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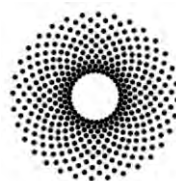
ENVIRONMENTAL
COMPLIANCE CONSULTANCY



ECC-107-273-REP-06-A

NAVACHAB TRIAL UNDERGROUND - ML 31 ENVIRONMENTAL CLEARANCE AMENDMENT APPLICATION

PREPARED FOR



QKR NAMIBIA
NAVACHAB GOLD MINE

November 2020

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ABBREVIATIONS

Backs	A term used to describe the roof of the underground mine
DEA	Department of Environmental Affairs
DMS	Dense Media Separation
ECC	Environmental Compliance Consultancy
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EMP	Environmental Management Plan
EPRP	Emergency Preparedness and Response Plan
ESIA	Environmental and Social Impact Assessment
Ha	Hectare
I&APs	Interested and Affected Parties
IFC	International Finance Corporation
ISO 14001	International Standards Organisation
Kg	Kilogram
Km	Kilometre
kW	Kilowatt
LHD	Loader Hauler Dumper
m ³ /s	Meters cubed per second
MEFT	Ministry of Environment Forestry and Tourism
ML	Mining Licence
MME	Ministry of Mines and Energy
Navachab	QKR Namibia Navachab Gold Mine
NDP5	National Development Plan 5
ppm	Parts per million
QRK	QKR Namibia Navachab Gold Mine
ROM	Run of Mine
SLOS	Sublevel open stoping
SOP	Safe Work Procedure / Standard Operating Procedure
Stope	A underground mining method
tpd	Tonnes per day
TSF	Tailings Storage Facility
TSP	Total Suspended Particulates
WRD	Waste Rock Dump

1 INTRODUCTION

1.1 PROJECT OVERVIEW

QKR Namibia Navachab Gold Mine (Navachab) is an operating gold mine owned and operated by QKR Namibia (QKR). Navachab is located in the (north-central) Namibia in the Erongo region, near Karabib. The Navachab deposit was first discovered in 1984 and the first gold produced was in 1989. The Navachab gold mine is owned and operated by QKR Namibia Navachab Gold Mine Pty Ltd. The site holds ISO 14001 certification for environmental management. The mine is located on the farm Navachab 58. The Project is located approximately 180km north west of Windhoek, and approximately 10km from Karibib, refer to figure 1 for the project location.

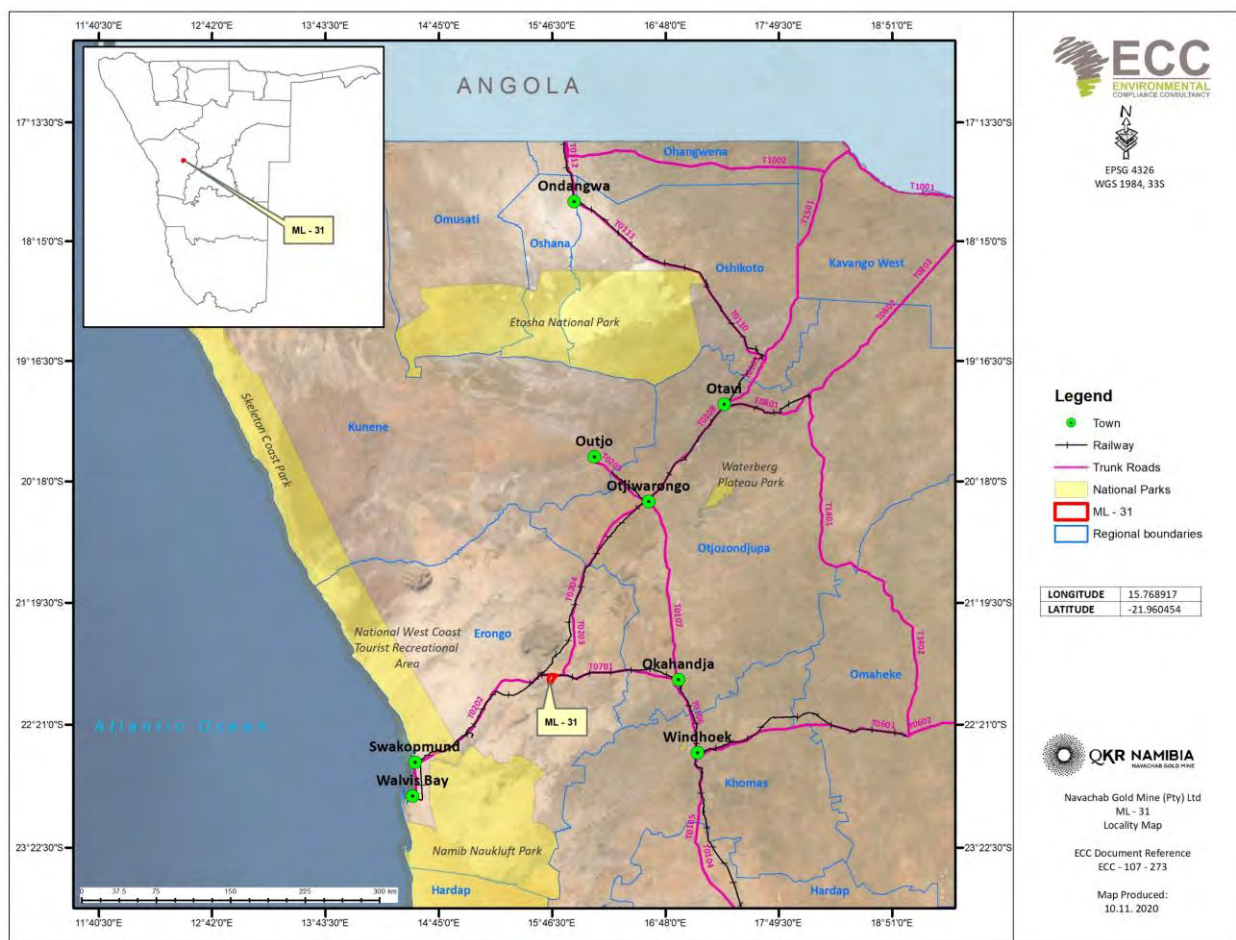


FIGURE 1 - A SATELITE IMAGE INDICATING THE LOCAL SETTING OF ML 31 - NAVACHAB GOLD MINE

1.2 AMENDMENT APPLICATION SCOPE

Environmental Compliance Consultancy was engaged by Navachab to undertake an Environmental Scoping Report plus Environmental Impact Assessment (referred to as an EIA herein) for the proposed trial underground mine to the Navachab Gold Mine (referred to as the 'Project' herein).

The existing and approved Navachab gold mine is an open pit operation, with gold production from two open pits (South and North pit). In addition to the current operations Navachab intends

to include underground mining as a method to extract ore at depth. This will be done in two phases:

- Phase 1 – Trial underground mine (this project)
- Phase 2 – Full scale underground mine (viability and feasibility of phase 2 will be assessed during phase 1)

1.3 ENVIRONMENTAL COMPLIANCE CONSULTANCY

Environmental Compliance Consultancy (ECC), a Namibian consultancy (registration number Close Corporation 2013/11401), has prepared this report and impact assessment on behalf of the proponent. ECC operates exclusively in the environmental, social, health and safety fields for clients across Southern Africa, in both the public and private sectors. ECC is independent of the proponent and has no vested or financial interest in the proposed project, except for fair remuneration for professional services rendered.

All compliance and regulatory requirements regarding this report should be forwarded by email or posted to the following address:

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2 APPROACH TO THE IMPACT ASSESSMENT

2.1 PURPOSE AND SCOPE OF THE ASSESSMENT

The aim of this assessment is to determine which impacts are likely to be significant (the main focus of the assessment); scope the available data and any gaps which need to be filled; determine the spatial and temporal scope; and identify the assessment methodology.

Subsequently, scoping of the EIA was undertaken by the EIA team. The scope of the assessment was determined through undertaking a preliminary assessment of the proposed project against the receiving environment obtained through a desk-top review, available site specific literature, monitoring data and site reports.

2.2 THE ASSESSMENT PROCESS

The EIA methodology applied to this EIA has been developed using the International Finance Corporation (IFC) standards and models, in particular Performance Standard 1, 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2017) (International Finance Corporation, 2012); Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008); international and national best practice; and over 25 years of combined EIA experience.

ECCs methodology for environmental impact assessments is adopted and based on models for environmental and social impact assessments set out by the International Finance Corporation (IFC) Performance Standard 1 'Assessment and management of environmental and social risks and impacts. Furthermore, this impact assessment was undertaken for Navachab in accordance with Namibian legal requirements.

This impact assessment is a formal process in which the potential effects of the project on the biophysical, social and economic environments are identified, assessed and reported, so that the significance of potential impacts can be taken into account when considering whether to grant approval, consent or support for the proposed project.

Final mitigation measures and recommendations are based on the cumulative experience of the consulting team and the client, taking into consideration the potential environmental and social impacts. The process followed through the basic assessment is illustrated in figure 2 and detailed further in the following sections.

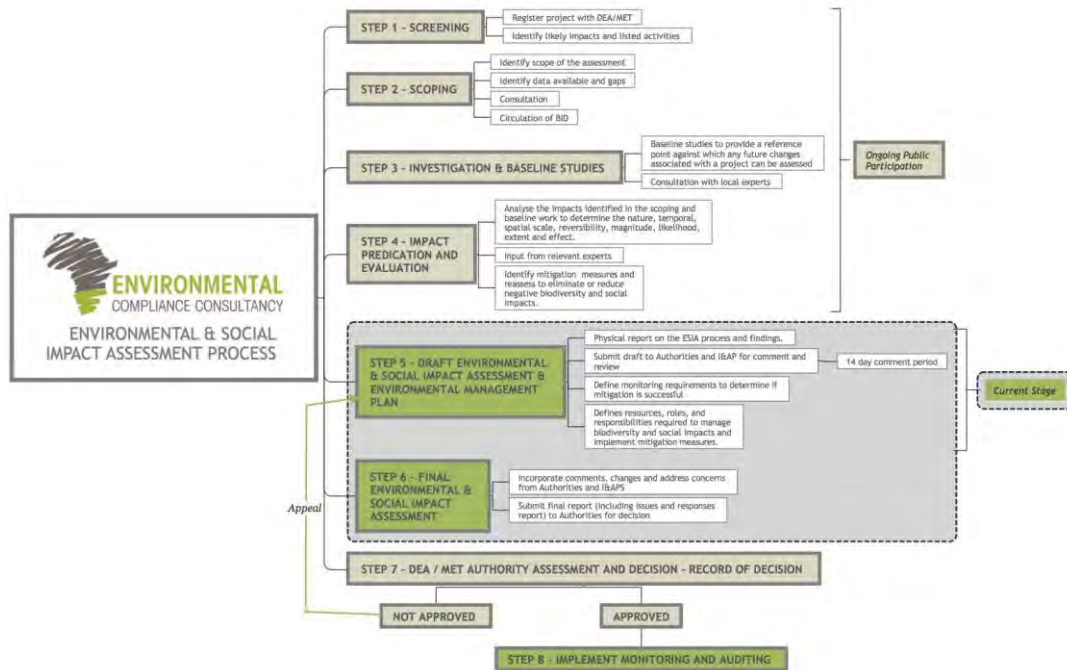


FIGURE 2 – ECC EIA METHOD

2.2.1 STEP 1 - SCREENING OF THE PROJECT

STATUS: COMPLETE

The first stages in the EIA process is to undertake a screening exercise to determine whether the changes to the project triggers any new or additional listed activity under the Environmental Management Act, 2007 and associated Regulations and if any potentially significant impacts could arise from the project changes that they are assessed. The location, scale and duration of project activities will be considered against the receiving environment.

The screening phase of the project is a preliminary analysis to determine ways which the project may interact with the biophysical, social and economic environment. Impacts that are identified as potentially significant during the screening and scoping phase are taken forward for further assessment in the EIA process. The details and outcome of the screening process are discussed further in sections 6 and 7.

2.2.2 STEP 2 – SCOPING

STATUS: COMPLETE

SCOPE OF ASSESSMENT

Where an EIA is required, the second stage is to scope the assessment. The main aims of this stage are to determine which impacts are likely to be significant (the main focus of the assessment); scope the available data and any gaps which need to be filled; determine the spatial and temporal scope; and identify the assessment methodology.

In response to the request from Navachab and in terms of the Environmental Management Act, 2007 an application for amendment to the sites current and approved environmental clearance certificate is to be applied for by means of an assessment and amendment application (this report).

Subsequently, scoping of the EIA was undertaken by the EIA team. The scope of the assessment was determined through undertaking a preliminary assessment of the proposed project against the receiving environment obtained through a high-level desktop review. Feedback from consultation with the client and stakeholders also informed this process. The following environmental and social topics and subtopics were scoped into the assessment, as there was potential for significant impacts to occur:

SOCIO-ECONOMIC ENVIRONMENT

- Employment
- Local businesses
- Underground safety for example emergency response and preparedness and ground stability

BIOPHYSICAL ENVIRONMENT

- Air quality

- Dust emissions
- Aerial pollution (air emissions e.g. oxides of nitrogen; nitrogen dioxide, particulate matter; sulphur dioxide and carbon monoxide)
- Vibration
- Groundwater
- Mineral mine drainage

The following topics were scoped out of the EIA, as no likely significant impacts are predicted as the proposed project poses little to no change from the current baseline, therefore are not discussed further in this report.

- **Soil and geology:** the surrounding soils and geology are common and have no significant value. The proposed project amendment will not generate new or additional impacts to surface soil or geology.
- **Terrestrial ecology:** The amendment proposed will not have any new or additional impacts on terrestrial ecology aside from potential inactions with trucks and surface working machinery which already exists and is managed as part of the open pit mining operations.

An assessment of high-level safety impacts or risks associated with developing an underground mine has been included in this report. The operation currently has in place a robust safety management system and this system will be modified in detail to manage health and safety risks to the workforce. Modifications to the safety management system will be reported separately to the relevant authorities.

2.2.3 STUDY AREA

This ESIA study area has been defined according to the geographic scope of the receiving environment and potential impacts that could arise as a result of the proposed project. The study area is presented in figure 3.

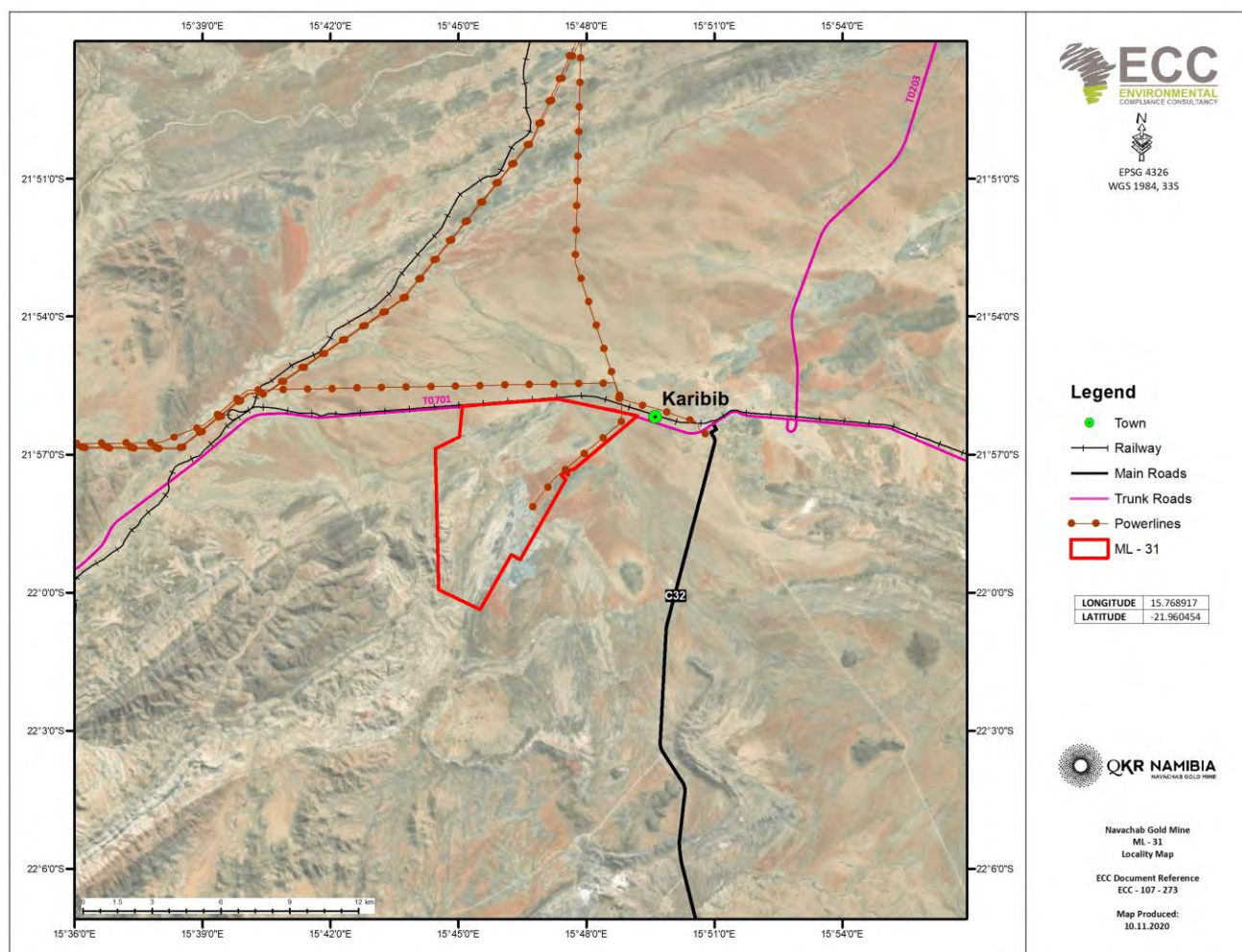


FIGURE 3 - STUDY AREA

2.2.4 CONSULTATION

STATUS: COMPLETE AND ONGOING

Public participation and consultation are a requirement stipulated in Section 21 of the Environmental Management Act, 2007 and associated regulations for a project that needs an environmental clearance certificate. Consultation is a compulsory and critical component in the EIA process in achieving transparent decision-making and can provide many benefits.

The objectives of the stakeholder engagement process are to:

- Provide information on the project, introduce the overall concept and plan;
- Clarify responsibility and regulating authorities;
- Listen and understand community issues, concerns and questions;
- Explain the process of the EIA and timeframes; and
- Establish a platform for ongoing consultation.

2.2.5 INTERESTED AND AFFECTED PARTIES

Appendix B provides a list of interested and affected parties, and evidence of newspaper consultation for the amendment application. Navachab advertised the amendment in two national newspapers.

2.2.6 SUMMARY OF ISSUES RAISED

During the compilation of this assessment several stakeholders were engaged to seek potential issues or concerns regarding the amendment to include underground mining as a method for ore extraction.

Two interested parties registered for the project, however no specific concerns were raised or noted. In order to ensure all potential interested and affected parties have the opportunity to comment and provided feedback on this assessment the completed report will be circulated to all neighbouring farmers, and potential interested and affected parties even though they may not have registered as an I&APs for the project. Should stakeholders have comments or questions, or areas that require further assessment that concern them, ECC will address these through an addendum report submitted to MME and MEFT.

2.2.7 STEP 3 - BASELINE STUDIES

STATUS: COMPLETE

A robust baseline is required in order to provide a reference point against which any future changes associated with a project can be assessed and allow suitable mitigation and monitoring to be identified. The site has been extensively studied in previous EIAs and site specific scientific studies and reports compiled and conducted over the mine life. This information has been referenced throughout this report. The environmental and social baseline is provided in Chapter 5, focussing on the topics that have been scoped into the EIA, as listed in 2.2.2.

2.2.8 STEP 4 - IMPACT IDENTIFICATION AND EVALUATION

STATUS: COMPLETE

The key stage of the EIA process is the impact identification and evaluation stage. This stage is the process of bringing together project characteristics with the baseline environmental characteristics and ensuring all potentially significant environmental and social impacts are identified and assessed. It is an iterative process that commences at project inception to the final design and project implementation. The impact identification and evaluation stage were undertaken in November 2020.

The final design of the proposed project has been assessed, as well as alternatives considered during the design process in accordance with the Environmental Management Act, 2007. Refer to chapter 7 for the findings of the assessment.

Chapter 6 in this report sets out the assessment methodology used to assess the project against the environmental and social baseline that would be affected. Chapter 7 presents the findings of the assessment, focussing on the significant impacts or those considered sensitive to the community.

2.2.9 STEP 5 - DRAFT EIA REPORT AND EMP

STATUS: COMPLETE

This report and EMP for the Navachab gold mine environmental clearance amendment includes an assessment of the biophysical and social environment which satisfies the requirements of Step 5.

The EIA report documents the findings of the assessment process, provides stakeholders with opportunity to comment and continued consultation and forms part of the environmental clearance amendment application. The EMP provides measures to manage the environmental and social impacts of the proposed project and outlines specific roles and responsibilities to fulfil the plan.

This EIA report focuses on the significant impacts that may arise from the proposed project as described in Step 4. These impacts are discussed in Chapter 7.

This EIA report will be issued to stakeholders and I&APs for consultation for a period of 14 days, meeting the mandatory requirement of 7 days as set out in the Environmental Management Act and associated Regulations. The aim of this stage was to ensure all stakeholders and I&APs have the opportunity to provide final comments on the assessment process and findings and register their concerns.

2.2.10 STEP 6 – FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT AND ENVIRONMENTAL MANAGEMENT PLAN

STATUS: COMPLETE AND ONGOING

All comments received during the public review period will be collated in an addendum report which will accompany this ESIA report when submitted to the DEA. All comments will be responded to either through providing an explanation or further information in the response

table, or sign posting where information exists, or new information has been included in the EIA report or Appendices. Comments will be considered and where they are deemed to be material to the decision making or enhanced the EIA will be incorporated.

The final EIA report and associated appendices, and the addendum report will be available to all stakeholders on the ECC website www.eccenvironmental.com All I&APs will be informed via email.

The EIA report, appendices and addendum will be formally submitted to the Office of the Environmental Commissioner, DEA as part of the application to amend the current environmental clearance certificate.

2.2.11 STEP 7 – AUTHORITY ASSESSMENT AND DECISION MAKING

STATUS: FUTURE STAGE

The Environmental Commissioner in consultation with other relevant authorities will assess if the findings of the ESIA presented in the ESIA report and addendum report are acceptable. If deemed acceptable, the Environmental Commissioner will revert to the proponent with a record of decision and any recommendations.

2.2.12 STEP 8 – MONITORING AND AUDITING

STATUS: FUTURE STAGE

In addition to the EMP being implemented by the proponent, a monitoring strategy and audit procedure will be determined by the proponent and competent authority. This will ensure key environmental receptors are monitored over time to establish any significant changes from the baseline environmental conditions caused by project activities.

3 REGULATORY FRAMEWORK

An environmental clearance is required for any activity listed as per Government Notice No 29 of 2012 of the EMA. The proponent holds several environmental clearance certificates for the project that includes the listed activities as detailed in the regulations. The proposed amendment does not trigger any new listed activities for the operations of the Navachab mine site.

The project area is located between Karibib and Usakos and is outside of any national parks, heritage listed areas or areas of known significance.

A thorough review of relevant legal legislation has been conducted for the proposed amendment; the table below identifies relevant legal requirements specific for the project. This chapter outlines the regulatory framework applicable to the proposed project.

3.1 CURRENT PROJECT APPROVALS

- The site is fully permitted in terms of the Minerals Act 1992, the Environmental Management Act, 2007 and the Water Resource Act 1956.
- The site operates in accordance with its current and approved environmental clearance certificates issued in terms of environmental management act 2007 by the Ministry of Environment and Tourism.
- The site has a valid water abstraction permit issued under the Water Act 1956.
- The site remains compliant with all Namibian laws and policies and relevant permits or approval are available upon request.

3.2 NATIONAL REGULATORY REGIME

TABLE 1 – LEGAL COMPLIANCE

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
Minerals (Prospecting and Mining) Act No 33 of 1992	Section 50 (i) requires <i>“an environmental impact assessment indicating the extent of any pollution of the environment before any mining operations are being carried out and an estimate of any pollution, if any, likely to be caused by such prospecting operations or mining operations”</i> Section 50 sets out that in addition to any term and condition contained in a mineral agreement and any term and condition contained in any mineral licence, it shall be a term and condition of any mineral licence that the holder of such mineral licence shall:	The proposed amendment to include underground mining requires amendment to the approved environmental clearance certificate therefore triggers the Environmental Management Act and its regulations. This report presents the findings of the EIA. The proponent will ensure the mine plans are approved by the inspector of mines.

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
	Exercise any right granted to him or her in terms of the provisions of this Act	
Environmental Management Act, 2007 (Act No. 7 of 2007) and associated regulations, including the Environmental Impact Assessment Regulation, 2007 (No. 30 of 2011)	The Environmental Management Act (EMA) (7 of 2007) has been compiled and is regulated by the Ministry of Environment and Tourism (MET). This Act was gazetted on 27 December 2007 (Government Gazette No. 3966) and the Environmental Impact Assessment Regulations: Environmental Management Act, 2007 (Government Gazette No. 4878) were promulgated on 6 February 2012. Section 39 of the Environmental management Act, 2007 states the Environmental Commissioner may amend a condition of an environmental clearance certificate; – If the certificate holder consents to or requests amendment or – At the initiative of the Environmental Commissioner, by giving written notice to the holder of the certificate The Environmental Commissioner may require the holder of the environmental clearance certificate to make an application in the prescribed form and manner to the Environmental Commissioner for the proposed amendment. Requires that projects with significant environmental impact be subject to an environmental assessment process (Section 27). In terms of this legal framework certain identified activities may not commence without an Environmental Clearance - a certificate that is issued by MET. This environmental clearance can only be granted after consideration of an EIA.	The certificate holder Navachab, requests an amendment to the certificate to incorporate underground mining operations. The proponent makes the application for amendment in the prescribed form (this amendment report to address potential impacts) accompanied by the prescribed form (Form 2) in accordance with the Act. This Act and its regulations have informed and guided this amendment process. Impacts identified through this amendment assessment application have been addressed throughout this report (and relevant studies) and project specific EMP. Environmental Clearance has been issued for the operations on Navachab via the consideration of previous EIAs processes.
Water Act, 1956	The Water Resources Management Act 24 of 2004 is presently without regulations;	Groundwater abstraction and relevant permits are in place and

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
	therefore the Water Act No 54 of 1956 is still in force: A permit application in terms of Sections 21(1) and 21(2) of the Water Act is required for the disposal of industrial or domestic wastewater and effluent. Prohibits the pollution of underground and surface water bodies (S23(1). Protection from surface and underground water pollution	upheld by the Mining Operation. The use of water will be required for the underground operations, the mine will utilise excess water from the mining operations in the processing plant.
National Heritage Act, No. 27 of 2004.	The Act provides for the protection and conservation of places and objects of heritage significance and the registration of such places and objects. It also makes provision for archaeological 'impact assessments. If applicable, the relevant permits must be obtained before disturbing or destroying a heritage site as set out in the Act.	Any heritage resources discovered would require a permit from the NHC for relocation. The site has conducted previous and extensive heritage assessments therefore sites are already known for the project area and non are located within the proposed project footprint therefore impacts not likely to occur.

3.3 NATIONAL POLICIES

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
Vision 2030	Vision 2030 sets out the nation's development programmes and strategies to achieve its national objectives. It sets out eight themes to realise the country's long-term vision. Vision 2030 states that the overall goal of the vision is to improve the quality of life of the Namibian people to a level in	The planned project shall meet the objectives of Vision 2030 and shall contribute to the overall development of the country through continued employment opportunities.

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
	line with the developed world.	
Fifth National Development Plan (NDP5)	The NDP5 is the fifth in the series of seven five-year national development plans that outline the objectives and aspiration of Namibia's long-term vision as expressed in Vision 2030. The NDP5 is structure on five pillars: economic progression, social transformation, environmental sustainability and good governance. Under the social transformation pillar is the goal of improved education. A desired outcome of NDP5 is to have a diversified and competitive tourism sector with increased number of tourists from 1.4 million in 2015 to 1.8 million.	The planned project supports meeting the objectives of the NDP5 through creating opportunities for continued employment by extending the mine life.
Minerals Policy	The Minerals Policy was adopted in 2002 and sets guiding principles and direction for the development of the Namibian mining sector while communicating the values of the Namibian people. It sets out to achieve several objectives in line with the sustainable development of Namibia's natural resources. The policy strives to create an enabling environment for local and foreign investments in the mining sector and seeks to maximise the benefits for the Namibian people from the mining sector while encouraging local participation, amongst others. The objectives of the Minerals Policy are in line with the objectives of the Fifth National Development Plan that include reduction of poverty, employment	The proposed project conforms with the Policy, which has been considered through the EIA process and the production of this report. Navachab supports local spending and procurement.

NATIONAL REGULATORY REGIME	SUMMARY	APPLICABILITY TO THE PROJECT
	creation and economic empowerment in Namibia.	
Labour Act, No. 11 of 2007	The Labour Act, No. 11 of 2007 (Regulations relating to the Occupational Health & Safety provisions of Employees at Work promulgated in terms of Section 101 of the Labour Act, No. 6 of 1992 - GN156, GG 1617 of 1 August 1997)	The proposed project will comply to stringent health and safety policies, including the compulsory use of specific PPE in designated areas to ensure adequate protection against health and safety risks. Proper storage and labelling of hazardous substances are required. The project will ensure employees in charge of and working with hazardous substances need to be aware of the specific hazardous substances in order not to compromise worker and environmental safety.

3.4 PERMITS AND LICENCES

3.4.1 MINING LICENCE

Navachab holds the mining licence for the project on (ML 31). The mining licence was granted by the Ministry of Mines and Energy on 31/10/2018 and expires on the 31/10/2033; beyond the expected life of mine for the current open pit and proposed underground mining operations. ML 31 is granted for mining of precious metals on an area of approximately 3700 ha.

4 PROJECT DESCRIPTION AND PROPOSED PROJECT CHANGES

4.1 NEED FOR THE PROJECT

In December 2019, Navachab commenced a new study evaluating the potential of an underground trial mine. The study investigates the potential for an underground mine at Navachab incorporating a new mineral resource model, updated costs and revised geotechnical parameters.

Open pit mining and mineral processing have been underway at Navachab since 1989. Open pit mining is planned to continue until 2030 and processing of stockpiles will continue until 2036. It is assumed that any potential underground ore will substitute open pit ore or low-grade stockpiles in the processing plant. The underground mine is based on a conventional longhole open stoping operation. This mining method is suitable for the vertical and sub-vertical orebody at Navachab.

Navachab has investigated the potential trial underground mining operation in order to de-risk and refine the geotechnical assumptions and geology model. A trial mine concept study has been undertaken to determine the feasibility of the underground mine. In the trial mining phase Navachab will determine factors such as dilution and ore loss, stope dimensions and other assumptions in order to refine the full-scale underground mine plan.

In essence the project is needed for in order to validate the possible underground mining method for future expansion at Navachab.

4.2 CURRENT OPERATIONS

The Ministry of Environment, Forestry and Tourism (MET) issued an environmental clearance certificate in August 2012 after an environmental impact assessment was conducted (between 2007 and 2012) for the Navachab Project, this clearance has been renewed every three years in line with the Act. A Mining Licence (ML 31) was subsequently issued by the Ministry of Mines and Energy. The mine has been in operation since these approvals were received and has ramped up to its peak production.

The mine is currently mining from two open pits, being North and South pits respectively. Gold production is 50,000 thousand ounces per year from processing 1.5 Mt of ore per annum.

All mining is being conducted through truck and shovel operations, averaging 1.4 Mt of material mined per month with 13 trucks. Over burden is placed on a waste rock dump (WRD) to the north, south and east of the current pits, while low grade ore is stockpiled close to the ROM.

Ore is taken to the plant for processing. After processing, the gold is produced as gold bars and shipped as final product. Tailings forms the final waste stream from the plant and is deposited as a slurry on the TSF at a rate of 35,000 tons per month and the balance disposed of as filter cake.

Water supply to the operations is from a NamWater supply pipeline, and power is generated provided to the site via the NamPower national grid, with standby generators as backup power supply for the mine. The trial mine will be power by a 500Kva generator, another 500Kva generator will be on standby. Detailed descriptions of the current operations can be found in the original EIAs and EMPs for the mine.

4.3 PROPOSED PROJECT CHANGES

The current underground mining project looks at accessing the ore body via a portal in the Stage 5 Pit high wall and a development decline, which will be used for the main haulage and ventilation exhaust. The decline links up to the stoping areas in the ore body. A primary ventilation intake raise for the full scale underground mine will be raise-bored to ensure adequate ventilation is supplied underground as shown in figure 4.

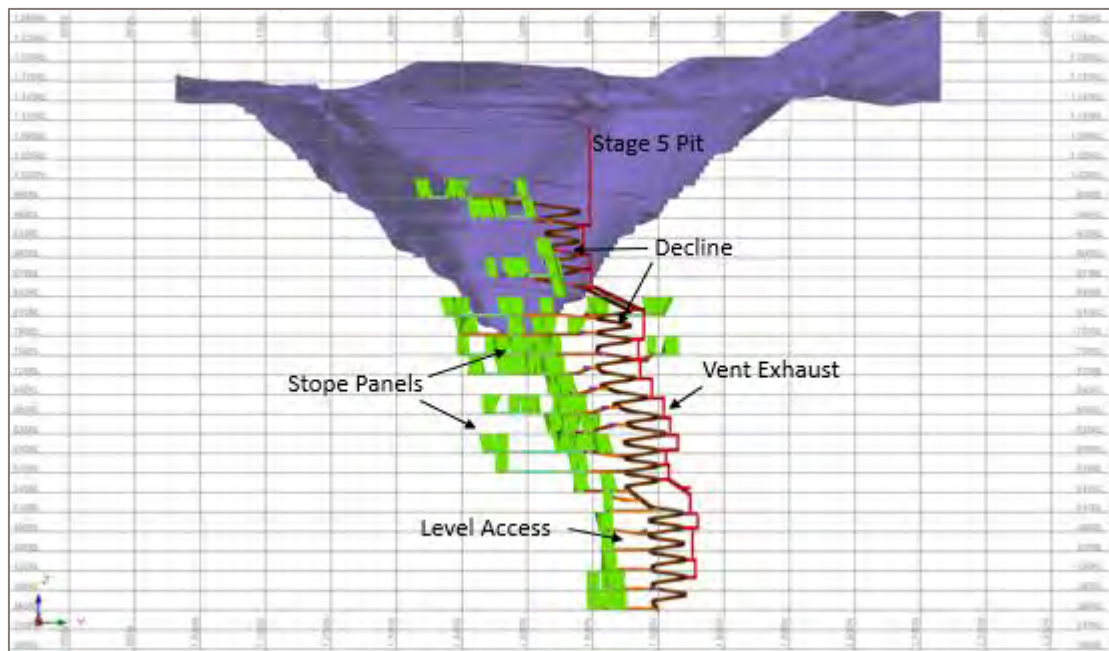


FIGURE 4 - A CROSS SECTION OF THE PROPOSED UNDERGROUND WORKINGS WITH THE DECLINE (ORANGE), THE PRIMARY VENTILATION INTAKE RAISE (RED), STOPES (GREEN) AND THE PLANNED PITS (GREY) INDICATED (CUBE, 2020).

The open pit operation comprises 2 pits, the South Pit and the North Pit. Open pit operations scheduled to continue until 2030 will be developed as a series of 3 pushbacks starting with the Western Pushback. The trial underground mine is to be established in the north east high wall of the South Pit, while the full underground mine will be accessed from and be located beneath the North Pit.

Specifically, the Operation involves the establishment of a portal on the 930m elevation bench in the north east highwall of the South Pit, including support of the portal, mechanised, trackless development and longhole stoping drill and blast operations, incorporating remote loading of ore and waste transport to the pit base outside of the portal.

The mining method is sublevel open stoping (SLOS). Mining is from a single sublevel consisting of 2 parallel drives with an internal pillar across strike between the lodes.

The trial mine consists of mining a development heading of 343m (164m waste and 197m of ore), stoping of 120,327 tonnes of ore and diamond drilling for grade control of 2880m with an average hole length of 60m. Drives will be nominally 5.5 m x 5.5 m and at an upgrade of 1:100 to allow for drainage; see figure 5.

Ore will be trucked to the Run of Mine (ROM) stockpile located on the 930m bench within the South Pit. Development drive waste will be trucked to the designated waste rock dump.

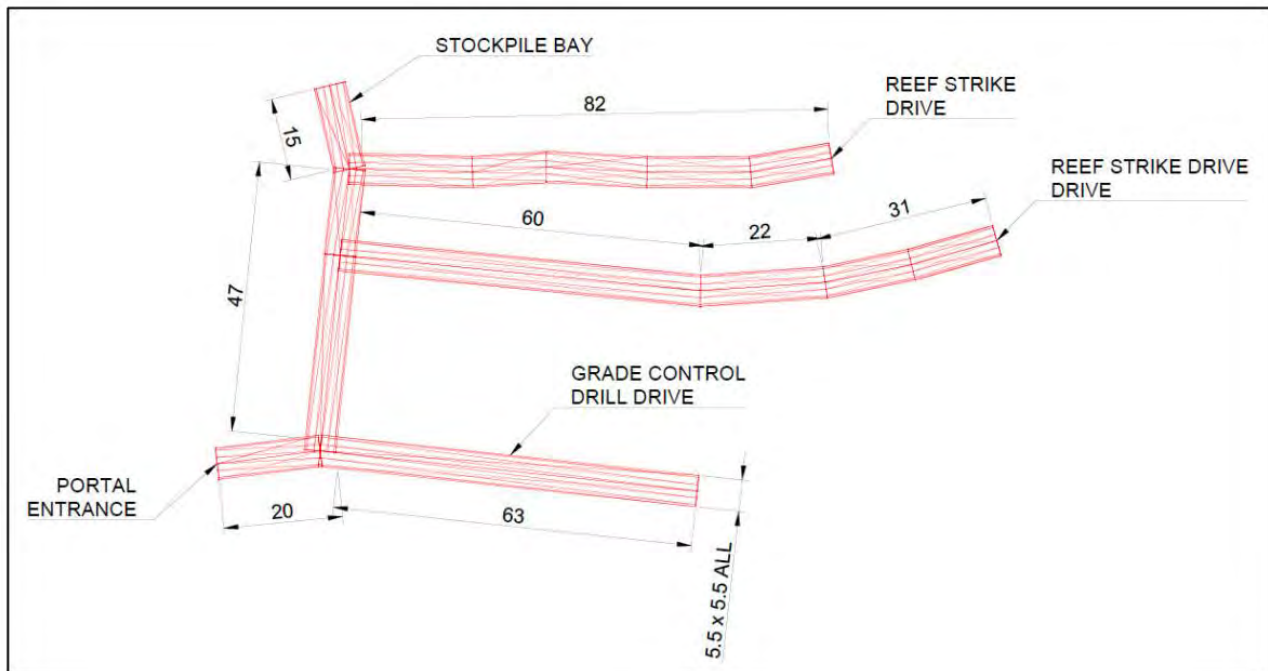


FIGURE 5 – A MODEL SHOWING THE TRIAL MINE DEVELOPMENT DETAIL

4.4 UNDERGROUND MINING, INFRASTRUCTURE AND SERVICES

The underground trial mine will be undertaken through the use of diesel-powered machines. A standard underground mining fleet will be used, and not all equipment will be operating within the mine concurrently. The current envisioned trial mining fleet will likely consist of:

- 1 x 10T class Loader Hauler Dumper (LHD);
- 1 x 45t Dump Truck;
- 1 x Twin boom development jumbos;
- 1 x Development cable bolter;
- 1 x Longhole drill;
- 1 x Explosives loader;
- 1 x Normet scissor lift; and
- 1 x Land cruiser.

The main underground mine, upon successful completion of the trial mine will also be undertaken through the use of diesel-powered machines. A standard underground mining fleet will be used, the current envisioned fleet will likely consists of:

- 3 x 30T class haul trucks;
- 1 x 10T class (loader hauler dumper) LHDs;

- 2 x Twin boom development jumbos;
- 1 x Development cable bolter;
- 2 x Longhole drills;
- 1 x Explosives loader; and
- Miscellaneous support equipment including telehandlers, boom trucks, crew trucks, etc.

The haul trucks (or LHD) will be used for moving ore and waste mineral material. Mechanized equipment will be utilized to ensure working areas are scaled and supported. The trial mine production rate will be 171 tpd of ore for the first four months, and 525 tpd from producing stopes during the last six to ten months of the trial mine. There will be no concurrent development ore and production ore handling.

Decline development is planned for the main underground mining operations if the trial mine phase is successful.

Developing the underground mine can be achieved in two distinct phases, phase 1 portal and decline development in order to access the mining areas and the second phase being underground mine production. Therefore, it is currently planned to use contractors for the development phase with the strategy for the production phase still under evaluation.

If the trial mine is viable and successful it is envisaged that the steady-state production by means of underground mining would be expected in early 2023.

The stoping method of mining is the preferred mining method for orebodies with a geometry to that of the QKR Namibia Navachab Gold Mine. The method involves extracting the ore between on-reef sublevel drives at determined vertical intervals by long hole drilling and blasting from the drives. For the trial mine, two drives on only one level will be operated.

The method involves a slot being created at one end of the orebody, which will be established using airleg (hand-held) ladder rising to 25 metres above the drive. Longhole rings are drilled from drill drives using longhole drill rigs and production is on a retreat basis. The blasting separates a vertical slice of ore from the orebody that breaks up and falls into the empty stope, from where it is loaded using load haul dump units with a remote loading capability.

Remote loading (for safety reasons) will be to an internal stockpile. All ore and waste will be trammed directly to the open pit from underground (therefore no underground trucking is planned for the trial mine but will be used in the full-scale underground mine operations).

Stope widths range from a minimum of 5 m to approximately 20 m. The level interval is 30 m from floor to the top of the stope. No backfill will be used in the trial mining phase but may be considered in the full-scale underground mining operations.

Basic services to the underground area will be electricity, water, and compressed air for production purposes. Water will be sourced from inflows into the underground workings and water pumped from the mine water supply and dewatering boreholes. It will be pumped underground and secondary recirculation with water treatment where needed will be used to

optimise water use efficiency. Electricity will be supplied to underground by generators and back-up generators. Compressed air will be supplied via surface compressors and distributed with an underground reticulation system. The layout design and services for the underground are provided in figure 6.

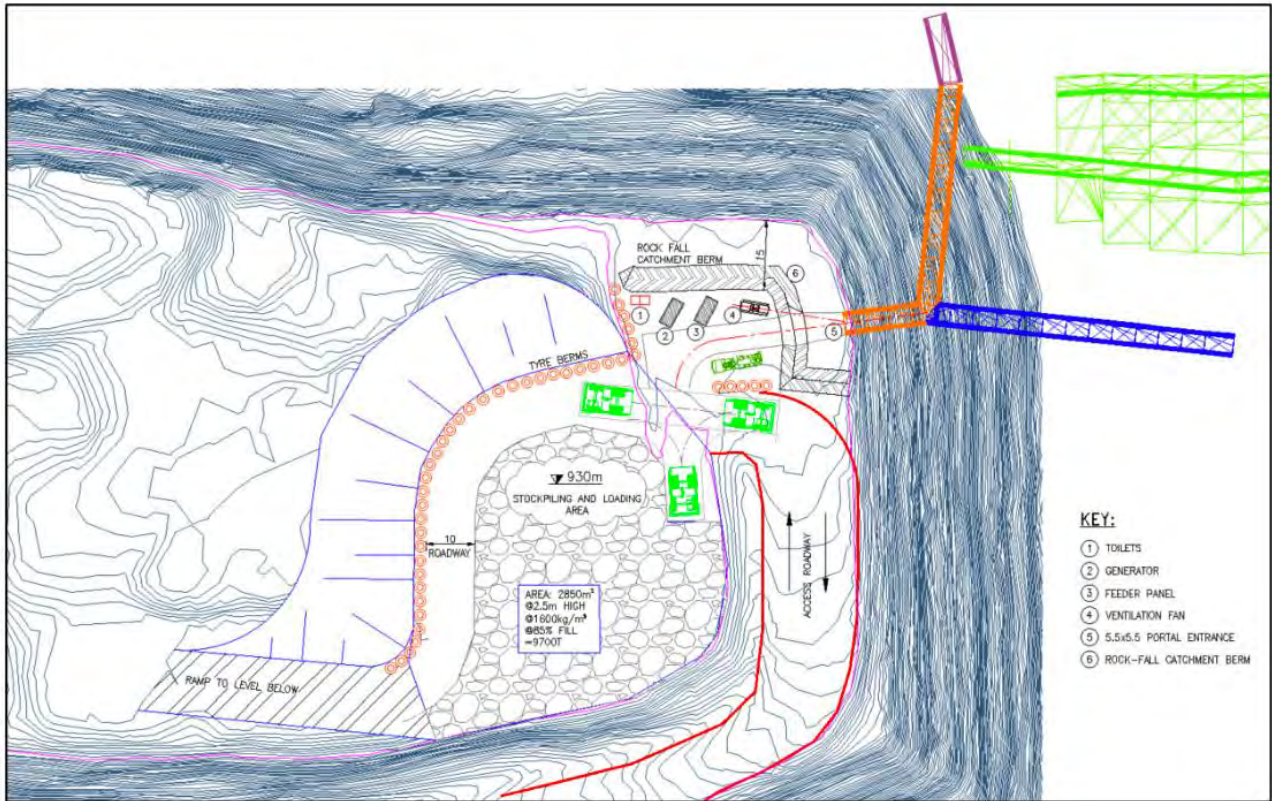


FIGURE 6 – A VIEW OF THE 930M BENCH SHOWING THE LOCATION OF THE UNDERGROUND TRIAL MINE AND ASSOCIATED INFRASTRUCTURE

4.4.1 ORE BODY

The targeted ore body dips at 72° away from the current South open with a 30 m vertical height as shown in figure 7.

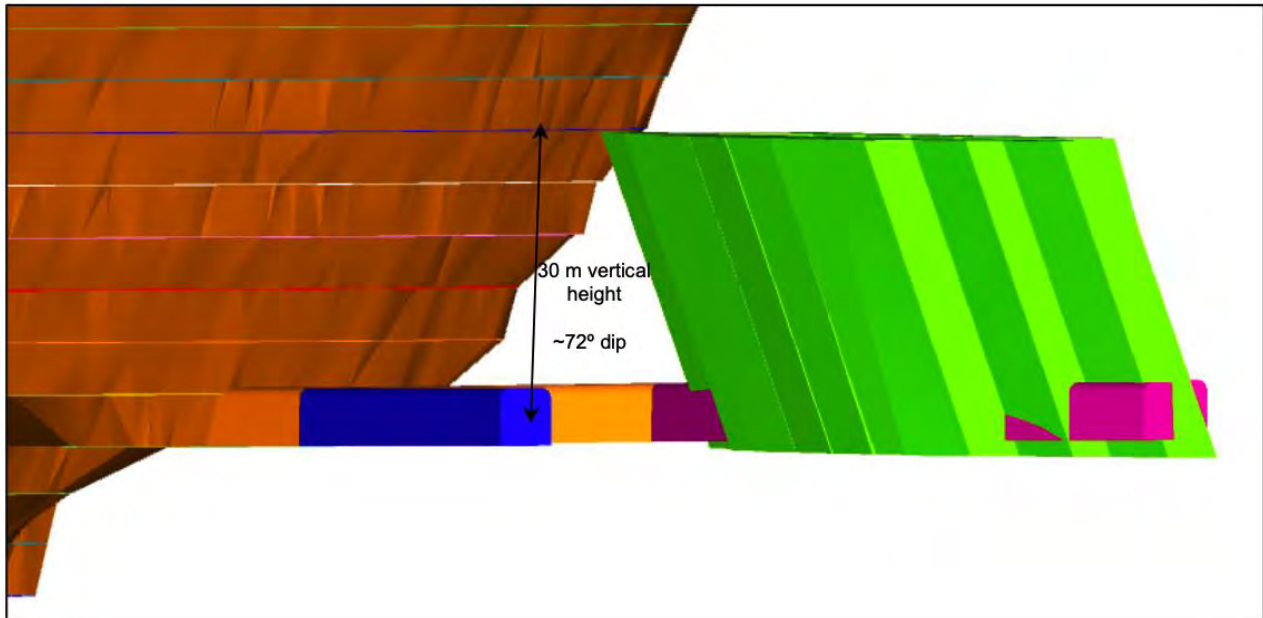


FIGURE 7 – VIEW OF CONNECTION OF THE TRIAL MINE TO THE EXISTING SOUTH PIT

A geotechnical assessment of Navachab to determine the possibility of underground mining was undertaken by Geotech Africa under the supervision of SRK Consulting as part of a 1996 Underground Appraisal Study by L J H Fourie (Fourie, 1996). This assessment has been superseded for the purposes of this current study and has been updated with additional work by SRK Consulting (South Africa) (Joughin, 2020).

The geotechnical work conducted by SRK produced parameters in terms of the underground mine design including rib pillars, stope dimensions, crown pillars and pillars across strike between (and/or within) lodes.

The envisaged full-scale underground mine depicting the ore body and relationship to the open pit shells is presented in figure 8.

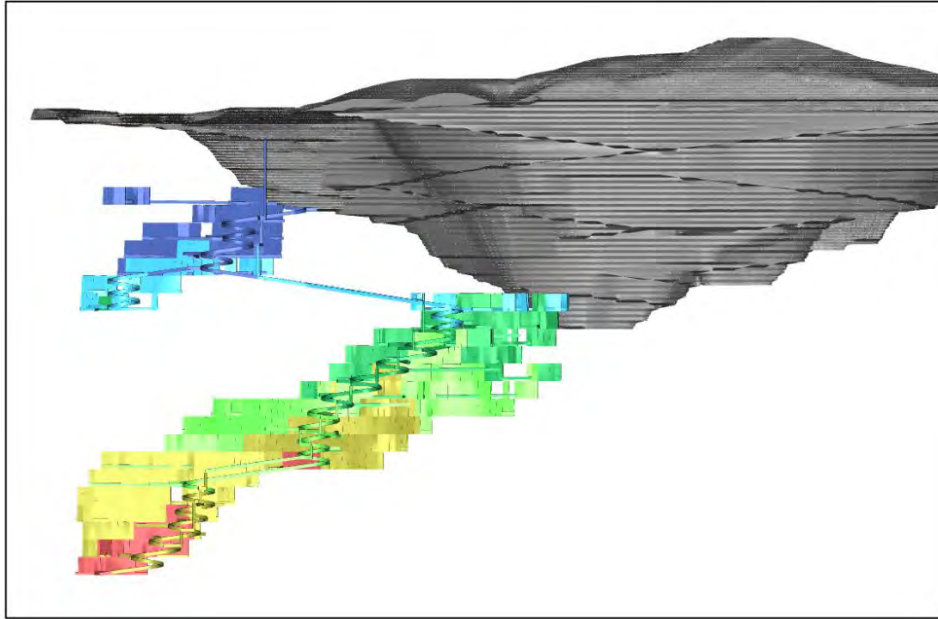


FIGURE 8 – VIEW OF THE RELATIONSHIP BETWEEN THE FUTURE FULL-SCALE UNDERGROUND MINE AND THE FINAL PIT SHELL

4.4.2 MINING METHOD

On the basis of the available geotechnical guidance, it was determined that the most suitable mining method for the deposit would be sublevel longhole open stoping (LOS). This is a high productivity, self-supported non-entry mining method. Longhole stoping consists of vertically stacked levels with stoping panels recovering ore between levels. Drilling and blasting are conducted on retreat from the end of a drive back towards the level access. Remote loading is required to fully extract ore once blasted.

For longhole stoping, 30 m (from floor to floor) is considered a practical maximum. Minimum drill hole length will be circa 25 m (30 m stope height subtract the drive height). Large rubber tyred electric-hydraulic mobile drill rigs will be used for longhole drilling. The planned stopes and development blocks are presented in figure 9.

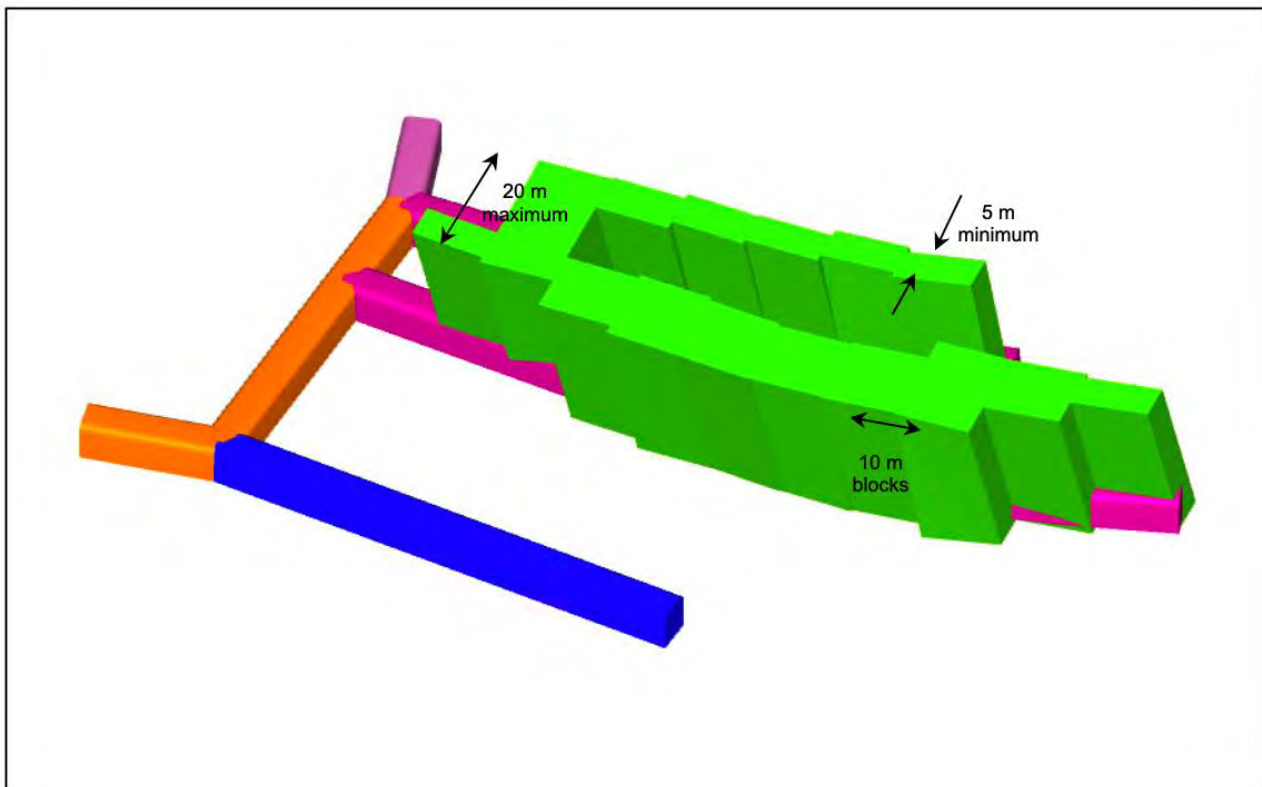


FIGURE 9 – OBLIQUE VIEW OF PLANNED DEVELOPMENT AND STOPING

In general, for orebodies where the grade is close to cut-off, it is more economically viable to leave pillars as opposed to removing more ore and placing fill. Where average grade is substantially higher than the cut-off, the extra revenue from greater ore recovery usually makes it worth the additional cost of backfill or other means of alternative ground support.

Blasting will utilize either an ANFO or emulsion-based product. Underground production blasts will not exceed 500 tonnes and vibrations will therefore be significantly less than from the surface blasts at the current open pit operations.

Phase 1

Initial development end blasting from the portal entrance to the stoping reef drives. Development end dimensions: 5.5 m x 5.5 m x 3.5 m deep. Explosive quantity: 250 kg.

Phase 2

Stope blasting in the reef drives. Open-hole stope dimensions: 8m x 1.5 m x 30.0 m deep. Explosive quantity: 1200t at Stope ring blasting stage.

In Phase 1 at the maximum development end limits, with moderate dispersion, the blasting fumes cleared within 10 minutes. With slow dispersion, the fumes cleared within 15 minutes. In the initial development end blasting, the fumes will clear within 5 to 10 minutes. However, for safety purposes the re-entry time should be fixed at 15 minutes.

In Phase 2 at the maximum reef drive limits, with moderate dispersion, the blasting fumes cleared within 15 minutes. With slow dispersion, the fumes cleared within 30 minutes. In the initial stope blasting, the fumes will clear within 10 to 20 minutes. For safety purposes in the initial stoping phase, the re-entry time should be fixed at 30 to 35 minutes. However, when mining on strike beyond 40.0 m in the top reef drive and 50.0 m in the second reef drive, the re-entry times have to be increased to 45 minutes.

4.4.3 CHANGE TO THE MINE PLAN

The most significant change to the current planning will be from accessing ore from surface to using underground mining methods. The mine layout will change as shown in figure 10, and potential future changes could be forthcoming based on the results of the trial mine studies.

4.4.4 VENTILATION

The design criteria are based off the Mine Health & Safety Regulations, 10th Draft, as issued by the Namibian Ministry of Mines and Energy. In the absence of regulatory guidance, industry best-practice was followed.

This ventilation design is aimed at minimizing all occupational hygiene exposures to below occupational exposure limits. The ventilation system was designed based on the proposed mine design, mining schedules, fleet and relevant design criteria over the life of mine. In term this was then used to determined secondary ventilation and equipment requirements (fans, ducks, airlocks etc.)

Overall ventilation requirements were dominated by the provision of ventilation for diesel emission dilution. A ventilation design rate of 0.08m³/s per Kilowatt was recommended for engines using 50 ppm diesel fuel and 0.06 m³/s per kW for engines using 10 ppm diesel fuel.

Ventilation quantities have been planned to take the number of vehicles and total kilowatts produced by the vehicles into consideration.

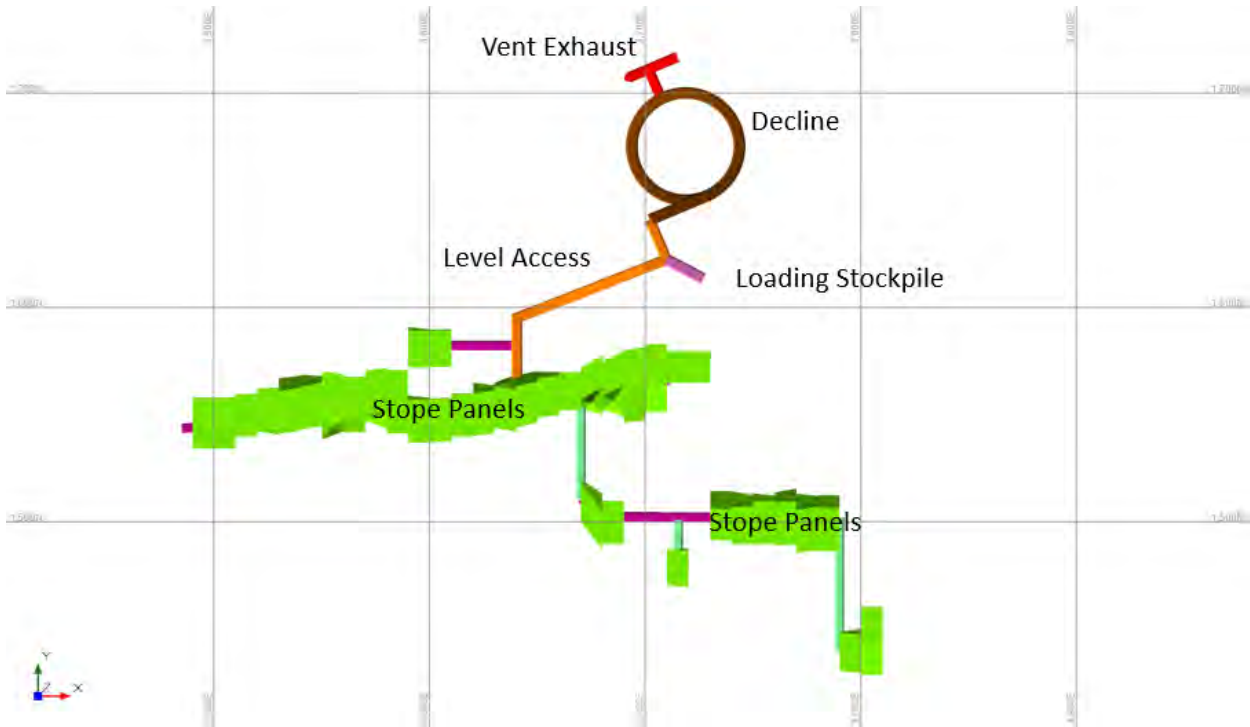


FIGURE 10: A DEPICTION OF THE VENTILATION SYSTEM PLANNED FOR THE UNDERGROUND MINING AT NAVACHAB (991 RL LEVEL) FUTURE PLANNED VENT RISE/EXHAUST.

The trial mine will be force ventilated by means of:

- Force ventilate the top reef drive with a 110 kW Fan and 1400 mm diameter column to supply 35.0 m³/s (includes 10% per 100 m leakage allowance) through ventilation for the other development ends;
- Ventilate the second reef drive and grade control drives with 75 kW fans and 1015 mm columns. Maximum column length: 100 m. The fans will comfortably provide ± 20 m³/s over 100 m.;
- Force ventilate the stockpile cross cut with a 15 kW fan and 570 mm $\varnothing$ column;
- The column distance to face should not exceed 20.0 m;
- In order to minimize the risk of re-circulation, the 110 kW fan be positioned 30 m from the portal entrance at the infrastructure zone; and
- One additional 110 kW, 75 kW and 15 kW spare fan required to prevent production delays.

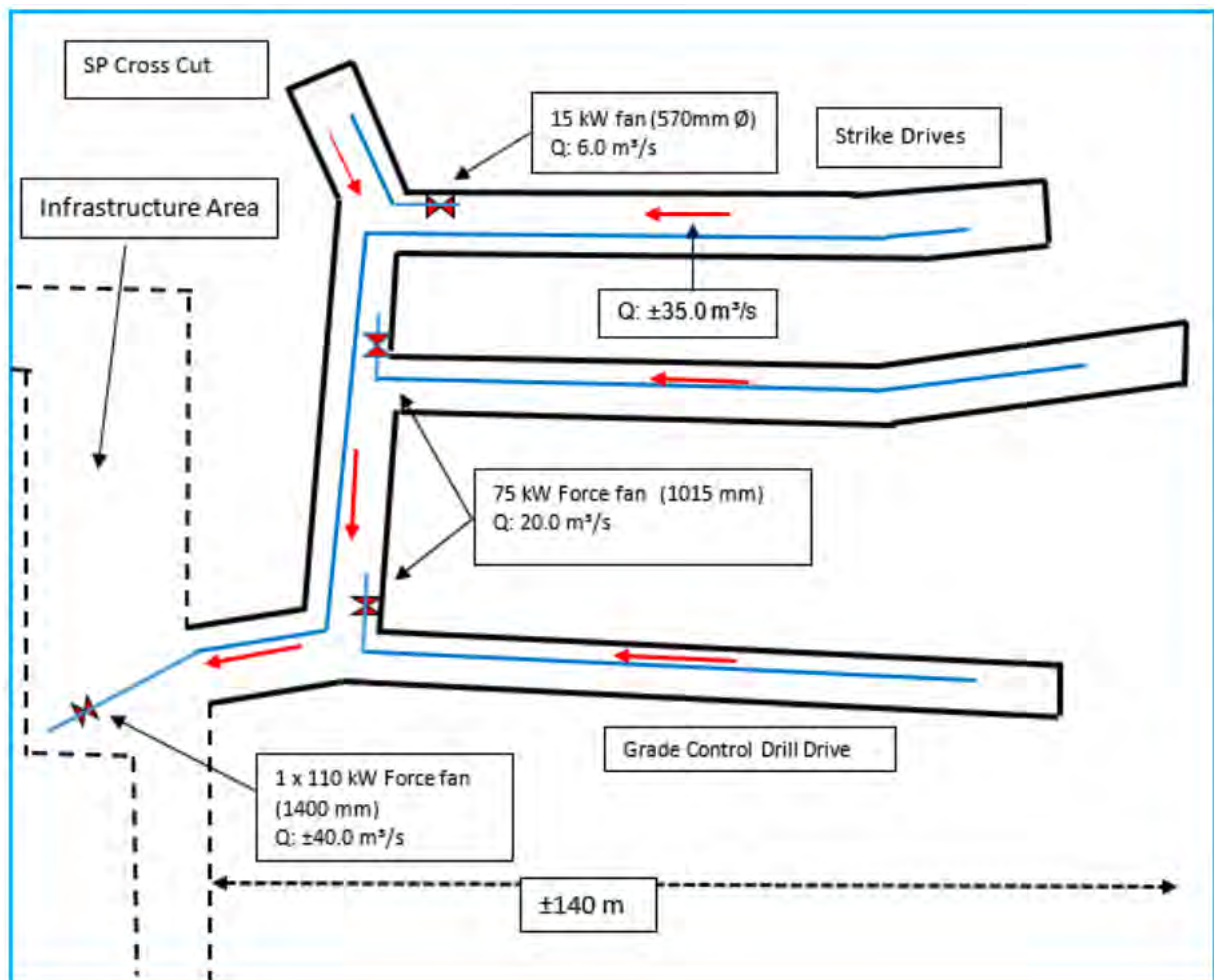


FIGURE 11 – A DIAGRAM SHOWING VENTILATION SPECIFICATIONS FOR NAVACHAB TRIAL MINE

Ventilation monitoring will be conducted in accordance with Namibian Mine Regulation 9.14:

- The mine manager shall cause at any workings
 - The quantity and quality of air circulating in any ventilating district
 - Head and humidity; and
 - The amount of respirable dust in the air at places fixed by him or her in the main airways and the workplaces
- The measurements referred to in table 2 shall be made during the main working shift at intervals not exceeding three (3) months or at such shorter periods as may be determined by the Chief Inspector in writing
- A record of the measurements taken, and samples analyzed shall be kept
- The chief inspector may verify the measurements

In addition to the above:

- Designated supervisors and engineers will carry gas monitors to ensure verify gas concentrations in the air in all active working areas and to ensure any problematic areas can receive corrective attention immediately
- Navachab will maintain an as-built ventilation model of the underground mine with industry-leading software in order to support ventilation design

TABLE 2: A LIST OF PERMISSIBLE GAS LEVELS

Gas	Limit
Oxygen	>19%
Carbon Dioxide	5,000 ppm
Carbon Monoxide	100 ppm
Oxides of Nitrogen	5 ppm
Hydrogen Sulphide	20 ppm
Sulphur Dioxide	2 ppm
Ammonia	25 ppm
Aldehydes	5 ppm

A secondary egress system should be included in the design in accordance with Part VII Outlets, Travelling Ways, and Ladderways of the Namibian Mine Regulations. However, a secondary egress system is not deemed necessary for the trial mine due to the short strike distance therefore exemption from a second outlet will be applied for by the mine. The full-scale underground mine would require a secondary egress and this has been planned for.

The envisaged future secondary egress system presents a number of important benefits, namely:

- Numerous entrance points into the secondary egress system or refuge chambers ensures travel time into the egress system can occur quickly and with relative ease during a mine emergency
- The entirety of the secondary egress system will be in fresh air with no mobile equipment, meaning the potential risk for fire in this egress system is extremely low. Should a fire start on surface or nearby to the vent intake, and the potential for smoke to be drawn into the underground mine, the underground mine can be evacuated via the main portal through standard procedures.
- In the event of a surface fire nearby that resulted in smoke being drawn into the main fans, the underground mine could be evacuated via the main portal through standard emergency procedures and the main fans could be reversed to provide fresh air to the decline if required
- The ladderway system will be self-contained for worker safety and with rest platforms no more than every 9m per regulation 7.3 (h)

4.4.5 FUEL SUPPLY

No significant change to the supply of diesel is expected and the current bulk supply facilities will be used. Refuelling is planned to occur on surface with no fuel storage in the underground workings.

4.4.6 WATER SUPPLY

Water will be sourced from inflows underground and water pumped from the mine water supply and dewatering boreholes. It will be pumped underground and secondary recirculation with water treatment where needed used to optimise water use efficiency.

4.4.7 COMMUNICATION

All verbal communication will be via leaky feeder radio system in vehicles and hand-held radios issued to key personnel. Written communication will follow the mine's normal procedures. Refuge chambers will be equipped with a secondary communications system, which have a form of communication to surface.

Emergency situations will be communicated by sounding the agreed alarms for specific situations and using radio communication where feasible.

4.5 WASTE

4.5.1 MINERAL WASTE (ROCK AND TAILINGS)

Waste rock will be hauled to an in-pit location then transported to the appropriate waste rock dump. The total waste rock generated from underground is expected to be approximately 5590 tonnes.

Tailings will still be disposed onto the TSF as slurry forming part of the overall production waste from the open pit mining. Enough storage space is available for both the waste rock and the tailings arising from the underground production and no extra capacity needs to be created.

4.5.2 NON MINERAL WASTE

Extra solid waste streams that would be associated with the new mining development is poly pipes, ventilation bags, scrap metal, tyres, hazardous waste associated with machines, packaging material for various consumables and electrical components such as batteries. All of the waste can currently be handled by waste management systems in place on the mine.

4.5.3 WASTEWATER EFFLUENT

Water will be recirculated underground for as long as possible with conditioning treatment done to prevent scaling and corrosion. Dilution of salinity in the water will occur as make-up water enters the system from underground inflows and through addition of water from raw water supplies. Excess water will be pumped to surface and form part of the wider water circuit on the mine. Contaminated water and sludge from wash down of rock surfaces and haulages will be collected in designated traps and pumped from underground to be blended into the mill feed stream.

4.5.4 HUMAN EFFLUENT WASTE

Sanitation will be provided by placement of chemical toilets underground. These will be serviced in line with the procedures for the same toilets currently placed at strategic locations on surface. The effluent will be pumped out, as required, by a waste contractor and will be disposed of at a registered facility in Karibib or the nearest available registered site.

4.6 SOCIAL

4.6.1 EMPLOYMENT

A total of 100-150 jobs will be created by developing the full scale underground mine, approximately 20 jobs will be created by the trial underground mine. These jobs will be filled by local labour as far as possible.

It is envisaged that in future some jobs in the open pit mining operations may become redundant as the open pits reach the end of their productive life, it will be the company's intention that some people in these redundant positions will be retrained to work in the underground operations.

4.6.2 OCCUPATIONAL HEALTH AND SAFETY – GROUND SUPPORT

Safety is a core component of the Navachab mining operation. There will be some changes to the safety risk profile of the mine as the underground mining method is introduced.

In anticipation of transitioning mining operations from open pit to underground, Navachab will develop a strategic plan to evaluate the current skillset of employees in relation to the scope of work and jobs that will be available within the underground operations. It is anticipated that the initial decline development will be supported by an external contractor. Training will be provided to employees working underground, and a competent mine rescue team will be in place prior to underground mining operations commencing.

Scaling of the backs (the roof of the underground mine) is a task to remove loose rocks, this task forms part of the 'make safe procedure' for the mining areas and headings. The majority of scaling should be conducted by machines to reduce this risk. Ground control and support will be a combination of cable bolting or friction bolts in a 2m by 2m pattern, with split sets and grouted cable anchors. The ground support requirements will depend on the rock class to be supported and mined, the ground support requirements for Navachab are provided in figure 12.

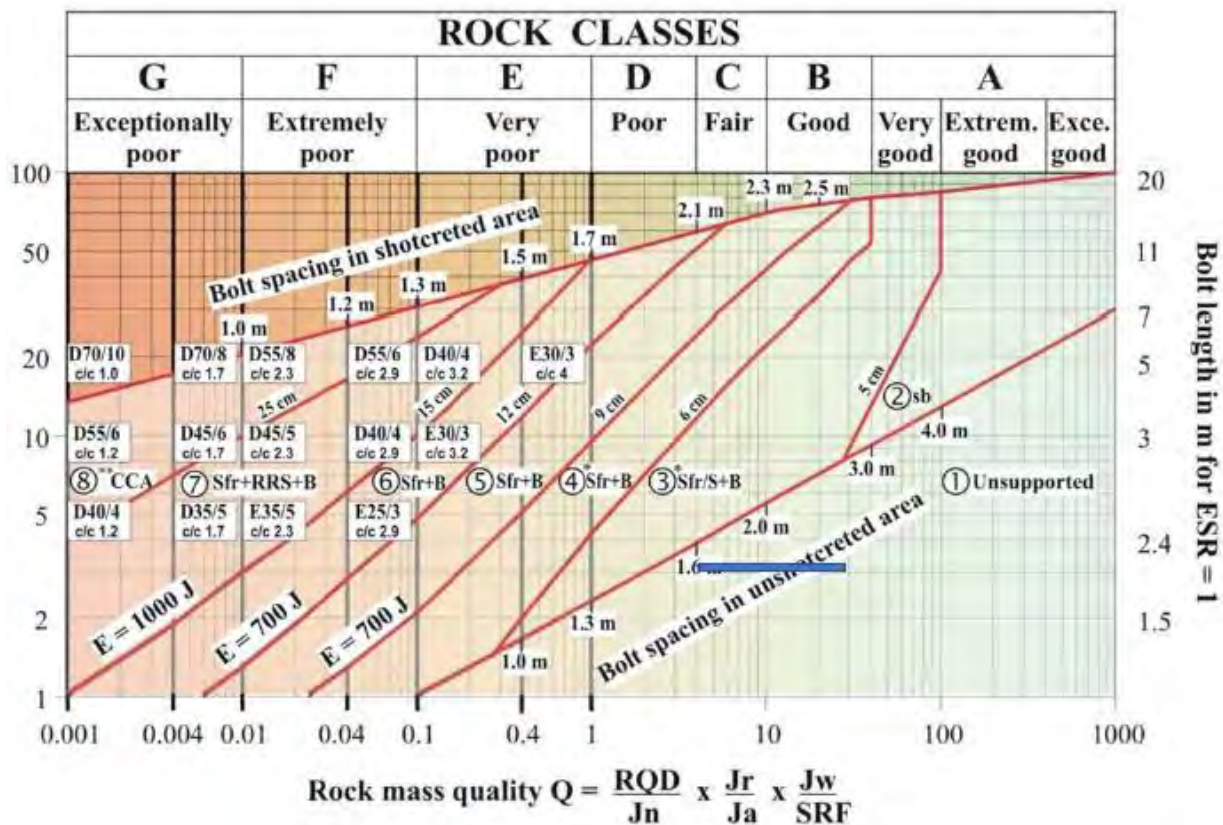


FIGURE 12 – A DIAGRAM SHOWING GROUND SUPPORT SPECIFICATIONS FOR NAVACHAB TRIAL MINE BASED ON ROCK TYPE

4.6.3 OCCUPATIONAL HEALTH AND SAFETY – GAS EXPOSURE

A baseline gas exposure audit will be conducted and based on the results, an appropriate gas monitoring procedure will be compiled and implemented. Based on the outcome, this may include daily/weekly/monthly requirements for shift captains to carry out and log in their daily shift logs certain gas levels, either through calibrated monitors (gas detectors) or Draeger tubes. On a monthly to quarterly basis this will be audited as part of the occupational hygiene program as well as part of the ventilation management program.

Typically, the following gases are present in an underground mine

- Carbon Monoxide
- Hydrogen Sulphide
- Sulphur Dioxide
- Methane
- Nitrogen Dioxide
- Ammonia

Standard re-entry procedures will be in place after each and every blast. Additional gas monitoring will be evaluated based on risk assessment following a baseline gas exposure audit.

Personnel monitoring will be carried out to keep record of and manage exposure levels. The following will be monitored:

- Dust sampling and for substances such as silica
- Noise measurement to determine the noise output of machinery and the daily noise exposure levels
- Water sampling
- Standard underground monitoring would typically include:
 - Air Quality Monitoring (personal)
 - Air Flow/Ventilation Monitoring (personal)
 - Hazardous gas monitoring (personal)
 - Noise Surveys (personal)
 - Ground Control Monitoring
 - Occupational Hygiene Monitoring (personal)
 - Sanitary Hygiene management/monitoring (personal)
 - And if necessary, ground pressure/movement monitoring (based on ground pressures and seismicity in the area)

4.6.4 EMERGENCY PREPAREDNESS AND RESPONSE

The mine currently maintains an Emergency Preparedness and Response Plan (EPRP) including a highly trained Mine Rescue team. This is in line with all legal requirements for mining in Namibia and international best practice. The methodology for identifying potential emergencies are captured in the mine's internal risk management system. An update of the mine's risk assessment to include the underground operations is planned for quarter one 2021, ahead of the initiation of underground mining operations. The emergency preparedness and response procedures, plans, training and etc. will be updated to incorporate risks associated with the underground operation.

4.7 ALTERNATIVES CONSIDERED

4.7.1 OTHER MINING OPTIONS

The mine investigated the option of moving straight into a full-scale underground mining method however due to some uncertainties, namely ground support, the viability of using the underground mining method could only be confirmed through developing a trial mine. Extraction of ore, at the planned future depth will likely become uneconomical and physically difficult to achieve safely, therefore the alternative to investigate the underground mining method is key to ensure the longevity of the mine life.

Several underground mining methods were investigated and will continue to be investigated for potential use in the mine.

4.8 REHABILITATION AND CLOSURE

The underground extension will increase the life of mine and extend mining operations by approximately X years. No changes are envisaged to the existing closure plan for surface infrastructure. At closure, all equipment and cables will be reclaimed from the workings before the decline and ventilation shafts (planned for future use) will be sealed. A monitoring casing will be installed in the vent shaft seal to monitor the rebounding water table and water quality in the workings. The underground mine will be incorporated into the updated mine closure plan being developed to align with the Namibian mine closure framework developed by MME.

5 CURRENT ENVIRONMENT

Initial baseline specialist studies of relevance to the Navachab Project were conducted between 2009 to 2012 and site monitoring data since this time has continued to build on the dataset from these baseline studies.

The Navachab Project is located in a relatively dry area that receives approximately 200-230 mm of rain per year. Most rain falls in the late summer months (January – April) in the form of convective summer thunderstorms in a few isolated rainfall events. Rains are unpredictable, highly variable between years and patchy.

Navachab has a semi-desert climate, characterised by low rainfall, high evaporation and a high diurnal range of temperature. The area experiences hot summers and mild winters, with temperatures varying between summer highs of around 32 °C and winter lows of around 8 °C. Frost is rare in the area (Mendelsohn et al. 2002). Evaporation rates are between 2,330 - 2,440 mm per year. The Namibian Weather Service operated a manned meteorological station at Karibib from 1967 to 1983 and a rainfall station only from 1983 to 2002. A weather station was established on site at Navachab in 1989 which records temperature and rainfall data on a daily basis.

Karibib experiences very hot summers and mild winters. The average annual temperature is 22.3°C with the monthly average maximum temperature of 30°C or more occurring from September to March and the winter month minimums are between 25°C and 28°C (Zunckel, 2008).

5.1 GEOLOGY

The Navachab ore body is hosted by Damara greenschist-amphibolite facies, calc-silicates, marbles and volcanoclastic rocks that have been intruded by granites, pegmatites and quartz porphyry dykes. The bedding is steep to sub-vertical, striking approximately North- South and dipping to the West. Marble and arkose formations outcrop to the west of the pit, and some solution features have locally developed in the marble. A thick (15-40m) calcrete cap overlies the mineralised zone in the vicinity of the pit but does not appear to extend southwards.

The sheeted vein swarms cuts across the entire stratigraphic succession and generally dips at 15° to the north or the NNW. Gold occurs in the gold silicate skarn and quartz vein ore assemblages containing 2-5 volume % pyrrhotite, chalcopyrite and very minor pyrite, but the bulk proportion of sulphides is relatively small (<1% of all rock mined) (Steven et al 2001 in ASEC 2009).

The main gold mineralisation forms a sheet-like body which plunges at an angle of approximately 20° to the NW. The mineralisation is predominantly hosted in a sheeted quartz vein set (±60%) and a replacement skarn (±40%). The mineralisation in the main pit is hosted by a NE to SW striking metamorphosed sequence of calc-silicates, marbles and volcanoclastic rocks that dip at 70° to the west. The gold is very fine-grained and associated with pyrrhotite and minor amounts of pyrite, chalcopyrite, arsenopyrite, sphalerite, maldonite and bismuthinite. An estimated 90% of the gold occurs as free gold and the remainder is present in minerals such as maldonite (Au₂Bi). Silver is also present with a gold to silver ratio of approximately 15 to 1 (NGM Project description 2012).

5.2 SOIL

According to the Atlas of Namibia, the soil types found at the proposed mining site is Regosols and Leptosols soils. These soil types are medium- or fine textured soils of actively eroding landscapes, the thin layers lying directly above the rock surfaces from which they formed. These soils are very shallow and does not support any form of irrigation but are limited to grazing utilization. Water runoff and water erosion can be high when heavy rains fall, due to low vegetation cover and the surrounding topography (ASEC, 2012).

5.3 TOPOGRAPHY

The town of Karibib lies on the edge of the Central – Western Plains stretching from the coast to about 450 km to the east which connects the Escarpment. The escarpment divides most of the country into two general landscapes: the low lying coastal plain (Karibib), and the higher inland plateau (Khomas Hochland to the east of Karibib). The topography varies between 1150 and 1450 meters within the ML area (ASEC, 2012).

Navachab is located in a valley on the northern margin of the Karibib-Usakos range, at an altitude of 1,100m. These hills trend North East-South West and may locally extend to over 400m above the calcrete plain. The mining operations lie in a valley between two small ridges that run in a southwest to northeast direction (ASEC, 2012).

5.4 SURFACE WATER

Navachab falls in the Khan River catchment. All surface water drains to small water courses and to one particularly large tributary of the Khan River, which runs through the catchment area from east to west. The ephemeral Khan River joins the Swakop River, some 40km east of the Atlantic Coast (ASEC, 2012).

In the very arid conditions of western Namibia, river flows are predominantly episodic from discrete though erratic rainfall events. River flows are mostly short-lived flash floods. The nature of the run-off, created by high intensity but short rainfall events is an important characteristic to consider in the storm water design for the mine. The frequent rock outcrops and the significant dissection and erosional cutback in the landscape further enhances high intensity run-off. Significant erosion in the past has resulted in landscapes of low gradient hills with a typical dendrite drainage pattern in the plains (Du Toit 2009).

Drainage from the catchment that contains the bulk of mine infrastructure (pit, waste rock dumps, stockpiles, plant, contractors' yards, mine administration block) takes place towards the north. The existing tailings storage facility (TSF) is located at the southern end of this catchment area. Run-off from the area to the south of the waste rock dumps drains into three steep, sub-parallel valleys that drain to the Kachab ephemeral river system in the south. The waste rock dump to the east of the pit drains towards the north and meets up with the mine area drainage system (ASEC, 2012).

The quality of surface water (and thus, eventually of groundwater) could potentially be compromised if the ore body were to prove acid-generating. To date, the risk of acid mine drainage has been considered to be low because of:

- The low bulk proportion of sulphide minerals present (less than 1% by volume of all rock mined); and
- The abundant carbonate gangue and carbonate lithologies of the overlying Karibib Formation (Steven et al, 2001).

5.5 HYDROGEOLOGY

Hydrogeological studies conducted for pit dewatering have indicated that the rock mass in the vicinity of the pit is generally dense and impermeable, except in areas where secondary permeability has been developed. The ore body functions as a fractured secondary rock aquifer, but yields are generally low (SRK, 2001a). The dominant groundwater flow paths encountered are along bedding planes, joint sets, dyke margins and shear zones, and there appears to be little or no hydraulic connection between these flow zones.

In July 2000, the only significant groundwater inflow to the pit was noted from the J2 joint on the north face of the pit, which yielded 0.6L/s (2.2 m³/h). This seepage had apparently been flowing at this rate for the previous five years since this zone was first intersected by mining (SRK, 2001a).

The dolomitic marble is generally dense, with minimal to low primary porosity. The development of karstic features has contributed towards secondary permeability of this formation, but the dolomitic marble is still considered to have low groundwater supply potential (ASEC, 2012).

Low borehole yields encountered during studies conducted at Navachab indicated that it was not feasible to meet the mine's water requirements from groundwater sources. Mine water supply is instead sourced from the Swakoppoort Dam via an 85km-long series of pipelines. The water is purchased from NamWater and an average permissible abstraction rate of 240m³/h is guaranteed (ASEC, 2012).

5.5.1 GROUNDWATER LEVELS

In piezometers installed around the pit, groundwater levels are between 25m and 50m below ground level. It should be noted however, that some of these levels are likely to have been drawn down below the pre-development groundwater level and reflect the development of a cone of depression due to pit dewatering (ASEC, 2012).

Groundwater levels recorded in four monitoring boreholes (P374, P375, P376 and P377) drilled to the south of the pit during 2000 indicate rest water levels of between 16m and 88m below surface (with the deepest groundwater levels being recorded in boreholes drilled on elevated ground) (ASEC, 2012).

Dewatering is achieved by groundwater drainage into the pit, although dewatering borehole(s) may be installed in the near future to control inflow along the J2 seep. Seepage water and runoff that enters the pit is collected in sumps and either used for dust suppression or discharged into an adjacent water course (as licensed under exemption permit No.503, Ministry of Agriculture, Water and Forestry) (ASEC, 2012).

5.5.2 GROUNDWATER QUALITY AND MONITORING

Groundwater quality is monitored on a monthly basis in 12 boreholes located around the site. In addition, groundwater quality from other boreholes and seeps is determined on an ad hoc basis (such as the programme described in Steven, 2001).

Water sampled from the J2 seep is slightly alkaline, with a pH of 7.9, and has a Total Dissolved Solids (TDS) concentration of 1,395mg/L (SRK, 2001a). This water falls within the parameters for Limit B (i.e. maximum allowable limit for drinking water) for all inorganic parameters except hardness. The mixed geochemical signature of water from the J2 seep suggests that this water may be derived from a combination of both surface and groundwater sources.

Sixteen localities on the R/E of Farm Navachab 58 were sampled in the period 28-29 April 2000 and fifteen water samples were taken from several boreholes and drainage sumps in the area from 2-5 May 2000. The following findings were given (EIA 2009 and supplementary Report on Hydrochemical work conducted in 200-2001 at the Navachab Gold Mine, Namibia, N. Steven):

- The field pH and laboratory pH of ground and sump water at NGM range between 6.7 and 8.1 compared to a range of 6.6 to 9.1 for ground waters on the surrounding farms. A first order conclusion would be that acid waters are not present in boreholes or sumps at NGM and hence there is not a potential problem due to Acid Mine Drainage.
- Water salinity in the mine area is normal;
- Deleterious metal concentrations are generally below most international drinking water limits
 - sulphate concentrations = 600 mg/litre, a widely used drinking water limit;
 - highest arsenic concentration = 43 ug/litre, average arsenic concentration = 15ug/litre, this is less than the US maximum contaminant level for drinking water value of 50 ug/litre;
- Ficklin (Zn + Cu + Cd + Pb + Co + Ni) diagram (this index of six elements is a widely used environmental indicator) show that groundwater at Navachab Gold Mine can be classified as being of 'near-neutral, low-metal' type.
- Groundwater levels vary between 5meters and 67meters, with the mean in the region of 20-30 meters.

Cyanide is widely used in modern gold mining industry. Environmental concern over the use of this chemical has become more publicly a concern, because it is a hazardous substance that can affect the environment. As such Navachab has implemented a ground water monitoring programme whereby 12 boreholes around the Mine area are sampled to test and analyse the cyanide as well as the chemical content of other hazardous substances in the ground water.

5.6 AIR QUALITY

During the initial Environmental Impact Assessment, the air quality assessment of 2010 focused on airborne particulates (PM₁₀ emissions and total suspended particles).

Particulates represent the main air pollutant from Navachab's operations. The highest emissions of PM₁₀ and Total Suspended Particulates (TSP) are due to the crushing processes, followed by material handling and in pit activity. By far the most important source of emissions is the secondary and tertiary crushing at the DMS plant comprising almost 80% of all the emissions¹.

Dispersion modelling undertaken by Airshed in 2010 found that the resulting ground level concentrations are high close to the DMS and Primary Crusher but low and well within the respective guidelines at the plant boundary and at Karibib. Even with simulated background concentrations (Liebenberg-Enslin and van Blerk, 2010), the area of exceedance of the WHO guideline (50 µg/m³) is limited to the Navachab mine property. Dust fallout rates are also low compared to available dust fallout limits at the plant boundary and at Karibib. Airshed recommended potential control measures to reduce emissions at the crushing and DMS plant, during material handling processes and on haul roads.

5.7 SOCIO-ECONOMIC ENVIRONMENT

It is estimated that Namibia's population has increased from about 2.1 million in 2011 (when the last census was held) to about 2.5 million in 2020. The national population density is estimated at about 3 persons per km² and the population growth rate at 1.86%, slightly lower than most African countries². The population density of the Erongo Region, where the Navachab Project is located, is slightly higher at about 3.3 persons per km² and the current population of the region in projects at 209,000³. The Karibib constituency had a population of 13,320 in 2011. Most of the employees at the Navachab Project reside in Karibib.

The presence of the Navachab Project has brought employment and skills development at the local and regional level, which had a knock-on effect in terms of reducing income inequality, increasing job creation and economic growth. As the last national census was conducted in 2011, there is good reason to believe that the demographics of the Erongo Region, and more particularly Karibib has changed markedly, not only as a result of the expansion of the Navachab Project, but also as a result of other mining projects such as Husab, Rossing, Langer Hinrich (although currently in care and maintenance) but other mining projects within the neighbouring regions such as the Otjikoto gold mine.

The socio-economic environment has been explained in detailed in previous assessments and therefore not repeated here as the introduction of a trial mine will have very limited effects if any on the socio-economic environment.

¹ ASEC - Navachab Gold Mine Expansion Study Environmental Scoping Report – Final

² (retrieved from www.worldpopulationreview.com)

³ (retrieved from www.citypopulation.de)

6 IDENTIFICATION AND EVALUATION OF IMPACTS METHODOLOGY

6.1 INTRODUCTION

This chapter outlines ECC's method to identify and evaluate impacts arising from the proposed project. The findings of the assessment are presented in chapter 7.

The evaluation and identification of the environmental and social impacts require the assessment of the project characteristics against the baseline characteristics, ensuring all potentially significant impacts are identified and assessed. The significance of an impact is determined by taking into consideration the combination of the sensitivity and importance/value of environmental and social receptors that may be affected by the proposed project, the nature and characteristics of the impact, and the magnitude of potential change. The magnitude of change (the impact) is the identifiable changes to the existing environment which may be negligible, low, minor, moderate, high, or very high; temporary/short term, long-term or permanent; and either beneficial or adverse.

This chapter provides the following:

- Details on the assessment guidance used to assess impacts;
- Lists the limitations, uncertainties and assumptions with regards to the assessment methodology;
- Details how impacts were identified and evaluated, and how the level of significance was derived; and
- Details how mitigation was applied in the assessment and how additional mitigation was identified.

ECC ESIA METHOD

- Predication and evaluation of impacts is a key step in the EIA process.
- The methods ECC follows to identify and evaluate the impacts arising from projects is outline in this diagram.

THE FOLLOWING PRINCIPLES ARE USED BY ECC FOR ASSESSMENTS

- International Finance Corporation standards and models, in particular Performance Standard 1, Assessment and management of environmental and social risks and impacts (International Finance Corporation, 2017) (International Finance Corporation 2012);
- International Finance Corporation OIA and Management Good Practice Handbook (International Finance Corporation, 2013) and;
- Norwegian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008).

DETERMINE THE SIGNIFICANCE OF AN IMPACT

SENSITIVITY AND VALUE OF A RECEPTOR

The sensitivity and value of a receptor is determined by identifying how sensitive and vulnerable a receptor is to change, and the importance of a receptor (internationally, nationally, locally)

NATURE AND CHARACTERISTICS OF THE IMPACT

The nature and characteristics of the impact is determined through consideration of the frequency, duration, reversibility and probability of the impact occurring.

MAGNITUDE OF CHANGE

The magnitude of change measures the scale or extent of the change from the baseline condition, irrespective of the value. The magnitude of change may alter over time, therefore temporal variation is considered (short-term, medium-term, long-term, reversible, irreversible environmental assessment methodology).

ECC – NATURE OF IMPACT

BENEFICIAL (POSITIVE)

An impact that is considered to represent an improvement on the baseline or introduces a positive change.

ADVERSE (NEGATIVE)

An impact that is considered to represent an adverse change on the baseline or introduces a new undesirable factor.

REVERSIBILITY

REVERSIBLE

Impacts are reversible and recoverable in the future

PARTLY REVERSIBLE

Some parts of the impact can be reversed while others remain

IRREVERSIBLE

Impacts which are not reversible and are permanent

ECC – TYPE OF IMPACT

DIRECT

Impacts causing an impact through direct interaction between a planned project activity and the receiving environment/receptors.

INDIRECT

Impacts that result from other activities that are encouraged to happen as a result / consequence of the Project. Associated with the project and may occur at a later time or wider area

CUMULATIVE

Impacts that arise as a result of an impact and effect from the project interacting with those from another activity to create an additional impact and effect

MAGNITUDE OF CHANGE

VERY HIGH / UNKNOWN

Loss of resource, significantly affecting the long term quality and integrity of a resource; irreparable damage or loss of key characteristics, features or elements; or the magnitude is too great to quantify as it is unknown.

HIGH / MAJOR

Loss of resource, and quality and integrity of resource; severe damage to key characteristics, features or elements; or Large scale or major improvement of resources quality; extensive restoration or enhancement; major improvement of attribute quality

MODERATE

Loss of resource, but not adversely affecting its integrity; partial loss of/damage to key characteristics, features or elements; or Benefit to, or addition of, key characteristics, features or elements; improvements of attribute quality.

LOW / MINOR

Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (or maybe more) key characteristic, feature or element; or Minor benefit to, or addition of, one (or maybe more) key characteristic, feature or element; some beneficial effect on attribute quality or a reduced risk of a negative effect occurring.

NONE / NEGLIGIBLE

Very minor loss or detrimental alteration to one (or maybe more) characteristics, feature or element; or Very minor benefit to, or positive addition of, one (or maybe more) characteristic, feature or element

SCALE OF CHANGE - EXTENT / GEOGRAPHIC SCALE

ON-SITE

Impacts that are limited to the boundaries of this proposed project site

LOCAL

Impacts that occur in the local area of influence, including around this proposed site and within the wider community

REGIONAL

Impacts that affect a receptor that is regionally important by virtue of scale, designation, quality or rarity

NATIONAL

Impacts that affect a receptor that is nationally important by virtue of scale, designation, quality or rarity

INTERNATIONAL

Impacts that affect a receptor that is internationally important by virtue of scale, designation, quality or rarity

PROBABILITY

IMPROBABLY (RARE)

The event may occur in exceptional circumstances yet, rarely occurs in the industry. The event could occur once every 100 years

LOW PROBABILITY (UNLIKELY)

The event has happened elsewhere yet, is unlikely to occur. The event could occur once every 10 years

MEDIUM PROBABILITY (POSSIBLE)

The event could occur under some circumstances. The event could occur once every 5 years.

HIGH PROBABILITY (LIKELY)

The event is expected to occur. The event could occur twice per year

DEFINITE (ALMOST CERTAIN)

The event will occur. The event could occur once per month

	To ensure the beneficial impacts are brought out in the assessment, given has been applied to evaluate the different type of impact is clear:		SIGNIFICANCE OF IMPACT				
	- The significance of impacts has been derived or by applying the identified thresholds if receptor sensitivity and magnitude of change, as well as the definition of significant. Moderate and more adverse impacts are considered as significant. - The following threshold were iterative used to double check the assessment of significance had been applied appropriately; a significant impact would meet at least one of the following criteria: - It exceeds widely recognized levels of acceptable changes; - It threatens or enhances the viability or integrity of a receptor or receptor group of concern; and, - It is likely to be material to the ultimate decision about whether or not the environmental decisions certificate is granted.		Significance of Impact	Impacts are considered to be local factors that are unlikely to be critical to decision-making	Impacts are considered to be important factors but are unlikely to be key decision-making factors. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards; and/or the receptor is of low sensitivity/value. Impacts are considered to be short-term, reversible and/or localized in extent	Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/features that are unique and which, if lost, cannot be replaced or relocated.	Impacts are considered to be key factors in the decision making process that may have an impact of major significance or large magnitude. Impacts occur to highly valued/sensitive resource/receptors. Impacts are expected to be permanent and non-reversible on a national scale and/or have international significance or result in a legislative non-compliance.
	Bioophysical	Social	Low	Minor (2)	Moderate (3)	Major (4)	
SENSITIVITY	A bio-physical receptor that is protected under legislation or international convention (CITES), listed as rare, threatened or endangered IUCN species. Highly valued sensitive resource receptors.	Those affected people/ communities will not be able to adapt to changes or continue to maintain pre-impact livelihoods.	High (3)	Minor (3)	Moderate (4)	Major (9)	
	Of value, importance/rarity on a regional scale, and with limited potential for substitution; and/or not protected or listed globally but may be a rare or threatened species in the country, with little resilience to ecosystem changes, important to ecosystem functions, or one under threat or population decline.	Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support	Medium (2)	Low (2)	Minor (4)	Moderate (6)	
	Not protected or listed as common/abundant; or not critical to other ecosystems functions.	Those affected are able to adapt with relative ease and maintain pre-impact status. There is no perceptible change to people's livelihood.	Low (1)	Low (1)	Low (2)	Minor (3)	
					Moderate (4)		

SENSITIVITY AND VALUE		
Low	Medium	High
Of value, importance or rarely on a local scale; and/or not particularly sensitive to change or has considerable capacity to accommodate a change.	Of value, importance or rarely on a regional scale, and with limited potential for substitution; and/or moderate sensitivity to change, or moderate capacity to accommodate a change.	Of value, importance or rarely on an international and national scale, and with very limited potential for substitution; and/or very sensitive to change or has little capacity to accommodate a change.

MITIGATION
Mitigation comprises a hierarchy of measures ranging from preventative environmental impacts by avoidance, to measures that provide opportunities for environmental enhancement. The mitigation hierarchy is avoidance; reduction of source; reduction of receptor level; repairing and correcting; compensation; remediation; and enhancement.
Mitigation measures can be split into three distinct categories, broadly defined as:
Standard practice and core best practice measures for avoiding and minimizing environmental impacts. These are considered as good practice measure. Action undertaken by the EIA proponent that influences the design process through implementing design measures that would entirely avoid or eliminate an impact or modifying the design through the inclusion of environmental features to reduce the magnitude of change. These are considered as embedded mitigation. Specified additional measures or follow-up action to be implemented to further reduce adverse impacts that remain after the incorporation of embedded mitigation. This level are considered as additional mitigation.

LOW – MAJOR (BENEFICIAL)
Low (negative) 0 - 25 Impacts are considered to be beneficial to the environment and society. Impacts are considered to be local factors that are unlikely to be critical to decision-making.
Minor (negative) 25 - 50 Impacts are considered to be important factors but are unlikely to be key decision-making factors. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. Impacts are considered to be short-term, reversible and/or localized in extent.
Moderate (negative) 50 - 75 Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/features that are unique and which, if lost, cannot be replaced or relocated.
Major (negative) 75 - 100 Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impacts are expected to be permanent and non-reversible on a national scale and/or have international significance or result in a legislative non-compliance.

The EIA is an iterative process whereby the outcomes of the environmental and social assessments inform the project. The EMP provides the good practice mitigation measures and specified additional measures or follow-up action EGC has recommended for the project.

7 IMPACT ASSESSMENT FINDINGS AND PROPOSED MITIGATION MANAGEMENT MEASURES

7.1 INTRODUCTION

This chapter presents the findings of the EIA for the proposed project as per the EIA process, scope and methodology set out in Chapter 2 and Chapter 6. A range of potential impacts have been identified that may arise as a result of the proposed project. The aim of this EIA report is to focus on the significant impacts that may arise as a result of the proposed project. This chapter therefore only considers the significant impacts and or those that may have specific interest to the community and stakeholders. A summary of impacts that are not considered significant is discussed in section 7.3.

Impacts that are considered significant or are those of interest to the community and stakeholders are as follows:

- Socio-economic: employment
- Socio-economic: employee occupational health and safety
- Environment: groundwater quality and quantity
- Environment: air quality Impacts

For each potential significant or sensitive impact, a summary is provided which includes the activity that would cause an impact; the potential impacts; embedded or best practice mitigation (stated where required / available); the sensitivity of receptor that would be impacted; the severity, duration and probability of impacts; the significance of impacts before mitigation and after mitigation measures are applied.

7.2 IMPACTS NOT CONSIDERED AS SIGNIFICANT

As a result of an iterative development process, mitigation has been incorporated and embedded into the project, thereby designing out potential environmental and social impacts or reducing the potential impact so that it is not significant. Best practice has also played a role in avoiding or reducing potential impacts. The EMP provides best practice measures, management and monitoring for all impacts.

Impacts that have been assessed as **not being significant** are summarised in table 3 and thus not discussed further.

TABLE 3 - IMPACTS NOT CONSIDERED SIGNIFICANT

ENVIRONMENT OR SOCIAL TOPIC	POTENTIAL IMPACT	SUMMARY OF ASSESSMENT FINDINGS
Cultural heritage	Potential to uncover heritage remains during project activities.	An archaeological and historical assessment for Navachab was conducted in 2009 and seventeen archaeological sites were recorded.

ENVIRONMENT OR SOCIAL TOPIC	POTENTIAL IMPACT	SUMMARY OF ASSESSMENT FINDINGS
		Findings are unlikely as the site has been studied and known heritage sites are already mapped and protected for the project area. The site also has a tried and tested chance find procedure in place in the very unlikely event a heritage item is discovered.
Climate change – adaptation	The potential for climate change impacts to impact the proposed project, for example, extreme fire, heat or storm events	The proposed project will not be significantly impacted by the impacts of climate change as the design has considered management measures in the event of increasing temperatures, emergency response plans will be in place in the event of a fire and sufficient dewatering systems will be in place for managing potential water inflows into the underground workings.
Climate change – cause / contribute to	The proposed project contributing to climate change through the discharge of greenhouse gas emissions	The proposed project will generate emissions contributing to greenhouse gas however the underground amendment will not alter significantly from the emissions from the current open pit mining operations, it is possible that the underground amendment may in future reduce emissions from the site with a smaller fleet of machinery.
Non Mineralised Waste	Potential to generate excessive volumes of solid waste or new solid waste streams	The underground operations is unlikely to generate excessive volumes of waste nor new waste streams that cannot be managed by the on-site waste management facility. Negligible change to current operations.
Mineralised Waste	Potential to generate mineralised waste that is significantly different to the mineralised waste being produced by open pit mining	As the ore body and general geology is the same as the existing operation this is unlikely. Furthermore advance drilling has been conducted to understand the geology and no significant changes are anticipated. Should mineralised waste containing sulphides or waste that has the potential to generate acid or mine drainage this waste will be managed in accordance with site procedures and

ENVIRONMENT OR SOCIAL TOPIC	POTENTIAL IMPACT	SUMMARY OF ASSESSMENT FINDINGS
		encapsulated within the mine mineral waste dump.
Ecology	Potential impacts to flora and fauna from underground mining operations.	Due to the nature of underground mining this risk is limited. The potential interactions with fauna would occur when hauling material to the surface on surface haul roads, which is an existing risk for the open pit mine. The site is fenced and wildlife occurrence and interactions with mining equipment to date has been limited. Negligible change to current operations.
Noise and Vibration	Potential for vibrations from underground to follow fault paths and cause vibration on surface and distance. Noise impacts to neighbours.	The potential for the underground mine to generate noise that will impact neighbours is extremely unlikely given the distance from the underground operations to the nearest sensitive receptor. Underground mining operations are quieter than open pit mining and therefore the addition of the underground mining method is unlikely to cause any noise concern for neighbours. Vibrations from underground mining are orders of magnitude smaller than open pit mining, furthermore the vibration pattern and methods for underground blasting are such that smaller blasts are required. As with open pit mining there is the potential for vibration to follow fault lines and sometimes vibrations can be felt some distance away from the operation. The site will continue to monitor vibrations and ensure vibrations are below allowable limits. Negligible change to current operations.
Landscape and visual amenity	Potential changes to the landscape by introducing underground mining	The portal entrance into the underground mine will be within the existing open pit mine, no significant infrastructure will be required on surface and the underground will produce less volumes of waste rock to be transported to the surface. Given

ENVIRONMENT OR SOCIAL TOPIC	POTENTIAL IMPACT	SUMMARY OF ASSESSMENT FINDINGS
		the limited impacts on surface there will be no notable change in the landscape or visual amenity to the site.
Rehabilitation and Decommissioning	Potential changes to the rehabilitation and decommissioning plan with the introduction of underground mining.	Typically, at closure underground portals are sealed, plugged and made safe so that entry into the underground workings isn't possible. Any associated surface infrastructure at closure will be assessed in the closure plan, alternative uses evaluated and if not, suitable alternative use identified infrastructure would be removed and remediated. Negligible change to current operations.

7.3 POTENTIAL PROJECT IMPACTS AND ASSESSMENT: SOCIOECONOMIC ENVIRONMENT

7.3.1 EMPLOYMENT

Whilst Namibia has a generally high unemployment rate, the Erongo Region is one of the regions with a higher rate of employment in Namibia. In the region, the majority of employment is through the mining, fishing, and tourism sectors. The value and sensitivity of employment is considered to be high, as it is of importance to the country with a high unemployment rate.

7.3.2 DIRECT EMPLOYMENT: DECLINE DEVELOPMENT

Approximately 20 jobs will be generated during the trial mining phase and 100-150 during the full scale underground mining phase.

The proponent will employ the specialised services of a contract mining company to develop the underground portal and decline. This phase of the project is likely to last approximately 12-24 months, during this contactor engagement underground specific safety and training procedures will be implemented by the contractor and will be carried over by means of a training process to the Navachab workforce some of whom will transmission to underground operators when full scale underground mining commences.

A potential impact associated with the use on a contractor mining company will be the influx of workers and potential families to the Karibib area, this is considered beneficial as it stimulates the economy as an indirect impact. The sensitivity of the economy is considered to be medium as economic development is an important regional issue. The magnitude of change will be minor as local spends from the families of workers will attribute to the economy but is unlikely to result in medium scale improvements.

Another potential impact as a result of the influx of workers and their families is the potential impacts on community cohesion. The demographics of the workers that will fill the skilled roles during the underground development phase of the proposed project, is diverse. The community where workers would live are accustomed to change with the inflow and outflow of workers depending on the regional needs. Diverse communities are use to change and therefore are not considered as sensitive, however there is potential that there may be a reduction in community safety and cohesion as a result of the influx of contract workers to the area.

Therefore, the beneficial impact of creating 20 jobs during the trial mining phase and 100-150 during the full scale underground mining phase will result in a medium term impact with a moderate magnitude of change. A moderate beneficial impact on the community and economy is therefore expected.

7.3.3 DIRECT EMPLOYMENT: OPERATIONS

Approximately 100-150 jobs will be generated during the mining phase. The proponent will redeploy employees from the open pit mining operation into the underground mine when possible through a training and phased approach. This will enable the contractor miner with pre-existing training and safety system to progressively train some of the open pit mining personnel in

order for them to transmission to underground mining when the open pits reach the end of their economic life. This will also provide extended employment opportunities which would have otherwise ended upon completion of the open pit mines. Therefore, the magnitude of change during operations is consider as moderate having long term impacts thereby resulting in a major beneficial impact on the community and economy.

7.3.4 INDIRECT EMPLOYMENT IMPACTS

As with the current open pit mining operations there are various indirect employment impacts as a result of the mining operations. These impacts range from job creation through service providers, increase in skills, increase in population, increase in economic activities. With the increased mine life that is a result of this amendment indirect benefits will continue to flow into the neighbouring towns and the national economy.

7.3.5 SUMMARY OF EMPLOYMENT IMPACTS

TABLE 4 – IMPACTS ON EMPLOYMENT AND INFLUX OF CONTRACTOR TO NEIGHBOURING TOWNS.

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction works - general	– Community – Job seekers – Local economy	Creation of 20 jobs	Beneficial Direct Regional Short Term Reversible	Medium	Moderate	Beneficial Moderate (6)
Operations of the proposed project	– Community – Job seekers – Local economy	Creation of 100-150 jobs	Beneficial Direct Regional Long Term Reversible	High	Moderate	Beneficial Major (9)
Influx of workers & families	– Community – Local economy	Influx of contractor (workers and families) stimulating the local economy through increase spends	Beneficial Direct Local Long Term Reversible	Medium	Minor	Beneficial Minor (4)
Influx of workers & families	– Community	Changes to community cohesion	Adverse Direct Local Long Term Reversible	Medium	Low	Adverse Low (2)

7.4 MAJOR HAZARD AND RISK: EMPLOYEE HEALTH AND SAFETY

Major mining hazards associated with underground mining include but are not limited to underground fires, ground control failures, inrush and subsidence. These hazards pose a unique risk that is specific to underground mining operations. While some elements of these risks can be mitigated through detailed planning often the management of these risks rely on strong operational management, safe working procedures and where possible the use of mechanical aids to reduce employee exposure.

The potential risks and associated mitigation measures is outline in the table below.

7.4.1 SUMMARY OF IMPACTS ON EMPLOYEE HEALTH AND SAFETY

TABLE 5 – POTENTIAL IMPACTS TO EMPLOYEE HEALTH AND SAFETY DURING UNDERGROUND MINING

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Mitigation Measures	Significance of impact (Post mitigation)
Ground control	– Employee Occupational Health and Safety	Underground ground control and ground support failures	Adverse Direct Partly Reversible High Medium Term Local	High	High / Major	Major (9)	> The Company's safety management plan will ensure that the SOP and golden rules include that no person is to go beyond supported ground (meaning no one can go into an area of unsupported ground). Supported ground is ground that has been controlled to an approved standard and made safe. > A Ground Control Coordinator will be appointed > A Ground Control Plan will be developed > Navachab will ensure that the application of a rigorous mine design process is in place prior to mining and refined as data becomes available. > Navachab will ensure a ground conditions model is developed to ensure that the evaluation of long term ground control requirements are incorporated into the sites technical plans and planning process > Navachab will ensure that there is a multi-tiered response plan for ground support	Moderate (6)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Mitigation Measures	Significance of impact (Post mitigation)
							> Navachab will ensure that all underground operators are trained in underground hazard identification > Navachab will ensure that the site has ground control monitoring systems in place to proactively measure potential ground movement > Navachab will ensure that the ground control requirements are incorporated into shift plans and work plans > Navachab will ensure that the site develops a quality assurance program for all areas of ground control/support.	
Fire	- Employee Occupational Health and Safety	Underground fire incident	Adverse Direct Irreversible High Long Term Local	High	High / Major	Major (9)	> Navachab will develop a fire control plan through the process of risk assessment > Develop a maintenance system to prevent the deterioration of equipment condition and performance > Ensure no petrol is used underground > Design and control flammable substances use and storage > Ensure that the control of hot work through a hot work permit system is in place specifically for underground operations > Ensure the underground operators receive training to be able to identify and provide first	Moderate (6)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Mitigation Measures	Significance of impact (Post mitigation)
							response to fire emergencies > Ensure that the site has an operational and maintenance procedures for fire control > Ensure that the design requirements for underground mobile equipment includes fire suppression > Ensure that the site has specific design requirements for fixed mechanical, electrical and compressor installations > In the event that associated infrastructure is required for underground operations such as workshops, lunch rooms, toilets and refuge chambers ensure these are planned and requirement designed for purpose	
Mobile equipment	– Employee Occupational Health and Safety	Collision of underground mining equipment causing injury to people	Adverse Direct Partly Reversible Moderate Short Term On-site	High	Moderate	Moderate (6)	> Ensure that procedures are in place to minimise the instances where pedestrians and operating mobile equipment are in the same area at the same time > Ensure that operational risk assessments are part of the planning process > Develop equipment specifications which include minimum safety requirements and the identification of critical control systems for underground equipment > Develop a maintenance system that	Minor (4)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Mitigation Measures	Significance of impact (Post mitigation)
							identifies the maintenance requirements for critical safety systems > Design requirements of all underground roads to ensure good road conditions underground are maintained > Ensure ongoing maintenance of underground roads > Ensure suitable control of traffic through the development of standard working procedures > Ensure the site makes provisions for the use of remote controlled equipment to ensure high standards of safety > Ensure all operators understand and are trained for emergency response > Ensure all operators are trained in safety signally and that the risk of human and equipment interaction is addressed in the safety management plan prior to underground operations commencing.	
Inrush and subsidence	– Employee Occupational Health and Safety	Inrush or subsidence event within the underground mine causing injury and harm to	Adverse Direct Irreversible Very High Long Term Regional	High	Very high / unknown	Major (12)	> Ensure that due consideration of inrush and subsidence potential at each stage of a project is implemented at the planning phase > Ensure that the use of a risk assessment process is in place to identify specific hazards > Implement a systematic collection and analysis of data	Major (9)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Mitigation Measures	Significance of impact (Post mitigation)
		people and project feasibility					> Evaluate of climatic conditions > Identify risks of operating near water > Ensure that consideration of pathways for inrushes is evaluated at each phase > Develop, apply and monitor lead indicators for inrush potential > Develop and apply a response plan for lead indicators > Ensure the site has implemented contingency planning prior to the development of working areas > Ensure a Water Control Plan is developed and in place > Apply appropriate procedures for surface and underground drilling > Apply rigorous mine design process > Implement effective ore and waste design > Implement effective tailings and surface water storage > Implement effective backfill design and procedures > Implement effective underground and surface pumping and drainage systems > Ensure effective flood prevention measures are in place and ensure diversions are in place	

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Mitigation Measures	Significance of impact (Post mitigation)
							to prevent an inrush of water from the open pit into underground mine workings. > Ensure adequate pumping infrastructure is in place with both stand by and duty systems at the ready. > Ensure that there is a method for open and clear communication of experiences and outcomes of inrush and subsidence events	

7.5 POTENTIAL PROJECT IMPACTS AND ASSESSMENT: BIOPHYSICAL ENVIRONMENT

7.6 ODOUR AND AIR QUALITY

A potential impact to air quality is the deterioration in air quality from odour and particulate matter (i.e. total suspended particulate matter (TSP), PM₁₀ and PM_{2.5} (particulate matter of 2.5 micrometres or less in diameter) and dust deposition) generated from the underground operations.

The main pollutant of concern associated with the mining operations is particulates. Particulates are divided into different particle size categories with Total Suspended Particulates (TSP) associated with nuisance impacts and the finer fractions of PM₁₀ (particulates with a diameter less than 10 µm) and PM_{2.5} (diameter less than 2.5 µm) linked with potential health impacts. Gaseous pollutants (such as sulphur dioxide, oxides of nitrogen, carbon monoxide etc.) will derive from vehicle exhausts but are regarded as negligible in comparison to particulate emissions.

The 2012 air quality assessment was limited to airborne particulates (including TSP and PM₁₀). Mechanical operations associated with mining give rise to particles mainly in the TSP and PM₁₀ fraction, whereas combustion sources (such as stack emissions) result in the finer PM_{2.5} fraction. For this reason, the main focus of this study was on TSP and PM₁₀ and remains relevant for the proposed underground development.

Air quality has been monitored on site using depositional dust monitoring stations. Sensitive receptors were mapped in the 2010 air quality assessment and monitoring of impacts on these receptors has been ongoing since the site implemented an air quality management programme per the management plan.

The overall airflow requirements were based on airflow provision for diesel emission dilution, dilution of flammable gas, heat removal, clearance of blasting fumes or provision of a ventilation rate per 1000 tons mined per month whichever the greatest. A ventilation design rate of 0.08m³/s per Kilowatt is recommended for Tier 2 engines using 50 ppm diesel fuel and 0.06 m³/s per kW for Tier 3 engines using 10 ppm diesel fuel. Ventilation quantities have been planned to take the number of vehicles and total kilowatts produced by the vehicles into consideration.

This exhaust is unlikely to alter the emissions already being generated from the pit and, therefore, change to current conditions would not be material. In regard to the predicted concentrations of air exhausting via the portal into the South pit, it is likely that this will contain particulate matter (exhausted from machinery) and PM₁₀ fractions. Air quality will be managed in order to ensure potential occupational health risks are mitigated, furthermore it is unlikely that the underground operations will cause further negative impacts or cumulative impacts, to the current ambient air quality due to the scale and extend of the underground project.

As the exhaust of the underground air will be dissipated into the existing open pit mine, there will be limited change to the existing baseline. No new or additional impacts will be created in relation to air quality that do not already exist as part of the open pit mining operation. The scale of impact associated with the potential deterioration in air quality from odour and particulate matter

is considered direct and limited to site, the nature of the potential impact is considered short term and reversible, when operations cease the potential impact also ceases, therefore the magnitude of change is considered minor with limited change to existing conditions.

7.6.1 ODOUR

Odour can be generated from underground mining operations from gaseous emissions, poor ventilation, and poor ventilation management practices. Aside from the occupational health risks associated with poor ventilation practices there is potential to generate odour from underground ventilation exhausts that cause nuisance odours to sensitive receptors. The same sensitive receptors that were mapped for air quality, apply for odour with the addition of on-site receptors such as workers in the open pit operation.

The site must monitor through drilling campaigns, for any notable occurrences of natural gases. Monitoring during the development of any underground project requires occupational health monitoring for gases, this will be completed by site on a frequency set by the health and safety management plan.

7.6.2 SUMMARY OF IMPACTS ON AIR QUALITY

TABLE 6 - IMPACTS TO COMMUNITY DUE TO DUST GENERATED DURING CONSTRUCTION

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact	Mitigation Measures	Significance of impact (Post mitigation)
Impacts to Air Quality	– Community – Neighboring farmers – Workers	Deterioration in air quality from odour and particulate matter (i.e. total suspended particulate matter (TSP), PM10 and PM 2.3 (particulate matter of 2.5 micrometres or less in diameter) and dust deposition) from the underground operations	Adverse Direct Local Short Term Reversible	Low	Minor	Adverse Low (1)	> Ensure mechanical equipment is maintained and serviced to ensure particulate matter is reduced > Ensure ventilation systems are providing fresh air to working headings and the underground workings are exhausted after each blast	Adverse Low (1)
Odour	– Community – Neighboring farmers – Workers	Ventilation discharged from the underground workings via the portal could contribute to offensive odours	Adverse Direct Local Short Term Reversible	Low	Minor	Adverse Low (1)	> Implement gas monitoring procedures as part of the daily operations of the underground mine > Ensure adequate ventilation to prevent the build-up of odours and gas within the underground mine	Adverse Low (1)

Impacts to Air Quality	– Community – Neighboring farmers – Workers	Air quality and greenhouse gas (GHG) emissions from underground mining activities	Adverse Direct Local Short Term Reversible	Low	Minor	Adverse Low (1)	> Ensure mechanical equipment is maintained and serviced to ensure particulate matter is reduced > Ensure efficient waste handling to reduce haul distances and therefore reduce potential GHG emissions.	Adverse Low (1)
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7.7 HYDROGEOLOGY

7.7.1 GROUNDWATER QUALITY AND QUANTITY

The proposed underground development, as with any underground mining operation, has the potential to interact with water in numerous ways. Interactions with water in the underground environment can include, groundwater, sediments in water pumped to surface, dewatering, inrush and perched water bodies, to name a few. In order to access the ore body for both the open pit and underground mining methods, dewatering maybe required.

Hydrogeological studies conducted for pit dewatering have indicated that the rock mass in the vicinity of the pit is generally dense and impermeable, except in areas where secondary permeability has been developed. The ore body functions as a fractured secondary rock aquifer, but yields are generally low (SRK, 2001a). The dominant groundwater flow paths encountered are along bedding planes, joint sets, dyke margins and shear zones, and there appears to be little or no hydraulic connection between these flow zones.

In piezometers installed around the pit, groundwater levels are between 25m and 50m below ground level. It should be noted however, that some of these levels are likely to have been drawn down below the pre-development groundwater level and reflect the development of a cone of depression due to pit dewatering.

Groundwater levels recorded in four monitoring boreholes (P374, P375, P376 and P377) drilled to the south of the pit during 2000 indicate rest water levels of between 16m and 88m below surface (with the deepest groundwater levels being recorded in boreholes drilled on elevated ground).

The site has indicated that dewatering requirements are anticipated to be minimal, although an updated hydrogeological model should be developed to address the full-scale underground mine to confirm this.

Therefore, the potential impacts associated with dewatering remain largely unchanged in either the open pit or underground mining method. Impacts that are specifically related to underground mining and water interactions largely focus on employee health and safety, and economic feasibility of the underground mining method.

7.7.2 INRUSH

The potential for groundwater inrush into an underground mining operation has the potential to cause major impacts and incidents. Inrush events have the potential to cause catastrophic harm to employee's health and safety as therefore the potential for inrush requires technical expertise and management in order to mitigate the potential risk of inrush events. Inrush is mitigated through sound dewatering practices, furthermore geological mapping, mine planning and ongoing geotechnical monitoring is required. Irrespective of the assumption that dewatering requirements will be limited, the site will have in place a dewatering plan, accompanied by a geotechnical monitoring programme, and advanced cover drilling, this will ensure that early detection of potential intersections with faults bearing groundwater is identified.

The site should continue to model groundwater and potential groundwater inflows to ensure that dewatering and the potential risks for inrush is well understood as the project develops.

7.7.3 SURFACE WATER

The interactions with surface water from underground mining operations are limited. Water that may accumulate in the underground mine will be pumped to the surface via a controlled pumping system, with water piped directly into the processing plant for reuse within the processing circuit. Potential impacts of underground mine wastewater on surface water are predominantly associated with sediment laden water that often requires treatment, such as increased retention time, flocculant dosing and settlement in order to reduce the sediment volumes prior to reuse. Should this be required this will be done within the processing plant, as sediment will be processed for ore. Therefore aside from the potential operational impacts associated with dealing with sediment laden water the potential impact on surface water would be an incident whereby the pipe and or pumping system leaks, discharging water on surface. The impacts associated with potential leaks is considered temporary, reversible, short term with minor changes to the baseline environment, resulting in an impact of minor significance.

7.7.4 HUMAN WASTEWATER EFFLUENT

Human wastewater effluent from the underground operation will be contained within portal chemical toilets placed throughout the mine. The effluent from these toilets will be disposed of in the onsite wastewater treatment plant. The site has two wastewater treatment plants with adequate capacity to be able to cater for the effluent that would be generated from the underground mine. The magnitude of change associated with human effluent is considered negligible, and the extent limited to onsite, utilising existing infrastructure and services, the potential impacts of managing human effluent is minimised.

7.7.5 SUMMARY OF IMPACTS ON WATER

TABLE 7 - IMPACTS TO WATER

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact (pre mitigation)	Mitigation Measures	Significance of impact (Post mitigation)
Surface water discharge	– Surface Water Quality	Sediment loading of surface water from decline development activities	> Adverse > Direct > Reversible > Low > Medium Term > Local	Medium	Minor	Minor (4)	> Installation of diversion structures to divert non-contact surface water away and around the mining operations > Ensure wastewater produced is directed into the open pit > If the volume of water is too large and cannot be handled concurrently with open pit mining operations ensure water is diverted to the processing plant for reuse or if not feasible ensure an adequately sized sedimentation pond is constructed for handling the waste water during the decline development phase, alternatively find a suitable reuse strategy for the water.	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact (pre mitigation)	Mitigation Measures	Significance of impact (Post mitigation)
Discharge to surface water	– Surface Water Quality	Sediment loading of surface water from uncontrolled surface discharge of underground mine wastewater	> Adverse > Direct > Reversible > Moderate > Short Term > Local	Medium	Moderate	Minor (4)	> Ensure wastewater produced from underground mining activities is sent to the processing plant for reuse in the progressing plant. > If the volume of water is too large and cannot be handled by the processing plant for reuse ensure an adequately sized sedimentation pond is constructed for handling the wastewater from the underground mining operations. Reuse of the water back into the underground mine should be investigated once operations commence and the water quality is better known and understood.	Low (2)
Accidental spills	– Surface Water Quality	Discharges of chemicals to surface water	> Adverse > Direct > Partly Reversible > Negligible > Short Term > Local	Medium	Negligible	Low (2)	> Ensure correct chemical use and clean up procedures are in place and followed > Ensure chemical spills are cleaned up underground and prevent spills from entering the	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact (pre mitigation)	Mitigation Measures	Significance of impact (Post mitigation)
							dewatering system that would be transferred to surface	
Containment loss	– Surface Water Quality	Potential failure of containment dams that hold underground mine dewatering water	> Adverse > Direct > Partly Reversible > Moderate > Temporary > Local	Medium	Moderate	Low (2)	> Ensure water storage facilities are constructed and have capacity to hold the volume of water to be pumped from the underground workings	Low (2)
Groundwater contamination	– Groundwater Quality	Contamination of groundwater from underground mine operations including hydrocarbons, explosives	> Adverse > Direct > Irreversible > High > Long Term > National	High	Major	Moderate (6)	> Ensure correct chemical use and explosive charging practices are in place and followed for underground mining operations > Bulk fuel will not be stored underground and majority of fleet refuelling will occur on surface therefore risk is reduced > Refuelling of drills and equipment working at the face will be required, although this equipment will be powered by electricity, they require fuel for tramming purposes, this will be	Moderate (6)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact (pre mitigation)	Mitigation Measures	Significance of impact (Post mitigation)
							done in a controlled manner following standard underground refuelling procedures.	
Accidental spills	– Groundwater	Infiltration of potential spills or discharges of chemicals into groundwater	> Adverse > Direct > Partly Reversible > High > Medium Term > Regional	Medium	High / Major	Moderate (6)	> Ensure correct chemical and clean up procedures are in place and followed for underground mining operations. > Bulk fuel will not be stored underground and majority of fleet refuelling will occur on surface therefore risk is reduced. > Ensure all operators are trained on spill response for underground events.	Minor (4)
Groundwater inflows	– Groundwater	Potential infiltration of groundwater from the surrounding aquifer into the underground mining operation	> Adverse > Direct > Partly Reversible > High > Medium Term > Regional	Medium	Major	Major (8)	> Ensure that the mine plan is followed at all times. > Ensure known structures, and water bearing features are mapped and surveyed into the mine plans > Ensure monitoring systems are	Moderate (6)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact (pre mitigation)	Mitigation Measures	Significance of impact (Post mitigation)
							in place to detect potential inflows > Ensure the dewatering plan is followed and monitoring and reporting on the dewatering plan is undertaken	
Contamination	– Groundwater	Potential runoff of seepage from the solid waste landfill site as a result of additional solid waste being disposed of in the on-site landfill	> Adverse > Direct > Partly Reversible > Negligible > Short Term > Local	Medium	Negligible	Low (2)	> Ensure the landfill is managed in accordance with site procedures and the landfill is covered and rehabilitated as required > Reduce the volume of material entering the landfill by continuing to implement the reduce, reuse and recycle principle installed on site.	Low (2)
Inrush	– Groundwater, employees, project feasibility	Potential for inrush into the underground mine workings	> Adverse > Direct > Partly reversible > Very High > Long Term > Regional	High	Very High	Major (12)	> Ensure the dewatering plan is followed and monitoring and reporting on the dewatering plan is undertaken > Ensure all operations are undertaken in accordance with	Major (9)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact (pre mitigation)	Mitigation Measures	Significance of impact (Post mitigation)
							the mine plan > Ensure all water bearing features are mapped and included in survey plans > Ensure emergency response procedures are in place in the event of an inrush event > Ensure adequate pumping capacity with back up pumps as critical spares are kept on site.	

8 ENVIRONMENTAL MANAGEMENT PLAN

The site has an approved and existing environmental management plan. The assessment for the amendment to include underground mining and associated mitigation measures have been addressed in the environmental management plan provided as Appendix A.

9 FINAL REMARKS

Based on the findings of the assessment and taking into consideration the overall potential adverse impacts, mitigation measures and the potential beneficial impacts, ECC believes the long-term benefits of the proposed project outweigh the short-term adverse impacts. In addition, the proposed project will contribute to the sustainable development of mining in the region in line with National Development Plans.

The implementation of the EMP and associated programme of environmental protection as an outcome of the impact assessment process would serve to minimise the impacts and risks associated with the proposed amendment to an environmental and socially acceptable standard. An Environmental Clearance Certificate could be issued, on condition that the management and mitigation measures in the EMP are adhered to.

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APPENDIX A – ENVIRONMENTAL MANAGEMENT PLAN

APPENDIX B – PUBLIC CONSULTATION