....	23
6.5.1	Residual Surface Water Impacts .....	23
6.5.2	Residual Groundwater Impacts.....	25
6.5.3	Residual Noise Impacts .....	26
6.5.4	Residual Regional Socio-Economic Structure Impacts.....	26
6.6	Rehabilitation, Decommissioning and Closure Plan.....	26
7	Final Land Use .....	34
8	Financial Provisions.....	34
8.1	Current Un-scheduled Closure Financial Provision.....	34
9	Public Participation .....	35
9.1	Identification of Interested and Affected Parties (I&APs) .....	35
9.2	Notification of Interested and Affected Parties.....	35
9.2.1	Initial notification of I&APs .....	36
9.2.2	Notification of Basic Assessment Report and associated appendices.....	37
9.3	Record of Issues Raised.....	37



10	Mechanisms for Monitoring closure Plan Compliance .....	38
11	References .....	38

## List of Figures

Figure 1: Locality Map showing the greater project area .....	9
Figure 2: Aerial image of the site area taken in June 2018.....	10
Figure 4: Hydrology and topography of region.....	12
Figure 5: Hydrology and topography of site .....	13
Figure 6: Histograms of SO <sub>4</sub> (sulphate) concentrations in Harmony monitoring boreholes west of (left) and north of (right) the 10 Shaft assessment area. ....	15
Figure 7: Inferred groundwater elevations at the St Helena 10 Shaft assessment area (turquoise arrows show inferred groundwater flow direction). ....	17

## List of Tables

Table 1: Contents of a Closure Plan in terms of NEMA requirements.....	4
Table 2: Contents of a Closure Plan in terms of MPRDA requirements. ....	5
Table 3: Applicant Details .....	6
Table 4: EAP Details .....	6
Table 5: Summary of aquifer parameters of the Karoo aquifer .....	14
Table 6: Groundwater levels used in this study.....	15
Table 7: Groundwater analysis results .....	18
Table 8: Monitoring parameters.....	24
Table 9: Closure and Rehabilitation Plan: Closure .....	27
Table 10: Closure and Rehabilitation Plan: Post-Closure.....	31
Table 11: Liability summary .....	34
Table 12: Opportunities Provided for Public Participation .....	37

## Appendices

Appendix 1: Closure Cost Assessment

Appendix 2: Risk Assessment Report

Appendix 3: Performance Assessment Report

Appendix 4: Regulation 2(2) Plan





## 1 INTRODUCTION

Environmental Impact Management Services (Pty) Ltd (EIMS) was appointed by Harmony Gold Mining Company Limited (Harmony) to compile a Closure Plan as part of a closure application for the St Helena 10 Shaft. Harmony has embarked on a rehabilitation programme since 2011, and to date 38 shafts have been rehabilitated, including the St Helena 10 shaft which falls under the FS/30/5/1/2/2/86 Mining Right (FS86MR). Demolition work at St Helena 10 was started in 2014 and was completed in early 2017. No infrastructure remains on the site. The shaft has not been filled to surface and a temporary plug has been installed to prevent illegal access to underground workings.

In terms of the MPRDA, Section 43 (4), an application for a closure certificate must be made to the Regional Manager of the Department of Mineral Resources and must be accompanied by the required information, programmes, plans and reports prescribed in terms of MPRDA and NEMA, as amended.

## 2 LEGISLATIVE CONTEXT

This report is compiled to comply with the requirements of National Environmental Management Act of 1998 (NEMA), with specific reference to Appendix 5: Content of a Closure Plan as per the 2014 EIA Regulations as per Table 1 below.

Table 1: Contents of a Closure Plan in terms of NEMA requirements

NEMA Appendix 5 Content of Closure Plan		Relevant section in this report
(a)	<i>details of –</i>	Section 3
(i)	<i>the EAP who prepared the closure plan; and</i>	
(ii)	<i>the expertise of that EAP;</i>	
(b)	<i>closure objectives;</i>	Section 6.3 and 6.4
(c)	<i>proposed mechanisms for monitoring compliance with and performance assessment against the closure plan and reporting thereon;</i>	Section 10
(d)	<i>measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity and associated closure to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development, including a handover report, where applicable;</i>	Section 6.6
(e)	<i>information on any proposed avoidance, management and mitigation measures that will be taken to address the environmental impacts resulting from the undertaking of the closure activity;</i>	Section 6.6
(f)	<i>a description of the manner in which it intends to –</i>	Section 6
(i)	<i>modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation during closure;</i>	
(ii)	<i>remedy the cause of pollution or degradation and migration of pollutants during closure;</i>	
(iii)	<i>comply with any prescribed environmental management standards or practices;</i>	
(iv)	<i>comply with any applicable provisions of the Act regarding closure;</i>	
(g)	<i>time periods within which the measures contemplated in the closure plan must be implemented;</i>	Section 6.6



<i>(h) the process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of closure; and</i>	Section 6.6
<i>(i) details of all public participation processes conducted in terms of regulation 41 of the Regulations, including–</i> <i>(i) copies of any representations and comments received from registered interested and affected parties;</i> <i>(ii) a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments;</i> <i>(iii) the minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants;</i> <i>(iv) where applicable, an indication of the amendments made to the plan as a result of public participation processes conducted in terms of regulation 41 of these Regulations: and</i>	Section 9
<i>(j) where applicable, details of any financial provisions for the rehabilitation, closure and on-going post decommissioning management of negative environmental impacts.</i>	Section 8

The Report is also compiled to comply with the requirements for a closure plan in terms of Regulation 62 of the Mineral and Petroleum Resources Development Act (MPRDA, Act No. 28 of 2002).

Table 2: Contents of a Closure Plan in terms of MPRDA requirements.

<b>MPRDA Regulation 62 Content of Closure Plan</b>	
<i>(a) a description of the closure objectives and how these relate to the prospecting or mine operation and its environmental and social setting</i>	Section 6.4
<i>(b) A Regulation 2(2) plan showing the land or area under closure;</i>	Appendix 4
<i>(c) A summary of the regulatory requirements and conditions for closure negotiated and documented in the environmental management programme or plan;</i>	Section 6.2
<i>(d) A summary of the results of the environmental risk report and details of identified residual and latent impacts;</i>	Section 5
<i>(e) A summary of the results of progressive rehabilitation undertaken;</i>	Section 6.1
<i>(f) A description of the methods to decommission each prospecting or mining component and the mitigation or management strategy proposed to avoid, minimize and manage residual or latent impacts;</i>	Section 6.4
<i>(g) Details of any long-term management and maintenance expected;</i>	Section 6.5 and 6.6
<i>(h) Details of financial provision for monitoring, maintenance and post closure management, if required;</i>	Section 8
<i>(i) A plan or sketch at an appropriate scale describing the final land use proposal and arrangements for the site;</i>	Section 7
<i>(j) A record of interested and affected persons consulted; and</i>	Section 9
<i>(k) Technical appendices, if any.</i>	Refer to Appendices



### 3 DETAILS OF APPLICANT AND EAP

The details of the applicant are provided in Table 3 and Table 4 below:

Table 3: Applicant Details

Applicant Contact Details	
<b>Name</b>	Harmony Gold Mining Company Limited
<b>Tel</b>	011 411 2000
<b>Fax</b>	011 692 3879
<b>Postal Address</b>	P.O. Box 2, Randfontein, 1760, South Africa
<b>Physical Address</b>	Randfontein Office Park, Corner of Man Reef Road and Ward Avenue, Randfontein, South Africa
<b>Contact person</b>	<a href="mailto:Warren.deWit@Harmony.co.za">Warren</a> de Witt (Warren.deWit@Harmony.co.za)

Table 4: EAP Details

Applicant Contact Details	
<b>Name</b>	Environmental Impact Management Services (Pty) Ltd (EIMS)
<b>Contact Person:</b>	John von Mayer
<b>Tel</b>	+27 11 789 7170
<b>Physical Address</b>	Block 5, Fernridge Office Park, 5 Hunter Avenue, Ferndale, Randburg
<b>Contact person</b>	John von Mayer (email: john@eims.co.za)

EIMS has a proven ability and experience in producing high quality, thorough and informative documents and reports. The professional staff members have the relevant expertise and experience in environmental management projects.

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 and 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 disposal site; and
- Closure Application for the Molopo-Evander Exploration Right, Mpumalanga Province.

## 4 PROJECT OVERVIEW

The St Helena shaft project area is located in the magisterial district of Matjhabeng within the Lejweleputswa District Council, Free State. Figure 1 provides a locality map of the greater project area, with a photograph of the site area (the area of works) provided in Figure 2. The project area is approximately 10km south of Welkom and is surrounded by wetland, grazing, agricultural crops, and industrial as well as commercial land use areas. A Tailings Storage Facility (TSF) is located directly to the east of the site. The St Helena 10 shaft was not formally operational and no old bearing material was mined from it.

**Error! Reference source not found.** provides a broad overview of the current land cover at the site. Land use in the area was identified using aerial imagery and then ground-truthed. The land use categories applicable to the greater regional area include:

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

Co-ordinates for the shaft and waste rock dump are provided in Table 5.

Table 5: Site Co-ordinates

Feature	Co-ordinates
Shaft	28° 3'30.04"S; 26°44'42.15"E
Waste Rock Dump (centre point)	28° 3'35.42"S; 26°44'40.41"E

### 4.1 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 (Rutherford & Mucina, 2006). There is less vegetation in the immediate site area as the area has been disturbed and part of the site is also covered by the Waste Rock Dump (WRD).

### 4.2 CLIMATE

This region is characterised by a warm-temperate summer rainfall climate with the average annual precipitation being approximately 530mm, (Rutherford & Mucina, 2006). High summer temperatures are common for this region with severe frost occurring throughout the winter (on average 37 days per year).



### 4.3 SOILS

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 marginalitic soils which occur rarely. 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 (Rutherford & Mucina, 2006).

During the 2018 survey of the site area, 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.

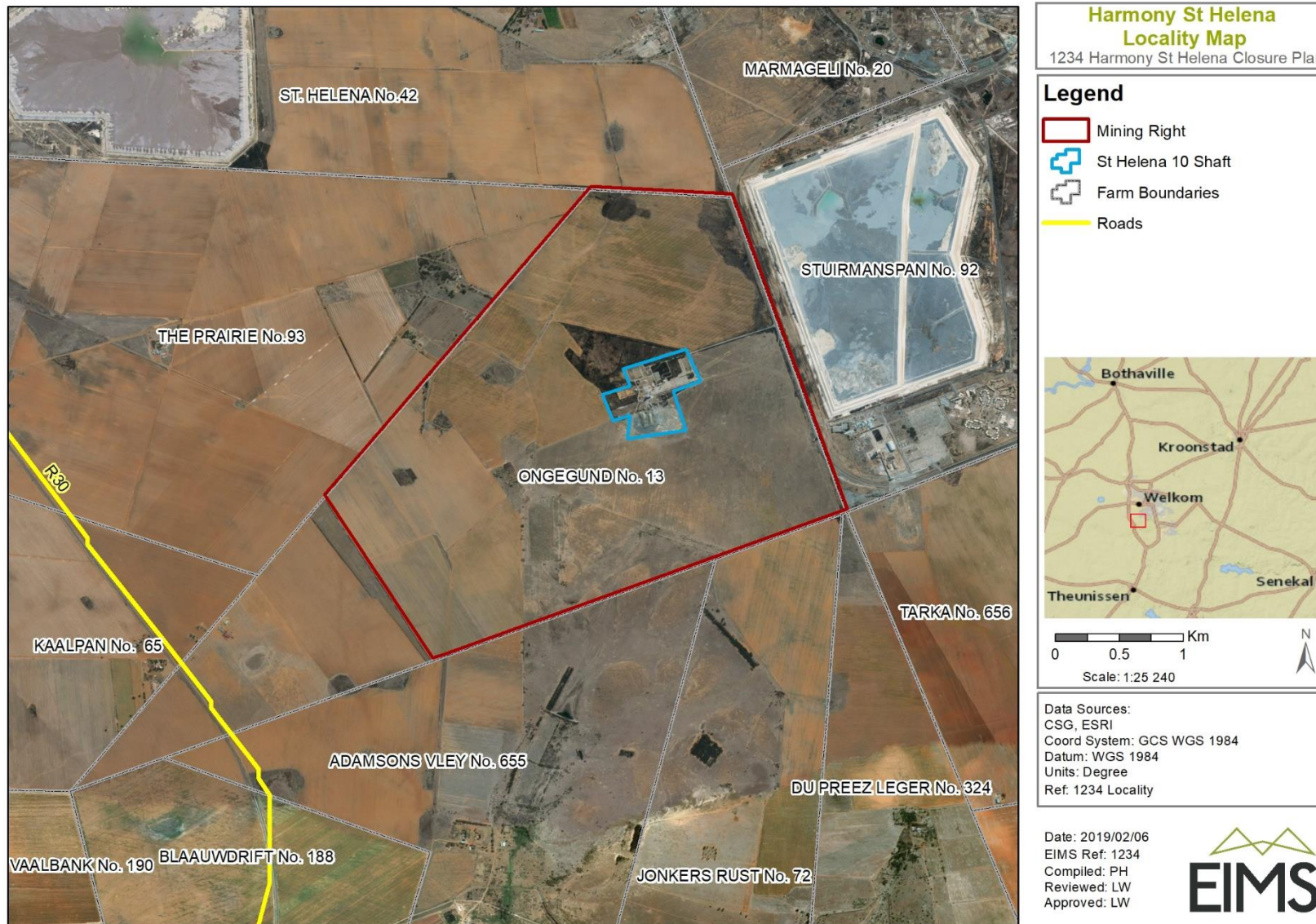


Figure 1: Locality Map showing the greater project area.

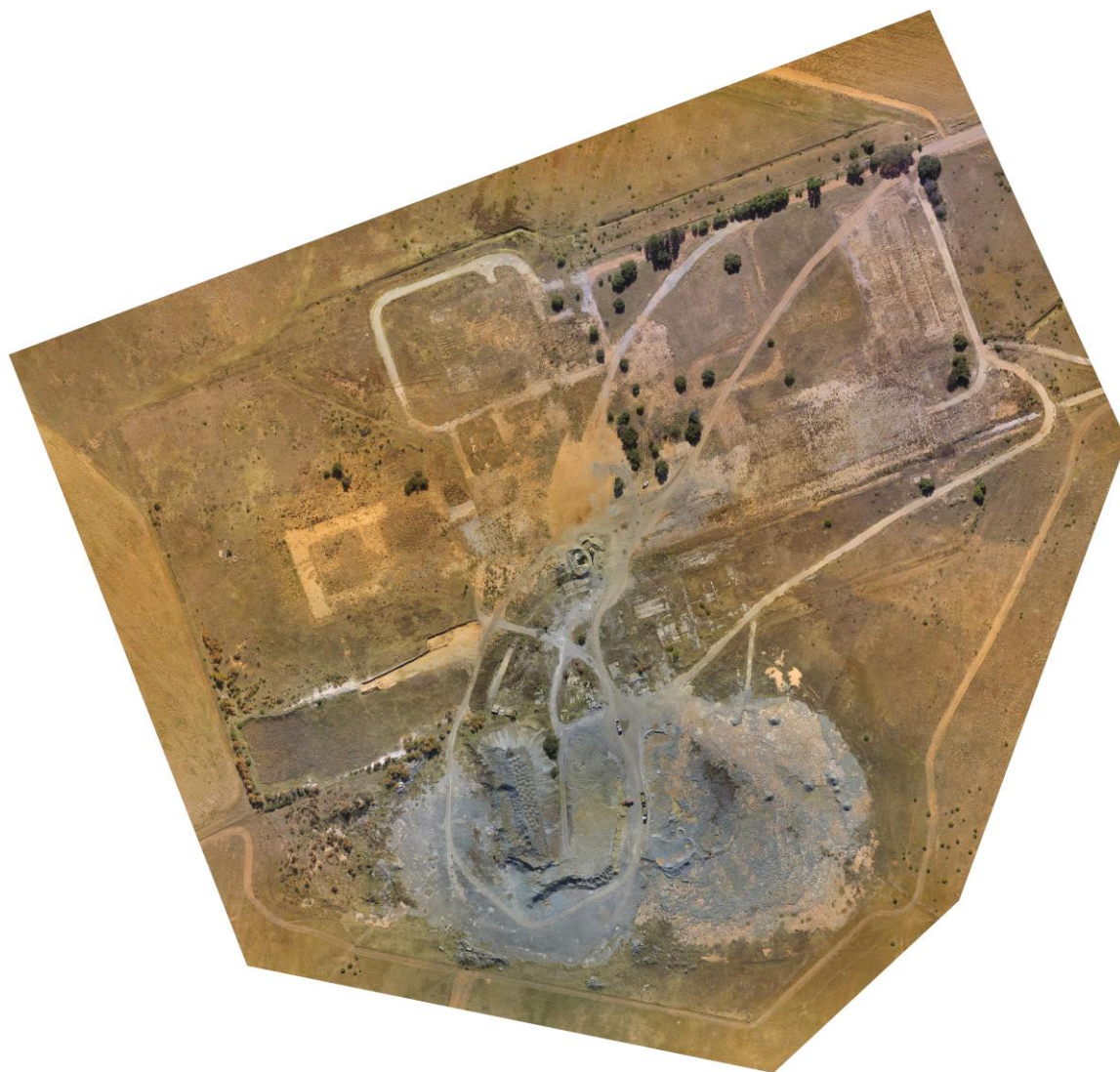


Figure 2: Aerial image of the site area taken in June 2018.



#### 4.4 SURFACE WATER AND WETLANDS

Figure 3 illustrates the topographical and hydrological setting of the site as identified by the surface water specialist. 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, reveals that the site drains to quaternary C24K (based upon SRTM30 data used). This variation from the quaternary catchment's 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 around 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 as a self-managed system. 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 of the mining right area.

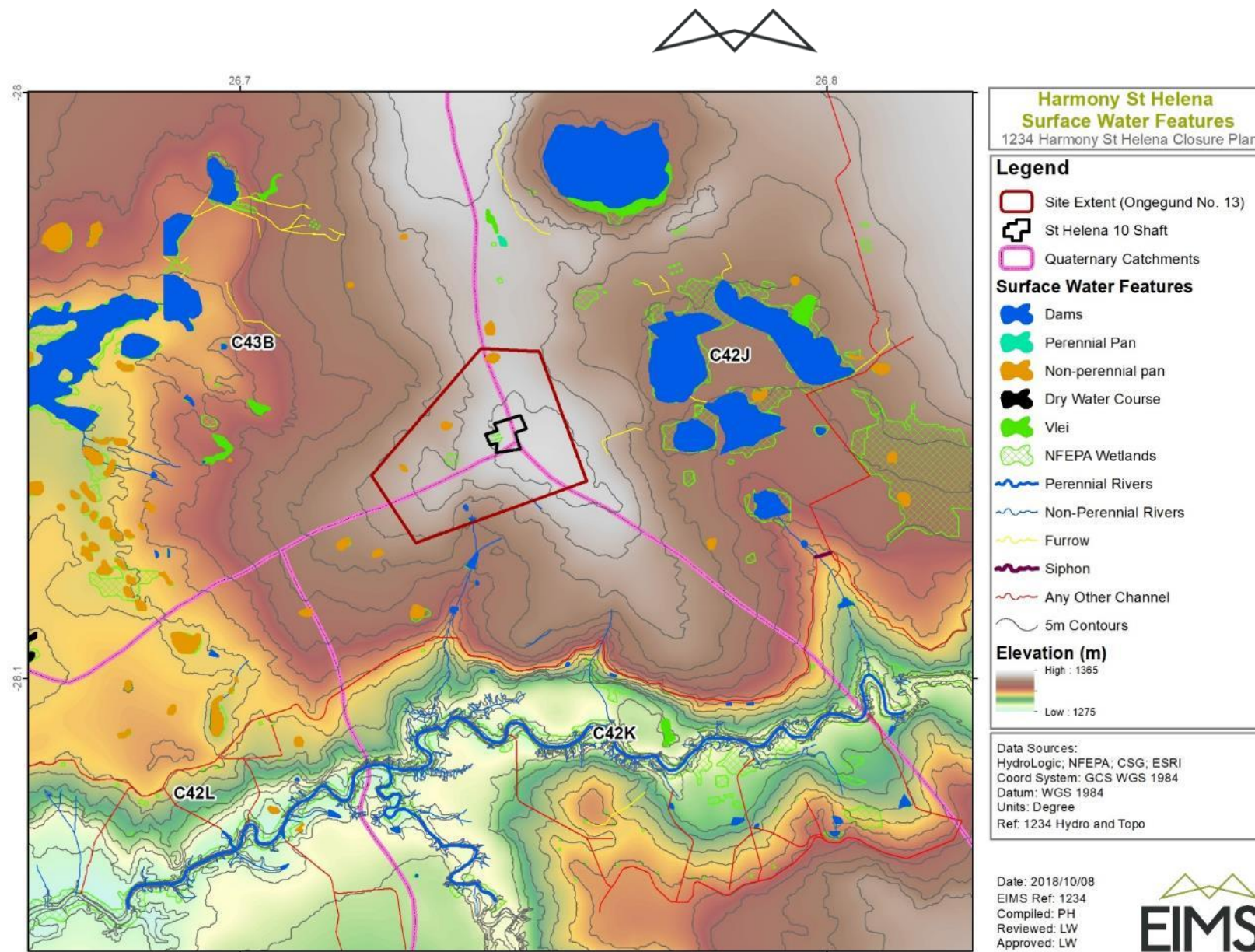


Figure 3: Hydrology and topography of region.

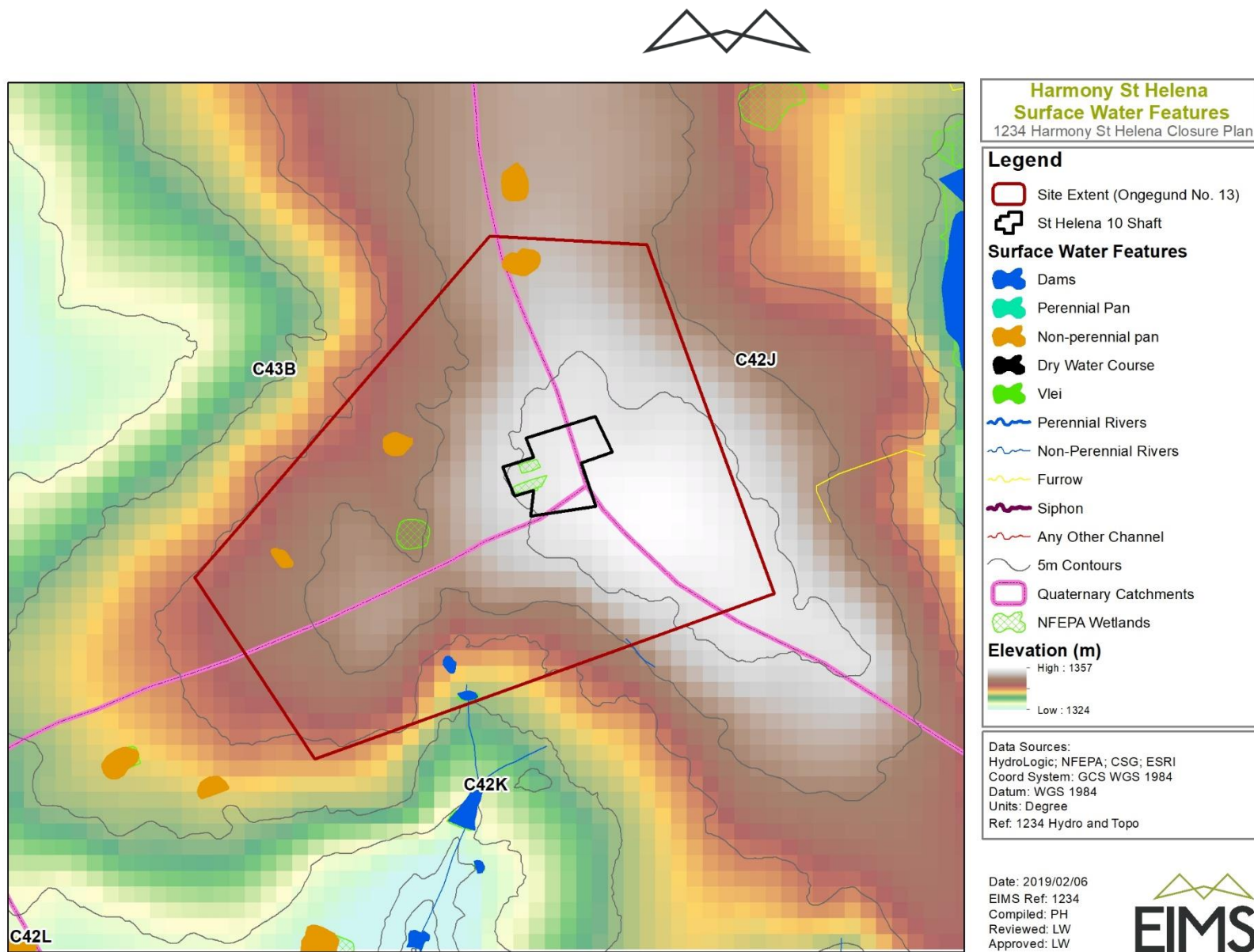


Figure 4: Hydrology and topography of site



## 4.5 GROUNDWATER

Two main aquifers exist in the area:

- Karoo aquifer, near surface and associated within the weathered and fractured Karoo Supergroup; and
- 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 Eccu Group rocks. The aquifer is confined to semi-confined. The impermeable shale horizons in the Beaufort and Eccu 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. The model results have indicated that the current groundwater impact from the WRD is indistinguishable from background groundwater quality, which is extensively contaminated by the FSS8 tailings dam. Further, removing the Waste Rock Dump (WRD) source, one outcome of shaft decommissioning activities, results in a low level (as indicated from the modelled distribution of sulphate concentrations) of offsite groundwater impact.

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 6: 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 <sup>-6</sup>	
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<sub>4</sub>) is available for five boreholes to the north of the 10 Shaft assessment area and six borehole to the west of the assessment area (Figure 6). There is some variance in the data. However, pH is generally between 7 and 8, while sulphate is generally less than 200 mg/L (Figure 5). There appear to be no trends in the Cl data.

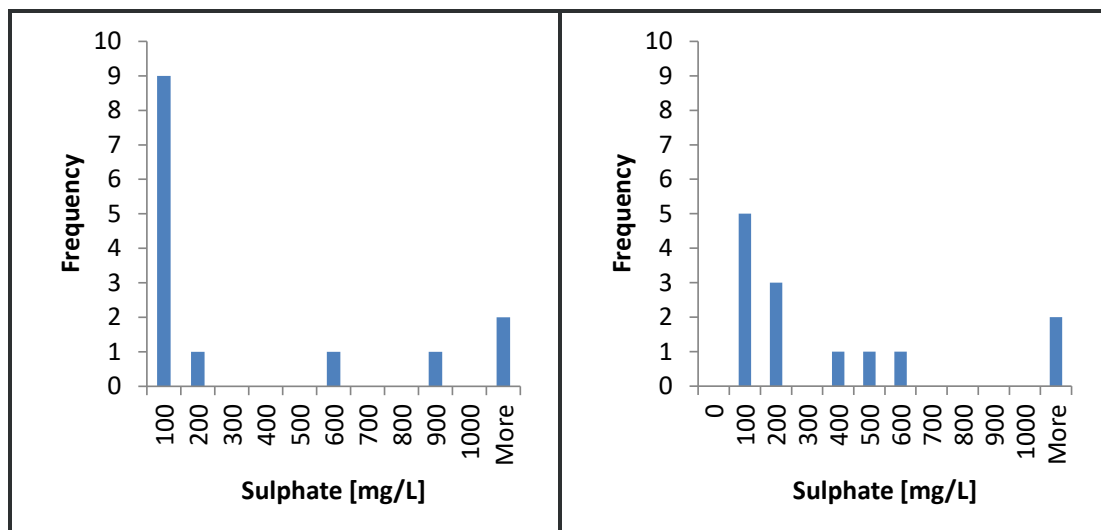


Figure 5: Histograms of SO<sub>4</sub> (sulphate) concentrations in Harmony monitoring boreholes west of (left) and north of (right) the 10 Shaft assessment area.

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 groundwater depth was measured, the actual depth of the boreholes is unknown.

Table 7 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 7: Groundwater levels used in this study

Borehole ID	Measured level (mbgl)	GW	Estimated elevation (mamsl)	GW	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



<b>STHH 23</b>	1.93	1 348	Harmony data
<b>STHH 6</b>	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. Figure 6 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.

Based on the two samples analysed, groundwater in the St Helena 10 Shaft area is neutral and saline (Table 8). 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 FSS8 TSF immediately upgradient of the 10 Shaft site and is separate from the St Helena 10 shaft area.

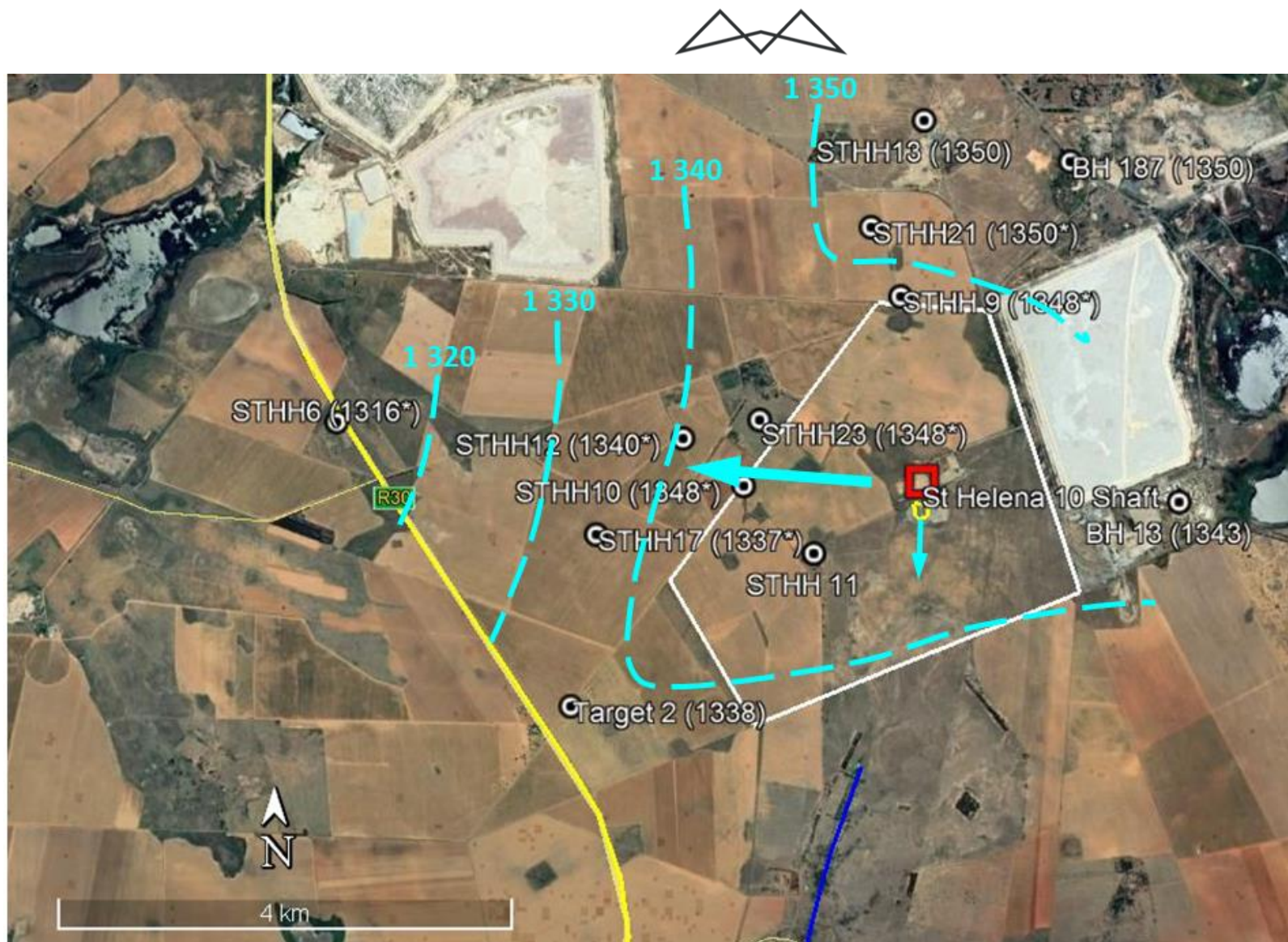


Figure 6: Inferred groundwater elevations at the St Helena 10 Shaft assessment area (turquoise arrows show inferred groundwater flow direction).



Table 8: Groundwater analysis results

Aqueous parameter	component/Units	STHH13	STHH11	SANS 241 <sup>A</sup>
pH	pH units	7.9	7.5	
Total Dissolved Solids	mg/L	1 322	914	<b>1 200</b>
Total Alkalinity as CaCO <sub>3</sub>	mg/L as CaCO <sub>3</sub>	220	252	
Chloride (Cl)	mg/L	326	248	<b>300</b>
Sulphate (SO <sub>4</sub> )	mg/L	358	61	<b>500*</b>
Fluoride (F)	mg/L	<0.2	0.4	<b>1.5*</b>
Nitrate (NO <sub>3</sub> )	mg/L as N	0.2	15	<b>11*</b>
Ortho Phosphate (PO <sub>4</sub> )	mg/L as P	<0.1	<0.1	
Free & Saline Ammonia (NH <sub>3</sub> )	mg/L as N	1.1	0.7	<b>1.5</b>
Al	mg/L	<0.100	<0.100	<b>0.3</b>
As	mg/L	<0.010	<0.010	<b>0.01*</b>
B	mg/L	0.167	0.086	<b>2.4*</b>
Ba	mg/L	0.061	0.114	<b>0.7*</b>
Ca	mg/L	60	120	
Cd	mg/L	<0.010	<0.010	<b>0.003*</b>
Cr	mg/L	<0.010	<0.010	<b>0.05*</b>
Cu	mg/L	<0.010	<0.010	<b>2*</b>
Fe	mg/L	0.430	<0.025	<b>2*</b>
Hg	mg/L	<0.010	<0.010	<b>0.006*</b>
K	mg/L	32	10.5	
Mg	mg/L	87	49	
Mn	mg/L	0.193	<0.025	<b>0.4*</b>
Na	mg/L	194	70	<b>200</b>
Ni	mg/L	<0.010	0.035	<b>0.07</b>
Sb	mg/L	<0.010	<0.010	<b>0.02*</b>
Se	mg/L	0.076	0.059	<b>0.04*</b>
U	mg/L	<0.010	<0.010	<b>0.03*</b>
Zn	mg/L	0.258	1.30	<b>5</b>



**Notes:**

<sup>A</sup> 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.

Key features of the conceptual groundwater 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 FSS8 tailings dam east (that is, upgradient) of 10 Shaft is unlikely to contribute to shallow groundwater contamination as the plume is moving in a North Easterly direction.
- 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 Waste Rock Dump (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; and
- Any contamination from decommissioning activities at 10 Shaft is likely to be superimposed on the contamination from the upgradient tailings dam.

Recovery of the 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. The February 2018 groundwater report from Digby Wells indicates that the shallow and deep aquifers in this area are not interconnected hydraulically. This is confirmed by the fact that although mine dewatering at Shaft 3 has been ongoing since 1952 in the deep aquifer, the water table of the shallow aquifer in the area is not affected. Modelling for other shafts in the area indicate that decant is unlikely due to the fact that neither the rate of inflow of water into the underground area is sufficient as well as low volumes of available water.



## 5 RESULTS OF RISK REPORT

Following the risk assessment completed as part of the risk report, there were several risks that were ranked as potential significant risks. These include:

- Safety Risks;
- Explosion risk due to methane;<sup>1</sup>
- Surface Water Impacts; and
- Soils 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 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 should rather be addressed as part of the closure of the TSF which is located on a separate mining right.

## 6 MINE CLOSURE

Mine closure is the period when operational activities of the mine have ceased, and final rehabilitation, decommissioning and mine reclamation are being completed. Mine closure for the purposes of this report can be divided into three distinct phases, namely: Rehabilitation, Decommissioning/closure, and post Closure. It is crucial that the mine closure aligns with the commitments made in the mines original EMPR.

### 6.1 REHABILITATION ALREADY UNDERTAKEN

Demolition work at St Helena 10 was started in 2014 and was completed in early 2017. Most concrete bases have been removed from site. Only the waste rock dump and shaft remain on site. The shaft has been filled to surface and a temporary plug has been installed to prevent illegal access to underground working. The shaft is currently being backfilled with material from the waste rock dump.

### 6.2 CLOSURE REQUIREMENTS

An application for closure has been submitted to DMR accompanied, inter alia, by the following documentation as described in Regulation 57 of the Mineral and Petroleum Resources Development Act, (Act 28 of 2002) (MPRDA):

- Completion of the prescribed closure application forms;
- A closure plan as contemplated in Regulation 62;
- An environmental risk report as contemplated in Regulation 60;
- In terms of Regulation 55 (8 & 9), the holder of the right must also complete a Final Performance Assessment which will accompany the application for a closure certificate; and
- NEMA Application Form and Basic Assessment for decommissioning and closure.

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<sup>1</sup> It should be noted that the shaft has been completely backfilled.



## **6.3 CLOSURE OBJECTIVES**

### **6.3.1 CLOSURE OBJECTIVES IDENTIFIED IN REHABILITATION PLAN**

Various objectives are listed in the 2016 Rehabilitation Plan compiled by Harmony. These specific objectives are listed below:

- 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;
- 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 by forming participative communication channels;
- 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;
- Avoid or minimise costs and long-term liabilities to the company and to the government and public; and
- Exonerate the company and its directors of further responsibility and accountability post end of life.

### **6.3.2 CLOSURE OBJECTIVES IDENTIFIED IN EMPR**

The relevant closure objectives and goals committed to are noted below:

- 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.

## **6.4 POST CLOSURE OBJECTIVES**

This section deals with post-closure objectives identified in the EMPR as well as additional objectives identified by the specialists as part of the closure assessment. These are described in more detail below.

### **6.4.1 INFRASTRUCTURE AREAS**

The following post-closure objectives identified in the EMPR are applicable for all infrastructure areas for St Helena 10:

- The mines objective is to leave all usable structures intact and only to demolish those which cannot be used by a third party.
- If any cracks on ground surface or sink holes appear equipment will be used to create bermwalls around the sink holes and fill cracks in the ground.
- Excavations are to be filled with uncontaminated rubble (such as old foundations, bricks and builders excavation material) or with uncontaminated washed rock from a waste dump.
- 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, used to backfill the shaft or buried on site at depth not less than one metre below surface. Alternatively it will be put into the shaft.
- 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.
- All unwanted over-land and sub-surface pipelines and associated concrete works will be demolished.
- Maintenance of the rehabilitated land 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.
- Rip unwanted roads and dispose of base material; and
- Where it is practicable the roofs of subterranean tunnels and ducts will be demolished and rehabilitated.

### **6.4.2 MINE FACILITIES AND RESIDUE DEPOSITS**

The following post-closure objectives are applicable for mine facilities and residue deposits.

- As the majority of the surface area is free of sources of mine pollution, the only management action plans will be those that will be applied to reshape the surface area where demolition activities took place in order to ensure effective run off of surface water.
- A fertility assessment should be undertaken specifically on the currently disturbed/mining currently occupied by the waste rock (which 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.



- A fertility should be undertaken on the disturbed area to indicate how the proposed land capability (grazing) can be achieved. 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

#### **6.4.2.1 FINAL REHABILITATION WITH RESPECT TO EROSION AND DUST CONTROL**

The dust management measures undertaken during the operation of the mine should be adhered to where appropriate. The following mitigation measures are recommended throughout the closure phase of the proposed mine:

- Exposure of un-vegetated areas as a result of demolished infrastructure should be kept to a minimum and rehabilitated as timeously as possible.
- Monitoring of sensitive receptor areas to be continued; and
- Dust control measures should be adopted in critical locations during the rehabilitation process.

#### **6.4.2.2 SEALING OF UNDERGROUND WORKINGS AND REHABILITATION OF DANGEROUS EXCAVATIONS**

All underground workings will be sealed as soon as it becomes certain that no further mining is to be done. Vertical and incline shafts will either be sealed off by means of constructing a plug in the shaft 3.0 metres below surface. These plugs will be designed by professional engineers. All dangerous excavations will be filled and rehabilitated as soon as mining in the area is complete. Alternatively the underground methane trapped underground will be captured and extracted from the shaft.

### **6.5 RESIDUAL IMPACTS (POST CLOSURE IMPACTS)**

This section lists the applicable residual post closure impacts associated with each environmental aspect for the St Helena 10 shaft area:

- The residual impact on the geology is that of the actual underground mine. The shafts will be plugged, but the underground series of haulages and tunnels will still remain.
- Due to the fact that the shaft will be backfilled no subsidence of any kind expected to occur and therefore no impacts on topography are expected. Subsidence of material can only occur within the shaft, hence we need to monitor until this stabilises. There will be no subsidence of surrounding topography due to the depth of mining undertaken.
- 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 impacts will occur.
- Ecological succession will continue on many parts of the mine for many years after closure. In some areas, climax communities will develop after a few years, while in areas of major or persistent disturbance plant communities will continue to change almost indefinitely. Planting of indigenous grass species would mitigate this to an extent,

#### **6.5.1 RESIDUAL SURFACE WATER IMPACTS**

The quality of surface water after closure should improve. The rock dump may be removed by this stage, but only if economically viable. There is unlikely to be any significant residual impact on the surface water quality as a result of the remaining rock dump. 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.



### 6.5.1.1 SURFACE WATER MONITORING

The monitoring programme for the site (as managed by Harmony) should consequently focus on the two sampling locations identified in the Hydrological Report (HydroLogic, 2018). A surface water monitoring programme is recommended.

Sampling should take place on a quarterly basis (in line with Harmony, 2016) although frequency of monitoring should also be agreed with the DWS. No discharge of any water is expected.

Parameters that need to be monitored should include (but are not limited) to those in Table 9. This table can be refined through the focus on contaminants of concern if known or as they become identified over time (i.e. if a potential contaminant is shown to be constantly below effluent limits, then its monitoring can be reduced/excluded in favour of contaminants that are more relevant).

Table 9: Monitoring parameters

In field measurements		
pH	Electrical conductivity	Total dissolved solids
Laboratory analysis		
pH	Ammonium	Copper
Electrical conductivity	Alkalinity as CaCO <sub>3</sub>	Mercury
Boron	Sulphate	Chloride
Selenium	Cobalt	Fluoride
Arsenic	Phosphate	Magnesium
Nitrate	Total dissolved solids (TDS)	Zinc
Bicarbonate	Cadmium	Potassium
Sodium	Calcium	Barium
Chrome	Chrome VI	Iron
Aluminum	Lead	Manganese

Bi-annual monitoring reports should, as a minimum, include the following:

- Comparison of water samples to differentiate seasonal variations and general trends due to the mining activities;
- Comparison of water samples to standards and guidelines set by the Department of Water and Sanitation (DWS); and
- Analysis of parameters over time so that trends can be established.

Potential surface Water Sampling Locations are indicated in the hydrological report (Hydrologic, 2018). Applicable effluent standards are provided in the '*Revision of General Authorisations in Terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998)*' published under Government Notice 665 in Government Gazette 36820, dated 6 September 2013, while the Water Research Commission (WRC) provides gold mine specific guidance.

### 6.5.1.2 STORMWATER MANAGEMENT

A conceptual storm-water management plan is included in the 2018 hydrological study completed by Hydrologic. Modifications to the SWMP will likely be possible once rehabilitation is complete with no requirements for storm water management infrastructure (i.e. diversions and PCD) assuming all areas including the waste rock dump are rehabilitated. 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 (including PCD removal where



relevant), the recommendations in the hydrological report with regards to the SWMP will no longer be applicable as all areas will be defined as 'clean' with regards to GN704.

### **6.5.2 RESIDUAL GROUNDWATER IMPACTS**

Mine waste disposal facilities may continue to pose a threat to groundwater quality well into the future. Assuming complete flooding of underground workings is allowed to take place after final closure of all mines in the region, which are interconnected, it is most unlikely that any decanting from mine water will occur from any shaft. Based on the latest modelling (2008) no decant is expected from the shaft. As the dewatering of the lower aquifer had no impact on the upper aquifer during the operational phase it is expected that the recharge of the deeper aquifer will also have no effect on the upper aquifer.

With specific reference to a number of mines in the Welkom area, including St Helena WRC (1992) makes a point that, "pollution has probably reached a quasi-steady state situation within 4 to 6 kilometres downstream from the pollution source." This statement, together with the relatively short remaining life of the mine, is taken as indicative of the fact that the situation with respect to the ground water contamination will not deteriorate significantly relative to that of the present day. In addition, the major source of ground pollution comes from the evaporation system which will no longer be in use after closure.

Numerical modelling was conducted to assess the magnitude, extent, and duration of groundwater quality impacts. This involved geochemical and hydrogeological modelling. The models were based on conceptual models of the WRD and Karoo aquifer developed from professional experience, available information, and the results of a limited hydrocensus conducted at the site.

The numerical modelling results suggest that current and future impacts on groundwater quality at 10 Shaft are indistinguishable from the elevated background resulting from ongoing contamination from the FSS8 tailings dam to the east of the MR area. Even if the FSS8 tailings dam were not present, model results suggest that the offsite impact from the 10 Shaft WRD (and by assumption, hydrocarbon-contaminated soil) is likely to be undetectable.

Note that the St Helena 10 Shaft itself has not been identified as a source of contamination for the following reasons:

- Aquifer dewatering in the vicinity of the shaft will have prevented it from being a source of groundwater contamination during operation. This is because dewatering will direct groundwater flow towards, rather than away, from the shaft.
- The current groundwater level in the shaft is not known. However, recovery of the 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.
- The shaft was backfilled with waste rock from the adjacent rock dump and surface soil. From a water quality perspective, the impact on groundwater will be less than the waste rock dump. This is because the footprint of the shaft backfill is smaller than the WRD and the potential seepage volume from the backfill is lower. Therefore, once groundwater levels have recovered and flow is away from the shaft, the potential for groundwater contamination from the backfill will be low.

#### **6.5.2.1 GROUND WATER MONITORING**

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 shallow aquifer monitoring boreholes in the St Helena 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; and
- 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 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<sub>4</sub>) and Chloride (Cl);
- Major anions: Fluoride (F), Nitrate (NO<sub>3</sub>);
- Major cations: Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg); and
- Trace elements of environmental concern: Hydrocarbons: Petroleum range organics (C<sub>4</sub>-C<sub>10</sub>), Diesel range organics (C<sub>10</sub>-C<sub>40</sub>), Volatile organic hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylene).

The groundwater monitoring results should be periodically evaluated by an experienced hydrogeologist to provide an opinion on the status of groundwater at the site and the need for further monitoring.

#### **6.5.2.2 ACID MINE DRAINAGE OR POOR-QUALITY LEACHATES**

There is a low potential for acid mine drainage or poor-quality leachate emanating from the mine or a residue deposit to impact on groundwater resources.. However the acid-base accounting (ABA) results indicate that the sample from the 10 Shaft waste rock dump is not acid generating.

#### **6.5.2.3 WASTE ROCK DUMP**

The impact of waste rock dump on groundwater should be relatively low. Acid-base accounting (ABA) results indicate that the sample taken from the 10 Shaft waste rock dump is not acid generating. As far as can be determined, the WRD is a legacy of original shaft development operations. Therefore, it has been present on the site for approximately 70 years. The WRD is likely to be removed as part of the site clearing and rehabilitation activities. However, the residual impact of 70 years of seepage on the underlying groundwater quality remains. However the acid-base accounting (ABA) results indicate that the sample from the 10 Shaft waste rock dump is not acid generating.

#### **6.5.3 RESIDUAL NOISE IMPACTS**

There will be a positive impact as all the mining activities will cease with a concomitant drop in the noise levels. Note that no mining has taken place on the site for many years and there are no current noise impacts occurring.

#### **6.5.4 RESIDUAL REGIONAL SOCIO-ECONOMIC STRUCTURE IMPACTS**

The socio-economic structure will change as Harmony will no longer be a source of employment, revenue for the fiscus or generate development of associated supply and service businesses. Limited employment opportunities have been created during the rehabilitation phase.

### **6.6 REHABILITATION, DECOMMISSIONING AND CLOSURE PLAN**

A detailed Closure and Rehabilitation Plan is provided in Table 10. This includes objectives, timeframes and monitoring required for each of the identified potential significant impacts.



Table 10: Closure and Rehabilitation Plan: Closure

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
<b>Safety (Methane gas)</b>	Ensure shaft is free from methane and that there is no potential for explosions whilst backfilling	<ul style="list-style-type: none"> <li>Hourly monitoring of methane levels during backfilling and rehabilitation to ensure safety.</li> </ul>	Hourly monitoring.	During backfilling of shaft.	No deaths or health impacts to workers or public during closure.
	Limit safety and environmental risks associated with built up underground methane.	<ul style="list-style-type: none"> <li>Capture and extraction of underground methane is recommended.</li> </ul>	Not required.	Post-closure,	Extraction of all underground methane.
<b>Safety (Shaft)</b>	Ensure shaft area is safe	<ul style="list-style-type: none"> <li>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.</li> </ul>	Not required.	One year after backfilling	Shaft correctly sealed and capped in line with DMR requirements.
<b>Surface Water</b>	Stormwater Management to prevent potential surface water contamination.	<ul style="list-style-type: none"> <li>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.</li> <li>Designate a single location for refuelling and maintenance where possible and keep a spill kit on site to deal with any hydrocarbon leaks.</li> <li>Remove any soil from the site which has been contaminated by hydrocarbon spillage.</li> </ul>	None required.	During closure and rehab.	No hydrocarbon spillages during closure.



Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
	Eliminate the contamination of surface water	<ul style="list-style-type: none"> <li>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 be defined as 'clean' with regards to GN704.</li> </ul>			
<b>Soils and Land Use</b>	<p>Removal of infrastructure and replacement of topsoil</p> <p>Proper rehabilitation of soils</p>	<ul style="list-style-type: none"> <li>After mining activities have been ceased, decommissioning of all infrastructure components must be implemented. These components mostly include various slabs of concrete that were once part of foundations.</li> <li>Identify some structures that might be useful to future land users and establish how and why it should be preserved.</li> <li>Assess whether the remaining infrastructure that should be removed can be re-used or recycled.</li> <li>The re-usable items should be removed from site.</li> <li>All hazardous materials should be assessed by a specialist to ensure that suitable recommendations are made for the safe removal thereof, this includes waste material.</li> <li>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.</li> <li>Remaining infrastructure units must be demolished and removed.</li> <li>All remaining foundations must be covered by approximately 300mm of topsoil similar to that of the surrounding environment. The physical properties and chemical properties thereof should be similar to reference conditions and even improved on to ensure sustainable development. 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,</li> </ul>	Annual monitoring of rehabilitated areas to check for acceptable rate of pioneer species colonization	After removal of infrastructure from site	<p>No remaining infrastructure units on site.</p> <p>Rehabilitated areas correctly shaped and profiled.</p>



Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
		<ul style="list-style-type: none"> <li>• 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.</li> <li>• All the rehabilitated areas will be shaped and profiled to be free draining and to emulate the surrounding surface topography.</li> <li>• 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.</li> <li>• 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.</li> <li>• Rip unwanted roads and dispose of base material.</li> </ul>			
<b>Vegetation</b>	<p>Suitable revegetation and rehabilitation</p> <p>To cover mining areas with sufficient soil (where available) in order to</p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• In particular, common and abundant pioneer species from the local vegetative environment will be selected for re-vegetating the area and/or phytoremediating the selected area. Suitable pasture species based on the best available advice will be selected for re-vegetation of cleared land surface.</li> <li>• 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.</li> </ul>	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
	<p>maintain vegetation</p> <p>Reinstate mining land to natural vegetation.</p> <p>Limit the long-term visual impact of mining activities.</p> <p>To achieve self-sustaining vegetation on the mining area.</p>	<ul style="list-style-type: none"> <li>• The viability of the seed used for re-vegetation will be tested this includes the consideration of seed for phytoremediation or non-edible crops.</li> <li>• Seed will be stored and handled appropriately to ensure viability and prevent insect and fungal attacks.</li> <li>• Treatment to stimulate seed germination will be applied where appropriate.</li> <li>• Land surface will be ripped along the contour immediately prior to direct seeding.</li> <li>• 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.</li> <li>• 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.</li> </ul>			
Dust	Proper control of dust during rehabilitation	<ul style="list-style-type: none"> <li>• Exposure of un-vegetated areas as a result of demolished infrastructure should be kept to a minimum and rehabilitated as timeously as possible.</li> <li>• Dust control measures should be adopted in critical locations during the rehabilitation process.</li> </ul>	None required.	During rehab and closure	At least 70% of bare soil areas covered with vegetation.



Table 11: Closure and Rehabilitation Plan: Post-Closure

Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
<b>Groundwater</b>	<p>Groundwater monitoring to ensure no significant residual groundwater impacts.</p> <p>Ensure that individual facilities do not have long term adverse effects in terms of quality on the ground water users.</p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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;</li> <li>• The boreholes should be drilled to a depth of at least 35 m, although final depths should be decided by the appointed hydrogeologist;</li> <li>• The boreholes should be screened, constructed, and equipped as long-term monitoring boreholes;</li> <li>• The new boreholes should be added to Harmony's routine groundwater monitoring programme;</li> <li>• The three new boreholes and the existing borehole STHH 11 should be monitored as follows: <ul style="list-style-type: none"> <li>○ Quarterly measurement of groundwater levels;</li> <li>○ Quarterly measurement of groundwater quality; and</li> <li>○ 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.</li> </ul> </li> <li>• Groundwater samples should be analysed for the following: <ul style="list-style-type: none"> <li>○ Analytes as indicated in the RAP: pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Sulphate (SO<sub>4</sub>) and Chloride (Cl);</li> <li>○ Major anions: Fluoride (F), Nitrate (NO<sub>3</sub>);</li> <li>○ Major cations: Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg);</li> </ul> </li> </ul>	<p>Quarterly measurement of groundwater levels and monitoring reports for ten years post closure.</p> <p>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.</p>	As soon as possible post-closure.	Water samples comply with the relevant water quality limits.



Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
		<ul style="list-style-type: none"> <li>○ Trace elements of environmental concern;</li> <li>○ Hydrocarbons: Petroleum range organics (C4-C10), Diesel range organics (C10-C40), Volatile organic hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylene); and</li> </ul>			
<b>Surface Water</b>	To ensure that water pollution is contained on the mine property, and that natural watercourses are not affected.	<ul style="list-style-type: none"> <li>• The surface water monitoring programme for the site should focus on the two sampling locations identified in the surface water report (Hydrologic, 2018).</li> </ul>	<p>Sampling should take place on a quarterly basis. Bi-annual monitoring reports must be compiled. Monitoring to take place for ten years post closure.</p> <p>Parameters that need to be monitored are included in Table 9 above.</p>	As soon as possible post-closure.	Water samples comply with the relevant water quality limits.
<b>Soils and Land Use</b>	Ensure reference land capability is achieved	<ul style="list-style-type: none"> <li>• A fertility assessment should be undertaken specifically on the currently disturbed/mining currently occupied by the waste rock (which then will be rehabilitated) area and compared to the reference conditions.</li> <li>• 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</li> </ul>	Fertility assessment to be conducted to compare mining land with reference conditions once rehabilitation is complete.	The fertility assessment can only be undertaken in the mining area after decommissioning, backfilling and rehabilitation of the project area. Only after these phases will there be a rehabilitated soil form worth sampling. By acquiring information about	Land meets reference conditions (grazing land capability)



Aspect	Objectives	Implementation	Monitoring	Timeframes for Implementation	Target
		<p>exceeding a depth of 250mm. However to account for settling it is recommended that topsoil be replaced to at least 300mm.</p> <ul style="list-style-type: none"> <li>• A fertility should be undertaken on the disturbed area to indicate how the proposed land capability (grazing) can be achieved.</li> </ul>		fertility whilst the mining activities still commence means that reference conditions might change, which would account for a vital flaw.	
<b>Landform</b>	<p>Site to match surrounding topography</p> <p>To reduce the visual impact of the altered topography by a process of reclamation and rehabilitation.</p>	<ul style="list-style-type: none"> <li>• All the rehabilitated areas will be shaped and profiled to be free draining and to emulate the surrounding surface topography.</li> <li>• 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.</li> </ul>	<p>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 free-draining and establish vegetation on bare patches.</p>	As soon as possible post closure.	<p>Sustained unassisted vegetation growth for more than 2 years.</p> <p>At least 70% of bare soil areas covered with vegetation.</p>



## 7 FINAL LAND USE

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 and therefore “grazing” land capability should be favoured and the entire site should be rehabilitated to “grazing” or “arable” land capability. A fertility assessment is to be conducted to compare mining land with reference conditions once rehabilitation is complete. The fertility assessment must be undertaken in the mining area after decommissioning, backfilling and rehabilitation of the project area. 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. To account for settling it is recommended that topsoil be replaced to at least 300mm (if possible).

## 8 FINANCIAL PROVISIONS

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).

### 8.1 CURRENT UN-SCHEDULED CLOSURE FINANCIAL PROVISION

This section provides an overview of the findings of the closure assessment and financial provision estimation. The quantum for financial provisions for un-scheduled closure has been estimated using the rule-based approach defined in the DMR Guideline. Refer to for a summarised breakdown of the closure liability estimate. The itemised breakdown upon which this estimated is based on the 2018 Closure Cost Assessment completed by Digby Wells provided in Appendix 1 and a summary is included in Table 12.

Table 12: Liability summary

Summary - St. Helena #10	
<b>Shafts</b>	
Shaft 10	R 1,088,421
<b>WRD #10</b>	<b>R 4,774,431</b>
TOTAL (excludes rehabilitation)	R 4,774,431
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
<b>GRAND TOTAL</b>	<b>R 6,369,194</b>

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.

The following assumptions have been developed based upon the information provided and obtained from the site visit:

- The calculations do not account for any value recovered from the sale of plant, steel or other material;
- All roads within the mining area are the responsibility of the mine, except where they are proclaimed national or provincial roads;
- A contingency of 10% has been included to allow for areas which may have been undervalued or which have been overlooked;
- Figures received from Harmony were assumed to be correct for the purposes of the report;



- For post-closure vegetation monitoring and maintenance, costs for monitoring and maintenance the success of vegetation growth at rehabilitated sites has been assumed to take place for a period of three years with assessments taking place on an annual basis. A 75% vegetation success rate has been assumed on rehabilitated areas, hence vegetation maintenance only accounted for 25% of the rehabilitated areas for vegetation maintenance; and
- For post-closure monitoring, sampling of groundwater and surface water has been assumed to take place for a period of 10 years with sampling taking place twice a year.

## **9 PUBLIC PARTICIPATION**

A public participation process (PPP) as required by Chapter 6 of the EIA regulations, 2014 as amended has been undertaken. The PPP has been structured to provide I&APs with an opportunity to provide input on the closure project through the review of documents/reports and to provide comments throughout the Basic Assessment (BA) Process.

### **9.1 IDENTIFICATION OF INTERSTED AND AFFECTED PARTIES (I&APS)**

An initial I&AP database has been compiled from previous projects in the area and Windeed searches. I&APs identified 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.

The following list of stakeholders, but not limited to, have been notified of the project:

- |   |   |
|---|---|
| • National Department of Rural Development and Land Affairs;  | • Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs; |
| • National Department of Agriculture, Forestry and Fisheries; | • Free State Department of Agriculture and Rural Development;                                       |
| • National Department of Mineral Resources;                   | • Free State Department of Public Works and Infrastructure;   |
| • National Department of Environmental Affairs;               | • Lejweleputswa District Municipality;  |
| • National Department of Water and Sanitation;                | • South African Heritage Resource Agency;   |
| • Free State Department of Water and Sanitation;              | • Federation for a Sustainable Environment;   |
|   | • Transnet; and   |
|   | • Eskom.  |

### **9.2 NOTIFICATION OF INTERESTED AND AFFECTED PARTIES**

This section provides details on the notifications that were distributed as part of the consultation process to date.



## **9.2.1 INITIAL NOTIFICATION OF I&APS**

The PPP commenced on the 24<sup>th</sup> of July 2018 with an initial notification and call to register ending on the 28<sup>th</sup> of August 2018. Notification during this initial consultation was given in the manner described below.

### **9.2.1.1 REGISTERED LETTERS, FAXES AND EMAILS**

Notification letters (in English and Afrikaans), faxes, and/or emails were distributed to pre-identified.

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.

### **9.2.1.2 NEWSPAPER ADVERTISEMENTS**

Advertisements describing the proposed project and BA process were placed in the Vista Newspaper with circulation in the vicinity of the study area on the 26<sup>th</sup> 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.

### **9.2.1.3 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 19<sup>th</sup> 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.

### 9.2.2 NOTIFICATION OF BASIC ASSESSMENT REPORT AND ASSOCIATED APPENDICES

Notification regarding the availability of the BA Report (including the closure report) has been provided to registered I&APs in the following manner:

- Notification letters (in English and Afrikaans), faxes, registered mail and/or emails were distributed to all pre-identified key I&APs as well as I&APs registered during the initial notification period; and
- Notification documents included details on the duration of the BA report and associated appendices review period, as well as where the report will be available for public review.

The report and associated appendices will be made available for public review for a period of 30 days. A summary of Public Participation Processes is provided in Table 13.

Table 13: Opportunities Provided for Public Participation

PUBLIC PARTICIPATION PHASE			
ACTION	DESCRIPTION	PUBLICATION/PLACE	DATE
<b>Initial Public Notification (announcement of project and call to register)</b>	Newspaper advertisements	Vista Newspaper	<b>26<sup>th</sup> July 2018</b>
	Placement of site notices.	5 A1 site notices (English and Afrikaans) within and around the study area (5 placement locations). Poster placement at the Welkom public library, local municipality and the local Checkers.	<b>19<sup>th</sup> July 2018</b>
	Notification of landowners, occupiers, and other key I&APs.	Affected landowners and key I&APs were notified via email, fax, and/or post.	<b>24<sup>th</sup> July 2018</b>
<b>BA report</b>	<b>Notification of landowners, occupiers, and other key I&amp;APs.</b>	<b>Affected landowners, legal occupiers, and key I&amp;APs were notified via email, SMS, fax, and/or post.</b>	<b>TBA</b>

### 9.3 RECORD OF ISSUES RAISED

The comments presented in the comments and response report appended to the BA Report are those that have been received and addressed from 19<sup>th</sup> July 2018 to date and will be updated post the public review period of the BA report.

The majority of the received comments to date refer to registration, water and waste management and arable land. The comments and issues raised through the public participation will be considered and used inform the compilation of this closure plan and the BA report.



## 10 MECHANISMS FOR MONITORING CLOSURE PLAN 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.

## 11 REFERENCES

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

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Harmony Gold Mining Company (2016). *Free State Rehabilitation Action Plan*, St Helena. Rutherford, M., & Mucina, L. (2006). *The Vegetation of South Africa, Lesotho and Swaziland*. SANBI.

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Shangoni Management Services (Pty) Ltd (2009), St Helena Environmental Management Programme.