INTEGRATED WATER AND WASTE MANAGEMENT PLAN UPDATE FOR PMG MINING – BISHOP MINE IN THE NORTHERN CAPE PROVINCE

IWWMP Report ANK02 WU33242

Submitted to: Kgotlelelu Sihlangu

PostNet Suite 435
Private Bag X 4,
WierdaPark, 0149

Telephone:
+27 83 295 4315

Fax:
+27 86 666 6399

Email:
info@ankoneconsulting.co.za

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DOCUMENT APPROVAL RECORD

ACTION	DESIGNATION	NAME	DATE	SIGNATURE
Compiled	Hydrogeologist	Reborn Musie	April 2024	
Checked	Environmental Consultant	Vumile Ribeiro	April 2024	

RECORD OF REVISIONS AND ISSUING REGISTER

DATE	REVISION	DESCRIPTION	ISSUED TO	ISSUE FORMAT	NO. OF COPIES
01 April 2024	Draft_01	IWWMP Report			

TITLE:

INTEGRATED WATER AND WASTE MANAGEMENT PLAN UPDATE FOR PMG MINING – BISHOP MINE IN THE NORTHERN CAPE PROVINCE

CLIENT:

PMG Mining (PTY) Ltd

Farm Bishop 671, R325 Road

Kuruman - Dingleton

Northern Cape, 8420

Telephone No: 053 723 6510

REPORT NO: BISHOP/HG01_10/2023

CONSULTANT:

Ankone Consulting (Pty) Ltd

5 Bauhinia Street

Cambridge Office Park, Centurion

Telephone No: 083 295 4315

DATE: August 2023

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EXECUTIVE SUMMARY

Project Background:

PMG Mining (Pty) Ltd. (hereafter "PMG Mining") appointed Ankone Consulting (hereafter referred to as Ankone) to conduct the Water Use Licence Renewal Application. The update of the Integrated Water and Waste Management Plan (IWWMP) fulfills the requirements of the approved Water Use Licence (WUL) requirements, Licence No. 10/D73A/ABG/2393., and the renewal application of the WUL thereof. The mine is on Portion 1 and the Remainder of the farm Bishop 671 (543.3402 ha), within the Kuruman District Municipality, and the Registration Division of Kuruman, Northern Cape.

PMG Mining is authorised to extract iron and manganese ore from the Postmasburg iron and manganese field through opencast mining. However, the mine has decided to exclusively mine manganese due to iron ores' low grade. PMG Mining commenced its operations in 2004 and is currently operating under several approved environmental authorisations. The mine has its Mining Right (Reference No.: NC30/5/1/2/2/1 MR (MPT No.: 08/2008)) renewed on 31st July 2023 for a further twenty – three (23) year period; a Water Use Licence (Licence No. 10/D73A/ABG/2393) granted on the 11th of March 2014 and an amendment to the licence, issued on the 14th of April 2016. The licence authorises Section 21 (a), (b), and (g) water uses. The mine is operating under an approved Environmental Management Programme Report (EMPr) ((NC) 30/5/1/2/3/2/1/ (114) EM) granted on the 10th of January 2008.

Water and Waste Management Framework:

Appendix IV, Condition 11.1 of the WUL stipulates that "The Licensee must update an Integrated Water and Waste Management Plan (IWWMP), which must together with the Rehabilitation Strategy and Implementation Programme (RSIP), be submitted to the Regional Head for approval." Further, Condition 11.2 requires that "the IWWMP and RSIP shall thereafter be updated and submitted to the Regional Head for approval, annually."

The last IWWMP update was conducted by Nsovo Environmental Consulting in March 2022 in compliance with Condition 11.2 of the WUL. The mine is in the process of its WUL renewal application, wherein the IWWMP needs to form part of the application process, hence this current update of IWWMP..

This document is an update of the IWWMP undertaken by Nsovo in 2022. This IWWMP update document covers the operations of PMG Mining. The primary purpose of this IWWMP is to consolidate all the various site-specific activities such as water and salt balances, stormwater management, water reuse, water conservation, waste minimisation, and recycling into a simple, implementable management plan.

The IWWMP is, therefore, a living document that will be revised and updated throughout the life of the operations to accommodate additional information and improved technology (as per the requirements of the approved WUL (Licence No. 10/D73A/ABG/2393)). These will ensure that water and waste management is continually optimised and adapted to the changing needs of the mine and the WMA.

Potential Environmental Impacts:

A Risk Assessment was undertaken for the mine; the potential Environmental Impacts were low with effective implementation of mitigation measures. A risk assessment was conducted based on defining and understanding three primary components of the risk, i.e.:

- The source of the risk;
- The pathway; and
- The target that experiences the risk (i.e., groundwater).

Finally, a management plan was developed to minimise and mitigate the identified risks. This plan relates to water and waste management and is continuously implemented and updated to achieve the best water and waste management.

Public Participation Process:

The Public Participation Process (PPP) is not a legislative requirement of the IWWMP update. However, a public consultation is currently undertaken (April 2024) for the water use licensing (WUL) Renewal Application.

The PPP offers stakeholders a fair opportunity to be informed about the PMG Bishop Mine WUL Renewal Application, to raise issues of concern and to make suggestions for enhanced project benefits. This PPP is being undertaken to ensure compliance with the WULA process.

Water Balance:

A thorough assessment of the site-wide water balance has been conducted (as part of hydrological studies) to ensure effective water management practices. It was conducted in alignment with Best Practice Guideline G2 – Water and Salt Balances (DWA, 2010), and this water balance evaluation aims to estimate water inflows and outflows across different operational periods.

The primary objectives of the water balance model are to estimate external makeup water requirements during deficit periods and assess volumes of excess water during surplus periods. This strategic approach allows the mine to optimize water usage and minimize wastage, contributing to sustainable water management practices.

The development of the water balance relies on a detailed Process Flow Diagram (PFD) representing the mine's water circuit. This diagram serves as the foundation for modeling water flows during average dry, average wet, and average periods. Climate data, including rainfall and evaporation, coupled with estimations of mine water requirements, are key inputs for the water balance model.

Various water sources, such as groundwater, surface runoff, and direct rainfall, contribute to the site's water inflows, while evaporation, seepage, and process losses constitute outflows. Assumptions and input parameters, including static surface areas for evaporation calculations and fixed runoff coefficients, are essential for accurately modeling water dynamics.

The findings from the annual water balance assessment reveal a detailed breakdown of water inflows and outflows across different facilities within the mine. These findings provide valuable insights into the overall water management performance of the site, highlighting areas of potential water conservation and optimization.

Specifically, the annual water balance for PMG Bishop Mine indicates a total water inflow of 131,792.47 cubic meters and a total water outflow of 106,051.06 cubic meters. This analysis allows the mine to identify areas where water conservation measures can be implemented to improve overall water balance and sustainability.

Overall, the comprehensive water balance analysis outlined in the *Hydrological Impact Assessment Report, 2024* serves as a critical tool for PMG Bishop Mine to enhance water resource management strategies, mitigate water-related risks, and promote sustainable operations in line with regulatory requirements and industry best practices.

Stormwater Management:

The Conceptual Stormwater Management Plan (SWMP) addresses the requirements set forth by the National Water Act (Act 36 of 1998) and specific guidelines outlined in GN704, which pertain to the separation of clean and dirty water in mining activities. The plan adopts principles from the South African Department of Water and Sanitation's Best Practice Guidelines and aims to mitigate potential negative impacts of stormwater runoff from mining operations on local water resources.

The SWMP focuses on keeping clean water clean by routing it away from dirty areas and containing dirty water separately to minimize contamination risks. Sustainability considerations over the operational life cycle and adherence to regulations and stakeholder involvement are integral to the plan's design.

The proposed stormwater management measures include constructing perimeter berms to capture and contain rainwater from the mining area and implementing roadside drainage for moderately clean areas

like haul roads. Design considerations for these berms include material availability, construction equipment, environmental conditions, safety, and long-term maintenance requirements.

In assessing potential impacts during both operational and decommissioning phases of mining activities, various risks to surface water quality are identified, including fuel and oil leaks, release of pollutants from ore extraction, soil erosion, and alteration of water flow. Mitigation measures such as ensuring proper vehicle maintenance, fuel spill containment, erosion control, and rehabilitation planning are recommended to reduce these risks to acceptable levels.

Overall, the SWMP and impact assessments aim to manage stormwater effectively, minimize contamination risks to surface water, and ensure compliance with regulatory standards throughout the mining operation's life cycle. Implementation of these measures will be crucial for sustainable mining practices and safeguarding local water resources.

Checklist and Final Structure of IWWMP

Information	Included? (Yes/No)	Relevant Section of IWWMP Report
Evaluate to determine if the following aspects are addressed in the final/brief application (IWWMP) report:		
QUANTIFICATION OF THE WATER RESOURCE PROBLEM		
Are the existing water quality data adequate to identify contaminants of concern?	Yes	Section 4
How well have the nature, extent, and causes of on-site water management problems been identified?	Yes	Section 5
To what extent has the analysis and characterisation of the problems considered current thinking on water resource management?	Yes	Section 5
TARGETS, INDICATORS, AND MONITORING		
Does the IWWMP define medium and long-term goals toward sustainable management of water resources?	Yes	Section 6
Does the IWWMP make provision for the establishment of indicators of progress and set annual and medium-term targets?	Yes	Section 6

Information	Included? (Yes/No)	Relevant Section of IWWMP Report
Are these indicators and targets appropriate and consistent with the policies and strategies considered for implementing the IWWMP?	Yes	Section 6
Are the proposed monitoring, review, evaluation, and auditing systems adequate and sustainable?	Yes	Section 6.6
PRIORITY ACTIONS		
Does the IWWMP describe clear priorities for action, relevant to the goals and targets, the feasibility of achieving targets, estimated costs, available resources, institutional capacities, and effectiveness?	Yes	Section 6.6
To what extent do the structural and sectoral goals, objectives, and actions of the IWWMP address key performance areas of strategy, institutional matters, and the sustainable management of the water resource?	Yes	Throughout the report
Does the IWWMP address the components of section 27(1) of the NWA?	Yes	Section 7
CREATING AWARENESS		
Does the IWWMP describe the participatory process used to identify water use and waste-related aspects?	Yes	Section 5
Does the IWWMP summarise the major issues raised during the consultation process?	Yes	Section 5
To what extent have the matters raised impacted the content of the plan?	Yes	Section 5

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Abbreviations

°C	Degree Celsius
AIP	Alien Invasive Plant
C-Plan 3	Gauteng Conservation Plan Version 3
CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CBA	Critical Biodiversity Area
cm	Centimetre
CMA	Catchment Management Agencies
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
EMPr	Environmental Management Program
EP	Environmental Practitioner
ESA	Ecological Support Area
FEPA	Freshwater Ecological Priority Area
ha	Hectare
HGM	Hydro-geomorphic
IUCN	International Union for Conservation of Nature
IWULA	Integrated Water Use License Application
IWWMP	Integrated Water and Waste Management Plan
km	Kilometre
m	Metre
m.a.m.s.l.	Metres above mean sea level
MAP	Mean Annual Precipitation
mm	Millimetre
MM	Mine Manager

MRA	Mining Right Area
NBA	National Biodiversity Assessment
NBF	National Biodiversity Framework
NEM:BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM: WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecological Priority Area
NWA	National Water Act, 1998 (Act No. 36 of 1998)
ONA	Other Natural Area
PA	Protected Area
PCD	Pollution Control Dam
PES	Present Ecological State
PMG	PMG Mining (Pty) Ltd
ROM	Run of Mine
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SFI	Soil Form Indicator
STP	Sewage Treatment Plant
SWI	Soil Wetness Indicator
SWMP	Storm Water Management Plan
TUI	Terrain Unit Indicator
WET-Health	Wetland Ecological Health Assessment
WMA	Water Management Areas
WML	Water Management License
WRC	Water Research Commission
WUL	Water Use License
WULA	Water Use License Application

1. INTRODUCTION

1.1. Activity Background

PMG Mining (Pty) Ltd. (hereafter "PMG Mining") appointed Ankone Consulting (hereafter referred to as Ankone) to conduct the Water Use Licence (WUL) Renewal Application. The update the Integrated Water and Waste Management Plan (IWWMP) is a requisite in fulfilling the requirements of the approved Water Use Licence (WUL) requirements, Licence No. 10/D73A/ABG/2393 and the Renewal Application thereof.

The PMG Mining (Pty) Ltd. Bishop project is situated approximately 40km from Postmasburg on the R325 to Kathu/ Kuruman and is approximately 250 km from Kimberley in the Northern Cape Province of South Africa. The Mining Right Area (MRA) consists of Portion 1 and the Remaining Extent of Portion 1 of the farm Bishop № 671, (543.3402 ha) within the Kuruman District Municipality. The area is characterised by flat to undulating topography, with manganese ore closely associated with high-grade iron ore deposits currently mined at Sishen, Beeshoek, Bishop, Lomoteng, Gloucester, and other farms in the vicinity of the PMG Bishop mine.

The Bishop Mine produces approximately +60 000 tons of manganese (Mn) ore per month, predominantly for the export market. The mining method employed is strip-mining with oversize material from the gravel scalping and the tailings from the plant, being used as backfill material before final rehabilitation. The manganese ore is extracted via conventional truck and excavator methods usually associated with surface mining operations. The Run of Mine (ROM) ore is processed via crushing and screening at the processing plant. Ancillary mining infrastructure includes components such as offices, workshops, access, and haul roads, staff accommodation, a laboratory, ROM stockpiles, and product stockpiles.

PMG Mining has a Water Use Licence (WUL), Licence No. 10/D73A/ABG/2393, File No. 27/2/2/D173/7/1, issued by the Department of Water and Affairs (DWA), currently known as the Department of Water and Sanitation (DWS) on the 11th of March 2014, and an amendment to the Licence, issued on the 14th of April 2016. The licence authorises Section 21 (a), (b), and (g) water uses.

Accordingly, Appendix IV, Condition 11.1 of the WUL stipulates that "The Licensee must update an Integrated Water and Waste Management Plan (IWWMP), which must together with the Rehabilitation Strategy and Implementation Programme (RSIP), be submitted to the Regional Head for approval." Further, Condition 11.2 requires that "the IWWMP and RSIP shall thereafter be updated and submitted to the Regional Head for approval, annually". PMG Mining developed and submitted an IWWMP dated 12th of September 2012 to the Regional Head for approval; however, no subsequent updates were undertaken to comply with Condition 11.2 to date. The mine is currently in the process for its WUL renewal application, in which the IWWMP needs to form part of the application.

This report details PMG Mining's commitments to manage its activities to prevent pollution and re-use and recycle water where possible. This will ensure that water and waste management is continually optimised and adapted to the changing needs of the Mine and the Water Management Area (WMA).

1.2. Applicant and Environmental Assessment Practitioner (Eap) Details

The details of the applicant are presented in Table 1-1, and the details of the EAP are in Table 1-2.

Table 1-1: Contact Details of Applicant

Details of Applicant		
Name of Company	PMG Mining (Pty) Ltd	
Name of Mine	PMG Mining (Pty) Ltd	
Physical Address	Bishop Farm 671, Dingleton, Northern Cape, 8445	
Postal Address	Farm Bishop 671 Road R325 Postmasburg Northern Cape	
Contact Details	053 723 6510	
Details of Responsible Persons at the Mine		
Role	Environmental Manager	Mine manager
Contact Person	Kgotlelelu Sihlangu	John Ross Nel
Telephone Number Mobile Number	053 723 6508	053 723 6514
Email	kgotlelelu@pmgmining.co.za	jr@pmgmining.co.za

Table 1-2: Contact Details of EAP

Name of Company	Ankone Consulting (PTY) Ltd
Person Responsible	Vumile Ribeiro
Professional Registration	EAPASA (2019/1183)
Address	5 Bauhinia Street, Cambridge Office Park, Centurion
Telephone Number	082 767 2786
Fax Number	
Email	vumiler@ankoneconsulting.co.za info@ankoneconsulting.co.za
Qualifications & Experience	• MSc Environmental Management (UP)

1.3. Regional Setting and Location

The PMG Mining (Pty) Ltd. Bishop project is situated approximately 40km from Postmasburg on the R325 to Kathu/ Kuruman. It is approximately 250 km from Kimberley in the Northern Cape Province of South Africa. Figure 1 below shows the locality of the mine.

1.4. Property Description

The Mining Right Area (MRA) consists of Portion 1 and the Remaining Extent of Portion 1 of Farm Bishop No. 671, (543.3402 ha), within the Kuruman District Municipality.

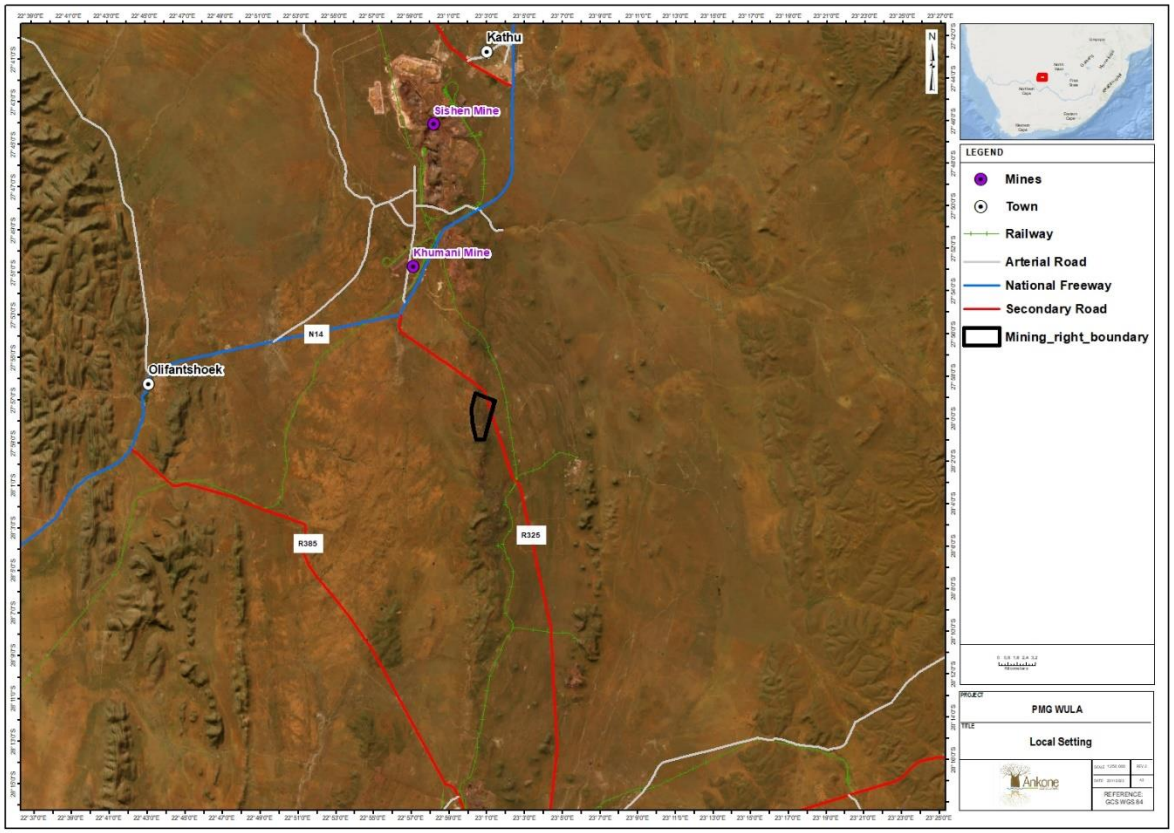


Figure 1-1: Locality Map

1.5. Purpose of the IWWMP

The DWS requires an IWWMP as a feasible, implementable plan with the main aim of directing and guiding the water user on effective management of water and waste of any triggered/ applicable water use activity. The development of the IWWMP should consider the nature of site-specific activities and their impacts in relation to (amongst others) the National Water Resource Strategy (NWRS), Catchment Management Strategy (CMS), Resource Quality Objectives (RQO's), sensitivity of affected receiving water resources, upstream and downstream cumulative impacts of water use activities.

The most important component of the IWWMP development process is the formulation of various strategies, goals and objectives for the water use or waste management of an activity, in accordance with set philosophies and policies. The policies must address the four key areas related to IWWMP development, namely process water, storm water, groundwater and waste.

From a legal perspective, the IWWMP fulfils the requirement of the Integrated Water Use Licence Application, provides a plan for implementation of the WUL commitments for the water uses related to the current operations at the mine. From a best management practice perspective, the IWWMP provides the mine with a consolidated approach for implementation of the Department of Water and Sanitation

(DWS) Best Practice Guidelines (BPGs) and PMG standards to achieve integrated mine water management while simultaneously protecting the surrounding water resource.

The IWWMP is an outline of a comprehensive plan for the complete water and water containing waste management cycle at the Bishops Mine over the lifetime of the operations. It has been devised in collaboration with the relevant mine personnel, to optimise water uses and minimise water-related impacts to achieve and maintain:

- Corporate and regulatory compliance, with emphasis on the water use licence conditions,
- Regulation 704 and EMPR water commitments;
- Environmental benefits and continued stewardship;
- Close/cordial/constructive community, neighbour and regulator relationships;
- Significant reductions in operating and remediation costs;
- Major reductions in closure liabilities;
- Enhancements in the technical capacity and personal satisfaction of mine personnel; and
- Enviable company reputation and shareholder approval.
- The IWWMP provides a structure that defines the regulatory framework and promotes:
- The setting of clear objectives and targets, aimed at achieving the bulleted benefits above;
- The development and optimisation of tools such as a water monitoring program, interactive water balances; assessment techniques, troubleshooting measures, reporting structures;
- The formulation of strategies to achieve the objectives; and
- The detailing of plans specifying targets, activities, resources, responsibilities, programs, feedback through monitoring, and modifications for maintenance of successes.

The IWWMP is, therefore, a living document that will be revised and updated throughout the life of the operations to accommodate additional information and improved technology to ensure that water and waste management is continually optimised and adapted to the changing needs of the water management area thereby reducing the risks of the operation to the environment and humans.

It is the responsibility of the water user to demonstrate to the Department that the selected management measures in the IWWMP action plan adhere to the “SMART” concept i.e.:

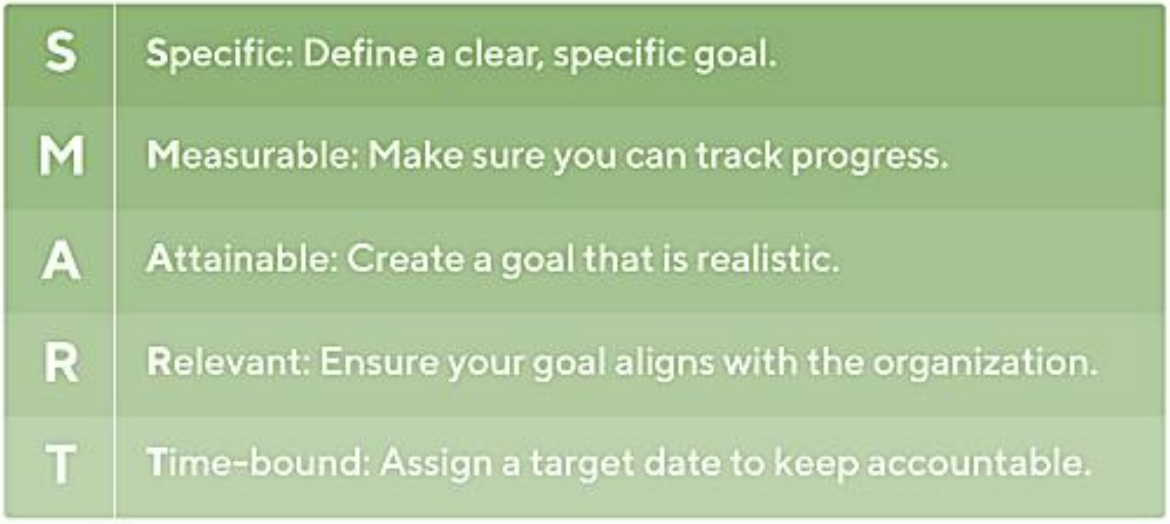


Figure 1-2: SMART Goal Setting

It is a Departmental requirement that a water user needs to compile an IWWMP for any one of the following purposes:

- As the supporting technical documentation for any WULA (the main purpose of this document);
- When converting Existing Lawful Use (ELU) to licensed water use; and
- In order to comply with the conditions of an existing water use licence.

The implementation of the IWWMP is an interactive process whereas its performance is monitored on an annual basis. The assessment of the IWWMP document itself, as well as the submission of information relating to monitoring and auditing conducted in terms of it could lead to its shortcomings, which must be addressed in the annual update of the action plan of the IWWMP. This will ensure that the concept of continual improvement is applied throughout the life cycle of the activity (Operational Guideline: IWWMP dated February 2010 and GNR 267, the Water Use Licence Application and Appeals Regulations, dated March 2017).

In line with the guidelines of the DWS Operational Guideline: Integrated Waste and Water Management Plan (2010) and GNR 267, Water Use Licence Application and Appeals Regulations (2017), Figure 2 and Table 5 provides a guide to the structure of the IWWMP.

2. CONTEXTUALISATION OF ACTIVITY

2.1. Site Description

The approved MR allows PMG Mining to extract iron and manganese ore from the Postmasburg iron and manganese field through opencast mining. PMG Mining has decided to exclusively mine

manganese due to iron ores' low grade. The infrastructure currently present at PMG Mining is listed in Table 2-1 and depicted in Figure 2-1 and Figure 2-2 below.

Table 2-1: PMG Mining Infrastructure

Mining	Ancillary
Opencast pit	Offices
Processing Plant	Staff and visitors' parking
Product (Manganese ore) stockpiles	Workshop (including the wash bay)
ROM stockpiles	Security and access control
Waste Rock Dump Producer Stockpile	Boreholes for water supply
Conveyor system for crushed Manganese ore	Laboratory
Overburden	Ablution facilities, mobile toilets, and conservatory septic tank
Pollution Control Dam	Access and haul roads
Overburden/spoil stockpile	Staff accommodation (hostel)
	Refuelling station

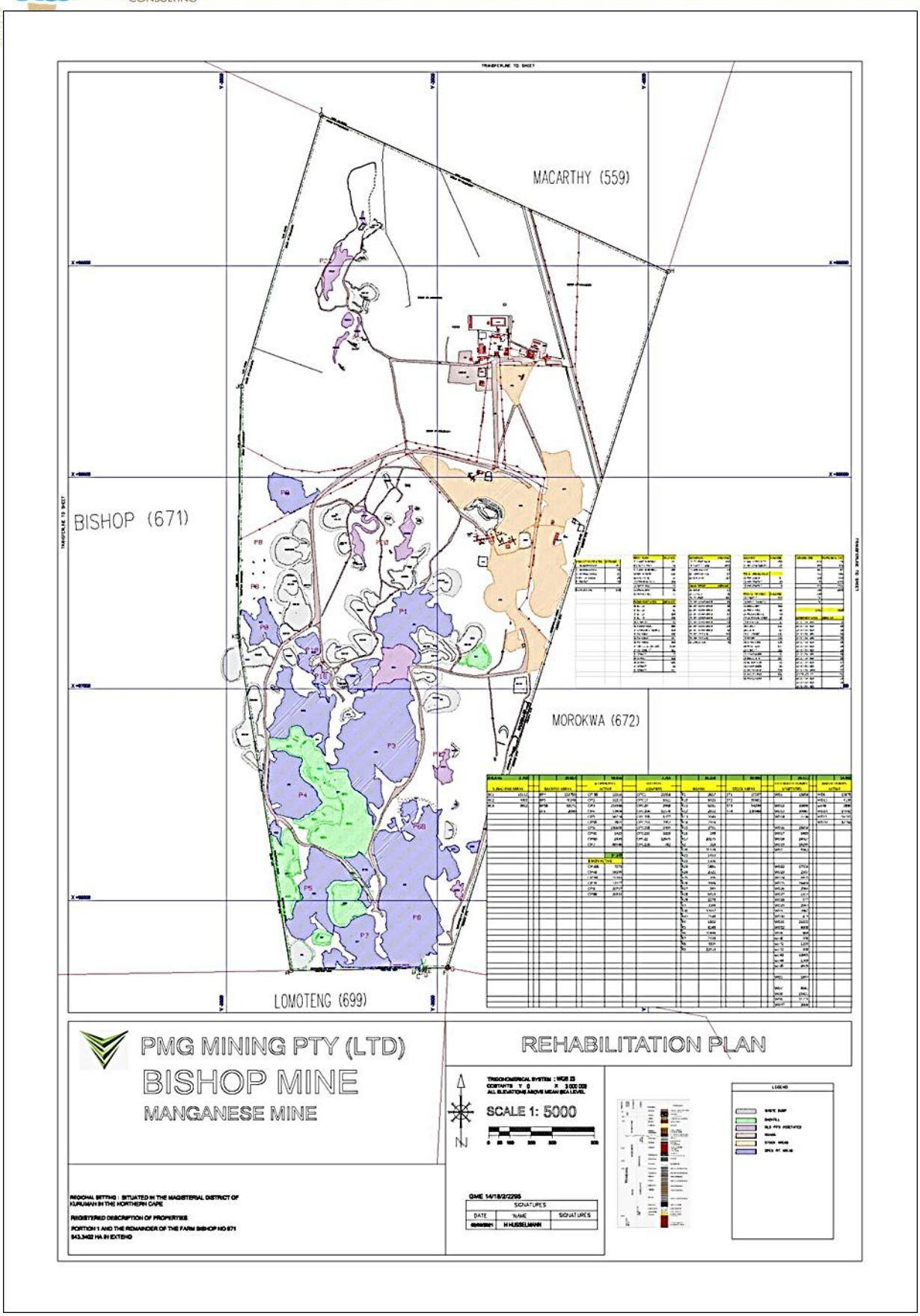


Figure 2-1: The layout plan showing site activities

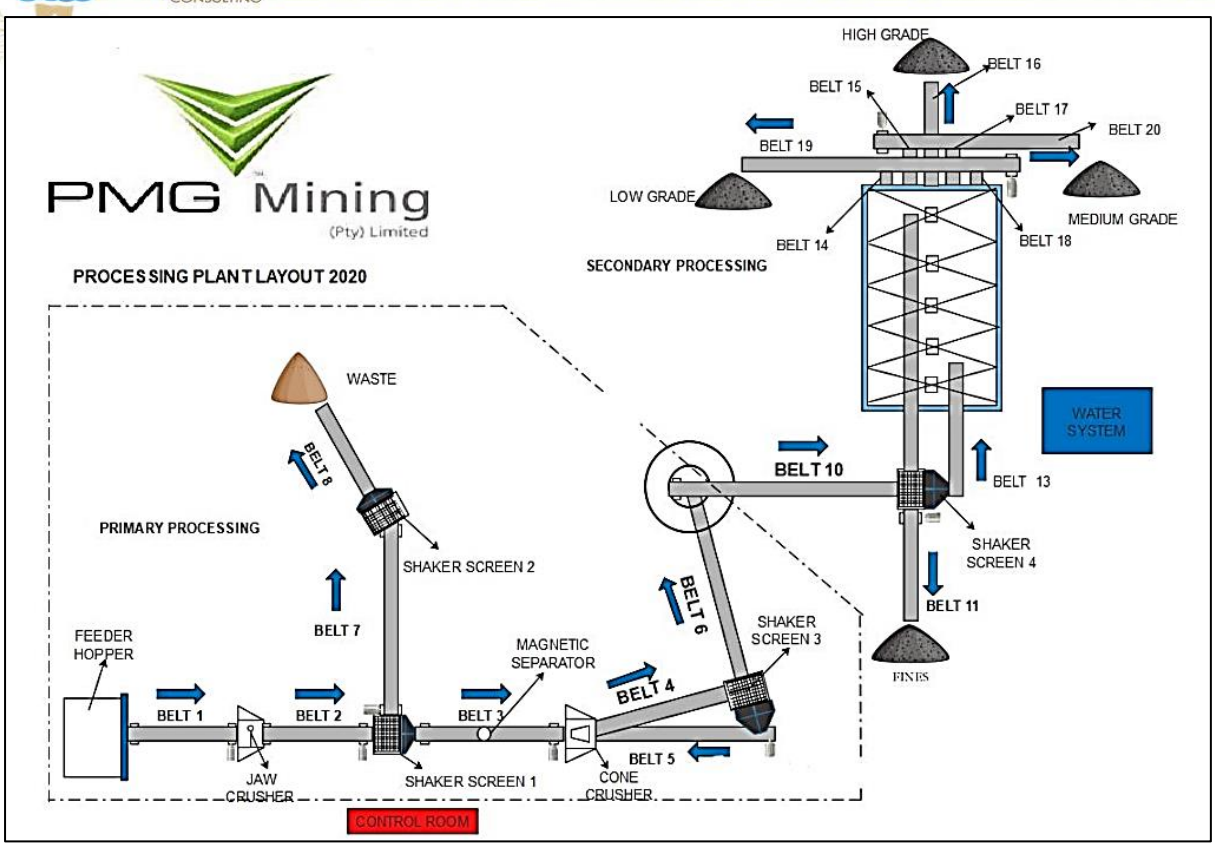


Figure 2-2: PMG Mining Processing Plant Layout

2.2. Description of Activity

PMG Mining has an existing IWWMP, which was last updated in 2012. This is the 2021/ 2022 update of the IWWMP, and the consolidations from the previous ten years include the following:

- Reservoir to supply the office area;
- Two temporal stormwater dams; and
- Two ablution facilities and one septic tank.

2.2.1. Mining Activity

Opencast activities are carried out by contractors utilising the PMG Mining plant and equipment for mining and removal of manganese from parts of Pits 4, 5, 6, and 7. Currently, there are no blasting activities at PMG. Mining operations are limited to using drilling machines and excavators to extract overburden and ore separately. Road trucks (Weichai) are used to haul the ore from the pits mentioned above into a crushing and screening plant where the Manganese ore is crushed and screen-sorted to size.

2.2.2. Beneficiation

The ROM material undergoes further concentration and upgrading of course materials is achieved through dense media separation methods while gravity separation techniques remove impurities. The waste product is deposited in waste rock dumps (which are further used to backfill pits). Final products are then stockpiled on product floors for shipment. The ROM is transported by trucks from the product floors to the loading area (Lohatla Transnet Loading Station), then to Port Elizabeth for shipment to various clients. Mining and beneficiation will take place on a 7-day week, with maintenance being performed over weekends. PMG operates its plants, which consist basically of a crusher, and screens to upgrade ROM ore to material suitable as smelter feed or sell as ore in terms of particle size and grade.

The manganese content of the concentrates (<1mm fraction) typically increases from 21% to 25%. The coarse fraction, "lumps" of 20 to 120mm, is processed by magnetic separation at grades varying between 32% and 34%. The fine fractions are concentrated as metallurgical, chemical, and foundry grade concentrates.

Table 4 summarises the authorised activities, categorised into operations, water, and waste management systems associated with the current operations, and proposed future approved projects at PMG Mining. A detailed map of the surface structures and infrastructure at PMG Mining is presented in Figure *1-1* and Figure *2-1* and attached as Appendix A.

Table 2-2: Aspects of the activity that the IWWMP covers

Aspect	Method/System
Mining and Beneficiation	
Life of Mine (LOM)	The expected LOM for PMG Mining is not known. However, the MR was granted until 2023 as stipulated in the Mining Right 30/5/1/1/3/2/1/114 MR. A Mining Rights renewal process to extend the mining activities for the next ten years is underway.
Mining via the conventional opencast strip-mining method	Opencast mining is carried out by PMG Mining. Currently, there are no blasting activities at the PMG Mine. Mining operations are limited to using excavators to extract overburden and ore separately. Road trucks are used to haul the ore to a crushing and screening plant where it is crushed, and screen sorted to size.
Beneficiation	The ROM material undergoes further concentration while the coarse materials are upgraded through dense media separation methods. Gravity separation techniques remove impurities. Final products are then stockpiled on product floors for shipment.
Support Infrastructure	• Offices • Staff and visitors' parking • Workshop (including the wash bay)

Aspect	Method/System
	• Security and access control • Boreholes for water supply • Laboratory • Ablution facilities (mobile toilets, and conservatory septic tank • Access and haul roads • Staff accommodation (hostel)
Water Supply	• Portable water is sourced from the Vaal Gamagara (Sedibeng water scheme). • Water supply for mining/ processing activities is sourced from three (3) boreholes and stored in three reservoirs (two are located next to the pump room and one is next to the generator room). The mine is waiting for yield test results to determine whether additional boreholes are required.
Electricity	• Power supply is sourced from Eskom.
Waste Management	
Waste rock/stockpile	• The waste rock dump stockpile is used to dispose of mining rocks used to backfill the mined-out pits.
Run of Mine	• ROM is disposed of at the stockpile and transported by trucks from the product floors plant to the Lohatla Transnet Loading Station, then to Port Elizabeth for shipment to various clients.
Domestic and Industrial Waste	• The domestic and hazardous waste are kept in separate color-coded bins at designated waste collection points. • General waste is removed from the site by a third party. • Industrial/hazardous waste is collected by a third party.
Steel Waste	• Scrap metal is collected by a third party.
Water Management	
Sewage	• Sewage from the PMG Mining operation is stored in several septic tanks around the site e.g. offices, security

Aspect	Method/System
	gate, hostel, plant area, workshop area, etc. A third-party service the septic tanks. • There are two mobile toilets in the pits area, which are serviced by a third party.
Clean and dirty water management systems	• The stormwater is managed by separating clean and dirty water areas through trenches. Dirty water is routed to the two temporal stormwater dams (one at the pits area and the other at the office area). • There is one PCD located near a non-operational wash plant. The PCD is also currently non-operational as the activities at the wash plant have ceased. • The PCD was constructed with a liner system that prevents any potential pollution of the surrounding environment. The PCD is equipped with silt traps designed to settle out particles are therefore expected to settle out a large portion of the silt and all the sand that may be transported to it.

2.3. Extent of the Activity

The MRA is located on Portion 1 and the remainder of Farm Bishop No. 671, which is affected by the proposed development. At the same time, Figure 1-1and Figure 2-1 show the mining areas.

2.4. Key Activity Related Processes and Products

The process, products, and facilities are briefly described in Table 2-3 below.

Table 2-3: Status Quo at the time of the assessment

Mine Areas	Observations	Photograph Reference
Screening and Plant	• The ROM from the pits is transported by road trucks to the processing plant. The processing plant was designed to generate saleable manganese ore products that meet specific grades and size specifications needed to satisfy further processing by third parties. • The processing plant comprises a feeding, crushing, screening station, and a final product stockpiling area adjacent to the plant. • During the time of assessment, the processing plant was operational, with no reported malfunctions.	 Photograph: Processing plant.
Waste Rock Dumps	• Waste rock is temporarily stockpiled and backfilled into the open pits as part of the ongoing rehabilitation initiative. • During the time of assessment, Pit 9 was completely backfilled. Backfilling of other mined-out blocks is underway.	 Photograph: Waste rock
Pollution Control Dam (PCD)	• The PCD is not working as the wet process at the mine has ceased.	

Mine Areas	Observations	Photograph Reference
		Photograph: Pollution Control Dam (not operational).
Surface Infrastructure	Stormwater management systems have been established on-site, including: • One PCD (not used at the time of the assessment). • Unlined canals and trenches to channel dirty water from the wash bay and the workshop area into the stormwater dam near the office area. • Trenches to direct water away from the pits area into the stormwater dam near the pits area. • Stormwater drains with unlined canals to direct clean water into the natural environment. • Reservoir to store groundwater.	 Photograph: Unlined canal  Photograph: Stormwater trench
Concurrent Rehabilitation Area	• Backfilling process at Pit 4.	
Wash Bay	• The wash bay has a concrete floor to contain dirty water. • There is an oil separator to separate water and oil (collected by a third). • The remaining clean water from the wash bay is channeled via unlined canals (with trenches) to a temporal stormwater dam located closer to the office area.	 Photograph: Oil separator
Waste Management Area	• The domestic and hazardous waste are kept in separate color-coded	

Mine Areas	Observations	Photograph Reference
	bins at designated waste collection points. • Sewage from the PMG Mining operation is stored in several septic tanks around the site e.g., offices, security gate, hostel, plant area, workshop area, etc. The septic tanks are serviced by a third party. • There are two mobile toilets in the pit areas, which are serviced by a third party.	
Oil and diesel storage area	• Oil and diesel storage at the workshop area. There is also a refuelling station near the workshop area.	
Product Storage Site	• Manganese ore is stockpiled around the pits, and road trucks are used to haul it into the processing plant. • Final Manganese product is stockpiled on product floors adjacent to the processing plant.	 Photograph: Final product stockpile.
Clean and Dirty Water separation	• The stormwater is mainly managed by separating clean and dirty water areas through trenches. Dirty water is routed to the two temporal stormwater dams (one at the pits area and the other at the office area). • There is one PCD, which is located near a non-operational wash plant. However, it is currently non-operational as the activities at the wash plant have ceased.	

Mine Areas	Observations	Photograph Reference
	• The non-operational PCD was constructed with a liner system that prevents any potential pollution of the surrounding environment. The PCD is equipped with silt traps designed to settle out particles are therefore expected to settle out a large portion of the silt and all the sand that may be transported to it.	

2.4.1. Solid Waste (Domestic, Industrial, and Hazardous)

PMG Mining has a waste management procedure in place (ID No.: ESP001), which covers the following:

- Waste storage;
- Waste assessment and disposal;
- Record keeping and waste management manifests system
- Auditing; and
- Training.

The mine is encouraged to keep records of waste manifest, safe disposal certificate, waste audit reports, waste training material, and dangerous goods declaration to confirm compliance during compliance.

2.5. Water Management

The primary objective of water management is to ensure that all water resources are protected and preserved in terms of quantity and quality. Implemented procedures and management measures should adhere to the relevant legal requirements to meet this requirement. Applicable. Further, water management infrastructure must be designed and operated with the following objectives in mind:

a) To ensure that water management measures considered fit into the broader regional water management context.
b) To ensure that water of different quality (clean and dirty water) is kept separate and managed separately if possible. This implies minimising the contact between water of different qualities to minimise potential deterioration of water quality.

c) To minimise the contact between clean water and potentially polluting substances such as waste products.
d) To address water pollution issued at sources.
e) To maximise water reuse, avoid discharge of polluted water, and maximise clean water runoff; and
f) To ensure that the water management measures minimise the post-closure impairment of water resources.

Operation closure is an activity regulated by the DWS with the best practice guidelines that specifically emphasise the identification and management of water-related closure risks and liabilities. These guidelines aim to ensure that the operation has a plan to be implemented to protect, sustain, and preserve water quality and quantity after operation closure. The DWS best practice guidelines further ensure that the procedures and management measures implemented are scientifically valid and meet the relevant legal requirements.

The Department of Water Affairs and Forestry, 2008. Best Practice Guideline G5: Water Management Aspects for operation Closure are based on the following principles:

a) Water management must comply with legal and regulatory conditions.
b) Design, operation, and closure of water management facilities should take the following components into account:
- Sustainability.
- Integrated water management approaches.
- Optimisation of water use to minimise potential impacts on water quality and quantity.
- Process water during the operational phase.
- Water quality and quantity; and
- Surface and groundwater.

c) Precautionary measures should follow the anticipatory and conservation approach.
d) Technical studies and the design of water management facilities should be undertaken by suitably qualified and experienced personnel.
e) Water management should consider the "polluter pays principle."
f) Water management measures should be designed and operated within the context of an overall closure plan. The design of water management measures should consider the potential impacts on closure and determine whether it will affect the closure objectives.
g) Adequate financial provision should be supplied during the LOM for water management measures to meet the closure objectives; and
h) Progressive rehabilitation should take place during the operational phases to
    - Meet the post-closure topography requirements.

- Minimise post-closure water management requirements by maximising free draining areas and minimising contamination of clean water; and
- Water management principles should play a key role in evaluating rehabilitation and closure strategies.

2.5.1. Water Supply and Use at the Mine (Potable and Process)

This section describes the primary water uses in the mine.

Table 2-4: Water sources and Use at the Mine

Water Source	Description
Potable Water	Since the groundwater quality is not suitable for potable water, potable water is sourced from the Sedibeng Vaal-Ga Mogara water pipeline. PMG Mine has a signed contractual agreement with Sedibeng Water to supply potable water.
Process Water	Process make-up water for the office and the processing plant areas are abstracted from dewatering boreholes and stored in the three reservoirs on site.
Sewage Treatment	Sewage from the PMG Mining operation is stored in several septic tanks around the site, e.g., offices, security gate, hostel, plant area, workshop area, etc. The septic tanks are serviced by a third party. There are also two mobile toilets in the pit areas serviced by a third party.
Dust Management	Dust suppression is undertaken at all significant dust generating points. The spray water pump is fed by a tank from where it supplies water to spray nozzles in strategic positions to manage the level of dust generated from the operations.

2.6. Stormwater (Clean and Dirty Water Management)

There was no evidence at the time of the update that a Stormwater Management Plan has been developed for the mine; however, for dirty water areas, the following applies:

a) Specific potentially hazardous dirty water generating areas, such as diesel storage and the wash bay area, water is channelled into an oil separator then directed into an unlined canal via trenches into an unlined temporal stormwater dam near the hostel.
b) Stormwater that may be passing through the general site areas that may cause stormwater pollution (i.e., the waste rock stockpile) is routed away from the stockpiles into the stormwater dam near the pits area.
c) The waste rock dump areas have all their stormwater individually managed within the footprint areas using toe paddocks with clean water diverted around these using earth berms.

2.7. Activity Life Description

The expected LOM for PMG Mining is not known. However, the MR was granted until 2023 as stipulated in the Mining Right 30/5/1/1/3/2/1/114 MR. A Mining Rights renewal process is underway to extend the mining activities for the next ten years.

2.8. Activity Infrastructure Description

As indicated earlier in section 2.1, the critical surface infrastructure and activities at the PMG Mine are as follows:

- Opencast pits.
- Waste rock dumps, RoM, and product stockpile.
- Drilling.
- Access and haul road
- Abstraction of groundwater.
- Facilities associated with the distribution of electricity.
- Storage and handling of hazardous chemicals (i.e., fuel.).
- Maintenance and servicing areas (i.e., workshop and wash bay area).
- Change houses.
- Ablution facilities.
- Temporary waste storage and handling area.
- Security and access control.
- Crushing and screening plant.
- Conveyor systems for crushed ore.
- First aid clinic.
- Maintenance workshops and washing bays.
- Overburden/ spoil stockpiles.
- Water management infrastructure (i.e., stormwater dams, trenches, no-operational PCD, channels, etc.),
- Refuelling of mobile plant equipment with diesel bowsers.
- Backfilling of open pit
- Reservoirs for storing underground water.
- Admin area, hard park area, warehouse, and workshop.
- Water supply boreholes (operating boreholes to be confirmed upon conducting yield tests).

2.9. Key Water Uses and Waste Streams

2.9.1. Key Water Uses

Table 2-5 below indicates the water uses approved in the WUL issued to PMG Mining.

Table 2-5: PMG Mining Approved Water Uses

Water Use	Description	Property (Farm name and portion)	Coordinates	Volumes
Section 21 (a): Taking water From a water resource	Taking of water from borehole HBH 5 to be used in mining activities.	Remaining Extent 0 of Farm Bishop 671	S: 270 .97276 E:23 .01495	13 000 m³/annum
	Taking of water from borehole HBH 8 to be used in mining activities.	Remaining Extent 0 of Farm Bishop 671	S: 27 .94725 E: 23 .03335	16 000 m³/annum
	Taking of water from borehole HBH 7 to be used in mining activities.	Remaining Extent 0 of Farm Bishop 671	S: 27 .97323 E: 23 .03952	13 000 m³/annum
	Taking water from the Pollution control dam for mining activities.	Remaining Extent 0 of Farm Bishop 671	S: 27 .58908 E: 23 .02071	7 300 m3/annum
21(b) – Storing water	Storage of water from Sedibeng Water Board for domestic use in Reservoir 1.	Remaining Extent 0 of Farm Bishop 671	S: 27 .58202 E: 23 .01571	9 850 m3/annum
	Storage of water from Sedibeng Water Board for domestic use in Dam 1.	Remaining Extent 0 of Farm Bishop 671	S: 27 .97323 E: 23 .01596	12 000 m3/annum
21 (g)–Disposing of Waste in a manner that may detrimentally impact a water resource.	Collection of seepages and runoff from site into Pollution control dam 1.	Remaining Extent 0 of Farm Bishop 671	S: 27 .58908 E: 23 .02071	36 520 m³/annum

Water Use	Description	Property (Farm name and portion)	Coordinates	Volumes
	Disposal of slimes from mine processes into the Slimes dam.	Remaining Extent 0 of Farm Bishop 671	S: 27 .59836 E: 23 .01733	21 900 m³/annum
	Disposal of sewage waste into the conservatory septic tank.	Remaining Extent 0 of Farm Bishop 671	S: 27 .58354 E: 23 .01993	720 m³/annum
Storage of Waste and wastewater	Disposing of processed ore at the processed stockpiles.	Remaining Extent 0 of Farm Bishop 671	S: 27 .97297 E: 23 .03290	64 566 m³/annum
	Storage of waste rock at the waste rock dump.	Remaining Extent 0 of Farm Bishop 671	S: 27 .68354 E: 23 .01993	24 000 m3/annum
	Collection of seepages and runoff from site into Pollution control dam 1.	Remaining Extent 0 of Farm Bishop 671	S: 27 .58908 E: 23 .02071	36 520 m³/annum
	Disposal of slimes from mine processes into the Slimes dam.	Remaining Extent 0 of Farm Bishop 671	S: 27 .59836 E: 23 .01733	21 900 m³/annum
	Disposal of sewage waste into the conservatory septic tank.	Remaining Extent 0 of Farm Bishop 671	S: 27 .58354 E: 23 .01993	720 /annum

2.9.1.1. Water Resource Protection

The impact of the mine activities on groundwater shall not exceed the in-stream water quality objectives detailed in the water quality reserve for the areas as indicated in Table 2-6 below:

Table 2-6: Groundwater Limits

Parameter	Limit in WUL
pH	9.5 - 10
Total Dissolved Solids (TDS)	1000 – 2450 mg/l
Sulphate (SO4)	400 – 600 mg/l
Chlorides (Cl)	200 - 600 mg/l
Sodium (Na)	200 - 400 mg/l
Manganese (Mg)	70 – 100 mg/l
Fluoride (F))	1.5 – 3.5 mg/l

Parameter	Limit in WUL
Feacal coliforms	1 – 10 counts/100
Nitrate (NO3)	10 – 20 mg/l
Potassium (K)	46 mg/l
Electrical Conductivity (EC)	150– 370 mS/s

2.9.2. Key Waste Streams

The waste streams associated with PMG Mining operational activities are limited to:

- General waste: office and domestic waste; hostel; first aid clinic; scrap metal; conveyor belts; and wood.
- Hazardous waste: mine residue; used hydrocarbons; and medical waste.
- Effluent waste: Sewage stored in a conservatory septic tank and on mobile toilets around the pits area.

2.10. Organisational Structure of Activity

Figure 2-3 shows the Organisational Structure at the PMG Mine.

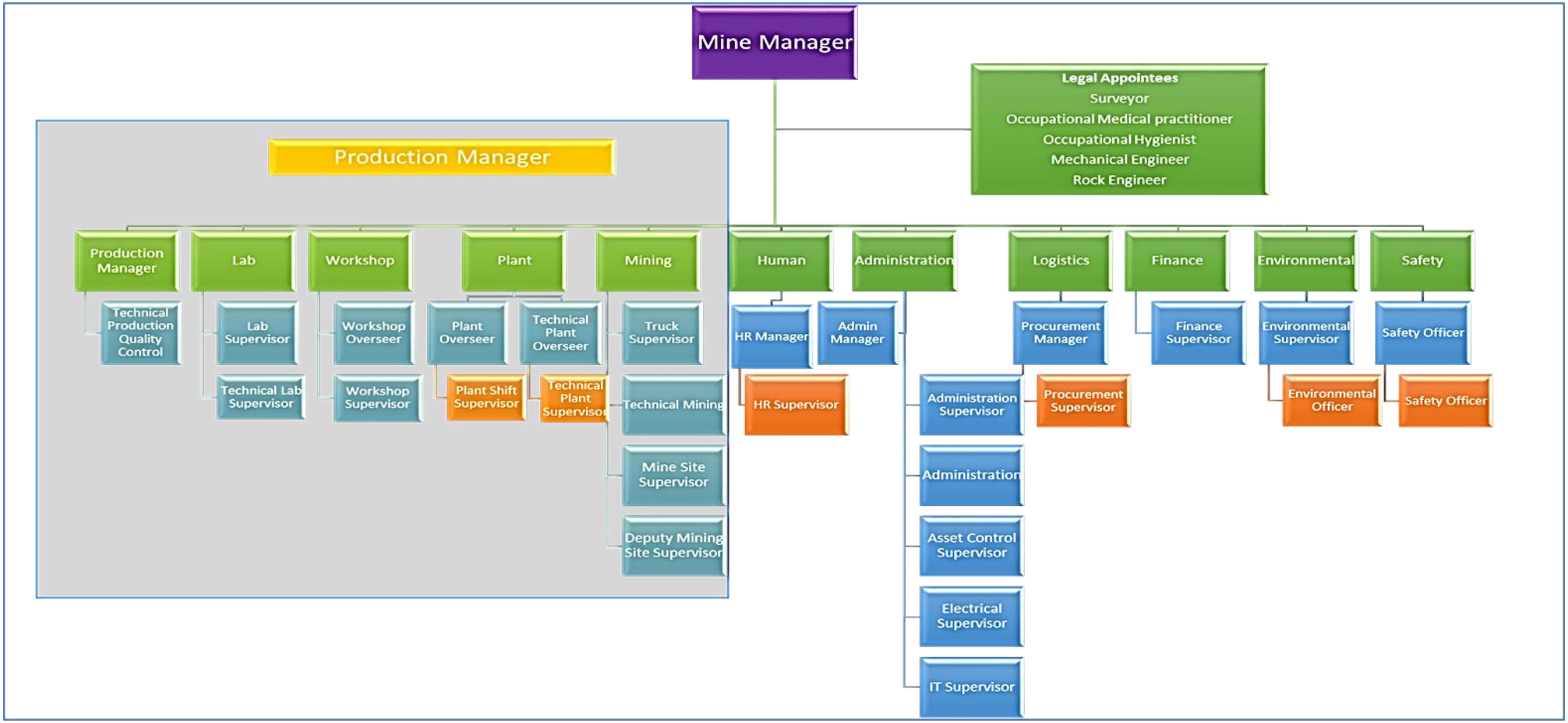


Figure 2-3: Organisational Structure

2.11. Business and Corporate Policies (Health and Safety and Environmental Policy)

PMG Mining is committed to a long-term sustainable approach in caring for and safeguarding the environment. The company is abiding by sustainability, ensuring that it constantly endeavours to balance environmental considerations and social responsibility with its business goals. PMG Mining has developed an internal Safety, Health, and Environmental Policy to ensure compliance with all environmental laws and regulations of South Africa, such as Section 24 of the Constitution, which states that Everyone has the right— (a) to an environment that is not harmful to their health or wellbeing; and (b) to have the environment protected, for the benefit of present and future generations. Therefore, PMG Mining pro-actively manages the effects of mining to prevent pollution, environmental degradation, ill health, and property damage.

3. REGULATORY WATER AND WASTE MANAGEMENT FRAMEWORK

There are several legal and regulatory frameworks which regulates mine water management in South Africa. A summary of these is provided in Table 3-1 with specific detail relating to the NWA and National Environmental Management: Waste Act (NEM: WA), Act 59 of 2008 provided in the remainder of this section:

Table 3-1: Water management legal and regulatory framework requirements

Legislation
Constitution of the Republic of South Africa, 1996 (No. 108 of 1996) Describes the Bill of Rights and is the cornerstone of democracy in South Africa, enshrining the rights of all people and affirming the democratic values of human dignity, equality and freedom. Section 24 is directly relevant to environmental law. The Bill of Rights states that everyone has the right to an environment that is not harmful to their health or well-being.
National Water Act (No. 36 of 1998) Provides for the protection of the quality of water and water resources in South Africa, for the establishment of Water Management Areas to be managed by Catchment Management Agency's (CMAs) and describes the actions that can be taken by the CMAs to enforce the requirements of the NWA. Section 19 of the NWA sets out the principles for "an owner of land, a person in control of land or a person who occupies or uses land" to: • Cease, modify or control any act or process causing pollution; • Comply with any prescribed waste standard or management practice; • Contain or prevent the movement of pollutants; • Eliminate any source of pollution; • Remedy the effects of the pollution; and

Legislation
• Remedy the effects of any disturbance to the bed and banks of a watercourse. In terms of Section 21 of the NWA there are eleven water uses that may require authorisation including: (a) taking of water from a water resource; (b) storing of water; (c) impeding or diverting the flow of water in a water course; (d) engaging in a stream flow reduction activity; (e) engaging in a controlled activity, such as, irrigation of any land with waste or water containing waste generated through any industrial activity or by a waterworks; (f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit; (g) disposing of waste in a manner which may detrimentally impact on a water resource; (h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial process or power generation process; (i) altering the bed, bank, course or characteristics of water courses; (j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; (k) use of water for recreational purposes.
NWA Amendment Act (No. 27 of 2014) This act makes provision for integration and alignment of the Water Use Licence Application (WULA) process with applications in terms of the NEMA and Mineral and Petroleum Resources Development Act (MPRDA), Act No. 28 of 2002
NWA Regulations: **Regulation 704 (GN R704, Gazette No. 20119, 1999)** Regulations that require separation of clean and dirty water systems including restrictions on activities within the 1:100 floodline or 100 m from a watercourse or use of waste rock in the construction of the tailings storage facility. **Regulations regarding the procedural arrangements for water use licence applications and appeals (GN R267, Gazette No. 40713, 24 March 2017)** Consideration of and decision on WULAs is now time regulated to align with the EIA/EMPr process. The final decision on the WULA is required within 300 calendar days from submission of the application. **The General Authorisation for Section 21(c) and (i) water uses (GN509, Gazette No. 40229, 26 August 2016)** Defines a regulated area of a watercourse as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500 m radius from the delineated boundary (extent) of any wetland or pan.
Water Services Act (No. 108 of 1997)

Legislation
Provides for the regulation of water boards and the setting of national water quality standards.
National Environment Management Act (No. 107 of 1998) Sections 28 (1) and (3) of NEMA set out the duty of care principle, which is applicable to all types of pollution and must be taken into account in considering any aspects of potential environmental degradation. Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.
Environmental Impacts Assessment Regulations, R982, R983, R984 and R985, December 2014 as amended These regulations were developed for the preparation, evaluation, submission, processing and consideration of, and decision on, applications for environmental authorisations.
National Environment Management: Waste Act (No. 59 of 2008) Follows the principle that waste generation be avoided, or if it cannot be avoided, that it is reduced, reused, recycled or recovered, and as a last resort treated and/or safely disposed of. The objects of this Act are- (a) to protect health, well-being and the environment by providing reasonable measures for- (i) minimising the consumption of natural resources; (ii) avoiding and minimising the generation of waste; (iii) reducing, re-using, recycling and recovering waste; (iv) treating and safely disposing of waste as a last resort; (v) preventing pollution and ecological degradation; (vi) securing ecologically sustainable development while promoting justifiable economic and social development; (vii) promoting and ensuring the effective delivery of waste services; (viii) remediating land where contamination presents, or may present, a significant risk of harm to health or the environment; and (ix) achieving integrated waste management reporting and planning; (b) to ensure that people are aware of the impact of waste on their health, well-being and the environment; (c) to provide for compliance with the measures set out in paragraph (a); and (d) generally, to give effect to Section 24 of the Constitution in order to secure an environment that is not harmful to health and well-being. The National Environmental Management Laws Amendment Bill, 2017, once promulgated, will reverse the inclusion of mine residues under NEM: WA and return these to NEMA.
Waste Classification and Management Regulations The Waste Classification and Management Regulations require that all waste generators must ensure that the waste they generate is classified in accordance with SANS 10234 within 180 days of generation and if the waste is to be disposed of to landfill that the waste is assessed in accordance with the Norms and Standards for Assessment of Waste for Landfill Disposal (refer to Section 3.6 for details).
Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits (Government Gazette No. 39020, GN: R632, 24 July 2015) The regulations specify the requirements relating to residue stockpiles and residue deposits as follows: • Assessment of impacts and analysis of risks; • Characterisation

Legislation
• Classification • Site selection • Design • Impact management • Monitoring and reporting • Dust management and control • Decommissioning, closure and post closure management When the National Environmental Management Laws Amendment Bill is promulgated these will be deemed to have been promulgated in terms of NEMA.
The National Environmental Management: Biodiversity Act, (No. 10 of 2004) The Act seeks amongst other things, to manage and conserve biological diversity, to protect certain species and ecosystems, to ensure the sustainable use of biological resources and to promote the fair and equitable sharing of benefits arising from bio-prospecting involving those resources. The NEM:BA includes a Regulation related to the management of threatened and protected species. A similar Regulation is applied to Threatened Ecosystems. NEM:BA has a set of norms and standards for the development of management plans for both species (e.g. Threatened or Migratory Species) and ecosystems (Endangered or Critically Endangered).
Mineral and Petroleum Resources Development Act (No. 28 of 2002) The MPRDA makes provision for equitable access to and sustainable development of South Africa's mineral resources. The MPRDA requires that the environmental management principles set out in NEMA shall apply to all mining operations and serves as a guideline for the interpretation, administration and implementation of the environmental requirements of NEMA.

In addition to the above, the DWS has developed the National Water Resource Strategy (NWRS) to give effect to Section 5 of the NWA. The second edition of the NWRS (NWRS2, DWA 2013) is the primary mechanism to manage water across all sectors towards achieving national government's development objectives. The water sector vision for the NWRS2 is "Sustainable, equitable and secure water for a better life and environment for all" and is aligned with the vision of South Africa 2030. Towards achieving this vision, the overall goal is: "Water is efficiently and effectively managed for equitable and sustainable growth and development". The NWRS2 strives to achieve three main objectives (DWA, 2013):

- Water supports development and the elimination of poverty and inequality;
- Water contributes to the economy and job creation;
- Water is protected, used, developed, conserved, managed and controlled sustainably and equitably.

The core strategies of the NWRS2 (DWA, 2013) include the following:

- Implementation of Equity Policy;
- Putting water at the centre of integrated development planning and decision-making;
- Ensuring water for equitable growth and development;
- Contributing to a just and equitable South Africa;
- Prioritizing and ensuring the implementation of water conservation and demand management;
- Optimizing and stretching of our available water resources (groundwater, water reuse, desalination (including seawater), water systems optimization and rainwater harvesting);
- Committing to the protection of our water resources and ecosystems;
- Achieving effective and smarter water governance;
- Embedding sustainable business principles and practices in water resources and systems management;
- Implementing a water sector investment framework for infrastructure, human resource capacity and institutions;
- Engaging the private and water use sectors.

Strategic actions have been developed per sector for the key priority areas. Measures to give effect to the strategies and priority areas are discussed in Section 6 of this IWWMP.

3.1. Summary of All Water Uses

Table 2-5 above summarises all water uses applicable to the mining operation. These water uses were approved on the 11th of March 2014 by the DWS under Water Use Licence (WUL) No.: 10/D73A/ABG/2393 issued to PMG Bishop Mining (Pty) Ltd.

3.2. Existing Lawful Water Uses

a) In terms of Section 32 of the NWA, an existing lawful water use is defined as follows:
b) "Water use which has taken place at any time during a period of two years immediately before the date of commencement of the Act (1 October 1996 to 30 September 1998) and which was authorised by or under any law which was in force immediately before the date of commencement of this Act, or which has been declared an existing lawful water use in terms of Section 33 of the Act".
c) According to the NWA, an existing lawful water use is defined as follows:
d) "32.(1) An existing lawful water use means a water use –
e) (a) Which has taken place at any time during a period of two years immediately before the date of commencement of this Act; or
f) (b) Which has been declared an existing lawful water use under section 33, and which –

g) (i) Was authorised by or under any law which was in force immediately before the date of commencement of this Act;

h) (ii) Is identified as a stream flow reduction activity in section 36(1); or

i) (iii) Is identified as a controlled activity in section 37(1).

j) (2) In the case of –

k) (a) A stream flow reduction activity declared under section 36(1); or

l) (b) A controlled activity declared under section 38, existing lawful water use means a water use which has taken place at any time during a period of two years immediately before the date of the declaration".

PGM Mining was incorporated on the 29th of June 2004 and commenced its operations in 2014. As such, there are no existing lawful uses applicable except for those listed in the WUL issued on the 11th of March 2014 (Reference No.: 10/D73A/ABG/2393).

3.3. Relevant Exemptions

Government Notice No. 704 (GN 704), published in terms of the NWA, provides different regulations to address the use of water to prevent pollution of water resources arising from mining and related activities with the specific focus of protecting water resources.

Regulation 4a, 4b, 4c, and 5 of GN 704 applies to the PMG Mine.

Regulation 4a s states that:

- No person may locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100-year flood-line or within a horizontal distance of 100 m from any watercourse or estuary, borehole, or wells, drilled specifically to monitor the pollution of groundwater, or on the water- logged ground or on-the ground likely to become water-logged, undermined, unstable or cracked.
    - The activities within the PMG mine are located outside the 1:100-year flood line of the drainage channel, except for the offices.

Regulation 4b states that:

- No person in control of the mine or activity may carry on any underground or opencast mining, prospecting, or any other operation or activity under or within the 1:50 year flood-line or a horizontal distance of 100 m from any watercourse.
    - According to Nsovo IWWMP Update report (2022), in reference to Kai Batla (2012) PGM Mining falls within the D41J quaternary catchment in the D41 catchment of the Gamagara River. Direct rainfall would naturally drain to the

nearby streams (non- perennial rivers that occur in the eastern and western areas of the mining area). Then, the Gamagara catchment is contained in the opencast areas. Water containment results in catchment yield reduction. The activities within the PMG mine are located outside the 1:50-year flood line of the drainage channel.

Regulation 4 c states that:

- No person in control of a mine or activity places or dispose of any residue or substance which causes or is likely to cause pollution of a water resource in the workings of any underground or opencast mine excavation, prospecting diggings, pit, or any other excavation.
    - The waste rock is used to backfill open pits.

Regulation 5 states that:

- No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment of an embankment, road, or railway, or for any other purpose which is likely to cause pollution of a water resource.
    - The use of solid mine residue (overburden) is used for backfilling in the initial rehabilitation of the open pits.

Exemption from GN 704, Regulation 4 (a) and Regulation 4(b) are required. In terms of GN 704 and other requirements of the NWA, it is stated in the Operational Guideline No. M6 which should provide an exemption from any provisions of GN 704 implies the necessity for a water use licence, the person in control of the mine or activity need only apply for the same.

3.4. Generally Authorised Water Uses

In terms of Section 22(1) of the NWA, a person may use water without a licence if that water use is permissible in terms of a General Authorisation (GA) issued under Section 39 of the Act. There are, therefore, no GA is applicable for PMG Mining operations.

3.5. Waste Management Activities

As defined by the National Environmental Management: Waste Act, Act No. 59 of 2008 (NEM: WA), waste means any substance, whether or not that substance can be reduced, reused, recycled, and recovered (a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of; (b) which the generator has no further use of for (the purposes of production); (c) that must be treated or disposed of; or (d) that is identified as a waste by the Minister by notice in the Gazette, and includes waste generated

by the mining, medical or other sector, but— (i) a by-product is not considered waste; and (ii) any portion of waste, once re-used, recycled and recovered, ceases to be waste. As per the NEM: WA definition, PMG Mining generates general and hazardous waste in its manganese ore-mining process. General waste includes office and domestic waste and scrap metal, while hazardous waste includes mine residue (excess subsoil and overburden), contaminated stormwater, and used hydrocarbons. A mega slimes dam is available on site to provide for the effective and economic disposal of waste material throughout the life of the operation.

Decision making at PMG Mining must always consider the hierarchy of waste management as follows:

- Prevention;
- Reduce;
- Re-use;
- Recycling;
- Energy recovery; and
- Disposal.

3.6. Waste Related Authorisations

When updating this IWWMP, there were no waste activities requiring a Waste Management Licence (WML).

3.7. Other Authorisations (EIA, EMP, and EA Regulations)

PMG Mining holds a Mining Right on Portion 1 and the remaining extent of the farm Bishop 671 (543.3402 ha) in terms of the Mineral and Petroleum Resources Development Act No. 28 of 2002 (MPRDA) for opencast operation and associated support infrastructure/activities, Mining Right Reference No.: NC30/5/1/2/2/2/10208 MRR (MPT No.: 08/2008), is a renewal granted on the 31st July 2023 for a further twenty-three (23) year period. The Environmental Management Programme Report (EMPr) ((NC) 30/5/1/2/3/2/1/ (114) EM) was approved and granted on the 10th of January 2008.

4. DESCRIPTION OF ENVIRONMENTAL STATUS

4.1. Regional Climate

PGM Mining is located approximately 40 km north of Postmasburg along the R325 to Khathu/Kuruman. The closest weather station to the mining area is in Postmasburg. The climate data presented in this section is that of Postmasburg. According to Climate-data.org (2022), the mine lies within the Steppe climatic zone, and the climate is classified as BSh. The area is a hot semi-arid region

characterised by erratic rainfall, high evaporation levels, hot temperatures in summer, and cold temperatures in winter. The regional average daily maximum temperature varies between 17.3°C to 30.9°C in January, and in July, it is approximately 4°C to 17.6°C.

4.1.1. Temperature and Wind

The information presented in Table 9 below is the temperature data obtained from the Climate Data Organisation (Climate-data.org, 2022). The temperatures are highest on average in January, at around 24.3 °C. July is the coldest month, with temperatures averaging 10.3 °C (Climate-data.org, 2022).

Table 4-1: Summary of temperature and wind speed data

Month	Average	Temperature (°C)	Minimum Temperature (°C)
January	24.3	17.3	30.9
February	23.6	17.3	30.1
March	21.6	15.5	28.1
April	17.5	11.4	24
May	14.1	8	21
June	10.5	4.4	17.6
July	10.3	4	17.6
August	12.9	5.6	20.7
September	16.8	8.7	24.8
October	20.4	12.3	28.1
November	22.4	14.1	29.8
December	24.1	16.4	31.3

4.2. Rainfall and Humidity

According to Climate Data.Org, the variation in the precipitation between the driest and wettest months is 71 mm for the area. Throughout the year, temperatures vary by 14.0 °C, and the month with the highest number of rainy days is January (10.60 days). The rain data in the area shows that the month with the lowest number of rainy days is July (1.30 days), while the month with the highest relative humidity is April (49.15 %). Kathu weather station indicates that the month with the lowest relative humidity is October (25.89 %).

Table 4-2: Summary of rainfall and humidity data

Month	Precipitation/ Rainfall (mm)	Humidity (%)
January	76	38
February	67	42
March	60	47

Month	Precipitation/ Rainfall (mm)	Humidity (%)
April	38	49
May	15	46
June	12	48
July	5	41
August	6	33
September	11	26
October	23	26
November	32	26
December	55	31

Table 4-3: Summary of evaporation data

Month	Symons Pan Evaporation (mm)	Lake Evaporation Factor	Lake Evaporation (mm)
January	276.9	0.84	232.6
February	209.9	0.88	184.8
March	193.3	0.88	170.1
April	-	0.88	126.8
May	114.7	0.87	99.8
June	91.0	0.85	77.3
July	106.0	0.83	88.0
August	153.8	0.81	124.5
September	213.0	0.81	172.5
October	269.7	0.81	218.4
November	248.0	0.82	232.9
December	294.6	0.83	244.5
Total	2351	N/A	1972

4.3. Surface Hydrology

According to Sustainable Drop Projects (2023) the project site within quaternary catchment D41J (Figure 4-1) which is within the Lower Vaal Water Management Area. It can be seen from Figure 4-1 that an un-named tributary of the Ga-mogara River flows through the North-Eastern site of the project site. This tributary is ephemeral or non-permanent meaning that flow in the tributary only occurs for brief periods as a direct result of rainfall. These types of rivers are also characterised by lack of well-defined channels; unlike perennial rivers with well-defined physical channels or beds. In this case, they present as mostly as dry riverbeds or shallow depressions.

With respect to the hydrological impact assessment, it should be noted that when ephemeral rivers flow, their energy can be significant with the capacity to erode the surrounding landscape and transport sediment.

4.3.1. Catchment Mean Annual Runoff (MAR), Mean Annual Precipitation (MAP) and Mean Annual Evaporation (MAE)

The quaternary catchment's MAR, MAP and MAE obtained from the Water Resources of South Africa, 2012 study (WR2012) are presented in Table 4-4.

Table 4-4: Quaternary D41J Physical and Hydrological attributes

Catchment Area (Km^2)	Gross	3878
	Net	2518
Mean Annual Runoff (Mm^3/annum)		7.26
Mean Annual Evaporation (mm/annum)		2351
Mean Annual Precipitation (mm/annum)		358

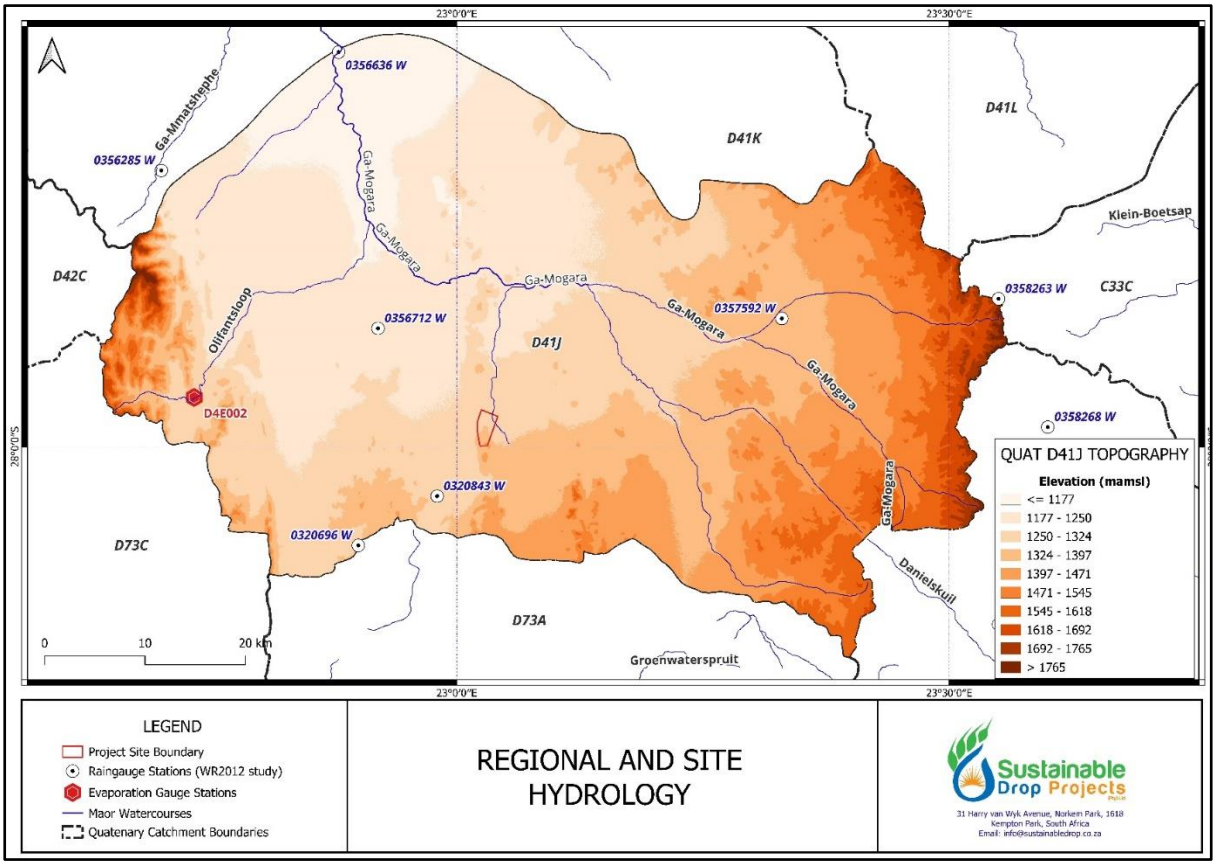


Figure 4-1: Regional and Site Hydrological Setting Map

4.3.2. Design Rainfall Depths

Design storm estimates for various return periods at a 1-day duration were sourced from the Design Rainfall Estimation Software for South Africa, developed by the University of Natal in 2002 as part of a WRC project K5/1060 (Smithers and Schulze, 2002). This method uses a Regional L-Moment Algorithm in conjunction with a Scale Invariance approach to provide site specific estimates of Design Rainfall depths for specified durations at various recurrence intervals. Table 4-5 presents the design rainfall depths that were derived from the Smithers and Schulze method based for rain gauge stations within the project site's vicinity. SMYTHE with a station ID number of 0356712 W is the closest to site and was, thus, used in subsequent assessments for the site in this study.

Table 4-5: Design Rainfall Depths (mm) for Rain Stations within the Project Site's Vicinity

Station Name	SAWS Number	Distance (km)	Record (years)	MAP (mm)	Altitude (m)	Return Period (years)		
						20	50	100
SMYTHE	0356712_W	19.1	86	337	1210	90.8	109.1	123.7
MANGANORE	0321159_W	19.4	34	377	1438	87	104.6	118.5
KHOSIS	0357413_W	24.1	59	336	1300	94.6	113.7	128.8
AUCAMPSRUS	0320828_W	31.9	57	304	1289	78.1	93.7	106.2
OLIFANTSHOEK (POL)	0356417_W	32.8	81	342	1317	81.3	97.7	110.7

4.3.3. Flood Analysis

The aim of the flood analysis undertaken as part of this study was to fulfil the requirements of the National Water Act (Act 36 of 1998).

According to flood analysis using the rational formula, the project site lies within a contributing catchment which is shown in Figure 4-2. This was derived using the SAGA toolbox that comes with the QGIS application. The contributing catchment covers an area of 85.5 km^2.

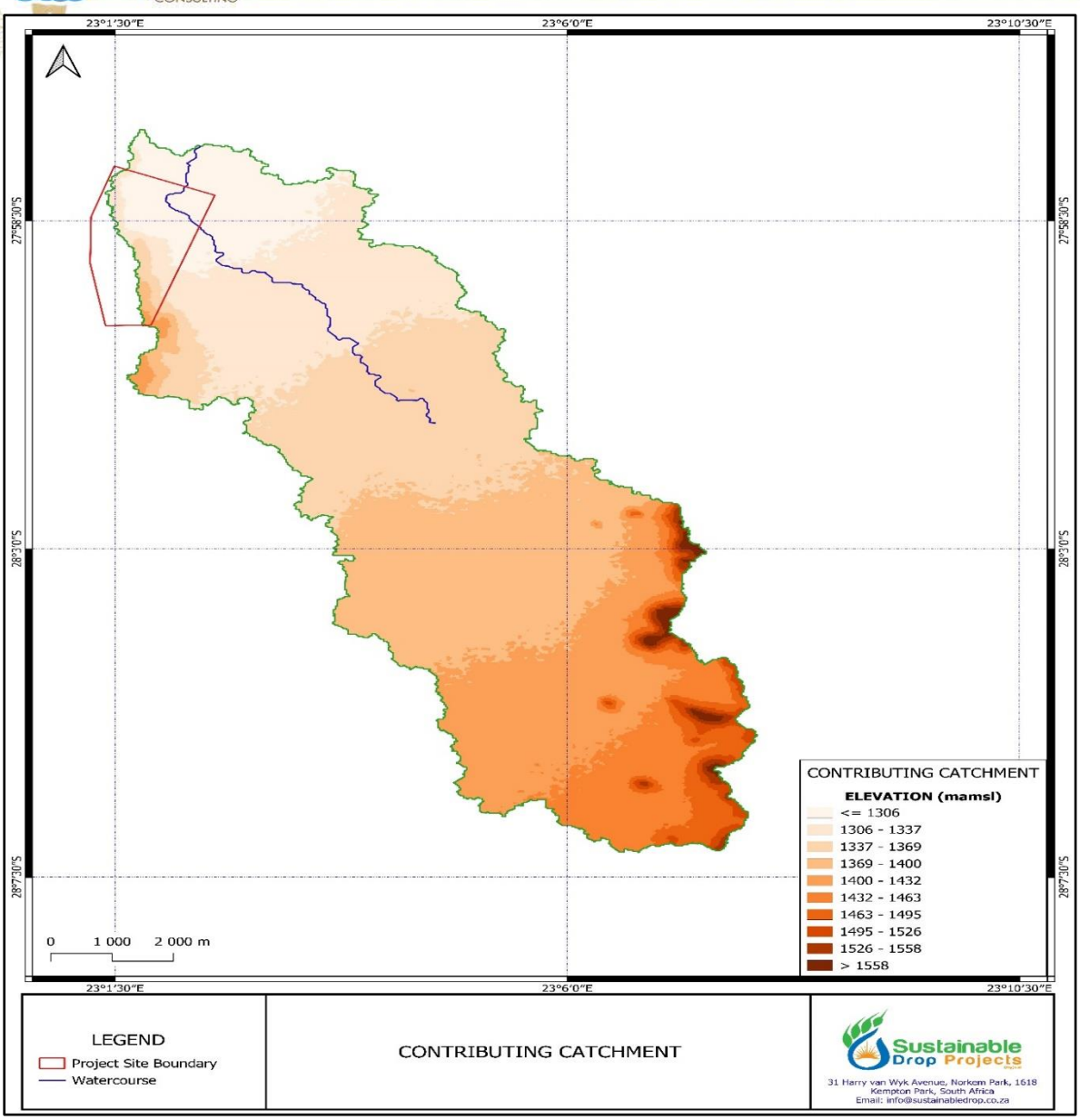


Figure 4-2: Delineated Catchment considered for Flood Analysis

4.3.3.1. Run-off Coefficients

There is no objective theoretical method for determining the run-off coefficient of a catchment (SANRAL, 2013) and as a result the subjective elements of experience and engineering judgement play a very important role in the determination of the run-off coefficient. For this study, SANRAL Drainage manual was referenced on how

Table *4-6* can be applied in the determination of the run-off coefficient.

Table 4-6: Recommended values of run-off factor C for use in the Rational method (Source: SANRAL Drainage Manual)

Rural (C_1)					Urban (C_2)	
Component	Classification	Mean annual rainfall (mm)			Use	Factor
		< 600	600 - 900	> 900		
Surface Slope (Cs)	Vleis and Pans (<3%)	0.01	0.03	0.05	Lawns	
	Flat areas (3 to 10%)	0.06	0.08	0.11	• Sandy, Flat (<2%)	0.05 – 0.10
	Hilly (10 to 30%)	0.12	0.16	0.20		0.15 – 0.20
	Steep areas >30%)	0.22	0.26	0.30	• Sandy, steep (>7%)	0.13 – 0.17
Permeability (Cp)	Very Permeable	0.03	0.04	0.05		0.25 – 0.35
	Permeable	0.06	0.08	0.10	• Heavy soil, flat (<2%)	0.30 – 0.50
	Semi Permeable	0.12	0.16	0.20		0.50 – 0.70
	Impermeable	0.21	0.26	0.30	• Heavy soil, steep (<7%)	0.50 – 0.80
Vegetation (Cv)	Thick bush and Plantation	0.03	0.04	0.05		0.60 – 0.90
	Light Bush and farm lands	0.07	0.11	0.15	Residential Area	0.70 – 0.95
	Grasslands	0.17	0.21	0.25	• Houses	0.50 – 0.70
	No vegetation	0.26	0.28	0.30	• Flats	0.70 – 0.95
					Industry	1.00
					• Light Industry	
					• Heavy Industry	
					Business	
					• City Centre	
					• Suburban	
					• Streets	
					• Maximum Flood	

4.3.3.1.1. Landcover

As demonstrated in

Table *4-6*, the value of the runoff coefficient depends on land cover type. To this end, determination of the landcover of the contributing catchment was required and for this the Lindeque, G.H.L and Koegelenberg, F.A. (2015) study was referenced. For this study, 18 land use/cover classes were applied

to delineate the whole country according to landuse patterns. For the contributing catchment, this is presented in Table 4-7and Figure 4-3.

Table 4-7: Land cover/use types of the contributing catchment

Land Use Type	Area	
	m^2	as %age of Total Area
Thicket /Dense bush	30,367	0.036%
Woodland/Open bush	1,104,639	1.294%
Grassland	15,908,296	18.633%
Low shrubland	65,579,106	76.811%
Mines 1 bare	469,844	0.550%
Mines 2 semi-bare	1,263,509	1.480%
Bare none vegetated	916,127	1.073%
Urban commercial	64,779	0.076%
Urban industrial	35,423	0.041%
Urban built-up (dense trees / bush)	1,012	0.001%
Urban built-up (low veg / grass)	4,048	0.005%

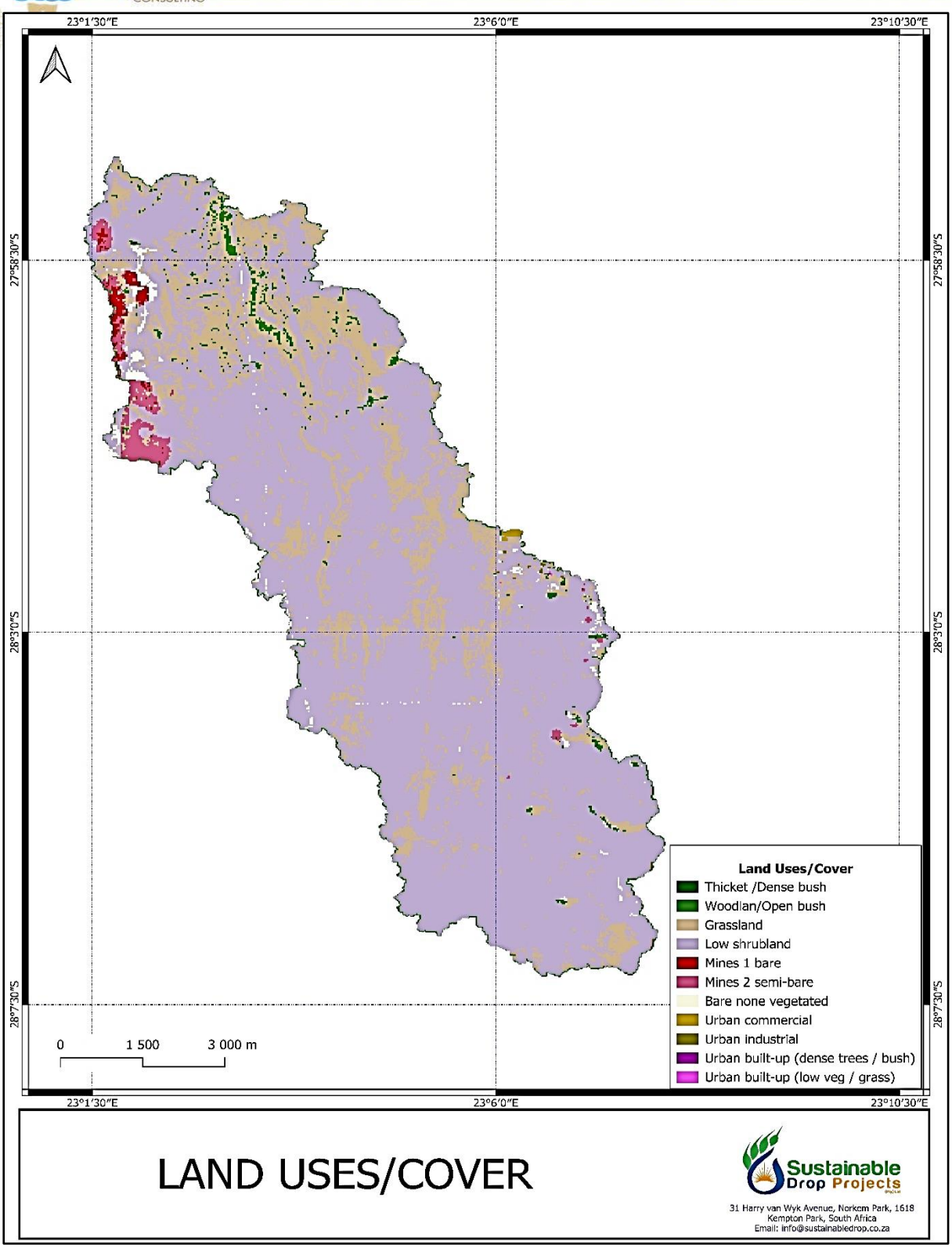


Figure 4-3: Land Use/Cover Types of the contributing Catchment

It is apparent from both Table 4-7 and Figure 4-3 about one third of the contributing catchment is grassland and nearly 24% is accounts for one or more forms of cultivated commercial fields. On a weighted area basis, the runoff coefficient estimate was obtained as 0.217.

4.3.3.2. Peak Flow Rates

Following the delineation of the contributing catchment in Figure 5 1, the rational formula was applied to obtain and determine the flood peaks for study basin. The detailed output is presented in Appendix B with a summary presented in Table 4-8.

Table 4-8: Catchment Flood Peak Estimates

Recurrence Interval (years)	Peak Flow (m^3/s)
50	210.580
100	238.760

4.3.3.3. Flood Determination

For floodline determination, the HEC-RAS application was used to set-up a 1-dimemsional hydraulic model (Figure 4-4) for the contributing catchment in Figure 4-2. In Figure 4-5, the area that would be inundated following a 100-year flood event is shown.

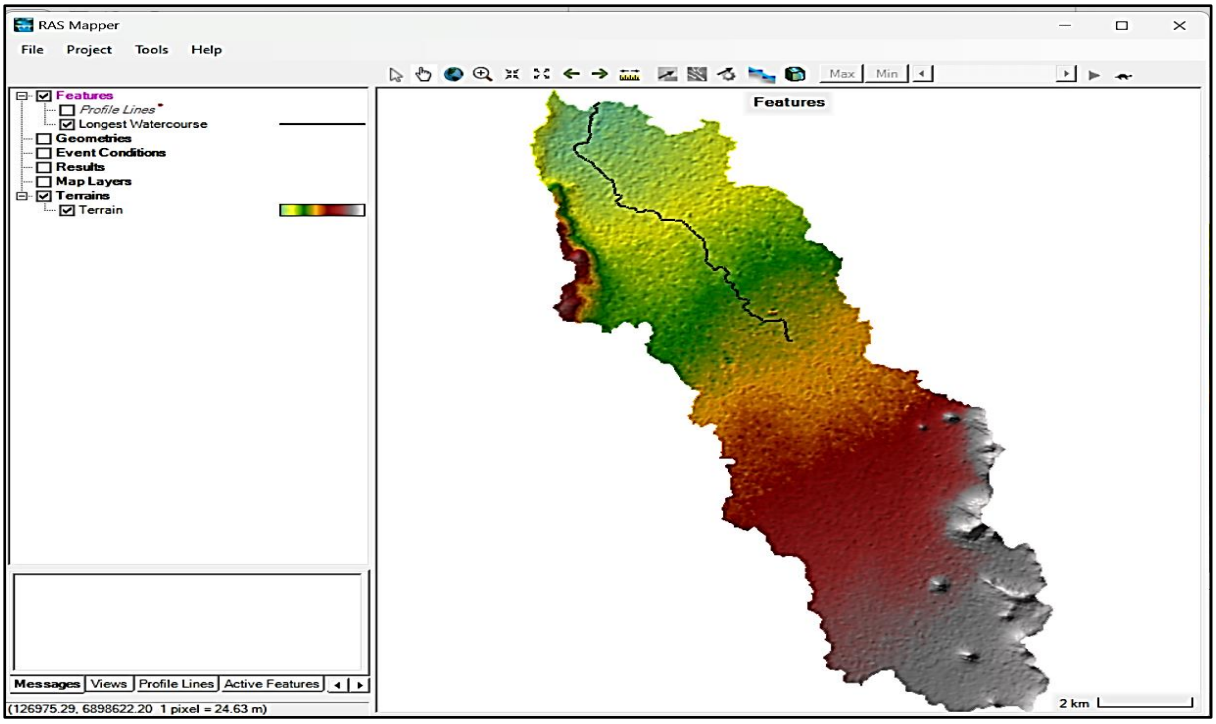


Figure 4-4: Catchment Representation within the HECRAS Environment

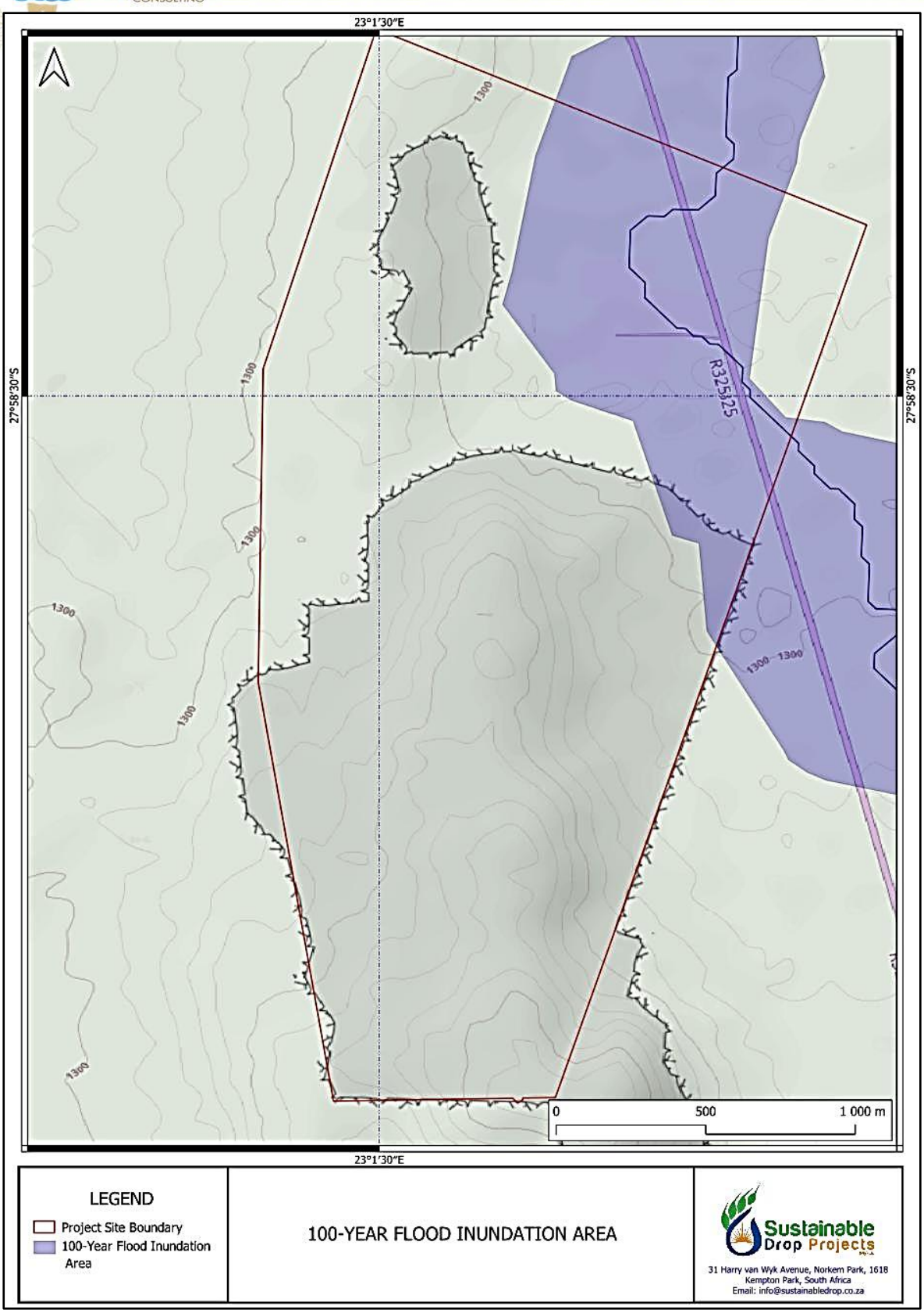


Figure 4-5: 100-year Inundation Area

Figure 4-5 depicts a map of the study area, illustrating the 100-year flood inundation area. It is apparent that a large part of the north-eastern section mine fall within the area that would be inundated by a 100-year flood.

While it is a seemingly large area, it is worth noting that this tributary is ephermal in nature and does not have a clearly defined channel. It is also worth noting that the site is generally relatively flat and thus lends itself to allowing river flow when it happens to spread over a wide area.

4.3.4. Wetlands

According to Eco-Care Consultancy (2017), the only natural wetlands within the larger landscape are small, endorheic, closed depressions. Further, these depressions have formed due to micro-topography variations of the underlying substrates (shallower soils over Calcrete), giving rise to low grasslands on pan bottoms. The wetlands within the area comprise a mixture of tall shrubs and trees. The pan-like alluvium consists of sandy loam with relatively high contents of Calcium and Phosphates. The pan soils consist of white (washed) sand and are exposed for most of the year and carry shallow pools for a short time following sufficient rains (Eco-Care Consultancy, 2017).

4.3.5. Surface Water Quality

Refer to section 5.1.

4.4. Water Management Area

PMG Mining project falls within the Vaal Water Management Area within the Orange River Basin. The Vaal River System supplies the water resources needs of 60% of the national economy and serves 20 million people.

4.5. Surface Water User Survey

The groundwater is excessively used by industries, mining operations, and agricultural activities for water supply due to the lack of perennial surface water resources within the vicinity of the project area. The Vaal Gamagara Water Supply Scheme abstracts water from the Vaal River below the Harts River confluence. In addition, the scheme is situated approximately 8km west of Kimberley, outside Delpotshoop. It consists of a raw water pump station, purification works, 6 booster pump stations, several reservoir facilities, and a pipeline network of about 1700km.

This scheme is important to the Northern Cape Province in supplying water for domestic, industrial, and mining use. The water is abstracted, purified, and pumped using a high lift pump station to Kneukel

some 20km away. The water flow from the Kneukel pump station is boosted to the Tredwill pump station and Clifton reservoirs, situated near Lime Acres, about 117 km from the purification plant. Clifton, the primary storage facility, consists of 4 reservoirs with a combined capacity of 27 000 m³. From Clifton, water gravitates past Postmasburg and Kathu to reservoirs at Blackrock. The scheme runs through six Water Service Authorities, i.e., Dikgatlong, Kgatelopele, Tsantsabane, and Gamagara.

4.6. Sensitive Areas Survey

According to Eco-Care Consultancy (2017), the only natural wetlands within the larger landscape are small, endorheic, closed depressions. Further, these depressions have formed due to micro-topography variations of the underlying substrates (shallower soils over Calcrete), giving rise to low grasslands on pan bottoms. The wetlands within the area comprise a mixture of tall shrubs and trees. The pan-like alluvium consists of sandy loam with relatively high contents of Calcium and Phosphates. The pan soils consist of white (washed) sand and are exposed for most of the year and carry shallow pools for a short time following sufficient rains (Eco-Care Consultancy, 2017).

4.7. Geology

Local geology of the site consists of different geological unit namely Ghaap Group and Gamagara Formation. Figure 4-6 shows the geological cross section and distribution of local geological unit in the in the mining right boundary.

Geologically, the area of investigation is typically found within the Western Belt of the Maremane Dome which is comprised in the Reveilo Formation of the Campbell Rand and the Kuruman-Iron Formation of the Asbestos Hill Subgroups of the Ghaap Group. The Gamagara Formation of the Olifantshoek Supergroup unconformable overlies the Kuruman-Iron Formation. The fragments of the resulting successions are found as unconsolidated quaternary systems in parts of the area of investigation.

Parts of the area of investigation show outcrop evidence of the Reveilo Formation of the Campbell Rand Subgroup on the northeast, central and the southern parts. Laminated manganese-rich dolomites also form part of the Bishop farm. The ferromanganese ores were formed through dissolution and karstification. Parts of the Asbestos Hill Subgroup are found in the area of investigation as outcrops of the Manganore Iron Formation to the northeastern and southern parts of the study area. The Manganore Iron Formation comprises of the hematitized chert-free iron ores and minor manganese ore. Above the Manganore Iron Formation the manganese ore form part of the cementing material and fragments of the Doornfontein conglomerate. The south-western part of the Bishop farm is comprised of the red-shale of the Gamagara Formation.

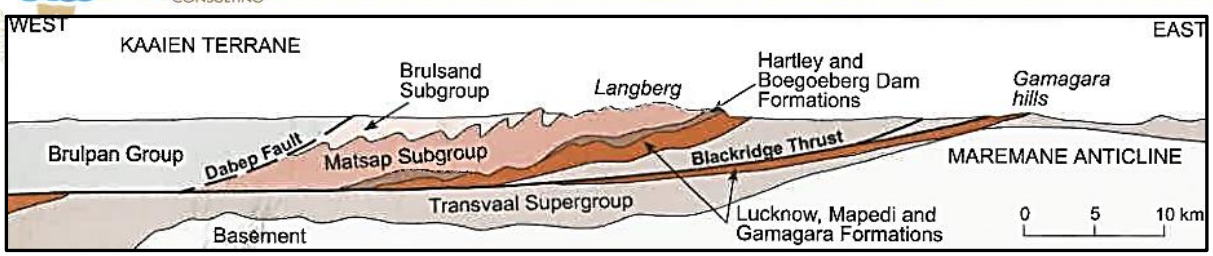


Figure 4-6: Geological cross section, of an area south of the mine (Johnson et al., 2006).

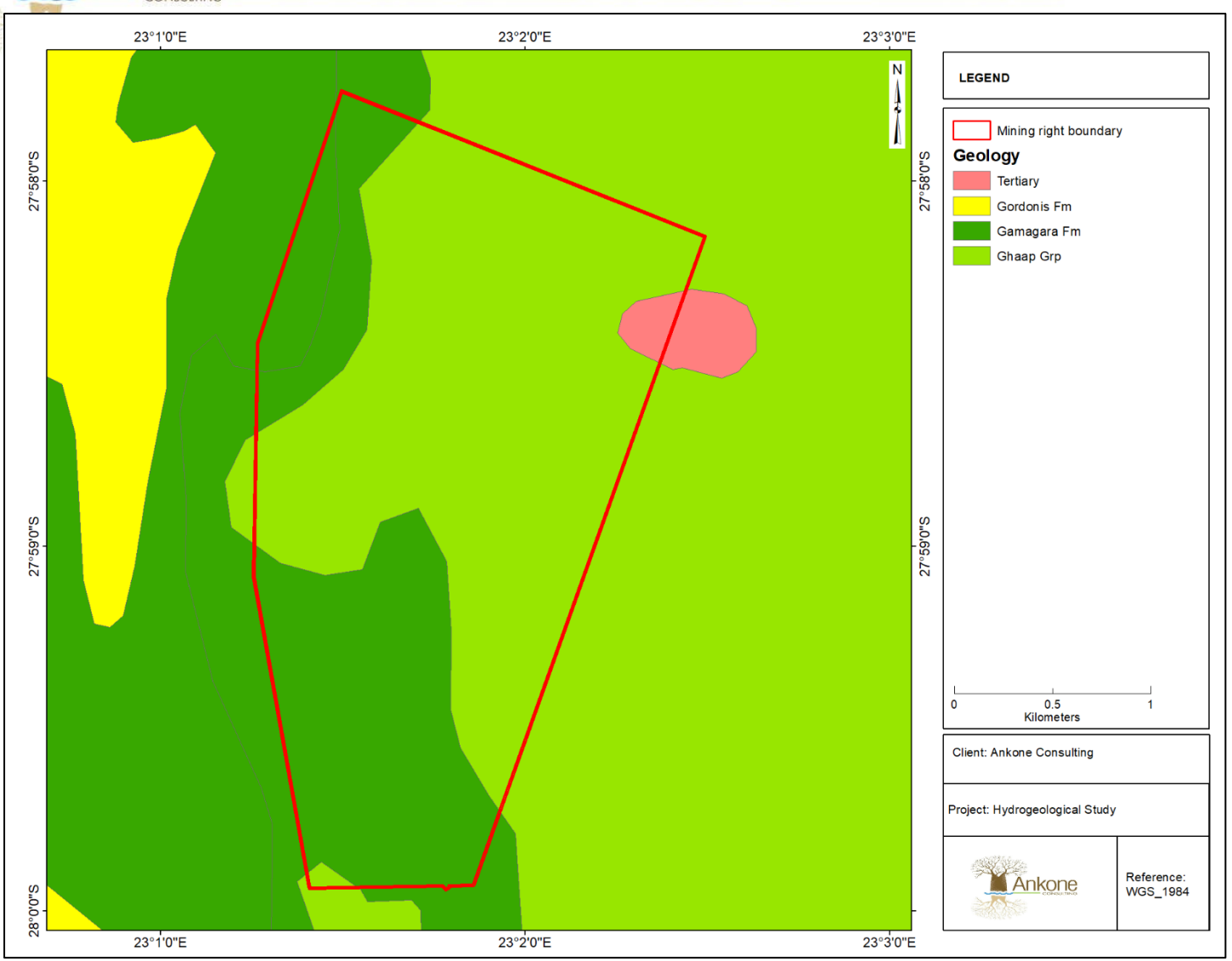


Figure 4-7 Surface geology of the site.

4.8. Hydrogeology

- The information in this section was compiled from the "PMG Mining: Hydrogeological Technical Report" compiled by Ankone Consulting in 2023 (Refer to Appendix F).
- The hydrogeological characteristics of the mine area are primarily characterized by a fractured and karst aquifer system. The geological formations predominantly consist of rocks hosting a combination of intergranular and fractured aquifers. Notably, karst aquifers within calcareous rocks on the Ghaap Plateau are identified as significant water sources, yielding large volumes of high-quality water due to the neutralization potential provided by carbonates.
- Fractured aquifers, located predominantly on the western side of the study area, have been influenced by tectonic forces, resulting in brittleness. Despite this, they exhibit relative competency with minor intergranular properties. Groundwater levels, as observed from hydro census boreholes, vary between 5.26 and 34.5 meters below ground level (mbgl).
- Moreover, Bayesian interpolation analysis indicates a robust correlation (98%) between groundwater levels and surface elevation, highlighting the interconnected nature of groundwater dynamics and land surface topography in the study area.

4.8.1. Aquifer Parameters

Kruseman and de Ridder (1994) describe the principles of aquifer hydraulic testing as tests that are often conducted by pumping water from a well while measuring the discharge rate as well as the drawdown within the pumped well or within observation wells in its vicinity. The measured discharge rates and drawdowns can be used to determine the hydraulic characteristics of the aquifer.

According to Jones (1963) the rate at which water can be withdrawn from a well is dependent on various factors such as: the permeability of the aquifer, the thickness of water bearing zone and the hydrostatic head above the aquifer to which water will rise in the well. The aquifer recharge volumes are between 4.6 – 8.2 mm/a or 1 – 4%. The transmitivity of the carbonate aquifers is measured to be ranging around 25 000m2/day, which is a true resemblance of dolomite aquifers. The aquifer yield of the intergranular and fractured is in the order of 0.1 – 0.5 L/s for most of the area and 0.5 – 3.0 L/s for the western of the study area.

The groundwater system in the study area is diverse and changes in storativity are expected to occur in the different parts of the study area. Variation in storativity values is evident in the western and eastern part of the study area; the difference is possibly due to the different degree of fracturing and the different geological conditions in the study area. According to Bredenkamp (1995) the S-values tend to change with distance because of the pressure relationship between groundwater in the matrix and in the fracture.

The storativity of the confined aquifer, which varies with specific storage and aquifer thickness, typically ranges from 5×10-5 to 5×10-3 (Todd, 1980), while in an unconfined aquifer the storativity ranges from 0.1 to 0.3 (Lohman, 1972). The hydraulic conductivities of the study area differ because of the different properties in the respective fault zones. In the Western Fault, permeability generally appears to be due to matrix porosity, while in the Eastern Fault permeability generally appear to be due to fractured zones and matrix porosity The hydraulic conductivity of the aquifers in the study area ranges between 3×10-3 m/day to 2.1 m/day (Golder, 2014).

4.8.2. Aquifer Characterization

The aquifer characterization study conducted in the study area revealed distinct features and vulnerability levels:

- Groundwater vulnerability: The study area comprises of karst aquifer within the east portion and fractured aquifer within the west portion. The fractured aquifer is classified as least (low) vulnerable to contamination while the karst aquifer is classified as most (high) vulnerable to contamination.
- Aquifer classification: The aquifer within the study area is classified as minor aquifer system.
- Aquifer protection classification: The study area falls under low (Fractured) to medium (Karst) level of aquifer protection.
- Aquifer Susceptibility: The study area falls under low level (Fractured) and High (Karst) level of aquifer susceptibility

4.8.3. Groundwater Use

According to Kai Batla (2012), groundwater is abstracted for the following mining activities:

- Hostel residents;
- Day workers;
- Laboratory;
- Irrigation;
- Dust suppression; and
- Plant.

4.8.4. Groundwater Quality, Bishop Mine

Groundwater quality monitoring at Bishop Mine is an ongoing task to assess the status of groundwater quality within the mine. This section provides a summary of groundwater quality based on water quality data for July 2023 (Appendix F:1). Groundwater quality monitoring is currently conducted ion four monitoring points as stipulated in the WUL. The water quality of the Boreholes is compared against the PMG Bishop Mining WUL (Licence No. 10/D73A/ABG/2393) and the SANS 241: 2015 guidelines.

Table 4-9 provides a summary of groundwater quality data for July 2023. Based on the water quality data for Julyn 2023, all boreholes comply with the SANS 241 2006 and 2015, with an exception of borehole HBH7 which have high concentration of NO3 above the SANS 2015. All monitoring points are non-compliant with the guideline value for pH as prescribed in the WUL document. The remaining parameters are within the WUL limits.

The presence of high EC in groundwater is directly related to the concentration of the ionized constituents in the groundwater. This may also relate to the presence of contamination and problem associated with excessive hardness. EC in the area generally ranges from 94.9 mS/m to 95.2 mS/m. All water samples are well below the SANS 2015 limit of 170 mS/m.

TDS represents the total amount of solid that remain when the water sample is evaporated to dryness. It refers to all solids dissolved in water and this include inorganic salts such as carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron, and small amount of organic matter and dissolved gases. TDS in the study area varies from varies from 572 mg/l to 639 mg/l. All water samples are characterised by TDS below the prescribed limit of 1200 mg/l (SANS 241 2015).

The concentration of Ca, Mg, K and Na varies from 112 - 118 mg/l, 45.9 – 55.8 mg/l, mg/l, 0.711 – 1.63 mg/land 12.8 – 13.1 mg/l respectively. These cations were recorded at very low concentration in the study area. They all comply with limits prescribed in the SANS 2006 and 2015, and also with WUL

limits. The concentration of Cl and SO4 at the mine ranges from 29.8 mg/l to 30.9 mg/l for Cl and from 31.3 mg/l to 34.3 mg/l for SO4.

The concentration of F in the study area were found to be within guideline limit prescribed in the SANS standards and WUL limits. AL, FE and Mn were recorded at concentration below the detection limit. One parameter of concern is NO3 which is high in HBH7. The WUL limit recommended concentration between 10 mg/l and 20 mg/l. NO3 in this borehole is recoded as 11.4 mg/l which comply with WUL limits. However, the SANS limit for domestic drinking water quality is 11 mg/l. This suggest that the concentration of NO3 is above the SANS limit for drinking water quality.

Table 4-9: Physical and chemical constituents for 2023.

VARIABLES	UNITS	WUL Limits	SANS 241; 2006;2015	HBH7	HBH6	HBH5	HBH8
PH @ 25*C	PH	9.5-10	5-9.7	7.76	7.81	7.79	7.79
Ectriccal conductivity (EC) @ 25*C	ms/m	150-370	≤150	95.1	95	95.2	94.9
Total dissollved solids (TDS)	mg/l	1000-2450	≤1200	589	580	572	639
Calcium (Ca)	mg/l		<150; 150-300	112	114	118	117
Magnisium (Mg)	mg/l	70-100	<70; 70-100	53.7	55.2	45.9	55.8
Sodium (Na)	mg/l	200-400	≤200	13.1	12.8	13.1	13.1
Potassium (K)	mg/l	46	<50; 50-100	1.63	0.722	0.782	0.711
Chloride (Cl)	mg/l	200-600	≤300	29.8	30.6	30.8	30.9
Sulphate (SO4)	mg/l	400-600	≤250; ≤500	31.3	34.3	31.5	31.7
Nitrate (NO3) as N	mg/l	10-20.0	≤11	11.4	10.6	10.6	10.6
Ammonium (NH4) as N	mg/l		≤1.5	0.328	0.343	0.326	0.351
Fluoride (F)	mg/l	1.5-3.5	≤1.5	0.777	0.752	0.75	0.713
Aluminium (Al)	mg/l		≤0.3	<0.002	<0.002	<0.002	<0.002
Iron (Fe)	mg/l		≤0.3; ≤2	<0.004	<0.004	<0.004	<0.004
Manganese (Mn)	mg/l		≤0.1; ≤0.4	<0.001	<0.001	<0.001	<0.001
Non-Compliant with WUL limit		Non-Compliant with SANS Limit					

4.8.5. Baseline Regional Groundwater Quality

Seventeen groundwater points located within a radius of 13 km from the mine were assessed for baseline groundwater quality (Table 4-11 and Figure 4-8). Groundwater chemistry from these boreholes were compared to South African National standards for drinking water (SANS 241; 2006; 2015). The pH of groundwater samples in the area is confined within the SANS limit. This pH ranges from 7.54 to 8.46. The EC of the groundwater samples in the study area ranges from 47.7 mS/m to 129.7 mS/m and falls below 170 mS/m which is prescribed by SANS 2015.

Guideline values for Ca in water as prescribed by SANS 2006 are less than 150 mg/l for Class I and between 150 mg/l and 300 mg/l for class II. Ca in groundwater found in the study area comprises of low concentration below Class I of the SANS. The minimum and maximum concentration for K in the area is 0.61 mg/l and 3.12 mg/l respectively. This concentration is well below SANS 2006 limit of 50 mg/l.

Most groundwater sample are within Class I of the SANS 2006 in terms of Mg, except four samples which have concentration falling within Class II of the SANS 2006. Groundwater from the four boreholes in the area can only be used for maximum of 7 years. This groundwater will require treatment before usage. The concentration of Na in the area varies from 5.4 mg/l to 97.9 mg/l which is way below SANS Class I limit of 200 mg/l.

The concentration of Cl and SO4 in the study area are well below the SANSS 2015 Class I limit. Generally, the concentration of Cl and SO4 ranges from 6.5 mg/l to 146 mg/l for Cl and from 5.6 mg/l to 83.5 mg/l for SO4. F and NH4 are characterised by concentration within the SANS 2015 recommended limit of 1.5 mg/l. The concentration of NO3+NO2 falls within Class II of the SANS 2006 with an exception of one sample which have high concentration above SANS 2006 and the remaining samples which comprises of Class I water quality. Samples falling within Class II of the SANS 2006 can only be used for a period of 7 years. This water will need to be treated.

The concentration of cations and anion was used to understand the hydrogeochemical processes of groundwater. These parameters were plotted in the piper diagram (Figure 4-9). In general, groundwater found in the area are characterised by signature of shallow groundwater

The Borehole use water was classified according to WRC Quality of Domestic Water Supplies to give an induction of the water quality should the water accidentally be consumed by someoneTable *4-10*.

Table 4-10:Colour Classification

Class/ Colour	Description	Effects
Class 0	Ideal water quality	No effects for many generations

Class/ Colour	Description	Effects
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects
Class 2	Marginal water quality	May cause some effects on sensitive users. Some effects are possible after a lifetime of use. Aesthetic effects.
Class 3	Poor water quality	Poses a risk of chronic health effects, especially in babies, children, and the elderly. Poor aesthetics.
Class 4	Unacceptable water quality	Severe acute health effects, even with short-term use. Taste and appearance will lead to the rejection of water.

Table 4-11: Physical and chemical composition of groundwater.

Name	Latitude	Longitude	pH	EC (mS/m)	Ca (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	Cl (mg/L)	SO4 (mg/L)	TAL (mg/L)	F (mg/L)	NH4 (mg/	NO3-NO2 (mg/L)
150050	-27.91	23.054444	8.12	76.1	14.7	2.21	84	16.8	42.1	28.4	296.3	0.25	0.02	3.89
162656	-27.9	22.941667	8.2	62.4	61.5	1.96	33.5	17	21.9	5.8	214.4	0.28	0.04	18.81
165204	-28.0622	23.056667	8	101.1	79.2	0.63	78	13.7	42.6	30.3	333.8	0.22	0.02	11.16
165205	-28.09	23.056944	8.09	91.2	84.4	0.61	74.5	5.4	10.7	14.3	366.6	0.18	0.02	5.16
172023	-27.8714	23.0175	8.23	70.4	73.9	2.03	49.4	15.9	24.1	21.3	338.9	0.27	0.02	7.63
172024	-27.8778	23.005	8.25	129.7	77.1	2.76	91.2	97.9	146.2	83.5	430	0.31	0.02	16.678
172075	-27.9744	23.020278	8.22	76.9	71.4	3.1	61.2	22.1	38	27.3	380.7	0.41	0.068	1.077
172076	-27.9661	23.009167	8.32	80.2	85.4	2.42	56.4	16.7	49	17.7	373.5	0.35	0.068	1.924
172830	-27.9267	22.906111	7.54	60	54.6	2.29	32.7	17.8	10.5	8	248.8	0.36	0.02	9.834
172842	-27.95	22.914444	8.14	62.7	57.4	2.18	34.3	22.2	13.5	11	222	0.38	0.02	21.15
172844	-27.9119	22.957222	8.05	72.8	66.4	1.11	35.5	27.3	25.7	13.9	253.4	0.47	0.02	16.045
172845	-27.9289	22.947222	7.91	60.6	57.1	1.91	30.9	16.2	12.4	12.8	210.5	0.39	0.02	17.518
172846	-27.9144	22.925278	7.97	68.2	55.4	3.12	36.9	25.9	21.4	15.8	242.3	0.35	0.02	15.61
172847	-27.8992	22.919167	8.32	69.4	62.8	2.81	38.6	26	14.6	14.3	293.6	0.35	0.02	10.932
172848	-27.8969	22.948611	8.13	89.4	74.7	2.54	45.4	46.6	62.5	25.3	312.7	0.4	0.02	10.974
172869	-28.0767	22.921667	8.46	47.7	46.8	1.4	26.4	14.8	6.5	5.6	201.5	0.25	0.02	8.562
172876	-28.0158	22.930556	7.72	58.6	63.6	1.33	34.1	19.7	24.2	10.2	241.8	0.31	0.02	11.379

Exceed SANS Limit
SANS Class II

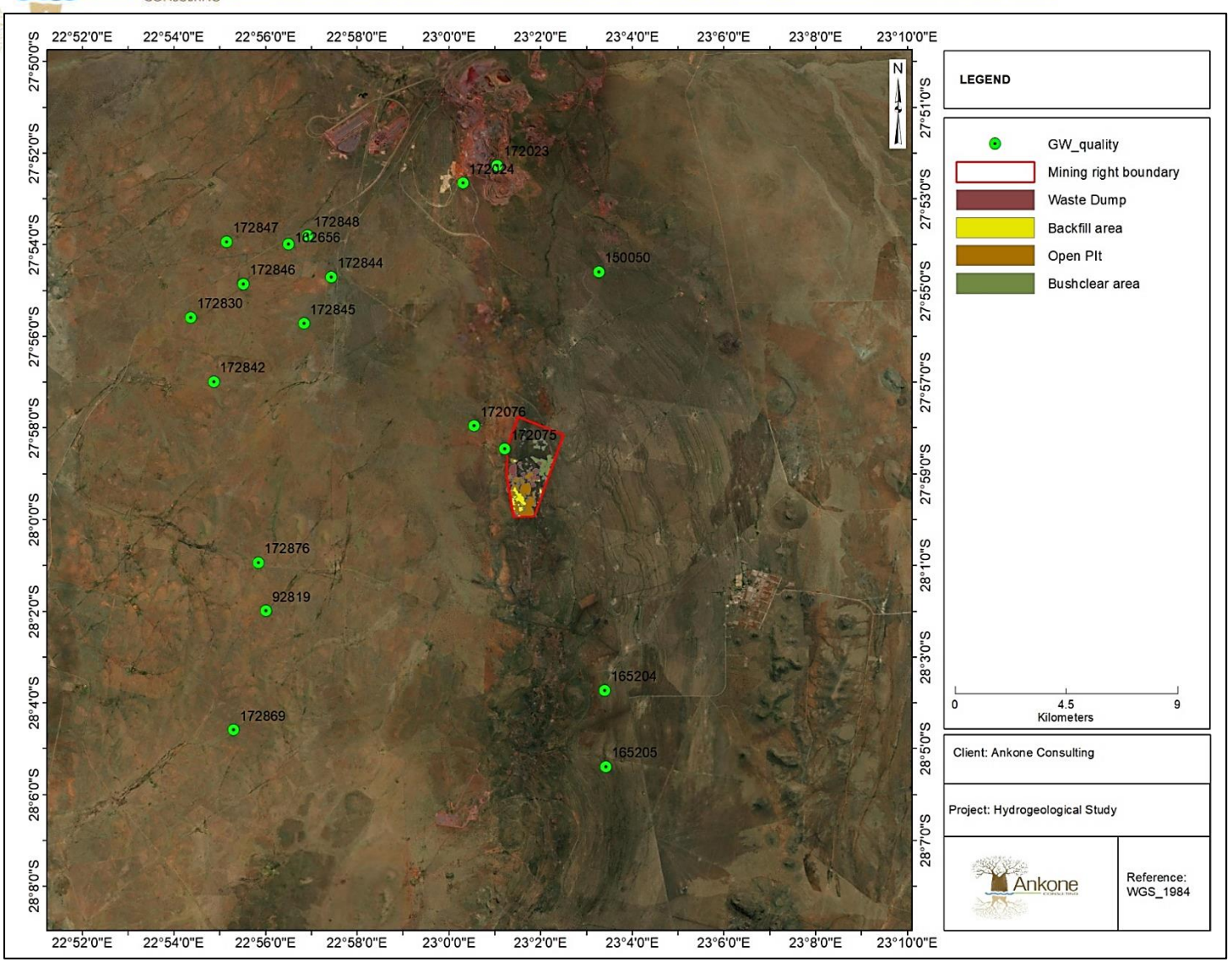


Figure 4-8: Distribution of baseline groundwater quality data.

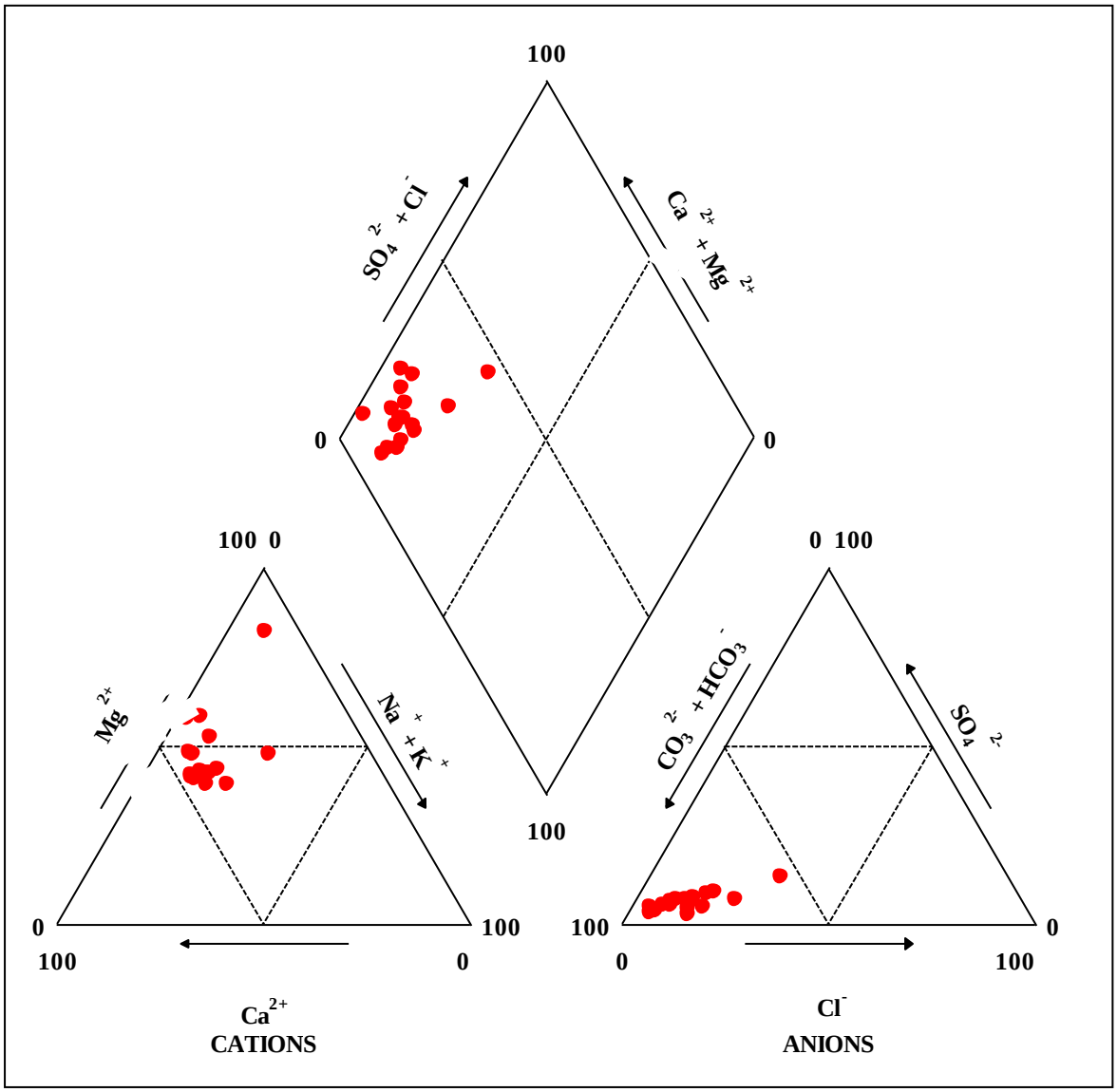


Figure 4-9: Piper diagram for hydrogeochemical facies.

4.8.6. Hydrocensus

Hydro census survey and site visit was conducted on 20 October 2023 where boreholes have been visited.

Table *4-12* shows available boreholes, while Figure 4-10 shows the distribution of the boreholes. Borehole information was collected during site visit. In total, 5 boreholes were visited while 3 boreholes were not found. Information on additional three existing boreholes were provided by the mine. In total, the mine has 8 boreholes where 3 boreholes are used for abstraction and 5 are used for monitoring. Groundwater resources in the mine is used mainly for domestic and mining related activities. 3 of the 8

boreholes are equipped with electric submersible pumps. Borehole depth was recorded from one borehole with a depth of 100 m. Only 3 boreholes were operational during the hydro census survey.

Table 4-12: Hydro census data.

Name	Latitude	Longitude	Water level (mbgl)	Elevation (mamsl)	Status	Purpose
HBH7	-27.97232	23.03312	19.2	1286	Equipped, electrical	Abstraction, Monitoring
HBH8A	-27.97304	23.0328	34.5	1286	Equipped, electrical	Abstraction, Monitoring
HBH8	-27.97298	23.03291	28.65	1286	Not equipped	Monitoring
HBH5 - Monitoring	-27.97997	23.03672	5.7	1294	Not equipped	Monitoring
HBH5 equipped	-27.980045	23.036742	5.7	1294	Equipped, electrical	Abstraction, Monitoring
HBH4	-27.97987	23.03568	6.15	1294	Not equipped	Monitoring
HBH6	-27.97957	23.03732	5.26	1293	Not equipped	Monitoring
HBH9	-27.97235	23.03302	12.81	1287	Not equipped	Monitoring

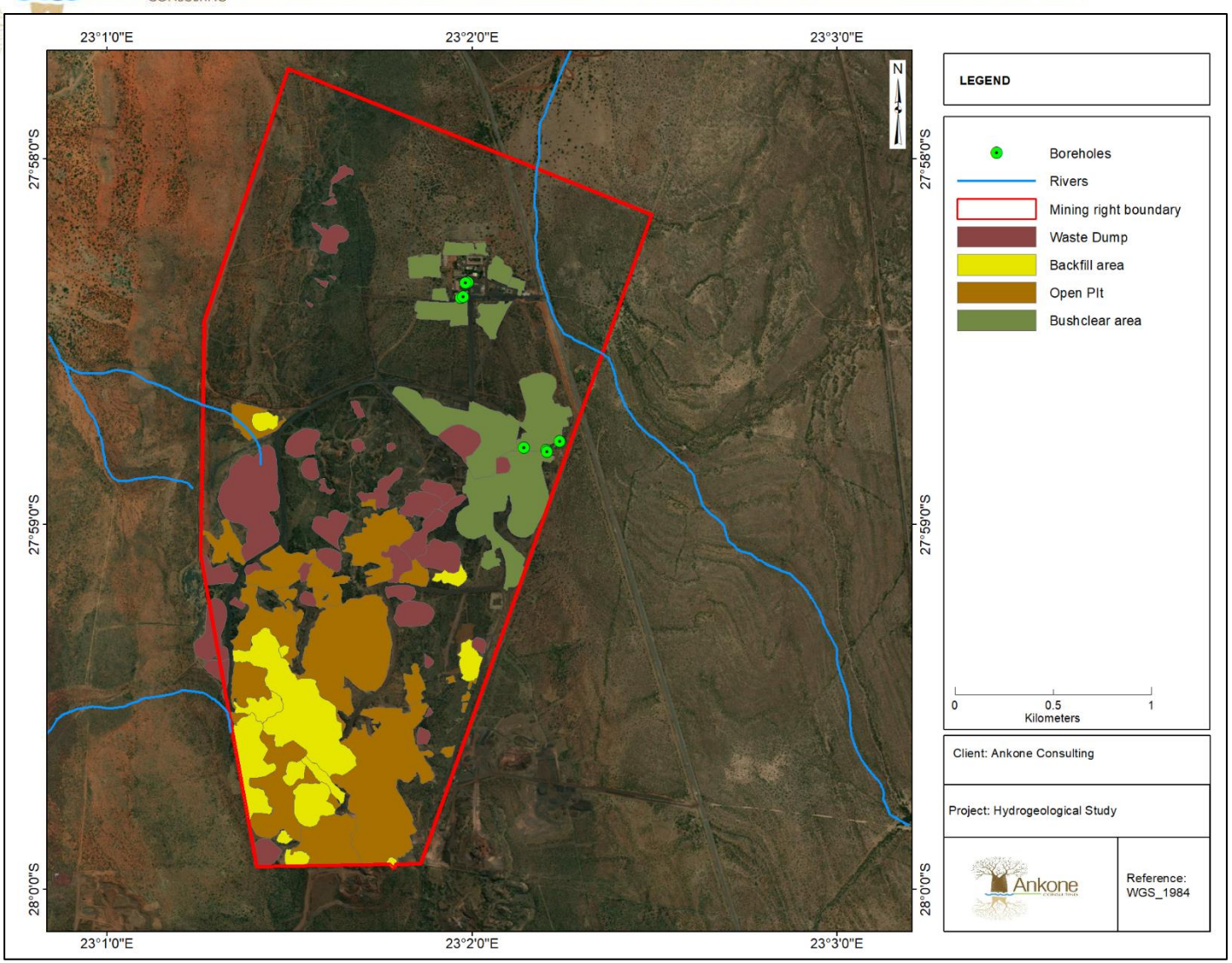


Figure 4-10 Distribution of hydro census boreholes and farms.

4.8.7. Groundwater Levels

The groundwater levels of the hydro census boreholes were measure by means of a dip meter where possible to determine the depth of the regional and local aquifers surrounding the Bishop mining area. It is observed that shallow boreholes are mostly found on the eastern part of the municipal jurisdiction which is underlain by dolomites and banded iron formations. Deeper boreholes are found towards the western part which is covered by thick Kalahari sediments.

The hydro census study included site visits and gathering of all relevant data from ten boreholes in the vicinity of the Bishop mine. Two of the ten monitoring boreholes at the site were from the high-grade stockpile and the main gate where the former was sealed and the latter was dry. The groundwater levels at the area of investigation during the hydro census study ranged from 5.26 to 34.5mbgl, as shown in the graph below. It is important to note that deeper groundwater level has been influenced by groundwater abstraction on several boreholes.

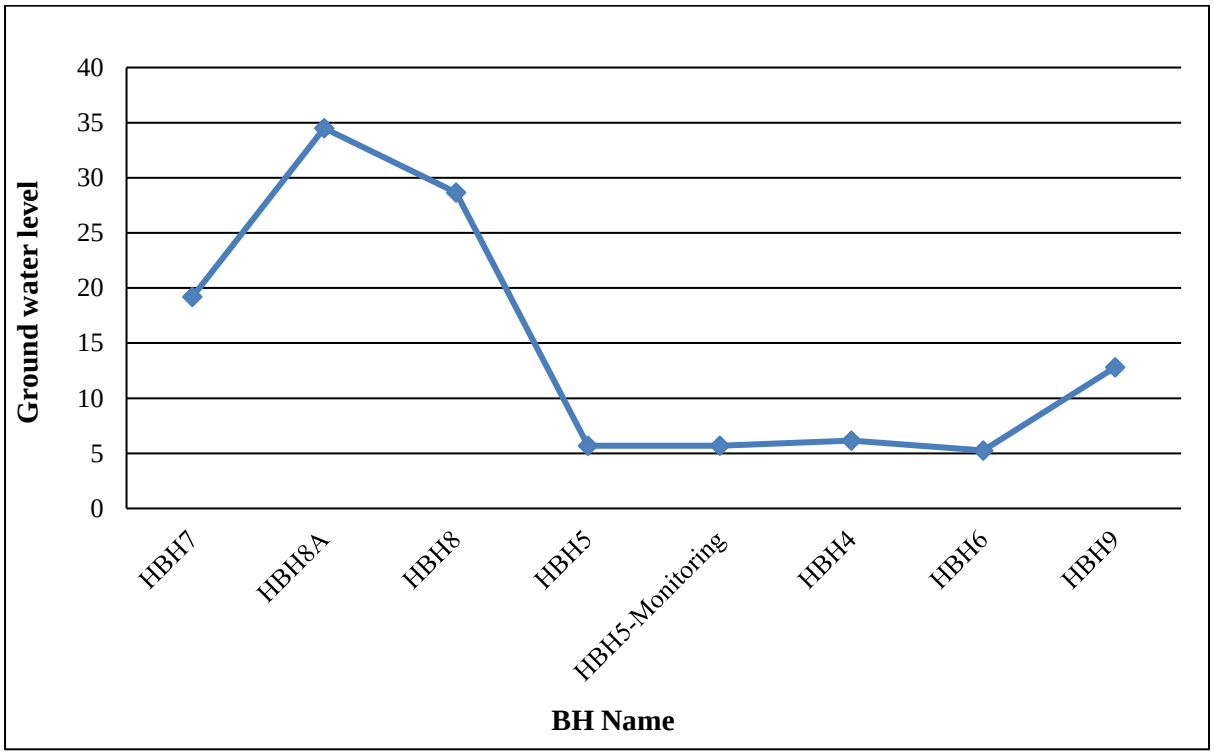


Figure 4-11: Groundwater levels at Bishop Mine

The Bayesian correlation was used to understand any correlation between surface topography and groundwater level elevation. In general, groundwater level will mimic topography under natural condition, except where geological structures contribute towards groundwater flow. This implies that the beyesian correlation method is critical in estimating groundwater level under natural condition. However, non-correlation may exist where there are groundwater abstraction or contribution of factors

that influence groundwater level. This suggest that the correlation can distinguish between groundwater level under natural condition and groundwater level affected by pumping.

Figure 4-12 shows the correlation between surface elevation and groundwater elevation. The result has shown a strong correlation between groundwater level and surface elevation, with correlation of 98%. It is expected that groundwater level elevation will be higher at topographic higher elevation compared to lower elevation. As a result, groundwater will most likely, under natural condition, flow from topographic high elevation to lower elevation, perpendicular to flow line or contour line. It must be indicated that three boreholes comprise of anomalous groundwater level due to abstraction. These boreholes were rejected for assessment and inclusion in the assessment. When incorporating these boreholes, correlation coefficient drops to 80%, which is also a strong positive correlation.

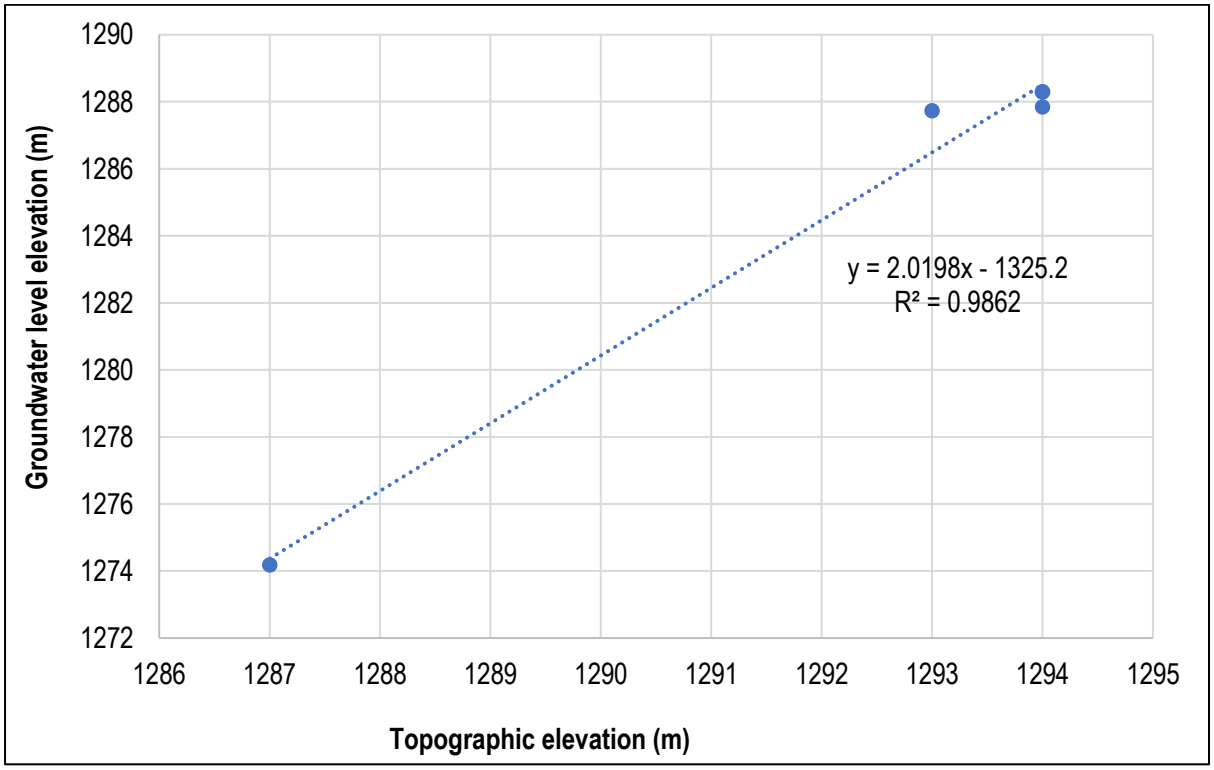


Figure 4-12: Groundwater level elevation

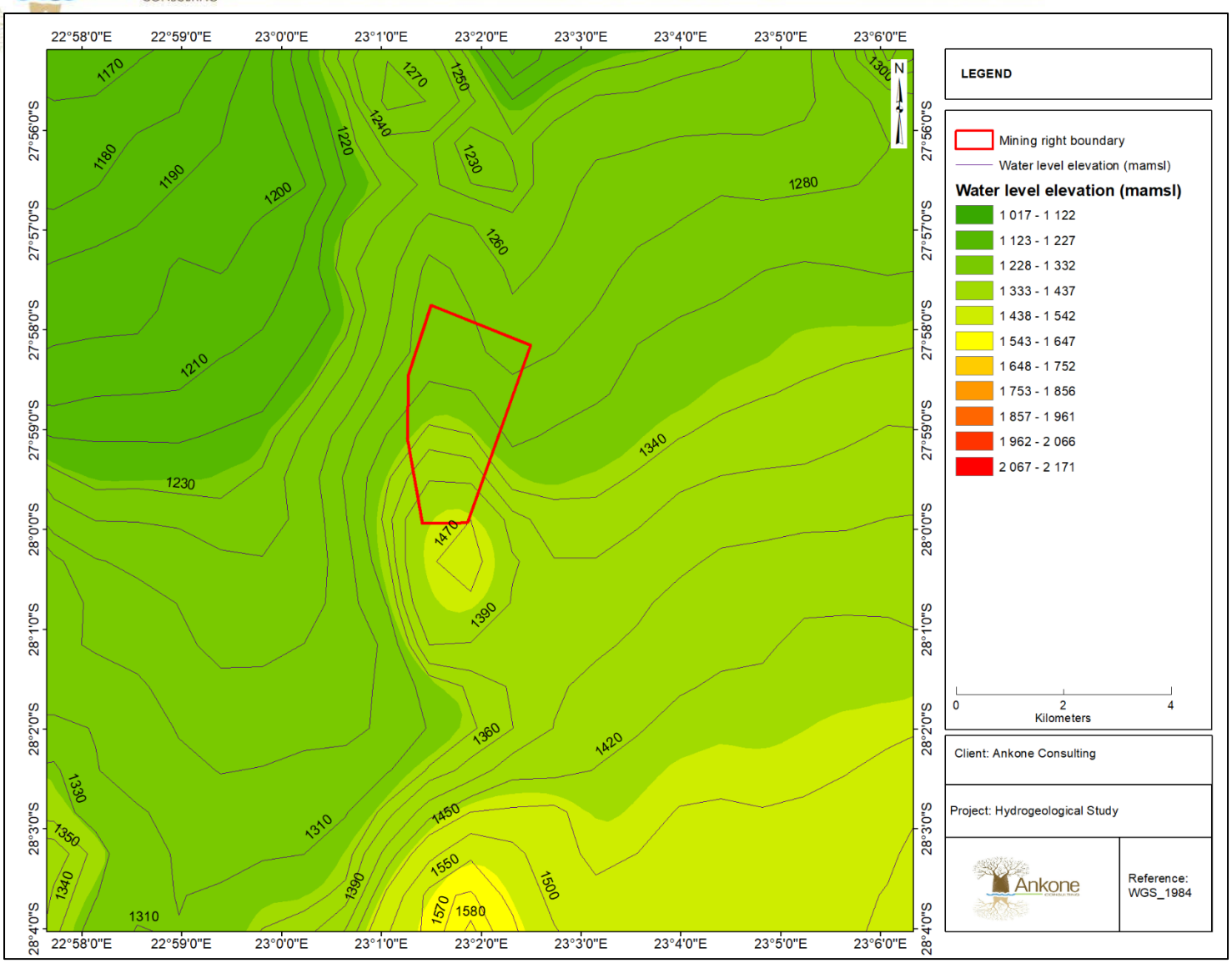


Figure 4-13: Groundwater level elevation

4.9. Groundwater Contaminants

The source, pathways, and receptor approach as outlined in the Best Practice Guideline (BPG) G4, for impact prediction was adopted for this discussion. This approach is critical and assist to identify risk associated with the proposed activities. The general risk assessment components is discussed in detail in the following sections.

4.9.1. Contaminants Sources

Contamination sources are any physical, chemical, biological and radiological substances that are considered hazardous in a particular environment. These are sources or material that generate contaminants which could affect the environment and other receptors. In general, mining operations are characterised by impacts which must be properly managed. Hence groundwater management strategies and mitigation measures are critical for any mining operation. The main contamination sources associated with the mining activities are:

- Opencast pit
- Processing Plant
- Product (Manganese ore) stockpiles
- Workshop (including the wash bay)
- ROM stockpiles
- Waste Rock Dump Producer Stockpile
- Conveyor system for crushed Manganese ore
- Overburden
- Pollution Control Dam
- Overburden/spoil stockpile
- Refuelling station

These are mine infrastructures with potential for surface and groundwater contamination. Hydrocarbon contamination may become dominant during the construction phase. Workshop and other area with machinery will become the sources with potential for hydrocarbon contamination. This relates to the use of grease, oil and other fuel with potential to contaminate the environment. Sewage facilities such as septic tanks and sewage treatment facilities remains the sources of contamination with potential to elevate the concentration of coliforms, E.coli, bacteria viruses, ammonia, phosphate, sulphate and nitrate.

It is known that manganese mining activities has potential for contamination which may lead to elevated concentration of manganese and other parameters. This related to contamination formation associated with manganese mining activities. Poor management, handling, spillage and leakage will most likely

affect the environment through the formation of contaminants, spread of contaminated water, deterioration of surface and groundwater quality and contamination of soil or environment in general. Increased salt load or contamination due to these sources is a concern which must be addressed through water management strategies focusing on prevention, mitigation and remediation.

4.1.1. Contamination pathways

A contamination flow path or pathway is defined as a route by which a contamination source takes to reach the receptor or receiving environment. However, the nature of the pathway will determine how fast the contaminant will travel, and thus its extent over time. The main pathways that are likely to transport contaminants within the mine site will be:

- Surface overflow and runoff
- Infiltration through soil and vadose zone
- Movement through an aquifer or groundwater
- Movement through unlined trenches

Any runoff, overflow, seepage and infiltration of contaminants or contaminated water are likely to drain into unnamed stream occurring to the east of the mine. These rivers will also serve as contamination pathways to downstream.

Infiltration of contaminant through soil and vadose zone will most likely occurs with the ROM, Product, opencast, PCD, crusher and screening area. This impact will immediately pose negative effects into groundwater resources. Groundwater management through monitoring, remediation and lining of facilities is critical to reduce the impacts. Implementation of storm water management is crucial to reduce the impacts.

4.1.2. Receptors

Receptors or receiving environment can be defined as any entity which can be affected through the migration of contaminants from contamination sources. Unnamed stream located in the east of the mine is likely to be affected. Surface water dependency ecosystem will be affected if such contamination reaches the river and flows downstream,

Storm water management is critical. Hence, it is crucial to implement storm water management that include collection and separation of dirty and clean water. Groundwater resources is at risk of being contaminated. This is because the farm is underlain by dolomite and fractured rocks. The contamination of surface and groundwater can lead to serious health problems for consumers, as well as the integrity and survival of surface and groundwater dependent ecosystems.

4.10. Groundwater modelling

A numerical groundwater flow and transport model has been constructed and calibrated to represent the groundwater flow and spread of contamination plume within the Bishop Mine model boundary. Simulation of the groundwater model incorporated natural groundwater condition of the site, which includes mapped geology, aquifer system and aquifer parameters.

The groundwater flow dynamics within the southern portion of the property indicate movement towards the west, north, and east. Groundwater levels across the property exhibit variability, ranging from 1213 meters above mean sea level (mamsl) to 1410 mamsl.

Predictive modeling suggests that a plume originating from the plant area will flow predominantly towards the east and northeast directions. This plume trajectory is expected to extend towards a drainage line situated east of the mine boundary.

Considering the elevation of the stream, contamination is anticipated to accumulate below the stream level, leading to downstream convergence and subsequent spread along the flow path, aligning with the direction of the stream.

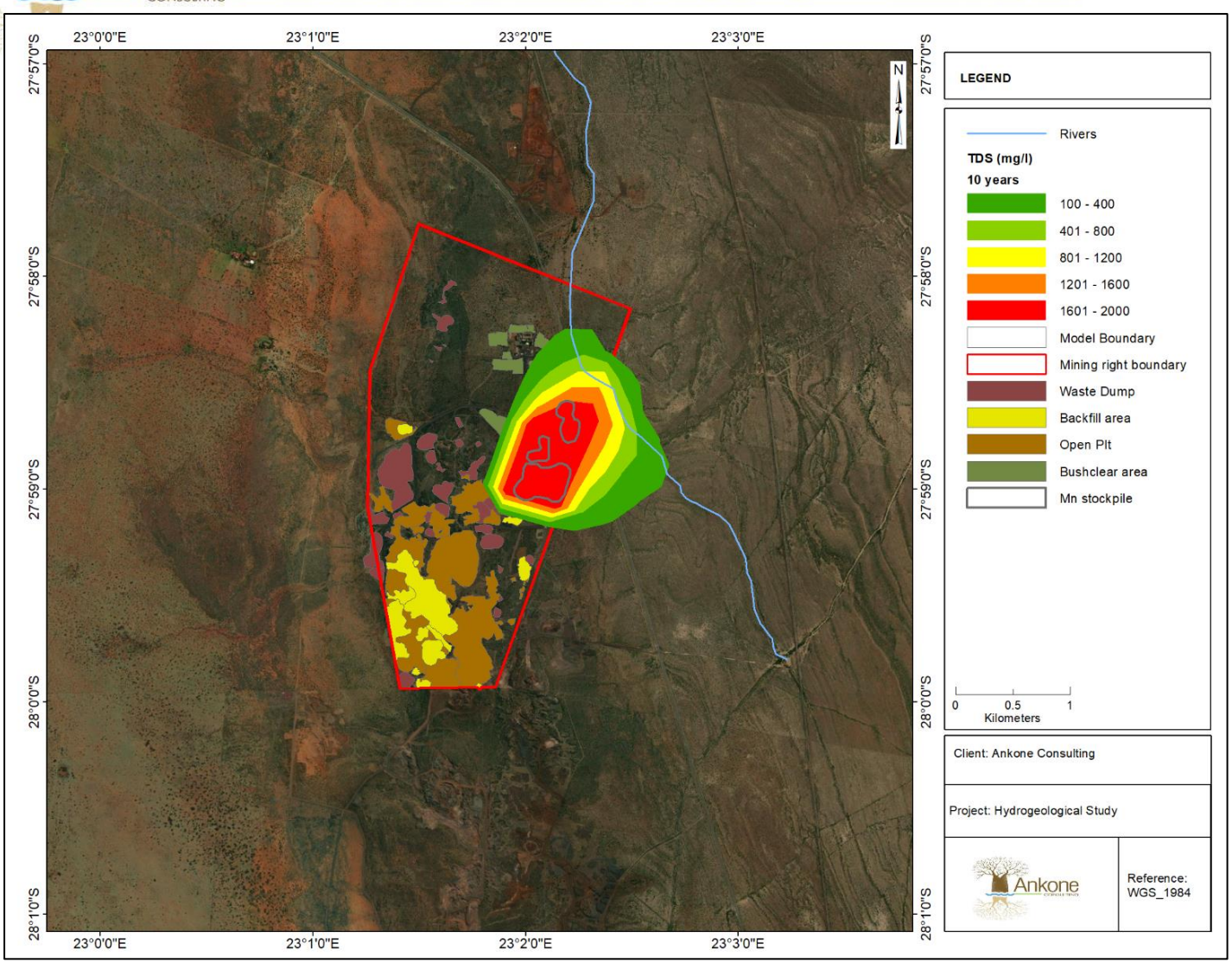


Figure 4-14:Simulated plume, 10 years.

4.11. Geophysical Survey

Geophysical survey was conducted by Groundwater Abstract (Pty) Ltd. The aim was to identify area of high groundwater occurrence based on deeper weathering of the rock and geological structures. This section provides the summary of the findings. Appendix F contain the geophysical report with detail observation. Two geophysical methods namely, the Magnetometer survey and the Electro-magnetic survey has been used.

The following provides the summary of the survey:

Traverse line 1

- The survey was conducted from east to west.
- It was conducted within a traverse line of 100 m from the old mine borehole.
- Magnetic response was noted from the start of the survey up to station number 130.
- It was assumed that this response relates to manganese and iron.
- Potential site for drilling was noted at station number 135.

Traverse Line 2

- The survey was conducted from east to west.
- A magnetic response from the start to station 210 was noted which was attributed to manganese and iron rock.
- An anomaly was noted at station 70, which translate to potential drill target.
- The site is also defined by an EM anomaly which is attributed to weathering and fractured zones.
- Station 70 was identified as a potential drill target.

Drilling target

Table 4-13: Potential drill targets

Site number	Latitude	Longitude	Priority per line
2-70	27°58'28.01"S	23°01'56.22"E	First option
1-135	27°58'20.89"S	23°01'50.78"E	

Figure 4-15: Survey layout map

4.12. Biodiversity

According to the vegetation map of Mucina et al. (2005), two vegetation units are present on-site (i.e., Kuruman Mountain Bushveld and Postmasburg Thornveld). Kuruman Mountain Bushveld is distributed in the Northern Cape and North-West Provinces at altitudes between 1 100 and 1 800 m. It stretches from the Asbestos Mountains southwest and northwest of Griekwastad, along the Kuruman Hills north of Danielskuil, passing west of Kuruman and re-emerging as isolated hills. The unit is typically presented as rolling hills with gentle to moderate slopes and hill pediment areas with an open shrub veld. The Hills consist of banded iron formation, with jasper, chert, and riebeckite-asbestos of the Asbestos Hills Subgroup of the Griqualand West Supergroup. The unit is classified as being least threatened with very little being transformed and with little erosion being present. It is not currently conserved within any formal conservation areas, and the succulent Euphorbia planiceps is the only endemic species known from this unit (Wadala Mining, 2021).

Kuruman Thornveld

According to Wadala Mining (2021), Kuruman Thornveld is distributed in the North-West and Northern Cape Provinces and lies at altitudes between 1 300 and 1 500 m. This unit is distributed east of Kuruman to Lykso and south of Bendell towards Good Hope. The unit is presented as flat rocky plains and some sloping hills with a well- developed, closed shrub layer and well-developed open tree stratum consisting of Vachellia erioloba. The author indicates that the unit mainly consists of Superficial Kalahari Group sediments, with deep red wind-blown sand, but Campbell Group dolomite and chert also occur. The dominant land types are Ae, Ai, Ag, and Ah. The unit is not currently conserved within any formal conservation areas and is classified as being least threatened with very low erosion and 2% transformation. The herb Gnaphalium englerianum is the only endemic plant species known to occur in this unit.

Postmasburg Thornveld

According to Wadala Mining (2021), Postmasburg Thornveld is only found in the Northern Cape Province, restricted to areas around Postmasburg, and lies at altitudes between 1 180 and 1 440 m. It is represented as flats surrounded by mountains supporting open, shrubby Thornveld characterised by a dense shrub layer, where trees and grasses are sparse. Shrubs are often low and of a karroid affinity. The unit occurs on red aeolian sand (Hutton form) of the Kalahari Group overlying the volcanic and sediments of the Griqualand West Supergroup that outcrop in places. The dominant land type is Ag. The unit is classified as being least threatened with very low erosionminimal transformation. It is not currently conserved within any formal conservation areas, and no endemic plant species are known from this unit.

Olifantshoek Plains Thornveld

According to Wadala Mining (2021), Olifantshoek Plains Thornveld is found in the Northern Cape at altitudes between 1 000 and 1 500 m. It is mainly restricted to the pediments of the Korannaberg, Langeberg, and Asbestos Mountains. The plains are typically represented by an open tree and shrub layer, with a usually sparse grass layer. The unit occurs on red aeolian sand of the Kalahari Groups with silcrete and calcrete and some andesitic and basaltic lava of the Griqualand West Supergroup. Soils are deep, and the most dominant land type is Ae, but Ah also occurs. Only 1 % of the unit has been transformed, and erosion is very low. It is classified as being the least threatened, and a very small proportion is being conserved in the Witsand Nature Reserve. The shrub Amphiglossa tecta is the only endemic plant species known from this unit.

The plant communities within the study area are delineated according to plant species correspondences, changes in soil structure, topographical changes, and disturbance regimes. The vegetation on-site can be divided into seven distinct units described below. These community descriptions include unique characteristics and the dominant species found in each unit. A complete plant species list, including those likely to occur in the area, is presented in Appendix I of the 2021 Annual External EMP Performance Audit Report.

Tarchonanthus camphoratus – Stipagrostis uniplumis open shrubland on red clayey soil

This community occurs on deep red clayey soils in the northeast of the study area. Bare ground constitutes approximately 20% of the ground cover. The plant community is open shrubland, where tall shrubs Tarchonanthus camphoratus and Senegalia mellifera are conspicuous in a glassy matrix. These two shrubs continuously alternate in their dominance across this unit. Other common tall shrubs found here include Ziziphus mucronata, Grewia Flava, Searsia ciliate, S. tridactyla, Vachellia hebeclada, and V. tortilis.

The nationally protected tree Vachellia erioloba occurs at high densities in a restricted patch in the north of the unit, near the border. More sparsely scattered individuals are also present across the unit. Another nationally protected tree, Boscia albitrunca is also present in this community, but occurs at very low densities and is sparsely distributed. They also predominantly occur as very young and small shrubs. The grass layer is very well developed and is dominated by Stipagrostis uniplumis, followed by Cenchrus ciliaris, Schmidtia pappophoroides, and Heteropogan contortus. Other common grasses include Aristida congesta subsp. barbicollis, Enneapogon cenchroides, and Eragrostis lehmanniana, while species like Eragrostis obtusa and E. rotifer occur sparsely.

Common lower shrubs include Chrysocoma obtusata, C. ciliata, Phymaspermum parvifolium, Aptosimum marlothii, Asparagus capensis, A. laricinus, Leonotis pentadentata and Pegolettia retrofacta. Other species found in the area include Geigeria filifolia, Dicoma capensis, Hertia pallens, Nidorella

hottentotica, Polichia campestris, Polygala scabra, Senna italica subsp. arachoides, Asparagus cf. africanus, Ehretia alba, Pupalia lappacea var. lappacea, Solanum sp., Othonna sp., Hermannia sp. and Atriplex sp Euclea crispa – Eragrostis lehmanniana open shrubland on rocky hill slopes

The community occurs on the slopes of the hills associated with the Gamagara Formation and has not been mined in the past. Rocky soil generally constitutes approximately 10% of the ground cover on the east-facing slopes, but on the west-facing slopes, the vegetation has evidently been over utilised, and here, bare ground accounts for up to 40%. Similarly, the vegetation characteristics on these slopes differ somewhat. The grass component on the west-facing slopes is much less developed and is replaced by a higher density of Senegalia mellifera.

In general, Euclea crispa shrubs are conspicuously scattered across the hill slopes, along with other dominant shrubs like Senegalia mellifera, Tarchonanthus camphoratus, Grewia flava, and Searsia ciliata. Other tall shrubs that occur on the slopes but at lower densities, include Vachellia tortillis and Rhigozum obovatum. Common lower shrubs include Pegolettia retrofracta, Chrysocoma obtusata, Hermannia spinosa, and Leonotis pentadentata.

The nationally protected tree Boscia albitrunca occurs at high densities on the hill slopes as adult trees and young, small shrubs. Vachellia erioloba is also present, but they occur at very low densities and are sparsely distributed. The grass layer is dominated by Eragrostis lehmanniana, but other common grasses include E. rotifer, Enneapogon desvauxil, Cenchrus ciliaris, Aristida diffusa, Heteropogon contortus and Stipagrostis uniplumis, Artistida congesta subsp. congesta, Enneapogon cenchroides, Eragrostis curvula and Melinis repens are also present at lower densities.

Pogonarthia squarrosa – Eragrostis rotifer grassy shrubland on quartzite

This community is associated with quartzite outcrops on the hills in the northwest of the property. Here, large rocks constitute 40% of the ground cover, with the vegetation scattered among them. The vegetation is present as grassy shrubland, where Pogonarthia squarrosa and Eragrostis rotifer are the dominant graminoids. However, Aristida diffusa and Eragrostis lehmanniana are also very common. Other grasses found here include Heteropogon contortus, Aristida congesta subsp. barbicollis, Elionurus muticus, Enneagon cenchroides, and Eragrostis nindensis.

Senegalia mellifera is scattered among the grasses and is the dominant shrub, but Euclea crispa and Grewia flava are also found. Common low shrubs include Monechma spermicides, Pegolettia retrofracta, Chrysocoma ciliate, and Hermannia affinis.

4.13. Socio-Economic Environment

This section presents the socio-economic aspects focusing on the Province and Municipalities within which the proposed study area is located.

4.13.1. Provincial Description

The Northern Cape is South Africa's largest province, taking up almost a third of the country's total land area. However, the province is sparsely populated with only 1,1 million people on 361 830 km² of land. About 68% of the people speak Afrikaans, while Setswana, isiXhosa, and English are also widely spoken. With two major airports at Kimberley and Upington and an excellent road network, the province's interior is easily accessible from South Africa's major cities, harbours, and airports.

The province is endowed with mineral resources it is most famous for the diamond mines around Kimberley; it also has mining activities for Manganese and iron ore. The Northern Cape also has an important agricultural area around the Orange River, including most of South Africa's sultana vineyards (www.municipalities.co.za).

4.13.2. District And Local Municipalities Within Which PMG is Located

PMG Mining Mine is located in Tsantsabane Local Municipality, within the in ZF Macgawu District Municipality. According to IDP (2021) the ZF Macgawu District Municipality covers a geographic area of 102 52 km² while Tsantsabane Local Municipality covers an estimated area of 18 333 km2. Tsantsabane Local Municipality is bordered by Siyancuma LM, //Khara Hais LM, Kheis LM, Gamagara LM, and Kgatelopele LM. The municipality comprises seven wards and it is also a host to the Lohahla South Africa Military Training Base.

The nearest business center is Kimberley, about 200 km away. The municipality's main town is Postmasburg. Three main traffic routes provide access to other cities, namely Johannesburg via Kuruman and the Kalahari and Cape Town via Kimberley. The rest of the Tsantsabane Municipality area comprises Boichoko, Postdene, New Town, Stasie, Groen Water, Skyfontein, Jean Heaven, the newly established settlement brought about by the land redistribution called Marenane, and the well-known Lohatlha Army Battle SchoolCities/Towns: Beeshoek and Postmasburg.

4.13.3. Local Context

The information detailed in this section is sourced from the Statistics South Africa website.

Population and Household Profile

Tsantsabane Local Municipality has a population size (persons) of 35 093. There are 9 839 households in the municipality, with an average household size of 3,5 persons per household. Of the households, 45.3% have access to piped water either in their dwelling or in the yard, while 83,5% of households have electricity for lighting.

Population Group

According to the 2011 Census, the majority of the population in the municipality are black African (52.8%), 37.6% are coloured, 8.4% white, 0.6% Indian/Asian with the other population groups making up the remaining 0.6%. Of those aged 20 years and older, 13.9% have some primary schooling, 5.3% have completed primary school, 35.4% have some secondary education, 25,4% have completed matric, and 6.4% have some form of higher education. Of the mentioned age group, 13.7% have no record of schooling.

Age

It is important to assess the age distribution of persons to determine both the current and future needs of an area. Age is an important indicator of education, skills, and dependency. A young population may require an improved educational system, whereas an older society may need an accented focus on healthcare. Population under 15 made 27.9%, population 15 to 64 made 67.6% and population over 65 made 4.4% of the total population in 2016.

Education

The 2020 Census data indicates that 25.3% of the population in Morolong Local Municipality finished matric while 6.3% have higher education. However, 13.7% of the population has not received any form of schooling.

4.13.4. Economic Profile

This section delineates the study area and a brief economic status quo pertaining to employment and labour profile. The employment status of the population has a variety of important implications. Economically active and employed persons can contribute to the overall welfare of a specific community by paying their taxes, looking after the youth and aged, and stimulating the economy. However, should a community have a large number of economically inactive and/or unemployed persons, the employment and labour profile of that community is amplified. Economically Tsantsabane is known for being rich in minerals, and for its mining, agriculture, manufacturing, and farming sectors. Tsantsabane has reinvented itself over the years as one of the leading investment hot spots in the Northern Cape. The 2020 Census showed that approximately 10 760 people are economically active (employed or unemployed but looking for work), and of these, 38,6% are unemployed. Of the 10 760 economically active youth (15–34 years) in the area, 32.3% are unemployed.

4.13.5. Services and Infrastructure Profile

Social service delivery centers on providing health, education, and community development facilities and services. The concept of service delivery also comprises various elements such as affordability,

quality, efficiency, and access. This indicator, therefore, examines the level of service provision in the study area. Services assessed include water, housing, and electrification.

Housing

According to StatsSA (2020), the majority (71.8%) of the population live in formal dwellings.

"In terms of key service achievements, the municipality was able to deliver services to its community, and the status quo in respect of access to services is as follows:

- 83.5% of households have access to electricity for lighting;
- 45.3% have access to piped water;
- Most households (66.7%) have access to flush toilets;
- 83.5% have access to internet facilities; and
- 58.6% have access to refuse removal.

Energy Use

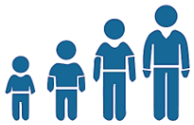
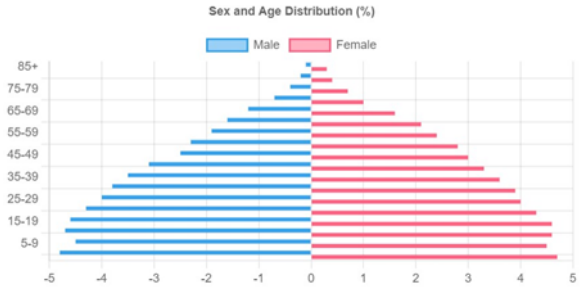
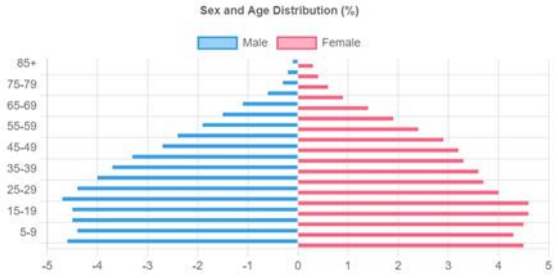
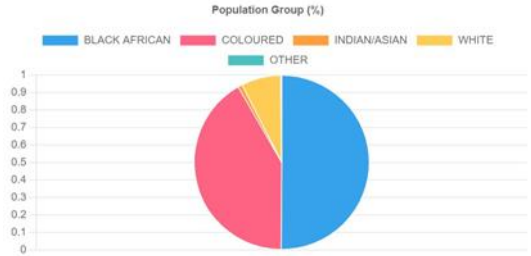
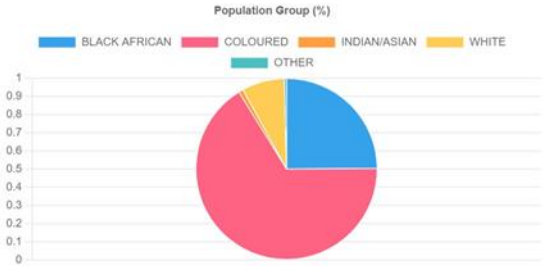
Electricity is by far the leading source of energy in the Municipality, followed by candles. . Coal, wood and animal dung are the least used sources of energy. The 2021 census data indicated that 83.5% of the households use electricity for lighting, 79.1% for cooking, and 69.1% for heating.

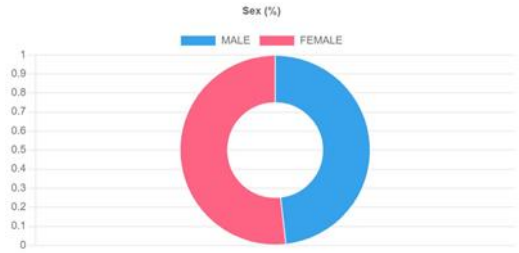
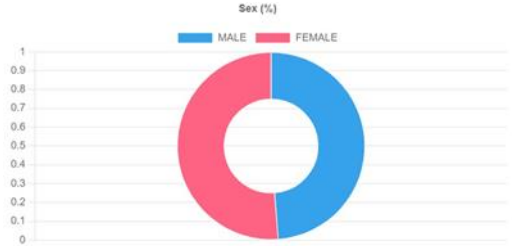
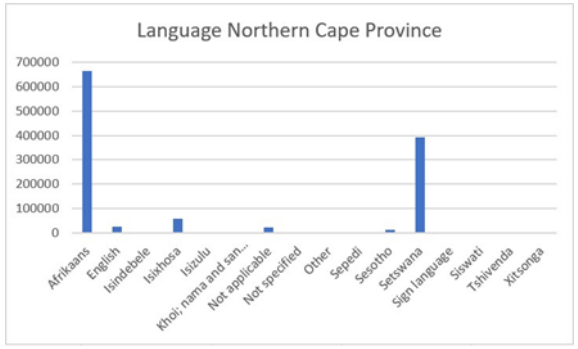
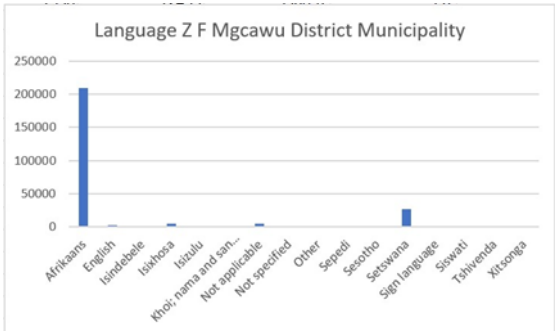
Water

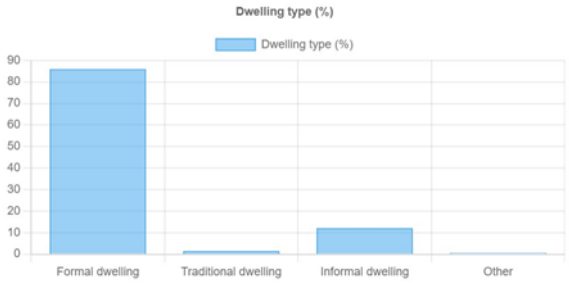
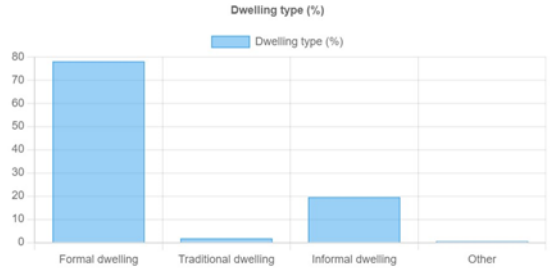
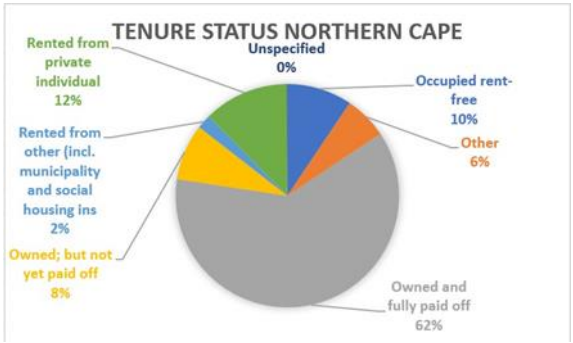
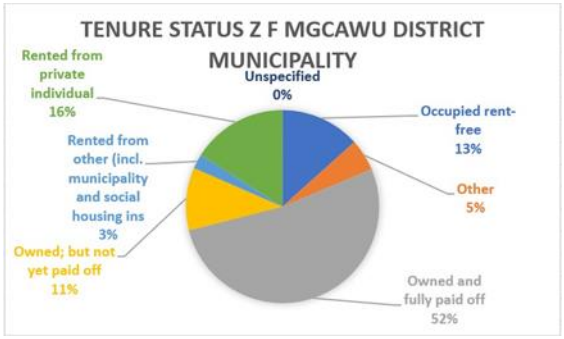
According to IDP (2021), Tsantsabane Local Municipality is the (WSA) Water Services Authority in its area of jurisdiction. This means it must regulate water issues within the region, guided by the National Water Act 32 of 1998. The Municipality also serves as a Water Services Provider (WSP), meaning that the Municipality must ensure that water is provided to residents on acceptable standards, including quality guided by SANS 241. According to the annual performance report, 2011-2012, Water provision remains a challenge to the Municipality. However, it is worth noting that approximately 76.7% of the population receives water from the regional/local water scheme operated by Tsantsabane and other service providers (StatsSA, 2020), while the minority (0.1%) receives water from rainwater tanks as well as rivers and streams (0.1%).

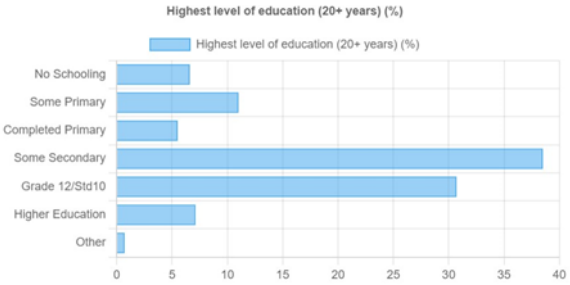
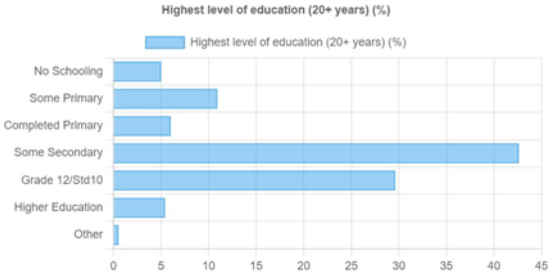
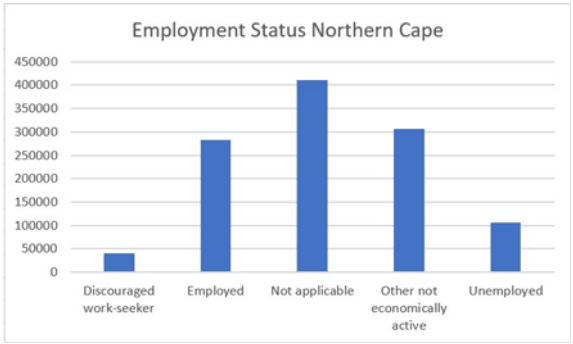
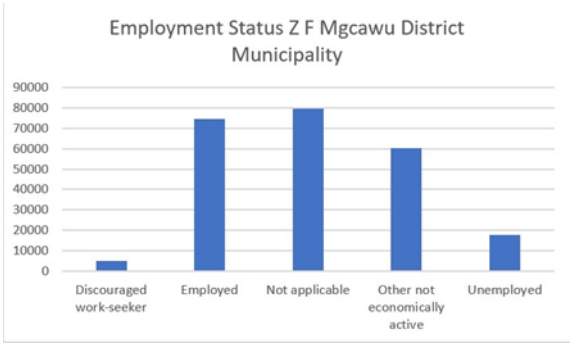
4.13.6. Socio-Economic Baseline: Tertiary Zones

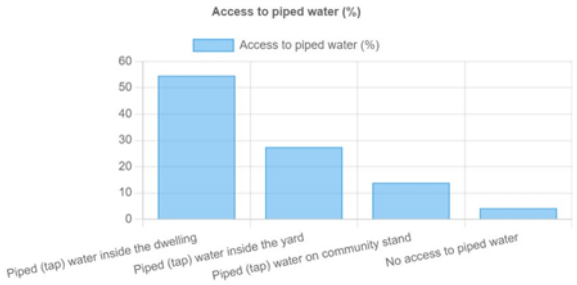
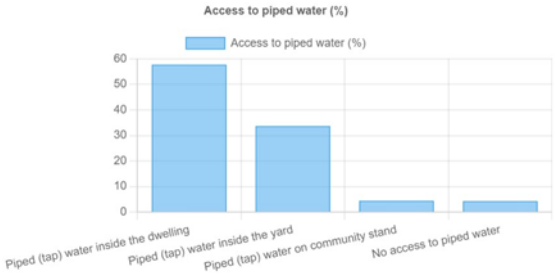
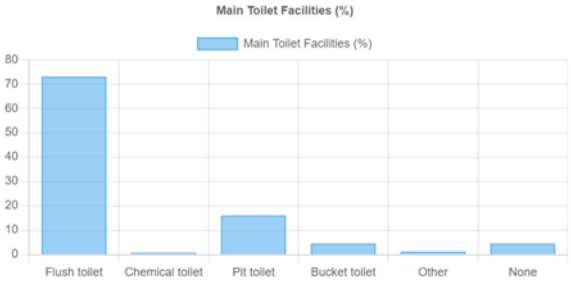
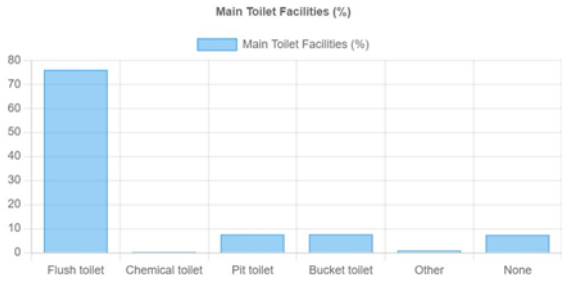
Table 4-14: Socio-Economic Baseline: Tertiary Zones

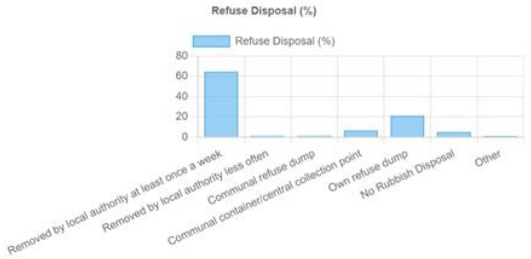
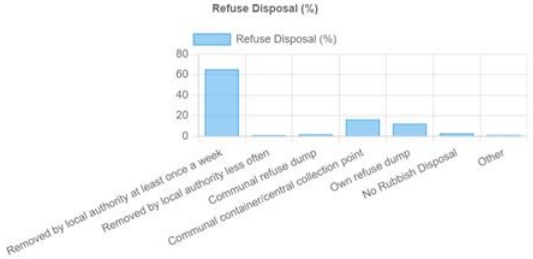
Tertiary Zone		
Demographic Aspect	**Northern Cape Province**	**Z F Mgcawu District Municipality**
Age 	 The populous age group in the province is between ages 00 to 04. Followed Ages between 10 to 14.	 The populous age group in the district is between ages 20 to 24. Followed Ages between 00 to 04.
Population 	 The majority of the population consists of Black African followed by Coloured.	 The majority of the population consists of Coloured followed by Black African.

Tertiary Zone		
Demographic Aspect	**Northern Cape Province**	**Z F Mgcawu District Municipality**
Gender 	 The gender distribution is at 52% females and 48% males.	 The gender distribution is at 51% females and 49% males.
Language 	 The majority of the population in the province speak Afrikaans (below 700 000), followed by Setswana (400 000).	 The majority of the population in the district speak Afrikaans (above 200 000), followed by Setswana.

Tertiary Zone		
Demographic Aspect	**Northern Cape Province**	**Z F Mgcawu District Municipality**
Households	 Majority of the population in the province live in house or brick structures household.	 Majority of the population in the district live in house or brick structures household.
Household Ownership		 52% of the total population of the district have owned and fully paid off tenure status. While 11% have a tenure status which is owned but not yet paid off.

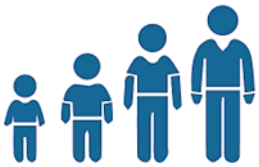
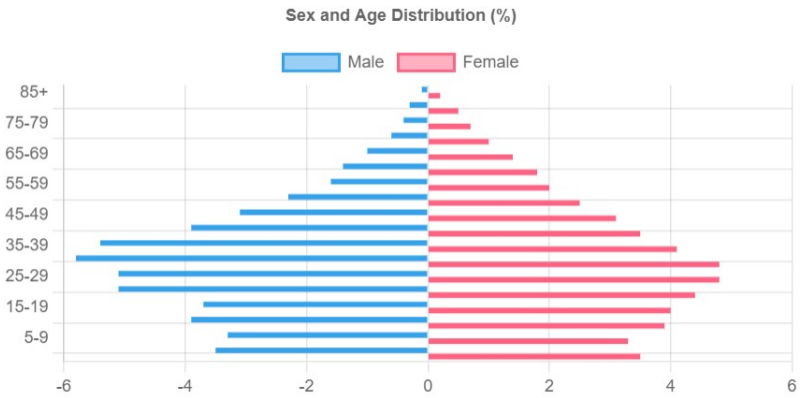
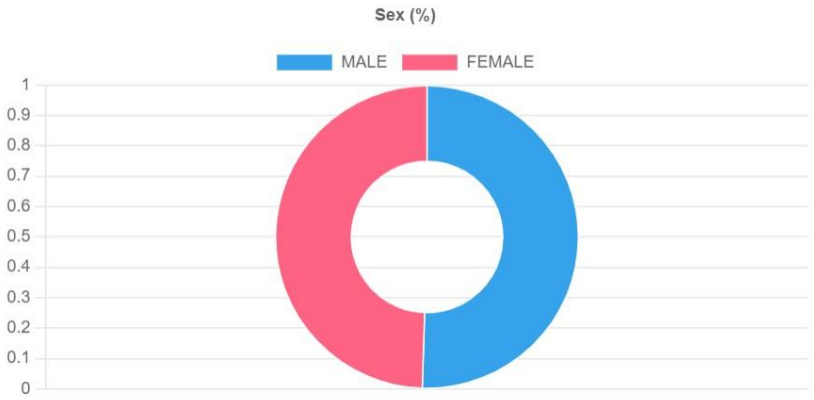
Tertiary Zone		
Demographic Aspect	**Northern Cape Province**	**Z F Mgcawu District Municipality**
	62% of the total population of the province have owned and fully paid off tenure status. While 8% have a tenure status which is owned but not yet paid off.	
Education Level 	 The population in the province have the highest education level at Grade 12. Followed by N6/NTC 6.	 The population in the district have the highest education level at Grade 12. Followed by N6/NTC 6.
Employment 		

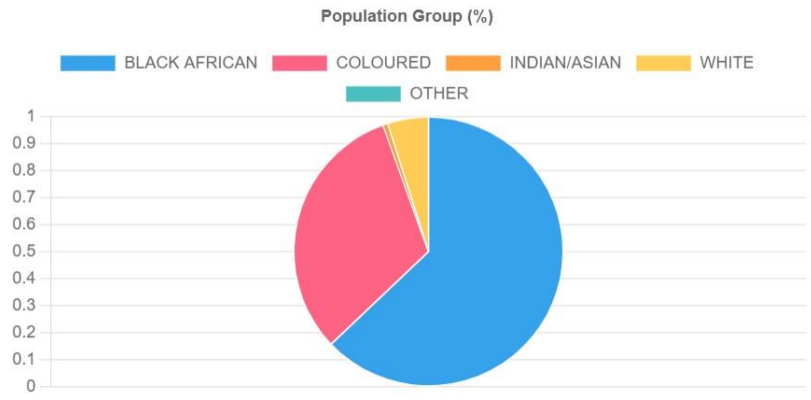
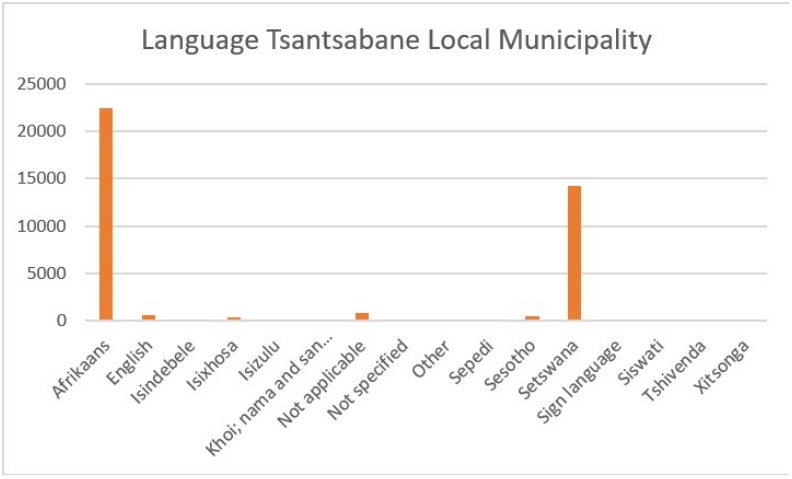
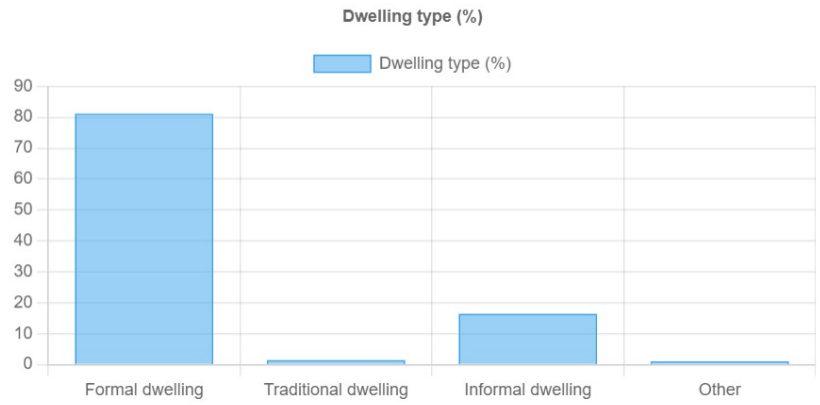
Tertiary Zone		
Demographic Aspect	**Northern Cape Province**	**Z F Mgcawu District Municipality**
	Majority of the people within the province are not economically active (300 000). Followed by people who are employed (below 300 000)	Majority of the people in the district are employed (above 70 000). Followed by people who are not economically active (60 000).
Water 	 Regional/local water scheme are the main source of water supply in the province.	 Regional/local water scheme are the main source of water supply in the district.
Toilet Facilities 		

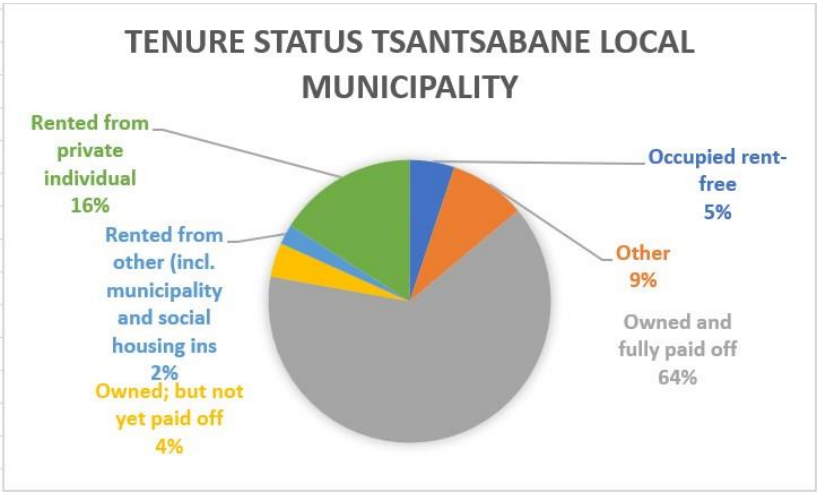
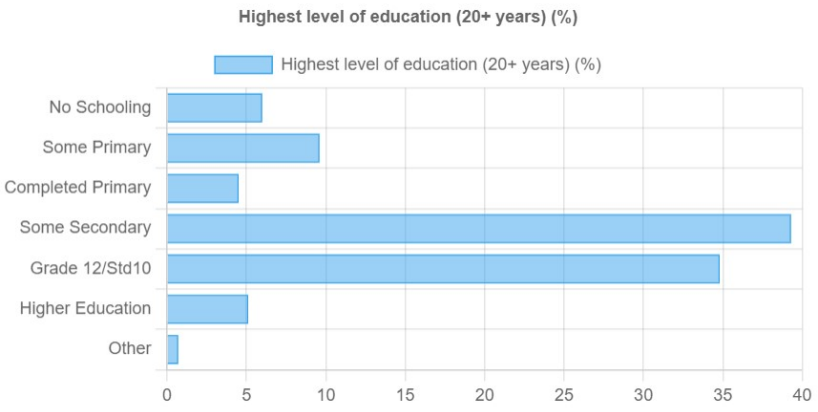
Tertiary Zone		
Demographic Aspect	**Northern Cape Province**	**Z F Mgcawu District Municipality**
	Out of all the residents of the province, the majority of them have flush toilets that are connected to the sewerage system.	Out of all the residents of the district, the majority of them have flush toilets that are connected to the sewerage system.
Refuse Disposal/ Removal 	 Majority of the households is collected by the local authority at least once a week followed by people who remove their own dump.	 Majority of the households have their waste collected by the local authority at least once a week.

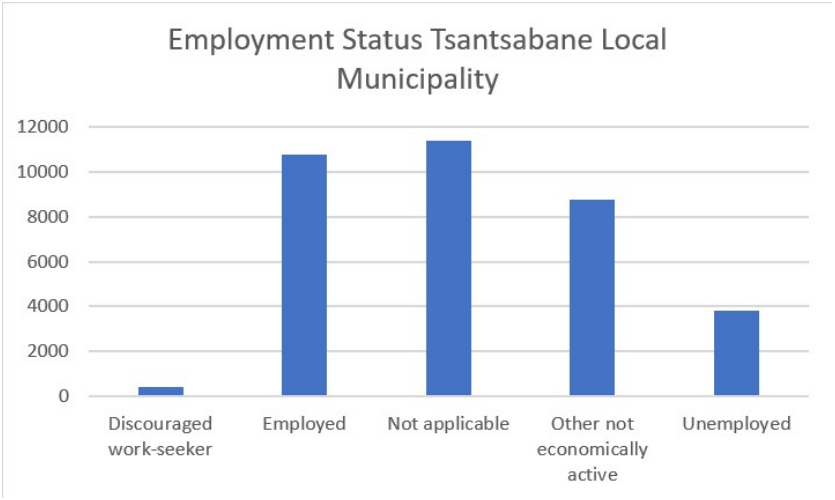
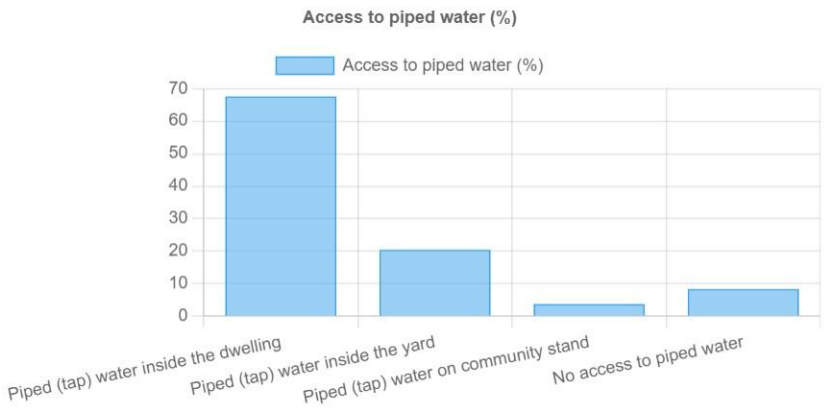
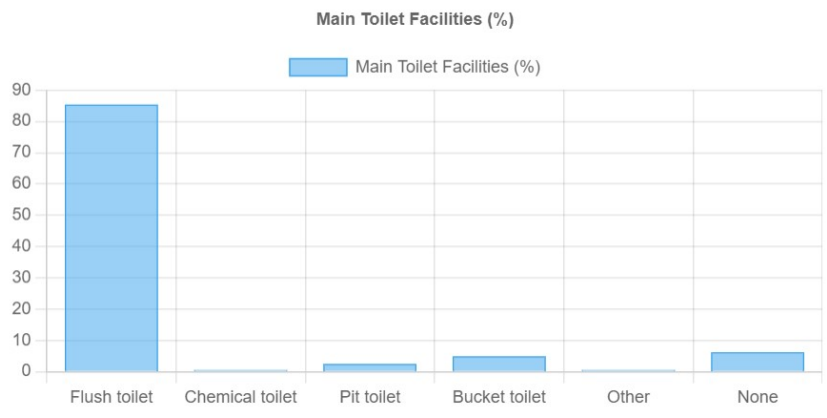
4.13.7. Socio-Economic Baseline: Secondary Zones

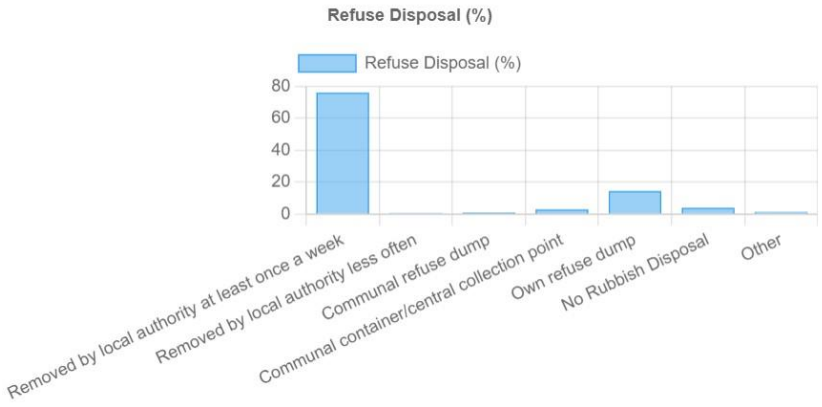
Table 4-15:Socio-Economic Baseline: Secondary Zones

Secondary Zones	
Demographic Aspect	**Tsantsabane Local Municipality**
Age 	 The populous age group is between ages 30 to 34. Followed Ages between 35 to 39.
Gender 	 There is 49.8% females and 50.2% males.

Secondary Zones	
Demographic Aspect	**Tsantsabane Local Municipality**
Population 	 Majority of the population are Black African followed by Coloured then White.
Language 	 The majority of the population in Tsantsabane LM speak Afrikaans (above 20 000), followed by Setswana (below 15 000).
Households 	

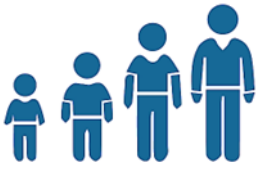
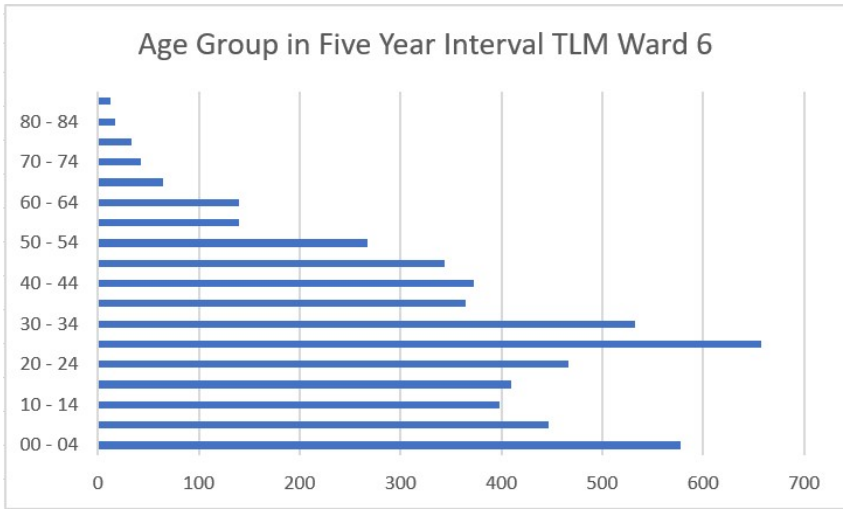
Secondary Zones	
Demographic Aspect	**Tsantsabane Local Municipality**
	Majority of the population in live in house or flat household (80%). Informal dwelling (18%).
Household Ownership	 64% of the total population have owned and fully paid off tenure status. While 18% have a rented from private individuals.
Education Level	  The population of the Municipality have the highest education level at Some Secondary.

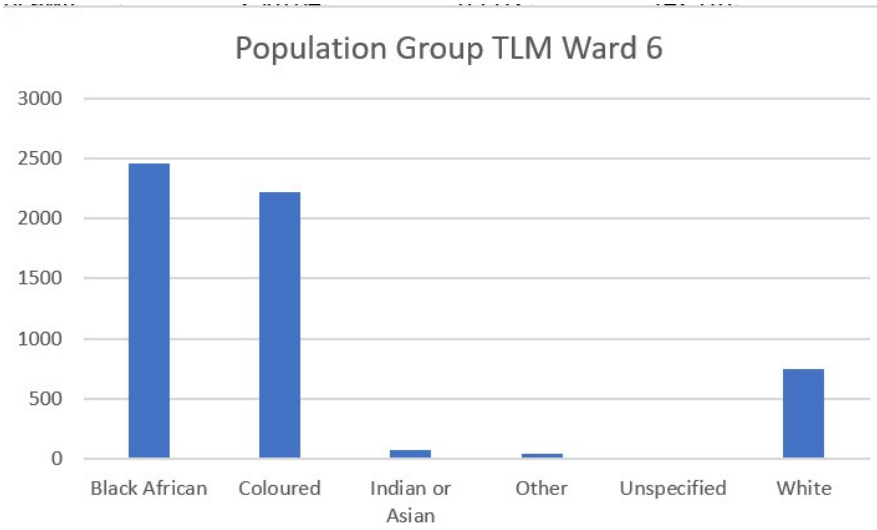
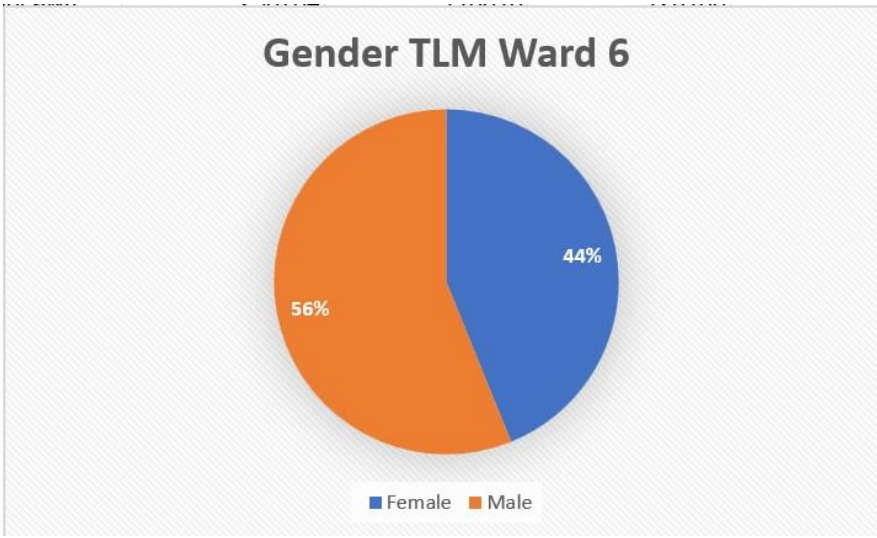
Secondary Zones	
Demographic Aspect	**Tsantsabane Local Municipality**
Employment 	 Above 10 000 of the population in Tsantsabane LM are employed. Below 4 000 are not employed, while just above 8 000 are not economically active.
Water 	 Regional/local water scheme are the main source of water supply.
Toilet Facilities 	 Majority have flush toilets that are connected to the sewerage system.

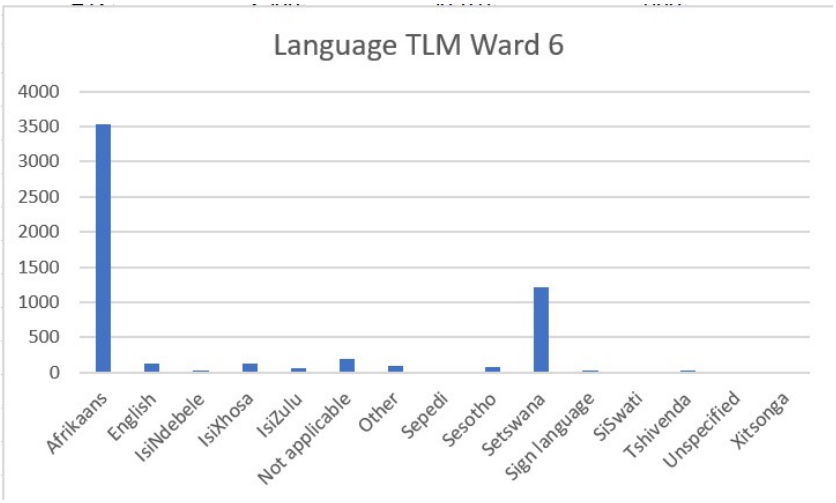
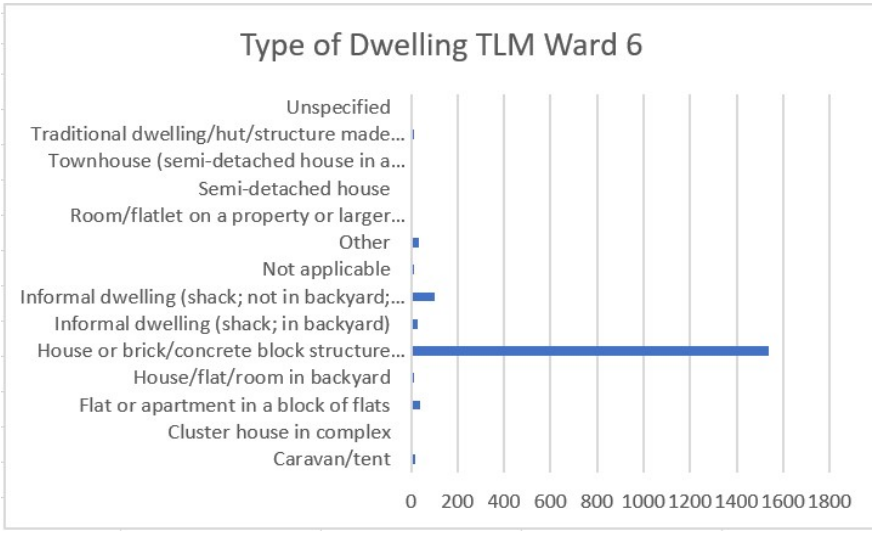
Secondary Zones	
Demographic Aspect	**Tsantsabane Local Municipality**
Refuse Disposal/ Removal 	 Majority of the refuse that is generated by the community is collected by the local authority at least once a week. There are some who depend on communal collection points.

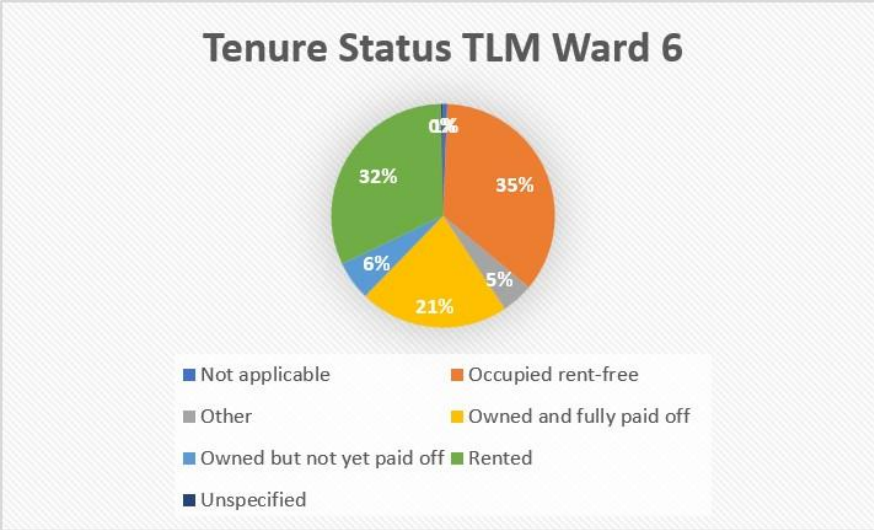
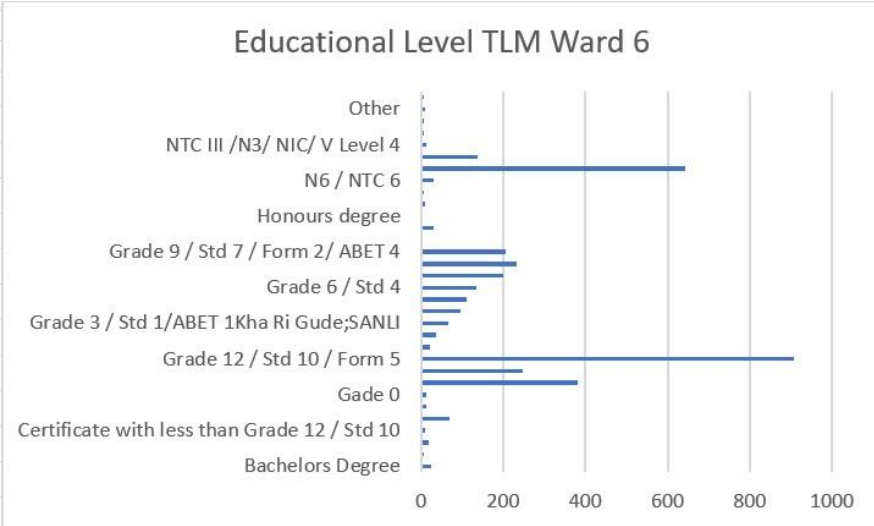
4.13.8. Socio-Economic Baseline: Primary Zones

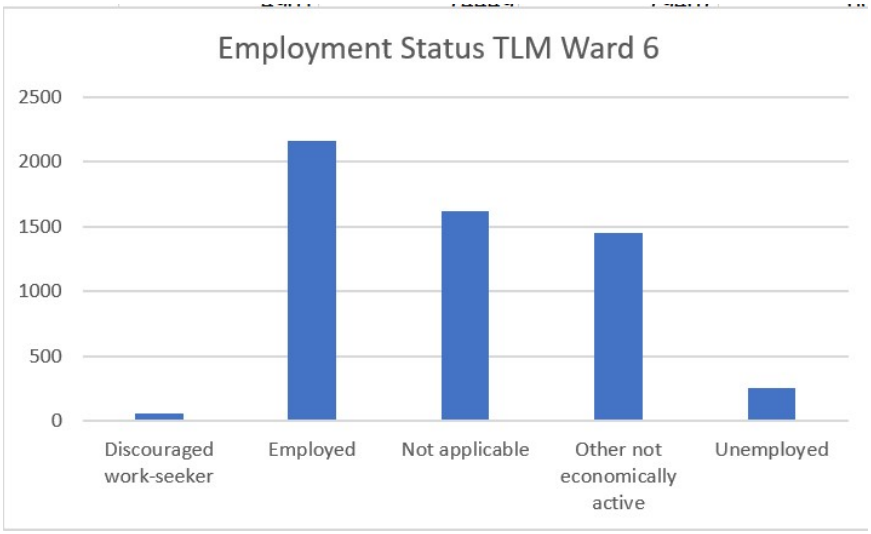
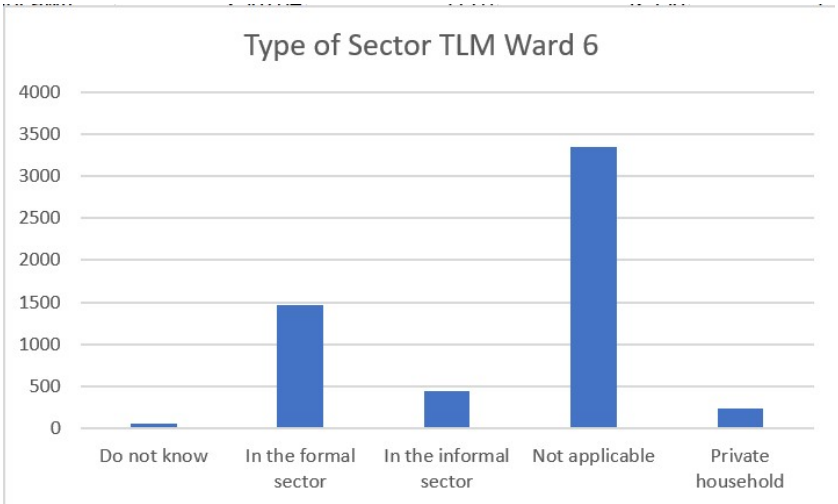
Table 4-16: Socio-Economic Baseline: Primary Zones

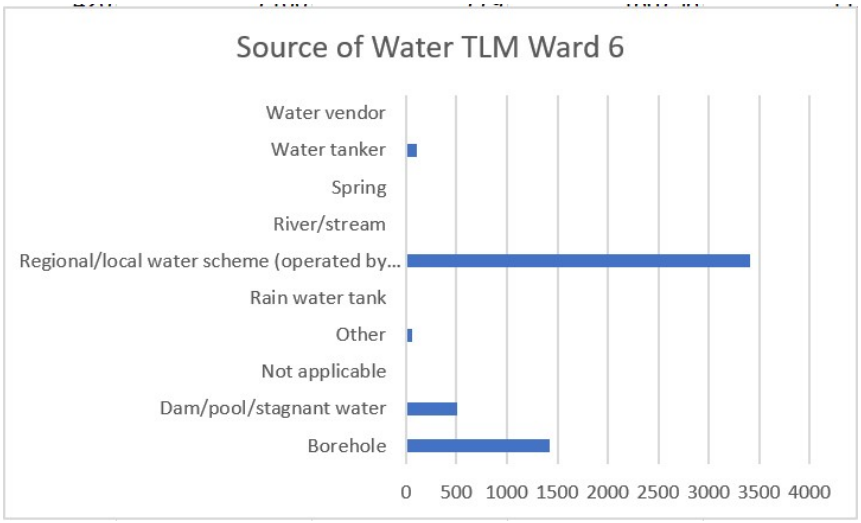
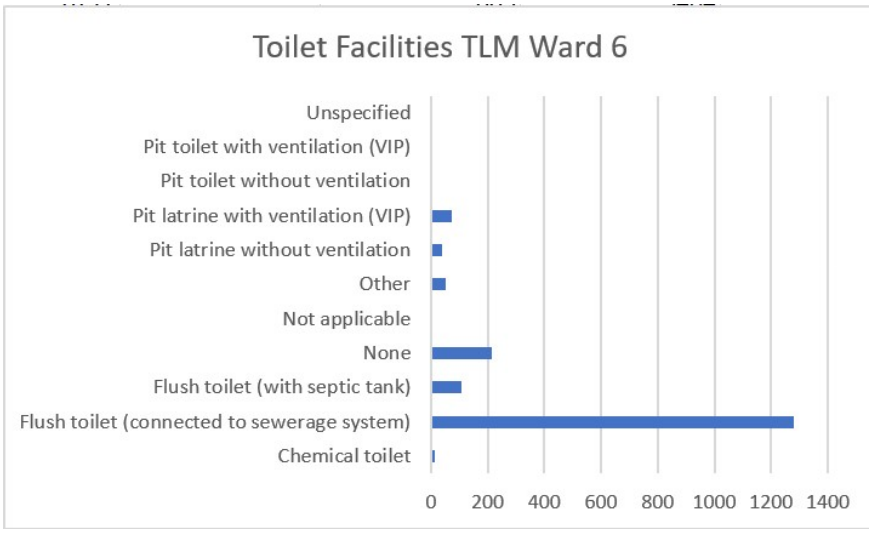
Primary Zones	
Demographic Aspect	**TLM Ward 6**
Age 	

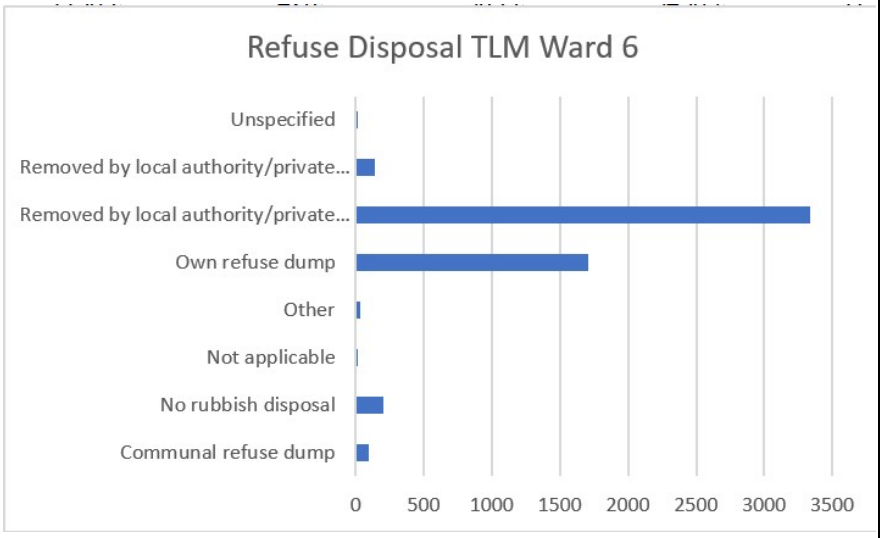
Primary Zones	
Demographic Aspect	**TLM Ward 6**
	The populous age group in TLM Ward 6 is between ages 25 to 29. Followed Ages between 00 to 04.
Population 	 Less than 2 500 of the population is Black African, followed by Coloured above 2 000 then White above 500.
Gender 	 There are slightly more males (56%) than females (44%).

Primary Zones	
Demographic Aspect	**TLM Ward 6**
Language 	 The majority of the population in TLM Ward 6 speak Afrikaans (3 500) followed by Setswana above 1 000.
Households 	 Majority of the population in TLM ward 6 live in house of brick just below 1 600 units.

Primary Zones	
Demographic Aspect	**TLM Ward 6**
Household Ownership	 With the majority occupying rent free tenure status at 35% then rented at 32% then owned and fully paid at 21%.
Education Level 	 The population in TLM ward 6 of the Municipality have the highest education level is Grade 12.

Primary Zones	
Demographic Aspect	**TLM Ward 6**
Employment 	 Above 2 000 of the population in TLM ward 6 are employed. Below 500 are not employed, while just below 1 500 are not economically active.
Employment Sector	 Most of the workforce in TLM ward 6 are employed in the formal sector (below 1 500).

Primary Zones	
Demographic Aspect	**TLM Ward 6**
Water 	 Regional or local authority are the main provider of water for majority of households in TLM ward 6. Followed by boreholes
Toilet Facilities 	 Majority have flush toilet connected to the sewerage system above 1 200.

Primary Zones	
Demographic Aspect	**TLM Ward 6**
Refuse Disposal/ Removal 	 Regional or local authority are the main provider of waste removal for majority of households in TLM ward 6.

5. ANALYSES AND CHARACTERISATION OF ACTIVITY

This section details water uses in relation to the PMG Mine, associated key activities, and supporting infrastructure for the mine.

5.1. Water And Waste Management

5.1.1. Water Management

The general principle of water management is the recognition that water is a scarce resource. This in turn leads to the other principles such as water use minimisation (water conservation) or re-use of water and pollution prevention or the limitation of pollution of water. All water that can be kept clean will be kept clean and dirty water areas will be minimized. No water is discharged unless authorised by the DWS especially water that exceeds the catchments water quality objectives, as set by the DWS, with the exception of emergency conditions if safety should demand so. All the relevant principles contained in DWA's Best Practice Guidelines (BPG) will be utilised for all designs and management practises.

Bishops Mine understands that their operations will have an impact on the environment and is committed to undertaking the necessary impact assessments to develop the necessary systems and practices to mitigate their impact during the entire lifecycle of their operations and associated infrastructure and to assess their performance on an on-going basis. Bishops Mine recognises that they will operate in an environment of scarce resources and will endeavour to optimise their usage. PMG will continue focus on the preservation of biodiversity and appropriate land use planning, both during and after the period of operation.

The aspects related to the management of waste and water at the Bishops Mine are described in the following sections, including the relevant aspects related to process-, storm-, groundwater and waste.

5.1.2. Stormwater

The Stormwater Management Plan for the Mine is designed to mitigate the impact of stormwater runoff, protect water quality, and ensure regulatory compliance. By implementing the strategies and measures outlined in this plan, the mining operation can effectively manage stormwater and minimize its environmental footprint. The aim of the stormwater management plan (SWMP) is to fulfil the requirements of the National Water Act (Act 36 of 1998) and more particularly, GN704, which deals with the separation of clean and dirty water.

The South African DWS (formerly the department of Water Affairs – DWA) Best Practice Guidelines G1: Storm Water Management (DWA, 2006a) states the following general principles:

- Keep clean water clean
- Route all clean water in a natural watercourse,
- Limit the dirty water areas to the smallest area possible,
- Ensure that the dirty water is kept separate and ensure the dirty water system has a o low risk of spillage.
- Collect and contain dirty water
    - Dirty water should be diverted, collected and contained separate from the clean water system,
    - Containment of dirty water should minimise the impact on the clean water resources.
- Sustainability over planned operation's life cycle

- Stormwater measure should be sustainable over the life of operations at the site and over different hydrological cycles.
- Consideration of regulations and stakeholders;

Consideration and incorporation of stakeholders and regulatory agencies should be taken into account according to the statutory requirements.

These principles were adopted as guidelines when designing the comprehensive Stormwater Management Plan (SWMP). The SWMP will provide conceptual inputs into the design requirements and placement of storm water management structures and recommendations based on the infrastructure plan. Mining operations have the potential to have a negative impact on the natural water quality of an area in the following ways:

- The planned earthworks which will strip vegetation will expose topsoil and sub-soils. Storm water flow will contribute to erosion thereby increasing levels of suspended solids within local watercourses and water features;
- Earthworks operations may expose elements naturally occurring within soils and geology to storm water, mobilising them into local watercourses and water features;
- Storage and use of process specific chemicals and vehicular related pollutants which, if not properly managed, may be washed by storm water into local watercourses and water features; and
- Discharge of polluted or improperly treated storm water into local watercourses or water features may occur.

5.1.3. Process Water

Water supply for mining activities is sourced from three boreholes (to be confirmed upon receiving the yield test results) and stored in three reservoirs. The processing plant is considered a dry process; as such, it uses less water.

5.1.4. Potable Water

Portable water is sourced from the Vaal Gamagara (Sedibeng water scheme). Various septic tanks collect wastewater from the offices, plant area, hostel, workshop, laboratory, etc. Figure 7 shows the monitoring locations for the water sampling points. The blue dots indicate six drinking water locations at the PMG Mine.

The PMG Mine undertakes monthly water monitoring. The drinking water quality monitoring data for PMG Mine used in this report was conducted in December 2021, which is compared with the SANS 241:2015 standard. The only variable that was monitored was E. coli. The SANS 241 standard has four categories of risk for the determinants:

a) Operational risk limit is the level that is essential for assessing the efficient operation of treatment systems and risk to infrastructure.
b) Aesthetic risk limits refer to determinants that taint water with respect to taste, odour, and color that does not pose an unacceptable risk if the concentration threshold is exceeded.
c) Acute health risk refers to a determinant that poses an immediate unacceptable health risk if consumed with water that exceeds this concentration.
d) Chronic health risk limit refers to the risk of ingesting the determinant over an extended period.

Water quality for all the samples is classified according to the WRC Domestic Use standard classification system (See Table 5-2).

Table 5-1: WRC Quality of Domestic Water Supplies – Colour classification system

Class/Colour	Description	Effects
Class 0	Ideal water quality	No effects, suitable for many generations
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects
Class 2	Marginal water quality	May cause some effects on sensitive users. Some effects are possible after a lifetime of use. Aesthetic effects.
Class 3	Poor water quality	Poses a risk of chronic health effects, especially in babies, children, and the elderly. Poor aesthetics
Class 4	Unacceptable	Severe acute health effects, even with short-term use. Taste and appearance will lead to rejection of the water.

The results of the drinking water analysis are presented in Table 16 below. Only the bacteriological variables were tested for these six samples. No E. coli and Total Coliforms were detected at any of the 6 Drinking water localities during December 2021. Based on the bacteriological variables tested, the Admin Drinking, Canteen DW, Clinic Drinking, Hostel Drinking, M/Workshop Drinking, and Oil Store sampling localities can be classified as Ideal (Class 0) water quality for Domestic use and Human Consumption. All the sampling localities are Fit for human consumption and domestic use.

Table 5-2: The recorded water quality data for Drinking Water localities during December 2021 compared to SANS241 and DWARF

VARIABLE	UNITS	Quality of Domestic Water Supplies: Drinking Class 1	SANS 241-1:2015 Drinking Water Standard	MONITORING LOCALITIES					
				Admin Drinking	Canteen DW	Clinic Drinking	Hostel Drinking	M/Workshop Drinking	Oil Store
E. coli	CFU/100ml	1	0	0	0	0	0	0	0
Total coliform	CFU/100ml	10	10	0	0	0	0	0	0

*Red values exceed the Quality of Domestic Water Supplies: Drinking Class 1

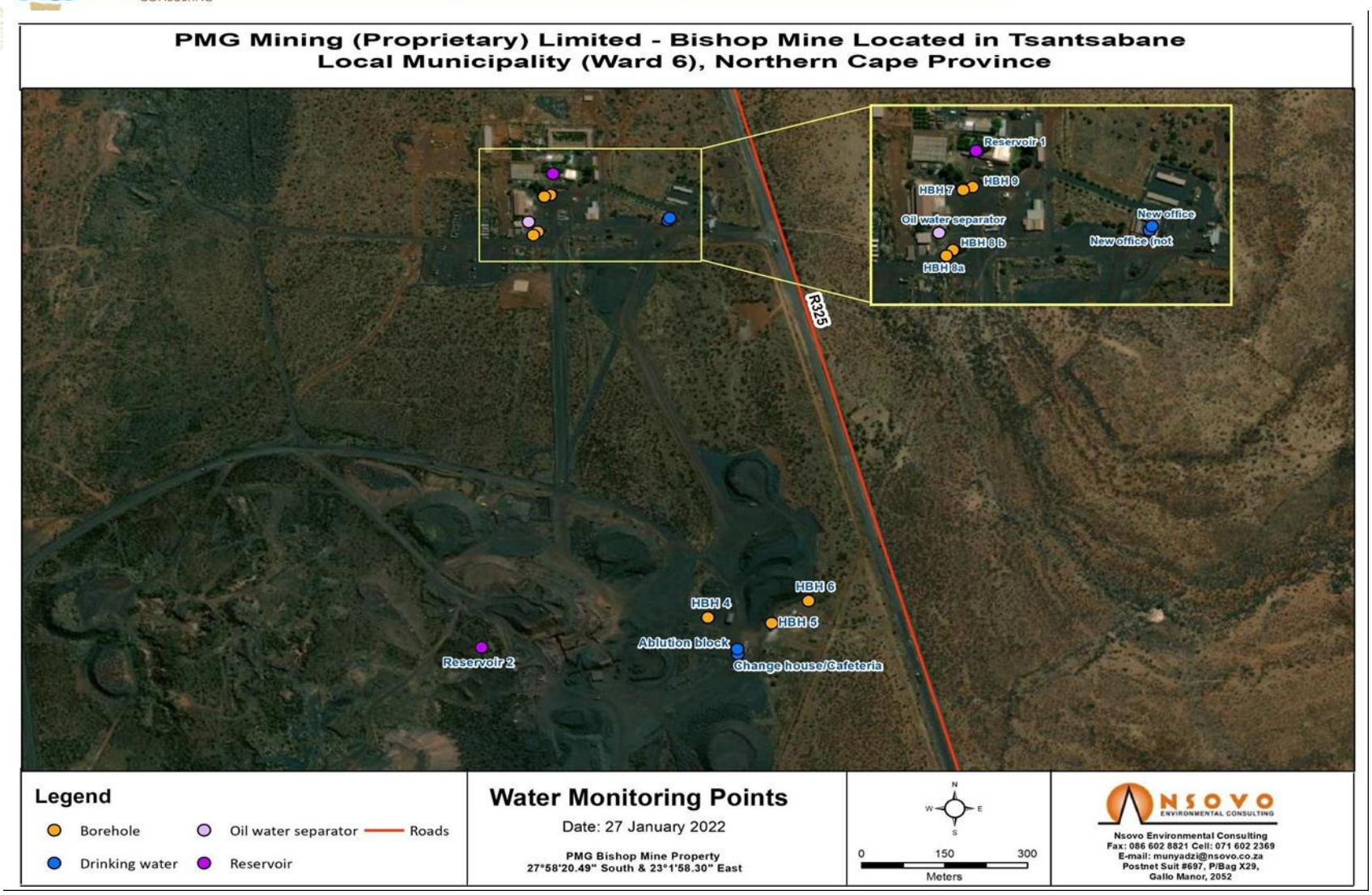


Figure 5-1: Water monitoring points (Portable, Borehole, and Industrial)

5.1.1. Sewage Waste Water

Sewage from the PMG Mining operation is stored in various septic tanks within the mine, which is serviced by a third party regularly. There is no wastewater treatment plant on site.

5.2. Water Demand Analysis

5.2.1. Water Supply Analysis

The water supply to the mine is given in Table 5-3.

Table 5-3: Water Supply Analysis

Aspect		Flow (m^3/a)
Boreholes	**Borehole ID**	
	HBH 5	13,000
	HBH 7	13,000
	HBH 8	16,000
	HBH 8A	-
Vaal Central Water		

5.2.2 Site Wide Water Balance

A site wide water balance was conducted to understand the flows within the operational water circuit during the dry, wet and average periods. This section details the water balance for the mine, which was done in accordance with the Best Practice Guideline G2 – Water and Salt Balances (DWA, 2010).

development of the water balance was based on an agreed Process Flow Diagram (PFD). The PFD serves as the basis for the representation of the mine's water circuit. A summary figure of the PFD which shows the water balance is shown in Figure 5-2.

The water balance was developed using an excel spreadsheet model, taking into consideration average dry, average wet, together with average periods. The average dry periods are based on the three driest months (June – August), whilst the average wet period is based on the three wettest months (November - January).

A summary of the information used in the water balance include:

- Climate data which includes rainfall and evaporation and
- Estimation of mine water requirements obtained including processing plant.

Water sources (inflows) were taken as:

- Groundwater supply from the 3 active boreholes
- Supply from Vaal Central Water
- Groundwater ingress into the Opencast Pits;
- Runoff from the office, workshops and changeroom areas collected conveyed to the Pollution Control Dam 1; and
- Direct rainfall into Dam 1, PCD 1, Slimes Dam, Opencast Pits, Product Stockpiles and the Overburden/Waste Rock stockpiles:

Water Sinks (Outflows) and temporary storages were taken as

- Evaporation from Dam 1, PCD 1, Slimes Dam, Opencast Pits, Product Stockpiles and the Overburden/Waste Rock stockpiles.
- Interstitial storage within Product Stockpiles and Overburden Stockpile;
- Seepage from the TSF and the RWD;
- Losses from the process Plant;
- Wastewater discharged from the Offices and Changerooms and contained within the Conservatory Tanks to be later collected by a contractor.

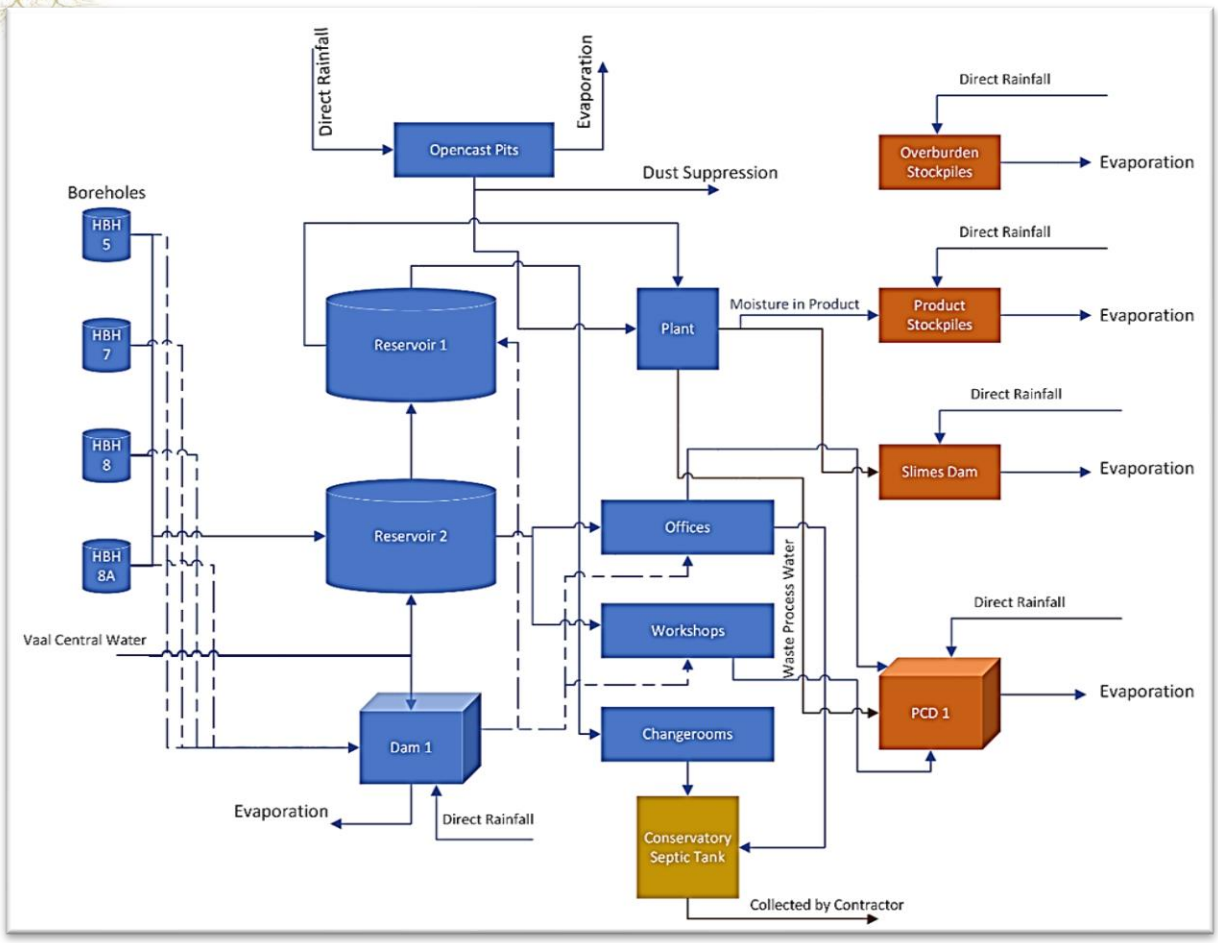


Figure 5-2: Bishop Mine Process Flow Diagram (PFD)

5.2.3 Assumptions and Input Parameters

The water balance assumes the following:

- Dam 1 is understood to be used as a backup for Reservoir 1 so it was assumed that Dam 1 only receives overflow water from Reservoir 1.
- Borehole HBH 8A is understood to be an alternate source to Borehole HBH 8A so it was assumed no abstractions were made from it during the year as Borehole HBH 8A was being utilized.
- Rainfall related inflows and evaporation related losses for the wet and dry conditions were estimated based on: i) average values during the three driest months of the year (June – August); and ii) average values during the three wettest months of the year (November – January);
- Runoff and evaporation coefficients for each surface were fixed and not influenced by antecedent climatic conditions;
- All catchment areas are constant;

- Evaporation from the Dam 1, the stockpiles and the Pollution Control Dam 1only occur if there is water in the respective containment facilities;
- No conveyance losses were considered;
- Evaporation losses were based on a static surface area, which relates to the specific surface area of the containment facility;
- The beginning storage of all reservoirs and dams were assumed to be their respective full storage capacities;
- Storm Water

5.2.4 Findings

Table 5-4: Summary of the Annual water balance for the PMG Bishop Mine

Facility Name	Water In		Water Out	
	Water Circuit/stream	Quantity	Water Circuit/stream	Quantity
Reservoir 1	From Reservoir 2		To Plant	27,375.00
	Total Water In	**30,135.00**	**Total Water Out**	**27,375.00**
Reservoir 2	Boreholes	42,000.00	Offices and Changerooms	1,248.00
	Vaal Central Water	3,696.00	To Reservoir 1	30,135.00
			To Dam 1 (backup)	11,493.00
	Total Water In	**45,696.00**	**Total Water Out**	**42,876.00**
Plant	From Reservoir 1	27,375.00	To Slimes Dam	21,900.00
			To PCD 1	4,755.00
			Moisture in Product	720.00
	Total Water In	**27,375.00**	**Total Water Out**	**27,375.00**
Offices and change rooms	Reservoir 1	1,248	To Conservatory Tanks	1,248
	Total Water In	**1,248**	**Total Water Out**	**1,248**
Slimes Dam	From Plant	21,900.00	Evaporation	705.30
	Direct Rainfall	106.93	Seepage	3,301.04
	Total Water In	**22,006.93**	**Total Water Out**	**4,006.34**
PCD 1	From Plant	4,755.00	Evaporation	3,170.72
	Direct Rainfall	480.71	Seepage Losses	
	Runoff from Offices and Workshop Area	96.24		
	Total Water In	**5,331.54**		**3,170.72**
Total Water Balance		**131,792.47**		**106,051.06**

The Storm Water Management Plan (SWMP) was undertaken to provide conceptual inputs into the design requirements and placement of stormwater management structures and recommendations based on the infrastructure plan. The stormwater management plan is based on separating dirty and clean stormwater generated on the site as per the requirements of GN704. The stormwater is managed by separating clean and dirty water areas by berms. Dirty water is routed to the PCD and clean water is routed to the evaporation dam. Waste from the wash bay is channeled to an oil/water separator. The oil recovered from the separator is collected by a registered third party.

Table 5-5: Clean and dirty area classification

Area Classification	Mine Areas	Stormwater Treatment Technique
Clean	Office and changeroom area	Divert runoff from the clean areas away from the dirty areas and discharge to natural environment system
Moderately Clean	Haul road(s)	Dust control
Dirty	Opencast Pits, Slimes Dam, PCD 1, the Plant Area, the Workshop Area	Perimeter berms around the Pits, Appropriate lining of the PCDs and allow water to evaporate, Cutoff drainage channels around the slimes dam to prevent dirty runoff from its side slopes from getting into the clean water areas.

- Proposed Storm Water Management Measures

The proposed conceptual stormwater management plan key features include:

- A perimeter berm around the quarry will be required to capture and contain rainwater falling directly over the dirty water area (quarry). The berm can be built out of the overburden material from site. The berm slopes will need to be grassed as a means of erosion control;
- To deal with stormwater from moderately clean areas (i.e. Haul roads), no formal diversions are recommended, rather normal roadside drainage with collectors should be constructed.
- Design Considerations for perimeter Berms

The design and construction of perimeter berms around the planned quarry site will involve a complex interplay of factors, including the local environment, available materials, construction equipment, safety considerations, and long-term maintenance needs. For the proposed perimeter berm around the quarry, the following design considerations are important to keep in mind: -

- Material Availability: Availability of rock and utilization of quarried material is essential in the design of the perimeter berm. To this end, the overburden and some of the waste rock will be appropriate for use.

- Construction Equipment: The choice of construction equipment can influence the design of the berm. Larger equipment can handle larger rocks, which can lead to a more robust berm.
- Environmental Conditions: The local environmental conditions can influence the design of the berm.
- Safety: The berm must be designed to ensure the safety of workers and equipment. This includes considerations for slope stability and the potential for rockfall.
- Maintenance: The design should consider the long-term maintenance requirements of the berm. This includes the potential for erosion and the need for periodic reinforcement or repair.

As such, it will be essential for a competent professionally registered design engineer to be engaged to undertake the design of an appropriate perimeter berm.

5.3 Impact Rating and Mitigation

The risk or impact assessment was undertaken for the planned operations at PMG Bishop Mine Site. Impact assessment was conducted for the 2 phases, namely: - the currently on-going operation phase and decommissioning phase and was done in accordance with the impact rating methodology.

The impact assessment assumes that the site will, in addition to quarrying operations, have only haul roads as the only other infrastructure.

5.3.1 Operational Phase

The potential impacts during the operational phase are as follows:

- Fuel and oil leaks excavation and haul vehicles. These leakages can contaminate the surface water making to the detriment of downstream users and riparian ecosystems
- The extraction of ore can release pollutants into nearby water bodies. These pollutants can include suspended solids, heavy metals, and other contaminants that can degrade water quality.
- The mining activities can increase soil erosion, leading to sedimentation in nearby water bodies. This can affect water quality, disrupt aquatic habitats, and potentially lead to the siltation of the river.
- Alteration of Water Flow: The operation of the mine can alter the natural flow of water, potentially impacting the water table and affecting the flow of the nearby river.

However, under normal design operational conditions, such releases are highly unlikely.

It is expected that without mitigation, the quantity of potential non-radioactive contaminants used and/or stored, and spilled and/or leaked at the sites, will be insufficient to extensively contaminate the surface water resources on and close to the site. With mitigation, the intensity is reduced to Low (Table 5-6).

Table 5-6: Potential surface water contamination caused by operational activities

Aspect	Corrective measures		Impact rating criteria				Significance
		Nature	Extent	Duration	Magnitude	Probability	
Surface hydrology	No	Negative	3	3	8	2	28 (<30 = Low)
	Yes	Negative	1	2	2	1	5 (<30 = Low)
Corrective Actions		• Ensure vehicles and equipment are in good working order and drivers and operators are trained with respect to actions to be taken in the case of a fuel spill or leak. • Place drip trays under stationary machinery, only re-fuel machines at the temporary fuelling station, install temporary structures to trap fuel spills at the temporary fuelling station. • Immediately clean oil and fuel spills and dispose of contaminated material (soil, etc.) at licensed sites only. • Equip the site with sufficient ablution facilities. Secure chemical toilets to ensure that they do not blow over in windy conditions. • Do not make uncontrolled releases of any pollutants, including sediment, sewage, cement, fuel, oil, chemicals, hazardous substances, wastewater, etc., into the environment. • Erosion control measures such as the use of silt fences, sediment ponds, and revegetation of disturbed areas can help reduce soil erosion and sedimentation. • Careful planning and design of the mine can help minimize impacts on the water table and local water flow. This could include the use of diversion channels to direct runoff away from the mine.				

5.3.2 Decomissioning Phase

The potential impacts during the Decommissioning phase are as follows:

- Water Pollution: The decommissioning process can disturb settled pollutants, potentially leading to a release into nearby water bodies.
- Sedimentation: Decommissioning activities can increase soil erosion, leading to sedimentation in nearby water bodies. This can affect water quality and disrupt aquatic habitats.

It is expected that without mitigation, the risk of contamination of the surface water resources within and close to the site will be Low. With mitigation, the intensity is reduced to Low (Table 5-7).

Table 5-7: Potential surface water contamination caused by mine decommissioning activities

Aspect	Corrective measures		Impact rating criteria				Significance
		Nature	Extent	Duration	Magnitude	Probability	
Surface hydrology	No	Negative	**3**	2	6	2	22 (<30 = Low)
	Yes	Negative	1	2	2	1	5 (<30 = Low)
Corrective Actions		• A Rehabilitation/decommissioning plan will need to be developed and should include monitoring of the site after closure to ensure that any necessary remediation work is carried out. This plan should be developed in consultation with local communities and regulatory authorities to ensure that it meets all necessary environmental and safety standards. • Implement proper waste management practices to help reduce the probability of release of pollutants. This could include the use of settling ponds to capture and treat runoff. • Sedimentation: Backfilling of the quarry and revegetation of stripped out areas will need to be done to control erosion.					

5.4 Groundwater

Groundwater quality monitoring at Bishop Mine is an ongoing task to assess the status of groundwater quality within the mine. This section provides a summary of groundwater quality based on water quality data for July 2023 (Appendix F). Groundwater quality monitoring is currently conducted ion four monitoring points as stipulated in the WUL. Table 4-11 provides a summary of groundwater quality data for July 2023. Based on the water quality data for July 2023, all boreholes comply with the SANS 241

2006 and 2015, with an exception of borehole HBH7 which have high concentration of NO3 above the SANS 2015. All monitoring points are non-compliant with the guideline value for pH as prescribed in the WUL document. The remaining parameters are within the WUL limits.

The presence of high EC in groundwater is directly related to the concentration of the ionized constituents in the groundwater. This may also relate to the presence of contamination and problem associated with excessive hardness. EC in the area generally ranges from 94.9 mS/m to 95.2 mS/m. All water samples are well below the SANS 2015 limit of 170 mS/m.

TDS represents the total amount of solid that remain when the water sample is evaporated to dryness. It refers to all solids dissolved in water and this include inorganic salts such as carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron, and small amount of organic matter and dissolved gases. TDS in the study area varies from varies from 572 mg/l to 639 mg/l. All water samples are characterised by TDS below the prescribed limit of 1200 mg/l (SANS 241 2015).

The concentration of Ca, Mg, K and Na varies from 112 - 118 mg/l, 45.9 – 55.8 mg/l, mg/l, 0.711 – 1.63 mg/land 12.8 – 13.1 mg/l respectively. These cations were recorded at very low concentration in the study area. They all comply with limits prescribed in the SANS 2006 and 2015, and also with WUL limits. The concentration of Cl and SO4 at the mine ranges from 29.8 mg/l to 30.9 mg/l for Cl and from 31.3 mg/l to 34.3 mg/l for SO4.

The concentration of F in the study area were found to be within guideline limit prescribed in the SANS standards and WUL limits. AL, FE and Mn were recorded at concentration below the detection limit. One parameter of concern is NO3 which is high in HBH7. The WUL limit recommended concentration between 10 mg/l and 20 mg/l. NO3 in this borehole is recoded as 11.4 mg/l which comply with WUL limits. However, the SANS limit for domestic drinking water quality is 11 mg/l. This suggest that the concentration of NO3 is above the SANS limit for drinking water quality.

5.5 Acid-Base Accounting

Acid-Base Accounting (ABA) is used to screen the acid-producing and acid-neutralizing potential of rocks. However, no information was provided with regards to the ABA for the mine.

5.6 Geochemistry Analysis – Leachate Potential

No geochemistry analysis (leachate potential) was undertaken for the mine. A risk assessment should be undertaken through comparison of the results with the following water quality standards to indicate chemicals of concern (CoCs) and to subsequently assess potential environmental risk in terms of the:

- World Health Organisation (WHO) Guidelines for drinking-water quality (WHO, 2011).

- International Finance Corporation (IFC) Guidelines for Mining Effluents (IFC, 2007); and
- South African National Standards (SANS) 241 (2011) Drinking Water. The leach test results would suggest:
- the pH of the leachates, and
- metals leachable at concentrations in excess of relevant water quality standards

5.6.1 Waste (Waste Stream Identification, Characterization, Reuse, Recycling, Minimization)

Domestic and industrial waste produced by the mine is collected at demarcated areas and disposed of off-site, by a certified waste contractor. PMG Mining has developed a waste management plan, which purpose is to ensure that waste is managed in compliance with the national environmental management: waste Act 2008(Act 59 of 2008) and relevant regulations, and to ensure that the conditions of EMPr for the project are met. The waste management procedure summarised below (Refer to Waste Management Procedure, Document ID: ESP001, Revision 0, 20 April 2020):

Waste will be managed in accordance with waste management hierarchy of control as stipulated by the Department of Environmental affairs at PMG Mining. Waste will be separated at source into the following main classes based on the impact it poses.

General or domestic waste (Green waste drums): consisting of food, glass bottles, garden waste, grass, plastic, rubber, building/demolition waste. NB: only waste that is not contaminated with hydrocarbons is considered general waste, once contaminated with grease, oil and diesel it is considered as hazardous waste. Separate boxes or bins will be provided for papers and cans at the offices.

Hazardous waste (red waste drums): Consisting of hydrocarbon or chemical contaminated rags, other material contaminated with oil, diesel or grease used absorbent material, old oil, empty oil/grease/paint drums and chemical containers. Oil filters must be stored in a separate bin labelled oil filters.

Metal waste (black waste drums): Consisting of scrap metal and any other material made-up of metal except paint tins.

Biological waste (blue): Any sewage waste as a result of spillages from portable toilets etc.

Old oil: old oil will be stored in oil drums and then transported from different sections to the oil store at mechanical workshop. Olegra oil will then be called by the Environmentalists to come empty the drums when a desired number of bins are full. Good housekeeping practices must be maintained.

Fluorescent tubes: Fluorescent tubes will be placed in boxes labelled hazardous waste containing mercury as per relevant regulations. The box will be stored at the workshop and only the Environmentalist, supervisors and the Electricians will have access to the box. Employees will be trained about the hazards

of improper handling of fluorescent tubes and records of trainings will be kept by the Environmentalist and will be made available upon request.

Medical waste: Medical waste is temporarily stored in yellow bins with labelling. A small quantity of these waste is generated by the mine. When the bins are full, waste is transported from the clinic to Postmasburg hospital. To comply with the cradle to grave principle, the clinic must request waste manifest from the hospital and submit such records to Environmental department. If the hospital is fails to provide such records it will then be concluded that waste is not being managed accordingly and a medical waste management company must be appointed to manage this waste. Surgical masks shall be disposed in brown, labelled and closed waste drums. This waste should then be stored for at least 72 hours at a designated area and thereafter taken to a landfill site for disposal. Chemical waste (red waste bin): Chemical waste must be disposed as hazardous waste and then transported to a proper landfill site by a registered hazardous waste transporter. The waste manifest must be kept for a period of 5years as required.

5.7 Operational Management

5.7.1 Organisational Structure

The mine operates under PMG Mining and the key personnel to ensure compliance to PMG Mine's WUL is the Mine Manager and the Environmental Officer. As a minimum, these roles as they relate to the implementation of monitoring programmes and management activities will include

- Ensure that the monitoring programmes and audits are scoped and included in the annual mine budget.
- Identify and appoint appropriately qualified specialists/engineers to undertake the programmes.
- Appoint specialists in a timeously manner to ensure work can be carried out to acceptable standards.
- Stakeholder engagement department:
- Liaise with the relevant structures in terms of the commitments in the Social and Labour Plan (SLP).

5.7.2 Resources and Competence

PMG Mine does not yet have ISO14001 certification but is establishing an Environmental Management System (EMS) that will align with the ISO14001:2015 standard. The environmental management resources at the PMG Mine include:

- Infrastructure and equipment, e.g., pollution control dams, oil traps, etc.

- Personnel including an Environmental Coordinator, Engineering Manager, and SHE Manager, and appointed external contractors and consultants, all of whom are qualified and trained for the appointed positions.
- Financial provisioning, which incorporates aspects such as the costs for infrastructure and the total liability costs which are updated annually as part of the closure costing process.

5.7.3 Education and Training

In-house training sessions are held with relevant employees. The training sessions are determined by the relevant department and allow for employees to participate in determining what the environmental issues and concerns are with regard to their specific occupation. Education with regard to environmental incident reporting is detailed at these sessions.

5.7.4 Awareness Raising

The purpose of the environmental awareness plan is to ensure that all personnel and management understand the general environmental requirements of the site. In addition, greater environmental awareness must be communicated to personnel involved in specific activities which can have a significant impact on the environment and ensure that they are competent to carry out their tasks on the basis of appropriate education, training and/or experience. The environmental awareness programme should enable the PMG Mine to achieve the objectives of the environmental policy.

Personnel needs to be equipped with the knowledge, skills, and training to enable them to manage their tasks competently. While management will ultimately be responsible and accountable, personnel should also be given responsibility and accountability to report to management on certain aspects. Basic water knowledge and water conservation training during induction should be implemented. A water awareness campaign to educate the community and employees on the importance of water conservation should also be initiated.

Awareness is raised through implementation of the Environmental Awareness Plan, which includes communication and in-house and on-the-job training. Through this communication and training all employees, contractors and managers are made aware of company policies, standards, procedures, as well as environmental obligations directly related to their job. Procedures and awareness raising materials included as appendices to the Environmental Awareness Plan are as follows:

- Waste management
- Environmental degradation
- Water conservation
- Rehabilitation

- Stakeholder engagement, and
- Managing stockpiles.

5.7.5 Internal and External Communication

People and their competencies are a source of competitive advantage and trust is built among employees through good ethics and communication. This is largely driven by their values, which prioritise respect and dignity within the workplace by applying fair labour practices and communicating with employees. Formal participation structures exist at the corporate and business unit level, where interaction with recognised organised labour on matters regarding the employment relationship takes place regularly. The Environmental Officer will be responsible for all environmental related issues, including the overall implementation of the IWWMP and the EMPr. Direct two-way communication between management and employees using various communication channels extensively. This is done by:

- Managing employees in an equitable, trustworthy, and transparent manner;
- Investing in employees' development and provide the challenges and opportunities they need to reach their full potential;
- Valuing diversity and reflect the demographics of the communities in the areas of operation;
- Energising employees to continuously deliver superior operational performances; and
- Actively caring for the safety, health, and welfare of employees.

A complaints register is available onsite for the employees to record complaints; however, no complaints have been brought forward to date. An incident register for recording incidents is also available on site. The registers indicate the details of the affected parties, the date and time as well as the nature of the complaint or incident.

5.7.6 External Communication

It is important to consider and address the concerns and requirements of stakeholders. Stakeholders include the relevant Government Departments (authorities), interest groups (community working groups), employees and the general public (Interested and Affected Parties (I&APs)).

Transparent communication and liaison with DWS, catchment management agencies (CMAs) and downstream water users is essential. Stakeholders' constitutional rights (Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)), expectations and concerns should be considered by ensuring that upstream and downstream users are not adversely affected, sensitive habitats are protected, and a progressive improvement of water quality is achieved.

The catchment should be considered within the larger context of resource quality objectives, the reserve, and water use requirements. Communication media such as placards, posters, leaflets, information letter and display boards, forums, SHEQ, etc. should be used.

A system of information sharing with regulatory authorities and I&APs should be developed with the following objectives:

- Update them on environmental management progress at the PMG Mine;
- Inform them about new developments and provide them with an opportunity to express their concerns about these;
- Provide them with a means to discuss environmental matters with PMG Mining whenever necessary;
- Provide a forum for a detailed discussion of issues when necessary;
- Simplify involvement in the processes of updating existing and obtaining new permissions.

Basic public involvement principles that need to be applied include the following:

- Involvement of all I&APs;
- Respect for the opinions of all I&APs;
- A two-way exchange of information, with listening on both sides;
- Follow up on commitments made;
- Feedback on how concerns expressed by I&APs have been or are being addressed;
- Clear channels of communication;
- Accurate records of every interaction with I&APs, including names and contact details of people involved;
- Accurate records of information exchanged with I&APs – including letters, reports and other documents that were exchanged; and
- Records of meetings circulated to I&APs so that they can check that the record of information shared is correct.

For public meetings, the following principles will be applied-

- Advance notice of any meetings (at least 21 days) to allow people sufficient time to attend the meetings; and
- Scheduling of meetings with consideration of people's time constraints.

5.7.7 Monitoring and Control

A monitoring programme is essential as a tool to identify any risks of potential impacts as they arise and to assist in impact management plans by assessing if mitigation measures are operating effectively. Monitoring should be implemented throughout the life of the mine including post closure.

The purpose of adhering to the monitoring program is to provide timely and accurate water quality data to the DWS and to manage impacts caused by the mining operations. This data is used for a variety of purposes which may be summarised in broad terms as the determination of status and trends in water quality. Specific objectives of the water quality monitoring program include the following:

- Determine whether water quality at sampling sites exceeds water quality standards;
- Assess the status of water quality in the surrounding areas;
- Provide analytical quality information that describes the present conditions and changes (trends); and
- Provide timely data for other users.

The following monitoring programs are currently being undertaken at the PMG Mine:

- Groundwater monitoring;
- Drinking water monitoring;
- Industrial water monitoring; and
- Dust fallout monitoring.

5.7.8 Surface Water Monitoring

The Ga-Mogara is a non-perennial river that is mostly dry throughout most of the seasons, therefore monitoring of surface water quality should be undertaken in the event that surface water flow is present in the Ga-Mogara drainage channel. Water quality analyses results should be classified in terms of the DWAF Guidelines Domestic Water Supply (1999), the DWAF guidelines for livestock watering, WHO guidelines and SANS guideline limits.

5.7.9 Drinking Water Monitoring

Portable water is sourced from the Sedibeng water scheme. The recommended monitoring locations for the water sampling points are presented in Table 5-8.

Table 5-8: Recommended drinking water monitoring schedule (Aquatico Hydrocensus Survey and Monitoring Program Audit, 2018)

Location	Description	GPS coordinates		Sampling Frequency
		Latitude	Longitude	
Ablution Facilities	Ablution block not drinking water	S27.98052	E23.03617	Monthly
Change house/Cafeteria	Change house and cafeteria building no drinking water currently sampled	S27.98043	E23.03616	Monthly
New office	Drinking water in new offices	S27.97277	E23.03503	Monthly
New office not drinking	New office not drinking water sampled from big tap	S27.97273	E23.03506	Monthly

5.7.10 Groundwater Monitoring

Groundwater monitoring must continue during all phases of the mine operation to identify impacts over time, and those effective measures can be undertaken at the early stage before negative impacts to the environment takes place. Groundwater monitoring within the mine have been designed to monitor strategic or specific locations that includes the following:

- Background monitoring: Boreholes located up gradient of activities or development, to determine the actual state of groundwater quality within the aquifer. This data is critical to determine baseline groundwater quality prior to development, and to collect baseline data for future comparison.
- Source monitoring: Boreholes located down gradient of activities or development, down gradient of contamination sources, to monitor impact of contamination sources.
- Plume monitoring: Boreholes located within the flow path or predicted plume direction and monitor the spread and extent of contamination.
- Impact monitoring: Boreholes where receptors are located, restricted to areas where impact is expected and serves as early warning system.

The Groundwater Monitoring is ongoing at the PMG mining operation. The locations of the groundwater monitoring points are illustrated in Figure 4-8 above. Current monitoring program allow monitoring on a monthly basis for all parameters including levels. Therefore, the following monitoring frequency is recommended:

- Groundwater quality: Must be conducted on quarterly basis
- Groundwater level: Must be conducted monthly

- Dewatering volumes (opencast): Must be recorded daily.

Table 5-9: Recommended groundwater monitoring schedule (Aquatico hydrocensus survey and monitoring audit, 2018)

Location	Description	GPS coordinates		Sampling Frequency
		Latitude	Longitude	
HBH 4	Monitoring borehole in front of change houses	S27.97987	E23.03568	Monthly
HBH 5	Borehole next to change house	S27.97997	E23.03672	Monthly
HBH 6	Borehole on Eastern side of PMG next to road	S27.97957	E23.03732	Monthly
HBH 7	Borehole next to HBH 9	S27.97232	E23.03312	Monthly
HBH 8b	Borehole next to workshops	S27.97298	E23.03291	Monthly
HBH 8a	Borehole next to parking bay	S27.97304	E23.03284	Monthly
HBH 9	Borehole behind wash bay	S27.97235	E23.03302	Monthly

5.7.11 Dust Monitoring

PMG Mining commissioned Aquatico Scientific (Pty) Ltd to monitor the air quality at their mine. The monitoring undertaken comprise dust fall monitoring. Sources of atmospheric emissions at PMG Mine include open pit operations including drilling and hauling, handling of ore and waste; vehicle entrainment from unpaved in-pit roads, materials handling of ore materials and products, primary and secondary crushing and screening of ore, and vehicle entrainment of dust from unpaved mine roads. The locations for each monitoring points are indicated on Table 5-10 below.

Table 5-10: Recommended dust monitoring locations (Aquatico hydrocensus survey and monitoring audit, 2018)

Location	Description	GPS coordinates		Sampling Frequency
		Latitude	Longitude	
DS 1	Dust bucket south east of plant	S27.98758	E23.03485	Monthly
DS 10	Dust monitoring point next to fence North of DS 9	S27.97872	E23.02113	Monthly
DS 11	Dust monitoring point South of Wash plant	S27.97244	E23.02808	Monthly

Location	Description	GPS coordinates		Sampling Frequency
		Latitude	Longitude	
DS 12	Dust monitoring point being domestic waste bay	S27.97047	E23.03370	Monthly
DS 13	Dust monitoring point behind office car park next to road	S27.97136	E23.03519	Monthly
DS 2	Dust bucket on top of hill south of plant	S27.99846	E23.03050	Monthly
DS 3	Dust monitoring point next to mining operations on top of hill	S27.99854	E23.02929	Monthly
DS 4	Dust monitoring point west of DS3	S27.99862	E23.02786	Monthly
DS 5	Dust monitoring point west of DS 4 and south west of mining area	S27.99864	E23.02365	Monthly
DS 6	Dust monitoring point on western rim of mining area and on western side of hill	S27.99255	E23.02237	Monthly
DS 7	Dust monitoring point on western rim of mining area North of DS 6	S27.98913	E23.02201	Monthly
DS 8	Dust monitoring point on western rim of mining operations	S27.98562	E23.02131	Monthly
DS 9	Dust monitoring point on western side of hill North of DS 8	S27.98341	E23.02354	Monthly

5.7.12 Waste Monitoring

The PMG Mine has a waste management procedure that addresses safe handling, sorting, storage, removal, transportation, and disposal of waste to minimise the impacts of waste on the health of employees and the

surrounding environment and to prevent ground and underground pollution. The procedure also aims to promote continual improvement of the waste management practices within the mine.

The waste management area at the mine has different waste streams, including steel, hazardous, and general waste. Cardboard waste is caged to prevent it from being blown by the wind. General waste is stored in skips, while hazardous is stored in wheelie bins. Waste tyres were stockpiled in a separate area. Contractors are appointed for sorting and removal of waste to the disposal site.

Table 5-11: Recommended dirty water monitoring locations (Aquatico hydrocensus survey and monitoring audit, 2018)

Location	Description	GPS coordinates		Sampling Frequency
		Latitude	Longitude	
PCD/Slimes dam	PCD/Slimes dam next to washing plant	S0.00000	E0.00000	Monthly
Oil water separator	Oil water separator at wash bay	S27.97280	E23.03276	Monthly

5.8 Risk Assessment / Best Practice Assessment

The DWS guideline on the development of IWWMP requires that a quantitative risk assessment be conducted in which the impact of the water uses on the water resources are identified. The impact assessment methodology described below was utilised for the assessment of the environmental impacts:

5.8.1 Risk Assessment Methodology

The impact assessment is inclusive of the following:

- Issue identification - each specialist will be asked to evaluate the 'aspects' arising from the project description and ensure that all issues in their area of expertise have been identified;
- Impact definition - positive and negative impacts associated with these issues (and any others not included) then need to be defined – the definition statement should include the activity (source of impact), aspect and receptor as well as whether the impact is direct, indirect, or cumulative. Fatal flaws should also be identified at this stage.
- Impact evaluation – this is not a purely objective and quantitative exercise. It has a subjective element, often using judgement and values as much as science-based criteria and standards. Therefore, a need exists to clearly explain how impacts have been interpreted so that others can see the weight attached to different factors and can understand the rationale of the assessment.

The assessment of risks methodology is largely based on the Department of Environmental Affairs and Tourism's (1998) Guideline Document: Environmental Impact Assessment Regulations. The assessment

will consider impacts arising from the proposed activities of the project both before and after the implementation of appropriate mitigation measures.

The impacts are assessed according to the criteria outlined in this section. Each issue is ranked according to extent, duration, magnitude (intensity) and probability. From these criteria, a significance rating is obtained, the method and formula is described below. Where possible, mitigation recommendations have been made and are presented in tabular form.

The criteria given in Table 5-12 below will be used to conduct the evaluation. The nature of each impact will be assessed and described in relation to the extent, duration, intensity, significance, and probability of occurrence attached to it.

Table 5-12: Methodology used in determining the significance of potential environmental impacts

Status of Impact

The impacts are assessed as either having a: negative effect (i.e., a `cost' to the environment), positive effect (i.e., a `benefit' to the environment), or

Neutral effect on the environment.

Extent of the Impact

(1) Site (site only),

(2) Local (site boundary and immediate surrounds),

(3) Regional (within the Northern Cape Province), and / or

(4) National

Duration of the Impact

The length that the impact will last for is described as either:

(1) immediate (<1 year)

(2) short term (1-5 years),

(3) medium term (5-15 years),

(4) long term (ceases after the operational life span of the project),

(5) Permanent.

Magnitude of the Impact

The intensity or severity of the impacts is indicated as either:

(0) none,

(2) Minor,

(4) Low,

(6) Moderate (environmental functions altered but continue),

(8) High (environmental functions temporarily cease), or

(10) Very high / Unsure (environmental functions permanently cease).

Probability of Occurrence

The likelihood of the impact occurring is indicated as either:

(1) None (the impact will not occur),

(2) Improbable (probability very low due to design or experience)

(3) Low probability (unlikely to occur),

(4) Medium probability (distinct probability that the impact will occur),

(5) High probability (most likely to occur), or

(5) Definite.

Significance of the Impact

Based on the information contained in the points above, the potential impacts are assigned a significance rating (S). This rating is formulated by adding the sum of the numbers assigned to extent (E), duration (D) and magnitude (M) and multiplying this sum by the probability (P) of the impact.

S=(E+D+M)P

The significance ratings are given below

(<30) low (i.e., where this impact would not have a direct influence on the decision to develop in the area),

(30-60) medium (i.e., where the impact could influence the decision to develop in the area unless it is effectively mitigated),

(>60) high (i.e., where the impact must have an influence on the decision process to develop in the area).

5.8.2 Impacts of the Construction Phase

The site clearing and establishment activities bring about impacts during the construction phase. The expected impacts during the construction phase are:

- Sedimentation as a result of bare areas of soil;
- Disturbance of watercourse channels and sedimentation;
- Pollution of water resources as a result of hydrocarbon spills;
- Physical alteration of riparian habitat;
- Alteration of aquatic habitat through increased flow and water level;
- Modification to stream morphology due to increased flow and runoff (i.e., increased erosion /sedimentation and bank instability);

- Use of contaminants/ substances harmful to aquatic biota entering the downstream reaches during construction - Increasing the toxicity of the associated water leading to loss of aquatic biota sensitive to physiochemical changes;
- Increased impermeable surface area.

Table 5-13: Impacts of the Construction Phase

Activity	Impact Description	Before Mitigation	Mitigation Measures/ Recommendations	After Mitigation
		Significance		Significance
Site clearance for establishment of access roads, infrastructure, and pit area	Sedimentation as a result of bare areas of soil	Medium	a) Sediment trapping berms b) Stormwater management plans c) Dry season construction	Low
Establishment or access roads and crossings structures	Disturbance of watercourse channels and sedimentation	Low	a) Upgrade existing roads and causeways b) Dry season construction	Low
Hydrocarbon spills	Pollution of water resources as result of hydrocarbon spills	Low	a) Service all vehicles and machinery b) Refuel in hard park/bunded area c) Store hydrocarbons safely in bunded area d) Vehicle maintenance and inspection daily Spill kits must always be available and ready on-site	Low

5.8.3 Impacts Of the Operational Phase

The impacts during the operational phase are brought about by the operation of the mine, access roads and associated activities. The expected impacts during the operational phase are:

- Vehicular movement and sedimentation;

- Pollution of water resources as a result of mine waste;
- Pollution of water resources as result of hydrocarbon spills;

Table 5-14: Impacts of the Operational Phase

Activity	Impact Description	Before Mitigation	Mitigation Measures/ Recommendations	After Mitigation
		Significance		Significance
Operation of mine and access roads	Vehicular movement and sedimentation	Medium	a) Sediment trapping berms b) Stormwater management plans	Low
Operation of mine and access roads	Pollution of water resources as a result of mine waste	Medium	Implement the IWWMP	Medium
Operation of mine and access roads	Pollution of water resources as result of hydrocarbon spills	Medium	a) Service all vehicles and machinery b) Refuel in hardpark/bunded area c) Store hydrocarbons safely in bunded area d) Vehicle maintenance and inspection daily e) Spill kits must always be available and ready on-site	Low

5.8.4 Impacts of the Closure and Rehabilitation Phase

Impacts during the closure and rehabilitation phase will be brought about by the activities relating to the removal of infrastructure, closing and sealing-off of pits and the final landscape shaping and revegetation. The expected impacts during the closure and rehabilitation phase are:

- Sedimentation because of bare areas of soil

- Pollution of water resources as result of hydrocarbon spills

Table 5-15: The impact ratings and mitigation measures for impacts of the Closure Phase

Activity	Impact Description	Before Mitigation	Mitigation Measures/ Recommendations	After Mitigation
		Significance		Significance
Shaping of landscape	Sedimentation because of bare areas of soil	**Medium**	a) Sediment trapping berms b) Stormwater management plans c) Dry season working	Low
Vehicular and machinery movement	Pollution of water resources as result of hydrocarbon spills	**Medium**	a) Service all vehicles and machinery b) Refuel in hard park/bunded area c) Store hydrocarbons safely in bunded area d) Vehicle maintenance and inspection daily e) Spill kits must always be available and ready on-site f) Spill kits must always be available and ready on-sit	Low

5.8.5 Impacts of the Post-Closure Phase

The post-closure phase consists primarily of the monitoring of the water resources after the final rehabilitation and impacts will likely be monitoring the (improving) health of water resources.

Table 5-16: Impacts of the Post Closure Phase

Activity	Impact Description	Before Mitigation	Mitigation Measures/ Recommendations	After Mitigation
		Significance		Significance

Monitoring of rehabilitation	Improving the health of water resources	Low	Implement rehabilitation biomonitoring plan and remedy actions	Low

Table 5-17: Risk Assessment

Ranking Scale				
Assessment of Impacts Identified			**Mitigation Measures**	
Potential Impact	**Activity**	**Risk**	**Recommended Mitigation Measures**	**Risk**
Surface Water				
Contamination by dirty water runoff and dirty water containment structures	Spills from PCD	H	Effective clean and dirty water separation measures implemented on site. Containment of all dirty water runoff from the site returned to the PCD and return water dam for reuse in the process.	L
Possible contamination by fuel, oil and chemical spills	Spills throughout the life of the Mine	M	To avoid or where not possible, minimise and remedy pollution of water through the life of the Mine.	L
Erosion and increase sediment load in nearby water courses as a result of runoff	Overburden Stockpiles, tailings dam	M	All contained runoff in the dirty areas will be collected and contained in the PCD.	L
Groundwater				
Seepage from PCD	Seepage	H	Limit seepage by lining the PCD	L
Ponding of contaminated runoff in operational areas may seep to groundwater	Ponding	H	To avoid or where not possible minimise and remedy pollution during operation. Containment of dirty water runoff in the dirty PCD	L
Soil				
Loss of soil due to erosion	Erosion of bare and exposed areas and other disturbed places as a result of	M	Manage stormwater according to Regulation 704. Revegetate cleared areas. Implement dust suppression measures	L

Ranking Scale				
Assessment of Impacts Identified			Mitigation Measures	
Potential Impact	Activity	Risk	Recommended Mitigation Measures	Risk
	Stormwater runoff			
Contamination of soil due to leaching contaminants	Possible contamination by fuel, oil and chemical spillages	M	Design, operation and management to minimise seepage and spills	L

5.9 Public Consultation Processes

5.9.1 Previous PPP undertaken for initial IWULA in 2010

A public participation process was undertaken as part of the Integrated Water Use Licensing application (IWULA) in 2010. It involved the consultation of individuals and organizations throughout the wider study area representing a broad range of sectors of society. Issues and concerns raised during the IWULA process were recorded and captured. The following methods of consultations were used:

- Advertisements in the local newspaper
- Site notifications
- Local authority consultations
- Advertisements

The proposed project was advertised in the Noordkaap newspaper on the 15th of September 2010 to inform adjacent owners and/or interested and affected parties of the proposed development and to allow for comments.

a) Site notifications

Site Notices were placed at the main entrances to the sites (properties) where the proposed development is to take place as well as on prominent sites and localities within the affected areas of Postmasburg.

b) Local authority consultations

Pre-application meeting was held with the official from the DWS on Monday 10th of May 2010 at DWS Kimberly office.

Table 5-18: Attendees for the meeting

Attendees for the meeting	Organisation	Designation
Ms. Boitumelo Moalusi	DWS	Water Pollution Control Officer
Ms. Matshilele Ramovha	DWS	Water Pollution Control Officer
Mr. Johan Harmse	PMG Mining	Company Secretary
Dr. Avinash Bisnath	Kai Batla (Consultants)	Consulting Geologist
Takalani Mahuva	Kai Batla (Consultants)	Environmentalist
Mr. Tuis Mahlangu	Kai Batla (Consultants)	Hydrologist

In addition, a PPP is currently being undertaken for the WUL Renewal Application. The Public Participation Process (PPP) offers stakeholders a fair opportunity to be informed about the PMG Bishop Mine WUL Renewal Application, to raise issues of concern and to make suggestions for enhanced project benefits. This PPP is being undertaken to ensure compliance with the WULA process.

Public participation is the involvement of all parties who are either potentially interested or affected by the PMG WUL Renewal. The principal objective of public participation is to inform and enrich decision-making. Public participation plays a key role in the Environmental Impact Assessment process where it informs the public of the PMG WUL Renewal Application and invites people to register as interested and affected parties (I&APs) and provide any comment or information that may be of use during the environmental impact assessment. The role of public participation during the Public Review phase is to allow the registered I&APs to comment on the Draft IWWMP Report before submission to the relevant decision-making authority. This allows I&APs to evaluate whether their concerns will be appropriately addressed.

One of the general objectives of integrated environmental management laid down in Section 23(2)(d) of NEMA is to “ensure adequate and appropriate opportunity for public participation in decisions that may affect the environment”. An inadequate and non-transparent PPP has the potential to provide a negative decision and perception regarding the PMG Bishop Mine WUL Renewal Application. The EIA Regulations (2010) places a lot of emphasis on the public participation process and will be revised to contain comprehensive guidelines to involve the public in the EIA process. The primary aims of the public participation process include:

- Meaningful and timeous participation of interested and affected parties (I&APs);

- Identification of issues and concerns of key stakeholders and I&APs with regards to the Project, i.e., focus on important issues;
- Promotion of transparency and an understanding of the WULA and its potential environmental (social and biophysical) impacts;
- Accountability for information used for decision-making;
- Serving as a structure for liaison and communication with I&APs;
- Assisting in identifying potential environmental (social and biophysical) impacts associated with the Project and
- Inclusivity (the needs, interests and values of I&APs must be considered in the decision-making process).

5.9.2 Details of Public Participation Followed in 2024

Notice of the WULA process has been given by:

- Placing of site notices along by the PMG Bishop Mine Site and other public places neighbouring the facility on the 3rd of April 2024;
- Emailing written notice and Background Information Document (BID) regarding the WULA to Interested and Affected Parties, including neighbours, competent authority and other relevant Government departments on the 3rd of April 2024.
- Placing an advertisement in the on the 'Noordkaap Bulletin' 4th of April 2024, which allowed potentially Interested and Affected Parties to register and to submit comments within 60 days regarding the Draft IWWMP/ WULA Report;
- Letters notifying, I&APs of the release of the Draft IWWMP / WULA Technical Report will be made available for public review and comment from the Thursday 4th April 2024 until Wednesday 5th June 2024 (60 days public review period).
- A copy of the WULA Report has been placed on the Niara Environmental Consultants (Pty) Ltd website: www.niara.co.za on the 4th of April 2024.

The Proof of Public Participation has been included as Appendix D. All comments raised by I&APs during the review of the BID will be captured and addressed within the Final IWWMP Report.

5.10 Matters Requiring Attention

No matters have been described as requiring attention.

5.11 Assessment of Level of Confidence of Information

This IWWMP considered input from the specialist studies conducted for the project area and the approved IWWMP. The specialists appointed to undertake the various investigations are deemed competent in their

particular fields. Considering the above, the level of confidence regarding the information and reports used to compile this document is high.

6. WATER AND WASTE MANAGEMENT

6.1. Water and Waste Management Philosophy

The general principle of water management is the recognition that water is a scarce resource. This in turn leads to the other principles, such as water use minimisation (water conservation) or reuse of water and pollution prevention or the limitation of pollution of water.

Water that exceeds the quality, as set by DWS shall not be released from site, except for emergency conditions, but it must be reused, thus reducing the quantity of intake of clean water. The Applicant will endeavour to:

- Continually seek ways to improve its performance in terms of consumption, and water related impacts;
- Reduce consumption of clean water;
- Implement pollution prevention at source;
- Maximise, recycling and reuse of dirty storm water and process water;
- Implementation of process water treatment to facilitate reuse; and
- Collect, contain dirty storm water and process water on site for preferential use as process water.

The hierarchical management approach comprises the implementation of best practice measures to minimise water consumption and reduce impacts on water resources, by:

- Implementing measures to ensure compliance with relevant water and waste legislation and with other standards to which the organisation subscribes;
- Proactively identifying and implement actions that are required to achieve the water and waste related objectives;
- Implement these actions in an open and transparent manner;
- Implement on-going water and waste related monitoring to support legal compliance;
- Continually seeking ways to improve the performance of water and waste management systems, process and objectives; and

- Encourage open and transparent communication with regulatory authorities and other interested and affected parties within the context of the National Water Resource Strategy and Local Catchment Management Strategies.

The NWA gives effect to the rights enshrined in the Constitution of the Republic of South Africa with regards to water resource management. The purpose of the Act is to provide for the protection, usage, development, conservation, management, and control of the country's water resources in an integrated manner.

The NWA provides the legal basis upon which to develop tools and means to affect the said activities. One of these tools is the authorisation of the water uses as defined in Chapter 4 of the NWA. Section 21 of the NWA lists 11 water uses which can only be legitimately undertaken through the water use authorisation issued by DWS.

Various water uses and waste activities related to the mining activities taking place at the Bishops Mine require authorisation under the National Water Act of 1998 (No. 36) [NWA], or under the National Environmental Management: Waste Act of 2008 (No 59) [NEM: WA]. An overview of the two Acts and their legislative requirements are briefly set out below.

PMG Mining is committed to optimise water uses and minimise water and -related impacts to achieve and maintain the following:

- Corporate and regulatory compliance;
- Environmental benefits and continued stewardship;
- Close/cordial/constructive community, neighbour and regular relationships;
- Significant reductions in operating and remediation costs;
- Major reductions in closure liabilities;
- Enhancements in the technical capacity and personal satisfaction of mine personnel; and
- Enviable company reputation and shareholder approval.

6.2. Performance Objectives

According to the 2021 Annual External EMP Performance Audit Report, the following objectives and strategies are followed at PMG Mining:

Surface Water

- Identification of sources of water pollution on site;
- Removal of potential water pollution; and
- Collection and containment of dirty stormwater in appropriate collection and containment systems (i.e. sumps, pipes, canals, pumps and dams) sized and designed by professional engineers to minimise the contamination of water resources.

Groundwater:

- Monitoring of borehole water quality and volume;
- Daily monitoring of discharge water quality that is carried out at end of pipe as detailed in the Environmental Monitoring Plan; and
- Monthly samples are taken for analysis against the determinants defined in the monitoring plan.
- Collection of water data levels during the decommissioning and closure of the mine to assess groundwater rebound post closure.

Stormwater

- To maintain the stormwater control berms upslope of the active pit to route clean runoff around the open pit; and
- Collection and containment of dirty stormwater in appropriate collection and containment systems (i.e., sumps, pipes, canals, pumps and dams) sized and designed by professional engineers to minimise the contamination of water resources.

6.3. Measures To Achieve and Sustain Performance Objectives

To achieve and sustain the performance objectives identified in section 6.3 above, management activities and mitigation measures will be implemented during the construction, operation, and closure phases. PGM Mining has identified several measures to achieve the set performance objectives.

Table 6-1: Measures to achieve performance objectives

Performance Objectives	Management Measures
Process Water	
Dirty storm water to be contained	Maintain the stormwater control berms upslope of the active pit to route clean runoff around the open pit.
	Compile a detailed stormwater management plan.
	Care must be given to ensure that the stormwater berms diverting clean runoff past the pit do not become blocked or contaminated. All stormwater diversion berms/ trenches will be inspected monthly during the wet season by the EO.

Performance Objectives	Management Measures
	The pollution control dam must be located within the pit dirty water system so that contained water will report back to a pit in the event of dam failure or overtopping.
	The dam must be equipped with a float switch to prevent water in excess of the dam's design capacity being pumped into the dam.
	Pollution Control Dam must be lined to contained dirty stormwater
Minimise contamination of surface water resource	Maintain the stormwater control berms upslope of the active pit to route clean runoff around the open pit.
	Collection and containment of dirty stormwater inappropriate collection and containment systems (i.e., sumps, pipes, canals, pumps, and dams) sized and designed by professional engineers to minimise the contamination of water resources.
Groundwater	
Minimise the impact on local groundwater resources	Monitoring of borehole water quality and volume must be conducted to ensure that groundwater contamination is avoided.
	Daily monitoring of discharge water quality must be carried out at the end of pipe.
	Monthly water samples must be collected for analysis against the determinants defined in the monitoring plan.
Soil	
To prevent soil erosion	Soils must be stripped during the dry winter months. Soil stripping must be guided during the pre-mining soil map and a soil stripping guide
	Soils must be stockpiled at a slope of no more than 25 percent (25%), to prevent erosion by flowing water.
	Stockpiles must not be located near water courses.
	Soil stockpiles must be seeded at the earliest opportunity after placement to reduce the impact from water and wind erosion.
	Topsoil layers must be placed at the top of the profile to improve fertility in the upper soil layers and to retain seed stocks in the rehabilitated environment.
	Soil stockpiles must be placed upslope of operational areas, to prevent contamination by PMG products and waste.
	Soil that is contaminated by fuel or oil spills must be collected and treated at a predetermined and dedicated location, or within the mine using bioremediation.
	Stockpiles must be restricted to less than five meters in height.
	Surface water flow must be diverted around soil stockpiles.

6.4. Options Analysis

Not applicable to this IWWMP. This IWWMP serves as an update to the IWWMP already approved for the PMG Mining.

6.5. IWWMP Action Plan

Refer to Table 6-2 for the IWWMP Action plan for PMG Mining. The plan details actions needed to be taken to improve water and waste management on site and to monitor and manage any changes that require implementation.

Table 6-2: Action Plan for Water Uses at PMG Mining

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
Earthworks Open pit mining Processing plant Transportation Demolition Rehabilitation Maintenance and aftercare	Contamination of surface water resources	a) Mine infrastructure, will be constructed and operated to comply with the National Water Act (36 of 1998) and Regulation 704 (4 June 1999): Clean water systems are separated from dirty water systems. • Clean run-off and rainfall water is diverted around dirty areas and back into its normal flow in the environment. • The size of dirty water areas is minimized and dirty water is contained in systems that allow the reuse and/or recycling of this dirty water. • Discharges of dirty water may only occur in accordance with authorisations that are issued in terms of the relevant legislation specifications and they must not result in negative health impacts for downstream surface water users. The relevant legislation specifications comprise any applicable authorisation/exemption, the National Water Act (36 of 1998) and Regulation 704. b) All hazardous chemicals (new and used), mineralized waste and non- mineralised waste must be handled in a manner that they do not pollute surface water. This will be implemented by means of the following: • Pollution prevention through basic infrastructure design.	On-going	

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		• Pollution prevention through maintenance of equipment. • Pollution prevention through education and training of workers (permanent and temporary). • Pollution prevention through appropriate management of hazardous, materials and • The required steps to enable containment and remediation of pollution incidents. • Specifications for post rehabilitation audit criteria to ascertain whether the remediation has been successful and if not, to recommend and implement further measures. c) The designs of potentially polluting structures will take account of the requirements for long term surface water pollution prevention.		
Earthworks Open pit mining Processing plant Transportation Demolition Rehabilitation Maintenance and aftercare	Alteration of natural drainage patterns	a) In all phases mine infrastructure will be constructed, operated and maintained to comply with the provisions of the National Water Act (36 of 1998) and Regulation 704 (4 June 1999) of any future amendments thereto. These include: • Clean water systems are separated from dirty water systems. • The size of dirty water areas is minimized and clean run-off and rainfall water is	On-going	

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		diverted around dirty areas and back into the normal flow in the environment. • The site wide water balance is refined on an on-going basis with the input of actual flow volumes and used as a decision-making tool for water management and impact mitigation. • The location of all activities and infrastructure should be outside of the specified zones and/or flood lines of watercourses. If this is unavoidable the necessary exemptions/approvals will be obtained. b) Due to the uncertainties associated with the peak flood events, it is recommended that these uncertainties are managed by applying a 1 m freeboard to design levels for any infrastructure within close proximity to the Ga-Mogara drainage channel, including the encroachment of flood lines and any flood defence berms.		
Earthworks Civil works Open pit mining Processing plant Transportation Power supply and use Water supply and use Mineralised waste	Contamination of groundwater resources	a) PMG mine will comply with both the National Water Act (36 of 1998) and Regulation 704 (4 June 1999) b) All hazardous chemicals (new and used), mineralized wastes and non- mineralized waste are handled in a manner that they do not pollute groundwater. This will be implemented by covering the following:		

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		• Pollution prevention through basic infrastructure design. • Pollution prevention through maintenance of equipment. • Pollution prevention through education and training of workers (permanent and temporary). • Pollution prevention through appropriate management of hazardous chemicals, materials and nonmineralized waste. • Required steps to enable containment and remediation of pollution incidents. • Specification for post rehabilitation audit criteria to ascertain whether the remediation has been successful and if not, to recommend and implement further measures. d) Infrastructure that has the potential to pollute groundwater resources will be designed and implemented in a manner that pollution is addressed in all mine phases. In this regard design of overburden stockpiles need to comply with Section 7 of GN. 632 of NEM: WA where relevant. e) Planned infrastructure that has the potential to pollute groundwater (waste rock dump etc.) will be identified and included into the groundwater pollution management plan which will be		

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		implemented and needs to comply with Section 7 of GN. 632. The plan includes: • Identify potential pollution sources. • Determine the extent of the pollution plume. • Design and implement intervention measures to prevent, eliminate and/or control the pollution plume. • Limit unauthorized access to waste rock dump. • Monitoring all potential impact zones to track pollution and mitigation impacts. • Where monitoring results indicates that third party water supply has been polluted by the PMG Mine, the mine will ensure that appropriate compensation will be provided. • Waste rock will be backfilled into the open pit as part of rehabilitation. • Any remaining waste rock on surface will be shaped to be free draining and re-vegetated. f) The PMG Mine will implement the groundwater monitoring programme outline above.		
Water supply and use Open pit mining	Reduction of groundwater levels and availability	a) During the construction and operational and decommissioning phases, the following will be implemented:		

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		• All potentially affected third party boreholes will be included in the groundwater monitoring program to ensure that changes in water depths can be identified, where possible. • Where PMG Mine's dewatering causes a loss of water supply to third parties, appropriate compensation will be provided by PMG Mining until such time as the dewatering impacts cease. • The PMG Mine will monitor groundwater quantity as per the monitoring programme.		
Open pit (concurrent backfilling)	Positive impact associated with backfilling	a) During construction, operation and decommissioning the PMG Mine will implement the IWWMP commitments with a view not only to prevent and/or mitigate the various environmental and social impacts, but also to prevent negative impacts on surrounding land uses. b) During closure planning the PMG Mine will incorporate measures to achieve the future land use plans for the land within the proposed project area.		
Construction of flood defence berms Open pit mining (encroachment of flood lines)	Destruction of riparian habitat and disturbance of downstream habitat	a) The 'tie-ins' of the flood berms must be designed and constructed in such a way that should a flood event occur, that turbulent and/or super critical flows are not created as far as possible, i.e. the flood berms should not cause		

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		water to be re- directed by the tie-ins, thus causing erosion anywhere along the length of the berms and further downstream. b) The area around the flood berms must be monitored regularly throughout the life of mine to ensure that no erosion or incision of either the banks or bed of the watercourse occurs. c) The footprint area of the pits must remain as small as possible whilst allowing for economical and optimal extraction of the ore. Throughout the life of mine, non- essential personnel and non-essential vehicles are not to be permitted within the demarcated riparian zone. Special care must be taken to ensure that no waste relating to the construction or mining process is disposed of within the riparian habitat or the active channel of the watercourse. d) As far as possible, mining surface infrastructure (including soil stockpiles and any temporary structures) should remain out of the riparian zones and associated zone of regulation in line with the requirements of Regulation GN704 of the National Water Act. e) Limit the footprint area of the construction activity (including the placement of temporary infrastructure) to what is essential in order to minimise the loss of clean water runoff areas and loss of catchment yield which recharge the receiving aquatic environment.		

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		f) The mine's water balance will always be strictly controlled to ensure optimal water use, prevent overflow in dirty stormwater management systems and prevent spills to the environment. g) No dirty water runoff (as defined by Regulation GN704) must be permitted to reach the freshwater resource during the entire life of mine, and clean and dirty water management systems must be maintained and operated efficiently to prevent any contaminated runoff from entering the receiving aquatic environment. Clean and dirty water runoff systems should be implemented in accordance with the stormwater management plan. h) Should the mine water balance during operations prove to be positive, the mine shall consider pumping water from the dewatering boreholes around the Hotazel pit to recharge the Gamagara River downstream of the mine, with due authorization from DWS. i) All dirty water containment structures should be designed to contain a minimum storm event of a 24 hour 1 in 50-year flood event. These containment facilities must remain outside of the defined riparian area and the respective zone of regulation as a measure to minimise the impact on the receiving environment. In this regard special mention is made of:		

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		• Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed. • Runoff from paved surfaces should be slowed down by the strategic placement of berms; and • All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff from the facilities. j) All pollution control facilities must be managed in such a way as to ensure that storage and surge capacity is available if a rainfall event occurs. k) Strict control of sewage water treatment must take place and the sewage system must form part of the mine's closed process water system. l) During construction activities and the operational phase of the proposed mining development, erosion berms must be installed on roadways to prevent gully formation and alteration of the sediment balance of the riparian habitat. The following points should serve to guide the placement of erosion berms: m) Where the track has slope of less than 2%, berms every 50m should be installed. • Where the track slopes between 2% and 10%, berms every 25m should be installed.		

Activity	Potential Impact	Mitigation	Implementation date	Person Responsible
		• Where the track slopes between 10%-15%, berms every 20m should be installed. • Where the track has slope greater than 15%, berms every 10m should be installed. n) No disposal of any wastes should take place within the riparian habitat. If any spills occur, they should be cleaned up immediately. o) Implement alien vegetation control program within riparian areas. Alien floral invasion is expected within any disturbed areas, and therefore regular monitoring and control of alien invasive vegetation should take place in accordance with the EIA/EMPr. p) Upon closure all haul and access roads which are no longer required, as well as all unnecessary mining infrastructure (including temporary structures) should be removed in order to minimise the impacts on the aquatic resources of the area beyond the life of mine. q) It is recommended that the design and construction of these flood berms be undertaken with a view to the structures being permanent because removal is considered to result in further unnecessary impacts on the ecological integrity (particularly geomorphology) of the Ga-Mogara River at this site.		

6.6. Control and Monitoring

6.6.1. Monitoring of Change in Baseline Information

6.6.1.1. Surface Water Monitoring

Please refer to Section 5.4.1 of this report for information pertaining to the surface water monitoring conducted at PMG Mining.

6.6.1.2. Groundwater Monitoring

Please refer to Section 5.4.2 of this report for information pertaining to the groundwater monitoring conducted at PMG Mining.

6.6.1.3. Biomonitoring

Please refer to Section 5.4.3 of this report for information pertaining to the biomonitoring conducted at PMG.

6.6.2. Audit and Report on Performance Measures

Each component within the IWWMP has an associated audit and performance review component. Regular review and auditing are important to ensure systems are up-to-date and still relevant for current situations. Evaluation is required to verify its appropriateness and suitability by comparing performance to objectives set. Changes or adjustments to systems are required where review/audit highlights shortcomings or gaps. Performance should be measured against the following:

- WUL Internal audit (conducted annually); and
- WUL External audit (conducted annually).

6.6.3. Audit and Report of Relevance of IWWMP Action Plan

All existing and new systems need to be reviewed and modified to ensure continual improvement. It is considered good practice to review or audit all systems at least annually and to update the IWWMP as required in the WUL issued to PMG Mining.

An annual audit must be compiled by a suitably qualified, external party on the conditions of the IWUL and should also include an audit of activities against GN704. The conditions proposed by DWS within the IWUL and the requirements of GN704 will be critical to attaining performance objectives. The IWUL and GN704 audit will compare activities on site and determine the status of thereof. These should be identified

as compliant or non-compliant, and recommendations made to rectify any non-compliance identified. Further, the IWWMP and associated monitoring programmes should be reviewed annually and updated where relevant.

Other Performance Assessments include:

- All information as required by the various Government Departments should be captured and be readily available for submission when required. Therefore, all monitoring data, inspections, incidences and remedial actions taken must be recorded and logged and be at the disposal of authorities during site visits.
- A monitoring/inspection and action log will be maintained on site which will record date of inspection, any evidence of non-compliance observed with regard to the EMP and IWUL, all issues observed during inspections or through monitoring data, and all remediation actions taken. This log will be part of the public domain and be available to authorities during site visits.
- A complaints register will be maintained on site and operated in much the same as the incident log as discussed above.

An annual performance assessment (different timeframe may be stipulated by authorities which will then be relevant) will be conducted by an external consultant throughout the life of mine as required by the NEMA. This is conducted to assess the adequacy and compliance of the EMP, and the relevant legislation

7. REHABILITATION STRATEGY AND IMPLEMENTATION PLAN

7.1. Rehabilitation Approach

The closure process is essentially aimed at restoring the surrounding environment to a state, resembling as closely as possible that which existed prior to the commencement of mining, as measured by both chemical, physical, and biological parameters. An additional requirement is that the site is secure for any planned future land use. Therefore, it is necessary to ensure that neither discharge from the mine area, nor harmful substances remaining at the site soil, present any long. The key rehabilitation objective is to ensure that processes are undertaken generally in accordance with the Section 43 of the MPRDA to:

- achieve land capability following the cessation of mining that is comparable to pre-mining land capability and consider stakeholder's interest;
- allow for sustainable post-mining land use to occur; and
- improve linkage between existing areas of remnant vegetation.
- In planning for closure, there are four key objectives that must be considered:
- protect public health and safety;

- alleviate or eliminate environmental damage;
- achieve a productive use of the land, or a return to its original condition or an acceptable alternative; and
- to the extent achievable, provide for sustainability of social and economic benefits.

7.2. Rehabilitation Actions

7.2.1. Mine Infrastructures with no Alternative Uses:

Infrastructure for which alternative uses cannot be found will be demolished and the surface rehabilitated, as follows.

Table 7-1: Rehabilitation Actions

Infrastructure	Description
Steel Structures	Steel structures will be demolished and sold to an accredited steel dealer.
Processing Plant	Infrastructures from the processing plant will be removed, steel will then be taken to a recycling company, machinery which might be in good condition during mine closure will be sold. The general surface rehabilitation at the plant will ensure the following • Surface topography that emulates the surrounding areas and aligned to the general landscape character; • Landscaping that would facilitate surface runoff and result in free draining areas. If possible, drainage lines should be reinstated; • An area without unnecessary remnants of structures and surface infrastructure to give the rehabilitated area a neat appearance
Pollution Control Dams (PCD)	The PCD's will be removed at closure. The plastic lining must be removed and can be recycled. The earth walls will be flattened and the area profiled. The pipes associated with the dam must be removed and if possible, sold.

Infrastructure	Description
Stockpile Areas	It is assumed that material from the stockpile area with good grade will be taken for processing and cost has been allocated to rip the footprint, reshape the surface and vegetate.
Access Roads	Access roads around the site should be ripped for all areas except those needed to access the facilities for inspection after closure. Roads that can and will be used by other users post closure should, however, be left provided this is agreed upon by all parties concerned. For the rehabilitation of roads, a cost has been allocated to rip the area.
Opencast/ Mining Area	The purpose of pit closure is to ensure the pits become safe for humans and animals and for the purpose of the liability assessment it has been assumed that the shaping of the pit area slopes will be undertaken during the operational phase of the mine to reduce closure costs. After the mining activities are completed, topsoil will be spread on the disturbed areas. Once placed, the "soil" should then be ripped, fertilised, and re-vegetated. Special attention must be given to shape and/or removal of heaps of excess material, and the area should be suitable for vegetation.
Pipe Lines	All pump stations will be demolished, pipelines removed and the area rehabilitated.
Substations	All substations except the ones that serve the remaining infrastructure will be demolished and the areas rehabilitated.
Clean Water Dams	All clean water dams will remain in place if the water quality is acceptable according to the water act. If not, the dams will be demolished and the area rehabilitated.

Infrastructure	Description
Waste rock dumps	All the waste rock will be removed and the footprints rehabilitated.
Ablution block	The ablution block will be demolished.
Septic tanks	Septic tanks will be removed except those of facilities with alternative use, the tanks must then be taken to proper landfill sites and open pits should be rehabilitated by backfilling, cleaning every waste, ripping the area, or planting local grass.

7.2.2. Mine Infrastructures with Alternative Uses:

The following mine infrastructure has possible alternative uses:

- Workshops as light industries
- Warehouse
- Main Offices
- Hostel
- Security Offices
- Clinic
- Weighbridge

7.3. Maintenance

7.3.1. Maintenance and Aftercare

Maintenance and aftercare must be planned for two to three years after the land preparation and replanting of vegetation have been completed. Maintenance will specifically focus on annual fertilising of the rehabilitated area, control of all other alien plants, and general maintenance, including rehabilitation of cracks, subsidence, and erosion gullies. Continuous erosion monitoring of rehabilitated areas and slopes should be undertaken and zones with excessive erosion should be identified. The cause of the erosion should be identified and rectified. Zones with erosion will need to be repaired with topsoil and re-vegetated.

7.3.2. Long Term Water Issues

Groundwater and surface water - the post-closure monitoring should take place for two years or until a long-term acceptable trend can be determined.

7.3.3. Post-Closure Monitoring and Management

The purpose of monitoring is to ensure that the objectives of the rehabilitation program are met and that the rehabilitation process is followed.

7.3.4. Flora

The following recommendations have been suggested for post-mining rehabilitation and monitoring of the proposed development area. Biodiversity assessments mid wet season should be undertaken by a qualified ecologist / botanist to monitor the rehabilitation progress with regards to flora.

7.4. Risk Monitoring Informing Rehabilitation

This section provides a summary of the risks associated with rehabilitation and remediation activities applied as per the closure plan and linked to the appropriate planned rehabilitation action. However, no risk assessment was undertaken as part of the Rehabilitation and Closure Plan.

7.5. Financial Provision

Regulation 54 of the MPRDA (No. R527, 2004) requires the holder of a mining right to annually review and update the financial provision of the mine. PMG Mining undertook a detailed assessment of the financial provision and the results for 2021 are presented in Table 7-2 below.

Table 7-2: Summary of the calculated closure liability cost

No.	Description	Unit	A Quantity	B Master Rate	C Multiplication factor	D Weighting factor 1	E=A*B*C*D Amount (Rands)
1	Dismantling of processing plant and related structures (including overland conveyors and powerlines)	m3	16083	15.68	1	1.1	277399.584
2(A)	Demolition of steel buildings and structures	m2	0	218.41	1	1.1	0
2(B)	Demolition of reinforced concrete buildings and structures	m2	0	321.86	1	1.1	0
3	Rehabilitation of access roads	m2	0	39.08	1	1.1	0
4(A)	Demolition and rehabilitation of electrified railway lines	m	0	379.34	1	1.1	0
4(A)	Demolition and rehabilitation of non-electrified railway lines	m	0	206.91	1	1.1	0
5	Demolition of housing and/or administration facilities	m2	0	436.81	1	1.1	0
6	Opencast rehabilitation including final voids and ramps	ha	69.86	222313.32	0.52	1.1	8883622.482
7	Sealing of shafts adits and inclines	m3	0	117.25	1	1.1	0
8(A)	Rehabilitation of overburden and spoils	ha	41.32	152653.61	1	1.1	6938411.882
8(B)	Rehabilitation of processing waste deposits and evaporation ponds (non-polluting potential)	ha	1	190 127.32	1	1.1	209140.052
8(C)	Rehabilitation of processing waste deposits and evaporation ponds (polluting potential)	ha	0	552219.84	1	1.1	0
9	Rehabilitation of subsided areas	ha	0	127824.41	1	1.1	0
10	General surface rehabilitation	ha	3	120927.41	1	1.1	399060.453
11	River diversions	ha	0	120927.41	1	1.1	0
12	Fencing	m	3723	137.94	1	1.1	564905.682
13	Water management	ha	0	45980	1	1.1	0
14	2 to 3 years of maintenance and aftercare	ha	35.26	16093	1	1.1	624183.098
15(A)	Specialist study	Sum				1.1	0
15(B)	Specialist study	Sum				1.1	0
						Sub Total 1	17896723.23
1	Preliminary and General		1073803.394		weighting factor 2 1.05		1127493.564
2	Contingencies		1789672.323				1789672.323
						Subtotal 2	20813889.12
						VAT (15%)	3122083.37
						Grand Total	23935972

8. CONCLUSION

8.1. Regulatory Status of the Activity

PMG Mining has a Water Use Licence (WUL), Licence No. 10/D73A/ABG/2393 issued on the 11th of November 2014. The WUL request that the Integrated Water and Waste Management Plan (IWWMP) must be updated annually and submitted to the Regional Head for approval. Currently, there are new water uses or amendments that require an addition to the Water Use Licence. The current Water Use Licence (WUL) issued to PMG Mining was, for the following water uses:

- Section 21(a) – Taking of water from a water resource;
- Section 21 (b)- Storing Water;
- Section 21(g) – Disposing of waste in a manner which may detrimentally impact on a water resource;

8.2. Statement of Water Uses Requiring Authorisation

This IWWMP update will be submitted to the Regional Head for a WUL amendment.

8.2.1. Statement on IWWMP Update

The IWWMP update is required on an annual basis to ensure compliance with Condition 11.2 of Appendix IV of the WUL issued to PMG Mining. The IWWMP is a living document that is required to be updated on an annual basis to ensure its relevance to the mining activities which are continuously changing as the operational LoM progresses.

Since the last IWWMP submitted to the DWS dated the 21st of September 2012, substantial infrastructure changes and/or plans are in progress at PMG Mining, especially related to the upgrading of the stormwater management facilities. Stormwater management systems have been established on-site, including:

- Pollution Control Dams;
- V-drains to channel water into water containment systems;
- Stormwater channels around the buildings and offices; and
- Berms along haulage roads.

8.2.2. Amendments Required to the Existing Water Use License

There have not been any amendments to the existing WUL since it was issued on the 11th of March 2014. However, this IWWMP update will be submitted to the Regional Head with the application to amend the water uses on the current WUL.

9. MOTIVATION IN TERMS OF SECTION 27(1) OF THE NWA

The NWA includes considerations set out in Section 27(1) that must be applied in the assessment of license applications for water use. The objective of this section is to provide the necessary information required in terms of Section 27(1) to allow the DWS to evaluate this application to issue the license. There are many compelling reasons for the favourable consideration and award of this water use authorisation application. The key issues and considerations, as required by section 27 (1) of the NWA are outlined below.

Benefits of the project

It is recognised that mining activities are an essential component of South Africa's economic development. According to the Chamber of Mines of South Africa's Integrated Annual Review (2015), the mining sector accounted for 7.7% of South Africa's Gross Domestic Product (GDP) directly, and approximately 17% of direct, indirect, and induced effects are included. South Africa specifically is one of the world's largest producers and exporters of manganese ore (DMRE, 2011). Further, South Africa hosts about 75 percent of the world's identified manganese resources and about 24% of the world's reserves. Over 90 percent of these reserves are found in the Kalahari Manganese Fields (KMF) located in the Northern Cape.

The South African annual manganese production amounts to 6.2 million tonnes, with a majority of manganese mining concentrated in the Kalahari Desert, which is believed to hold more than 70% of global reserves. Consequently, contributes to the national economy. At the regional level, the project will contribute security of local employment due to the extension of the life of mine. There would also be a less tangible but important benefit of positioning the Municipalities ahead in terms of job opportunities.

Supporting Strategies

At the regional level, the project would contribute to the improvement in the socio-economic status of the adjacent communities and the region at large (DMRE, 2011). At the national level, employment is expected to grow further as manganese mining projects reach operational stages in South Africa. This optimistic market will have a positive effect on the national economy in terms of increased revenue through the collection of mining tax as well as personal income tax, which will afford more developments in the country. Manganese plays a significant role in the socio-economic development of our country, while simultaneously providing the necessary infrastructural economic base for the country to become an attractive host for foreign investments in the energy sector. The priorities to which this project would contribute are laying the groundwork for enhancing steel, clear glass, and electronics.

9.1 Section 27(a) – existing lawful water uses

According to the National Water Act (Act 36 of 1998), an existing lawful water use means a water use –

a. which has taken place at any time for two years immediately before the date of commencement of NWA and which –

i. was authorised by or under any law which was in force immediately before the date of commencement of NWA;

ii. is a stream flow reduction activity contemplated in section 36(1); or

iii. is a controlled activity contemplated in section 37(1); or

b. Which has been declared an existing lawful water use under section 33.

In the case of –

a) streamflow reduction activity declared under section 36(1); or

b) a controlled activity declared under section 38.

Therefore, no existing lawful uses exist or were previously authorised or implemented for the project under any water/environmental-related legislation. PMG Mining has existing lawful uses issued in March 2014, Licence No.:10/D73A/ABG/2393.

9.2 Section 27(b) – the need to redress the results of past racial and gender discrimination

PMG Mining is and will continue to subscribe to the mine's SLP and socio-economic objectives and demonstrate exemplary corporate citizenship and harmony with society through continued focus on affirmative action and actively promoting women and disability equity. Further, PMG Mining continues to adhere to the B-BBEE codes of conduct by awarding contracts to black, women, and youth-owned emerging companies. Key performance indicators of PMG Mining to redress the results of past and gender discrimination are indicated as follows:

- Black management professional and supervisory staff;
- Women management professional and supervisory staff;
- People with disabilities;
- Procurement expenditure and supply of services, both capital and operating for Black Economic and Women Empowerment.

PGM Mining is committed to the development of the South African workforce and to ensure that it has available the mining operations skills and competence required for the successful mining and production of this commodity. PGM Mining will always adhere to the requirements of the Skills Development Act, the Skills Development Levies Act, and any other legislation that has an impact on the skills development of the employees including the Broad- Based Socio-Economic Development Charter for the Mining Industry.

One of the objectives of the NWA is to address past racial and gender discrimination and to alleviate poverty in South Africa; therefore, it is of utmost importance to support and stimulate economic development to realise the upliftment of Historically Disadvantaged South Africans (HDSAs).

PMG Mining to submit Social Labour Plan detailing how past racial and gender discrimination and poverty issues are addressed.

9.3 Section 27(c) – efficient and beneficial use of water in the public interest

The main principle of the NWA is to ensure that the Reserve is protected before any other water allocations are granted. The Reserve is defined as the quantity and quality of water required for basic human needs and to sustain the aquatic ecosystem. The remaining water is allocated for beneficial use, PMG Mining ensures the water is used sustainably to minimise wastage. The Mine uplifts the Socio-economic status of the communities in the form of employment opportunities, social stability and ultimately results in Gross Domestic Product (GDP) growth, therefore eradicating poverty in such a case stimulating Local Economic Development.

When undertaking the EA and WUL authorised activities, the mine will ensure that the possible impacts on water resources are avoided, minimised, or reduced. PMG Mining will continue to implement the mitigation measures recommended by the specialists and conditions in the Environmental Management Programme (EMPr) to ensure environmental protection, sustainability, and management. Further, PMG Mining will provide information to the surrounding landowners as, and when requested and an open-door policy will be maintained for dealing with any complaints and issues.

9.3.1 The Socio-Economic Impact of the Water Use or Uses If Authorised (Section 27(1)(D)(I))

PMG Mining to submit Social Labour Plan *

9.3.2 The Socio-Economic Impact of The Failure to Authorise the Water Use (Section 27(1)(D)(II))

Water is the most essential component required for mining, if PMG Mining was not granted the Water use right to its mining operation it will mean no mining will be undertaken. As this could affect the mine's ability to comply with South African legislation regarding mining and the environment and add value to the mineral resources of South Africa. This would essentially terminate the development and the socio-economic benefits will not be revealed.

9.3.3 The Catchment Management Strategy Applicable to the Resource (Section 27(1)(E))

The former Department of Water Affairs and Forestry is responsible for the National Water Resource Strategy for South Africa. According to the National Water Act, 1998 (Act 36 of 1998), a Catchment Management Agency should be established for each water management area, however, in the case of Lower Vaal Water Management Area (WMA) has no Catchment Management Agency and Catchment Management Strategy (CMS) is in place. Consideration was afforded to the Internal Strategic Perspective (ISP) document for Lower Vaal WMA. According to the ISP, the Lower Vaal is stressed and in deficit. As such no licenses can be considered for additional surface water above the existing lawful use unless a local groundwater resource can be developed to meet the additional requirement.

9.3.4 Section 27(e) The Likely Effect of the Water Use on Water Users (Section 27(1)(F))

To a certain extent the mining activities especially, dewatering will cause a drawdown in the regional groundwater levels and degradation in water quality during the mining operations. However, if mitigation measures are implemented other water users might not be directly affected by the authorisation of the Water Use License. The groundwater monitoring plan is implemented to monitor the quality and depth of water throughout the operational phase of the mine. Further, during decommissioning and closure, water level data will be collected to assess groundwater rebound post closure.

9.3.5 Section 27(f) Effect of the Water Use on Other Water Users

According to Eco-Care Consultancy (2017), the only natural wetlands within the larger landscape are small, endorheic, closed depressions. Further, these depressions have formed due to micro-topography variations of the underlying substrates (shallower soils over Calcrete), giving rise to low grasslands on pan bottoms. The wetlands within the area comprise a mixture of tall shrubs and trees. The pan-like alluvium consists of sandy loam with fairly high contents of Calcium and Phosphates. The pan soils consist of white (washed) sand and are exposed for most of the year and carry shallow pools for a short period following sufficient rains (Eco-Care Consultancy, 2017). Therefore, it is anticipated that the mining activities have a minimal impact due to the nature of the activities to be undertaken and will affect other water users. However, proposed mitigation measures will reduce the severity of the identified impacts.

9.4 Section 27(h) – investments already made by the water user in respect of the water use in question

PMG Mining has made significant investments through this mining project, to mention; in terms of finances and time especially feasibility and environmental studies associated with the environmental

assessment work; the prospecting applications, drilling as a requirement to prospecting, mining right application fees, the appointment of specialists in terms of environmental, social and engineering studies.

PMG Mining supplies manganese to local and international customers, which leads to a significant investment in terms of income generation, foreign exchange, increase employment opportunities, and improvement in the economy of South Africa.

9.5 Section 27(i) – the strategic importance of the water use to be authorised

According to Eco-Care Consultancy (2017), the only natural wetlands within the larger landscape are small, endorheic, closed depressions. Further, these depressions have formed due to micro-topography variations of the underlying substrates (shallower soils over Calcrete), giving rise to low grasslands on pan bottoms. The wetlands within the area comprise a mixture of tall shrubs and trees. The pan-like alluvium consists of sandy loam with fairly high contents of Calcium and Phosphates. The pan soils consist of white (washed) sand and are exposed for most of the year and carry shallow pools for a short period following sufficient rains (Eco-Care Consultancy, 2017). Therefore, it is expected that after mining activities, there will be minimal to no disturbance to water resources. Further, PMG Mining, the mitigation measures recommended by the specialists, and conditions in the EMPr and the WUL will be implemented to ensure environmental protection. The strategic importance of the PMG Mining operations is to ensure that all the benefits are realised, including job security for skilled and unskilled workers.

PMG Mining project is not regarded as part of a National Water Resource Strategy since it is a mine and the required water use is not for power generation has been declared a strategic water use in the NWRS. However, PMG Mining has resulted in significant socioeconomic benefits. The mining industry in general is paramount to South Africa's economy. According to SRK consulting report, 2017, the primary value chain for the mining sector alone accounts for 500 000 jobs, directly and indirectly, creating another 500 000 jobs giving a total contribution of 1 000 000 jobs created for the economy. It produces almost a fifth of GDP and pays a similar percentage of corporate tax. The value of mining companies listed on the JSE is R1.9 trillion, which represents 43% of the total market capitalisation of the exchange and therefore helps create wealth for millions of South African pension fund holders and investors, while at the same time attracting significant foreign capital flows that help unlock our mineral potential. More than half of our export earnings are derived from mining and mineral products (SRK, 2017). Likewise, the water uses applied are critical for the operation of PMG Mining and therefore socio-economic upliftment of the region.

9.6 Section 27 (j) – the quality of water in the water resource which may be required for the reserve and for meeting international obligations

The climatic conditions within the Lower Vaal Water Management Area vary considerably from west to east across the WMA, with the Mean Annual Precipitation (MAP) reducing from 500 mm in the east to 200 mm in the west with an average of 350 mm. This tendency is reversed when considering potential annual evaporation, which increases from 2650mm in the east to 2 700 mm in the dry western parts of the WMA.

The land use in the Lower Vaal WMA is characterised by agriculture with the main crops being maize, cotton, groundnuts, vegetables, and sunflowers. Agricultural activities are however dominated by livestock farming. There are also extensive diamond mining activities located in the Lower Vaal water management area. These activities are generating substantial return flow volumes in the form of treated effluent from the urban areas and mine dewatering that are discharged into the river system. These discharges are having significant impacts on the water quality in the main stem of the Vaal River in the Lower Vaal WMA.

The Lower Vaal WMA has an average economy, contributing approximately 2 % of the GDP of South Africa. It is expected that economic activity will remain relatively static in the medium to long term. Mining and agriculture are important contributors to the economy of the region and are expected to continue to play an important role in the economy of this WMA. Due to the extensive development in the Vaal River System, the local surface water resources in all three Vaal WMAs have been fully exploited, more than three decades ago (SLR, 2017).

Moreover, the water quality within the Lower Vaal WMP varies from poor in the highly developed areas to good in the less developed areas. The water quality is impacted by point discharges from industries, wastewater treatment works, mine dewatering, irrigation return flows, and diffuse sources such as runoff from mining and industrial complexes, agriculture, and urban areas. The cascading characteristic of the three Vaal WMAs has the consequence that the water quality of the main stem of the Vaal River in the downstream WMAs is impacted, not only by the activities in the WMA itself but also by the water received from upstream. In addition, the water quality in the Vaal River will also impact the water quality of the Orange River in the Lower Orange WMA. It is planned that the water quality within the Lower Vaal WMA will be managed across sub-catchments to meet shared water quality objectives in major tributaries as well as in the main stem of the Vaal River. This will be achieved using an assessment during which Interim Water Quality Objectives (WQO) will be established and water quality variables of concern and sources of pollution are identified (SLR, 2017).

9.7 section 27 (k) – the probable duration of any undertaking for which water use is to be authorised

The mining activities at PMG Mining will take up to 2023. However, the mine is planning on extending the Mining Right by a maximum of ten years from the year 2023.

9.8 Key Commitments

PMG Mining operation has already been issued with a Water Use License in March 2014; the necessary conditions have been included in this approved license. However, the mine is in the process of applying for the WUL amendment to include new water use activities. The next IWWMP update will include these water uses and new conditions.

Table 9-1: Key commitments for PMG Mining (WUL) and (Wadala Mining, 2012)

Water Use	Key Commitments
21 (a) Water abstraction	a) PMG Mining shall abstract a maximum of 13 000m³/ annum from the remaining extent 0 of Farm Bishop 671 (borehole HBH5) and the water will be used for the PGM Mining and associated activities. b) PMG Mining shall abstract a maximum of 16 000m³/ annum from the remaining extent 0 of Farm Bishop 671 (borehole HBH8) and the water will be used for the PGM Mining and associated activities. c) PMG Mining shall abstract a maximum of 13 000m³/ annum from the remaining extent 0 of Farm Bishop 671 (borehole HBH7) and the water will be used for the PGM Mining and associated activities. a) PMG Mining shall abstract a maximum of 7 300m³/ annum from the remaining extent 0 of Farm Bishop 671 (Pollution Control Dam) and the water will be used for the PGM Mining and associated activities. b) PGM Mining shall ensure that water pumped from the boreholes should not be supplied for human consumption purposes

Water Use	Key Commitments
	c) The high-yielding boreholes such as HBH7 must be pumped according to the recommended safe yield and must be used as a main borehole for water supply. d) A groundwater monitoring report shall be established and implement a continual process of raising awareness amongst itself, its workers, and stakeholders with respect to Water Conservation and Water Demand Management initiatives. e) PMG Mining shall continually investigate new and emerging technologies and put into practice water-efficient devices or apply techniques for the efficient use of water containing waste, in an endeavour to conserve water always. f) The groundwater model should be refined and updated where necessary when information relating to abstraction is available. g) An operational water balance must be developed for the PMG Mine during operation. Data obtained during the dewatering monitoring record should be used to update this water balance.
21 (b) Water Usage- Storing of water abstracted from boreholes	a) PMG Mining will contain a reservoir with a maximum of 230 m³ to store 9 850 m³/a of water abstracted from the boreholes indicated under 21 (a). b) PMG Mining will contain a dam with a maximum capacity of 308 m³ to store 12 000 m³/a of water abstracted from the boreholes indicated under 21 (a). c) The quantity of water stored shall be recorded on the last day of each month.

Water Use	Key Commitments
21 (g) Water Use - Storage of contaminated water in holding facilities	a) PMG Mining will collect a total volume of 36 520 m³/a seepage from the site and runoff and store it in the Pollution Control Dam (PCD 1) with the capacity of 4800 m³. b) The waste facilities shall be operated and maintained to have a minimum freeboard of 0.8m above full supply level to be capable of handling the 1:50 year flood event on top of its mean operating level.
21 (g) Water Use – Disposal of Slimes from mine process	a) PMG Mining will dispose of a total volume of 21 900 m³ slimes from the mining process into a Slimes dam with a capacity of 23 000 m³/a.
21 (g) Water Use- disposal of sewage wastewater	a) PMG Mining will dispose of a total of 720 m³/a of sewage waste into a conservatory septic tank with a capacity of 60 m³.
21 (g) Water Use- waste rock dump and backfilling	a) A maximum of 24 000m³/a will be disposed of onto the waste rock dump. The waste rock has been used to backfill some of the mined-out sections.
21 (g) Water Use- processed iron ore	a) PMG will store processed iron ore with a maximum capacity of 41 566m³/a. b) PMG Mining shall monitor on monthly basis the water resources at the surface and water monitoring points and groundwater quality by taking samples at monitoring points and submit quarterly to DWS.

10. REFERENCES

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