LIST OF ANNEXURES

ANNEXURE 1- IWWMP

Integrated Water Use Licence Application For Giyani Stateland Gold Mine Integrated Water and Waste Management Plan (IWWMP)

Project No.: A221/28

Date: April 2021

Prepared by:

HEADWATERS
Water and Environmental Consultants

Prepared for:

Kusile Invest 133 (Pty) Ltd

PROJECT INFORMATION

PROJECT DETAILS:

Report Title:	Giyani Stateland Gold Mine Water Use Licence Application: Integrated Water and Waste Management Plan (IWWMP)
Report Number:	A221/28
Date:	April 2021
Document Status:	Draft

WATER USER

Company Name:	Kusile Invest 133 (Pty) Ltd
Registration Number:	2015/452317/07
Contact Person:	Mzamani Mdaka
Designation:	Director
Tel:	+27 (82) 819 5398
Email:	mzamanim@vodamail.co.za
Postal Address:	2 Wilhelmina Avenue, 698 Strubens Ridge Estate, Allens Nek Ext 21, Roodepoort, 1737

CONSULTANT

Company Name:	Headwaters cc.
Contact Person:	Mr. Absalom Lekau Hlabolwa
Designation:	Water Resources Scientist
Tel:	011 312 0294
Fax:	086 238 4157
Email:	lekau@headwaters.co.za
Physical Address:	Birchwood Court, 43 Montrose Street, Vorna Valley, Midrand

APPROVALS

Headwaters cc	
____________________________ Mr. A.L. Hlabolwa, Pr.Sci.Nat. Water Resources Scientist	Date: _________________
____________________________ Mr. R.J. Bulasigobo, Pr.Sci.Nat. Geohydrologist	Date: _________________

Kusile Invest (Pty) Ltd	
_____________________ Mr. M.E. Mdaka Director	Date: _________________

LIST OF ABBREVIATIONS

BPEO	Best Practicable Environmental Option
BPG	Best Practice Guideline
DMR	Department of Mineral Resources
DWS	Department of Human Settlements, Water and Sanitation
EIA	Environmental Impact Assessment
EISC	Ecological Importance and Sensitivity Category
EMP	Environmental Management Plan
EMS	Environmental Management System
ERA	Environmental Risk Assessment
EWR	Ecological Water Requirements
FRAI	Fish Response Assessment Index
GA	General Authorization
GGP	Gross Geographic Product
GN704	Government Notice 704 published in Government Gazette No. 20119, 4 JUNE 1999
Ha	Hectares
HGM	Hydro-Geomorphic Unit
IHAS	Invertebrate Habitat Assessment System
I & AP	Interested and Affected Party
IWRM	Integrated Water Resources Management
IWULA	Integrated Water Use Licence Application
IWWMP	Integrated Water and Waste Management Plan
LOM	Life of Mine
MIRAI	Macro-Invertebrate Response Assessment Index
MAE	Mean Annual Evaporation
MAMSL	Meters Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff

Mbgl	Metres below ground level
Ml/d	Mega litres per day
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
Mt	Million tons
NWA	National Water Act, 1998 (Act No. 36 of 1998)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMWA	National Environmental Management Waste Act, 2008 (Act No. 59 of 2008)
PCD	Pollution Control Dam
PES	Present Ecological Status
PPR	Public Participation Report
ROI	Radius of Influence
ROM	Run of Mine
SHE	Safety, Health and Environment
SLP	Social and Labour Plan
SASS5	South African Scoring System Version 5
SWMP	Storm Water Management Plan
TDS	Total Dissolved Solids
TPA	Tonnes Per Annum
TPM	Tonnes Per Month
WARMS	Water Authorization and Registration Management System
WMA	Water Management Area
WUL	Water Use Licence

EXECUTIVE SUMMARY

Kusile Invest 133 (Pty) Ltd is the holder of a Prospecting Right for gold and related gold-bearing minerals on unsurveyed state land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246, situated approximately 10 km north-east of Giyani within the Greater Giyani Local Municipality in Limpopo Province. The mineral rights holder has applied for a Mining Right in terms of section 22 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). Thus, an Environmental Impact Assessment (EIA) process is underway for the MR application and an Integrated Environmental Authorisation and Waste Licence application as required.

In common with typical mining operations, the project (referred to as Giyani Stateland Gold Mine) involves activities that fall within the ambit of water uses defined in section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). Thus, Kusile Invest 133 is also applying for a Water Use Licence under the NWA, and has appointed Headwaters cc. to undertake and submit an Integrated Water Use Licence Application (IWULA) for Giyani Stateland Gold Mine. The IWULA is being undertaken under Regulations Regarding Procedural Requirements for Water Use Licence Application and Appeals, administered by the Department of Human Settlements, Water and Sanitation (hereinafter referred to as "DWS"). An abridged list of water use activities applied for in relation to the proposed mining and related infrastructure is provided below.

Table 0-1: Summary of proposed water uses

Section 21 Water Use Definition	Activity Description
21(a): Taking water from a water resource	Groundwater abstraction through a borehole
21(b): Storing Water	Storing water in water tanks
21(c): Impeding or diverting the flow of water in a watercourse	Flow impedance for diversion of clean runoff to allow mining activities within 100 m of a watercourse
21(g): Disposing of waste in a manner which may detrimentally impact on a water resource	Retention of dirty water within a Pollution Control Dam (at Swartkoppies)
	Disposal of slimes into a Tailings Storage Facility (TSF)

Section 21 Water Use Definition	Activity Description
	Disposal mining waste onto a Waste Rock Dumps
	Backfilling of mine Pit 1, Pit 2, Pit3, Pit 4 and Pit 5 with overburden
	Dust suppression with water containing waste
21(i): Altering the bed, banks, course or characteristics of a watercourse	Flow impedance for diversion of clean runoff to allow mining activities within 100 m of a watercourse

Mineral Resources and Mining Method

The proposed Giyani Gold Mine operations will commence from five open cast pits, mining will commence using open pits on outcrops. The Life of Mine (LoM) is estimated at 30 (thirty) years. The establishment of open cast pits will be aimed at creating production capacity of 12 000tons per months. The steady state of 12 000 tons per month will yield on average, 595 kilograms of gold sales per year during that period after processing, at a recoverable grade of 4.13 g/ton.

The planned mining methods will include both open cast/surface mining. Mining activities will be carried out on the reef horizon by means of excavating, drilling, blasting, and cleaning of ore using heavy earth moving equipment and blasting using commercial explosives scraper cleaning operations and truck loading or hoisting. The broken ore will be loaded on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts.

Project Extent and Locality

The Giyani gold mine is located within the town of Giyani, approximately 140 km to the northeast of the N1 National Road from Polokwane. A well maintained R 81 road, from the N1 will provide as the main access to the mine. The proposed Giyani Gold Mine Pty (Ltd) is a mining operation on un-surveyed state land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, and intends to establish an open cast mine. The project area covers a surface area of 13894.66 hectares and the extent of the area required for the infrastructure, roads and servitudes is 150 Hectares within Mopani District Municipality in

Limpopo Province. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Mninginisi, Mbatlo, Mavalani and Shikukwani. The existing town roads will be utilized for trucking of ore to the processing plant which will be located within a 20km radius from various mining pits.

Surface Water Resources

The proposed gold mine falls within B82H quaternary catchment. The catchment is located in the Luvuvhu and Letaba Water Management area (WMA).There are two(2) main rivers within the quaternary catchment which are Ntsami River on the western side of the proposed mine and Magobe River on the eastern side of the proposed mine site. These rivers are seasonal and the area is mostly dominated by Mopani veld .The streams on the western side of proposed gold mine Ntsami River drains into Ntsami Dam with some streams nearby Swartkoppies farm (Pit 1).These streams drains directly into Ntsami Dam which is 2km downstream of the site, while Gemsbok Pit 3 is located at the headwaters of Magobe River 350 meters away which joins Ntsami River downstream into Klein Letaba River.

Groundwater Occurrence

According to the geohydrological investigation (J7 Royal Group, 2021), the main aquifers are associated with fractured dyke contact zones and lithological contact zones (DWAF, 1990). Although they may be highly permeable, storage in these fractured aquifers is very limited, especially where a deep overlying weathered zone is absent. As a result they may provide high initial yields, which decline rapidly as the larger joints and fractures are dewatered.

This greenstone belt region includes highly metamorphosed ultramafic to mafic schist, amphibolite, mafic metalava, quartzitic schist, quartzite and ironstone. Local fractured aquifers dominate this region as a result of the intense folding and associated fracturing. Borehole yields typically vary between 2 and 5 ℓ/s, with the highest yields occurring in brittle quartzite. Large-scale groundwater abstraction currently takes place at Giyani (0.1 to 1.0 million m^3) for domestic purposes. Localized low yielding boreholes (0.5 to 3.0 ℓ/s) are also in use by various rural communities to meet their basic human need requirements.

Mine Water Supply

The primary water supply for the mine will be sourced from a groundwater abstraction borehole. It is proposed that groundwater abstraction will provide for potable water requirements and process water make-up for the mine. A water purification system will be installed for the raw water component required for human consumption.

Table 0-1: Process Water Make-up Sources

Facility	Source of Supply	Quantity (m^3/day)
Raw water reservoir	Groundwater abstraction boreholes	1000
Pollution Control Dam	Package sewage treatment plant	223
	Return water from TSF	
Pollution Control Dam	Mine workings	100

Sewage Management

Raw sewage and grey water from the mine offices and ablution facilities will be disposed of into a package sewage treatment plant to be located on the farm Swartkoppies. Treated effluent from the sewage plant will be drained to a PCD and then reused.

Considerations in terms of Section 27(1) of the NWA

The NWA requires that the responsible authority, i.e. Department of Water and Sanitation (DWS), considers factors summarised below in deciding on an application for authorisation of water uses.

(a) Existing lawful water uses

There are no existing registered water uses on the farms. However, it is notable that the site was previously mined and abandoned before the applicant acquired the mineral rights.

(b) Need to redress the results of past racial and gender discrimination

The applicant, Kusile Invest 133 (Pty) Ltd is a black owned company. Therefore, authorised of the proposed water uses would contribute to efforts towards meeting transformation imperatives and giving effect to racial redress. Furthermore, the applicant has developed a Social and Labour Plan (SLP), which is being considered by the DMR as part of the Mining Right application. The SLP is a requirement within the context of the mining sector transformation charter.

(c) Efficient and beneficial use of water in the public interest

The demands of the proposed mining operation on the affected surface and groundwater resources are considerably low in relation to benefits that accrue from the project in the public interest. In this regard, the approximately 365 000 m^3/annum proposed to be abstracted from groundwater resources would facilitate the employment of more than 400 employees on a permanent basis over the 30 year life of mine. This projection excludes contractors and temporary workers. Furthermore, local entrepreneurs will benefit from the project through procurement opportunities for goods and services.

(d) Socio-economic impact of the water use:

(i) <u>If authorised</u>

The applicant`s operations will contribute towards the economic development in the surrounding communities through job creation, procurement of goods and services from local enterprises, and the enhancement of the gross geographic product in the Giyani Region. Authorisation of water uses activities for Giyani Gold Mine will also contribute to the much needed economic growth in the country, with associated contributions to tax revenue. Programmes will be put in place, including those in the SLP, to manage and minimise unintended consequences of influx of job seekers, e.g. informal settlements and associated impacts, crime and prostitution.

(ii) <u>of the failure to authorise the water use or uses</u>

The failure to authorise the water use will render the project non-viable. The mining project that would catalyse the economy and social development in the region over at least 30 years would be abandoned. Benefits for upstream and downstream businesses and sectors would be lost together with the more than 400 permanent employment opportunities in the mine. A decision not to authorise the water uses would thus be inconsistent with the government’s efforts to supporting the economic growth required to meet the vision in the country’s National Development Plan (NDP), as well as economic recovery efforts in the light of the impact of the novel COVID19 and associated lockdown regulations.

(e) Any catchment management strategy applicable to the relevant water resource

There is currently no Catchment Management Strategy (CMS) for the Limpopo WMA – as envisioned in the NWA. There is no CMS applicable to the subject water resources. Nonetheless, consideration has been afforded to the Limpopo WMA Internal Strategic Perspective (ISP), as well as the Limpopo WMA Reconciliation Strategy (DWS, 2015). According to the reconciliation strategy and the ISP, the Ntsami River Catchment (and the Limpopo WMA as a whole) is in stress (i.e. deficit) since demand already exceeds the gross resource yields. Hence, the demand on water resources in the area is on groundwater, and does not include new surface water development.

(f) Likely effect of the water use to be authorised on the water resource and on other water users

The likely effect of the proposed water uses on the water resources includes lowering of groundwater levels and yields within the 1 km radius from the mine workings, e.g. Pit 1. This impact will be localised within the mine boundary and is not likely to extend to neighbouring users.

Seepage from the Tailings Storage Facility (TSF) may also result in groundwater pollution during the life of mine (and post closure). Furthermore, groundwater and surface water pollution may occur post closure, as groundwater levels recover and reach natural ground level. The site location for the TSF is not on geological structure that create flow paths, and a containment barrier system may be included to prevent seepage into underlying resources. Post closure water management measures have been proposed, including pollution control dams for retention (and evaporation) of decant. A water monitoring system has also been proposed to detect contamination and allow for implementation of mitigation and corrective measures.

(g) Class and the resource quality objectives of the water resource

Information on the class and resources quality objectives of the groundwater resources was not at the applicant's disposal at the time of finalisation of the application. Provisionally, it suffices to note here that information on the Class and RQOs is at the DWS' disposal and the authority will take into consideration when evaluating the IWULA. Implementation of the storm water management plan will ensure that the class of the ephemeral Ntsami River and tributary is not affected by the proposed operations.

(h) Investments already made and to be made by the water user in respect of the water use in Question

Investments already made by the applicant include the funds associated with prospecting and exploration, as well as professional services on pre-feasibility studies and environmental studies. The applicant has also made significant investment on securing mineral processing infrastructure and establishment of the site for prospecting activities.

(i) Strategic importance of the water use to be authorised

The proposed water uses for Giyani Stateland Gold Mine are not of strategic importance as defined the National Water Resources Strategy II.

(j) The quality of water in the water resource which may be required for the Reserve and for meeting international obligations

Mitigation measures have been recommended to ensure that the mine does not impact negatively on surface and groundwater resources in the study area. Therefore, the proposed mine is a zero discharge operation, and will not result in violation of the quality of water for the Reserve if all mitigation measures are adhered to as a minimum. These measures including containment barriers for the TSF and PCD. Furthermore, a monitoring programme has been developed, and the quality parameters would be evaluated against the requirements for the Reserve. The project will thus not compromise SA's ability to meet international obligations in relation to water quality in the Limpopo River basin, which a shared river basin.

(k) Probable duration of any undertaking for which a water use is to be authorised

Kusile Invest 133 proposes to operate the Giyani Stateland Gold Mine over a period of 30 years. Therefore, the duration of undertakings on execution of the mining right will be 30 years.

Key Commitments

Key commitments relating to water and waste management have been outlined in the Action Plan and will be reviewed and updated annually. These include the following:

- Obtaining requisite authorisations for water uses and waste management activities regulated by the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and the National Environmental Management: Waste Act, 2008 and Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) prior to commencement with the proposed mining operations.
- Appointing suitably qualified and experienced individuals to ensure implementation of the water use and waste licences, and compliance with conditions therein.
- Ensuring compliance with GN 704 Regulations, as amended, and applying for exemptions where required.
- Implementation of the DWS' Best Practice Guidelines for Protection of Water Resources within the South African Mining Industry.
- Undertaking of baseline groundwater monitoring for a period not less than one year prior to commencement with mining or related activities.
- Implementation of a Storm Water Management Plan (SWMP) with separation of clean and dirty water systems, adequate capacities of storm water drainage and retention (or storage) systems, locality of systems outside watercourse regulated areas and complying with all applicable regulations in Government Notice 704, as amended.
- Inclusion of a containment barrier to prevent seepage from the TSF into underlying groundwater resources.
- Implementation of the water monitoring system within the LOM and post closure for a reasonable period as may be determined by impact studies and in consultation with the DWS.

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Activity Background

Kusile Invest 133 (Pty) Ltd has lodged a mining right application on un-surveyed state land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, Limpopo Province. The proposed mining project entails open cast workings and ore processing for gold extraction. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

Giyani is situated at the intersection between R578 road (South Africa) and R81. It is located in the heart of Limpopo Bushveld, on the northern bank of the Klein (Little) Letaba River west of Kruger National Park. Giyani is now the administrative capital of Mopani District Municipality. The application area is located approximately 10 km North East town of Giyani and accessible along the R81 road from the N1 National Road in Polokwane.

Mining operations will commence from five open cast pits which will later be developed into underground workings and expand into four working levels to reach the steady state production of 12 000 tons per month. Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas.

The open pit mine design shows the ore-body being located centrally to the pit outer walls or pit shell. The waste surrounding the ore-body will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the ore-body and have enough area for movement of machinery inside the pit. The sidewalls of the excavation, surrounding the ore-body, referred to as benches, will be excavated at intervals to a maximum depth 12 metres and must be slanted to ensure slope stability as per specifications determined by the project’s Rock Engineering expert.

The pit development will include the creation of Berms, representing the flat area or horizontal distance of approximately 5 metres in width, when measured from the bottom of the preceding or top bench to the edge of the next bench as the pit goes dipper. An access ramp and haul road will also be created from the top bench on the outer limits of the pit, traversing the lower benches in order to have mining equipment and personnel accessing the pit floor where excavating or blasting of the ore bearing rock will be conducted.

1.2 Contact Details of the Water User

Table 1-1: Details of the Water User

Name of Water User	**Kusile Invest 133 (Pty) Ltd.**
Company Registration No.:	2015/452317/07
Physical Address	2 Wilhelmina Avenue, 698 Strubens Ridge Estate, Allens Nek Ext 21, Roodepoort, 1737
Postal address	P O Box 4603, Weltevreden Park, 1715
Contact Person	Mzamani Mdaka
Designation	Director
Cellular no	0828195398
E-mail address	mzamanim@vodamail.co.za

1.3 Details of the Mine

Table 1-2: Details of the Mining Operation

Name of the Operation	**Giyani Gold Mine (Pty)Ltd**
Commodities	Ore containing gold, copper, zinc, nickel, lead, uranium Gold
Property Details	Portion 0 of the farm 246 Greater Giyani 891 LT
Total Surface Area	Surface area of 13894.66 hectares.(Extent of surface area required for mining is 1000 Hectares and extent of the area required for infrastructure, roads, servitudes etc. is 150 Hectares)
Local and District Municipality	Greater Giyani Municipality, within Mopani District Municipality in Limpopo Province
Magisterial District	Greater Giyani Municipality, within Mopani District Municipality in Limpopo Province
Province	Limpopo Province
Total Life of Mine	30 years
Mining Right Reference Number	LP 30/5/1/2/2 10188MR
WUL Reference Numbers	

1.4 Regional Setting and Location of Activity

The Giyani Gold Mine Pty (Ltd) is a mining operation on un-surveyed state land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, and intends to establish an open cast mine. Giyani is a town which is surrounded by a number of villages, which are administered by the Greater Giyani Municipality, which explains the rich Tsonga cultural activities surrounding the area. Giyani is situated at the intersection between R578 road (South Africa) and R81. A well maintained R 81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Mninginisi, Mbatlo, Mavalani and

Shikukwani. The existing town roads will be utilized for trucking of ore to the processing plant which will be located within a 20km radius from various mining pits and shafts.

It is located in the heart of Limpopo Bushveld, on the northern bank of the Klein (Little) Letaba River west of Kruger National Park. Giyani is now the administrative capital of Mopani District Municipality. The main business is the exploration, mining and marketing of gold. The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment, shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

Mining operations will commence from five open cast pits and expand into four working levels to reach the steady state production of 12 000 tons per month (Figure1-1). Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas. The open pit mine design shows the ore-body being located centrally to the pit outer walls or pit shell. The site falls within Quaternary Catchment B82H of the Letaba Water Management area (WMA).There are two(2) main rivers within the quaternary catchment which are Ntsami River on the western side of the proposed mine and Magobe River on the eastern side of the proposed mine site. These rivers are seasonal and the area is mostly dominated by Mopani veld The streams on the western side of proposed gold mine Ntsami River drains into Ntsami Dam with some streams nearby Swartkoppies farm (Pit 1).The streams drains directly into Ntsami Dam which is 2km downstream of the site, while Gemsbok Pit 3 is located at the headwaters of Magobe River 350 meters away which joins Ntsami River downstream into Klein Letaba River. The surface topography is mainly consisting of a gently undulating plateau. This B82H quaternary catchment is mostly impacted by unregulated grazing and development in the form of village holdings, farm dams, road networks, and previous mining.

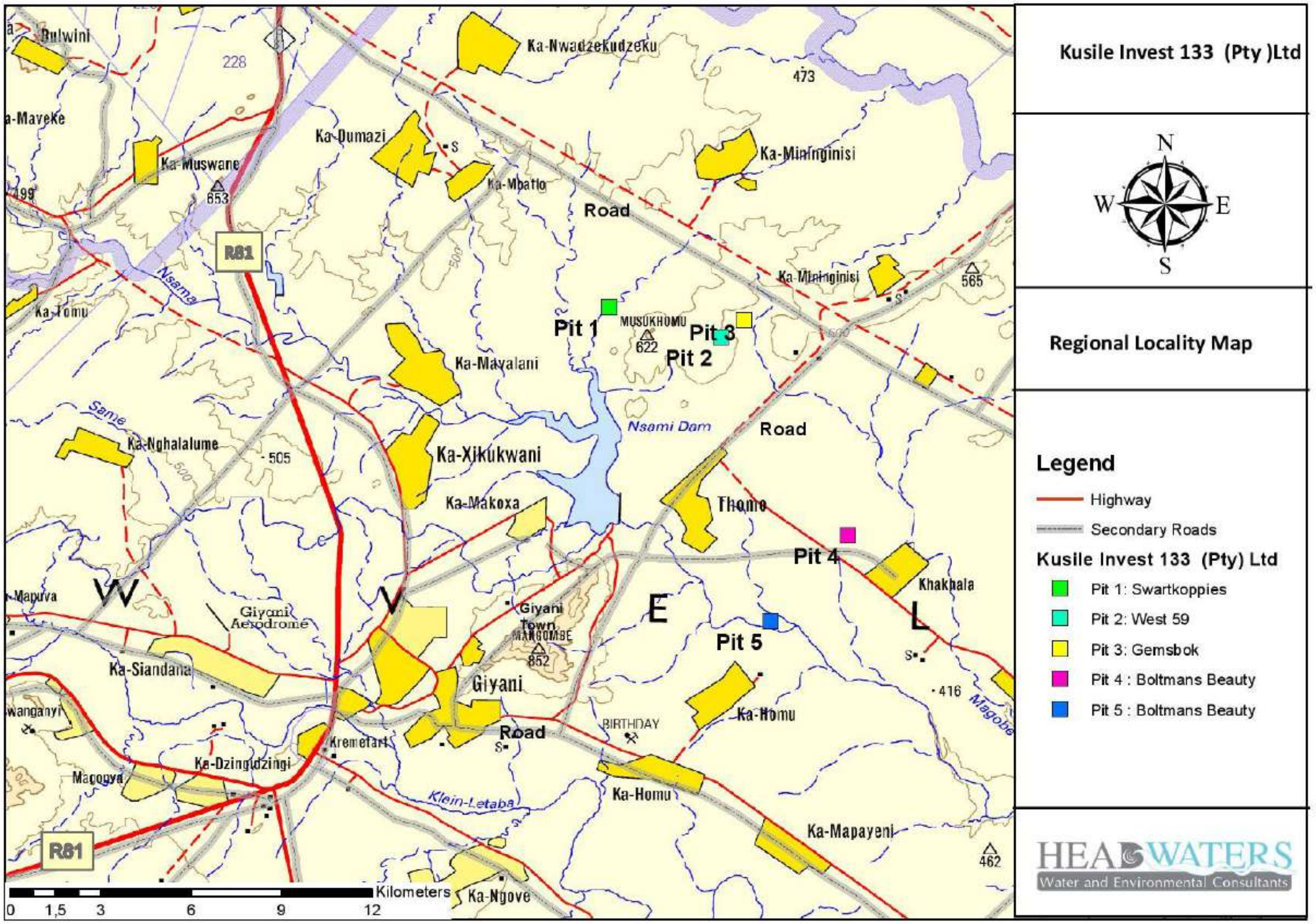


Figure 1-1 Giyani Gold Mine regional locality map

1.5 Property Description

The following portions also fall within the responsibility area of the mine

Table 1-3 Project details

Property Name	Property Owner	Surveyor General Code	Title Deed Number	Extent (Hectares)	Province
Un-Surveyed State land of Greater Giyani 891 LT	**Owner:** Republic of South Africa **Lawful User**: Shiviti Traditional Authority	T0LT0000000089100000	LT891/0	13894,66	Limpopo
Portion of portion 0 of the farm 246 LT		T0LT0000000024600000	LT246/0		Limpopo

The Giyani Gold Mine is situated on the on un-surveyed state land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani.

1.6 The purpose of IWWMP Update

This Integrated Water and Waste Management Plan (IWWMP) represents the Water Use Licence Application (WULA) technical report for Giyani Gold Mine as required in terms of the regulations. It highlights key mining activities within the water cycle, and activities that fall within the ambit of water uses that must be subject to the NWA and waste management activities subject to the NEMWA. The document also applies the Giyani Gold Mine (Pty) Ltd IWWMP in order to review and ensure that the plan remains relevant and applicable to current and planned activities at the mine, whilst allowing an assessment of actual impacts on water resources and other water users, as well as an appraisal of the adequacy of impact prevention and mitigation measures, monitoring plan and compliance to the NWA. Key to the effective implementation of the IWWMP is commitment and support from the Giyani Gold Mine (Pty) Ltd management and operational personnel.

Furthermore, 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 the identification of 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 of the mine.

This IWWMP addresses identified water uses and waste management activities incidental to the mining operations, in order to meet set goals and objectives in line accordance with Integrated Water Resources Management (IWRM) principles applied within a major tributary of the Letaba Water Management Area (WMA).The hydrology of the Letaba Water Management Area (WMA) River catchment. The water use and waste related aspects include, but are not necessarily limited to:

- Water uses associated with the mine
- Water use activities applied for
- Consumptive water usage and wastage (water balances)
- Water reuse and reclamation
- Storm water management
- Groundwater management
- Pollution prevention
- Waste management, including minimization and recycling
- Impacts on water resources and management or mitigation measures
- Water monitoring systems

2 Project Description

2.1 Description of Activity

Mining operations will commence from five open cast and expand into four working levels to reach the steady state production of 12 000 tons per month. Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas.

The open pit mine design shows the ore body being located centrally to the pit outer walls or pit shell. The waste surrounding the ore body will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the ore body and have enough area for movement of machinery inside the pit.

The sidewalls of the excavation, surrounding the ore body, referred to as benches, will be excavated at intervals to a maximum depth 12 metres and must be slanted to ensure slope stability as per specifications determined by the project’s Rock Engineering expert. The pit development will include the creation of Berms, representing the flat area or horizontal distance of approximately 5 metres in width, when measured from the bottom of the preceding or top bench to the edge of the next bench as the pit goes dipper.

An access ramp and haul road will also be created from the top bench on the outer limits of the pit, traversing the lower benches in order to have mining equipment and personnel accessing the pit floor where excavating or blasting of the ore bearing rock will be conducted. The pit will be excavated to an optimal operating final depth of 60 metres below surface level.

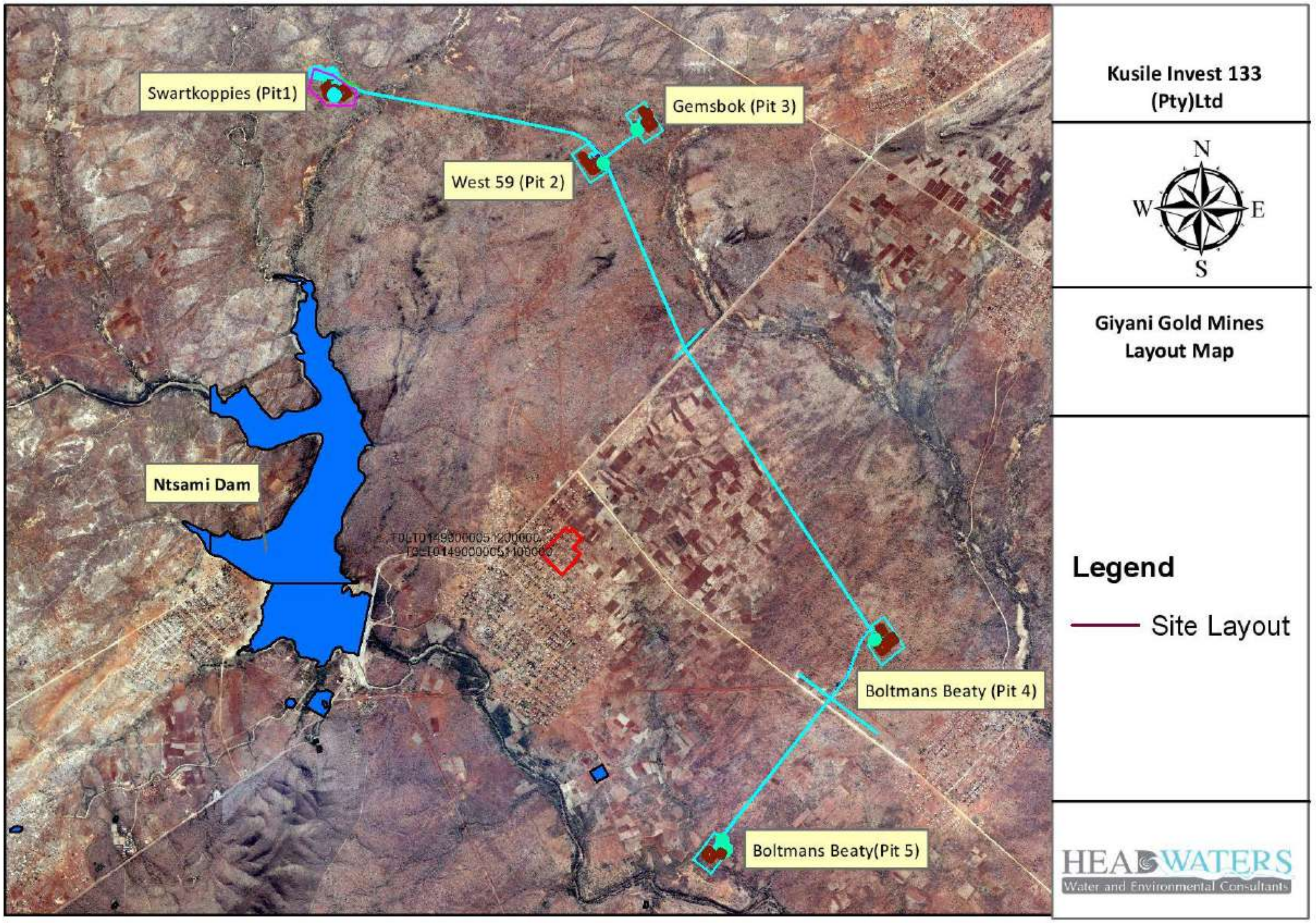


Figure 2-1: Site layout

2.1.1 Mining Method and Products

The planned mining methods will include open cast/surface mining. Mining activities will be carried out on the reef horizon by means of excavating, drilling, blasting, and cleaning of ore using heavy earth moving equipment and blasting using commercial explosives scraper cleaning operations and truck loading or hoisting. The broken ore will be loaded on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts. The following type of minerals are applied for:

- Gold Ore/Bearing Minerals: Code: (Au),
- Copper Ore/Bearing minerals: Code: (Cu),
- Silver Ore/Bearing minerals: Code: (Ag),
- Nickel Ore/Bearing minerals: Code: (Ni),
- Platinum Group Minerals: Code: (PGM),
- Zinc Ore/Bearing Minerals: Code: (Zn),
- Lead Ore/Bearing Minerals: Code: (Pb),
- Uranium Ore/Bearing Minerals: Code: (U),
- Chrome Ore/Bearing Minerals: Code (Cr),
- Aggregate Material

Mining will commence using open pits on outcrops on the site .Separate declines will be developed for men and material access and rock handling. Footwall haulages will be developed from the declines to create crosscuts and raise lines similar to those used in a shaft system. Stoping or conventional breast mining commences from the raise line with mining panels laid out at 20 - 30m lengths. The rock breaking process or excavation entails drilling of blast holes and charging of holes. Blasting of ore is done from both sides of the raise advancing on strike along the reef horizon. The broken ore will be loaded by LHD’s on to trucks and transported through the declines which will be developed below the reef horizon/stoping area for transporting to surface by conveyor belts. In a typical SA gold mine, cleaning of broken ore is conducted by scraper winches to collect ore from the panel into an ore-pass for loading onto a hoppers on the haulage below the stope. The development of the access haulage and the on-reef development is carried out using hand-held rock-drills and pneumatic loaders employed for cleaning of the broken rock into hoppers. The broken rock loaded onto the hoppers is transported/trammed by a locomotive into an ore-pass or rock handling system for hoisting to surface.

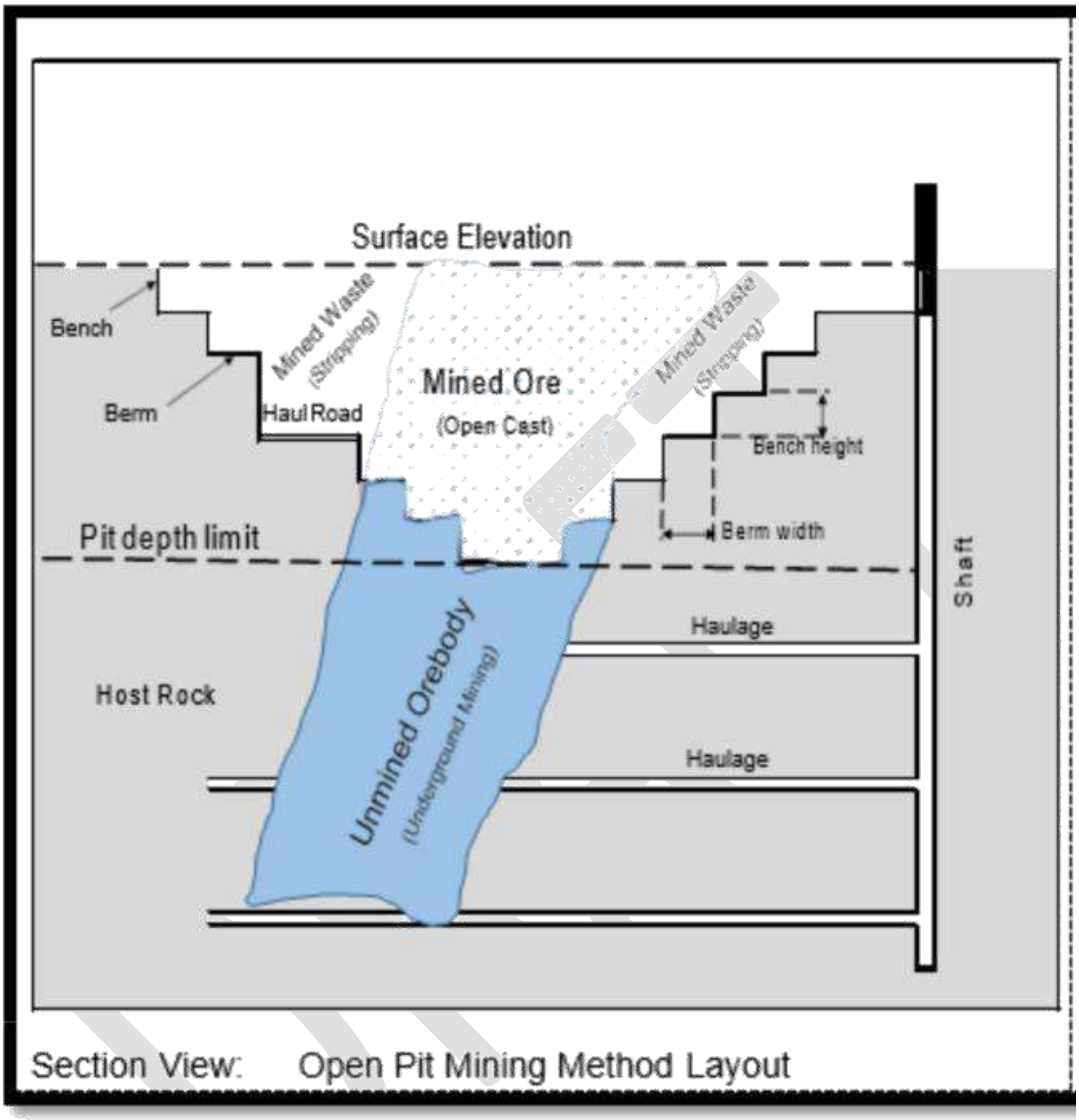


Figure 2-2 Schematic Diagram of Proposed Mining Methods (Open Cast)

2.2 Extent of Activity

The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment; shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

2.2.1 Expansion Plans

The construction work required to develop the mine and mining infrastructure will commence in January 2021 for a period of six months. Thereafter, the mining operation is scheduled to commence immediately after the completion of construction work and granting of the Mining Right in September 2021. Mining operations will be conducted on surface, using open cast mining methods applying conventional stoping methods

2.3 Activity Life Description

The construction work required to develop the mine and mining infrastructure will commence in January 2021 for a period of six months. Thereafter, the mining operation is scheduled to commence immediately after the completion of construction work and granting of the Mining Right in September 2021. Mining operations will be conducted on surface applying conventional stoping methods. The Giyani Gold Mine project is comprised of three different phases which include the construction phase, operational phase, and decommissioning phase.

Construction Phase

The construction work required to develop the mine and mining infrastructure will commence in January 2021 for a period of six months. Thereafter, the mining operation is scheduled to commence immediately after the completion of construction work and granting of the Mining Right in September 2021

Operational Phase

- Total estimated Life of Mine (LoM) for the operational phase is 30 years with a production capacity of 12000 tons per month of Run of Mine Material; which equates to 3,4 million tonnes over the 30 year period
- Mining will commence using open pits on outcrops.
- Total recoverable and sealable ore for the total resource is 14 tonnes

Decommissioning Phase

- The decommissioning phase is expected to begin once all economically exploitable ore reserves have been extracted. This phase will kick-off immediately after end of the operational phase.

2.4 Activity Infrastructure Description

2.4.1 Surface infrastructure

The proposed project would comprise of the design and construction of all building structures, related earthworks and building services, electrical and mechanical installations. This would include *inter alia*:

- Central Plant and Mobile Process plant
- Loading area
- Stockpile areas
- Site clearing and storm water berms and trenches;
- Administration building and first aid;
- Change house and laundry;
- Lamp room, self-rescuer and proto room;
- Access control and security centre;
- TMM Maintenance workshop, services, lubrication, bays;
- Wash bay and oil skimmer;
- Bulk fuel storage area;
- Refuelling bay
- Tyre storage, repair and pump area;
- LVD workshop;
- Fitting, electrical and boiler making workshop;
- Main stores and yard;
- Salvage yard;
- External parking, shade ports and walkways;

- Electrical, water and sewage reticulation;
- Terraces, pavements, access, internal and haul roads;
- Perimeter and internal fencing; and
- Explosives off-loading, storage and distribution.
- One Slimes Dam and PCD"s

2.4.2 Water Supply

Water requirements on the mine will include the supply of water for drinking, dust suppression, general office use; cleaning of equipment; workshops and hauling roads. Potable water will also be needed for human consumption and change house facilities. The mine will source its water supply from groundwater boreholes to be drilled on each mine site. Any excess water will be channelled into settling ponds and used as make-up water in the event of losses associated with mining operations, waste streams and evaporation.

2.4.3 Sewage Disposal

Waterborne sanitation will be in place for ablution facilities at the mine office, change house, and workshop area, to be located. An internal sewage reticulation system will be provided to drain all raw sewage and grey water from the mine office complex and workshops. The sewage will be treated in a package sewage treatment plant. The treated sewage effluent will be drained to the PCD for reuse in the processing plant and for dust suppression. The system will employ an activated sludge process and disinfection to General Effluent Standards. In addition, portable chemical toilets will be provided at the pit area. The raw sewage will be collected by an authorized contractor for disposal into an authorized sewage treatment works. Safe Disposal Certificates will be kept in record at the mine.

2.4.4 Process Water

Process water includes all water pumped and used in especially mine operations for various processes such as washing , crushing , ore processing and dust suppression. Water utilisation will be maximised through recycling of dirty water within the process operations.

2.5 Processing Plant facility

Gold ore mined will be transported by Articulated Dump Truck (ADT) from open cast pits and hoist skips or conveyor belts to stockpiles and storage areas, where it will be transported to the central processing plant by side tipper trucks for stockpiling onto a ROM pad in front of a crusher unit. A ramp will be utilized to provide access for the loading and dumping of ore on the tipping station for crusher feed. A conveyor belt will carry the ore from the tipping station and feed the load on top of a grizzly above the feed bin of a crusher.

The key installations and stages of the processing plant for gold recovery are crushing, milling, gravity concentration, flotation, leaching or cyanidation, elution/concentration and smelting. Summarized below is a high level description of the processing plant for the Giyani mining operations:

2.5.1 Crushing

Ore extracted from the mine will be trucked and delivered to the ROM pad where it will be stockpiled. It will then be fed through a two stage crushing process. The Primary Crusher will be a single toggle jaw crusher with the Secondary Crusher being a cone crusher.

2.5.2 Milling

The process is used to further agglomerate the crushed ore being fed into a semiautogenous grinding (SAG) mill with lime, water and steel balls to liberate the gold contained in the rock. The larger particles from this mill are returned to the SAG mill for more grinding. The finer particles receive more grinding in a ball mill, and are size classified to give a final product of 80% <70 microns. Crushed ore will be ground using a 4.2m diameter, 5.3m long primary ball mill with 1650kw motor.

2.5.3 Gravity concentration

This stage of the process separates gold from the milling process using the metal's higher specific gravity to settle in a solution and separate from other metals and material. This will be done in two centrifugal concentrators installed as part of the plant.

2.5.4 Flotation

It's a process for producing a mineral concentrate through the use of chemical conditioning agents followed by intense agitation and air sparging of the agitated ore slurry to produce a mineral rich foam concentrate. The installation comprises a bank of eight forced air, mechanically agitated cells ($8m^3$ each).

2.5.5 Cyanidation/leaching –

This process involves the dissolution of gold containing ores in dilute cyanide solution in the presence of lime and oxygen contained in acid resistant leach tank.

2.5.6 Elution/concentration –

This process is called Carbon in Pulp (CIP) and is applied to control the gold precipitation from the cyanide solution by use of activated gold (carbon). The final loaded carbon then is removed and washed before undergoing "elution" desorption of gold cyanide at high temperature and pH.

2.5.7 Smelting

The rich eluate solution that emerges from the elution process is passed through electro winning cells where gold and other metals are precipitated onto the cathodes. After precipitation, the product is treated with dilute sulfuric acid to dissolve residual zinc and most of the copper (if any is present). The gold precipitate is then filtered out of the solution, mixed with fluxes and smelted to form crude and impure bars which are sent to a refinery to remove the copper and silver.

2.6 Basic plant design. (supported by a process flow diagram, of the plant).

The basic plant design and anticipated process flow diagram (see diagram below) is based on the proven metallurgical technology currently being used by mines in South Africa and represents a typical free milling carbon-in-leach (CIL)/carbon-in-pulp (CIP) gold processing circuit comprising:

- Two stage crushing;
- Single stage milling designed for a grind size of 105 micron;
- Knelson Concentrator or Gravity recovery cyclone;

- Thickeners;
- CIL/CIP leaching and adsorption with a retention requirement of only 16 hours;
- Elution, gold smelting and carbon regeneration;
- Tailings disposal.

The modular nature of the proposed process plant layout will allow for modifications, including increasing plant throughput, to be undertaken when required.

The process flow diagram of the processing plant showing the key components of the plant is as below:

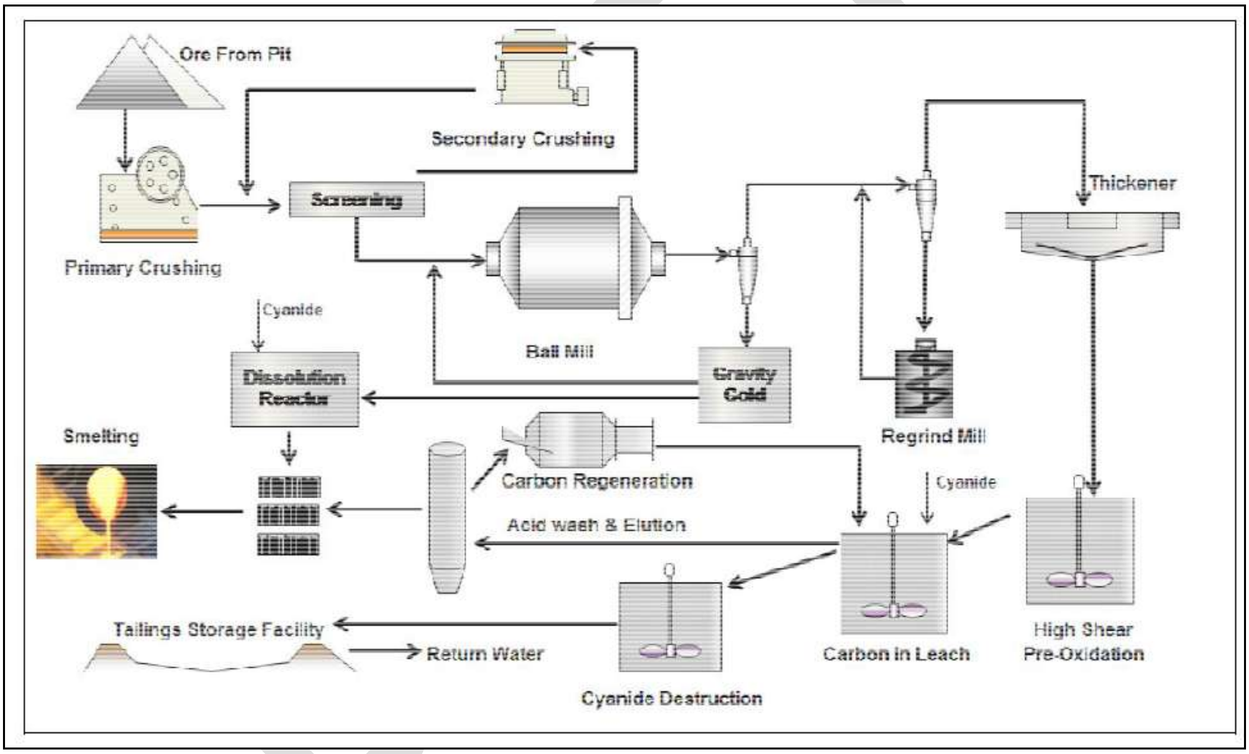


Figure 2-3: Schematic layout of processing plant

2.6.1 Efficiency of the process

Together with an estimate of the mineral recovery rate, and the expected mass or volume of mine waste or residues together with the manner in which it would be disposed of.

The processing plant is based on the production rate of 50 tons per hour of feed material. Based on the flow above diagram, the ROM broken ore will be fed on the primary crusher using front end loaders and dump trucks, operating on a two 12-hour shifts per day. Liberation of mineral product will be achieved through crushing the ROM, milling, floatation, leaching and concentration to liberate the gold and separate it from other metals before smelting into gold bars in a furnace. A ROM stockpile will be established to allow for continuous feed to both the primary and secondary crushers.

When using the Carbon in Leach process, the expected overall recovery of gold in comparison to the plant feed or head grade will be approximately 95% for every gramme of gold contained in the ROM feed material. The amount of residue using a head grade of 5 grammes for every ton of rock implies that 12000 tons/month will contain 57kg or 0.057tons of recovered gold, the balance being waste rock to be disposed as residue. Therefore, the expected mass or volume of mine waste/tailings or residue is calculated to be approximately 11 999.94 tons. The design, construction and operation of the tailings dam will take into account the final closure and rehabilitation requirements of the mine as well as safety. This must be done in a manner that will minimize negative impact on the land and environment post mining operation. The greatest danger of tailings deposition is dam failure, as this can result in catastrophic damage to property and loss of life. To prevent the possible negative impacts as stated above, a conventional tailings disposal method will be applied. Using this method, the underflow from the thickeners will be pumped and discharged on a relatively flat ground to an approved purpose-built tailings dam by means of controlled deposition. The supernatant water contained in the tailings will be collected behind a water-retaining perimeter containment wall or in a water-tight perimeter channel surrounding the tailings dam to prevent affluent water from running into the streams

2.7 Key Water Uses and Waste Streams

2.7.1 Key Water Uses

Based on the project description discussed herein as per the Mining Works Programme (MWP), there are mine related activities falling within the ambit of water uses defined in section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (“NWA”). A summary of the water uses associated with the proposed Gold Giyani Mine are provided in the tabulation below, with details and regulatory requirements discussed in section 3 of the IWMMP.

Table 2-1: Summary of Key Water Uses

Section 21 Water Use Definition	Activity Description
21(a): Taking water from a water resource	Groundwater abstraction through a borehole
21(b): Storing Water	Storing water in water tanks
21(c): Impeding or diverting the flow of water in a watercourse	Flow impedance for diversion of clean runoff to allow mining activities within 100 m of a watercourse
21(g): Disposing of waste in a manner which may detrimentally impact on a water resource	Retention of dirty water within a Pollution Control Dam (at Swartkoppies)
	Disposal of slimes into a Tailings Storage Facility (TSF)
	Disposal mining waste onto a Waste Rock Dumps
	Backfilling of mine Pit 1, Pit 2, Pit3, Pit 4 and Pit 5 with overburden
	Dust suppression with water containing waste
21(i): Altering the bed, banks, course or characteristics of a watercourse	Flow impedance for diversion of clean runoff to allow mining activities within 100 m of a watercourse

2.7.2 Key Waste Streams

According to the available information, the following waste streams might be generated at the proposed Giyani Gold Mine:

- General domestic waste (e.g. food waste, papers, plastics, glass, cans, garden waste, etc.);
- Sewage and sullage from the office, change house and workshop;
- Overburden;
- Tailings/Slimes ;
- Spent oil and grease from mine workshops, as well as hydrocarbon containers ;
- Fluorescent tubes, old batteries, waste paints ;

- Scrap waste (scrap metals, empty chemical containers, and metal off-cuts) ;
- Wood waste (packaging material) ;and
- Disused electronic equipment

The overburden and tailings/slimes are mine residues falling within the ambit of hazardous waste requiring authorisation under the National Environmental Management: Waste Act, 2008. Thus, the mining right application includes an integrated environmental authorisation and waste licence application, which are running concurrently to the IWULA compilation process.

2.7: Organizational Structure of the Applicant

The proposed mining operation will employ approximately 400 permanent employees when operating at a steady state. The majority of the workforce will be recruited from the local and surrounding communities. The aggregate wages that will be paid to these employees will contribute towards poverty alleviation and also improve the local economic activities. The mine will also contribute towards the development of small business enterprises and support local suppliers of capital goods and services, in so doing help create other jobs in the community.

Kusile Invest will also contribute in stimulating the economy in the area through local procurement. The mine will implement a preferential procurement policy to ensure that the bulk of its procurement spend is used for purchasing goods and services from 55 companies that comply with the BBBEE requirements. Preference will be given to local or regional suppliers which have a broad-based empowerment shareholding.

This will include technicians, managers (mine, environment, and safety), and plant and machine operators. Labour will preferably be recruited from within the boundaries of Giyani Local Municipality. The applicant will sub-contract independent companies to carry out functions such as mining, processing, tailings disposal.

All positions will require certificate of competency in line with the requirements of Mine Health and Safety Act, 1996 (Act No.29 of 1996) and other requirements in line with the National Qualification Authority (NQA). The organization structure of the applicant is presented in the figure below. The mine will employ its own permanent employees to conduct the mining, processing and marketing functions with no mining activities outsourced and sub-contracted to independent companies. The details of the mine's functional positions are shown below (Figure 2-4 and Table 2-2).The table below depicts the total planned skills, including both mining and processing personnel for various positions on the mine (own mine personnel excluding outsourced personnel).

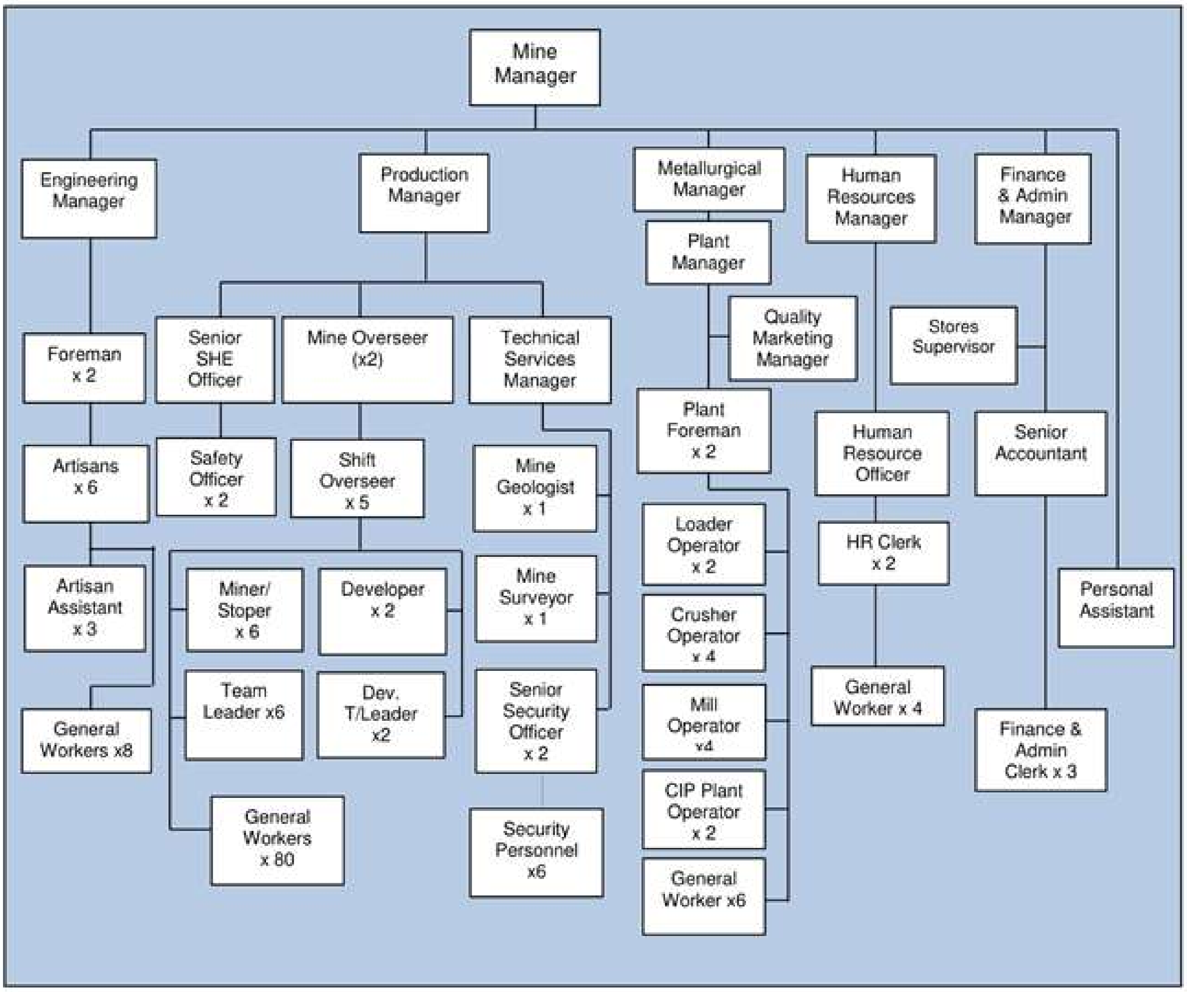


Figure 2-4 General Mine Organizational Structure

Table 2-2: Total skills categories for the mining operations

Employment Levels		Mining	Engineering	Health and Safety	Processing	Finance & Administration	Human Resources	Total
Grading	**Position**							
F	Top management	0	0	0	0	0	0	0
E	Senior management	2	1	0	1	1	0	5
D	Professionals/ Middle management	6	4	4	4	4	2	24
C	Skilled technical/Junior management	12	8	2	4	3	2	31
B	Semi-skilled	220	35	1	24	4	4	288
A	Unskilled	24	16	2	6	0	4	52
TOTAL		**264**	**64**	**9**	**39**	**12**	**12**	**400**

2.8 Business and Corporate Policies Related to the Environment

Giyani Gold Mine is committed to the safety and protection of its employees and the environment. The applicant has developed policies for the Giyani Gold Mine. Furthermore, the proponent (Giyani Gold Mine) has a signed occupational health, safety, and environment commitment statement as shown below:

2.8.1 Health , Safety and Environmental Policy(HSE)

Giyani Gold Mine will be engaged in the exploration, development and mining of gold. In line with the Mine Health and Safety Act, 29 of 1996, Mineral Act, 50 of 1991, Giyani Gold Mine implements and continuously maintain an integrated SHE management system to comply to zero harm with people, communities and the environment.

Our Commitment

To function in a safety and responsible manner that delivers suitable protection for the environment and the heath, and safety of our employees, contactors, visitors and public

Our Aim

To develop, implement and maintain an effective Safety, Health Environment (SHE) management system to ensure risk and impacts are well managed and accomplished

Environment;

- Prevent Pollution ;and
- Rehabilitation of disturbed and mined out land by operations
- Identifying environmental impacts
- Comply with all Environmental applicable Legislation

Safety and Health: (SH)

- Comply with all applicable statutory and regulatory legislation
- To proactively reduce the frequency and severity of injuries through hazard identification, risk assessment and control processes;
- To promote an environment where all employees accept responsibility for their own Health and Safety and everyone engaged in our core business

Continual Improvement

Institute continual improvement efforts by reviewing our performance and the effectiveness of our management system .The policy will be reviewed periodically by managements for continued suitability to ensure that it remains relevant and appropriate to Giyani Gold Mine

3 Regulatory Water and Waste Management Framework

3.1 Summary of all Water Uses

Table 3-1: Summary of water uses

Section 21 Water Use Definition	Activity Description
21(a): Taking water from a water resource	Groundwater abstraction through a borehole
21(b): Storing Water	Storing water in water tanks
21(c): Impeding or diverting the flow of water in a watercourse	Flow impedance for diversion of clean runoff to allow mining activities within 100 m of a watercourse
21(g): Disposing of waste in a manner which may detrimentally impact on a water resource	Retention of dirty water within a Pollution Control Dam (at Swartkoppies)
	Disposal of slimes into a Tailings Storage Facility (TSF)
	Disposal mining waste onto a Waste Rock Dumps
	Backfilling of mine Pit 1, Pit 2, Pit3, Pit 4 and Pit 5 with overburden
	Dust suppression with water containing waste
21(i): Altering the bed, banks, course or characteristics of a watercourse	Flow impedance for diversion of clean runoff to allow mining activities within 100 m of a watercourse

3.2 Relevant Exemptions

The following activities as described in the tabulation below will not be in line with the regulations in the General Notice 704 Regulation of 1999. Therefore, Kusile Invest 133 hereby requests exemption from compliance with the restrictions of the regulations, subject to approval of the Water Use Licence Application (WULA) and conditions of a licence.

Table 3-2: Activities and Infrastructure in GN 704 Exemption Application

Regulation No.	Regulation Narration	Activity/Facility	Motivation/Rationale
4(b)	No person in control of a mine or activity may – except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest.	Swaartkoppies Pit (i.e. Pit 1) and Boltsmans Pit (i.e. Pit 5) encroachments into the 100 m regulated area of watercourse	The pit encroachment into the 100 m buffer zone is a legacy issue that Kusile invest found at the site on commencement with prospecting. Nonetheless, the applicant is addressing the risk by instituting remedial measures, which include a berm and rehabilitation works on completion of the pit workings. Furthermore, the activity is part of the water uses applied for and would thus be controlled through Water Use Licence conditions.
4(c)	No person in control of a mine or activity may –	The deposition (backfilling) of	Backfilling with the overburden is part of

Regulation No.	Regulation Narration	Activity/Facility	Motivation/Rationale
	place 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.	overburden into the mined-out areas (Swartkoppies (Pit 1), West 59 (Pit 2), Gemsbok (Pit 3), Boltmans Beaty (Pit 4); and Boltmans Beaty (Pit 5)	rehabilitation of the pits. The activity is defined as a section 21(g) water use and included in the WULA. Thus, it would be controlled through licence conditions and implementation of mitigation and monitoring protocols recommended in the IWWMP – as a minimum.

3.3 Generally Authorized Water Uses

Since some of the water use activities associated with Giyani Gold Project are subject to authorisation by a Water Use Licence, General Authorisation provisions are generally not applicable. Hence, whilst water uses such as storage of raw water in reservoir may be permissible in terms of the GA, it has been included in the activities proposed for authorisation by a licence, and would be part of licence if granted.

This water use activity involves the storing of potable water for human consumption and processing. The water will be sourced from groundwater abstraction boreholes to be drilled on-site and stored in a potable water tank with a capacity of approximately 400 m^3.

3.4 Water Uses to be Licensed

The water use activities for which the licence is applied for are listed in the table overleaf. The activities are listed in line with corresponding categories in section 21 of the National Water Act, 1998 (Act No. 36 of 1998).

Table 3-3: New Water Uses to be Licensed

#	Water Use	Activity Description	Capacity/Flow Rate/Dimensions	Property	Coordinated
1.	Section 21 (a)	Groundwater abstraction through a borehole	1000 m³/day	Un-Surveyed State land of Greater Giyani 891 LT	30˚46’2.79” E 23˚11’17.36” S
2.	Section 21 (b)	Raw water reservoir	10 000 m³ (x2)	Un-Surveyed State land of Greater Giyani 891 LT	30˚45’58.32” E 23˚11’16.16” S
3.	Section 21 (c)	Pit 1 encroachment into 100 m buffer of a watercourse	Pit edge 70 m to watercourse	Un-Surveyed State land of Greater Giyani 891 LT	30˚46’7.19” E 23˚11’23.04” S
4.	Section 21 (c)	Pit 5 encroachment into 100 m buffer of a watercourse	Pit edge 50 m to watercourse	Un-Surveyed State land of Greater Giyani 891 LT	30˚48’59.49” E 23˚16’59.66” S
5.	Section 21 (g)	Pollution Control Dam (PCD)	Capacity: 10 000 m³ Surface area: 1 ha Depth: 4.0 m	Un-Surveyed State land of Greater Giyani 891 LT	30˚45’55.78” E 23˚11’17.03” S
6.	Section 21 (g)	Tailings Storage Facility	Deposition Rate: 12 000 tpm Area: 5 ha Max. Height:	Un-Surveyed State land of Greater Giyani 891 LT	30˚45’52.48” E 23˚11’14.09” S
7.	Section 21 (g)	Overburden (Waste Rock) Stockpile (Swaartkoppies)	675 000 tpa Surface area: 3 ha	Un-Surveyed State land of Greater Giyani 891 LT	30˚45’59.99” E 23˚11’20.97” S

#	Water Use	Activity Description	Capacity/Flow Rate/Dimensions	Property	Coordinated
8.	Section 21 (g)	Dust suppression with water containing waste	282.00 m^3/day	Un-Surveyed State land of Greater Giyani 891 LT	30˚46’0.79” E 23˚11’18.03” S
9.	Section 21 (g)	Run of Mine Stockpile	Deposition Rate: 144 000 tpa Surface Area: 4 ha	Un-Surveyed State land of Greater Giyani 891 LT	30˚46’1.59” E 23˚11’19.80” S
10.	Section 21 (g)	Backfilling of the open pit with overburden: Pit 1 (Swartkoppies)	675 000 tpa Area: 5 ha	Un-Surveyed State land of Greater Giyani 891 LT	30˚ 46’5.06” E 23˚ 11’22.90”S
11.	Section 21 (g)	Backfilling of the open pit with overburden: Pit 2 (West 59)	1 080 000 tpa Area: 5 ha	Un-Surveyed State land of Greater Giyani 891 LT	30˚ 48’59” E 23˚ 17’0” S
12.	Section 21 (g)	Backfilling of the open pit with overburden: Pit 3 (Gemsbok)	1 134 000 tpa Area: 5 ha	Un-Surveyed State land of Greater Giyani 891 LT	30˚ 48’30” E 23˚ 11’37 ” S
13.	Section 21 (g)	Backfilling of the open pit with overburden: Pit 4 (Boltsman Beauty)	810 000 tpa Area: 5 ha	Un-Surveyed State land of Greater Giyani 891 LT	30˚ 48’5” E 23˚ 11’55 ” S

#	Water Use	Activity Description	Capacity/Flow Rate/Dimensions	Property	Coordinated
14.	Section 21 (g)	Backfilling of the open pit with overburden: Pit 5 (Boltsman Beauty)	1 350 000 tpa Area: 5 ha	Un-Surveyed State land of Greater Giyani 891 LT	30˚ 46’5” E 23˚ 11’23” S
15.	Section 21 (i)	Pit 1 encroachment into 100 m buffer of a watercourse	Pit edge 70 m to watercourse	Un-Surveyed State land of Greater Giyani 891 LT	30˚46’7.19” E 23˚11’23.04” S
16.	Section 21 (i)	Pit 5 encroachment into 100 m buffer of a watercourse	Pit edge 50 m to watercourse	Un-Surveyed State land of Greater Giyani 891 LT	30˚48’59.49” E 23˚16’59.66” S

4 Baseline Environmental Situation

4.1 Climate

This climate type is characterized by extremely variable temperature conditions. The climate is characterized by low rainfalls with a very hot summer. This could be caused by its position in the Lowveld. The project area is situated in a semi-arid climatic zone characterized by dry winters and hot summers. Effectively two seasons exist, namely cool dry season (May to August) and warm wet summers (October to March). Mean Annual Precipitation is about 200-400 mm. Historical temperature records obtained was used to compute the average minimum and maximum monthly temperatures for the area. The average minimum and maximum monthly temperatures were calculated. Average monthly maximum temperatures were recorded at 27°C in January and 16°C in July. The average monthly minimum temperatures for the dry season range between 16°C to 11°C. The beginning of the wet season (October) recorded an average monthly maximum temperature of about 30°C.

Table 4-1: Average Maximum and Minimum Monthly Temperatures

Month	Average Maximum Temperature (°C)	Average Minimum Temperature (°C)
Jan	29	19
Feb	29	18
Mar	28	18
Apr	26	16
May	26	14
Jun	23	12
Jul	23	11
Aug	26	14
Sep	29	16
Oct	30	17
Nov	30	18
Dec	30	19
Min	**23,00**	**11,00**
Average	**27,42**	**16,00**
Max	**30,00**	**19,00**

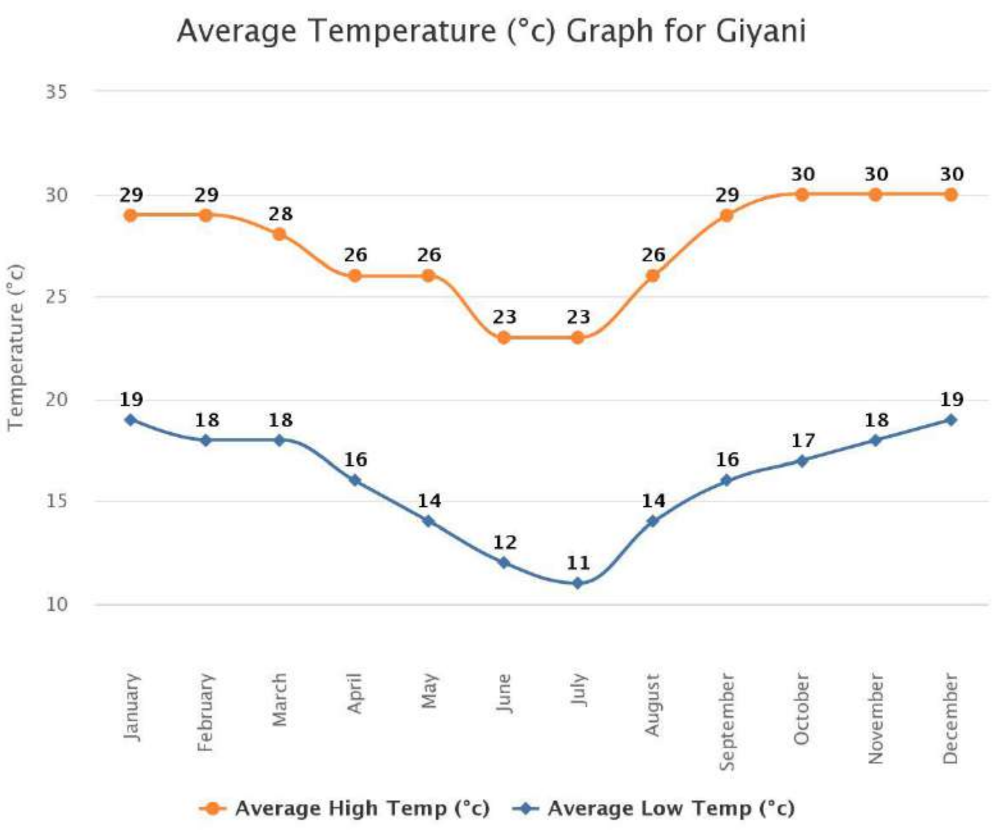


Figure 4-1 Average Maximum and Minimum Monthly Temperatures

4.2 Regional Climate

The proposed project area lies within the summer rainfall region of South Africa and thus approximately 90 percent of the Mean Annual Precipitation (MAP) occurs within the six month period between October and March, with only five percent of the MAP occurring between April and September.

4.3 Rainfall

Historical rainfall records obtained was used to compute the mean annual precipitation. The municipal area received between 200 – 400mm of rain annually. The general rainfall has a direct impact on development, especially on agriculture. This results in the shortage of surface water, leaving the municipality to rely on ground water

Table 4-2 Average Monthly Rainfall Depth (mm)

No.	Month (Time)	Rainfall (mm/month)
1	January	300,5
2	February	231,9
3	March	136,8
4	April	71,5
5	May	22,7
6	June	11,5
7	July	15,3
8	August	11,8
9	September	24,2
10	October	50,9
11	November	156,5
12	December	238,1
	Average	**105,98**
	Min	**11,50**
	Max	**300,50**

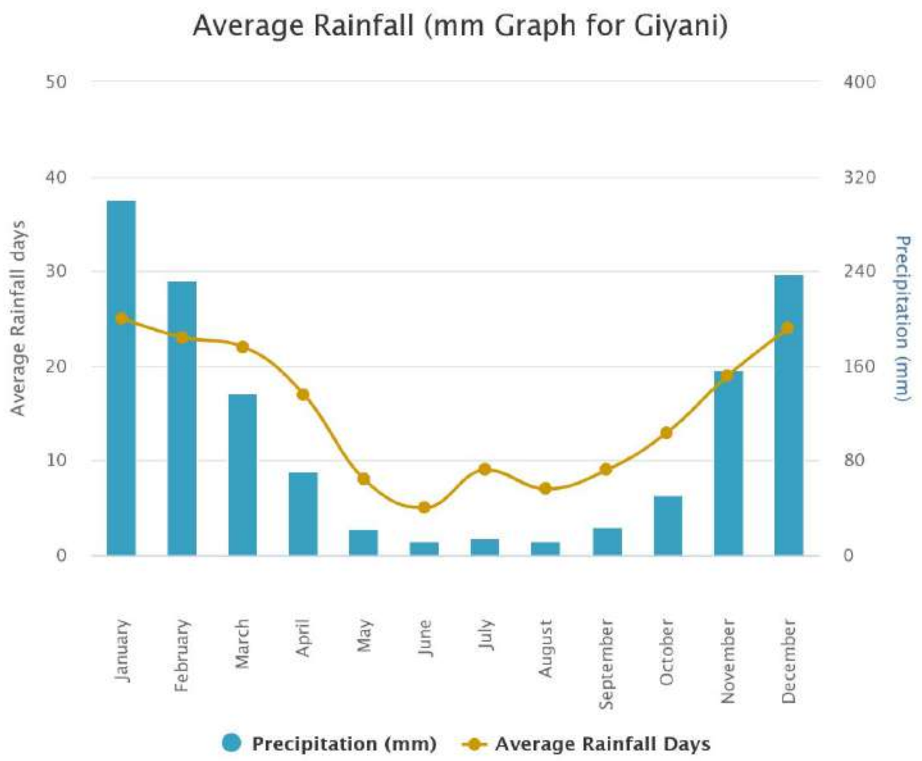


Figure 4-2 Average Rainfall graph

4.4 Evaporation

The average potential mean annual gross evaporation (as measured by A-pan) is about 1,700 mm

4.5 Topography and Geography

The topography is gently undulated and the dominant soils are red, massive or weakly structured, with high base status. Dominant land cover in the area is agricultural, grassland and indigenous Mopani bush forest.The topography is generally flat, except where steep ridges where quartzite and ironstone formations outcrop.

The regional elevation ranges between 420 - 760 meters above mean sea level (mamsl), whereas for the Kusile Invest 133 (Pty) Ltd local site the elevation ranges 420-460 meters above mean sea level (mamsl) .The topography of the investigation area ranges from flat to undulating surfaces in the headwaters of the B82H catchments where Nsami River is perennial and feeds into the Letaba River in the south. Several drainage depression areas are evident around the site but outside the proposed open mine. Topography is the key element affecting how land drains to a particular point (Figure 4-3).

The Giyani gold mine is located within the town of Giyani, approximately 140 km to the northeast of the N1 National Road from Polokwane. A well maintained R 81 road, from the N1 will provide as the main access to the mine

4.6 Surface Water

4.6.1 Water Management Area

The Luvuvhu/Letaba WMA is divided into three (3) primary catchments, namely Luvuvhu, Shingwedzi and Letaba. The town of Giyani is in the vicinity of the Middle Letaba and Nsami dams in its vicinity. The largest user of the available water resources in the WMA is irrigation, while other significant users include forestry and rural domestic water use, international requirements and transfers out of the WMA.

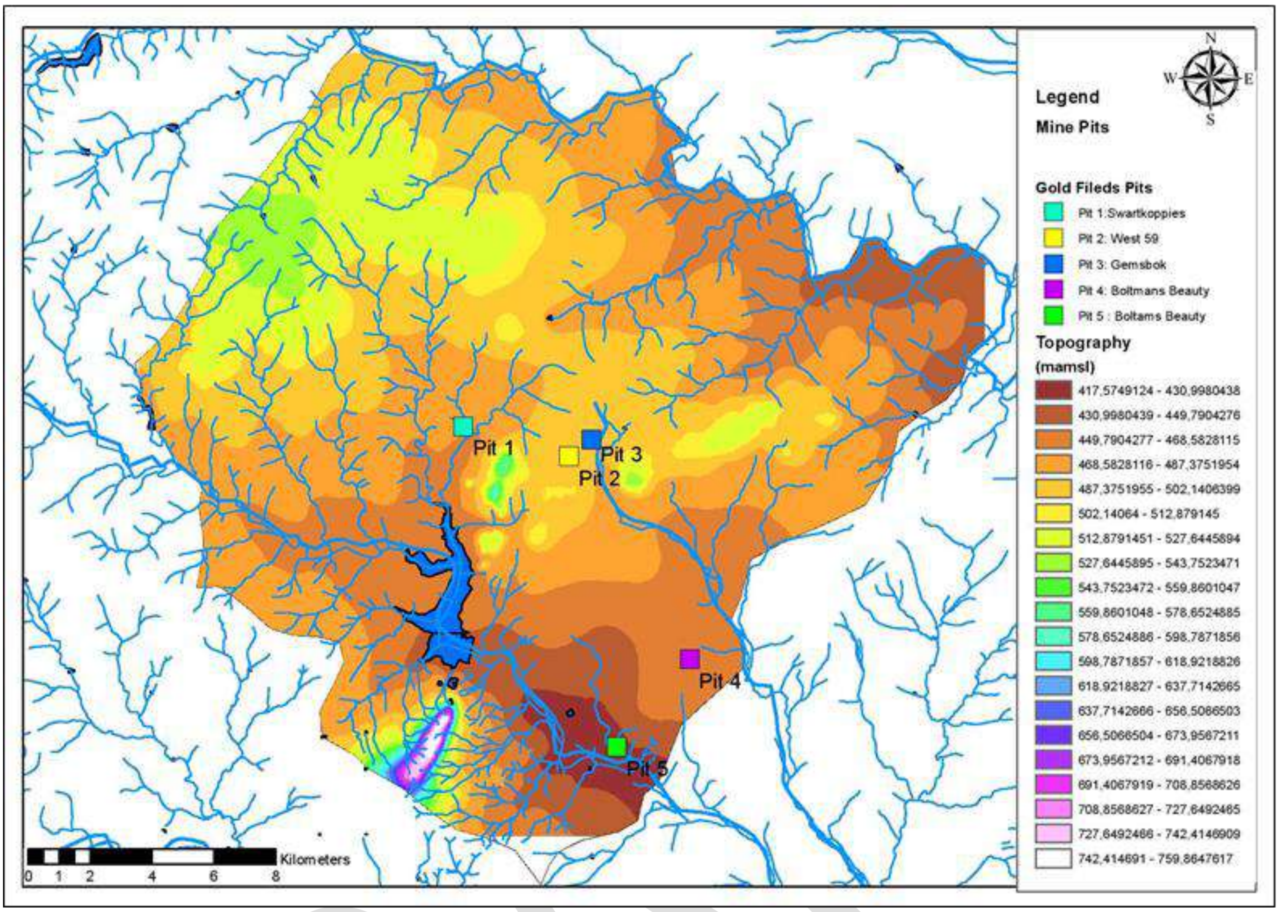


Figure 4-3 Topographical Map of the Proposed Project Area

In the Luvuvhu/Letaba WMA, irrigation accounted for nearly 75% of the total water requirements in the WMA (in 2003). Mean annual runoff depends strongly on rainfall and land use. Deep fractured aquifers occur in the high-lying areas at the base of the escarpment, where the weathered layer is thin or absent bare leucogranites are often exposed. Alluvial deposits can be found along the main rivers, where Intergranular aquifers occur overlying weathered material. Time series of climate, hydrological and groundwater data are submitted together with this report, as well as soil, geology and land cover maps for the Letaba catchment. These data can be used for setting up and calibrating hydrological models.

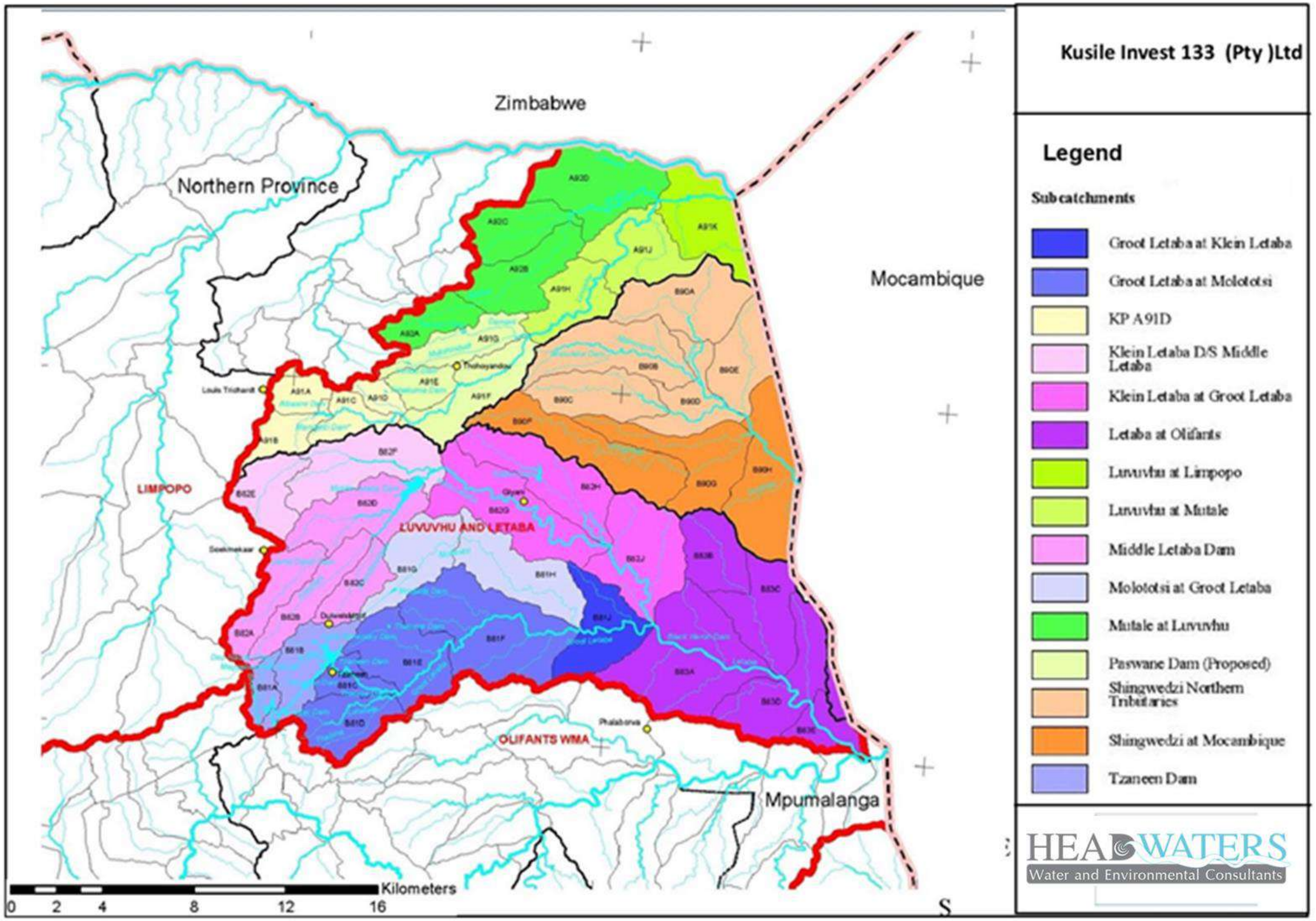


Figure 4-4 Luvuvhu and Letaba Water Management Area Locality Map

4.6.2 Surface Water Hydrology

Kusile Invest 133 (Pty) Ltd Gold falls within B82H quaternary catchment. The catchment is located in the Luvuvhu and Letaba Water Management area. The site can be sub-divided into secondary drainage regions comprised of smaller catchment areas and streams. The surface topography is mainly consisting of a gently undulating plateau. The Ntsami River flows north-eastward directions and has deep gorges through the hills and mountain ranges which resulted in spectacular landscape units. The Ntsami River is seasonal and the area is mostly dominated by Mopani veld. The Ntsami River is situated in low rainfall areas and records peak flows during wet summer times only. Tributaries and streams have their origin in this area e.g. Nsami River, sourced from springs occurring on the North East (NE) .The drainage forms a dendritic pattern flowing north-east along the stream channels. This B82H quaternary catchment is mostly impacted by unregulated grazing and development in the form of village holdings, farm dams, road networks, and previous mining.

Table 4-3 WMA and Quaternary Catchments Descriptions (WR2012, 2017)

WMA	Quaternary catchment	Catchment Area(km^2)	MAP (mm)	PET (mm)	Hydrological sensitivity
Luvuvhu and Letaba Water Management Area(WMA)	B82H	749	400	1700	Low

The site is located on B82H catchments where Nsami feeds into the Letaba River in the south. Several drainage depression areas are evident around the site but outside the proposed open mine. Topography is the key element affecting how land drains to a particular point and the Nsami Dam capacity is 24.4 $x10^6m^3$ and its main purposes is for irrigation and domestic use Table 4-5 and Figure 4-6 below.

Table 4-4 Nsami Dam

Dam Name	Capacity(10^6m^3)	Purpose
Ntsami Dam	24,4	Irrigation and Domestic

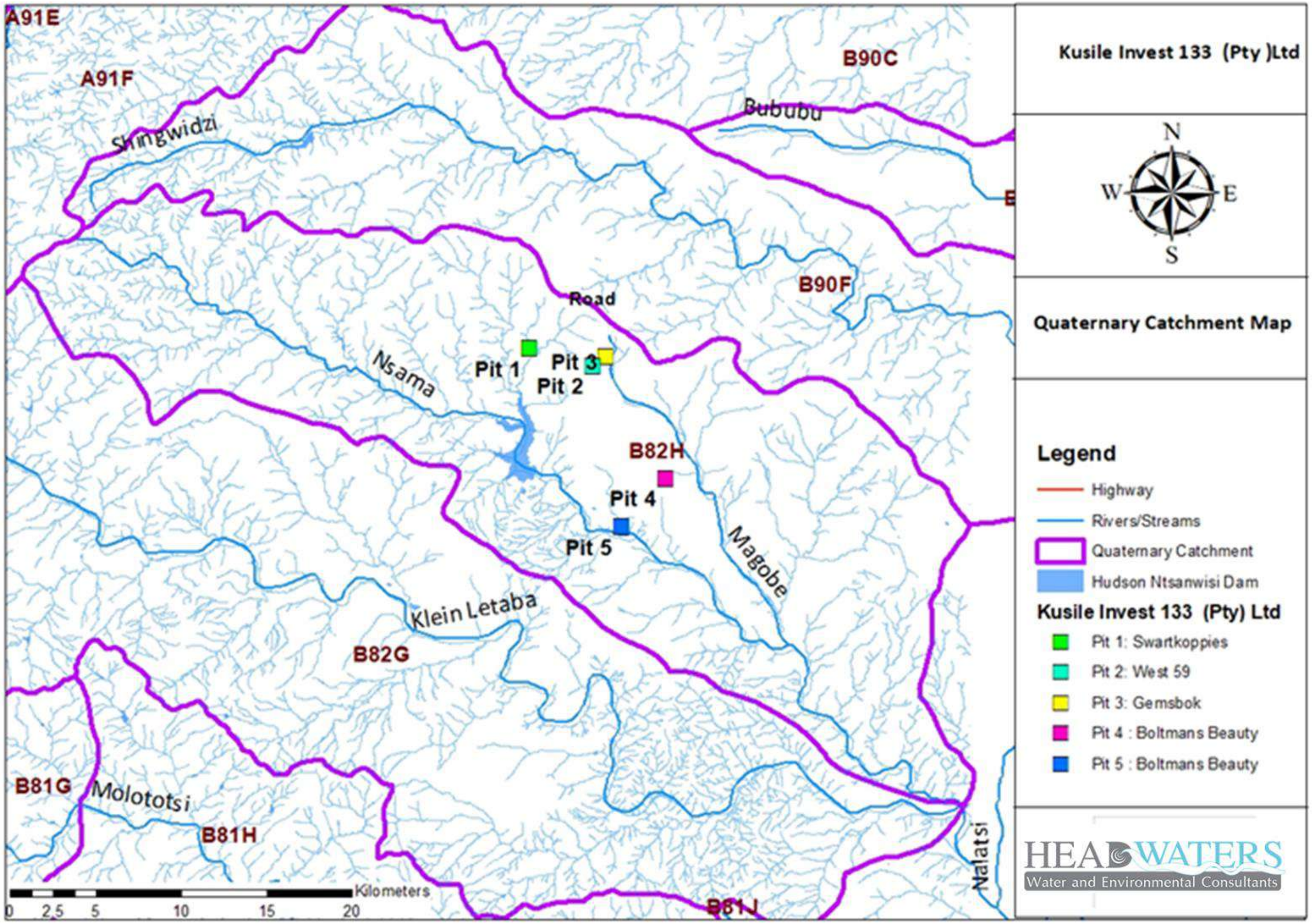


Figure 4-5 : B82H quaternary catchment map

4.7 Sensitive Areas Survey

4.7.1 Critical Biodiversity Areas

According to the Biodiversity Assessment Study (2021) conducted by Oasis Environmental Specialist (Pty) Ltd the biodiversity datasets provided by SANBI (2021), the current mining area (Swartkoppies) and the 2 western pit areas (West 59 and Gemsbok) falls within a Critical Biodiversity Area 2 as seen in Figure 4-6.

These sections were confirmed to be Mopani forest and bushveld areas during the site visit. The two remaining eastern pit areas falls within an Ecological Support 1 area and the other within an Other Natural Areas. These areas had disturbance by informal settlements surrounding these areas.

Critical Biodiversity Areas (2) (CBA 2) are classified as best design selected sites and are selected to meet biodiversity pattern and/or ecological process targets. Alternative sites may be available to meet targets. Ecological Support Areas (1) (ESA 1).

Natural and/or near natural and degraded areas supporting CBAs by maintaining ecological processes. Other Natural Areas are classified as natural and intact but not required to meet targets, or identified as CBA or ESA. No natural habitat remaining areas are not significant to direct biodiversity value.

4.7.2 Threatened Ecosystems and Protected areas

The mining areas does not overlap with any protected ecosystems.

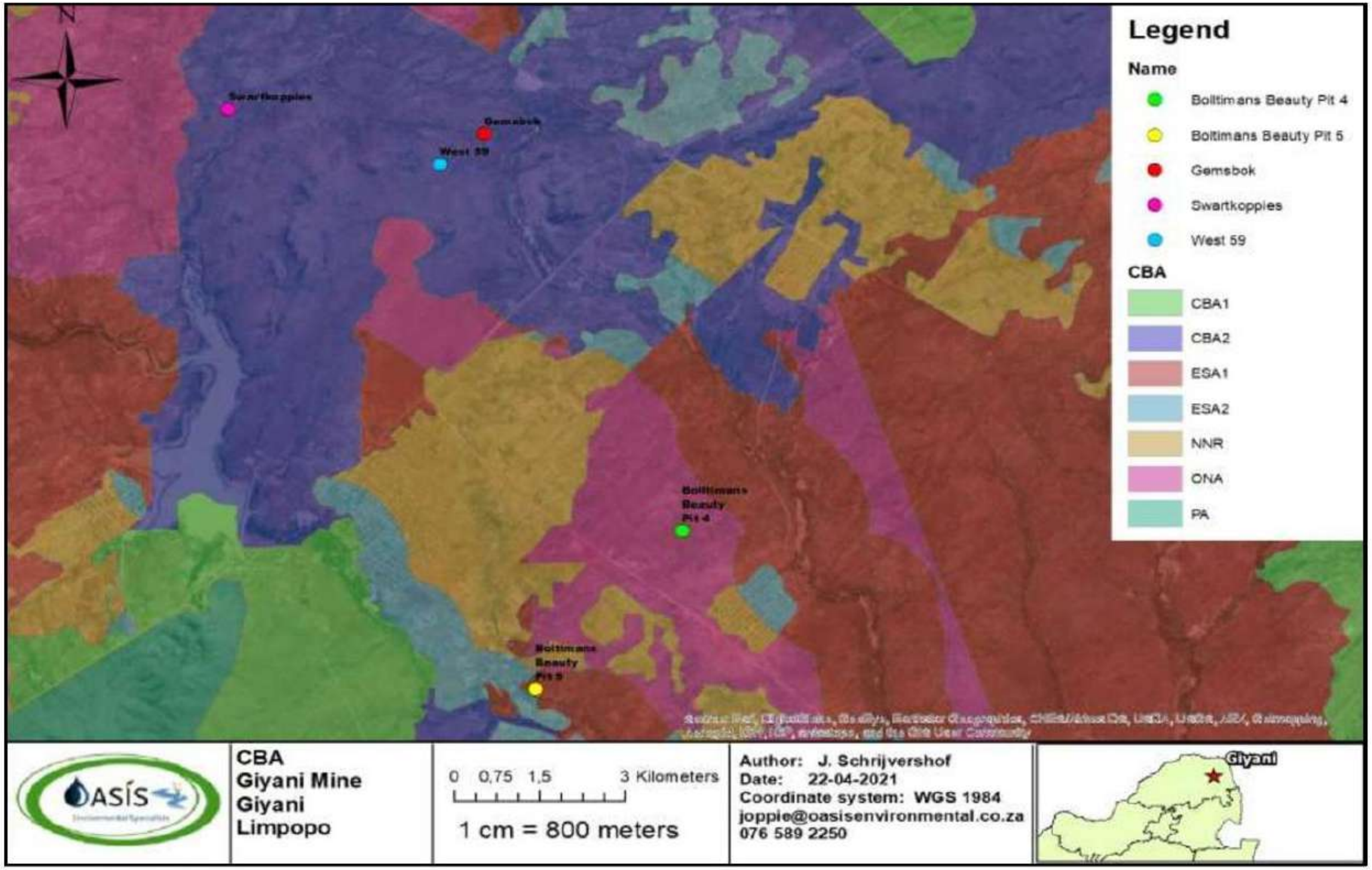


Figure 4-6: Critical Biodiversity Areas map.

4.7.3 Sensitivity Mapping

According to the Biodiversity Assessment Study (2021) conducted by Oasis Environmental Specialist (Pty) Ltd. All Bushveld areas and watercourses still intact can be considered highly sensitive areas serves as a breeding and foraging habitat for a number of faunal species. These channel areas can be regarded as ecologically irreplaceable and covers a portion of the application area. It will be nearly impossible to imitate these areas after mining has been completed with a rehabilitation programme.

Historical transformed Grasslands with cultivation which have been considered as moderately sensitive as they have been disturbed by surrounding anthropogenic activities, but some vegetation has started establishing again. Current transformed land by urbanisation and agriculture can be considered low sensitive and covers the majority of the area. These areas are illustrated in Figure 4-7.

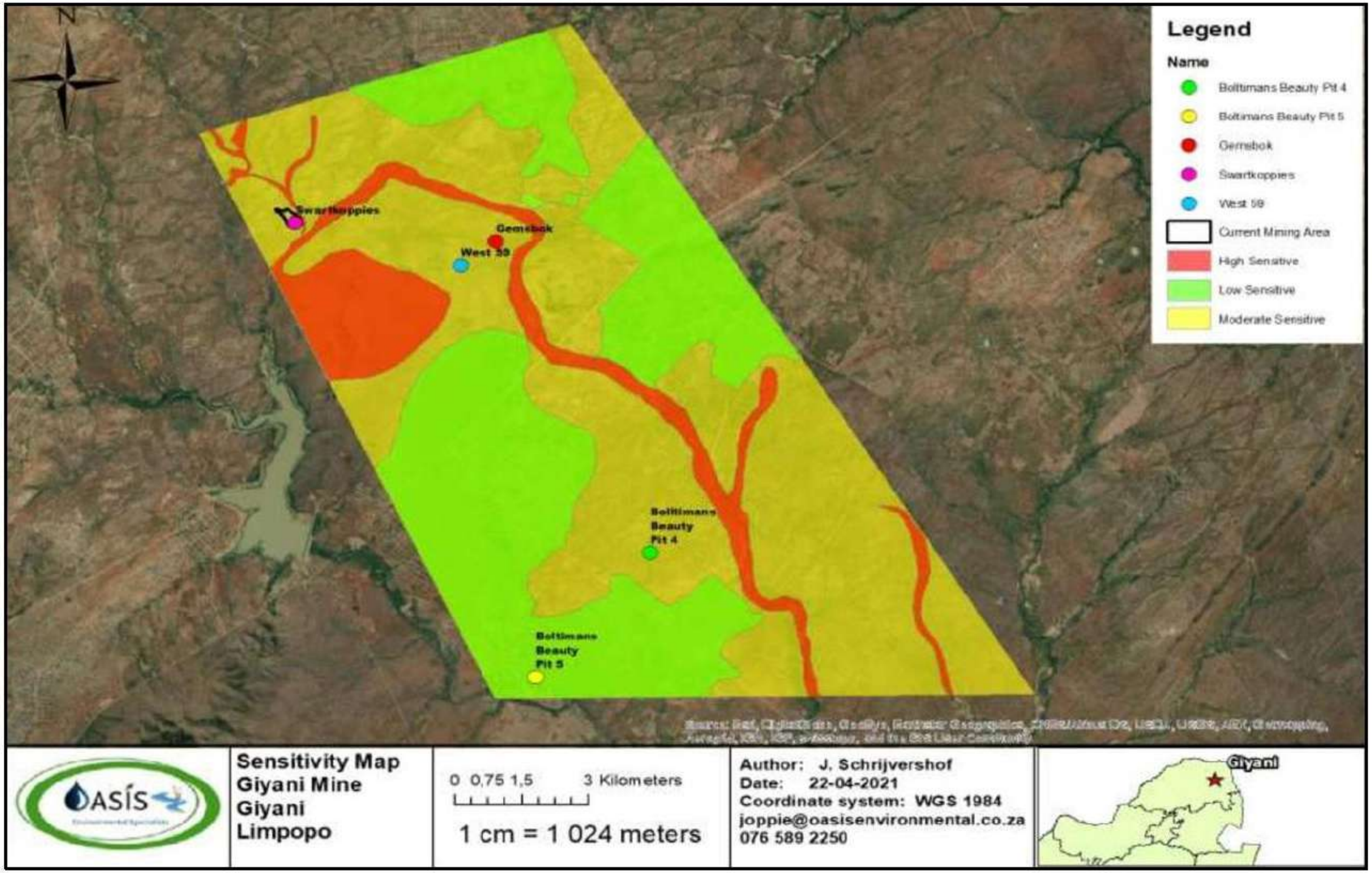


Figure 4-7 Giyani sensitive map

The proposed mining operations fall within close proximity to Important Bird Areas (IBAs), where the proposed mining area falls close to the Kruger National Park.

Trees dominated the area and included *Combretum spp.*, *Vachellia Robusta*, *Vachellia tortilis*, *Senegalia nigrescens* and *Colophospermum mopane.* However, *Cissus cornifolia, Albizia harveyi, Mundulea sericea, Terminalia sericea, Terminaliaprunioides, Grewia bicolor, Dichrostachys cinerea, Sclerocarya caffra, Dalbergia melanoxylon, Peltophorum africanum, Strychnos madagascariensis and Commiphora africana* are also abundantly present.Limited faunal species were observed and the majority was sites near game farms and private reserves and included:

Communal spider nests, sociable weaver (*Philetairus socius*), Laughing dove (*Spilopelia senegalensis*), Ring-necked dove (*Streptopelia capicola*), Cape glossy starling (*Lamprotornis nitens*), Southern red-billed hornbill (*Tockus erythrorhynchus*), Bronze winged courser (*Rhinoptilus chalcopterus*), Golden Orb Spider (*Trichonephila spp*.). Leopard and African elephant listed as vulnerable are thought to occur within this areas according to SANBI (2021), but is found within the Kruger National Park and is unlikely to occur within this area.

A number of potential ecological impacts relating to proliferation of alien invasive species, loss of species of conservation concern, loss of indigenous vegetation, floral and faunal habitat and ecological structure of water resources and soil, loss of floral diversity and ecological integrity. The significance of potential impacts on biodiversity within the area was rated as high significance without mitigation and moderate with mitigation as the proposed areas lies in Mopani bushveld areas

4.8 Regional Geology

The regional geological setting relating to the area of the mining right application is depicted by the characteristics of the Archaean crust of southern Africa, comprising the Kaapvaal Craton, the Zimbabwe Craton and the Limpopo Metamorphic Complex. The Kaapvaal Craton has three major crustal elements, namely a core of Palaeo- to Meso-Archaean metamorphic rocks termed the Kaapvaal Shield and exemplified by the Barberton granitoid-greenstone terrane; the northern and western "rims" to this shield formed by granitoid-greenstone terranes accreted to the Kaapvaal Shield in the Neoarchaean and the Cratonic Basin successions. The northern rim to the Kaapvaal Shield comprises the Murchison, Pietersburg and Giyani greenstone belts. The Giyani Greenstone Belt (GGB) is the main focus in relation to the area of application. The rock stratigraphy within the Giyani Greenstone Belt forms part of the Kaapvaal Craton sequence. The figure below shows the geological setting and extent of the Kaapvaal Craton, and the northern rim in which the application area is located. The Cratonic Basin successions were deposited on the Kaapvaal Shield during the Mesoarchaean and are preserved as the Dominion Group and Witwatersrand Supergroup in the central part of the craton and the Pongola Supergroup in the southeast.

4.8.1 Local Geology

The GGB is approximately 17km wide and has a strike length of 70km. The belt has an overall NE-trend, but to the west, the GGB splits into a northern Khavagari arm and a southern Lwaji arm separated by granitoid gneiss (the Klein Letaba Gneiss) and younger granite. The Lwaji arm has more or less the same trend as the main part of the belt but the Khavagari arm has been rotated into an E-W orientation. The GGB is a shallow structure with a down dip extension of around 1.5km in the NW and 4km in the SE.

The predominant rocks in the project area include the ultramafic (tremolite) schists; mafic (chlorite) schists which are common throughout the belt. Also present in the area are the metasedimentary rocks which comprise Banded-Iron-Formation (BIF), quartzite, metapelite and rare dolomite. Although these formations are discontinuous, they form important structural markers throughout the belt. They are best developed in the northern sections including the Khavagari arm and the clastic metasedimentary rocks with obvious primary structures are abundant along the Nsama River in the central part of the belt.

The supracrustal rocks of the GGB have been subjected to amphibolite facies metamorphism. Peak metamorphism was followed by uplift and the influx of CO2 rich aqueous fluids. This rehydration event occurred during the exhumation of the Limpopo Complex along the Hout River Shear Zone and was responsible for shear-zone hosted alteration of the rocks in the GGB and the formation of the orogenic gold deposits.

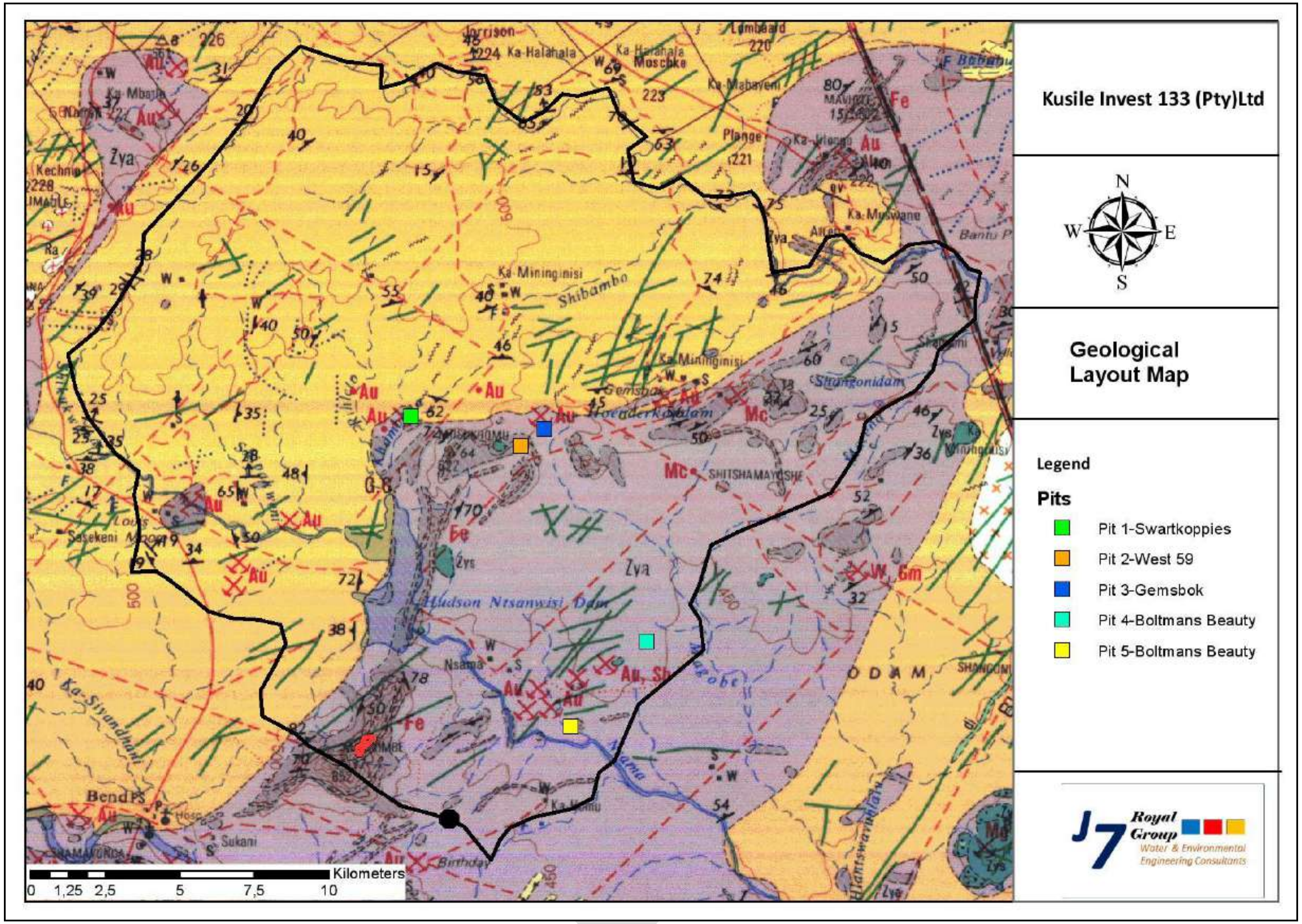


Figure 4-8 Geological Map of the Project Area

4.8.2 General Hydrogeology

The hydrogeology of the Letaba catchment is characterized by secondary or fractured aquifers formed by mainly metamorphic basement rocks of the Goudplaats Gneiss, Giyani and Gravelotte Greenstone belts, Igneous rocks of the Lebombo Granite, Makhutzi Granite, various younger granitoid intrusions of the Vorster Suite and gabbroic intrusions of the Rooiwater Suite Timbavati Gabbro. Intergranular aquifers (unconsolidated to semi-consolidated materials, with primary porosity) occurs on the Letaba River, mainly inside the Kruger Park.

The hydrogeology of Giyani area is mostly characterised by fracture-bound aquifers formed mainly within the rocks of Goudplaats Gneiss, the Giyani Greenstone Belt and to a smaller extent the Shamariri Granite and Schiel Alkaline Complex. Nsami is main major river in the study area which flows into easterly directions and the river forms part of the secondary drainage, which falls within the Letaba/Luvuvhu Water Management Area (WMA).The Goudplaats Gneiss rocks have a moderate to good groundwater potential and the yield varies from 0.2 to 0.5 ℓ/s.The high yield groundwater in these rocks is associated with fractured zones, pegmatites, transitional zone between weathered and solid gneiss.

4.9 Groundwater

4.9.1 Aquifer Characterization

The main aquifers are associated with fractured dyke contact zones and lithological contact zones (DWAF, 1990). Although they may be highly permeable, storage in these fractured aquifers is very limited, especially where a deep overlying weathered zone is absent. As a result they may provide high initial yields, which decline rapidly as the larger joints and fractures are dewatered

This greenstone belt region includes highly metamorphosed ultramafic to mafic schist, amphibolite, mafic metalava, quartzitic schist, quartzite and ironstone. Local fractured aquifers dominate this region as a result of the intense folding and associated fracturing.

Borehole yields typically vary between 2 and 5 ℓ/s, with the highest yields occurring in brittle quartzite. Large-scale groundwater abstraction currently takes place at Giyani (0.1 to 1.0 million m^3) for domestic purposes. Localized low yielding boreholes (0.5 to 3.0 ℓ/s) are also in use by various rural communities to meet their basic human need requirements.

4.9.2 Groundwater Quality

4.9.2.1 Water Quality Assessment (Hydrogeochemistry)

Characterisation of hydro geochemistry and risks to groundwater quality and knowledge of the processes that control natural water composition is a necessity for rational management of water quality. Hydrogeochemistry pursues to determine the origin of the chemical composition of groundwater and the relationship between water and rock chemistry as they relate to water resources and users. A basic and straightforward tool in hydrochemical studies used to summarize and present water quality data are graphical interpretation which are also used in this study.

4.9.2.2 Baseline Surface Water Quality

Water sample was collected and analysed by UIS Laboratories (Pty) Ltd Laboratories which is SANS accredited laboratory. An existing borehole(Pit 1 Area : Swartkoppies) water samples was submitted in the laboratory in March 2021.Water quality chemistry results was observed ,TDS is quite high for drinking water.The pH value remains in the neutral to slightly alkaline range, within the stipulated limits in the SANAS limits.

The water quality results was analysed using the different water quality software's which are computer program capable of displaying thematic maps with data and graphs depicting the data in a more specialized way. Specialized chemical diagrams included in this report are:

- Piper diagram (Piper, 1944);
- Durov Diagram ;
- Schoeller–Breakoff's diagram (Schoeller, 1962);
- Sodium Adsorption Ratio diagram (United States Salinity Laboratory, 1954);

- Water quality is determined by several factors including temperature, colour or clarity, taste, suspended matter, dissolved matter, organisms, pH and radioactivity.

4.9.2.3 Hydrochemistry Modelling –Surface Samples

Piper diagram –Groundwater Monitoring

Piper Diagrams illustrates cations and anions shown by separate ternary plots. The apexes of the cation plot are calcium, magnesium and sodium plus potassium cations. The apexes of the anion plot are sulphate, chloride and carbonate plus hydrogen carbonate anions. The two ternary plots are then projected onto a diamond, where the water type is determined. In this project water samples were collected and analysed at the UIS Laboratories (Pty) Ltd whereby the results in piper diagram were obtained.

Characteristics of piper diagram:

- Normalizes the cations and anions, separately
- Does not show absolute concentrations: waters with the same relative concentrations will plot on top of each other, no matter how different the actual salinity is
- Helps identify water types
- Can show mixing lines between water types

Based on table below and figure below, the water type table (Table 4-5) was generated as shown.

Table 4-5: Water types from piper diagram

No.	Sample Name	Water Type
1	KUBH1	Ca-Mg-SO_4 waters typical of Domestic waste dumps/Natural saline waters –indicative of high levels of TDS

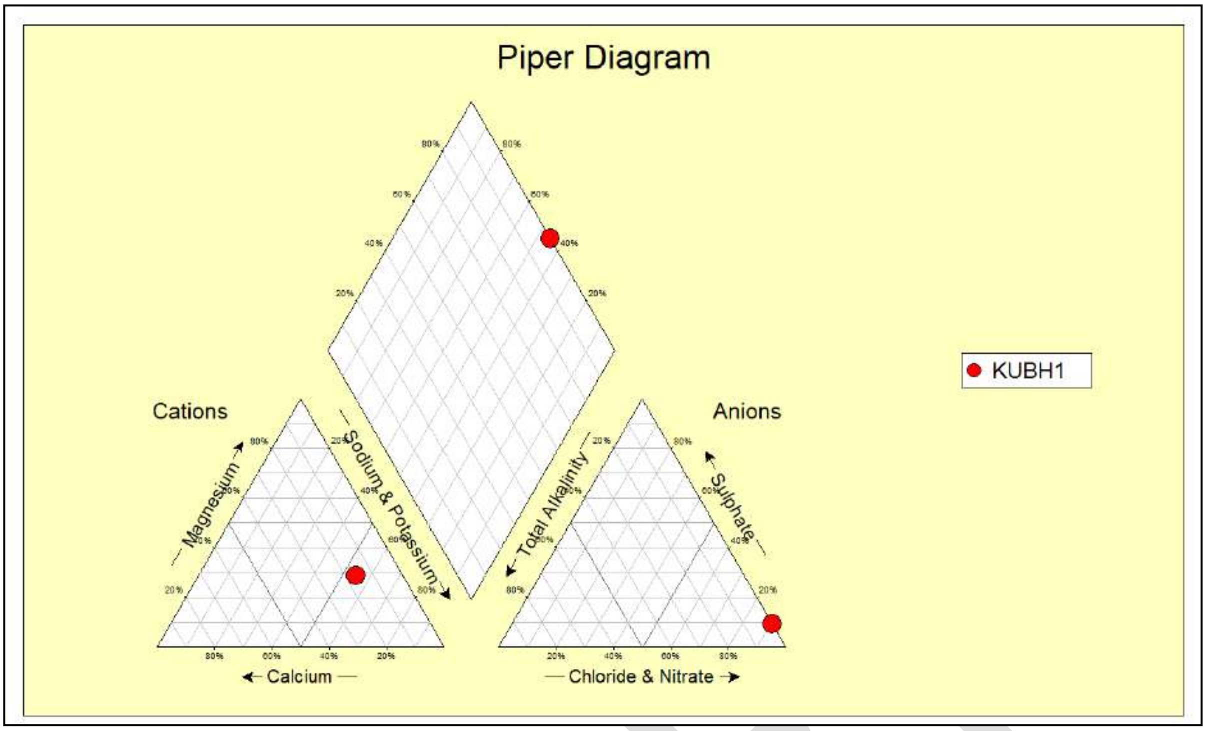


Figure 4-9 Piper Diagram Ground Water Plots 2021

Characteristics of Durov diagram:

The Durov diagrams (Figure 4-7) are basically the same as the Piper diagram with two extra legs allowing pH and EC to be included in the diagram.

Interpretation:

The table below interprets clearly the dominant water types in this Gold Mine hydrocensus program (Table 4-7 and Figure 4-8).

Table 4-6 : Water type sub-fields (Durov diagram)

No.	Dominance	Interpretation	Present study
1	HCO^{3-} and Ca^{2+} dominant	Commonly Indicates recharging waters	
2	HCO^{3-} dominant and Mg^{2+} dominant	Cations indiscriminant	**KUBH1**
3	HCO^{3-} and Na^{+} dominant	Ion exchange waters	
4	SO_4^{2-} dominant and Ca 2+ dominant	Anions indiscriminate, recharge/ mixed water	

No.	Dominance	Interpretation	Present study
5	No dominant anion or cation (Dissolution/ mixing)		
6	SO_4^{2-} dominant and Na^+ dominant	Anions indiscriminate, mixing influences	
7	$Cℓ^-$ and Ca^{2+} dominant	Cement pollution or reverse ion exchange of NaCℓ waters	
8	$Cℓ^-$ dominant and no dominant cation	Reverse ion exchange of NaCℓ waters	
9	$Cℓ^-$ and Na+ dominant	End point water	

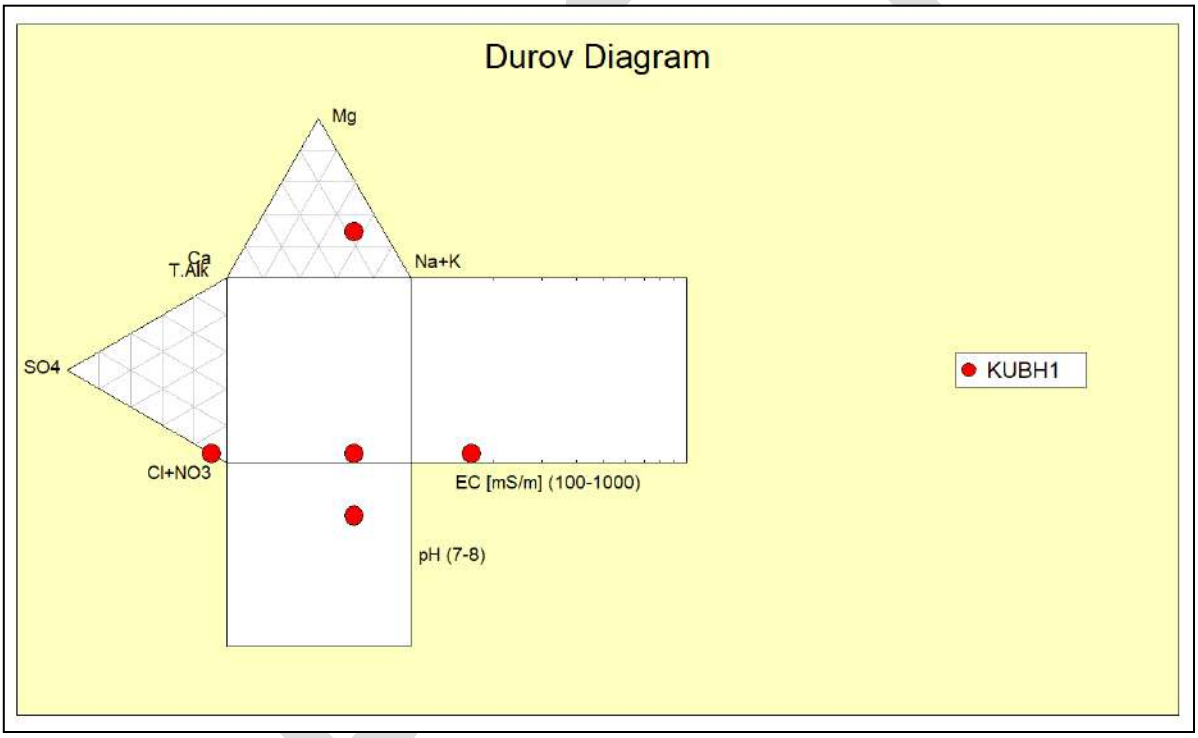


Figure 4-10 Durov diagram Ground Water Plots 2021

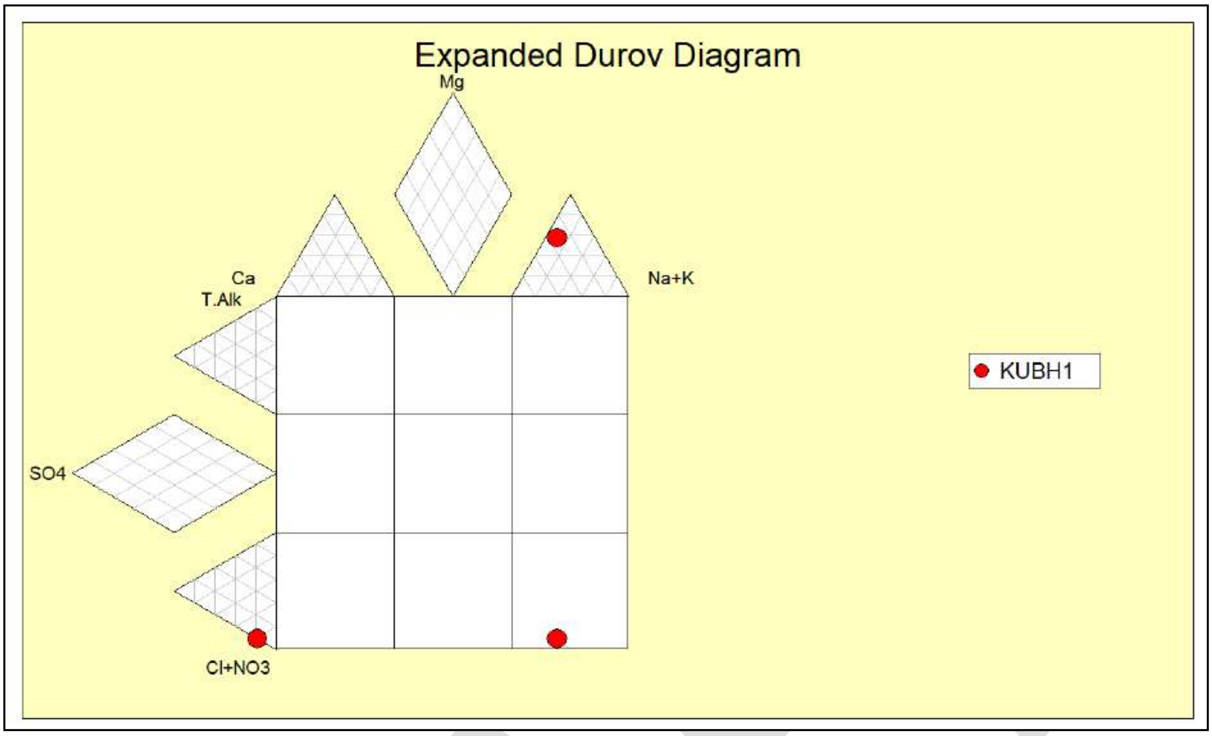


Figure 4-11 Expanded Durov diagram Ground Water Plots 2021

Expanded Durov Diagram(Figure 4-8) are a combined plot consisting of two (2) ternary diagrams (cations plotted against anions) or it uses the trilinear diagram, where two triangles are split into three areas each and projected to a rectangular area with nine different zones. This helps with the exploration of chemical compositions and total dissolved solids. It provides more understanding on the hydrochemical facies by assisting in the process to identify water types and shows geochemical processes that could assist in understanding and evaluating the quality of groundwater (Bosman, 2014).

From the assessment the Durov diagram indicates the following:

- KUBH1 : -Indicates the Domestic Waste Dumps or Natural Saline Water , indicative of TDS

Schoeller-Berkaloff Diagram-Surface Monitoring

Characteristics of piper diagram

Logarithmic diagrams of major ion analyses in **meq/ℓ** demonstrate different water types on the same diagram (Figure 4-9).

- Samples concentrations not ratios are displayed and compared
- Similar waters exhibit similar “fingerprints

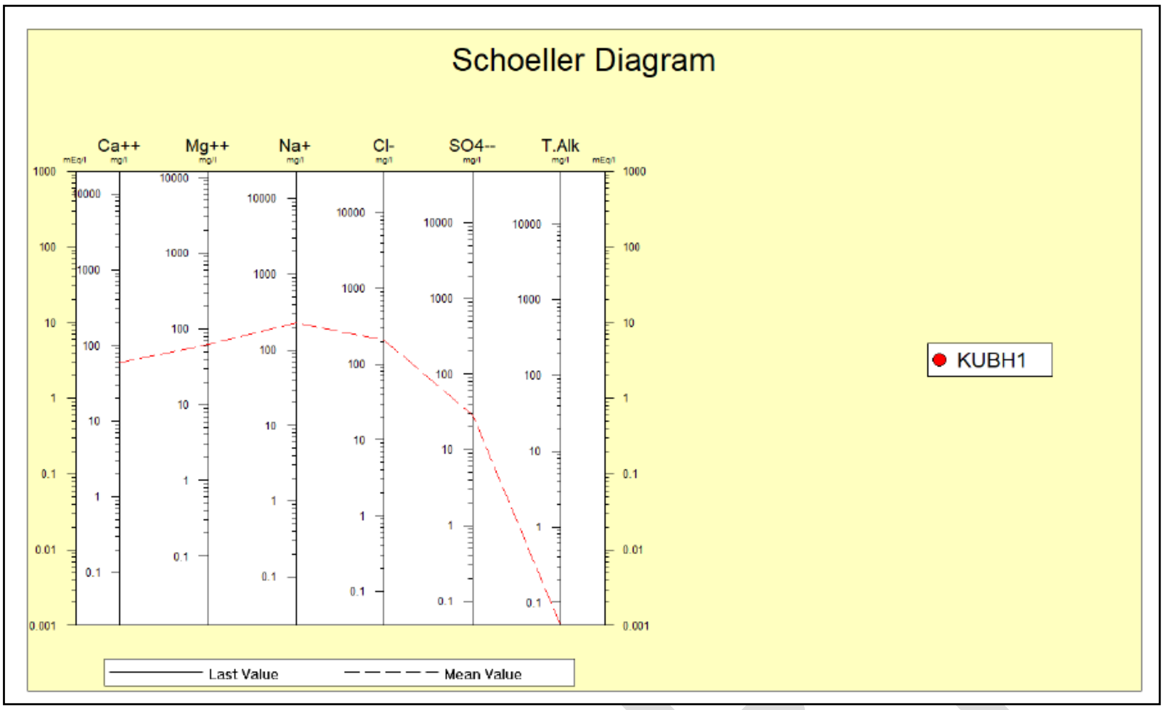


Figure 4-12 Schoeller-Berkaloff Diagram (DWAS, 2017)

Sodium Adsorption Ration diagram (S.A.R)

The SAR diagram (Figure 4-11) are used to determine if water is suitable for irrigation it uses the following equation (Driscoll, 1986):

SAR = Na / (Ca/2+Mg/2)0.5.

Where sodium, calcium and magnesium are in meq/l. Water with SAR values of 18 and above will result in an excess of sodium in the soil. Water with SAR values of 10 and below is safe and suitable for irrigation.

The KUBH1 samples for this project has SAR values are right on 10 which indicates water is unsafe and not suitable for irrigation.

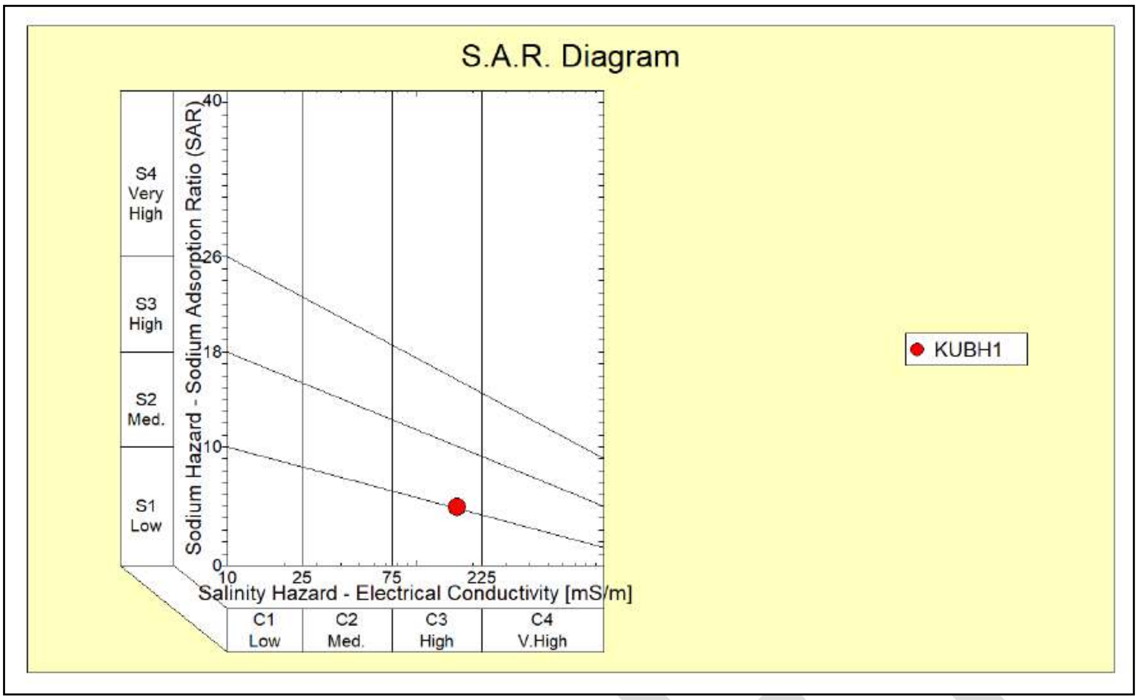


Figure 4-13 SAR diagram (DWS, 2017)

4.9.3 Hydrocensus

A detailed hydrocensus in the area was first conducted by J7 Royal in February 2021 for the Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani area. The area covers Giyani Gold mine farm and surrounding farms (Table 4-8).

Table 4-7 Hydrocensus boreholes

Type of pump	Equipped boreholes			Other Boreholes	
	Status of Boreholes	In use	Not in use	Not equipped	Destroyed
No pump	Monitoring		0	**0**	**0**
Electrical Submersible pump	Irrigation & Livestock	0	0		
Electrical Submersible pump	Domestic Water Supply	1	1		
Total		**1**		**0**	

4.10 Acid-Base Accounting

4.10.1 ABA Test Methodology

Acid-Base Accounting (ABA) is a static test where the net potential of the material to generate long-term acidic drainage when subjected to atmospheric (oxidizing) conditions is determined. It is mostly applicable to pyrite containing rock excavated and disposed of during operations. The test does not consider site-specific conditions or the timeframe for potential acidification.

The ABA test determines the percentage Sulphur (%S), the Acid Potential (AP), the Neutralization Potential (NP) and the Net Neutralization Potential (NNP) of the sample.

- If pyrite is the only Sulphide in the rock the AP (Acid Potential) is determined by multiplying the percentage Sulphur (%S) with a factor of 31.25, which is based on the oxidation reaction of pyrite. The unit of AP is kg $CaCO_3$/t rock and indicates the theoretical amount of calcite neutralized by the acid produced.
- The %S is determined through an infrared (IR) detector after sample combustion in an Eltra furnace. The total %S is determined after heating the furnace to ±2200°C and the Sulphide %S is determined at 1 000°C. The Sulphide %S is used to determine the acidification potential of the sample.
- The NP (Neutralization Potential) is determined by treating a sample with a known excess of standardized hydrochloric or sulfuric acid (the sample and acid are heated to ensure reaction completion). The paste is then back-titrated with standardized sodium hydroxide in order to determine the amount of unconsumed acid. NP is also expressed as kg $CaCO_3$/t rock as to represent the amount of calcite theoretically available to neutralize the acidic drainage.
- NNP is determined by subtracting AP from NP.

For the material to be classified in terms of their Acid Mine Drainage (AMD) potential, the ABA results could be screened in terms of its NNP, %S and NP:AP ratio as follows:

- A rock with NNP < 0 kg $CaCO_3$/t will theoretically have a net potential for acidic drainage. A rock with NNP > 0 kg $CaCO_3$/t rock will have a net potential for the neutralization of acidic drainage. Because of the uncertainty related to the exposure of the carbonate minerals or the pyrite for reaction, the interpretation of whether a rock will be net acid generating or neutralizing is more complex. Research has shown that a range from -20 kg $CaCO_3$/t to 20 kg $CaCO_3$/t exists that is defined as a "grey" area in determining the net acid generation or neutralization potential of a rock. Material with an NNP above this range is classified as *Rock Type IV - No Potential for Acid Generation*, and material with an NNP below this range as *Likely Acid Generating*.

- Further screening criteria could be used that attempts to classify the rock in terms of its net potential for acid production or neutralization. The following screening methods given in the table overleaf, as proposed by Price (1997), use the NP:AP ratio to classify the rock in terms of its potential for acid generation.
- Soregaroli and Lawrence (1998) further state that samples with less than 0.3% Sulphide sulphur are regarded as having insufficient oxidisable sulphides to sustain long-term acid generation. According to Li (2006), a material with an S% of below 0.1% has no potential for acid generation. Therefore, a material with a %S of above 0.3%, is classified as *Rock Type I - Likely Acid Generating,* 0.2-0.3% is classified as *Rock Type II,* 0.1-0.2% is classified as *Rock Type III*, and below 0.1% is classified as *Rock Type IV - No Potential for Acid Generation*.

Table 4-8: Screening methods using the NP: AP ratio (Price, 1997)

Potential for acid generation	NP: AP screening criteria	Comments
Rock Type I. Likely Acid Generating.	< 1:1	Likely AMD generating.
Rock Type II. Possibly Acid Generating.	1:1 – 2:1	Possibly AMD generating if NP is insufficiently reactive or is depleted at a faster rate than sulphides.
Rock Type III. Low Potential for Acid Generation.	2:1 – 4:1	Not potentially AMD generating unless significant preferential exposure of sulphides along fracture planes, or extremely reactive sulphides in combination with insufficient reactive NP.
Rock Type IV. No Potential for Acid Generation.	>4:1	No further AMD testing required unless materials are to be used as a source of alkalinity.

4.10.2 ABA Test Results

Acid Base Accounting (ABA) assessment results for samples of Waste Rock, Run of Mine (ROM) and Slimes/Tailings materials from Giyani Gold Project site are presented in the tables overleaf. The paste pH of all the materials registered a fairly alkaline values.

The NP/AP indicates the potential for the sample to generate acid drainage, whereas the %S indicated whether this drainage will be over the long term. The total Sulphur content of all samples was recorded below the 0.1 % guideline value Li (2006), indicative of no potential for acid generation in the long term (if neutralisation potential is not adequate to buffer acid formation). However, the Neutralisation Potential Ratio (NPR) is notably greater than 4:1 for all samples. Therefore, the material ABA rock classification for all the samples is Type IV Rock, which Non-Acid Forming. It is also noted that the waste rock and the ROM samples registered Net Neutralisation Potential (NNP) of +34 and +63,2, respectively, which are notably greater than +20, and thus confirming the samples as non-acid generating (Usher et al., 2003).

Table 4-9: ABA test results

Acid – Base Accounting	Run of Mine (ROM)	Tailings	Waste Rock	Duplicate (QC)
Sample Number	**767972**	**767973**	**767974**	**767972 QC**
Paste pH	8,02	9,21	8,45	8,04
Total Sulphur (%)	0,027	0,034	0,010	0,043
Acid Potential (AP) (kg/t $CaCO_3$)	0,84	1,07	0,31	1,34
Neutralization Potential (NP) (kg/t $CaCO_3$)	28,7	20,0	19,3	28,7
Nett Neutralization Potential (NNP) (kg/t $CaCO_3$)	27,8	18,9	19,0	27,3
Neutralising Potential Ratio (NPR) (NP : AP)	34,0	18,7	63,2	21,4
Total Carbon (%)	0,38	0,19	0,13	0,36
Rock Type	IV	IV	IV	IV

4.11 NAG Test Methodology

The NAG test provides a direct assessment of the potential for a material to produce acid after a period of exposure (to a strong oxidant) and weathering. The test can be used to refine the results of the ABA predictions. As with the ABA test, the NAG test does not consider site-specific conditions or the timeframe for potential acidification.

In the NAG test Hydrogen Peroxide (H_2O_2) is used to oxidize Sulphide minerals to predict the acid generation potential of the sample. The following relates to the methodology:

- In general, the static NAG test involves the addition of 25 ml of 15% H_2O_2 to 0.25 g of sample in a 250 ml wide mouth conical flask or equivalent. The sample is covered with a watch glass, and placed in a fume hood and a well-ventilated area for about 2 h.
- Once "boiling" or effervescing ceases, the solution is allowed to cool to room temperature and the final pH (NAG pH) is determined.
- A quantitative estimation of the amount of net acidity remaining (the NAG capacity) in the sample is determined by titrating it with sodium hydroxide (NaOH) to pH 4.5 (and/or pH 7.0) to obtain the NAG Value.
- In order to determine the acid generation potential of a sample, the screening method of Miller et al. (1997) is used.

Table 4-10: NAG test screening method (edited from Miller et al., 1997)

Rock Type	NAG pH	NAG Value (H_2SO_4 kg/t)	NNP ($CaCO_3$ kg/t)
Rock Type Ia. High Capacity Acid Forming.	< 4.5	> 10	Negative
Rock Type Ib. Lower Capacity Acid Forming.	< 4.5	≤ 10	-
Uncertain, possibly Ib.	< 4.5	> 10	Positive
Uncertain.	≥ 4.5	0	Negative (Reassess mineralogy) *
Rock Type IV. Non-Acid Forming.	≥ 4.5	0	Positive

** If low acid forming sulphides is dominant then Rock Type IV.*

4.11.1 Net Acid Generation (NAG) Screening Results

The NAG test results are presented in Table 4-10 below. The results were screened as per approach discussed above in relation to *Rock Type I to IV*. The NAG test results refine the ABA findings and indicate the sampled Waste Rock, Run of Mine (ROM) and Tailings as non-acid forming. Thus, there is sufficient neutralisation potential or capacity in the materials, which would buffer acid generation that may occur.

Table 4-11: Net Acid Generation (NAG) test results

Sample ID	NAG pH: (H_2O_2)	NAG at pH 4.5 (kg H_2SO_4 / t)	NAG at pH 7.0 (kg H_2SO_4 / t)	NNP ($CaCO_3$ kg/t)	# Rock Type
Run of Mine (ROM)	6,69	<0.01	0,44	27,8	IV
Tailings	6,25	<0.01	1,55	18,9	IV
Waste Rock	6,66	<0.01	0,47	19,0	IV
Duplicate	6,68	<0.01	0,42	27,3	IV

Rock Type IV is Non-Acid Forming

4.12 Potential Pollution Source Identification

Anticipated waste streams from the proposed Giyani Gold Mine include those listed in the tabulation below:

Table 4-12: Mine Pollution Source Identification

Infrastructure/Activity	Waste
Package sewage treatment facility	Sewage
Stockpiles	Tailings Disposal Facility Overburden waste
Offices	General waste (papers, plastic, glass bottles, food waste)
Mine operational vehicle	Hydrocarbon waste generated by spillages
Workshop	Used oil and grease, fuel contaminated material, and oil related products. Fluorescent tubes, old batteries, waste paints, and transformers.

Infrastructure/Activity	Waste
	Scrap waste (scrap metals, empty chemical containers, and metal off-cuts).

4.13 Groundwater Model

Before the development of a flow model, the hydrology of the study area must be understood conceptually. A conceptual model includes planning and constructing an equivalent but simplified conditions. For a real world problem that are acceptable in view of the objectives of the modelling and the associated management problems. Transferring the real world situation into an equivalent model system, which can then be solved using existing program codes, is a fundamental step in groundwater modelling.

A model is a summary of:

- The known geohydrological features and characteristics of the area;
- The static water levels/piezometric heads of the study area;
- The interaction of the geology and geohydrology on the boundary of the study area;
- Any simplifying assumptions necessary for the development of a numerical model and the selection of a suitable numerical code; and
- A description of the processes and interactions taking place within the study area that will influence the movement of groundwater.

4.13.1 Model scale, context and accuracy

The regional model context and accuracy was based on existing 1:50 000 topographical GIS data with 1:250 000 scale geological data. The research was based exclusively on the assessment of existing information, the bulk of which was supplied by National Groundwater Database (NGDB) and National Groundwater Archives (NGA) of DWA. Geohydrological information was obtained from local and regional boreholes to provide an understanding of the groundwater regime.

A dynamic groundwater flow model was developed by applying the modelling package 2D-Dimensional Visual Modflow (WEN-Hsing Chiang and Wolfgang Kinzelbach, 1998). The latter will be used as planning and management tool for quantification and qualification of proposed open pit Gold activities on aquifer conditions. The model domain was delineated based on regional drainages as well as topographical highs i.e. discharge zones and no-flow zones and governed by a set of boundary conditions. The numerical model was used in steady-state and transient simulations to assess the groundwater flow directions, head gradients and flow velocity and transient simulation was then conducted after the calibration of the model. The data and assumptions used in the model are listed in Table 4-10.

Table 4-13: Model context, data, boundary conditions and assumptions

Input parameter	Scale	Source, parameter or assumption description
Topography (DTM)	1:50 000	The DTM was obtained from DWS NGA Data (Figure 2-3).
Rainfall (recharge)		Rainfall data was obtained from SAPWAT. Modelled data for the quaternary catchments the B82H
Rivers streams, drainages	1:50 000	Obtained from DWAF as GIS shape files.
Dams	1:50 000	Obtained from DWAF as GIS shape files.
Geology	1:250 000	Obtained from DWS as GIS raster image files and from the Client.
Recharge		Recharge was assumed to be 1-4.5 % of MAP for the aquifer deposits The general recharge was assumed at 2% of MAP

Input parameter	Scale	Source, parameter or assumption description
Boreholes and pumping rates		Data sourced from previous reports and Water level data was available for some few boreholes and all were used to calibrate the model to a 80 % level of assurance.
Boundary conditions		No flow represented by surface water shed
Transmissivity		Information regarding transmissivity was obtained reports provided and DWS Data.
Storativity		Assumption of 0.001 to 0.005 for aquifer zones. No field test data was available for storativity values.
Aquifer thickness		It was assumed that the deposits were 60m thick at the lowest elevation gradually decreasing as the elevation rises. The area is underlain by fractured rocks.

4.13.2 Methodology

The model was calibrated, groundwater quality and groundwater levels were used .Most of the data applied and used for the status groundwater quality was supplied by the Kusile Invest 133 (Pty) Ltd. A dynamic numerical model for the aquifer was constructed using the modelling package VISUAL MODFLOW PMWIN (WEN-Hsing Chiang and Wolfgang Kinzelbach, 1998). Considering an unconfined/confined aquifer, with a recharge to the aquifer only occurs once a year during rainy season for a period of four months.

4.13.3 Life of Mine (LoM)

The Gold life of mine (LoM) is 30 years. A numerical groundwater flow model was developed using the modelling package Visual MODFLOW. Details of this software are provided at Visual MODFLOW, which is a MODFLOW based software package. The detailed site layout map are shown below in Figure 4-11 and Figure 4-12 for all the pits that are modelled.

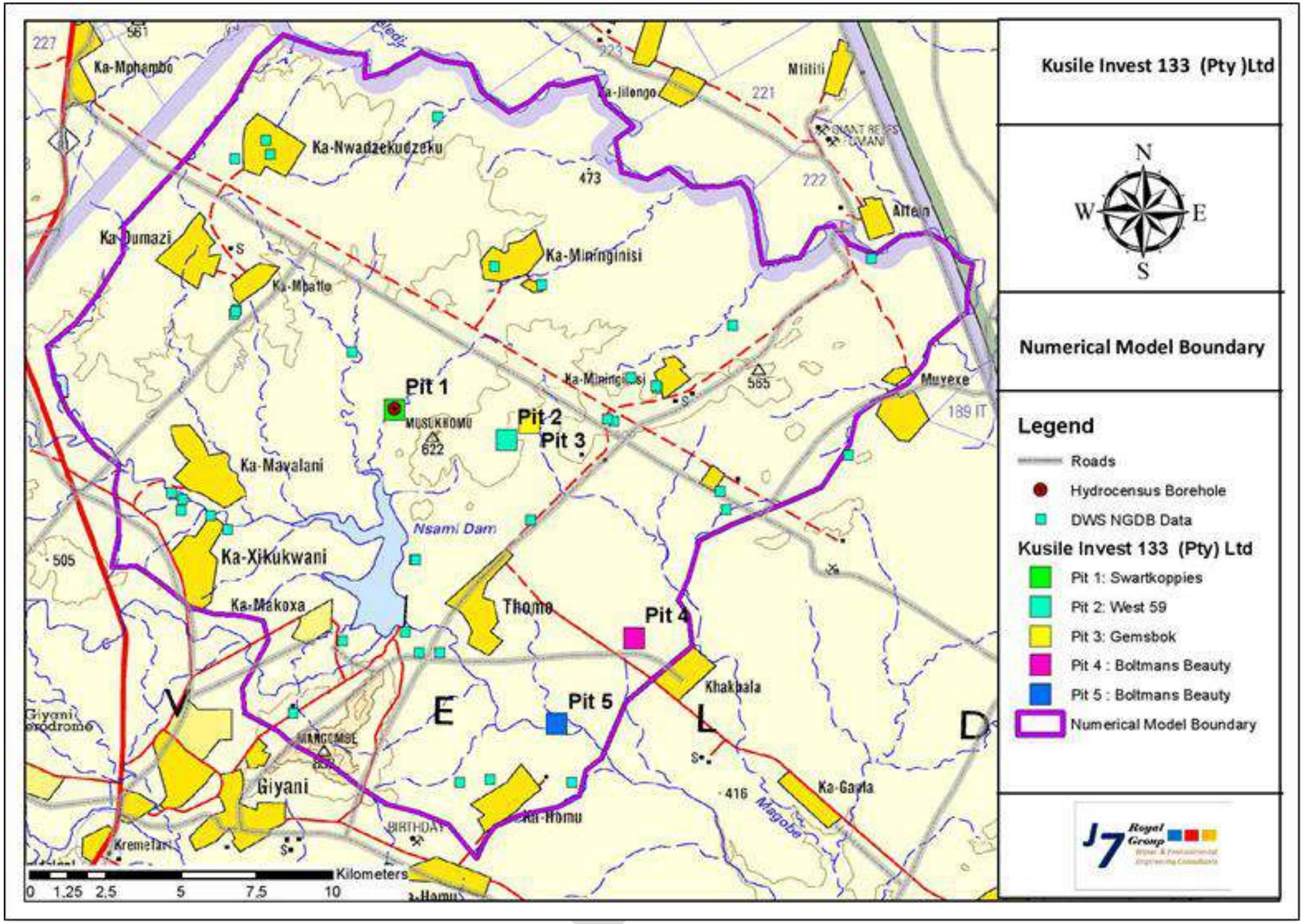


Figure 4-14 Model Boundary Map

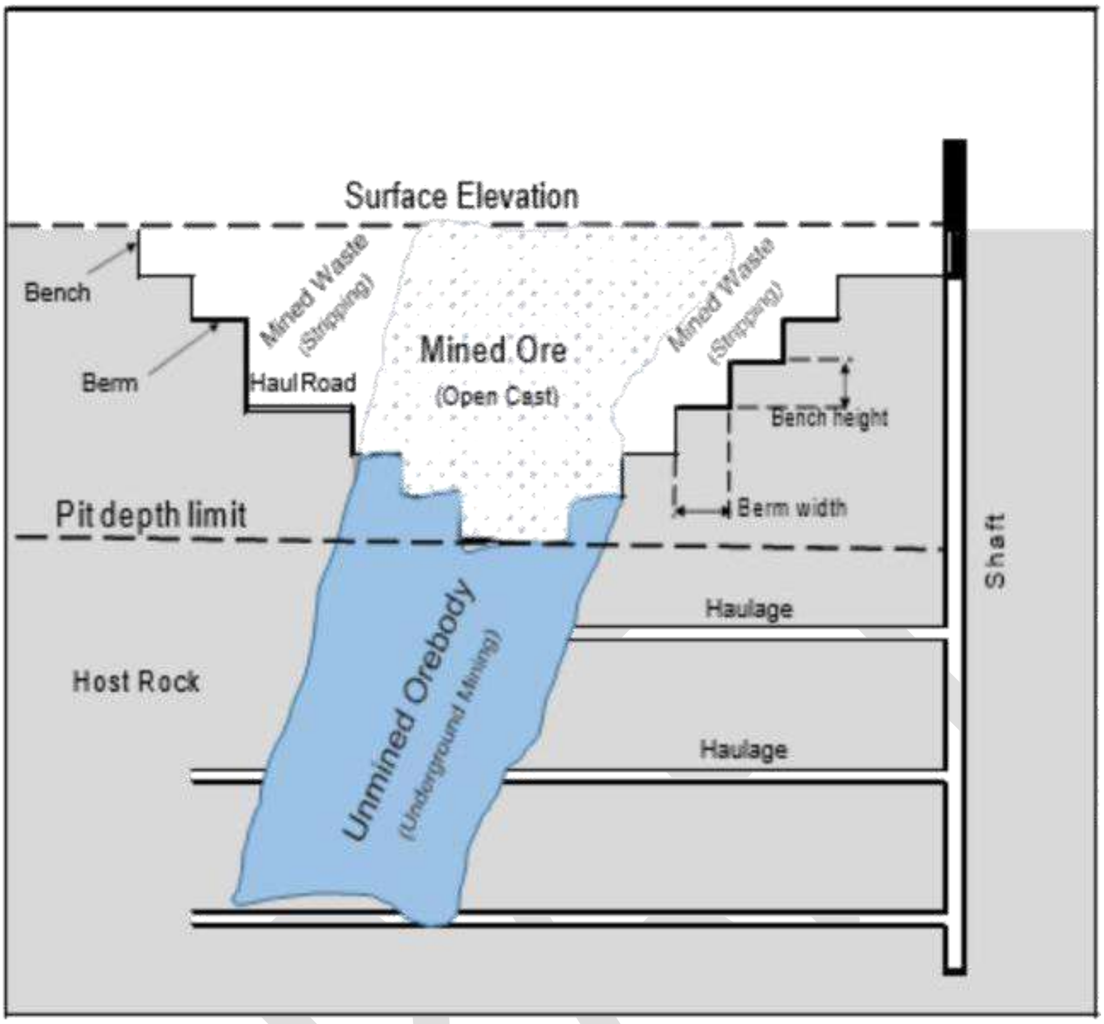


Figure 4-15 : Conceptual model: Open Pit Mining Method Layout

4.13.4 Modelling Software Selection

The modelling software selected for constructing and simulating the Kusile Invest 133 (Pty) Ltd Gold Mine model is VISUAL MODFLOW PMWIN (WEN-Hsing Chiang and Wolfgang Kinzelbach, 1998).MODFLOW was selected for construction of the model because it is a highly interactive groundwater modelling system capable of simulating flow in two or three dimensions for uncoupled, variably saturated, transient or steady state flow.

4.13.4.1 Generation of the Finite Difference Numerical Model (Model Setup)

A 2D numerical groundwater flow model was developed for the sub catchment using the modelling software MODFLOW .The model domain covers an area of 429,76km².The groundwater model was developed using 27200 rows and 28200 columns to generate a mesh that discretizes the model domain into a finite difference mesh (Figure 4-14).A regular grid space of 100m is used for each column and row. An aquifer thickness of 60m was also assumed for the model; hence this thickness will follow topography. The task is to assess the aquifer under the following conditions.

Steady State, (with recharge rate):Steady state refers to an equilibrium condition whereby over long periods of time, hydrogeologic systems may achieve or approximate some non-changing conditions in which heads or concentrations do not change with further passage of time. Such systems are said to have achieved steady state. Models may deal with this in different ways. Some have "steady state" options, while others require the user to specify some long period of time and/or closure criterion beyond which changes in head are considered inconsequential.

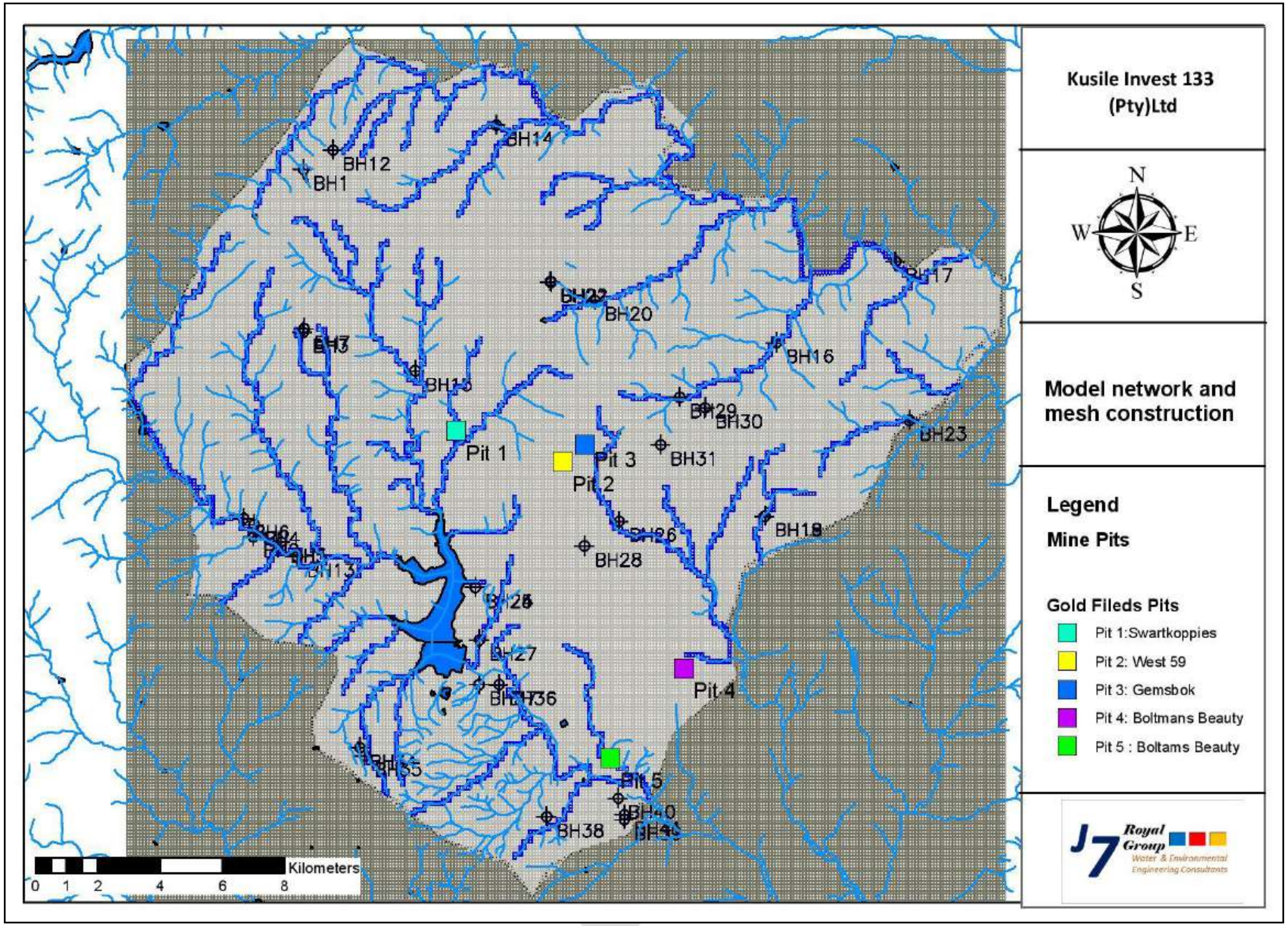


Figure 4-16 Model network and mesh construction

4.13.4.2 Model limitations and assumptions

The following assumptions were made with noted limitations:

1. The accuracy and scale of the assessment will result in deviations at specific points e.g. on the boundaries of mine layout areas however this effect is minimal and the selected mesh elements would represent the footprint of specific infrastructure.
2. For lithological units different than that of the immediate study area hydraulic parameters from literature were used for specific types of geology.
3. NGDB Data borehole data (water levels) and neighbourhood boreholes were only available around the area and the surrounding farms.
4. Sections of the model domain were therefore not thereby affecting the confidence level of the model.
5. Considering the spatial extent of the model domain and rainfall stations within the study area, rainfall data from a single station was used to represent entire study area. Once the model was calibrated, the proposed Gold Mine were incorporated into the model by applying drains to discharge water from the aquifer system.
6. The stream was constrained such that no water leaked from the streams to the groundwater system. By constraining infiltration
7. When the modelling assumptions were made or reference values used, a conservative approach was followed such that the trend was to overestimate groundwater discharges from dewatering. This gives a worst-case scenario for designing the dewatering system and impacts to the receiving environment .It should be noted that dewatering volumes should be less than those simulated by the model.

4.13.4.3 Model base boundary condition

The model domain was assigned to extend vertically to a depth of 60m. It is assumed that the base of the model is impermeable. The mine development stages were simulated as follows:

- Scenario 1: Current steady state conditions and initial groundwater regime
- Scenario 2: Transient dewatering from the proposed pit and zone of influence

- Scenario 3 : Transient mass plume transport

Scenario 1: Current steady state conditions and initial groundwater regime

The model was calibrated in steady state based on the known geological and hydraulic head distribution data for the project site. Calibration was accomplished iteratively by adjusting recharge and hydraulic conductivity values until a reasonable fit between the measured and simulated heads were obtained. The measured data consists of head elevation data from few existing boreholes around the site.

Model Calibration and Sensitivity Analysis

The objective of the model calibration process was to demonstrate that the model was capable of simulating hydraulic heads that match as close as possible the observed heads in Delmas proposed expansion open cast groundwater levels. The calibration process involved the continual adjustment of hydrogeological parameters including recharge, hydraulic conductivity and specific storage until the closest match between model predicted water levels and field measured water levels was obtained. Calibration was done into two (2) stages that is steady state calibration and transient state calibration. The aim of the steady state calibration was to represent the average (i.e. long term) groundwater conditions at the Kusile Invest 133 (Pty) Ltd aquifers.

The resulting groundwater heads of the steady state model are used to initialise the transient groundwater models for transient calibration and predictions. The aquifer parameters and boundary conditions determined during steady sate calibration were applied to the transient state model for manual calibration.

The transient state calibration satisfied an adequate match to observed groundwater levels affected by abstraction and any modifications to the model during transient calibration required a re-assessment of the steady state calibration. The numerical model was calibrated and adjusted in steady state by keeping the model complexity to minimum.

The quality of the fit between simulated and observed water levels was visually evaluated based on the elevations of the simulated hydraulic heads and by means of a statistical analysis.

The three (3) statistical analysis expressions were used to indicate the errors in calibration

1) **Mean Error (ME)**

Mean difference between the measured and simulated water levels

2) **Mean Absolute Error (MAE)**

Mean of the absolute value of the differences between the measured and simulated heads

3) **Root Mean Square Error (RMSE)**

RMSE measures how much **error** there is between two data sets and in other words, it compares a simulated value and a measured/observed or known value. It's also known as **Root Mean Square** The Root Mean Squared Error (RMSE) is an important statistical calculation used to determine the difference between simulated values in a model and measured values from observations. If this difference is large the model is likely to be less accurate than if the d difference is small; therefore, a modeller can calculate the RMSE and adjust other features until the RMSE is as small as possible to improve the model. The MAE addresses this problem by producing mean absolute values. However, the RMSE error is used most often by modellers in the industry to assess the adequacy of model calibration because the differences between observed and simulated water levels are normalized across the model domain. When the RMSE value is small, the errors are small relative to the overall water level and model response (Anderson and Woessner 1992).For this study, RMSE was used to assess the calibration of Tiara mining proposed open pit and RMSE error was evaluated as a ratio to the total water level change across the model domain.

For this simulation, the calibration indicators for the aquifers were 5,74 for the ME, 10,87 for the MAE on average and 5,97 for the RMSE. The RMSE value for the calibrated model is less than the typical range of **10%** used by most modellers as the threshold for a well calibrated model (Table 4-11).Based on this, the steady state model was determined to be adequately calibrated for use in adapting the model for predictive transient simulations to assess dewatering volumes and possible environmental impacts.

Table 4-14 : Statistical model calibration –simulated versus measured heads

No.	Component	Statistical Analysis	Observed Heads	Simulated Heads	Mean Error(m) ME	Mean ABS Error(m) MAE	Root Mean Square Error(m) RMS
1	Boreholes	**Max.**	495,17	484,53	23,72	23,72	562,70
2		**Min.**	398,73	419,74	-20,06	0,48	0,23
3		**Average**	448,84	454,59	5,74	10,87	168,59
4		**95th Percentile**	491,12	484,08	22,75	22,75	518,17
5		**5th Percentile**	399,15	422,31	-16,36	1,22	1,50
6		**Std.Dev**	27,60	19,47	11,90	7,26	178,34
7		**∑**			**137,84**	**260,86**	**4046,25**
8		**1/n**			**0,17**	**0,17**	**0,17**
10		**RMSE (Root Mean Square Error)**					**5,97**
11		**Correlation**	**0,93**				

In Figure 4-15, the difference between observed and simulated heads from the calibration process is shown. A negative value indicates that the observed head is lower than the head predicted by the simulation and vice versa.

The variances are due to known and/or unknown complexity in the geological environment that is not captured in the model. Once dewatering of the hydrogeological system start, then the model will be updated to reflect the major responses in hydraulic heads. The head elevation data from hydrocensus observation boreholes were used to calibrate the steady-state flow model. The steady-state calibration of the measured and the simulated water levels resulted in an acceptable correlation of $\mathbf{R^2 = 0.86}$ for the boreholes. The model was calibrated in steady state with the parameters and the measured water levels were compared with simulated water levels to get an acceptable fit which would represent a realistic aquifer system as it might be in nature (Figure 4-14). Table 4-11 indicates the fitted data as observed at all boreholes with known water levels

A preliminary regional groundwater balance is presented for the various scenarios discussed in the previous section. There is an average of less 10 m^3/d flowing into the proposed Gold Mine Pits as defined as possible overall recharge (Table 4-12).

Table 4-15 Catchment Water Balance-Gold Dewatering

No	Component	Inflow (m^3/d)	Outflow (m^3/d)	Balance (m^3/d)
1	Catchment Recharge	2385		2385
2	Catchment Baseflow and Spring Flow		-1717	-1717
3	Mine Dewatering(LoM)			
a	Pit 1 :Swartkoppies		-180	-180
b	Pit 2: West 59		-190	-190
c	Pit 3: Gemsbok		-215	-215
d	Pit 4: Boltmans Beauty		-83	-83
e	Pit5:Boltmans Beauty			
4	**Total**	**2385**	**-2385**	**0**
5	**Imbalance (%)**			**0**

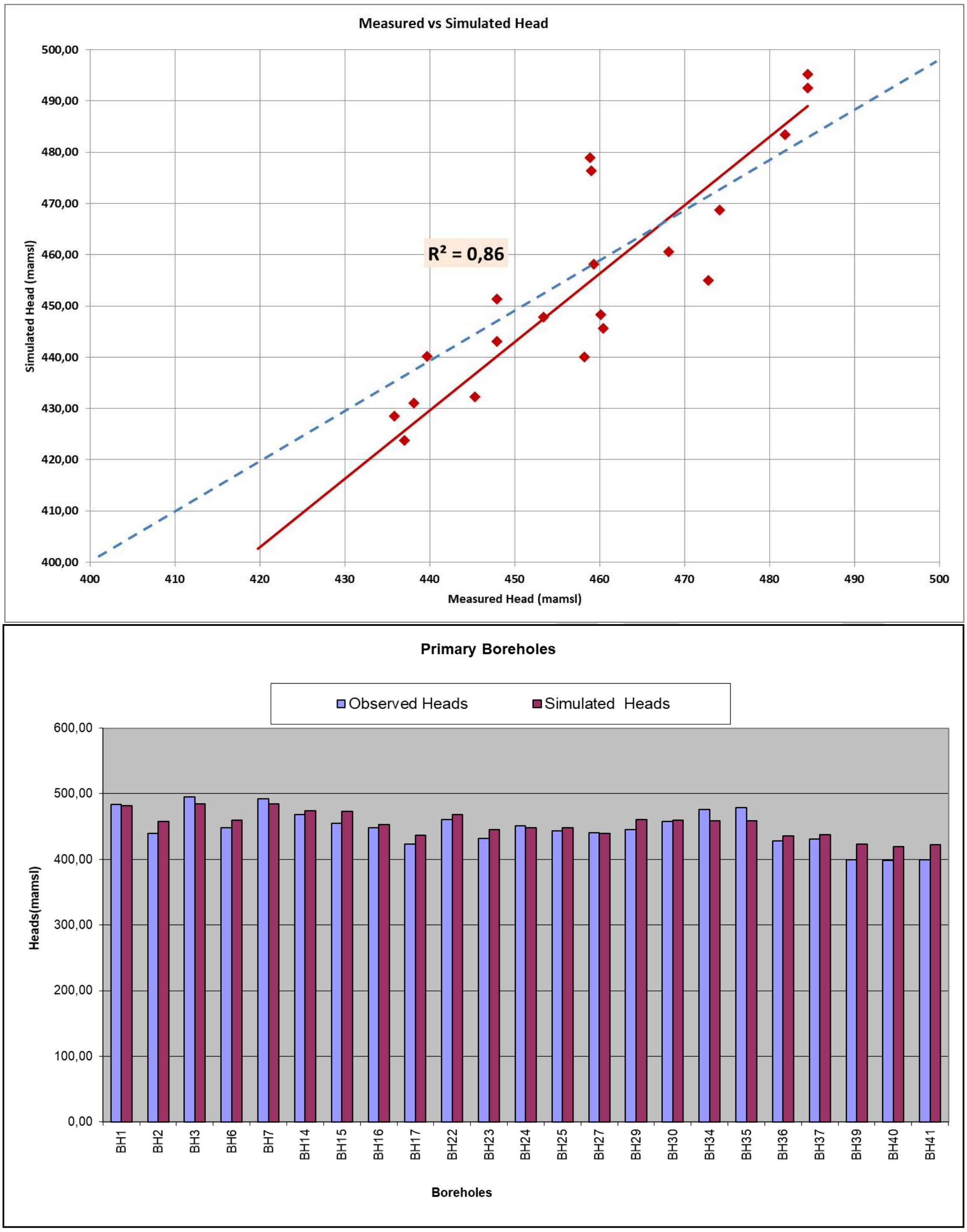


Figure 4-17 : Simulated versus measured calibrated heads

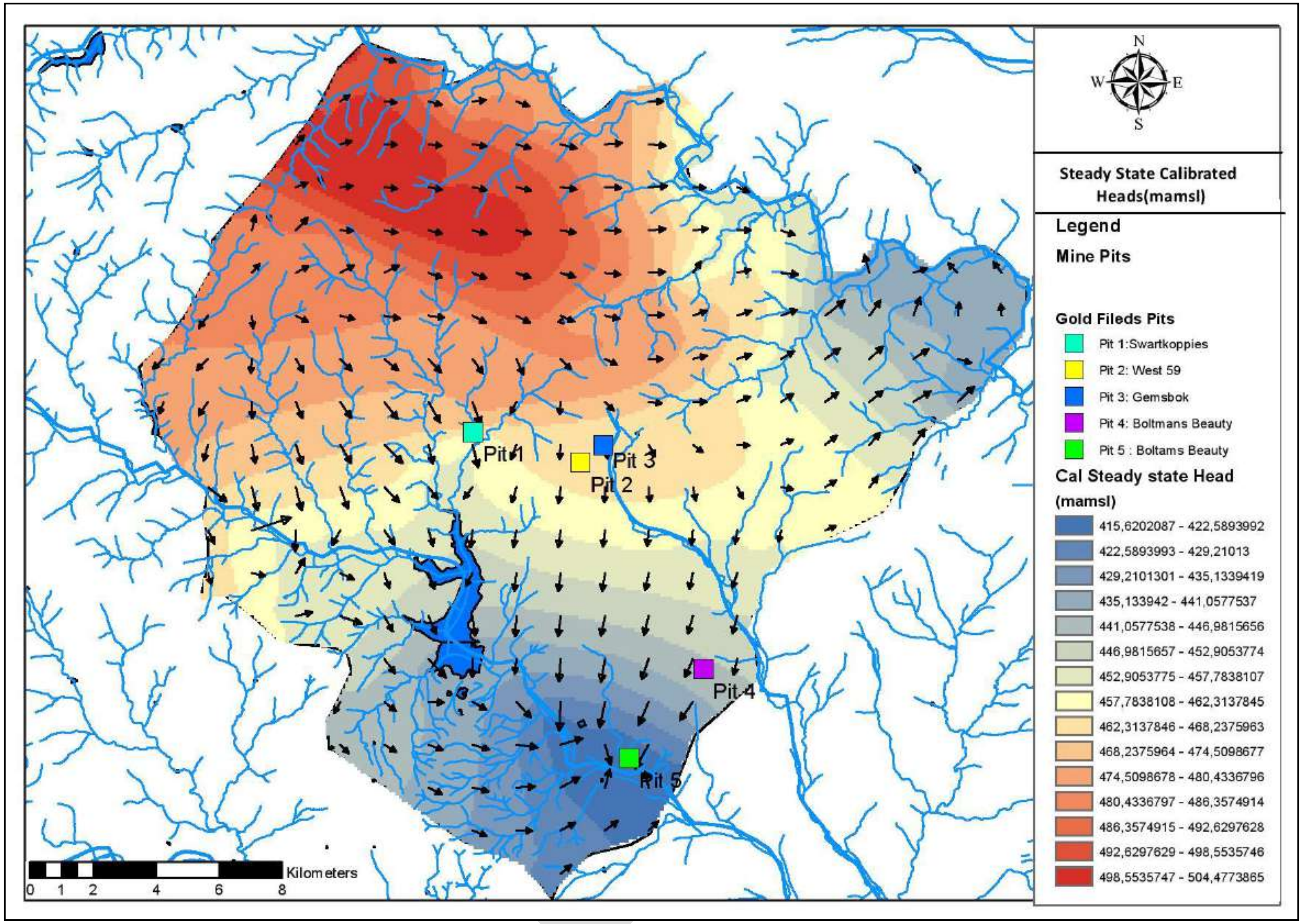


Figure 4-18 : Regional steady-state piezometric heads and flow direction

4.13.4.4 Piezometric Heads and gradients

The piezometric heads and gradients for the calibrated model showed that the gradient and general flow follows the topography which is from north to east, via the perennial streams Nsami River and other non-perennial streams as shown in Figure 4-16.The general drainage direction is north to east direction in the study area and the groundwater drains in a northeren to eastern direction. The head constrained boundary conditions at both non-perennial and perennial streams influences groundwater to drain down gradient towards drainages.

4.13.4.5 Groundwater drawdown contours (Dewatering)

The level of detail provided in the mine plan was modelled as accurately as possible by dividing the model into stress periods, representing each mining strip per the mine plan .Drain cells were used to model inflows due to mining and the modelled drain elevations were set to the final pit floors and progressed through yearly increments. The LoM forecast drawdown impacts at the caused during open cast mining to a depth of 60mbgl are presented in Figure 4-18 to Figure 4-22 and cumulative impacts with respect to all five(5) proposed mines. Increases and final size in the footprint, depth and timing have indicated growth in the predicted drawdown cone resulting from the pit dewatering. The drawdown is contained within a zone of influence 1km from the centre of the mining pit and the drawdown and only small impacts are anticipated in this area.

The simulation indicated a maximum Zone of Influence (ZOI) depth located at the open pits approximately 60m in depth. The maximum lateral extent of the ZOI is approximately less than 1km from the centre positions of the pits. A cumulative impact was also considered where neighbouring mines were assumed active together the proposed mine and the impacts is still within the 1km radius of influence.

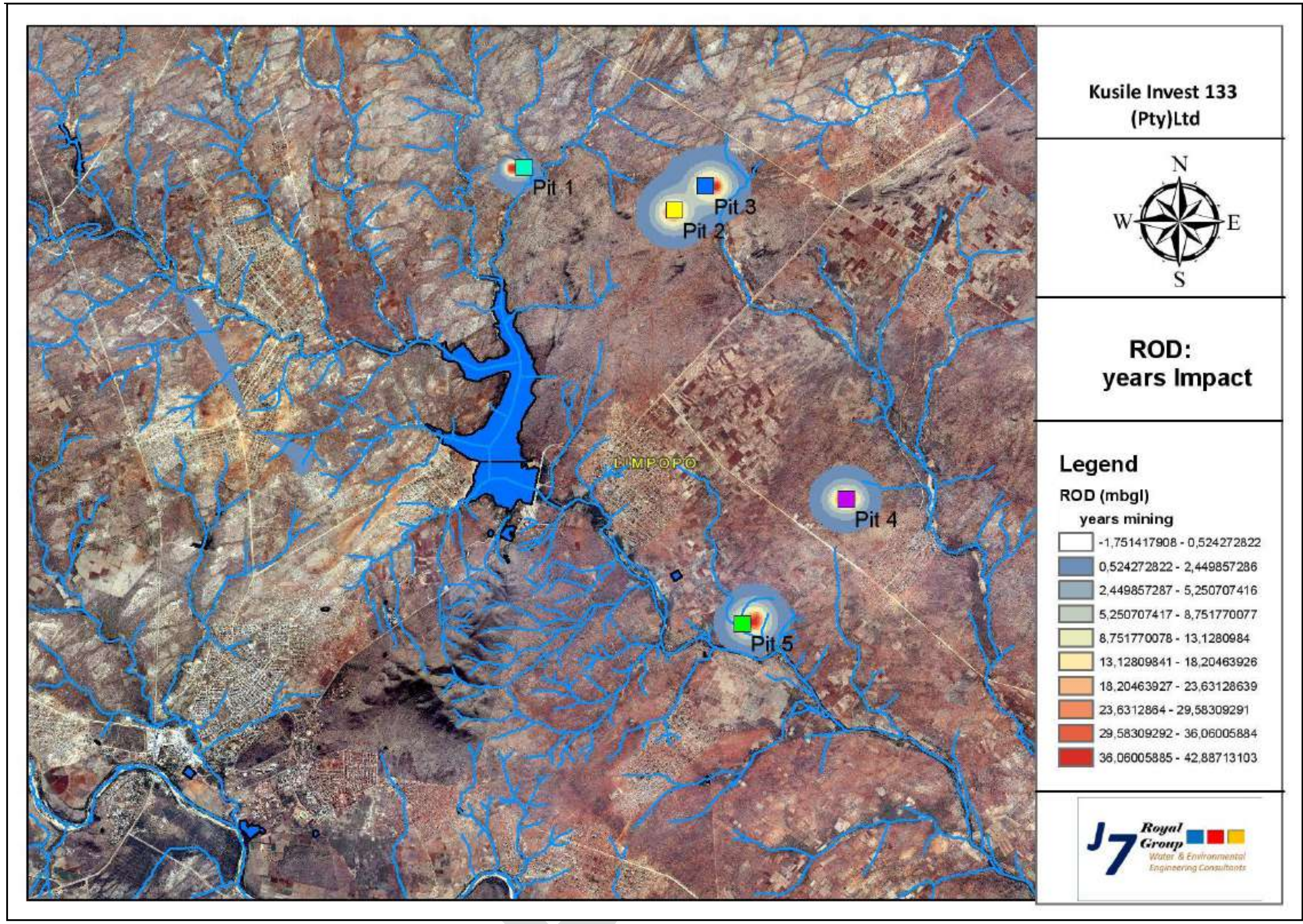


Figure 4-19 Water Levels drawdown and zone of influence

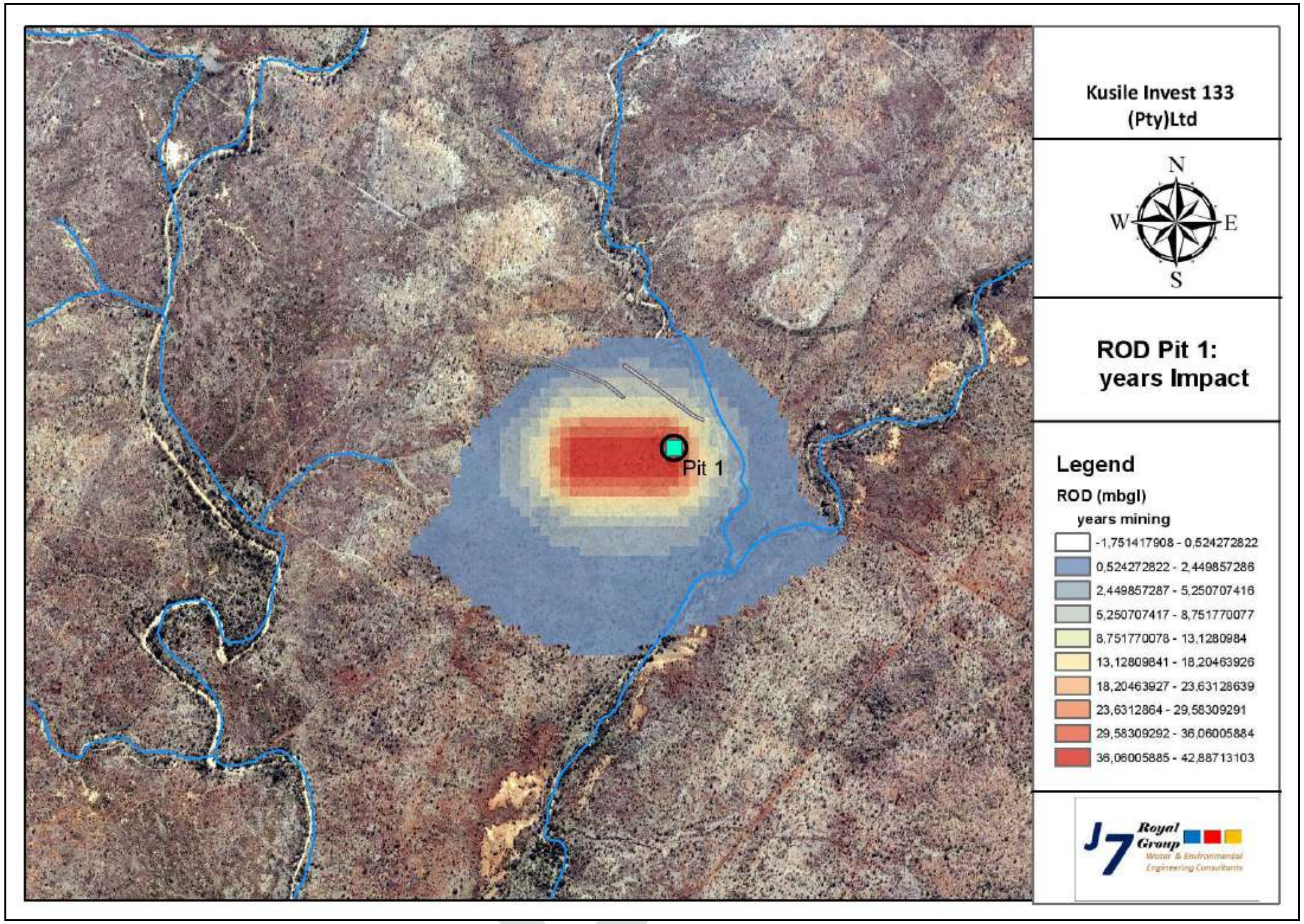


Figure 4-20 Pit 1 Water Levels drawdown and zone of influence

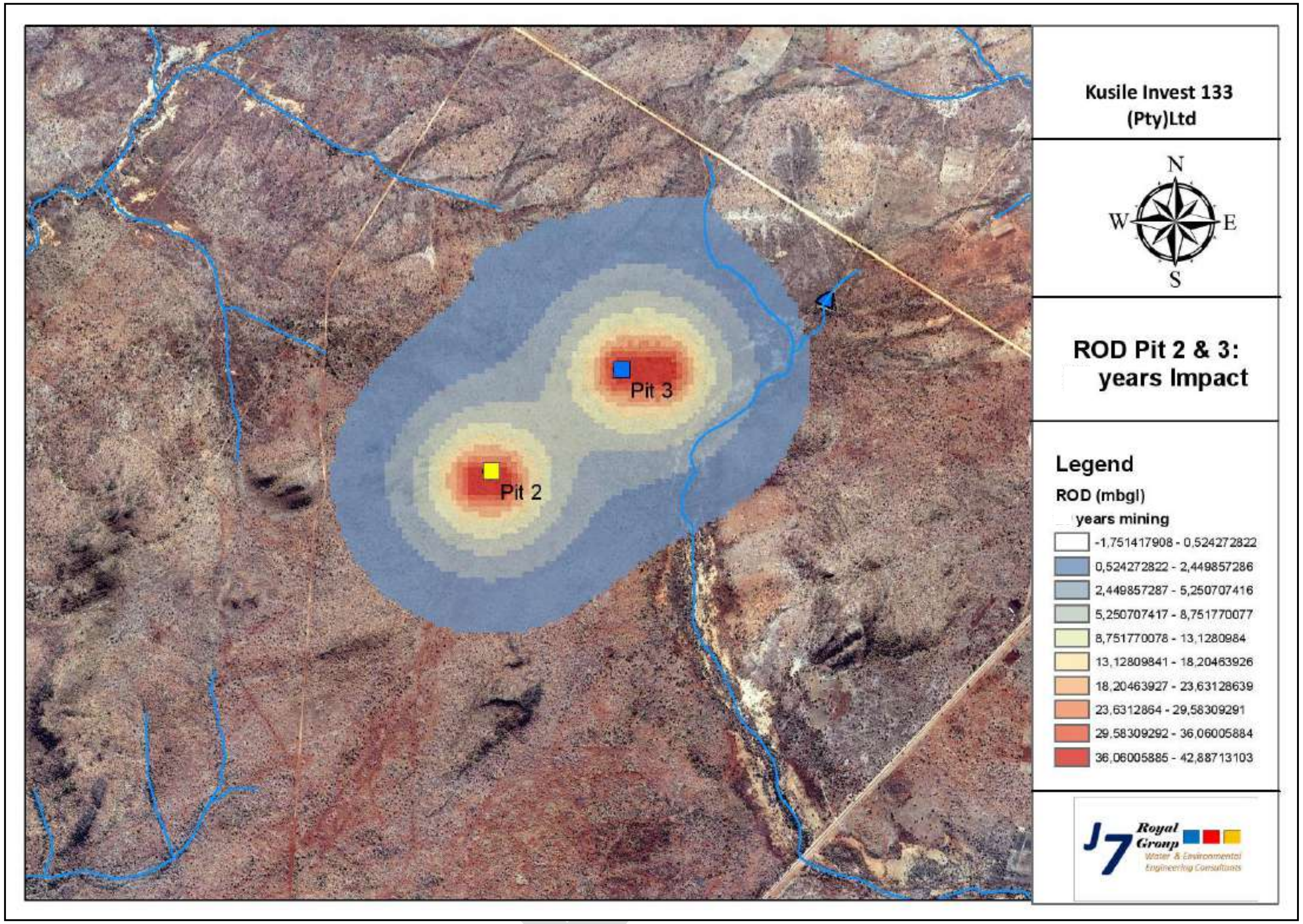


Figure 4-21 Pit 2 and Pit 3 Water Levels drawdown and zone of influence

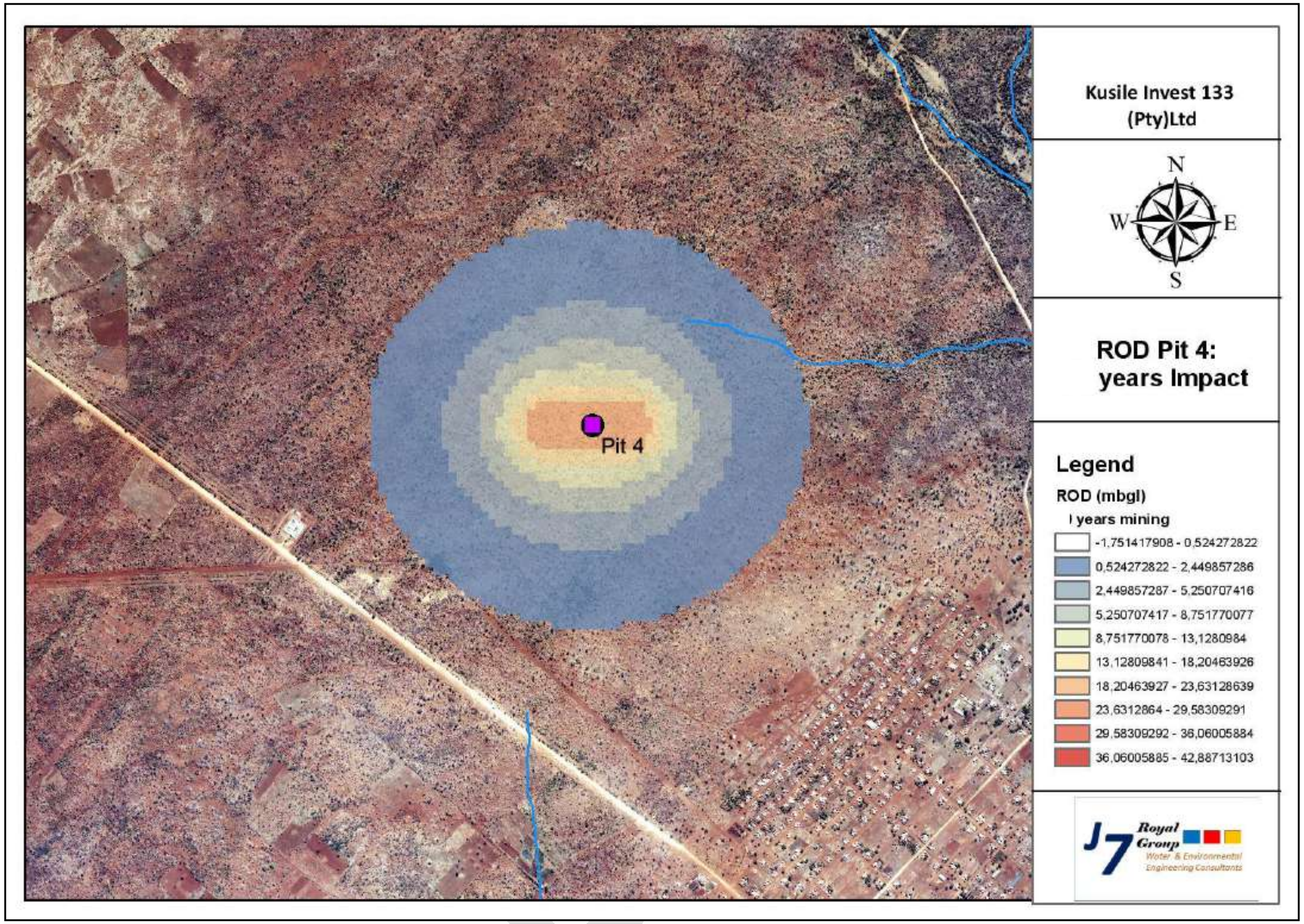


Figure 4-22 Pit 4 Water Levels drawdown and zone of influence

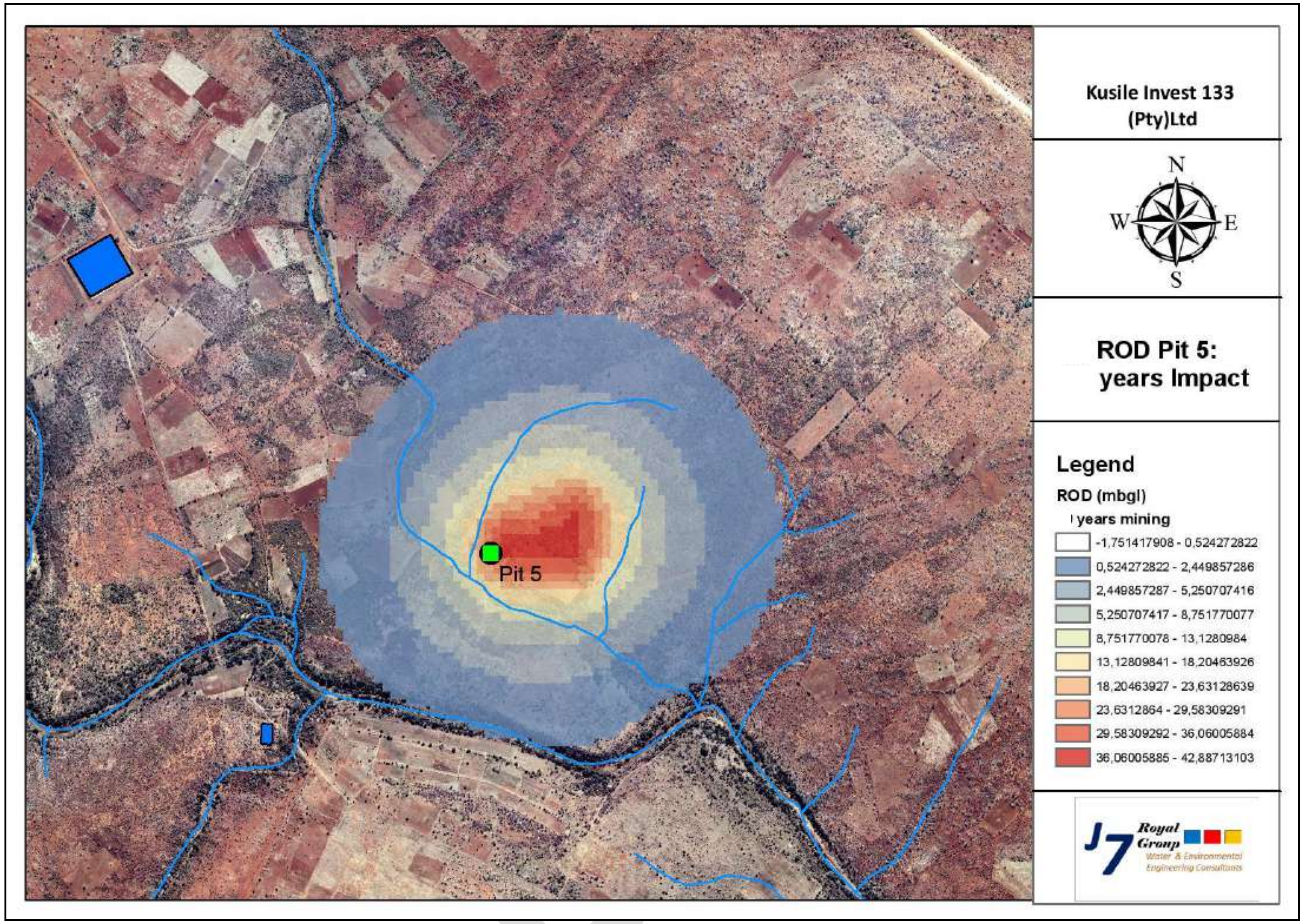


Figure 4-23 Pit 5 water Levels drawdown and zone of influence

4.13.5 Mass Transport with Simulated Dewatering

Following the potential post-operational water quality, the values quantified by UIS Laboratories was adapted and a conservative application of the data was applied with a TDS of 1160 mg/L (Table 4-13).

Table 4-16 : mine relative abundances of acid and buffer capacity

No	Variable	TDS(mg/L)	SO4(mg/L)
1	Values used in the Model	**1160**	**0**

It has been observed from the water quality analysis that TDS is identified as the main constituent from the water quality sample. Seepage concentration of 1000mg/ℓ for TDS; were observed and used for numerical simulation as the final accumulation concentration.

The mass transport model was conservatively simulated using advective transport with a regional porosity value of 2 - 3%.The background TDS concentration assigned to the regional area was 10 mg/ℓ.

The simulation results indicate a slow migration of mass from the TSF/WRD (Pit 1: Swartkoppies) and overburden stockpiles (Pit2 until Pit 5) and the following key observations:

- The TDS seepage from the TSF and overburden stockpiles is contained in the immediate facility of the rehabilitated pit,
- There is a tendency for the TDS to migrate towards the closest streams probably because of the groundwater movement directions along the drainages from the pit;
- The total migration distance towards the from TSF and overburden stockpiles is approximately 300m during the LoM and post-closure simulation. This would imply a migration rate of 0.001245m a day, without any seepage capturing methods implemented; and
- Groundwater monitoring boreholes should be drilled up gradient and down-gradient of the pit both shallow and deep boreholes to monitor the shallow and deep aquifer.
- Once monitoring data is available , numerical model must be updated

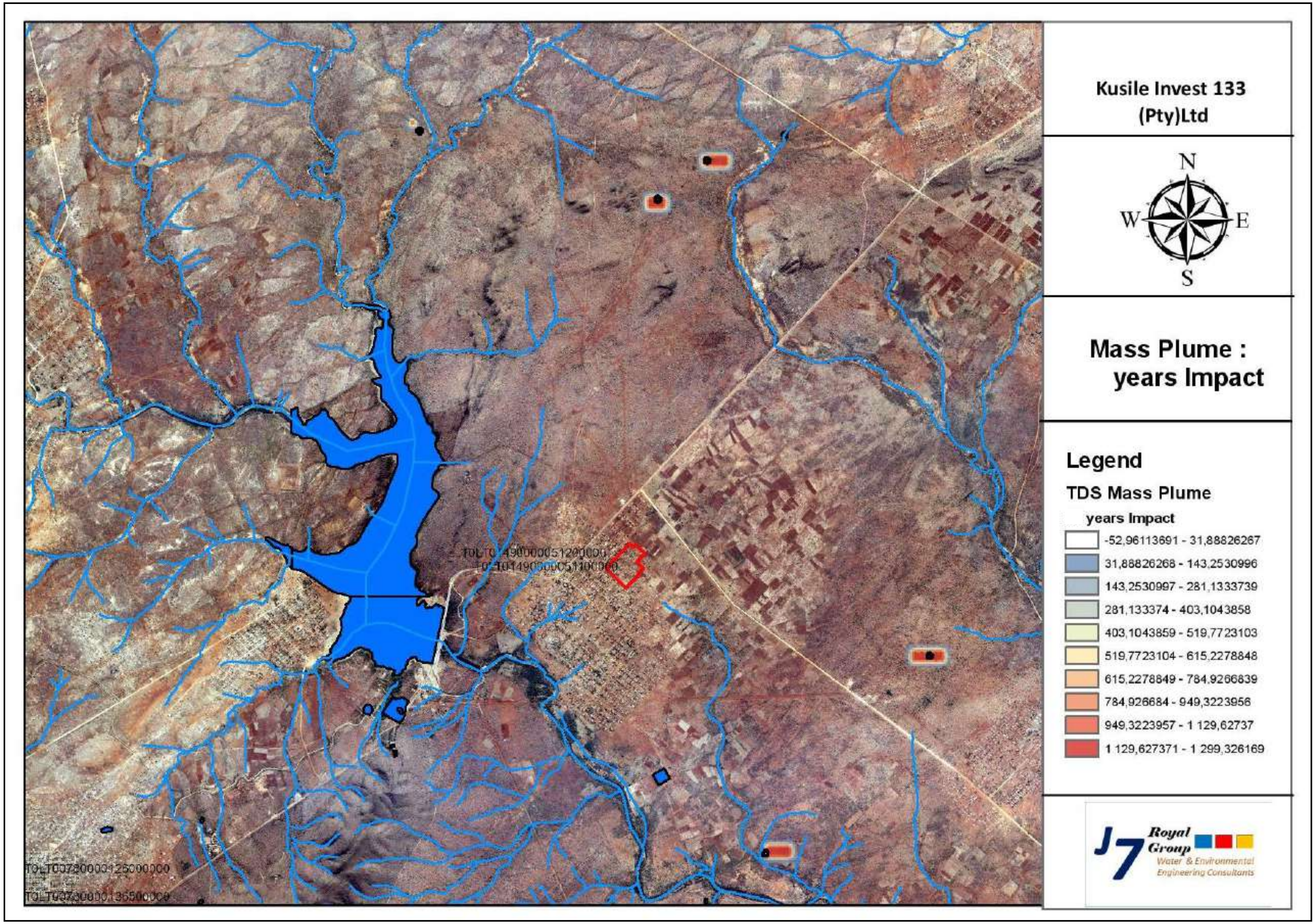


Figure 4-24 Cumulative TDS mass plume in 20 years impacts

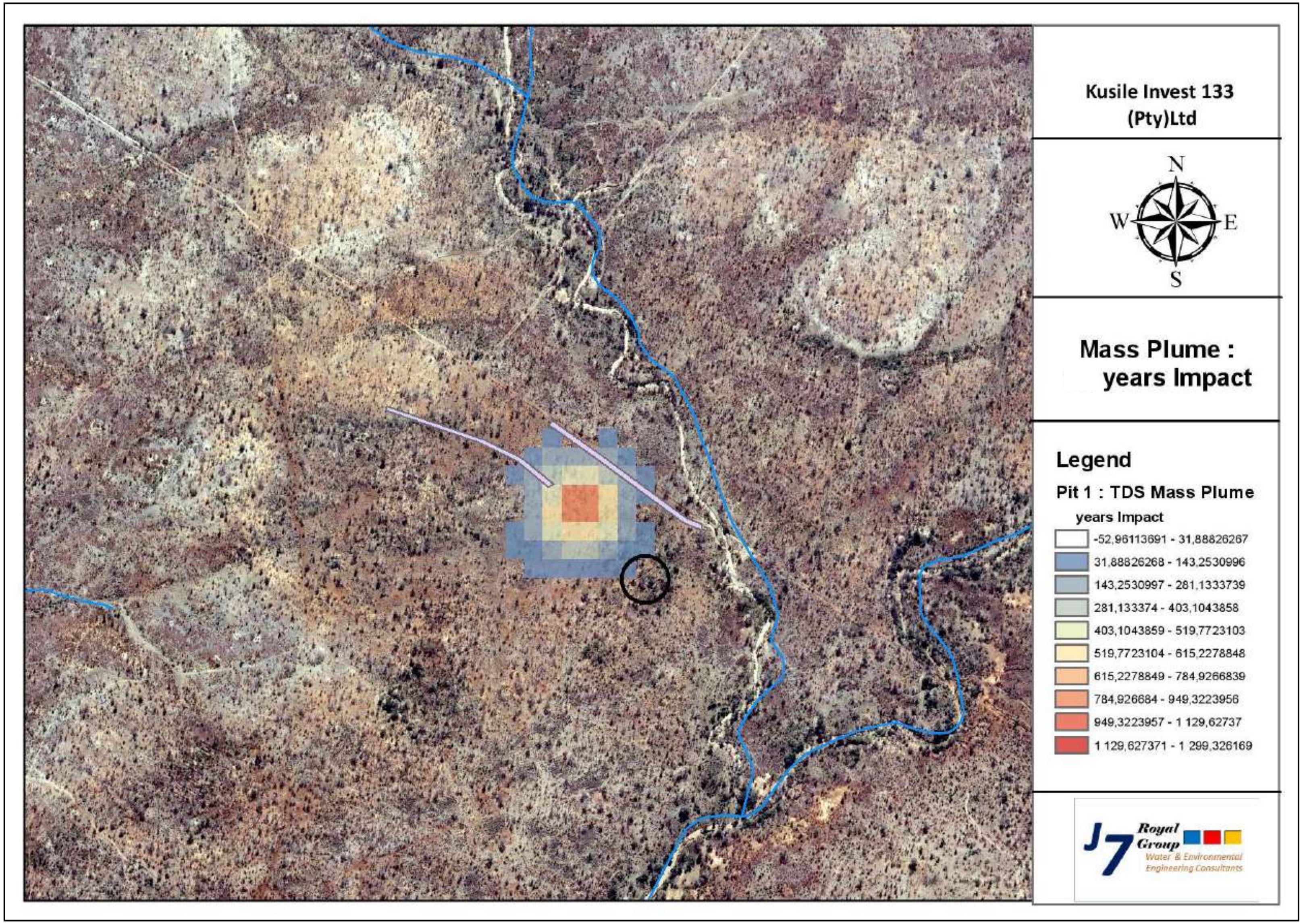


Figure 4-25 Pit 1 TDS mass plume in 20years impact

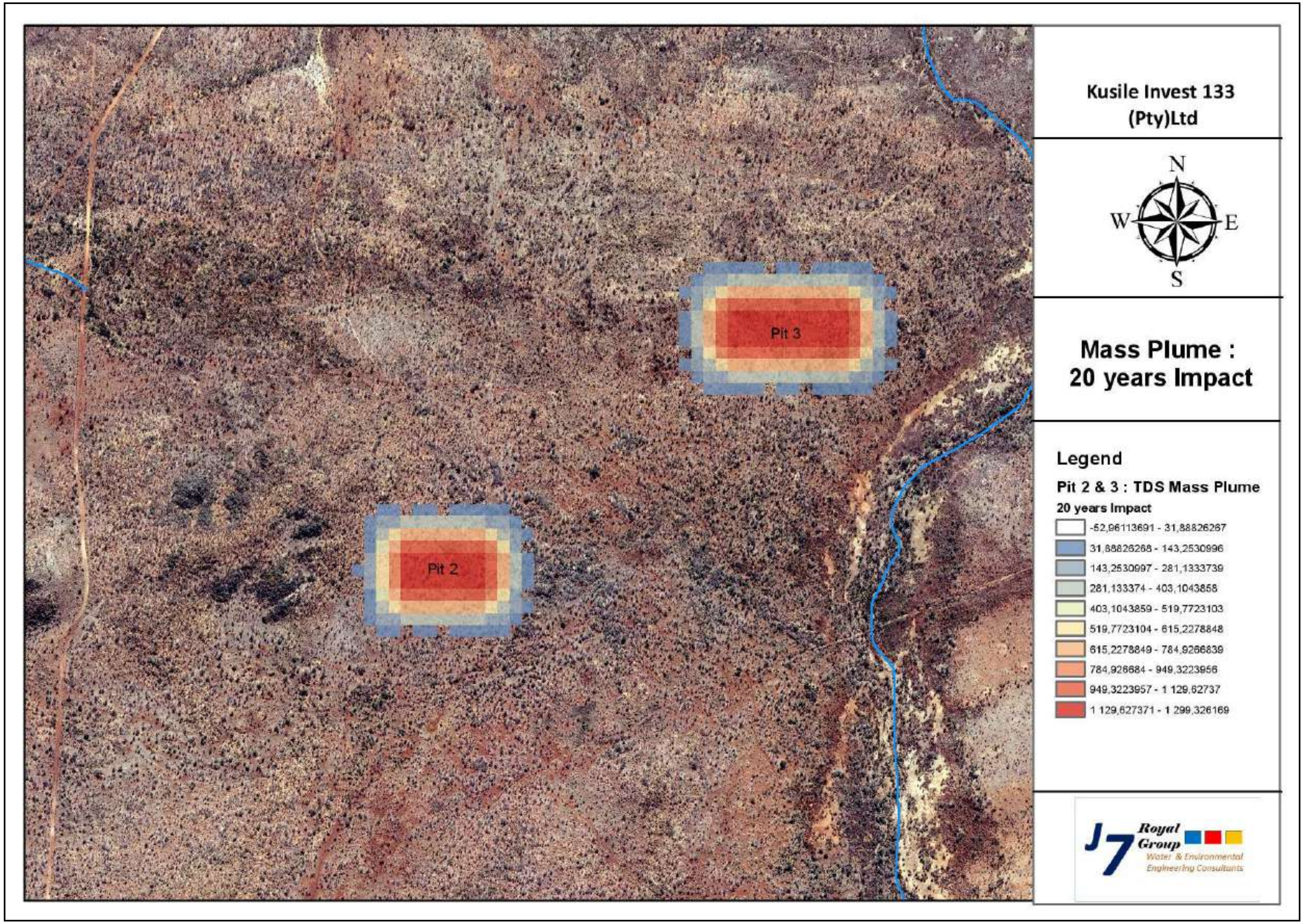


Figure 4-26 Pit 2 and Pit3 TDS mass plume in 20years impact

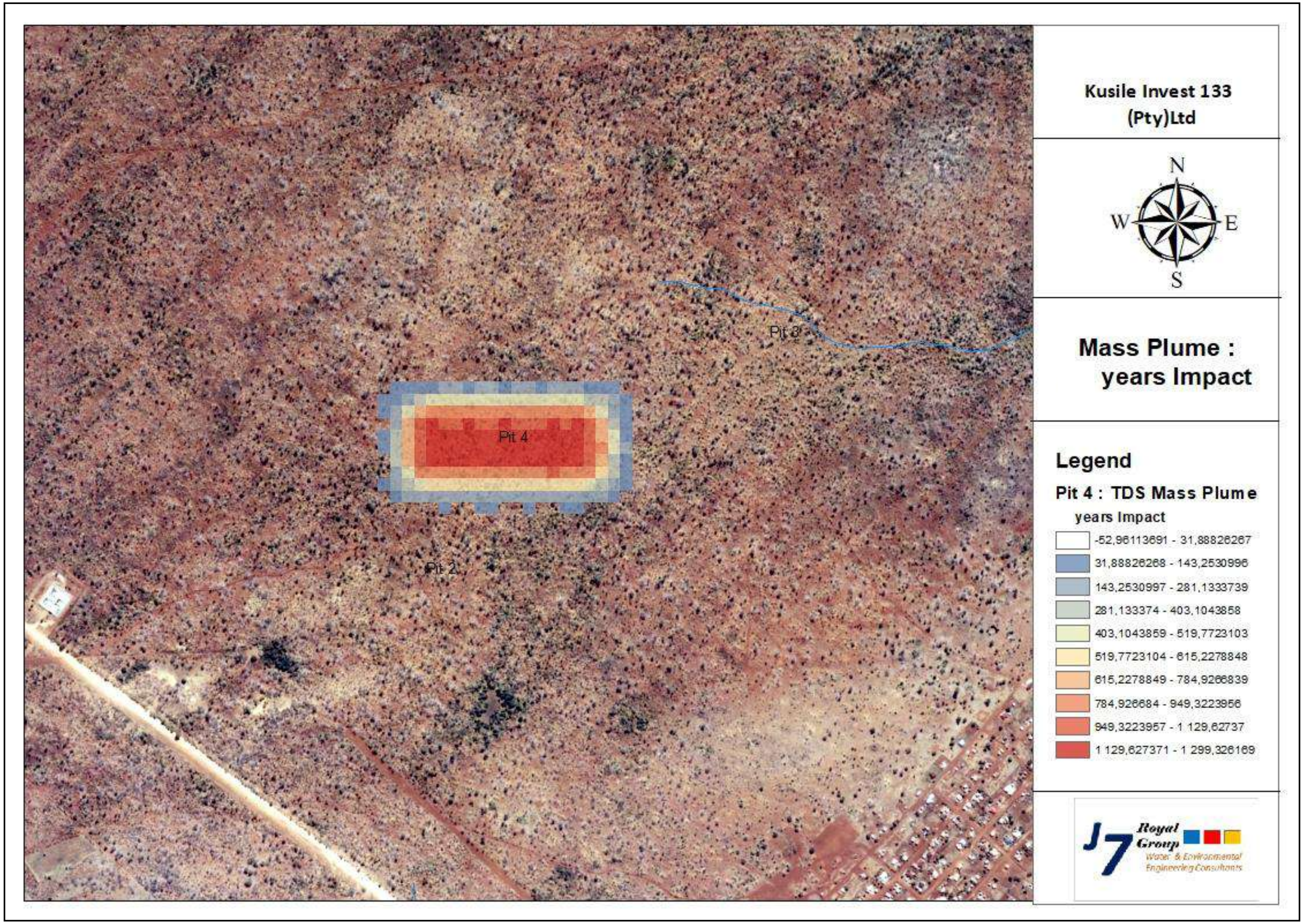


Figure 4-27 Pit 4 TDS mass plume in 20years impact

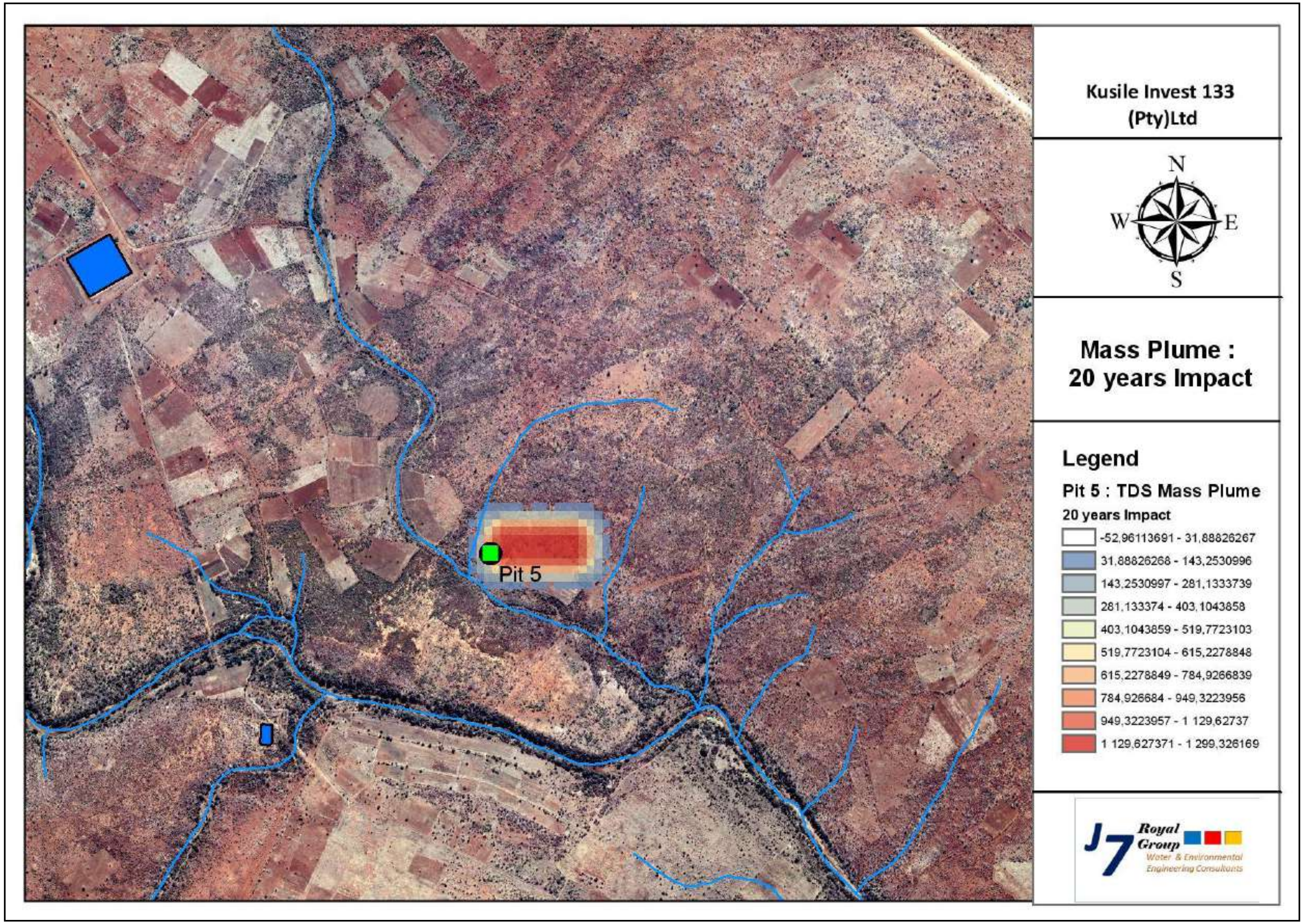


Figure 4-28 Pit 5 mass plume 20 years mining

4.13.6 Socio economic Environment

Description: The Greater Giyani Municipality is one of five (5) local municipalities falling within Mopani District Municipality in the Limpopo Province. The other four local municipalities are Greater Tzaneen (+/-120km), Greater Letaba (+/-90km), Ba-Phalaborwa (+/-160km) and Maruleng (+/-195km). The town is located +/- 185km from Polokwane, +/- 100km from Thohoyandou and +/- 550km from Tshwane. The municipality covers approximately 2967, 27km² areas with only one semi-urban area being Giyani.

The municipality is demarcated into 31 wards and has 62 councillors. It has 10 traditional authority (however as per the new provincial gazette three more traditional authorities are in the process of being recognized by office of the premier) areas comprising of +97 villages. Giyani town is the largest center of population concentration, employment opportunities, shopping and recreational facilities.

5 Analyses and Characterisation of Activity

5.1 Site delineation

The proposed open pits will be located on the following farms

- Swartkoppies (Pit - 1),
- West 59 (Pit - 2),
- Gemsbok (Pit - 3),
- Boltmans Beaty (Pit – 4); and
- Boltmans Beaty (Pit – 5)

The project area covers a surface area of 13894.66 hectares (ha) .Extent of surface area required for mining is 1000 hectares and extent of the area required for infrastructure, roads, servitudes etc. is 150 hectares. The site is delineated on the site layout plan depicted on the figure below. The proposed mining activities are outside the 1:50 and 1:100 year floodlines. The site layout plan depicts positions of the mining activity and related infrastructure including the following:

- Mine opencast workings (pits area)
- Ore/gold processing plant area
- Mine office complex
- Tailings Storage Facility
- Overburden dump
- Topsoil stockpiles
- Access and haul roads

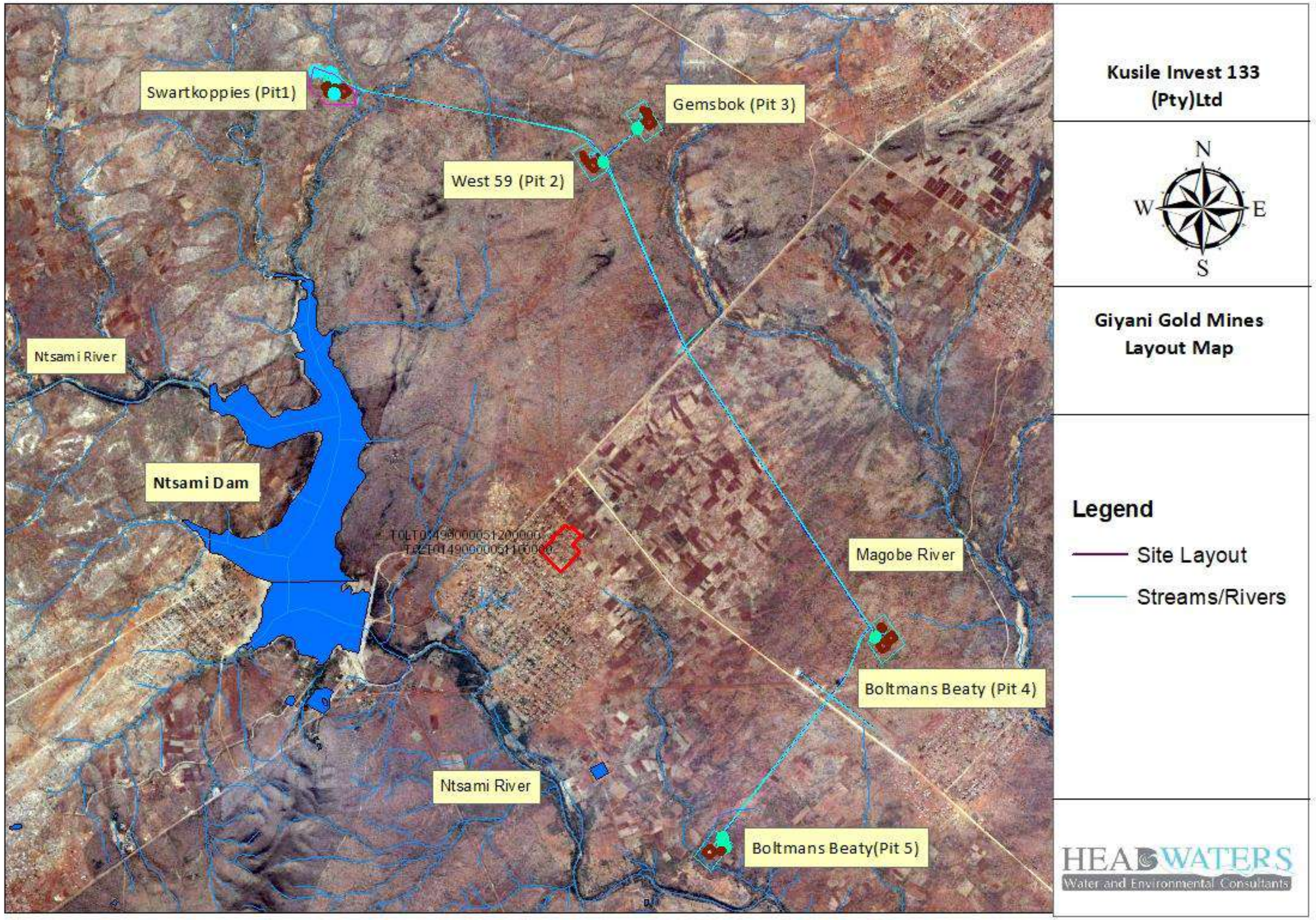


Figure 5-1 Preliminary Conceptual Layout Plan

5.2 Water and Waste Management

5.2.1 Water Management

The water management plan for the proposed Giyani Gold Mine is based on DWS Best Practice Guidelines for Surface Mines Water Management (A5). The primary objective of water management on the mine is to protect water resources and promote efficient use of water. This is achieved through adherence to the hierarchy of decision-taking, which is based on a precautionary approach and includes the following order of priority:

- Pollution prevention
- Minimisation of impacts through water reuse, reclamation, and treatment

The mine water management infrastructure will be designed and operated to achieve the following specific objectives:

- To ensure that water of different qualities (clean and dirty water) is kept separate, and managed separately, as far as practicably possible. This will ensure that the contact between water of different quality, and the potential for water quality deterioration is minimised;
- To address water pollution issues at source;
- To maximise water reuse, avoid polluted water discharges from the mine site and maximise clean water runoff;
- To ensure that the water management measures are sustainable in the long term.

5.2.2 Waste Management

The hierarchy for waste management will be followed as outlined below.

- **Waste prevention:** the prevention and avoidance of the production of waste;
- **Recovery:** the recycling or re-use of waste;
- **Waste reduction:** the reduction of the volume/quantity or hazardous nature of waste during mine operation and production; and
- **Waste treatment:** the treatment of waste to reduce the volume of waste, risk to human and the environmental, and the degree of hazard;
- **Waste disposal/discharge/emission:** the environmentally acceptable and safe disposal or discharge of waste in line with the National Environmental Management Waste Act, 2008 (Act No. 59 of 2008).

5.2.3 Potable Water Supply

Potable water for the mine will be sourced from an abstraction borehole drilled on site (see table below). Approximately 80 m^3 per day of potable water per each site will be required at Giyani Gold Mine (Swartkoppies (Pit - 1), West 59 (Pit - 2), Gemsbok (Pit - 3), Boltmans Beaty (Pit – 4); and Boltmans Beaty (Pit – 5). The water will be used for domestic purposes in the mine office, change house, workshop, processing plant and pit area. In keeping with the Mine Health and Safety Regulations, a purification plant will be established for treatment of raw water to ensure compliance with drinking water quality standards prescribed in the South African National Standard (SANS) 241: 2015.

5.2.4 Process Water

Process water at Giyani Gold Mine Swartkoppies farm includes water used in and recovered from the ore/gold processing plant, treated sewage effluent, as well as return water from the TSF. However, the primary water source for the mine is groundwater boreholes.

The proposed mining operation will utilize a two-stage dense medium separation (DMS) plant with make-up water requirements estimated at 545 m^3/day. The processing plant will be located on Swartkoppies area only.

A high-rate thickener and clarifier will be used to recover water from the slimes produced by the gold processing plant. The thickener increases the density of the solution slimes material to facilitate solid- liquid separation through gravity settling of the thickened material. The overflow from the clarifier will then be returned to the process water tank for reuse, which reduces make-up water demand from the primary source (groundwater abstraction boreholes).

Underflow slimes from the thickener and clarifier will be disposed on TSF. The facility will be equipped with a penstock, which will allow for recover of supernatant to the process water tanks (via a return water dam or dirty storm water dam (i.e. pollution control dam)).

Table 5-1: Process Make-up Water Supply Sources

Facility	Source of Supply	Quantity (m^3/day)
Raw water reservoir	Groundwater abstraction boreholes	1000
Pollution Control Dam 1	Package sewage treatment plant	223
	Return water from TSF	
Pollution Control Dam	Tailings Facility	100

5.2.5 Storm Water Management

A conceptual Storm Water Management Plan (SWMP) for Giyani Gold Mine has been discussed in Hydrological Assessment Report. The SWMP will be developed according to BPG G1 on Stormwater Management. As required in terms of Regulation 6 in Government Notice 704 under the National Water Act, 1998, the stormwater management system will be designed to ensure separate clean and dirty stormwater up to the 1:50 year design flood, with measures to prevent sub-surface pollution. All stormwater arising from outside of the mining site will be diverted around the perimeter of the project areas by berms and channels. The berms and channels will be sized for the 1:50 year flood recurrence interval.

Possible sources of stormwater contamination have been identified, and collection and impoundment systems will be put in place to isolate such areas in order to minimise potential for runoff contamination. Stormwater runoff dirty areas will be drained through a dirty stormwater system draining to lined PCDs. The following principles will be applied in the development of the stormwater management plan:

- Dirty water must be collected and contained in a system separate from the clean water system and the risk of spillage or seepage into clean water systems must be minimised;
- The SWMP must be designed to prevent or minimise the risk of spillage of clean water into dirty water systems.
- The SWMP must be sustainable over the life cycle of the mine and over different hydrological cycles and must incorporate principles of risk management

5.2.6 Water Balance

This section discusses Giyani Gold mines water balance for the first 30 years of the LOM. The water balance will be used on a frequent basis to assess the quantity, usage (consumption), and source of water at Giyani Gold Mine and will be update annually. This water balance will used at the mine to:

- Audit water usage from various sources;
- Identify areas of high water consumption and wastage;
- Locate and quantify sources of losses;
- Assist with the design and verification of storage requirements and minimizing the risk of spillage.

Components of the water reticulation network for Giyani Gold Mine are depicted in the schematic flow diagram overleaf. Mining of Swartkoppies Pit 1 opencast pit will commence in 2021 and are planned for 30 years LoM ending in year 2051.

In line with the Best Practice Guideline (BPG) for Water and Salt Balance (G2) (DWS, 2006), the water balance will be updated annually throughout the life of mine based on monitoring data and revision of projections to reflect the dynamic process of change at the mine. According to the provisional water balance, in the first 30 year of LoM, Giyani Gold Mine will require approximately 1000 m^3/d of water, sourced from boreholes for all the sites included ((Swartkoppies (Pit - 1),West 59 (Pit - 2),Gemsbok (Pit - 3), Boltmans Beaty (Pit – 4); and Boltmans Beaty (Pit – 5)).The water is to be used in areas including the mine office complex (change house and ablution), workshop, gold processing plant, and dust suppression of gravel haul and access roads. However, the processing plant in Swartkoppies will be equipped with a high-rate thickener to recover water from the slimes before disposal to the TSF. The recovered water will be recycled to the process water tank, thereby reducing process water make-up from the primary sources.

Raw sewage and grey water (i.e. sullage) from the mine will be treated with a package sewage treatment plant. The treated effluent together with dirty storm water runoff from the plant area will be disposed of into PCD located on the farm Swartkoppies pumped to the process water tank for reuse.

Dirty storm water runoff from the residue stockpiles (overburden waste) will be disposed of into PCD situated on the farm Swartkoppies and pumped to the processing plant for reuse. A minimum freeboard of 0.8 m will be maintained for the PCDs.

Table 5-2: Giyani Gold Mine Preliminary Water Balance

No.	Facility Name	Water In(m^3/d)		Water Out(m^3/d)		Balance(m^3/d)	Comment
		Water Circuit/stream	**Quantity (m^3/d)**	**Water Circuit/stream**	**Quantity (m^3/d)**	**Balance(m^3/d)**	
1	**Mining Component**	Groundwater influx	0,00	Pit dewatering through pumping to PCD	0,00		
		Total	**0,00**		**0,00**		
2	**Gold/Ore Processing Plant**	Raw feed (ROM) water	545,00	Product gold/ore moisture	163,50		
		Recycled water from PCD					
		Process water tank (primary water supply)					
				Slimes from processing plant	113,69		
		Total	**545,00**		**277,19**	**267,813**	
3	**TSF Facility**	Slimes from processing plant	113,69	Flow to pollution control dam	113,69		
		Rainfall on paddocks catchment area		Evaporation	10,00		
				Seepage losses	10,00		
		Total	**113,69**		**133,69**	**(20,000)**	
4	**Pollution Control Dam (PCD)**	Inflow from dewatering of Pit	0,00	Return water to processing plant	100,00		
		Inflow from TSF Facility	113,69	Evaporation	10,00		

No.	Facility Name	Water In(m³/d)		Water Out(m³/d)		Balance(m³/d)	Comment
		Water Circuit/stream	Quantity (m³/d)	Water Circuit/stream	Quantity (m³/d)	Balance(m³/d)	
		TSF paddocks inflow	113,69	Seepage	10,00		
		Rainfall on PCD catchment area		Dust suppression	282,00		
		Return flows from sewage treatment plant	65,15				
		Total	**292,52**		**402,00**	**(109,476)**	
5	**Sewage Package Plant**	Sewage from mine office and change house	123,00	Treated sewage effluent to RWD	65,15		
		Total	**123,00**		**65,15**	**57,850**	
6	**Raw Water Tank**	Groundwater Abstraction (Boreholes)	1000,00	Potable water tank (domestic water use)	50,00		
				Processing plant	545,00		
		Total	**1000,00**		**595,00**	**405,000**	
	Total Water Balance		**2074,21**		**1473,02**	**601,187**	**Deficit / + Surplus**

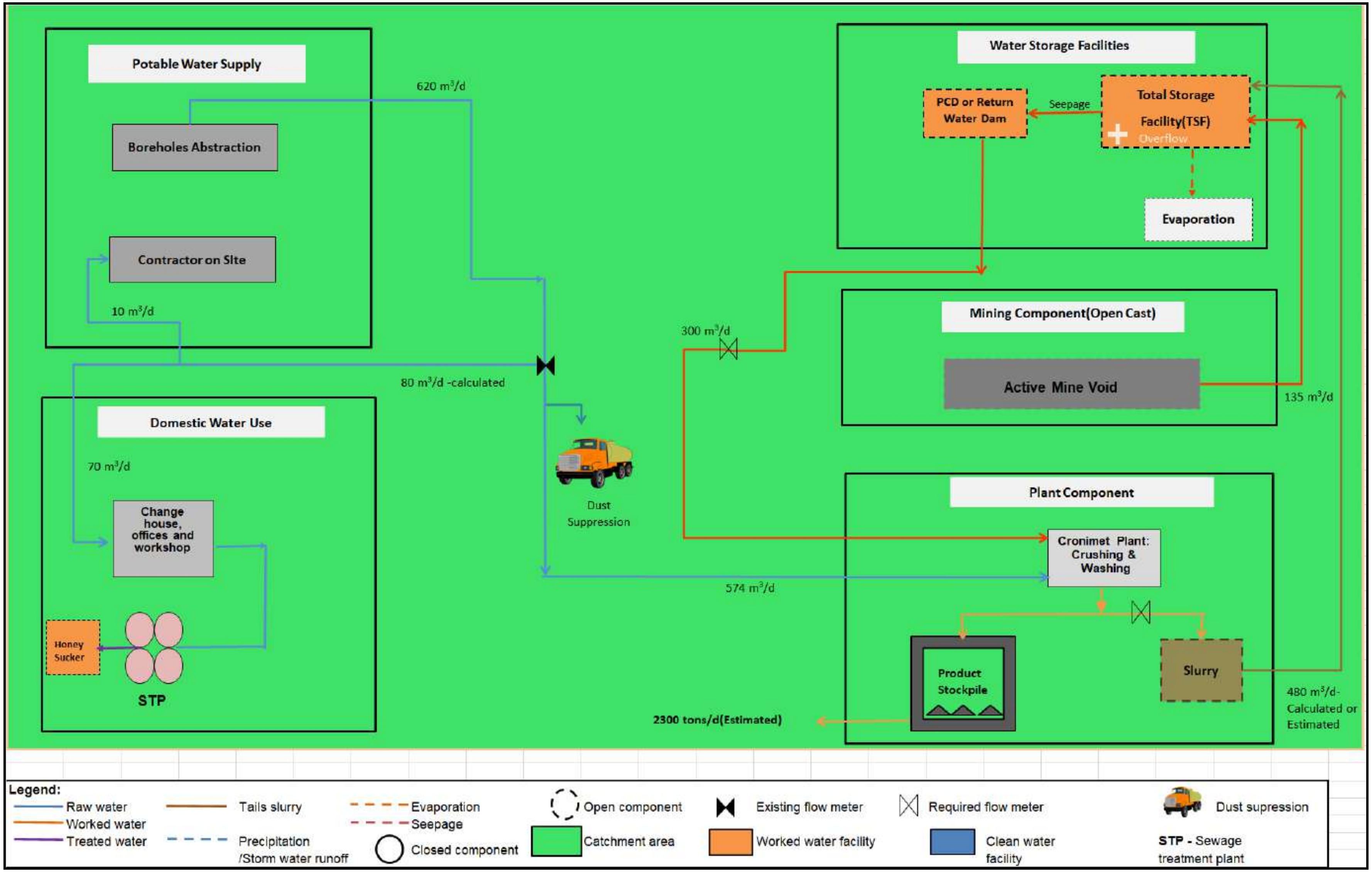


Figure 5-2: Giyani Gold Mine Schematic Water Flow Diagram

5.3 Solid Waste Management

Waste management is a key component of an IWWMP, particularly owing the potential impacts of waste disposal on resource water quality. Waste management at Giyani Gold Mine will be guided by the hierarchy for waste management, which supports sustainable development through promoting sustainable and cleaner production, waste minimisation, reuse, recycling and waste treatment. Disposal is regarded as a last resort, and practiced in an environmental sound and socially acceptable manner, and subject to the NEMWA and applicable regulations.

Figure 5-3: Waste Hierarchy

Hazardous wastes such as chemical containers, spent oil, diesel and grease will be stored in dedicated containers and collected at regular intervals by a registered sub-contractor and disposed of at a licensed disposal site. No hazardous waste streams will be disposed of on the mine premises, except authorised under the NEMWA, e.g. in the case of TSF. Spillages will be cleaned up and disposed of in an appropriate manner.

Scrap material that have salvageable value will be collected, sorted and reused where possible. However, if quantities of this waste stream are significant, Giyani Gold Mine will work with local communities through the established structures in SLP programmes, to establish a local-based organisation to recover and sell or reuse the scrap metal. General waste is collected in marked containers and removed from the premises by a registered contractor on a weekly basis. Safe disposal certificates will be retained for record-keeping, for all waste streams disposed off-site.

5.3.1 Waste Stream Identification

Anticipated waste streams from Giyani Gold Mine include those listed in the tabulations below.

Table 5-3: Giyani Gold Mine Waste Stream Identification

Infrastructure /Activity	Waste	Waste Categorization
Ablution	Sewage Sullage (grey water)	Hazardous
Stockpiles	Overburden stockpiles Tailings Disposal Facility (TSF)	Hazardous
Offices	Waste papers, plastic, glass bottles, food waste	General waste
Mine vehicles	Hydrocarbon waste generated by spillages; Operations of vehicle and diesel generators	Hazardous waste
Workshop	Fluorescent tubes, old batteries, waste paints, and transformers; Oily and grease waste, petrol contaminated material, and oil related products	Hazardous waste
	Scrap metals, empty chemical containers, metal off-cuts), used tyres	Hazardous waste

5.3.2 Waste Classification

Waste Classification Methodology

Assessment and classification of the coal sample was carried out according to requirements in Government Notice 635 National Norms and Standards for Assessment of Waste for Landfill. The classification is undertaken as follows:

1. Evaluation of the activities generating the waste streams and determination of relevant chemical elements and substances in relation to those listed in the Norms and Standards for Assessment of Waste for Landfill Disposal. According to the regulation, all the chemicals that could reasonably be expected to occur in the material being classified should be tested for. Hence, XRD and XRF results are taken into account.
2. Collection of samples of the relevant waste streams from the mine – in terms of the Waste Regulations and the NWA, and delivery of the samples to UIS Laboratories for analyses. Sampling was done on waste rock, tailings, as well as Run of Mine (ROM). Although ROM is not waste in terms of the NEMWA definition, it is also assessed for contextualisation of the waste stream results and since it may fall into the definition of waste in terms of the NWA.
3. Geochemical assessments of the samples and determination of Total Concentrations (TC) and Leachable Concentrations (LC) of the selected chemical elements and substances from section 6 of the Norms and Standards.
4. Determination of the type of waste based on an evaluation of the geochemical assessment results against the Total and the Leachable Concentration Threshold Limits in the Norms and Standards for assessment of waste for landfill.

Based on GNR 635, the type of waste can be determined as follows:

a. Material (or wastes) with any element or chemical substance concentration above the LCT3 or TCT2 limits (LC> LCT3 or TC> TCT2) are Type 0 Waste;

b. Wastes with any element or chemical substance concentration above the LCT2 but below or equal to the LCT3 limits, or above the TCT1 but below or equal to the TCT2 limits (LCT2 < LC ≤ LCT3 or TCT1 <TC ≤ TCT2), are Type 1 Waste;

c. Wastes with any element or chemical substance concentration above the LCT1 but below or equal to the LCT2 limits and all concentrations below or equal to the TCT1 limits (LCT1 < LC ≤ LCT2 and TC ≤ TCT1) are Type 2 Waste;

d. Wastes with any element or chemical substance concentration above the LCT0 but below or equal to the LCT1 limit and all TC concentrations below or equal to the TCT1 limits (LCT0 < LC ≤ LCT1 and TC ≤ TCT1) are Type 3 Waste;

e. Wastes with all element and chemical substance concentration levels for metal ions and inorganic anions below or equal to the LCT0 and TCT0 limits (LC ≤ LCT0 and TC ≤ TCT0), and with chemical substance concentration levels also below the corresponding limits for organics and pesticides, are Type 4 Waste.

Waste Classification Results

Total Concentrations of Arsenic (As), Barium (Ba), Copper (Cu) and Nickel (Ni) in all the samples exceeded Threshold Zero (TCT0) values, but are less than Threshold 1 (TCT0). Therefore, the materials would be classified as Type 3 Waste, based on the total concentrations of the said trace metals.

Table 5.7 presents the test results of reagent water leaching for the mono-disposed waste according to AS 4439.3 for the different materials. It is recommended that the rock samples are not strictly classified according to the TCT values because of the low TCT0 threshold values.

The AUC represents the average concentration of elements in the upper continental crust including rock (sub)-outcrops and serves as a background reference for the geochemical composition of rock near the earth's surface. The TCT0 for Ba and Cu are below the AUC; for As, Mn and Pb, the TCT0 is close to (not more than twice) the AUC. This implies that most natural rock and soils in the earth crust would classify as Type 3 waste based on the TCT0 value. Thus, for this analysis, only the LCT values will be used for classification of these materials.

For all material samples, reagent water leach LCs are below LCT0 values for the corresponding chemical elements and compounds.

- The waste rock and ROM would be classified as Type 4 Waste if only leachable concentrations are considered.

- The low leachable concentrations of constituents in the waste rock indicate that the risk from leachable constituents to contaminate the receiving environment, is low over the short term. Thus, there is a low risk of water resource pollution that may be attributable to contaminant mobilization over the short term (during operational phase).
- The slimes/tailings could be classified as Type 4 while still neutral (e.g. during operation). Since the material may acidify over the long-term upon oxidation, it should be classified as Type 3 Waste when disposed of over the long-term.
- Since the material comprises of natural rock material no organic chemicals, including petroleum hydrocarbons and pesticides, are expected to occur within it.

Table 5-4: Waste Classification Total Concentration Results (mg/kg)

Chemical Element/Substance	Waste Rock	ROM	Tailings	TCT0	TCT1	TCT2
As, Arsenic	7.48	13.4	10.8	5,8	500	2000
B, Boron	13.2	37.5	36.6	150	15000	6000
Ba, Barium	363	207	139	62,5	6250	25000
Cd, Cadmium	0.10	0.05	0.05	7,5	260	1040
Cr_{Total}, Chromium	265	1533	1097	46000	800000	N/A
Co, Cobalt	47.5	51.0	28.8	50	5000	20000
Cu, Copper	209	69.6	62.4	16	19500	78000
Hg, Mercury	0.03	0.04	0.08	0,93	160	640
Mn, Manganese	1307	878	729	1000	25000	100000
Mo, Molybdenum	0.67	0.76	0.62	40	1000	4000
Ni, Nickel	171	720	431	91	10600	42400
Pb, Lead	9.63	14.4	6.24	20	1900	7600
Sb, Antimony	0.35	0.57	2.27	10	75	300
Se, Selenium	0.51	0.23	0.18	10	50	200
V, Vanadium	217	110	111	150	2680	10720
Zn, Zinc	119	72.6	56.5	240	160000	640000
CN_{Total}, Cyanide Total	–	–	1.04	14	10500	42000

Table 5-5: Waste Classification Leachable Concentration Results (mg/L)

Analyses	Waste Rock	ROM	Tailings	LCT0	LCT1	LCT2	LCT3
As, Arsenic	0.002	0.003	0.003	0,01	0,5	1	4
B, Boron	0.070	0.097	0.058	0,5	25	50	200
Ba, Barium	0.268	0.340	0.222	0,7	35	70	280
Cd, Cadmium	<0.0001	<0.0001	<0.0001	0,003	0,15	0,3	1,2
Co, Cobalt	0.002	0.002	0.009	0,5	25	50	200
Cr_{Total}, Chromium	0.004	0.012	0.019	0.1	5	10	40
Cu, Copper	0.009	0.002	0.002	2,0	100	200	800
Hg, Mercury	<0.0001	<0.0001	<0.0001	0,006	0,3	0,6	2,4
Mn, Manganese	0.046	0.027	0.075	0,5	25	50	200
Mo, Molybdenum	0.001	0.002	0.001	0.07	3.5	7	28
Ni, Nickel	0.004	0.013	0.021	0,07	3,5	7	28
Pb, Lead	0.001	0.001	0.002	0,01	0,5	1	4
Sb, Antimony	0.001	0.001	0.003	0.02	1.0	2	8
Se, Selenium	<0.001	<0.001	<0.001	0,01	0,5	1	4
V, Vanadium	0.016	0.013	0.016	0,2	10	20	80
Zn, Zinc	0.007	0.006	0.019	5,0	250	500	2000

Analyses	Waste Rock	ROM	Tailings	LCT0	LCT1	LCT2	LCT3
Total Dissolved Solids*	60	100	148	1000	12 500	25 000	100 000
Chloride as Cl	1.37	0.92	5.23	300	15 000	30 000	120 000
Sulphate as SO_4	9.92	12.8	10.1	250	12 500	25 000	100 000
Nitrate as N	2.01	2.33	8.02	11	550	1100	4400
Fluoride as F	0.13	0.24	0.12	1,5	75	150	600
CN_{total}, Cyanide Total	–	–	<0.01	0.07	3.5	7	28

5.3.3 Waste Recovery and Reduction

Giyani Gold Mine will adopt the following principle for waste reduction and recovery in line with waste hierarchy plan as provided in the figure below.

(i) Key waste identified will be collected, handled, and disposed in accordance with the respective waste stream classification and legislation;

(ii) Opportunities for waste reduction, reuse, recycling and recovering will be regularly investigated and feasible opportunities implemented as part of the continual improvement philosophy adopted for the mining operation;

(iii) Mine residue dumps on the site will be rehabilitated in accordance with the nature of the deposited material and the contamination potential of the respective dumps as directed by legislation.

Waste reduction and recovery will be carried in the manner discussed in the tabulation below.

Table 5-6: Waste Recovery and Reduction

Waste stream	Description, management, reduction and recovery
Construction Phase	
Dirty storm water runoff	PCDs will be constructed prior to opening the box cut to contain dirty water from the box cut. Dirty water collected within the opencast pit will be pumped and channeled into a PCD located on the farm Swartkoppies. The storage capacity of the PCD will be approximately 140 000 m^3 and will accommodate 24 hr storm rainfall volume for the 1:50 year storm event. Clean storm water will be diverted around the dirty water areas using berms and channels.
Solid waste	Solid waste will be collected in bins and disposed of in existing licensed disposal sites around Giyani area. Waste will be separated into general waste, hazardous waste, metals, wood, glass and paper and recycled where possible. Certified contractors will be contracted to dispose of non-recoverable/recyclable waste into licensed waste disposal site.
Sewage	Chemical toilets will be made available on site for ablutions. These

Waste stream	Description, management, reduction and recovery
	toilets will be serviced as required by a contractor. No washing facilities will be provided on site.
Construction Phase	
Overburden (waste rock)	Temporary overburden stockpiles will be placed adjacent on the northern part of the open pit to facilitate concurrent backfilling of the mined-out areas. Rehabilitation will entail replacing any stockpiled blasted over-burden, inter-burden and parting material into the voids and then dressing with the sub-soil and then top-soil, contouring and re-vegetating.
Solid waste	All solid waste generated will be handled as during construction phase.
Sewage waste	Raw sewage and grey water from the mine offices and ablution facilities will be disposed of into package sewage treatment plants located on the farm Swartkoppies. The effluent from the sewage plants will be reused in the gold processing plant.
Decommissioning Phase	
Solid waste	The processing plant, offices, conveyors and other infrastructure will be removed and sold for re-use or disposed of as scrap.

5.3.4 Operational Management

5.3.4.1 Organization structure

The proposed mining operation will employ approximately 400 permanent employees when operating at a steady state. The majority of the workforce will be recruited from the local and surrounding communities. The aggregate wages that will be paid to these employees will contribute towards poverty alleviation and also improve the local economic activities. The mine will also contribute towards the development of small business enterprises and support local suppliers of capital goods and services, in so doing help create other jobs in the community.

Kusile Invest will also contribute in stimulating the economy in the area through local procurement. The mine will implement a preferential procurement policy to ensure that the bulk of its procurement spend is used for purchasing goods and services from 55 companies that comply with the BBBEE requirements. Preference will be given to local or regional suppliers which have a broad-based empowerment shareholding. This will include technicians, managers (mine, environment, and safety), and plant and machine operators. Labour will preferably be recruited from within the boundaries of Giyani Local Municipality. The applicant will sub-contract independent companies to carry out functions such as mining, processing, slimes/tailings disposal.

All positions will require certificate of competency in line with the requirements of Mine Health and Safety Act, 1996 (Act No.29 of 1996) and other requirements in line with the National Qualification Authority (NQA). The organization structure of the applicant is presented in the figure overleaf.

The mine will employ its own permanent employees to conduct the mining, processing and marketing functions with no mining activities outsourced and sub-contracted to independent companies

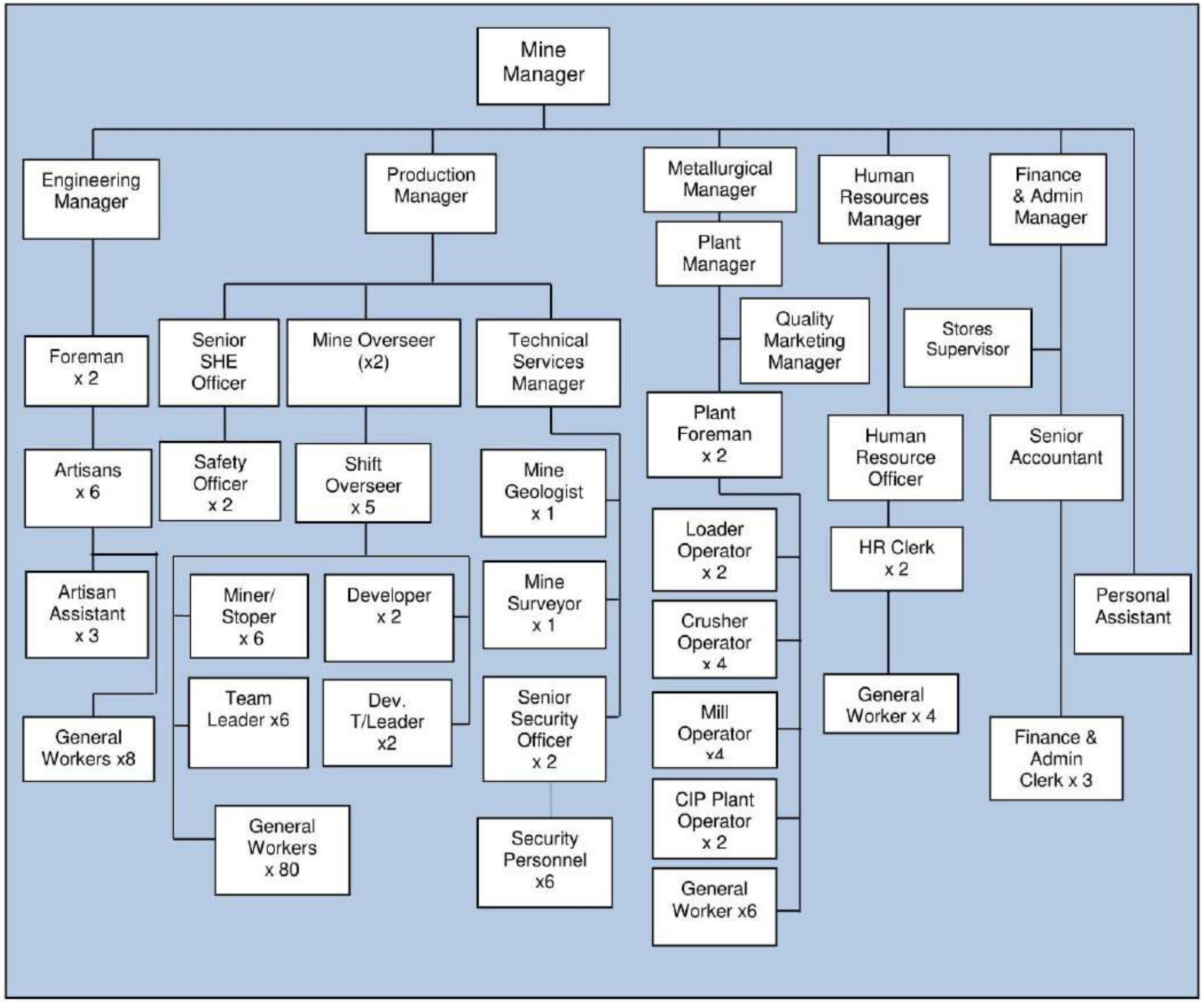


Figure 5-4: Giyani Gold Mine Organizational Structure

5.3.5 Resources and Competencies

Giyani Gold Mine will appoint an Environmental Officer and a Safety, Health, and Environmental (SHE) Manager who will be responsible for the mine environmental issues and compliance. The mine will conduct annual internal audit on compliance and the report on the audit will be submitted to the Department of Water and Sanitation (DWS) within one month of finalization of the report. Furthermore, the report will be made available to an external auditor.

5.3.6 Education and Training

The Environmental Awareness Plan (safety, health and environmental (SHE) training) at the proposed Giyani Gold Mine will be administered by the appointed SHE Manager and Safety Assistant. The following principles will apply to the Environmental Awareness Plan at the mine:

- All personnel will, as a minimum, undergo general SHE induction and awareness training
- An Environmental Manager identifies the SHE training requirements for all Giyani Gold Mine`s personnel and contractors. The training requirements will be recorded in a training needs matrix indicating particular training that must be undertaken by identified personnel and contractors. The training matrix will be administered by the Environmental Manager.

5.3.7 Internal and external communication

Interested and affected parties (I & AP) register will be updated and kept at the mine. Communication lines will be drawn and will cascade from the Site Manager through to the general workers, authorities and other interested and affected parties. Giyani Gold Mine will initiate numerous activities to engage stakeholders at a national level, including the following:

- One-on-one meetings with specific stakeholders on pertinent issues;
- Public liaison and forum participation;
- Distribution of information through newspaper advertisements, written documentation posted out within the vicinity of the mining area.

5.3.8 Awareness raising

All employees at Giyani Gold Mine have to undergo environmental awareness and training in terms of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

5.4 Risk Assessment

5.4.1 Safety, Health, Environment (SHE) Policy

Giyani Gold Mine will be engaged in the exploration, development and mining of gold. In line with the Mine Health and Safety Act, 29 of 1996, Mineral Act, 50 of 1991, Giyani Gold Mine implements and continuously maintain an integrated SHE management system to comply to zero harm to people, communities and the environment.

Our Commitment

To function in a safety and responsible manner that delivers suitable protection for the environment and the heath, and safety of our employees, contactors, visitors and public

Our Aim

To develop, implement and maintain an effective Safety, Health Environment (SHE) management system to ensure risk and impacts are well managed and accomplished

Environment;

- Prevent Pollution ;and
- Rehabilitation of disturbed and mined out land by operations
- Identifying environmental impacts
- Comply with all Environmental applicable Legislation

Safety and Health: (SH)

- Comply with all applicable statutory and regulatory legislation
- To proactively reduce the frequency and severity of injuries through hazard identification, risk assessment and control processes;
- To promote an environment where all employees accept responsibility for their own Health and Safety and everyone engaged in our core business

Continual Improvement

Institute continual improvement efforts by reviewing our performance and the effectiveness of our management system .The policy will be reviewed periodically by managements for continued suitability to ensure that it remains relevant and appropriate to Giyani Gold Mine

5.4.2 Objectives and Strategies

The purpose of impact assessment is to identify impacts on water resources, that are likely to occur as a result of mining activities at Giyani Gold Mine during construction, operation, decommissioning and closure, as well as post-closure phases of the mine. To that end, mitigation and management measures that must be put in place to avoid and minimize impacts are proposed.

5.4.3 Impact Assessment Methodology

The methodology is based on that in the DWS Operational Guideline for IWWMPs. The method assesses the significance of potential negative impacts in terms of Occurrence (Probability and Duration) and Severity (Magnitude/Intensity and Scale).The combined effect of these two aspects defines the Significance of each potential impact, as expressed below. The impacts on water resources are considered for scenarios before and after implementation of mitigation measures.

Significance Rating (SR) = (Magnitude + Duration + Scale) x Probability

Ratings for the other variables in the Significance Rating formula are determined from the tabulation below.

Table 5-7: Impact Rating Methodology

Probability (P)	**Duration (D)**
5 – Definite / don't know	5 – Permanent
4 – High probable	4–Long-term (ceases with operational life)
3 – Medium probability	3 – Medium-term (6 – 15 years)
2 – low probability	2 – Short-term (0 – 5 years)
1 – Improbable	1 – Immediate
0 – None	
Scale (S)	**Magnitude (M)**
5 – International	10 – Very high / Don't know
4 – National	8 – High

3 – Regional	6 – Moderate
2 – Local	4 – Low
1 – Site	2 – Minor
0 – None	

The significance of the impact is then categorized as Low, Medium or High depending on the Total Score for the Significance Rating. The categorization is described in tabulation below.

Table 5-8: Impact Categorization

• Rating (SR)	• Category
SR>60	High (H)
SR 30-60	Moderate (M)
SR<30	Low (L)

The approach for identifying potential impacts is as follows:

- Review of the Mine Works Programme, the EMPR and specialist study reports
- Review of the WUL internal and external audit findings
- Study environmental context and possible exposure pathways
- Identify possible impacts on water resources
- Review relevant monitoring data and compliance to relevant criteria in authorisations
- Determine significance of each impact for the scenarios before and after implementation of mitigation measures

5.4.4 Construction Phase

The construction phase involves site demarcation, clearance, and development of the Giyani Gold Mine (Swartkoppies (Pit - 1), West 59 (Pit - 2), Gemsbok (Pit - 3), Boltmans Beaty (Pit – 4); and Boltmans Beaty (Pit – 5) opencast box-cut and support infrastructure (services, offices, ablution, workshop, and dams). Mine support infrastructure will be development on the farms Swartkoppies. The main activities during this phase include:

- Stripping and stockpiling of topsoil to prepare sites for construction, mostly opencast pit and buildings
- Construction of access roads and haul roads
- Connection to power sources
- Construction of pollution control infrastructure such as pollution control dam, berms and channels for clean and dirty water separation
- Construction of buildings such as offices, workshops, change houses (including ablution facilities), stores, and gold processing plant
- Installation of services such as electricity, sewage, and raw water for mineral processing

Table 5-9: Impact Assessment- Construction Phase

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
Groundwater											
Construction and grading could cause changes in runoff and infiltration that could reduce groundwater recharge.	1	4	4	3	27 (L)	• Construction stage will be planned to minimize the removal of vegetation and opportunities for re-vegetation will be maximized.	1	4	2	3	21 (L)
Fuel & hydrocarbons leakages and spillages from the storage and transporting vehicles may cause groundwater contamination.	1	4	4	3	27 (L)	• All storage areas containing hazardous materials will have secondary containments capable of containing the volume of the largest tank or container plus 10%. Resort to immediate clean-up after accidental spillages. Divert run-off from haul roads that may contain hydrocarbons into lined pollution control dams.	1	4	2	3	21 (L)
Open cast mining below the water table will result in pit inflows	1	4	2	4	28 (L)	• Pit inflows cannot be mitigated (required to enable a safe work environment). Provision needs to be made within the mine water balance for the reuse or treatment of pit inflows. In case the water should be discharged, treatment will be required before discharge.	1	4	2	4	28 (L)
Baseflow reduction caused by mining	2	2	2	1	6 (L)	• Rivers and other streams in the project area are non-perennial and there are no baseflow into them. The baseflow into the streams and River won't be affected by mining activities	2	2	2	1	6 (L)
Groundwater abstraction for water supply purposes could reduce groundwater levels in the area	2	4	6	4	48 (M)	• Groundwater abstraction. The extent of the zone of influence will not extend beyond 1 000m and the maximum drawdown in the affected areas will range	1	3	4	4	32 (M)

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
						between 1 and 5 m, thereby not expected to impact on the yields of any supply boreholes around the mining area. Possible mitigation against such an impact is temporary water supply by the mine.					
Increased potential for groundwater contamination due to seepages from the overburden stockpiles	1	2	2	2	10 (L)	• Compact footprint area of the overburden stockpiles to minimize groundwater infiltration. Storm water run-off from the overburden stockpiles will be diverted into dirty water dams. A groundwater resources monitoring program will be implemented during to detect the groundwater contamination	1	2	2	2	10 (L)
Water contained in dirty water dams may impact on groundwater quality	1	4	4	4	36 (M)	• Pollution control dams need to be lined and designed to comply with NEMA and NWA requirements (Act 36 of 1998). Manage any leakages and spills to prevent groundwater contamination. Implement groundwater monitoring to detect groundwater contamination	1	2	2	2	10 (L)
Surface Water											
Increased sediment loads from vegetation clearance and soil compaction.	1	2	2	4	20 (L)	• Progressive rehabilitation of disturbed land should be carried out to minimize the amount of time that bare soils are exposed to the erosive effects of rain and subsequent runoff; • Implementation of the proposed basic storm water management plan is recommended at the mine site to channel and contain storm runoff; • Traffic and movement over stabilized areas should be	1	2	2	3	15 (L)

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
						controlled (minimized and kept to designated paths), and damage to stabilized areas should be repaired timeously and maintained; and • The total footprint area to be cleared for the development of mine infrastructure should be kept to a minimum by demarcating the construction areas and restricting removal of vegetation to the footprint areas only.						
Water resources pollution due to spillage of oils, fuel and chemicals.	1	2	2	4	20 (L)	• Oil recovered from any vehicle or machinery on site should be collected, stored and disposed of by accredited vendors for recycling.	1	2	2	3	15 (L)
Stream Resource Quality											
• Changing the quantity and fluctuation properties of the watercourse; • Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount); • Alteration of water quality – increasing the amounts of nutrients and toxins; and • Changing the physical structure within a water resource (habitat).	2	2	8	4	48 (M)	• Centralize the mine layout to affect as few surface watercourses as possible. • Capture and contain all dirty water from the construction operations. • Management of on-site water use and prevent storm water or contaminated water directly entering the watercourse (thus treat and reuse dirty water within construction activities). • Treat all surplus dirty water. Consider this water for treatment and discharge to receiving streams, or to third party users.	2	2	6	4	40 (M)

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
						• Given the sensitive nature of the receiving watercourses and the potentially far reaching effects within the River system, these recommendations should be coupled with the requirements of GN704. • If possible construction should preferably take place during the dry season. • All construction vehicles should be kept in good working condition to avoid. • All construction vehicles should be parked in demarcated areas when not in use and drip trays should be placed under vehicles to collect any spillages/ leaks. • Formalize access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas. • Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed. • Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance of the proposed infrastructure and take immediate corrective action where invasive species are observed to establish. • During the construction phase, measures must be put in place to control the flow of excess water so that it does					

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
						not impact on the surface vegetation. • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. • Demarcate the riparian areas and buffer zones to limit disturbance, clearly mark these areas as no-go areas. • Provision of adequate sanitation facilities located outside of the riparian area or its associated buffer zone. • Establishment of buffer zones to reduce nutrient inputs in diffuse flow • Implementation of appropriate storm water management measures around the excavation to prevent the ingress of run-off into the excavation. • Any activities within 50m of riparian areas are subject to authorization by means of a water use license. • Construction in and around watercourses must be restricted to the dryer winter months where responsible. • A temporary fence or demarcation must be erected around the works area to prevent access to sensitive environs. The works areas generally include the servitude, construction camps, areas where material is					

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
						stored and the actual footprint of the infrastructure • Planning of the construction site must include eventual rehabilitation / restoration of indigenous vegetative cover • Have oil/diesel spill kits on site. • Confirm surface water monitoring protocol and plans. Recommended that surface water monitoring be undertaken on a quarterly basis.					

5.4.5 Operational Phase

This phase represents the period during which gold is extracted from (Swartkoppies (Pit - 1), West 59 (Pit - 2), Gemsbok (Pit - 3), Boltmans Beaty (Pit – 4); and Boltmans Beaty (Pit – 5) opencast pit located on the farms Swartkoppies, West 59 Pit 2, Gemsbok Pit 3 and Boltmans Beaty (Pit 4 and Pit 5) for a period of 30 years starting from year 2021 to 2051. The RoM material will be transported via haul roads for crushing, screening, and washing on the farm Swartkoppies. The depth of Pit 1 until Pit 5 open pit will gradually increase as mining progresses to aconsiderable depth of approximately 60 m below ground surface.

Table 5-10: Impact Assessment-Operational Phase

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
Groundwater											
Construction and grading could cause changes in runoff and infiltration that could reduce groundwater recharge.	1	4	4	3	27 (L)	• Construction stage will be planned to minimize the removal of vegetation and opportunities for re-vegetation will be maximized.	1	4	2	3	21 (L)
Fuel & hydrocarbons leakages and spillages from the storage and transporting vehicles may cause groundwater contamination.	1	4	4	3	27 (L)	• All storage areas containing hazardous materials will have secondary containments capable of containing the volume of the largest tank or container plus 10%. Resort to immediate clean-up after accidental spillages. Divert run-off from haul roads that may contain hydrocarbons into lined pollution control dams.	1	4	2	3	21 (L)
Open cast mining below the water table will result in pit inflows	1	4	2	4	28 (L)	• Pit inflows cannot be mitigated (required to enable a safe work environment). Provision needs to be made within the mine water balance for the reuse or treatment of pit inflows. In case the water should be discharged, treatment will be required before discharge.	1	4	2	4	28 (L)
Baseflow reduction caused by mining	2	2	2	1	6 (L)	• Rivers and other streams in the project area are non-perennial and there are no baseflow into them. The baseflow into the streams and Rivers won't be affected by mining activities	2	2	2	1	6 (L)
Groundwater abstraction for water supply purposes could reduce groundwater levels in the area	2	4	6	4	48 (M)	• The extent of the zone of influence will not extend beyond 1 000m and the maximum drawdown in the affected areas will range between 1 and 5 m, thereby not expected to impact on the yields of any supply	1	3	4	4	32 (M)

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
						boreholes around the mining area. Possible mitigation against such an impact is temporary water supply by the mine.					
Increased potential for groundwater contamination due to seepages from the overburden stockpiles	1	2	2	2	10 (L)	• Compact footprint area of the overburden stockpiles to minimize groundwater infiltration. Storm water run-off from the overburden stockpiles will be diverted into dirty water dams. A groundwater resources monitoring program will be implemented during to detect the groundwater contamination	1	2	2	2	10 (L)
Water contained in dirty water dams may impact on groundwater quality	1	4	4	4	36 (M)	• Pollution control dams need to be lined and designed to comply with NEMA and NWA requirements (Act 36 of 1998). Manage any leakages and spills to prevent groundwater contamination. Implement groundwater monitoring to detect groundwater contamination	1	2	2	2	10 (L)
Surface Water											
Pollution of watercourses from general waste and sewage effluent due to hiring of mine workers.	2	5	4	3	33 (M)	• A reticulated sewage disposal facility at the proposed mine site should mitigate potential water quality issues that may arise due to population increase; • General waste should be collected and disposed of adequately; and • A water quality monitoring plan needs to be produced and implemented to determine any changes in the water quality.	2	5	2	2	18 (L)

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
Increased runoff due to soil compaction and increased paved surfaces.	2	4	6	3	36 (M)	• Compacted surfaces at the mine should be kept to a minimum and vegetation rehabilitation must be implemented within the mine setup; and • Proposed storm water drains should be designed to channel clean runoff to a single discharge point into the nearby watercourses while dirty water should be channeled to a central PCD.	2	4	2	2	16 (L)
Resource Quality											
• Hydrocarbon (oil, petrol and diesel) spills and/or leakages could occur from vehicles and/or equipment. These spills could contaminate the surface and ground water should they occur simultaneously with a heavy rainfall event. • Operational activities such as the establishment of increased hard surfaces could cause erosion which will lead to high volumes of sediment entering streams. This could again lead to increased silt loads entering the water bodies, especially under flood conditions (decreasing storage capacity). The mine's pollution control dams also pose a risk of contamination	2	4	8	4	56 (M)	• Centralize the mine layout to affect as few surface watercourses as possible, and ideally only one; • Capture and contain all dirty water from the operations activities; • Treat and reuse dirty water within construction activities; • Treat as a water resource all surplus dirty water. Consider this water for treatment and discharge to receiving streams, or to third party users; • All operational vehicles should be kept in good working condition, and should be parked in demarcated areas when not in use and drip trays should be placed under vehicles to collect any spillages/ leaks. • Keep dirty areas like stockpiles, workshops and oil and diesel storage areas as small as possible; and	1	4	6	3	33 (M)

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
of surface water during flood events.						• Contain poor quality runoff from dirty areas and divert this water to pollution control dam for re-use. • Have oil/diesel spill kits on site. • Confirm surface water monitoring protocol and plans. Recommended that monitoring be conducted on a quarterly basis.					

5.4.6 Decommission Phase

The decommissioning phase represents the period leading to the total cessation of the mining operations. During this phase the status quo from the operation phase persists until mining operations and dewatering finally stop. As soon as dewatering ceases, the groundwater levels are expected to recover.

Table 5-11: Impact Assessment- Decommission Phase

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
Groundwater											
Salt Load contribution towards Ntsami Dam or other streams	1	2	2	2	10 (L)	• The dominant direction of migration of contaminants from the surface facilities will be towards the pits and Ntsami Dam or any nearby streams won't be affected.	1	2	2		10 (L)
Aquifer contamination caused by backfill	2	5	8	4	60 (H)	• Pollution plume migration will be towards the mine pits and around the stockpiles areas and the plume won't affect the nearby farms. The final backfilled opencast topography should be engineered in such that runoff is diverted away from the opencast area.	2	5	6		52 (M)
Rebound water levels within backfill material may cause decant	2	5	6	4	52 (M)	• Decant positions are located within the mining area. In case there is decant, an impermeable layer can be applied below the topsoil cover, which will need to be compacted to prevent the ingress of water. Install water monitoring boreholes closer to the decant points to monitor the water level and water quality.	2	5	6		39 (M)
• **Surface Water**											
Compacted surfaces could lead to increased runoff into the nearby streams.	2	5	6	4	52 (M)	• Progressive rehabilitation of disturbed land should be carried out to minimise the compacted surfaces at the decommissioned	2	5	2	3	27 (L)

Impact before mitigation	S	D	M	P	SR	Impact after mitigation	S	D	M	P	SR
						mine.					
Contamination from leakage and spillage of chemicals, oils and grease.	2	2	6	3	30 (M)	• Chemical and oil recovered from any vehicle or machinery on site should be collected, stored and disposed of by accredited vendors for recycling.	1	2	2	2	10 (L)
Acid mine drainage problems and problems associated with the disposal of other waste material when the mine is decommissioned	2	2	6	4	40 (M)	• Implement phytoremediation measures to correct contamination of water resources. Employ new technologies which are recently being developed to treat acid mine drainage to usable water quality levels.	2	2	6	2	20 (L)

5.5 Public Participation Process

A Public Participation Process (PPP) for the WULA is underway as at the date of this draft IWWMP. The process is running for a period of 60 (sixty) days from the date hereof, within which Interested and Affected Parties (I&APs) are invited to register as stakeholders, and to submit comments and any objections to the application.

The PPP is being conducted according to the Regulations Regarding Procedural Requirements for Water Use Licence Applications and Appeals, Government Notice 267 of 24 March 2017, read with section 41 of the National Water Act, 1998 (NWA).

5.5.1 Interested and Affected Parties

I&APs are invited to register as stakeholders on the WULA process, and to submit comments and any objections to the application, in keeping with rights enshrined in the Constitution and the NWA. The invite is placed in form of newspaper adverts, site notices, emails to registered I&APs, and physical copies of the draft IWWMP, which represents the application technical report are placed at various accessible localities including the site entrance and the tribal authority office. I&APs include members of the public, landowners of properties on which the water uses take place and those of adjacent properties, farmers and business owners, ward councilors, traditional authorities, public representatives, municipal officials, regulatory authorities, non-governmental organizations, civil society organisations, etc.

A stakeholder database is thus progressively developed throughout the PPP, for registration of the I&APs, and recording of their objections and comments. To that end, a Public Participation Report with issues raised and responses thereto will be incorporated into this document, for consideration by the DWS in evaluation of the WULA. Furthermore, the final IWWMP with the PPP process and outcomes including the list of registered I&APs, the issues raised and responses thereto will be circulated to the registered stakeholders for record keeping, and may be made available to other stakeholders upon request.

5.5.2 Advertisements and Site Notices

An advertisement is placed in the ??? newspaper published on 06/05/2021. The advert notifies I&APs of the application, and provides contacts details for further information and participation in the WULA. Site notices have also been placed at the Giyani Gold Mine entrance, local shops and tribal authority office.

Figure 5-5: Newspaper advert (Publication Name, Date)

5.6 Floodline Determination

Thus, Giyani Gold Mine (Pty)Ltd appointed Headwaters cc to conduct a floodline assessment study and recommend mitigation measures, in consideration Regulation 4 of Government Notice 704 of 1998 (GN704), which prohibits mining within the 1:50 year floodline or a under or within a horizontal distance of 100 m from a watercourse, whichever is the greatest. The floodline study included a 1:100 year flood remedial. The catchment areas for the calculations of the flood peaks were delineated using the 1:50 000 topographical map together with the 0. 5 m contours. The hydrological and hydraulic parameters of the catchments contributing towards the proposed site of development were calculated. Peak flow rates were determined along the watercourse to carry out the hydraulic modelling for the proposed development site. The magnitude of the flood peak depends on the catchment characteristics and the rainfall intensity. For the large catchment, Standard Design Flood (SDF) and Regional Maximum Flood methods were used to calculate the peak flow rates while the Rational and alternative rational methods were used for the calculation of peak flows for small catchments. The peak flow data and other relevant information were entered into the backwater model HECRAS to produce the results on the flooding extent along the river banks in the vicinity of the proposed development site.

The study results included maps depicting 1:100 year floodlines of the existing streams reporting into Ntsami Dam around Swartkoppies and Pit 5 downstream of the Ntsami Dam. The streams (watercourses) within the study area are both tributaries of the Ntsami River which is seasonal, which flows into the Letaba River.

Mapping of the floodlines shows no major challenges and that a large portion of the Giyani Gold Mine is outside the 1:100 year floodline. In this light, the study recommends and modelled a scenario with a berm constructed along a 100 m horizontal distance from the all nearby streams and sized to restrict and prevent the 1:100 year flood from flowing into the proposed open cast, and consequently prevent mining within a 1:50 year floodline. It is required that erosion prevention measures be put in place.

The study report is appended hereto, together with results of the floodline assessment. The map for the pre-extension scenario is presented, as well as that for the scenario with the extension and the berm flood control or remedial measure. The recommended minimum berm bottom width is 25 m, with varying between 3.5 and 6.3 m with a slope of about 1:2.

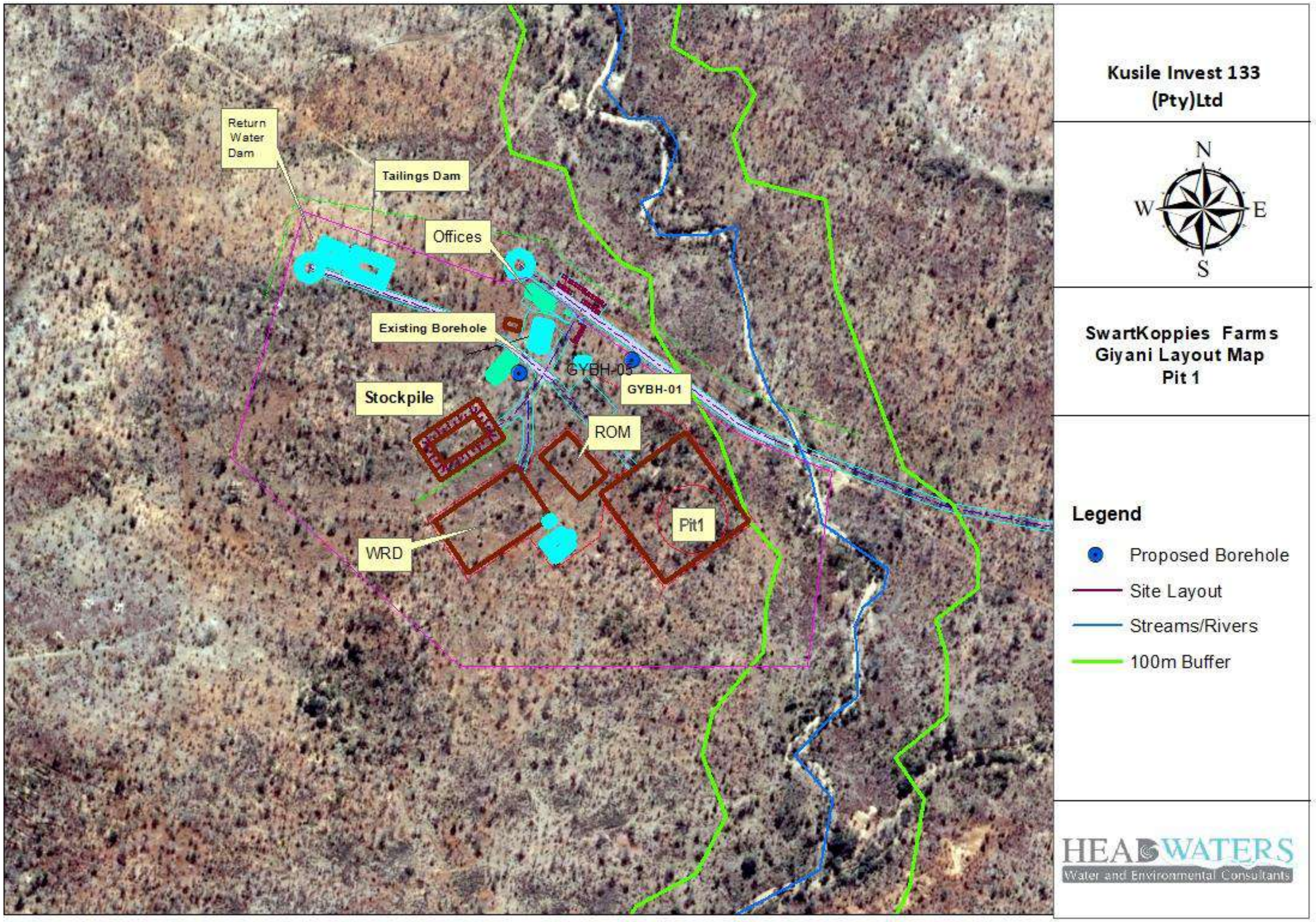


Figure 5-6 Floodline Map (1:100 year) Swartkoppies (Pit1)

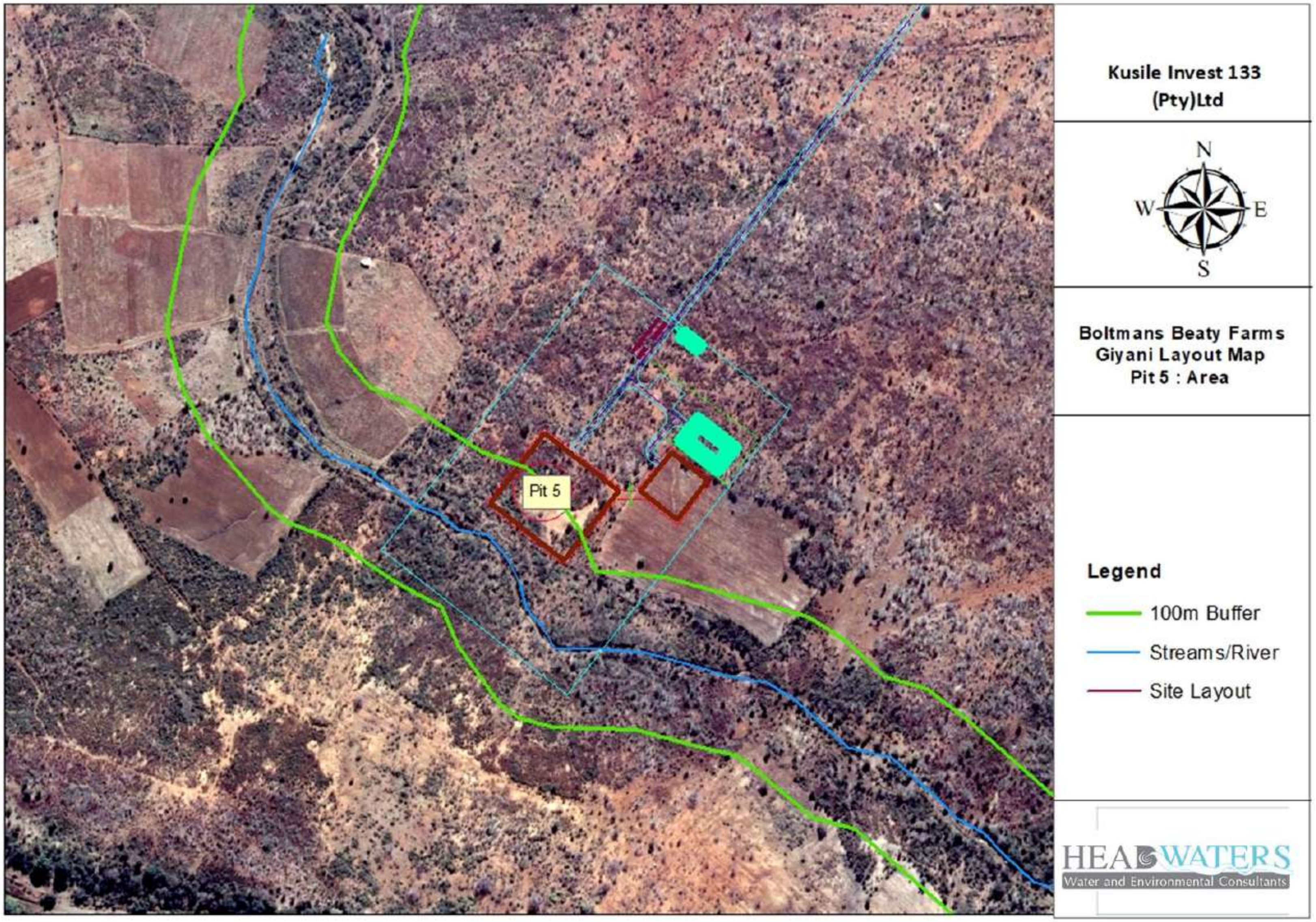


Figure 5-7:Floodline Map (1:100 year) Boltmans Beaty (Pit5)

6 Water and Waste Management

6.1 Water and Waste Management Philosophy

Several key principles will apply to all aspects of water management at the proposed Giyani Gold Mine:

- The water management hierarchy approach as proposed by the Department of Water and Sanitation (DWS) (Best Practice Guidelines for the Protection of Water Resources in the South African Mining Industry) is applied;
- Giyani Gold Mine is the responsible steward of water at the proposed mine, and shall not cause harm or adverse social conditions through the use of this resources;
- Giyani Gold Mine shall endeavour to optimally use water for business to generate value, both in the long and short term (within the concept of sustainable development- to meet the needs of the present generation without compromising the ability of the future generation to meet their own needs). Thus, the hierarchy of decision making is applied to best manage water and waste at the mine;
- Giyani Gold Mine considers the quantity and quality aspect of water resources (both surface and groundwater);
- Giyani Gold Mine considers and acknowledges access to water as a basic human right.

6.2 Strategies (surface water, groundwater, stormwater and waste)

Giyani Gold Mine is committed to follow the Department of Water and Sanitation (DWS) Resources Protection and Waste Management hierarchy of decision making as shown in the figure below. The hierarchy will inform the principle of water management applicable to Giyani Gold Mining Project. The mine will utilize water abstracted through boreholes to conduct mining and mining related activities. Groundwater abstraction boreholes will be positioned outside the pit dewatering compartments.

Water will be stored on site in a series of tanks to provide for process water requirements. Raw water from the boreholes will be treated and used as potable water supply for the mine. The

Geohydrological Assessment suggests that groundwater from the site contains elevated concentration of total dissolved solids (TDS), nitrates (NO_3), sodium (Na), and magnesium (Mg). Water treatment strategies will be implemented to reduce the concentration and to comply with drinking water standards.

The point of abstraction from the boreholes will equipped with flow meters to ensure accountability with anticipated legal and administrative requirements. Recycled water through the thickener (and clarifier) will be reused in the processing plant for washing of ore/gold. The PCDs will receive dirty stormwater runoff from the site and treated sewage effluent. Water required for dust suppression will be sourced from the pollution control dam.

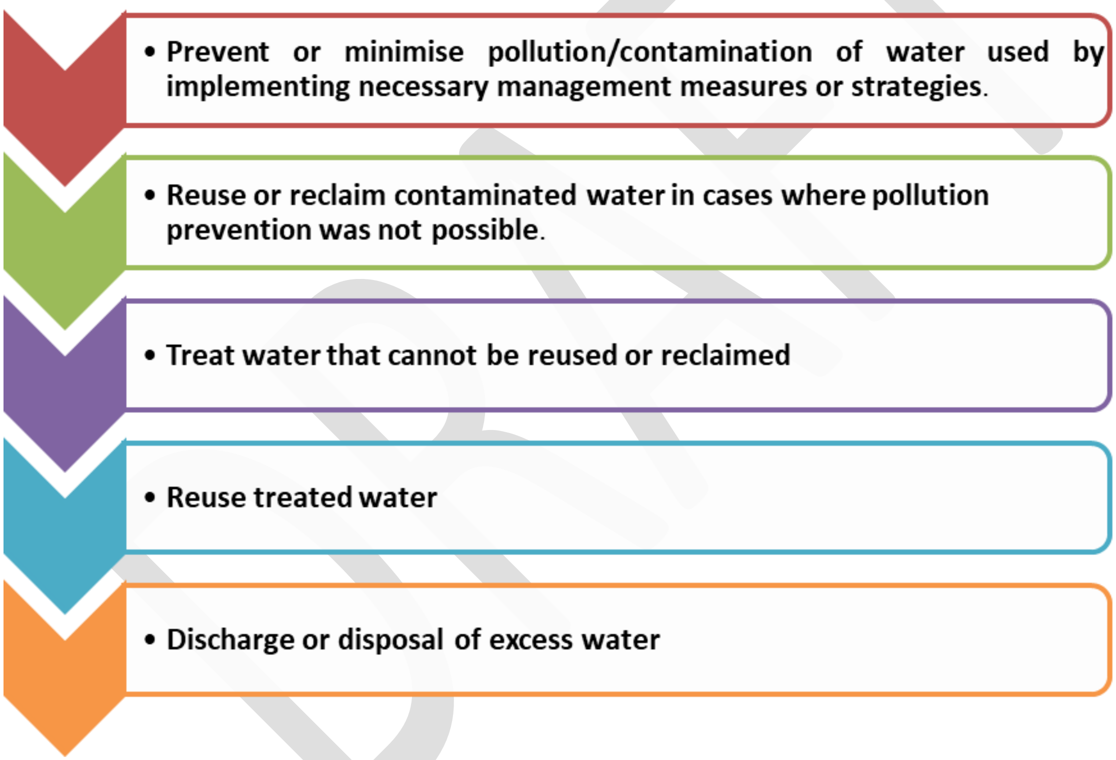


Figure 6-1: Resource protection hierarchy

6.2.1 Clean Stormwater Management

Detailed stormwater management plan (SWMP) is to be developed as part of the mine infrastructure planning and development. The plan will incorporate engineering design aspects and stormwater runoff calculations contained in the Hydrological Assessment Report for Giyani Gold Mine. The SWMP will be developed to separate clean (e.g. mine administrative buildings) and dirty water (e.g. plant area and residue stockpiles) emanating from the mine in line with the requirements of regulations in Government Notice 704 (GN704). The stormwater channels, berms, and pollution control dams will make provision for 1:50 year recurrence flood as required in terms of GN704.

The BPG for stormwater management will be consulted as part of development of the pollution control infrastructure. Clean stormwater diversion infrastructure will allow for unaffected runoff to flow away from dirty areas and drain through dedicated channels, berms, and culverts to natural drainage system. Cut-off drains/berms will be established around facilities such as TSF and overburden dumps as part of pollution prevention by isolation of dirty areas.

6.2.2 Dirty Stormwater Management

Giyani Gold Mine proposes to develop three pollution control dams (PCDs) on the farms Swartkoppies. All dirty storm water runoff from the processing plant area (gold product and RoM stockpiles) will be collected in two (2) PCDs situated on the farm Swartkoppies with gross cumulative storage capacity of approximately 140 000 m^3.

All PCDs will be lined with the potential to accommodate 1: 50 year flood and with freeboard of at least 0.8 m above its full capacity. The construction of berms will be carried out in phases, growing progressively as the need arises.

All stormwater management measures will be designed to meet the requirements of the Regulations GN 704, dated June 1999, under the National Water Act, 1998 (Act 36 of 1998) and the DWS's Best Practice Guideline (Department of Water and Sanitation, 2006. Best Practice Guideline G1: Stormwater Management).

6.2.3 Waste Management

The National Environmental Management Waste Act (NEMWA), 2008 (Act No. 59 of 2008) under the NEMA, 1998 (Act No. 107 of 1998) is the statutory regulator of all hazardous waste generated by any form of development. All waste (solid, liquid or gases) at Giyani Gold Mine will be managed in accordance with provisions and prescripts in the NEMWA and relevant Regulations. Giyani Gold Mine will develop waste management procedures as part of the ISO

14001 Environmental Management Systems (EMS) for the operation. These procedures will outline steps to be followed during handling, storage, transportation and disposal or reuse of all waste streams emanating from the activities, products and services of the mine. These procedures will also give an overview of different types of waste generated within the mine and will classify these accordingly. Furthermore, it will provide provision for reclamation and recycling of waste.

Waste Separation and Handling

General domestic waste will be disposed through a colour coded bin system at the proposed Giyani Gold Mine for different types of material. Domestic waste and scrap metals will be collected in rubbish bins. All domestic waste, commercial waste, industrial waste, and other waste classified as General Waste under the South African Minimum Requirements for Waste Disposal by Landfill (DWS, 1998) will be removed from the site by an appropriate licensed water removal contractor and disposed of at a licensed general waste facility.

Hazardous Waste

Hazardous waste such as grease, used oils, acids, fluorescent tubes, medical waste will be stored in containers at the mine. Care will be taken not to mix different hazardous chemicals within one container. Full, sealed hazardous waste containers will be removed from the site to the Temporary Hazardous Storage Facility within 48 hours and once sizeable loads are attained, they will be dispatched to an authorized hazardous waste disposal facility. There are no known authorised hazardous waste disposal sites in Limpopo Province.

Safe Disposal Certificates will be obtained and kept in record at the mine. Recyclable hazardous waste such as oils will be collected by an authorised contractor such as Oilkol and Kia-Ora Oils for recycling purposes.

Raw sewage and grey water from the mine offices, change house facility including ablution, and workshops will be handled by a package sewage treatment plant. The sewage system will have capacity for 550 people and thus has sufficient capacity to also handle the increased demand for the mine**.** Effluent from the sewage treatment plant will be drained to the pollution control dam for reuse at the processing plant facility and dust suppression. In addition, chemical mobile toilets will be provided for at the mine workings and the raw sewage will be collected by authorised contractors for disposal into a licensed waste water treatment works. Safe Disposal Certificates will be obtained and kept in record at Giyani Gold Mine.

6.2.4 Waste Management Facilities

Reclamation Yard

This area will be used for separation of domestic or industrial waste to be converted into energy and reusable materials resulting in savings of natural resources. The area will be barricaded to ensure that there is no litter and upkeep at all times. Only recyclables non-hazardous waste will be brought to this area from the different sites on the mine for sorting purposes.

Hazardous Waste Storage Facility

All hazardous waste generated on site will be temporarily stored at this facility. Hazardous waste will be removed by a contractor to a licensed off-site hazardous waste disposal facility.

Bio-remediation Facility

Soils that have been contaminated with hydrocarbons (oils, grease, diesel, petrol) and are to be taken to the designated bio-remediation facility for temporary storage before being dispatched to an off-site authorized hazardous waste facility or treated *in-situ*. Should it be deemed necessary in future, a bioremediation facility may be built to treat these materials on site using the proposed methodology below. However, it is currently anticipated that only limited quantities will be generated as the fleet required running a mine of this magnitude is minimal and thus expecting little waste soil generation.

Bio-remediation procedure:

The process of bio-remediation will be completed according to the following steps:

- **STEP 1:** For larger spills (covering a surface area of more than 1 m^2), contain the spill using equipment provided in the spill kit/absorbent materials. For smaller spills (covering a surface area of less than 1 m^2);
- **STEP 2:** Lift contaminated soils/ gravels and place them on a concreted surface/ plastic lining/drum where storm water run-off collected on this surface is contained;
- **STEP 3:** Apply selected bio-remediation product to the contaminated soils/ materials. The volume of product used will depend on the volume of the contamination in the soils and should be guided by the manufacturer's instructions;
- **STEP 4:** Wet the contaminated soils/ gravels. The volume of water used should be guided by the manufacturer's instructions;
- **STEP 5:** Till the soils/ gravels to mix in the bio-remediation products, ensure all contaminated material is wet and to aerate the contaminated material;
- **STEP 6:** Cover the contaminated soils/gravel with plastic to contain moisture and heat;
- **STEP 7:** Repeat steps 3 to 6 once a week until the soils appear and/or feel clean;
- **STEP 8:** Send a sample of the contaminated material for testing to determine the hydrocarbon contamination, in parts per million. As there is no guideline as to the allowable levels of hydrocarbons occurring in soils (due to the varying natural levels), a soil/ gravel sample from an un-polluted area of the site must be sent away for testing to determine the baseline condition which must be attained;
- **STEP 9:** If the soils/ gravels are still contaminated, repeat steps 3 to 7 until the hydrocarbon content of the soils/ gravels equals the baseline condition described above;
- **STEP 10:** Make use of the cleaned soils during concurrent rehabilitation.

6.3 Strategies and Performance Objectives/Goals

The purpose of this document is to clearly outline control strategies that link with agreed performance criteria for those potential environmental impacts as identified, be it public or worker related or specific to the broader surrounding environment. This is addressed through linkage to the following closure objectives:

- Leave rehabilitated ground to ensure blending with the surrounding environment.

- Minimization of environmental damage or impacts to the extent that they are acceptable to stakeholders involved;
- Safeguarding of the safety and health of people and other organisms from hazards associated with operations;
- To leave the sensitive areas untouched and intact as they were prior to the mining activity;
- The elimination of the risk to the environment due to naturally occurring forces by ensuring physical and chemical stability of all structures;
- Mine closure is achieved efficiently, cost effectively, and in compliance with the relevant legal requirements;
- The social impacts resulting from mine closure are managed in such a way that establishment of a socially stable community in line with the principles of sustainable development is facilitated;
- Comprehensive monitoring takes place and that sound environmental standards have been followed;
- The Best Practical Guidelines that are available at the time of closure will be used;

6.4 Measures to achieve and sustain performance objectives

Giyani Gold Mine intends to operate in line with the principles of ISO14001 Environmental Management System during all mining phases. The mine will develop an Environmental Management System (EMS) that will aim at ensuring that all possible impacts associated with activities or processes undertaken at the mine are identified and mitigation measures implemented to avoid or minimise environmental degradation and to promote a healthy and safe working environment.

The EMS will incorporate environmental procedures to manage aspects that will have the potential to pose a risk of environmental pollution or degradation. These procedures will include water and waste management procedures. Environmental procedures will be updated regularly as aspect change or when there is a need for operational and technological advancement. The EMS will provide the mine with reporting requirements and conditions of the issued licenses form an integral part of the system. This inadvertently ensure that mitigation measures for impacts associated with mining activities or processes on neighboring communities and other stakeholders are undertaken with due consideration of the relevant stakeholders interests. The ISO 14001 system is based on the Deming`s management approach (Plan-Do-Check-Act) (PDCA), and all systems, procedures and documents are reviewed regularly to ensure that objectives of the system are being met, and that the system is continually improved.

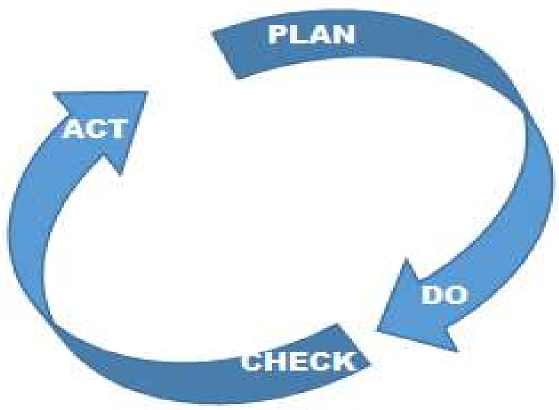


Figure 6-2: Deming`s Management Approach

In order for Giyani Gold Mine to measure their compliance with the closure objectives they require to:

- Remove all infrastructure from the site in such a manner that no contamination of soils and water takes place
- Slope the TSF to such an angle (24 degrees in most cases) that the site drains naturally after rainfall events.
- Re-place all topsoil stripped from the site and vegetate slopes with naturally occurring indigenous vegetation
- Continue with monitoring activities (surface and groundwater) during post-closure until the quality of the environment has returned to an acceptable state as agreed with appropriate stakeholders

Provide skills and training to the local community that will allow for sustainable job creation after mining has been completed.

6.5 Option analyses and motivation for implementation of preferred option

Mine Layout Plan

In terms of the initial mine layout plan for the proposed Giyani Gold Mine, options for mining within the 1:50 and 1: 100 floodline of the streams feeding into Ntsami Dam were considered since the gold seam extend towards the western parts of the proposed open pit workings. However, due to consideration of compliance with legal requirements such as GN704 Regulations and impacts on surface water resources, this option is not preferred and thus the mine layout plan has been revised to exclude working within the floodline. The non-preferred and preferred mine layout plans for Giyani Gold Mine are depicted in the figure (s) below.

Water Provision

Giyani Gold Mine is situated in a water management area with deficit in water availability (both surface and ground water) and is in a situation where all options of water supply are preferred. The following options have been identified in terms of water and waste management measures and Giyani Gold Mine (applicant/proponent) is committed to implement best practice in terms of pollution prevention at source, re-use and recycling of water and waste.

Water Supply Alternative 1: Abstraction of water from groundwater. Approximately 1000 m^3/d of water will be sourced from groundwater abstraction boreholes located at the site and its vicinity. The boreholes will be situated outside the dewatering compartment zone. Water from these boreholes will be used for both domestic purposes and the washing of gold. According to the hydrogeological investigation study (J7 Royal Group, 2021), groundwater quality at the site is saline with elevated concentrations of total dissolved solids (TDS), nitrates (NO_3), sodium (Na), and magnesium (Mg). Treatment measures will be implemented for water supplied to the mine office complex for human consumption. Groundwater monitoring plan will be implemented at the site. **This option is mostly preferred.**

Water Supply Alternative 2: The use of return water from the Tailings Disposal Facility (DSF). Approximately 100^3/day water from the TSF will be drained through a penstock into a pollution control dam located on the farm Swartkoppies. The option minimizes or reduces the abstraction and use of groundwater (raw water) and promotes reuse and recycling of water in the mine reticulation system. **This option is mostly preferred.**

Water Supply Alternative 3: The use of treated sewage effluent from the package sewage treatment plant (PSTP). Approximately 64 m^3/day of treated sewage effluent from the PSTP will be pumped into the PCDs for reuse. These PCDs will be located on the farm Swartkoppies. **This option is preferred.**

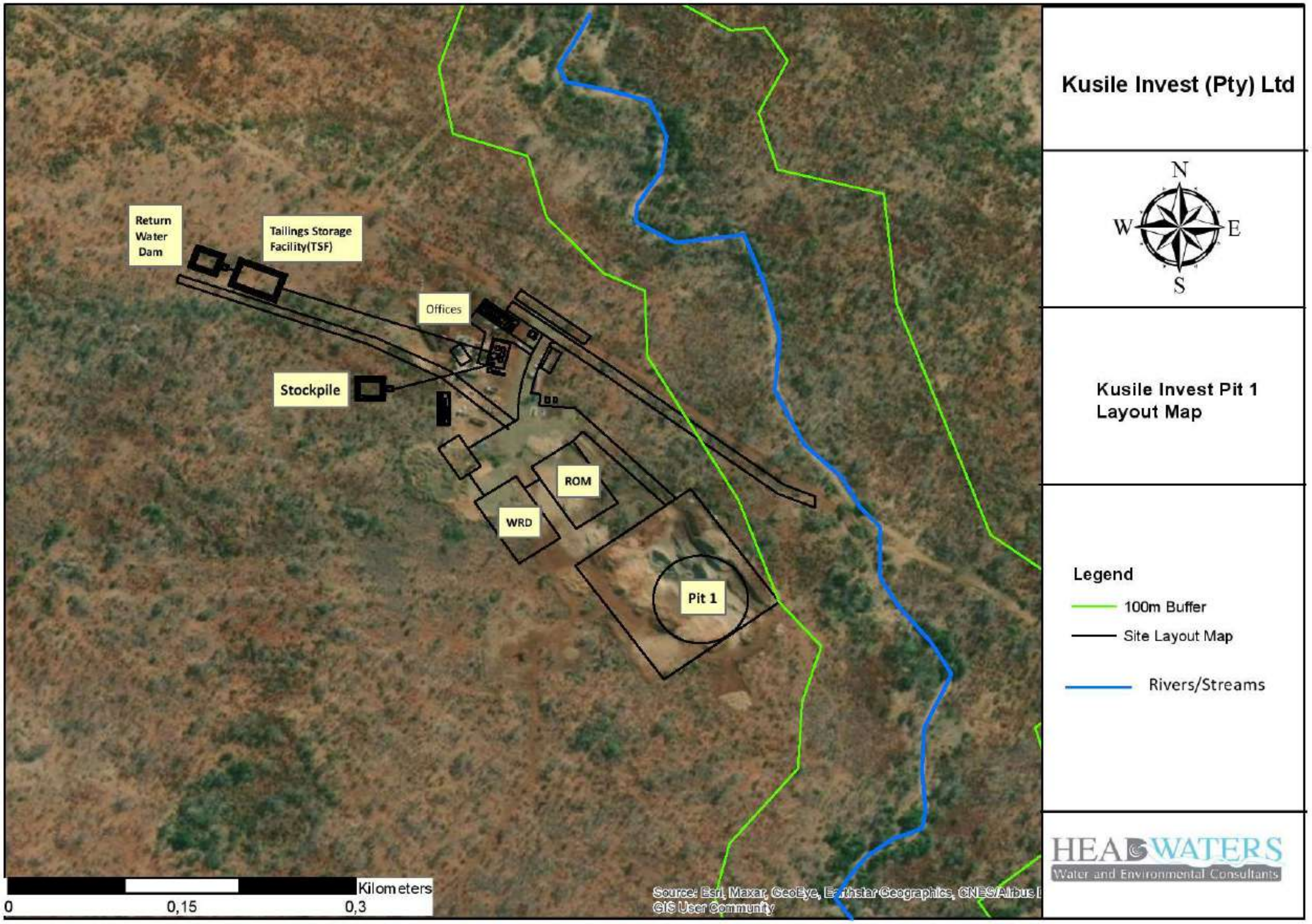


Figure 6-3: Initial Mine Layout Plan Not Preferred for Giyani Gold Mine

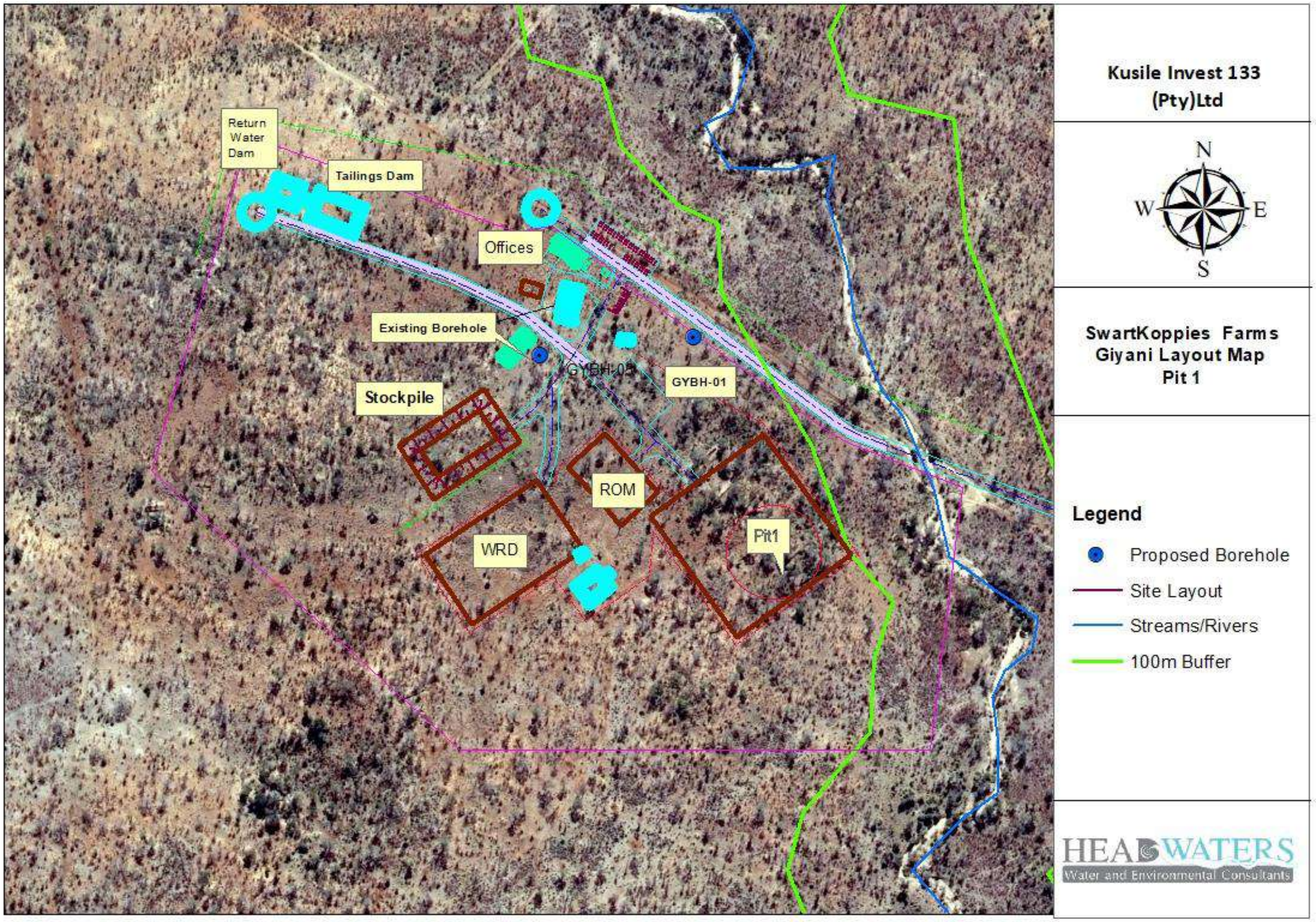


Figure 6-4: Preferred (Considered) Mine Layout Plan for Giyani Gold Mine

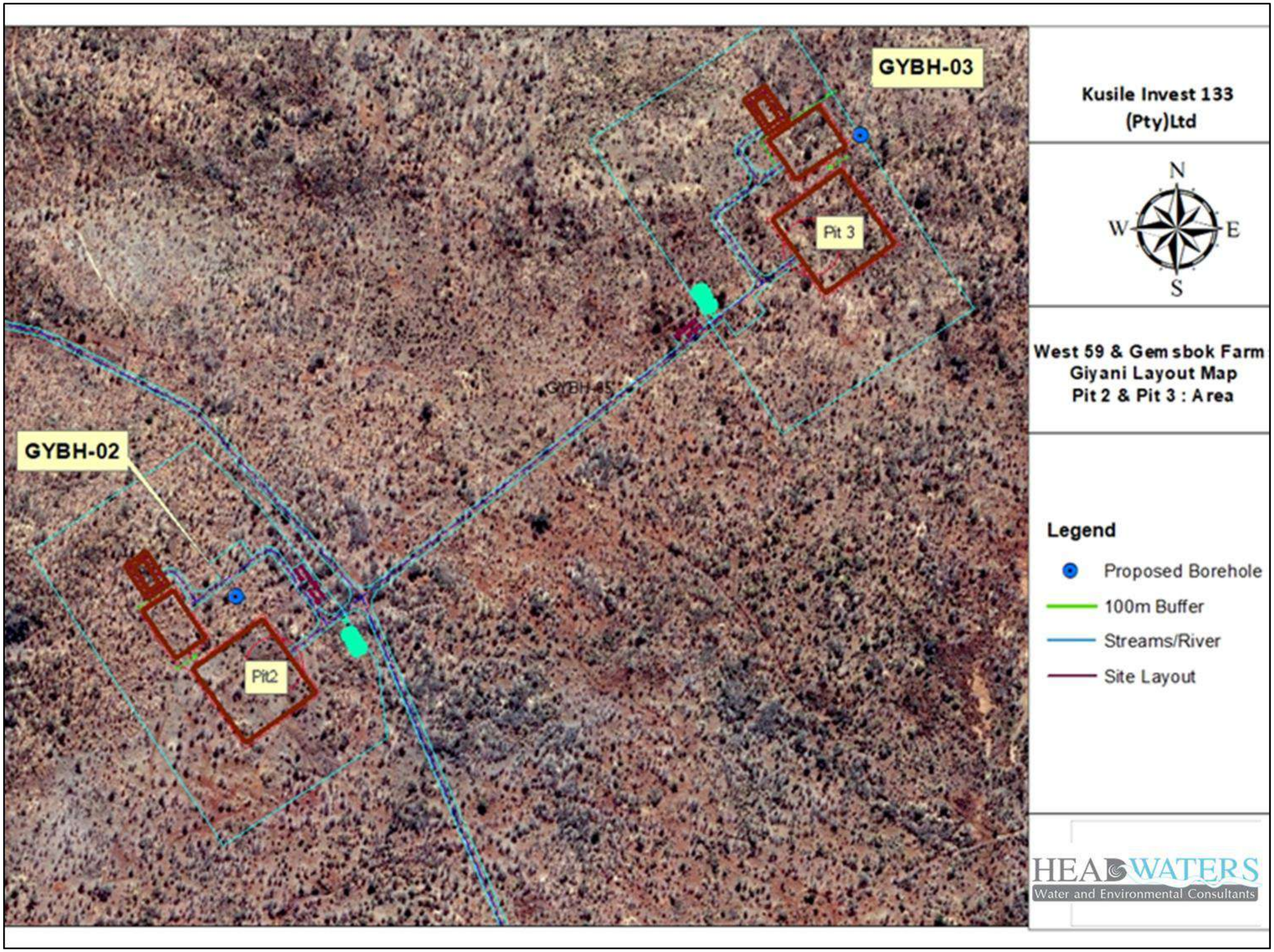


Figure 6-5 Preferred (Considered) Mine Layout Plan (Pit 2 & Pit 3)

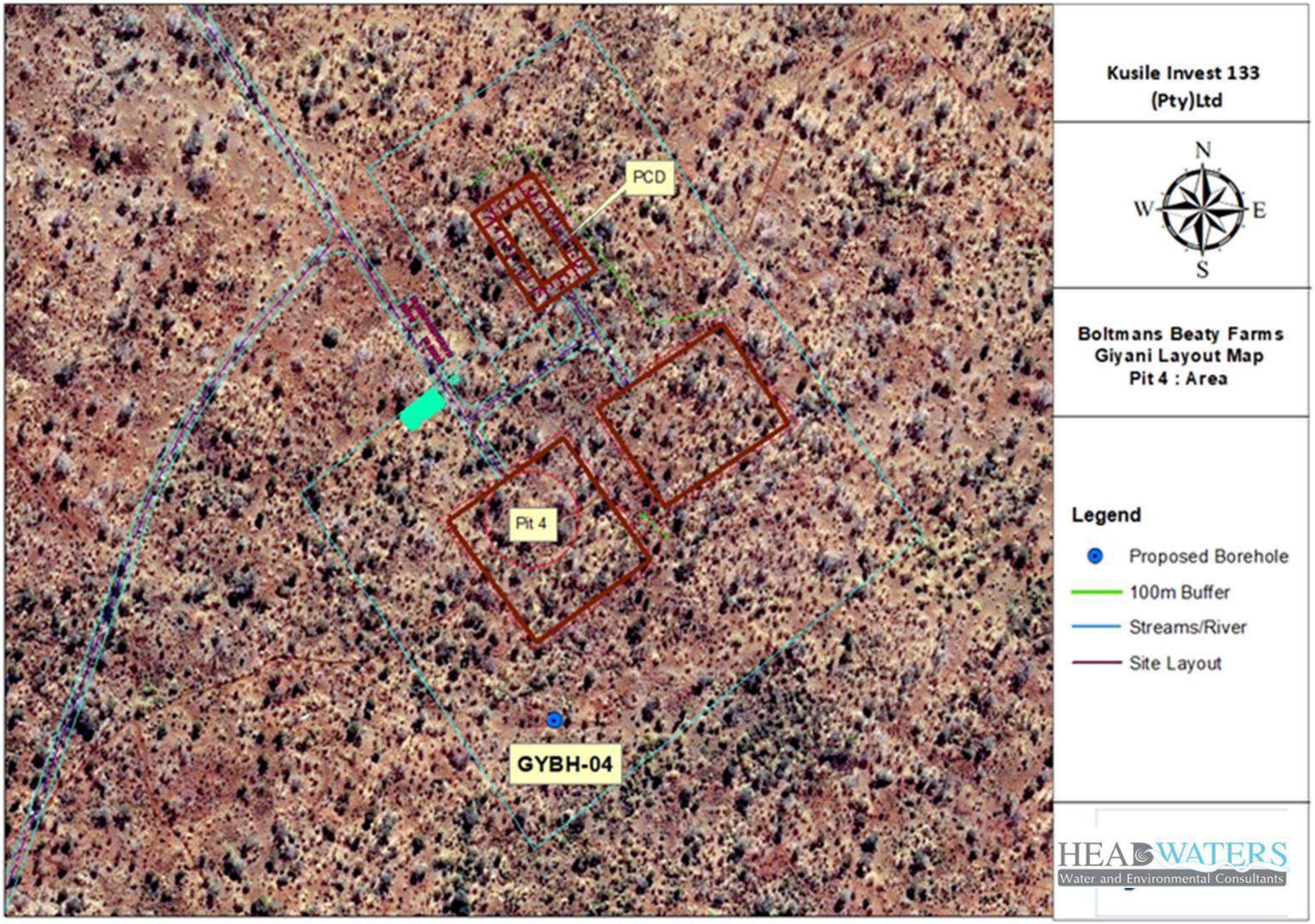


Figure 6-6 Preferred (Considered) Mine Layout Plan (Boltmans Beaty :Pit 4)

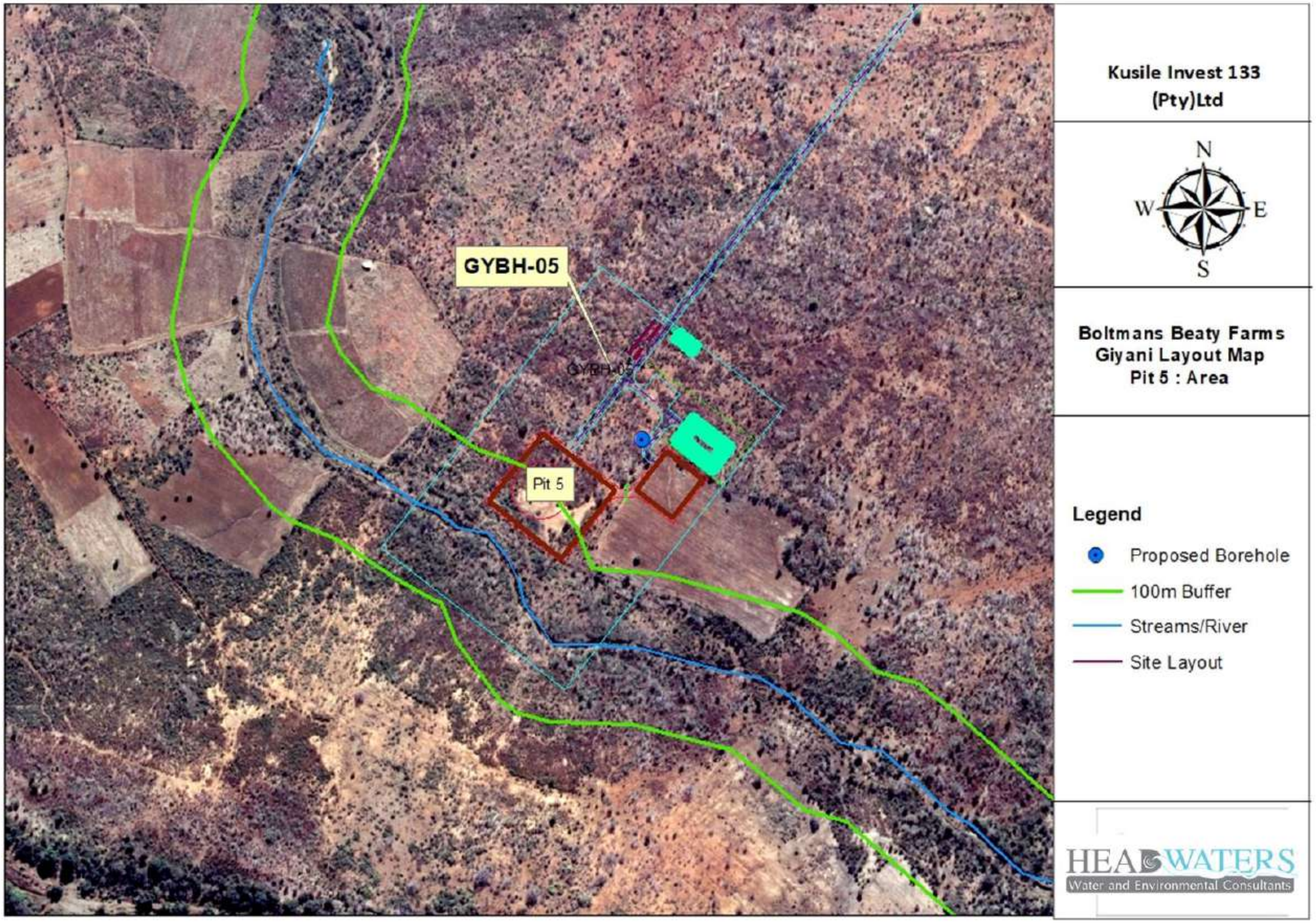


Figure 6-7 Preferred (Considered) Mine Layout Plan (Boltmans Beaty :Pit 5)

6.6 Impact Mitigation Measures

The mitigation measures for each identified impact are discussed in the Impact Assessment section above.

6.7 IWWMP Action Plan

An Action Plan provided herein provides water and waste management options for issues requiring immediate attention at the proposed Giyani Gold Mine. The broad objectives of the action plan is to provide a programme for aspects that must be addressed by the applicant within specified timeframes to ensure sustainable water and waste management practices are undertaken. The following aspect will be addressed as part of the Action Plan.

- Key performance areas;
- Objectives;
- Roles and responsibilities;
- Timeframes

The compilation of an IWWMP is a long term commitment in terms of resource requirements including technical investigations that are conducted. These also require disbursing financial resources to implement management measures which cab in most cases take months. With this in mind, this IWWMP has been developed for medium term (i.e. first 5 year of the operation of the mine), with the Action Plan herein reviewed and updated every year (annually). It is thus the intention of the mine to have yearly interaction with DWS and update the Action Plan accordingly without updating the entire IWWMP. The Action Plan for the proposed Giyani Gold Mine is stipulated in the table overleaf:

Table 6-1: Giyani Gold Mine Action Plan

	Objectives	Responsibility	Target Date
Statutory Requirements	Obtain Waste Licence (in terms of NEMA: Waste Act) for identified waste activities	Environmental Specialist	Before operations commence
	Ensure that a contract for removal of sewage waste by an authorized contractor is in place before commencement of the mining operation.	Supply Chain	Before operations commence
Risk Management	Develop and implement continuous bio-monitoring for the mine and incorporate the neighboring farms or monitoring data from neighbouring water users as part of baseline data to investigate the impact of Giyani gold mining activities on the environment.	Environmental Specialist	Before operations commence
	Design water quality monitoring programme for indicator variables at strategic boreholes and surface water monitoring points in relation to the infrastructure to be developed on site	Environmental Specialist/Water Resources Managers	6 months before commencement of mining
	Develop a stormwater management plan complying with regulation in GN 704	Engineering Manager	Before operations commence
	Investigate Best Practice Environmental Option (BPEO) for dust control systems (suppression	Engineering Manager	From commencement

	Objectives	Responsibility	Target Date
Water Efficiency	technologies and products) in the market and choose the appropriate one for haul road and general plant dust suppression with the view to reduce water usage for dust suppression		with mining operation
	Implement flow gauging from the mine water use cycle	Plant Manager and Environmental Specialist	From commencement with mine operation
	Quarterly review of water balance model to optimize water usage and conservation	Environmental Specialist	From commencement with mine operation
Waste Management	Compile a waste inventory and develop a Waste Management Procedure and outline how different waste streams are going to be managed	Environmental Specialist	Within 1 year of operation of the mine
	Determine footprint areas of waste disposal facilities and volumes of waste generated, stored, recycled or disposed of by the mine and contractors.	Environmental Specialist	Within 1 year of operation of the mine
	Investigate Local Economic Development (LED) opportunities for waste recycling initiatives and ensure maximization of waste management	Environmental Specialist + Supply chain	Within 1 year of operation of the mine

	Objectives	Responsibility	Target Date
	hierarchy		
Water Management	Regular monitoring of water management facilities according to water use licence conditions and report accordingly	Environmental Specialist	On issuance of the water use licence or on commencement with mining operations
	Ensure equipment used for monitoring purposes are calibrated and that calibration certificates are safely stored in water and fireproof storage areas for easy retrieval during unplanned audits	Environmental Specialist + Administrator	Ongoing from commencement with operations
	Logging of water and waste management data into the GIS system	Environmental Specialist	Ongoing

6.8 Control and Monitoring

Water resources monitoring will be undertaken in terms of the Department of Water and Sanitation (DWS) Best Practice Guidelines (BPG) for Water Monitoring Systems (2007). The objective of monitoring system is to:

- Develop environmental and water management plans base on impact monitoring;
- Generate baseline data before project implementation;
- Assess the impacts on receiving water environment;
- Assess compliance with legal requirements.

Internal reporting will include monthly reports to the mine management on the performance against management commitments and expectation against authorisations and permits. External reporting requirements will be guided by the permit and licences received to that effect and the mine commit to comply with these statutory requirements at all times. This will encompass incident reporting which in terms of the EMS, requires classification of incidents into three categories (Levels 1, 2 & 3) depending on their severity or potential consequence to the environment.

6.8.1 Surface Water Monitoring

The major objective of surface water monitoring is to ensure that mining activities have a limited adverse effect on surface water resources. The broad objective of the surface water monitoring system is to ensure that water management systems perform according to specifications, to act as a pollution early warning system, to check compliance with legal requirements and for reporting purposes.

Table 6-2: Surface water flow monitoring

Aspect	Point	Frequency	Coordinates
Surface water flows	Slimes to TSF	Monthly	S 23° 11’ 53.17” E 30° 48’ 2”
	Process water to the processing plant	Monthly	S 23° 11’ 51.90” E 30° 48’ 5.84”
	Sewage return flows	Monthly	S 23° 11’ 54.18” E 30° 47’ 58.92”

Table 6-3 : Surface water quality monitoring

Points	Frequency	Coordinates	Variables
Swartkoppies farm – located on non-perennial up streams	Monthly	S 23° 11' 5.32" E 30°46'26.94"	• pH • Electric Conductivity (EC) • Turbidity • Total Hardness • Total Suspended Solids • Total Dissolved Solid (TDS) • Calcium (Ca) • Magnesium (Mg) • Sodium (Na) • Potassium (K) • Iron (Fe) • Lead (Pb) • Manganese (Mn) • Chloride (Cℓ) • Sulphate (SO_4) • Fluoride (F) • Nitrate (NO_3) • Ammonia (NH_3) • Phosphate (PO_4) • Chemical Oxygen Demand (COD) • Total Cyanide • WAD Cyanide • Total Uranium • Bicarbonate (HCO_3) • Carbonate (CO_3) • E.Coli • Faecal Coliforms
Swartkoppies – located on non-perennial down streams	Monthly	S 23° 11' 36.16" E 30°45'52.67"	
West 59 and Gemsbok farms-located non-perennial upstream of the site	Monthly	S 23° 12' 23.80" E 30° 48' 51.6"	
Longford Beaty farm(Pit 4)-located non-perennial upstream of the site	Monthly	S 23° 16' 7.19" E 30° 50' 14"	
Longford Beaty farm(Pit 4)- located non-perennial downstream of the site	Monthly	S 23° 15' 4.73" E 30° 51' 33.36"	
Longford Beaty farm(Pit 5)- located non-perennial upstream of the site	Monthly	S 23° 16' 55.62" E 30° 48" 23.34"	
Longford Beaty farm(Pit 5)- located non-perennial upstream of the site	Monthly	S 23° 17'6.84" E 30° 49" 29.73"	

Laboratory Analysis

Analysis must be done by a lab that has SANAS (South African National Accreditation System) accreditation for all the required water quality determinants.

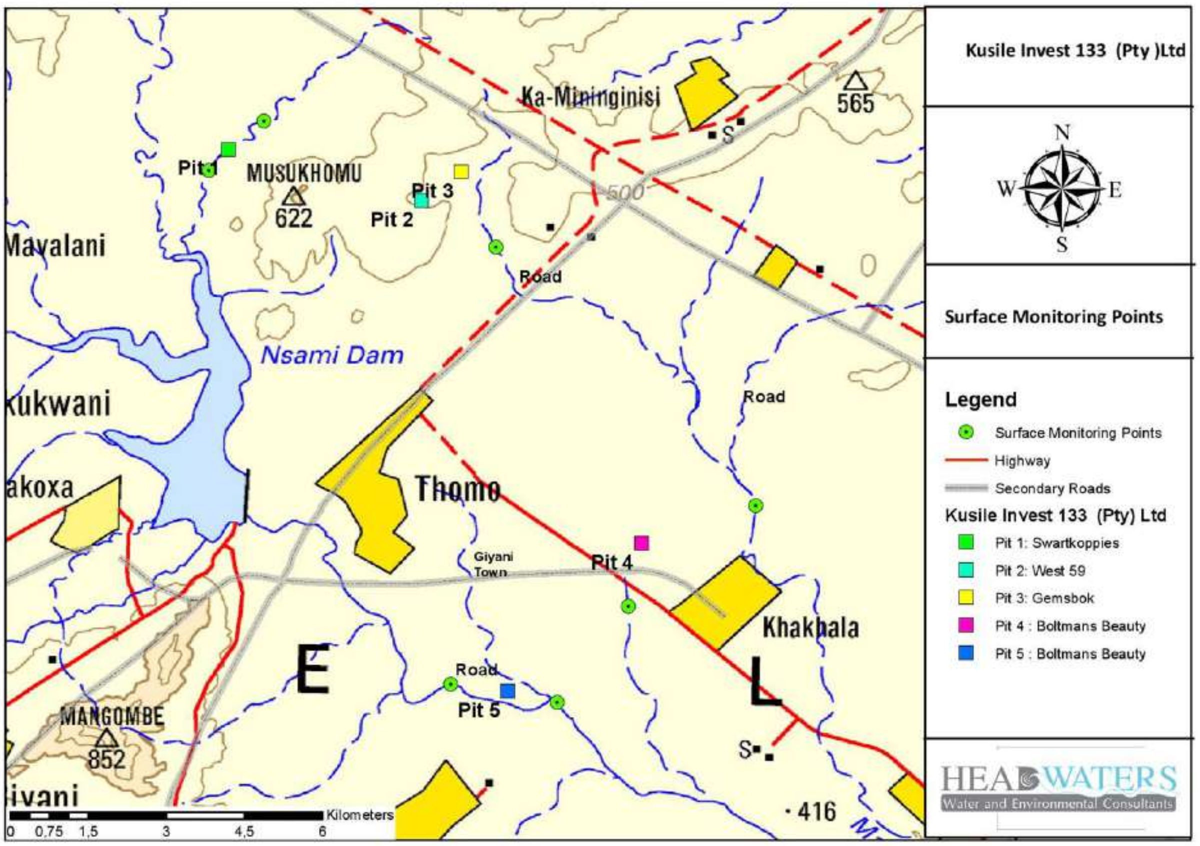


Figure 6-8: Surface Water Monitoring Locality Map

6.8.2 Groundwater Monitoring

Giyani Gold Mine will develop and implement groundwater monitoring programme for the proposed Giyani Gold Mine. The main objective of the programme is to ensure that mining activities have limited adverse effect on local groundwater resources. The following key aspects will form part of the monitoring programme:

- Generation of information regarding groundwater quality and quantity
- Determination and quantification of impacts as a result of the mining activities on site

- Managing the impacts on groundwater at the mine. These include development of monitoring response protocol. This protocol will describe the procedures to be followed in the event pertinent issues arise on groundwater resources;
- Prevention of potential pollution on groundwater resources;
- Updating and verification of the groundwater flow model;
- Reviewing the mine water balance model and compilation of annual compliance reports.

Table 6-4: Groundwater Monitoring

Aspect	Points	Frequency
Groundwater quality	Boreholes	Quarterly
Groundwater levels	Boreholes	Monthly

The tabulation below sets out groundwater quality and levels monitoring points.

Table 6-5: **Groundwater Monitoring Points**

Borehole Name/Number	Coordinates
GYBH - 01	S 23° 11’ 17.61” E 30° 45’ 58.97”
GYBH - 02	S 23° 11’ 17.36” E 30° 46’ 2.79”
GYBH - 03	S 23° 11’ 32.23” E 30° 48’ 32.37”
GYBH - 04	S 23° 15’ 25.08” E 30° 50’ 21.11”
GYBH - 05	S 23° 16’ 57.87” E 30° 49’ 3.74”

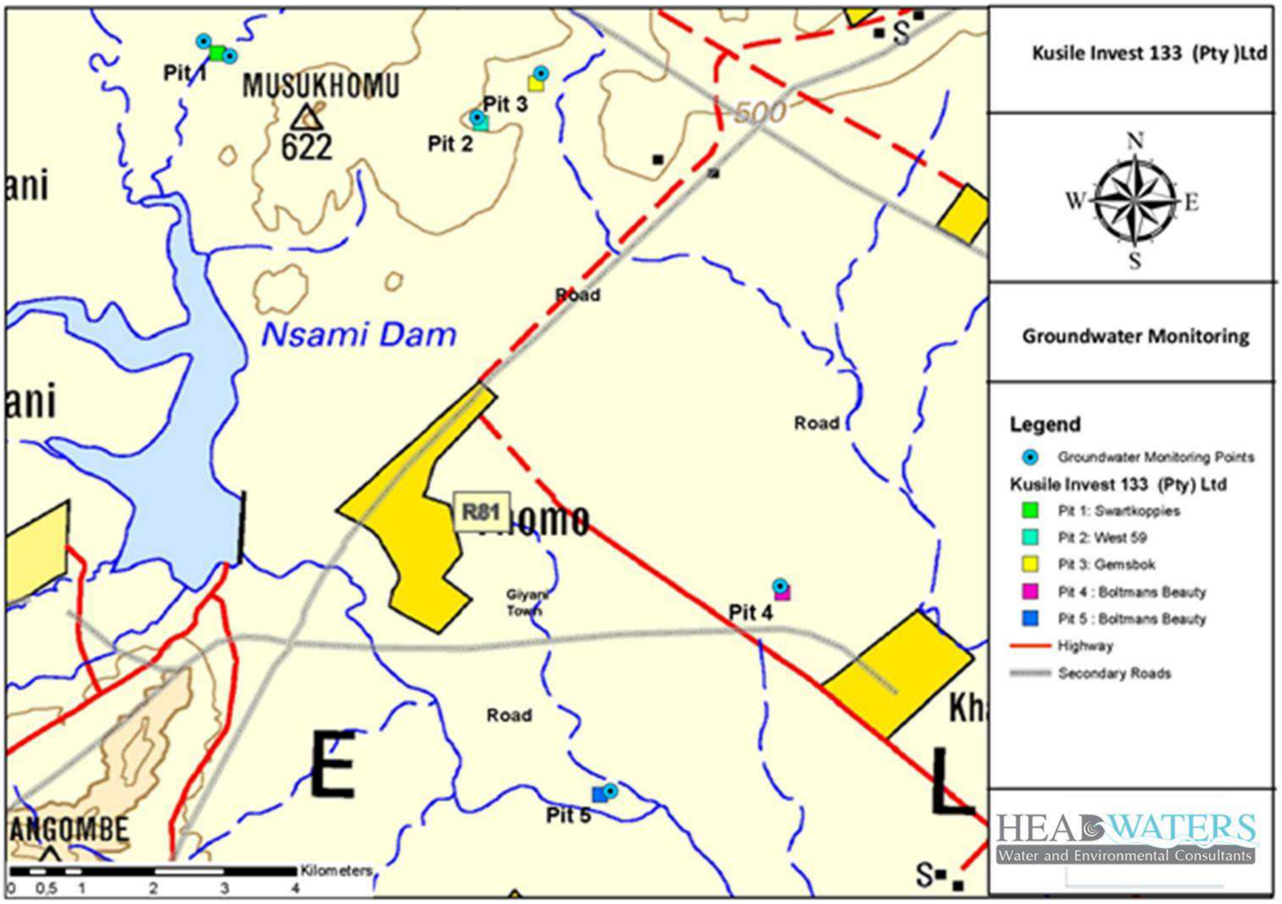


Figure 6-9: Groundwater Monitoring Locality Map

According to the Geohydrological assessment undertaken by J7 Royal Group (2021), additional recommended groundwater monitoring boreholes must be drilled on site. The groundwater quality monitoring determinants are listed in table 6.6 below. Furthermore, baseline groundwater monitoring must be undertaken for a period not less than one year prior to commencement with mining or related activities.

Table 6-6: Groundwater Quality Monitoring

Water Quality Parameters	Unit of Measurements	Timeframes for Measurement		
		Monthly	Quarterly	Annually
pH	pH units		✓	
Electric Conductivity (EC)	mS/m		✓	
Turbidity	NTU		✓	
Total Dissolved Solid (TDS)	mg/l		✓	
Total Suspended Solid (TSS)	mg/l		✓	
Total Hardness	mg/l		✓	
Calcium (Ca)	mg/l		✓	
Magnesium (Mg)	mg/l		✓	
Sodium (Na)	mg/l		✓	
Potassium (K)	mg/l		✓	
Iron (Fe)	mg/l		✓	
Lead (Pb)	mg/l		✓	
Manganese (Mn)	mg/l		✓	
Chlorine (Cℓ)	mg/l		✓	
Sulphate (SO_4)	mg/l		✓	
Fluoride (F)	mg/l		✓	
Nitrate (NO_3)	mg/l		✓	
Phosphate (PO_4)	mg/l		✓	
Carbonate (CO_3)	mg/l		✓	
Chemical Oxygen Demand (COD)	mg/l		✓	
Total Cyanide	mg/l		✓	
WAD Cyanide	mg/l		✓	
Total Uranium	µg/l		✓	

Water Quality Parameters	Unit of Measurements	Timeframes for Measurement		
		Monthly	Quarterly	Annually
Bicarbonate (HCO_3)	mg/l		✓	
E.Coli	cfu/100 ml		✓	
Faecal Coliforms	cfu/100 ml		✓	

Monitoring procedure

The mine water monitoring programme will be developed and implemented using the following guidelines and standards:

- DWS, 2007. Best Practice Guideline for Protection of Water Resources in the South African Mining Industry. G3: Water Monitoring Systems;
- DWS, 2003. Quality of Domestic Water Supplies, Volume 2: Sampling Guide;
- ISO 5667-3: 2006 Part 1: Guidance on the design of sampling programmes and sampling techniques;
- ISO 5667-3: 2003 Part 3: Guidance on sample preservation and sample handling;
- ISO 5667-6: 2005 Part 6: Guidance on sampling of rivers and streams;
- ISO 5667-11: 2006 Part 11: Guidance on sampling of groundwater.

Laboratory Analysis

Analysis must be done by a lab that has SANAS (South African National Accreditation System) accreditation for all the required water quality determinants.

7 Conclusion

7.1 Regulatory Status of Activity

Giyani Gold Mine is a proposed mining operation. Thus, there are no activities on the site except for those associated with previous land uses on the site. A Mining Right application has been lodged concurrent to the Integrated Water Use Licence Application (IWULA) entailed in this document.

7.1.1 Existing water uses

Giyani Gold Mine is not yet operational and there is no water use associated with the applicant taking place on the farms (Swartkoppies (Pit - 1), West 59 (Pit - 2), Gemsbok (Pit - 3), Boltmans Beaty (Pit – 4); and Boltmans Beaty (Pit – 5). There is also no record of existing or previous Water Use Licences (WULs) or permits on the subject properties. No general authorization has been granted by DWS on the project area.

Furthermore, GN704 exemption will be required for the proposed backfilling of the mined-out areas with overburden material. The water use activity has been included in this IWULA for Giyani Gold Mine as section 21 (g) of NWA, defined as "disposing of waste in a manner which may detrimentally impact on a water resources". Exemption from GN704 regulations is also required for Pit 1 and Pit 5 encroachments into 100 m regulated area of watercourses. The pit encroachments are also part of the WULA as section 21(c and i) water uses, and would thus be subject to licence conditions if granted.

7.1.2 Proposed water uses that requires licensing

Section 21 water uses to be undertaken at the proposed Giyani Gold Mine are summarized in the tabulation below.

Table 7-1: New Water Uses to be licensed

Section 21 Water Use Definition	Activity Description
21(a): Taking water from a water resource	Groundwater abstraction through a borehole

Section 21 Water Use Definition	Activity Description
21(b): Storing Water	Storing water in water tanks
21(c): Impeding or diverting the flow of water in a watercourse	Flow impedance for diversion of clean runoff to allow mining activities within 100 m of a watercourse
21(g): Disposing of waste in a manner which may detrimentally impact on a water resource	Retention of dirty water within a Pollution Control Dam (at Swartkoppies)
	Disposal of slimes into a Tailings Storage Facility (TSF)
	Disposal mining waste onto a Waste Rock Dumps
	Backfilling of mine Pit 1, Pit 2, Pit3, Pit 4 and Pit 5 with overburden
	Dust suppression with water containing waste
21(i): Altering the bed, banks, course or characteristics of a watercourse	Flow impedance for diversion of clean runoff to allow mining activities within 100 m of a watercourse

7.2 Statement on water uses requiring authorization, dispensing with the requirement for a licence and possible exemptions from regulations

The following activities as described in the tabulation below will not be in line with the regulations in the General Notice 704 Regulation of 1999. Therefore, Kusile Invest 133 hereby requests exemption from compliance with the restrictions of the regulations, subject to approval of the Water Use Licence Application (WULA) and conditions of a licence.

Table 7-2: Activities and Infrastructure in GN 704 Exemption Application

Regulation No.	Regulation Narration	Activity/Facility	Motivation/Rationale
4(b)	No person in control of a	Swaartkoppies Pit	The pit encroachment into

Regulation No.	Regulation Narration	Activity/Facility	Motivation/Rationale
	mine or activity may – except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, whichever is the greatest.	(i.e. Pit 1) and Boltsmans Pit (i.e. Pit 5) encroachments into the 100 m regulated area of watercourse	the 100 m buffer zone is a legacy issue that Kusile invest found at the site on commencement with prospecting. Nonetheless, the applicant is addressing the risk by instituting remedial measures, which include a berm and rehabilitation works on completion of the pit workings. Furthermore, the activity is part of the water uses applied for and would thus be controlled through Water Use Licence conditions.
4(c)	No person in control of a mine or activity may – place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the	The deposition (backfilling) of overburden into the mined-out areas (Swartkoppies (Pit 1), West 59 (Pit 2), Gemsbok	Backfilling with the overburden is part of rehabilitation of the pits. The activity is defined as a section 21(g) water use and included in the WULA. Thus, it would be controlled through licence conditions

Regulation No.	Regulation Narration	Activity/Facility	Motivation/Rationale
	workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation.	(Pit 3), Boltmans Beaty (Pit 4); and Boltmans Beaty (Pit 5)	and implementation of mitigation and monitoring protocols recommended in the IWWMP – as a minimum.

7.3 Motivation in terms of Section 27(1) of the NWA

A motivation for authorisation of the proposed water uses associated with Giyani Gold Mine is being developed. A section 27 motivation is discussed below.

(a) Existing lawful water uses

There are no existing registered water uses on the farms. However, it is notable that the site was previously mined and abandoned before the applicant acquired the mineral rights.

(b) Need to redress the results of past racial and gender discrimination

The applicant, Kusile Invest 133 (Pty) Ltd is a black owned company. Therefore, authorised of the proposed water uses would contribute to efforts towards meeting transformation imperatives and giving effect to racial redress. Furthermore, the applicant has developed a Social and Labour Plan (SLP), which is being considered by the DMR as part of the Mining Right application. The SLP is a requirement within the context of the mining sector transformation charter.

(c) Efficient and beneficial use of water in the public interest

The demands of the proposed mining operation on the affected surface and groundwater resources are considerably low in relation to benefits that accrue from the project in the public interest. In this regard, the approximately 365 000 m^3/annum proposed to be abstracted from groundwater resources would facilitate the employment of more than 400 employees on a permanent basis over the 30 year life of mine. This projection excludes contractors and temporary workers. Furthermore, local entrepreneurs will benefit from the project through procurement opportunities for goods and services.

(d) Socio-economic impact of the water use:

(iii) <u>If authorised</u>

The applicant`s operations will contribute towards the economic development in the surrounding communities through job creation, procurement of goods and services from local enterprises, and the enhancement of the gross geographic product in the Giyani Region. Authorisation of water uses activities for Giyani Gold Mine will also contribute to the much needed economic growth in the country, with associated contributions to tax revenue. Programmes will be put in place, including those in the SLP, to manage and minimise unintended consequences of influx of job seekers, e.g. informal settlements and associated impacts, crime and prostitution.

(iv) <u>of the failure to authorise the water use or uses</u>

The failure to authorise the water use will render the project non-viable. The mining project that would catalyse the economy and social development in the region over at least 30 years would be abandoned. Benefits for upstream and downstream businesses and sectors would be lost together with the more than 400 permanent employment opportunities in the mine. A decision not to authorise the water uses would thus be inconsistent with the government's efforts to supporting the economic growth required to meet the vision in the country's National Development Plan (NDP), as well as economic recovery efforts in the light of the impact of the novel COVID19 and associated lockdown regulations.

(e) Any catchment management strategy applicable to the relevant water resource

There is currently no Catchment Management Strategy (CMS) for the Limpopo WMA – as envisioned in the NWA. There is no CMS applicable to the subject water resources. Nonetheless, consideration has been afforded to the Limpopo WMA Internal Strategic Perspective (ISP), as well as the Limpopo WMA Reconciliation Strategy (DWS, 2015). According to the reconciliation strategy and the ISP, the Ntsami River Catchment (and the Limpopo WMA as a whole) is in stress (i.e. deficit) since demand already exceeds the gross resource yields. Hence, the demand on water resources in the area is on groundwater, and does not include new surface water development.

(f) Likely effect of the water use to be authorised on the water resource and on other water users

The likely effect of the proposed water uses on the water resources includes lowering of groundwater levels and yields within the 1 km radius from the mine workings, e.g. Pit 1. This impact will be localised within the mine boundary and is not likely to extend to neighbouring users.

Seepage from the Tailings Storage Facility (TSF) may also result in groundwater pollution during the life of mine (and post closure). Furthermore, groundwater and surface water pollution may occur post closure, as groundwater levels recover and reach natural ground level. The site location for the TSF is not on geological structure that create flow paths, and a containment barrier system may be included to prevent seepage into underlying resources. Post closure water management measures have been proposed, including pollution control dams for retention (and evaporation) of decant. A water monitoring system has also been proposed to detect contamination and allow for implementation of mitigation and corrective measures.

(g) Class and the resource quality objectives of the water resource

Information on the class and resources quality objectives of the groundwater resources was not at the applicant's disposal at the time of finalisation of the application. Provisionally, it suffices to note here that information on the Class and RQOs is at the DWS' disposal and the authority will take into consideration when evaluating the IWULA. Implementation of the storm water management plan will ensure that the class of the ephemeral Ntsami River and tributary is not affected by the proposed operations.

(h) Investments already made and to be made by the water user in respect of the water use in Question

Investments already made by the applicant include the funds associated with prospecting and exploration, as well as professional services on pre-feasibility studies and environmental studies. The applicant has also made significant investment on securing mineral processing infrastructure and establishment of the site for prospecting activities.

(i) Strategic importance of the water use to be authorised

The proposed water uses for Giyani Stateland Gold Mine are not of strategic importance as defined the National Water Resources Strategy II.

(j) The quality of water in the water resource which may be required for the Reserve and for meeting international obligations

Mitigation measures have been recommended to ensure that the mine does not impact negatively on surface and groundwater resources in the study area. Therefore, the proposed mine is a zero discharge operation, and will not result in violation of the quality of water for the Reserve if all mitigation measures are adhered to as a minimum. These measures including containment barriers for the TSF and PCD. Furthermore, a monitoring programme has been developed, and the quality parameters would be evaluated against the requirements for the Reserve. The project will thus not compromise SA's ability to meet international obligations in relation to water quality in the Limpopo River basin, which a shared river basin.

(k) Probable duration of any undertaking for which a water use is to be authorised

Kusile Invest 133 proposes to operate the Giyani Stateland Gold Mine over a period of 30 years. Therefore, the duration of undertakings on execution of the mining right will be 30 years.

7.4 Key Commitments

Key commitments relating to water and waste management have been outlined in the Action Plan and will be reviewed and updated annually. These include the following:

- Obtaining requisite authorisations for water uses and waste management activities regulated by the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and the National Environmental Management: Waste Act, 2008 and Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) prior to commencement with the proposed mining operations.

- Appointing suitably qualified and experienced individuals to ensure implementation of the water use and waste licences, and compliance with conditions therein.
- Ensuring compliance with GN 704 Regulations, as amended, and applying for exemptions where required.
- Implementation of the DWS' Best Practice Guidelines for Protection of Water Resources within the South African Mining Industry.
- Undertaking of baseline groundwater monitoring for a period not less than one year prior to commencement with mining or related activities.
- Implementation of a Storm Water Management Plan (SWMP) with separation of clean and dirty water systems, adequate capacities of storm water drainage and retention (or storage) systems, locality of systems outside watercourse regulated areas and complying with all applicable regulations in Government Notice 704, as amended.
- Inclusion of a containment barrier to prevent seepage from the TSF into underlying groundwater resources.
- Implementation of the water monitoring system within the LOM and post closure for a reasonable period as may be determined by impact studies and in consultation with the DWS.

8 References

ArcView GIS 3.2a. 2000. Environmental Systems Research Institute, Neuron`s Data Open Interface Software Programme

ASTM E1915-13, 2013. Standard Test Methods for Analysis of Metal Bearing Ores and Related Materials for Carbon, Sulfur, and Acid-Base Characteristics. ASTM International, West Conshohocken, PA, 2013, www.astm.org

Bethke, C.M. 2008. Geochemical and Biogeochemical Reaction Modeling 2nd Ed., Cambridge University Press

Department of Water Affairs. 2006. Best Practice Guideline (G1): Storm Water Management, Pretoria, South Africa

Department of Water Affairs. 2007. Best Practice Guideline (G3): Water Monitoring System, Pretoria, South Africa

Department of Water Affairs. 2008. Best Practice Guideline (A5): Water Management for Surface Mines, Pretoria, South Africa

Department of Water Affairs. 2008. Best Practice Guideline (H1): Integrated Mine Water Management, Pretoria, South Africa

Department of Water Affairs. 1998. Government Notice 704 of the National Water Act, 1998 (Act No. 36 of 1998)

J7 Royal Group, 2021. Geohydrogeological Specialist Investigation Report for the Proposed Giyani Gold Mine, Limpopo Province

Lawrence, R.W., and Wang, Y., 1997. Determination of Neutralization Potential in the Prediction of Acid Rock Drainage, Proc. 4th International Conference on Acid Rock Drainage, Vancouver, BC, p449-464.

Li. K., 2006. Acid-rock drainage prediction for low-Sulphide, low-neutralisation potential mine waste. 10th International Conference on Acid Rock Drainage, Cairns, Australia.

Middleton, B. J., and Bailey, A. K. 2008. Water Resources of South Africa: Book of Maps, Water Research Commission, Version 1

Mucina, L., and Rutherford, C. M. 2006. The vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, South African National Biodiversity Institute, Pretoria

Price, W.A., 1997. DRAFT Guidelines and Recommended Methods for the prediction of Metal leaching and Acid Rock Drainage at Mine sites in British Columbia. British Columbia Ministry of Employment and Investment, Energy and Minerals Division, Smithers, BC, p.143.

Republic of South Africa, 2013. National Environmental Management Norms and Standards for Assessment of Waste for Landfill. Government Gazette No. 36784, Volume 578.

Rudnick, R.L. and Gao, S., 2003. The Composition of the Continental Crust. Treatise on Geochemistry (eds. H.D. Holland and K.K. Turekian). Elsevier-Pergamon, Oxford. 3, 1-64.

Soregaroli, B.A. and Lawrence, R.W., 1998. Update on Waste Characterization Studies. Proc. Mine Design, Operations and Closure Conference, Polson, Montana.

Usher, B.H., Cruywagen, L.M., De Necker, E. & Hodgson, F.D.I., 2003. Acid-Base Accounting: Techniques and Evaluation (ABATE): Recommended Methods for Conducting and Interpreting Analytical Geochemical Assessments at Opencast Collieries in South Africa. Water Research Commission Report No 1055/2/03. Pretoria.

ANNEXURE 2 - HYDROGEOLOGICAL ASSESSMENT

Technical Report: **J7/R/2021/03**

Document version 1.0 – Update report

KUSILE INVEST 133 (PTY) LTD

Hydrogeological Assessment

Prepared for: KUSILE INVEST 133 (PTY) LTD

J7 Royal Group (Water & Environmental)

March 2021

Compiled by

JR Bulasigobo

PROJECT INFORMATION

Report Name:	KUSILE INVEST 133 (Pty) Ltd Hydrogeological Assessment located within the town of Giyani, Limpopo Province
Report Number:	JR7/2021/03
Project Number:	JR7/P2021/03
Date:	March 2021

APPLICANT (PROPONENT)

Company Name:	KUSILE INVEST 133 (Pty) Ltd
Registration Number:	(LP) 30/5/1/1//2/2724 PR
Contact Person:	Mzamani Mdaka
Designation:	Director
Tel:	082 819 5398
Email:	mzamanim@vodamail.co.za

CONSULTANT

Company Name:	J7 Royal Group (Water & Environmental)
Contact Person:	Mr. Joubert Bulasigobo
Designation:	Hydrogeologist
Tel:	(+27) 011—312 0294
Email:	Joubert@j7royalgroup.co.za
Physical Address:	Birchwood Court, 43 Montrose Street, Vorna Valley, Midrand

Project Team

Name	Designation	Qualifications	Signatures
Joubert Bulasigobo	Hydrogeologist	B.Sc. Chemical Engineering Post Grad.Dipl(IWRM); M.Sc. Water and Environment (Hydrogeology). ***Pr.Sci.Nat***	14
Caleb Siphiwe Magagula(CM)	Water Scientist	M.Sc. (Water and Environmental Engineering)	16

Declaration of Independence

I, _**Joubert Ridovhona Bulasigobo**_ the undersigned, hereby declare that J7 Royal Group (Water & Environmental), is an independent environmental consulting firm, has no interest or personal gains in this project whatsoever, except receiving due payment for rendering the independent professional service.

I further declare that I am part of the team that collected data and compiled this report. All assumptions, assessments, conclusions and recommendations are made in noble faith and are correct to the best of my knowledge and the information available at the time of completion of the study.

____

Joubert Bulasigobo (Hydrogeologist)

Signature

Date: March 2021

Table of Contents

List of Figures

List of Tables

1 Introduction

J7 Royals Group (Pty) Ltd was requested by Kusile Invest 133 (Pty) Ltd to undertake groundwater study. The project is referred to as the Giyani Gold Mine Project. The applicant Kusile Invest 133 (Pty) Ltd has lodged a mining right on un-surveyed state land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, Limpopo Province. Mining operations will commence from five (5) open cast pits which will later be developed into underground workings and expand into four(4) working levels to reach the steady state production of 12 000 tons per month. The basic mining methods to be utilised for the Giyani gold mining operation are both surface mining using open pit and conventional stopping methods applied underground to excavate hard rock or ore containing gold and associated minerals such as copper, zinc, nickel and lead and uranium. Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years will be produced. The average depth of deposit is 250m; the deepest mineralized zone is 500m below surface. Extent of area required for mining is 1000 Hectares. Extent of the area required for infrastructure, roads, and servitudes is 150 Hectares

The type of Mineral is Gold bearing minerals:

- Code: (Au), Type: (Gs)
- Copper bearing minerals.
- Code: (Cu), Type: (B)
- Silver bearing minerals.
- Code: (Ag), Type (I)
- Nickel bearing minerals
- Code: (Ni), Type (B)

The assessment is for a Gold Mine and this was achieved by evaluating the existing groundwater levels and chemistry datasets. The study will summarises key findings and recommendations on best practice mitigation and management measures to be implemented.

1.1 Project Background

Kusile Invest 133 (Pty) Ltd currently holds a prospecting right (LP) 30/5/1/1//2/2724 PR and intends to establish five (5) open pit mine for mining Gold with associated infrastructure. The mine is planned to produce standard gold bars containing about 90% pure gold. The weight of each full bar produced by crushing, floatation, leaching and smelting process at the metallurgical processing plant will be approximately 25kg. Gold will be the main commodity to be produced, with two other associated co-products being copper and silver. Copper makes a higher ratio of the co-products recovered at 1 to 10 parts for each kilogram of final product produced. Tailings will comprise mainly of small size materials and considered as waste product as this will have a low commercial potential after a high recovery of the target minerals and there is no market to sell the product. Tailings will be deposited at a designated tailings dam for the mine.

The standard gold bars produced will be delivered to the Gauta Refinery for further beneficiation and purification to contain 95% gold for minting of gold bullion bars and coins, and 99.99% for jewellery products. The quantities for the minting of gold bullion bars/coins and jewellery products is expected to be apportioned at 30% for bars and 70% for gold jewellery based on the current global demand and consumption for gold.

Market for each product in terms of Local, Regional or International

The global gold market is estimated to have an all-time above ground gold stocks at about 170,000 tonnes of gold, approximately 20% of which is owned and hoarded by central banks alone. Annual gold supply is just over 3200 tonnes per year, with roughly 60% coming from miners and 40% from recycled gold (unlike industrial silver, gold is almost completely recovered and recycled back into above ground inventories).

1.2 The scope of work for this project is as follows:

The scope of work is based on the following:

Review of the available geohydrological information, which will include;

- Existing reports and maps ;
- Borehole information;
- Conduct site visits;
- Groundwater Impact (Risk) Assessment;
- Conduct boreholes hydrocensus in order to assess the conditions of the boreholes and determine their physical properties;
- Obtain boreholes samples in the neighbouring farms for quality testing
- Assess the groundwater quality;
- Build a groundwater model to determine the groundwater levels and flows; calibrated using the measured data on site;
- Determine and estimate dewatering volumes to be pumped from the pit ;and
- Compile a report indicating the process followed , confirming the outcome of the investigations and models , and make recommendations

To develop a complete groundwater model; it depends on the field data. The data is then entered into a predictive model to allow simulations to be developed for a given field conditions. The results of these simulations are used as a guide during the decision making process. The reliability of these models and consequent understanding of site hydrological behavior is influenced by the quality and quantity of data available for consideration.

2 Locality Description

The Giyani gold mine is located within the town of Giyani, approximately 140 km to the northeast of the N1 National Road from Polokwane. A well maintained R 81 road, from the N1 will provide as the main access to the mine. The mining area will be accessed through existing tarred roads that will link the mine to the various villages such as Thomo, Mninginisi, Mbatlo, Mavalani and Shikukwani. The existing town roads will be utilized for trucking of ore to the processing plant which will be located within a 20km radius from various mining pits and shafts. These roads will form part of the road infrastructure to be utilized for the development of the mine. The initial capital costs to be incurred by the company will be limited to re-establishment and maintenance costs for the access roads within the pits and shaft areas and this will be provided for by the mine

As part of the assessment, the site visit was conducted to evaluate the geology, hydrogeology and potential receptors of pollution emanating from the proposed Gold Mine operations (Figure 2-1 and Figure 2-2).

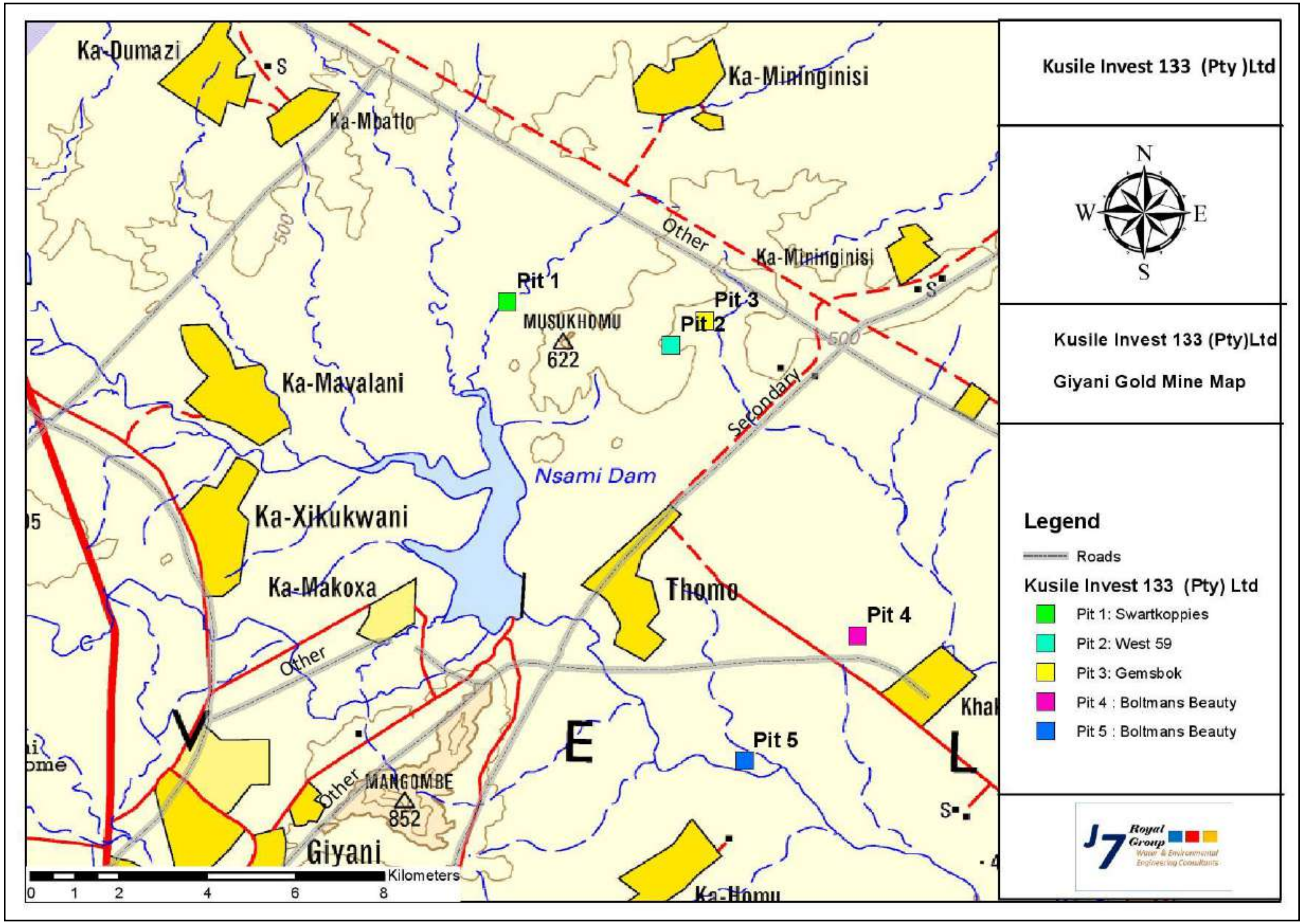


Figure 2-1 Topographic map showing site areas

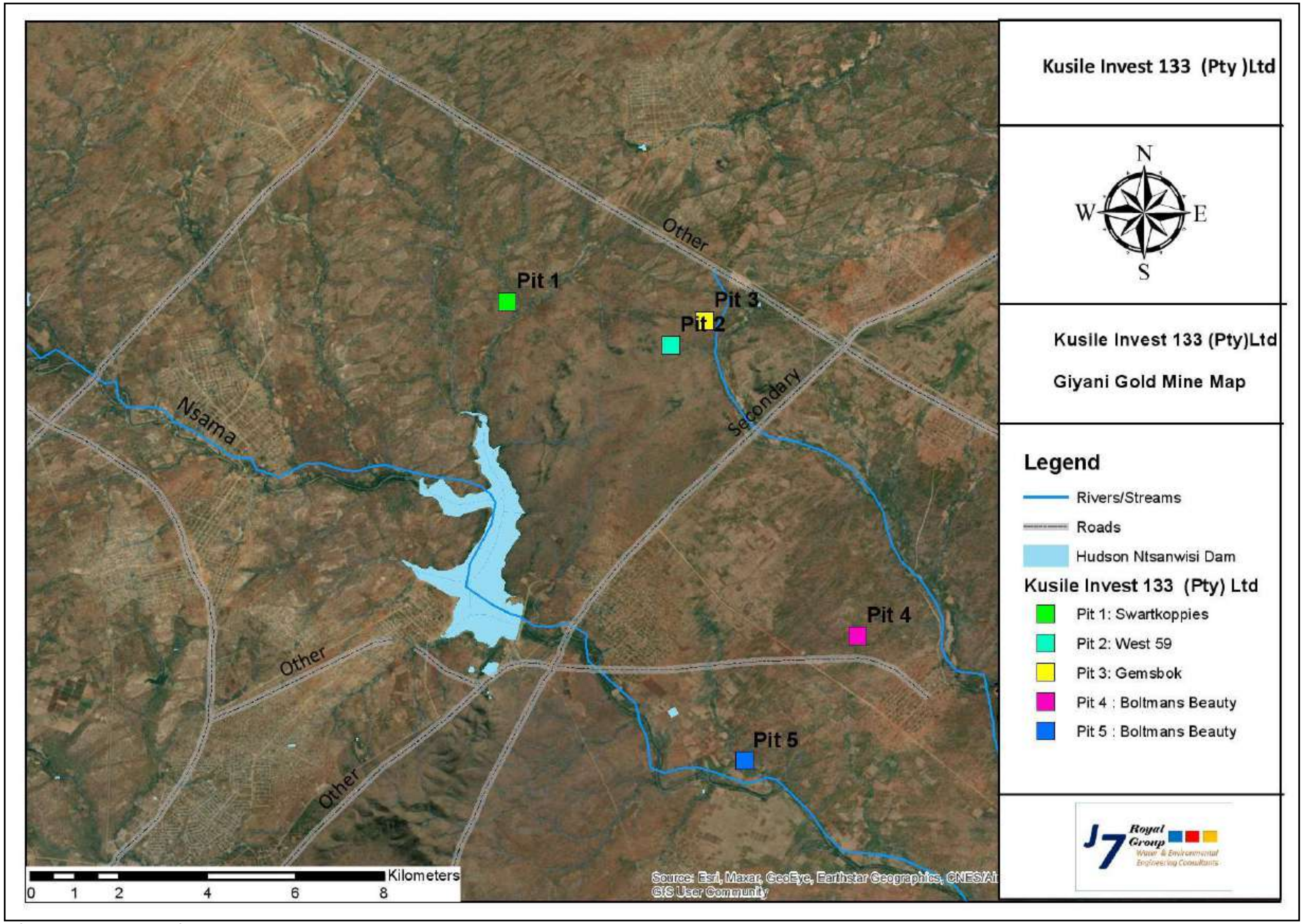


Figure 2-2 Site Area Map

2.1 Climate description for the site

This climate type is characterized by extremely variable temperature conditions. The climate is characterized by low rainfalls with a very hot summer. This could be caused by its position in the Lowveld. The municipal area received between 200 – 400ml of rain annually. The general rainfall has a direct impact on development, especially on agriculture. This results in the shortage of surface water, leaving the municipality to rely on ground water.

2.2 Topography and Drainage

The topography across the site is variable with a 0-0,5% gradient which trends in the North-East directions. The landscaping consist of moderately undulating plains and low hills dominated by tall, usually Hyperrhenia hirta dominated, grassland.

The regional elevation ranges between 420 - 760 meters above mean sea level (mamsl), whereas for the Kusile Invest 133 (Pty) Ltd local site the elevation ranges 420-460 meters above mean sea level (mamsl) as shown in Figure 2-3.The topography of the investigation area ranges from flat to undulating surfaces in the headwaters of the B82H catchments where Nsami River is perennial and feeds into the Letaba River in the south. Several drainage depression areas are evident around the site but outside the proposed open mine. Topography is the key element affecting how land drains to a particular point.
The boundary of a watershed is defined by the highest elevations surrounding a river segment. A watershed-boundary map is shown in Figure 2-4.

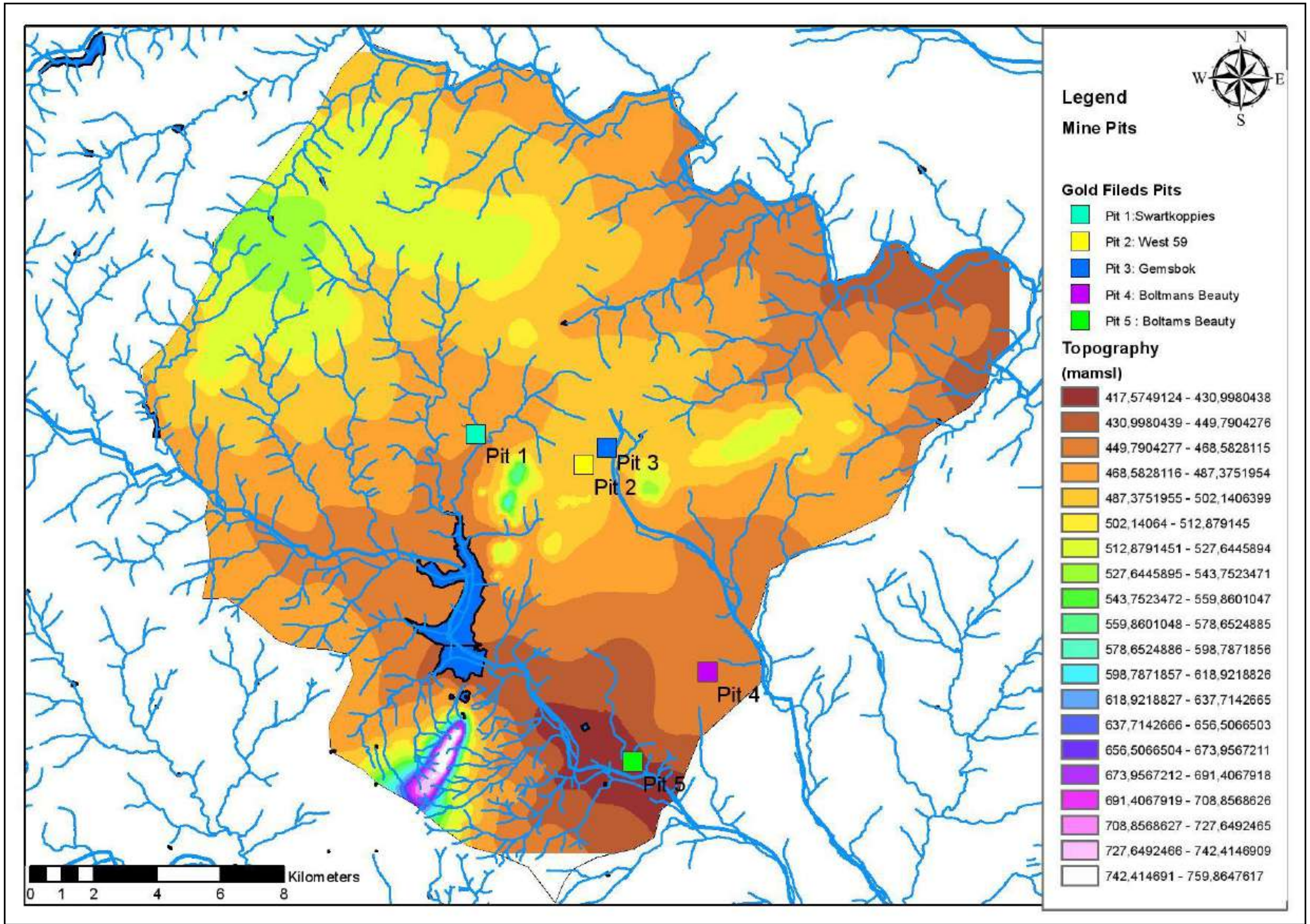


Figure 2-3 Regional topographic elevation map and flow directions map

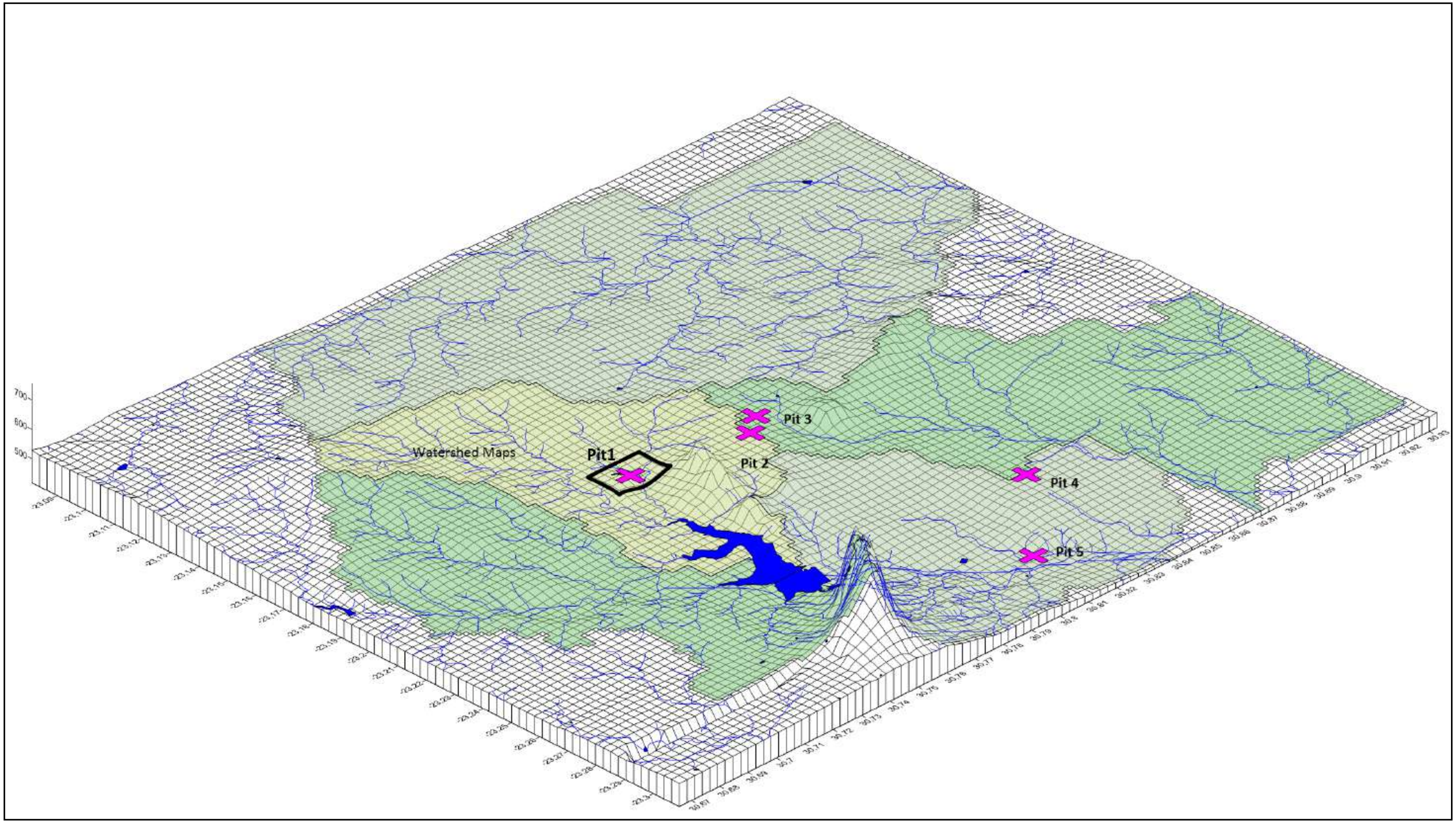


Figure 2-4 Three (3D) dimensional showing watershed boundaries map

2.3 Land use

The area is classified as rural while the main land use is agriculture and farming. Agriculture and arable farming are the dominant activities overlying aquifers. Within this category agriculture and farming increases remains the main activities with potentially wide spread effect on groundwater quantity and quality.

2.4 Quaternary Catchments

Table 2-1 WMA and Quaternary Catchments Descriptions (WR2012, 2017)

WMA	Quaternary catchment	Catchment Area(km^2)	MAP (mm)	PET (mm)	Hydrological sensitivity
Luvuvhu and Letaba Water Management Area(WMA)	B82H	749	400	?	Low

Kusile Invest 133 (Pty) Ltd Gold falls within B82H quaternary catchment. The catchment is located in the Luvuvhu and Letaba Water Management area. The site can be sub-divided into secondary drainage regions comprised of smaller catchment areas and streams. The surface topography is mainly consisting of a gently undulating plateau. Tributaries and streams have their origin in this area e.g. Nsami River, sourced from springs occurring on the North East (NE) .The drainage forms a dendritic pattern flowing north-east along the stream channels. This B82H quaternary catchment is mostly impacted by unregulated grazing and development in the form of village holdings, farm dams, road networks, and previous mining.

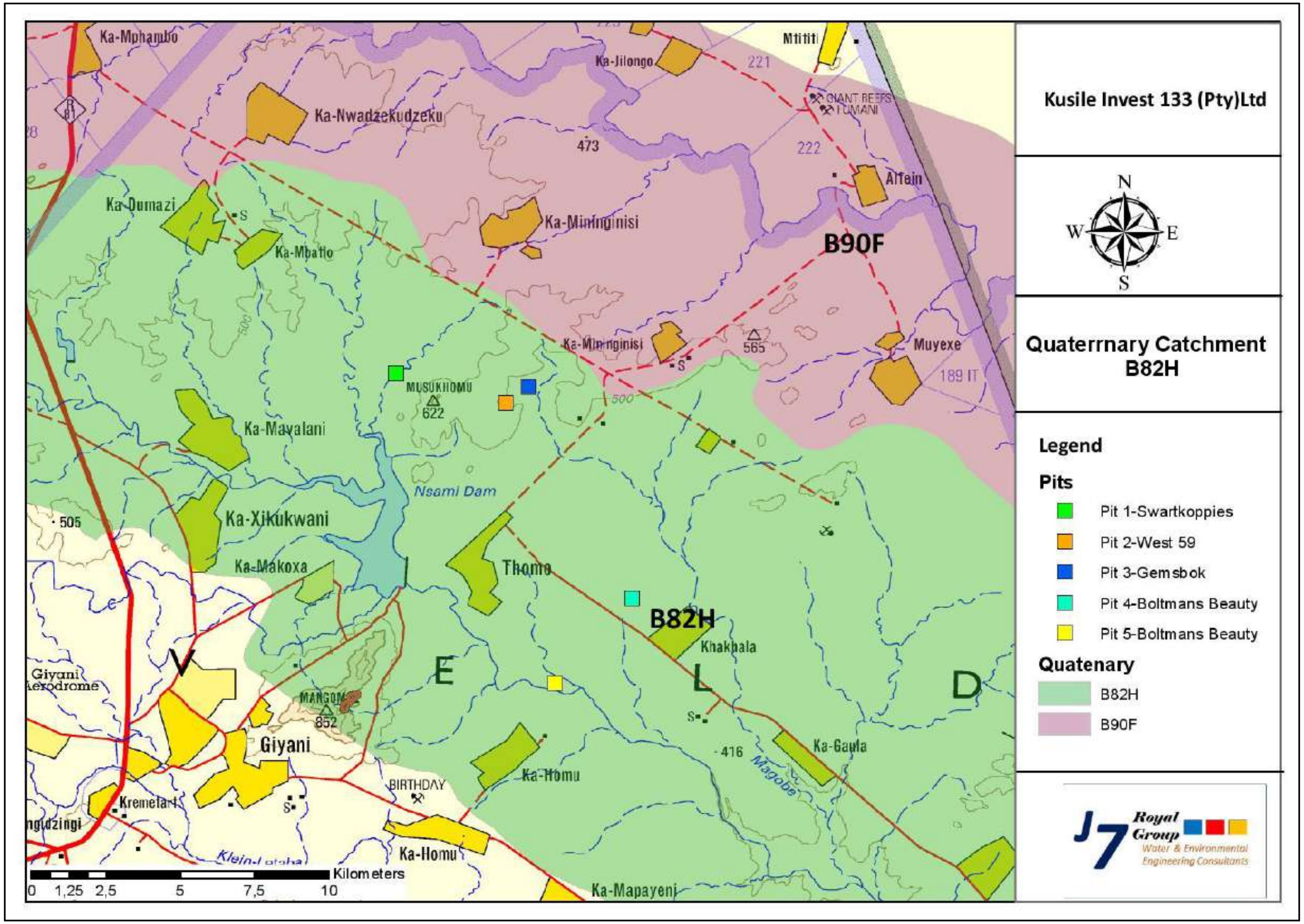


Figure 2-5 Topography quaternary catchment map

3 Geology

The regional geological setting relating to the area of the mining right application is depicted by the characteristics of the Archaean crust of southern Africa, comprising the Kaapvaal Craton, the Zimbabwe Craton and the Limpopo Metamorphic Complex. The Kaapvaal Craton has three major crustal elements, namely a core of Palaeo- to Meso-Archaean metamorphic rocks termed the Kaapvaal Shield and exemplified by the Barberton granitoid-greenstone terrane; the northern and western "rims" to this shield formed by granitoid-greenstone terranes accreted to the Kaapvaal Shield in the Neoarchaean and the Cratonic Basin successions. The northern rim to the Kaapvaal Shield comprises the Murchison, Pietersburg and Giyani greenstone belts. The Giyani Greenstone Belt (GGB) is the main focus in relation to the area of application. The rock stratigraphy within the Giyani Greenstone Belt forms part of the Kaapvaal Craton sequence. The below shows the geological setting and extent of the Kaapvaal Craton, and the northern rim in which the application area is located.

The Cratonic Basin successions were deposited on the Kaapvaal Shield during the Mesoarchaean and are preserved as the Dominion Group and Witwatersrand Supergroup in the central part of the craton and the Pongola Supergroup in the southeast.

3.1.1 Local Geology

The GGB is approximately 17km wide and has a strike length of 70km. The belt has an overall NE-trend, but to the west, the GGB splits into a northern Khavagari arm and a southern Lwaji arm separated by granitoid gneiss (the Klein Letaba Gneiss) and younger granite. The Lwaji arm has more or less the same trend as the main part of the belt but the Khavagari arm has been rotated into an E-W orientation. The GGB is a shallow structure with a down dip extension of around 1.5km in the NW and 4km in the SE.

The predominant rocks in the project area include the ultramafic (tremolite) schists; mafic (chlorite) schists which are common throughout the belt. Also present in the area are the metasedimentary rocks which comprise Banded-Iron-Formation (BIF), quartzite, metapelite and rare dolomite. Although these formations are discontinuous, they form important structural markers throughout the belt. They are best developed in the northern sections including the Khavagari arm and the clastic metasedimentary rocks with obvious primary structures are abundant along the Nsama River in the central part of the belt.

The supracrustal rocks of the GGB have been subjected to amphibolite facies metamorphism. Peak metamorphism was followed by uplift and the influx of CO2 rich aqueous fluids. This rehydration event occurred during the exhumation of the Limpopo Complex along the Hout River Shear Zone and was responsible for shear-zone hosted alteration of the rocks in the GGB and the formation of the orogenic gold deposits (Figure 3-1).

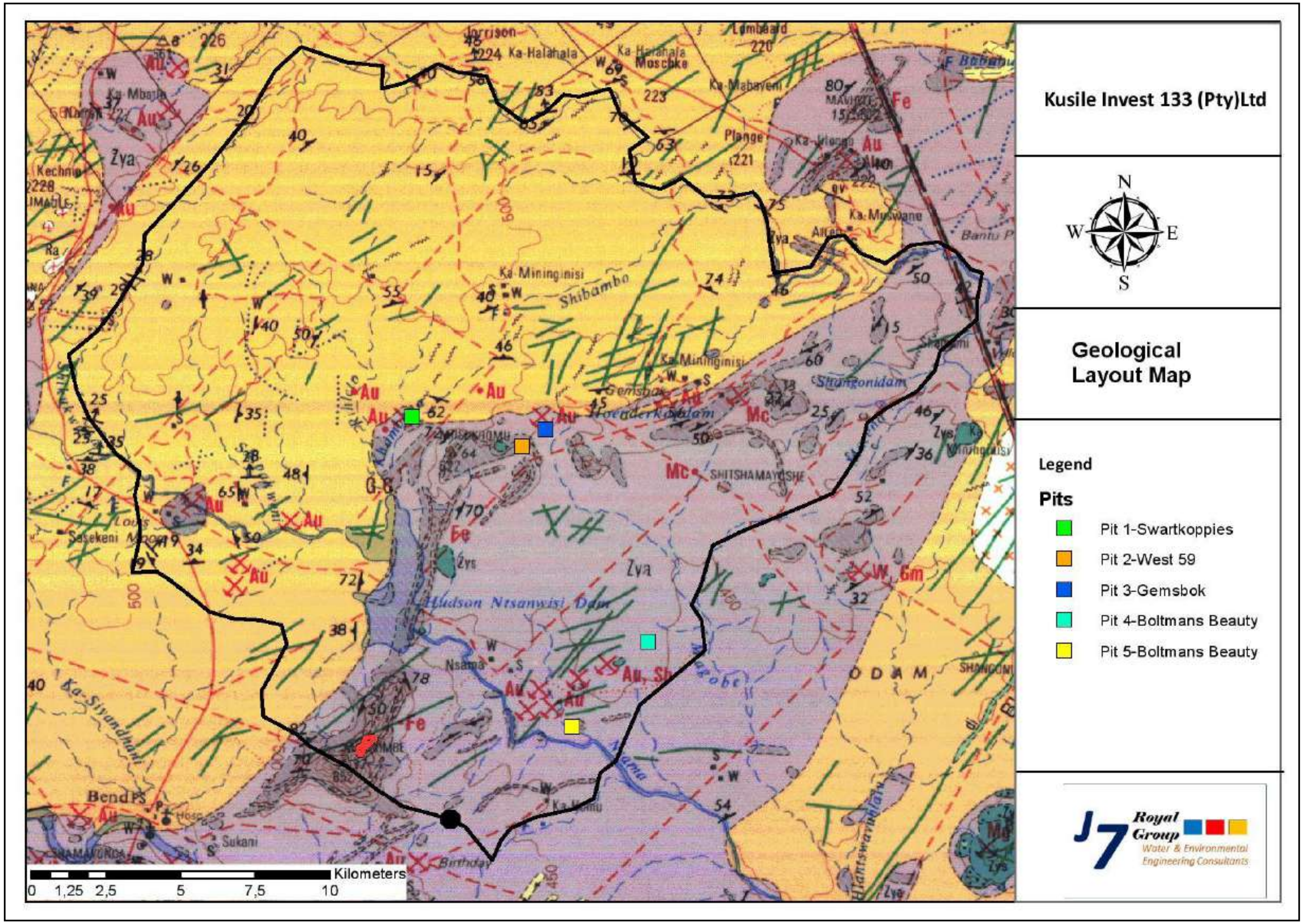


Figure 3-1 Site geological map

4 Hydrocensus

The description of the regional groundwater water levels and chemistry is based on data retrieved from the National Groundwater Archive / Database (NGDB/NGA, maintained by the Department of Water and Sanitation, DWS for the area. The most comprehensive sampling campaign of groundwater levels and chemistry was performed by DWS and hence used for the assessment of the regional water levels and water quality.

The databases containing borehole data on this area have been reviewed in order to form a comprehensible understanding of the present boreholes in the area in terms of their location, status, risks, use, equipment and possible yields. The tasks performed during this hydrocensus survey are listed below in Figure 4-1. The identified boreholes on site visited were thirty (30) boreholes.
The water levels in area ranges between 37 to 70 meters below ground levels (mbgl) as shown in Figure 4-2.
The first is the Giyani water type, which is a Ca-Mg-HCO_3 facies (represented in the DWS NGA by only 3 samples) related to the basic metamorphic rocks (ultramafic schists, iron formation, felsic schists) of the Giyani Greenstone belt(Figure 4-3) and the quality of the water has shown high levels of TDS in the area (Figure 4-4)

The primary objective of the hydrocensus was done to identify the baseline groundwater use and users within the study area. The hydrocensus survey forms part of the specialist studies in support of the Environmental Impact Assessment (EIA) Report. The proposed activity has a potential to contaminate the groundwater through mining in the area. It is with this basis that the hydrocensus was deemed necessary for the site to gather all relevant information related to groundwater and its related potential impacts.

In order to achieve the purpose of the study, the following scope of work has been formulated:

- Perform site assessment and hydrocensus survey;

- Sampling and lab results analysis;
- Desktop study;
- Technical reporting of the above;
- Locate and identify all groundwater users;
- Determine all groundwater users,
- Locate and log boreholes for inclusion into a comprehensive database; and
- Measure groundwater levels and sampling of groundwater for the purpose of an inorganic chemical analysis.

A geohydrological baseline condition was established in the form of a hydrocensus survey. The hydrocensus survey entails gathering of water use, quality and quantity within the study area and the surrounding areas

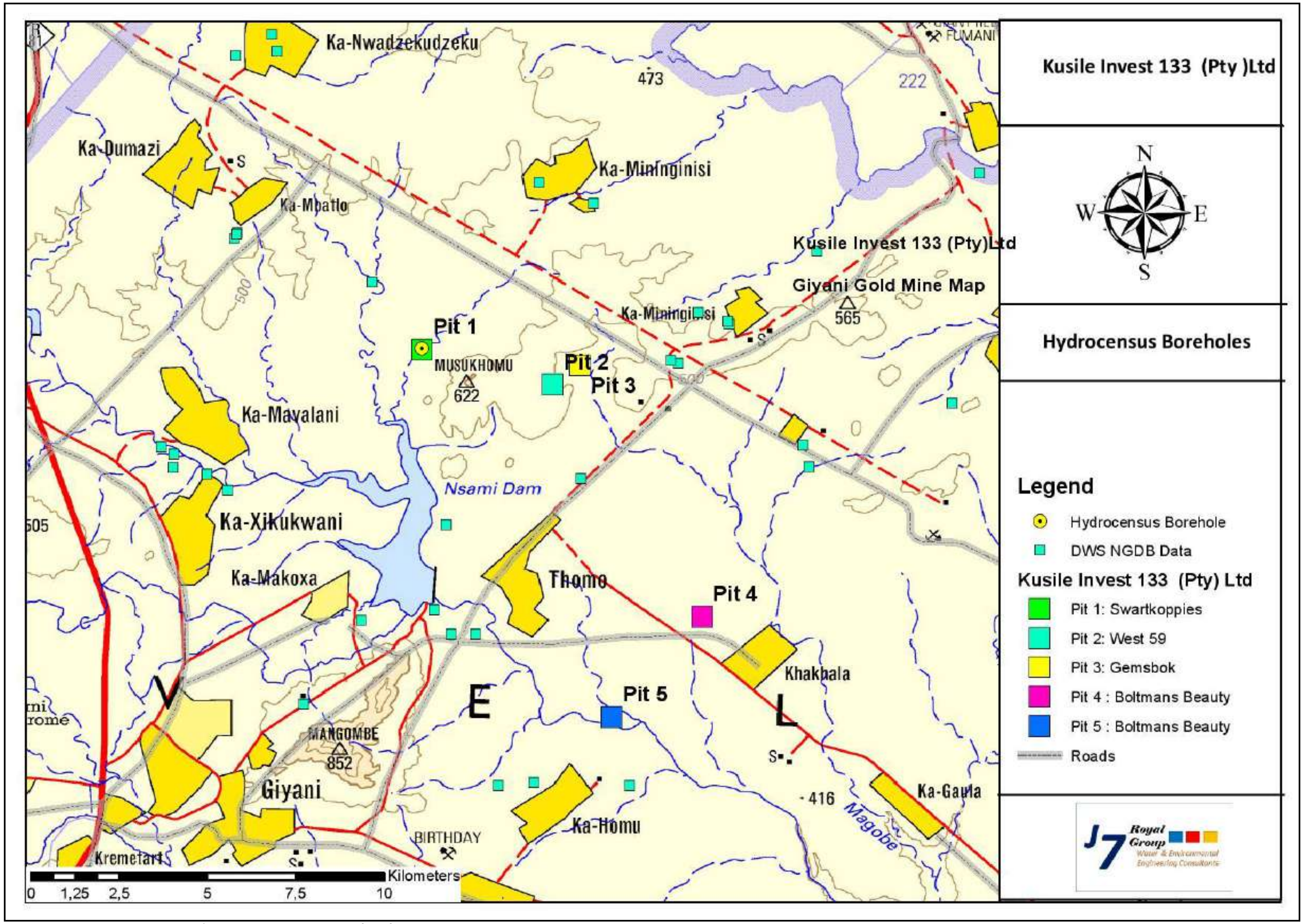


Figure 4-1 Hydrocensus Boreholes 2021

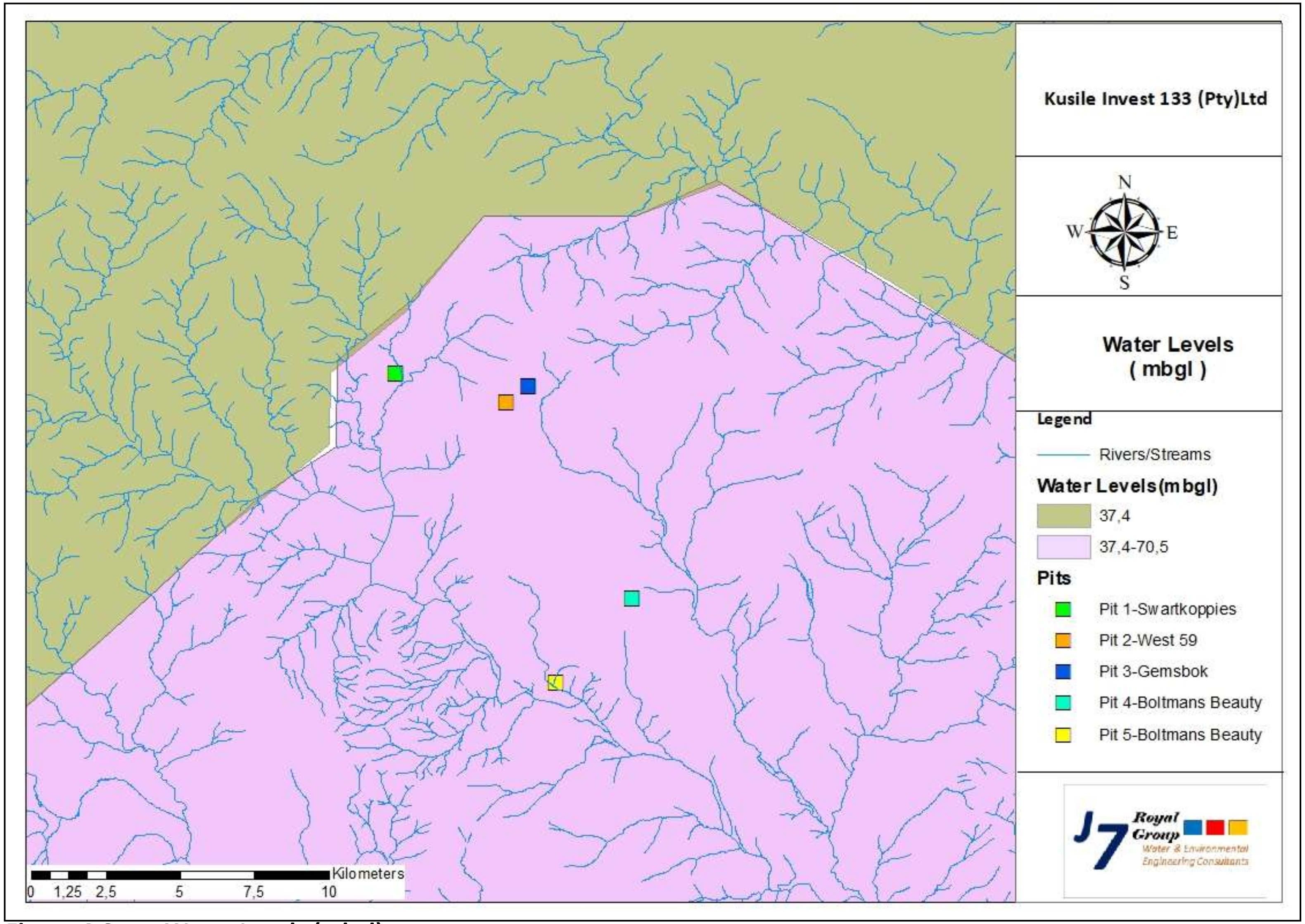


Figure 4-2 Water Levels (mbgl) map

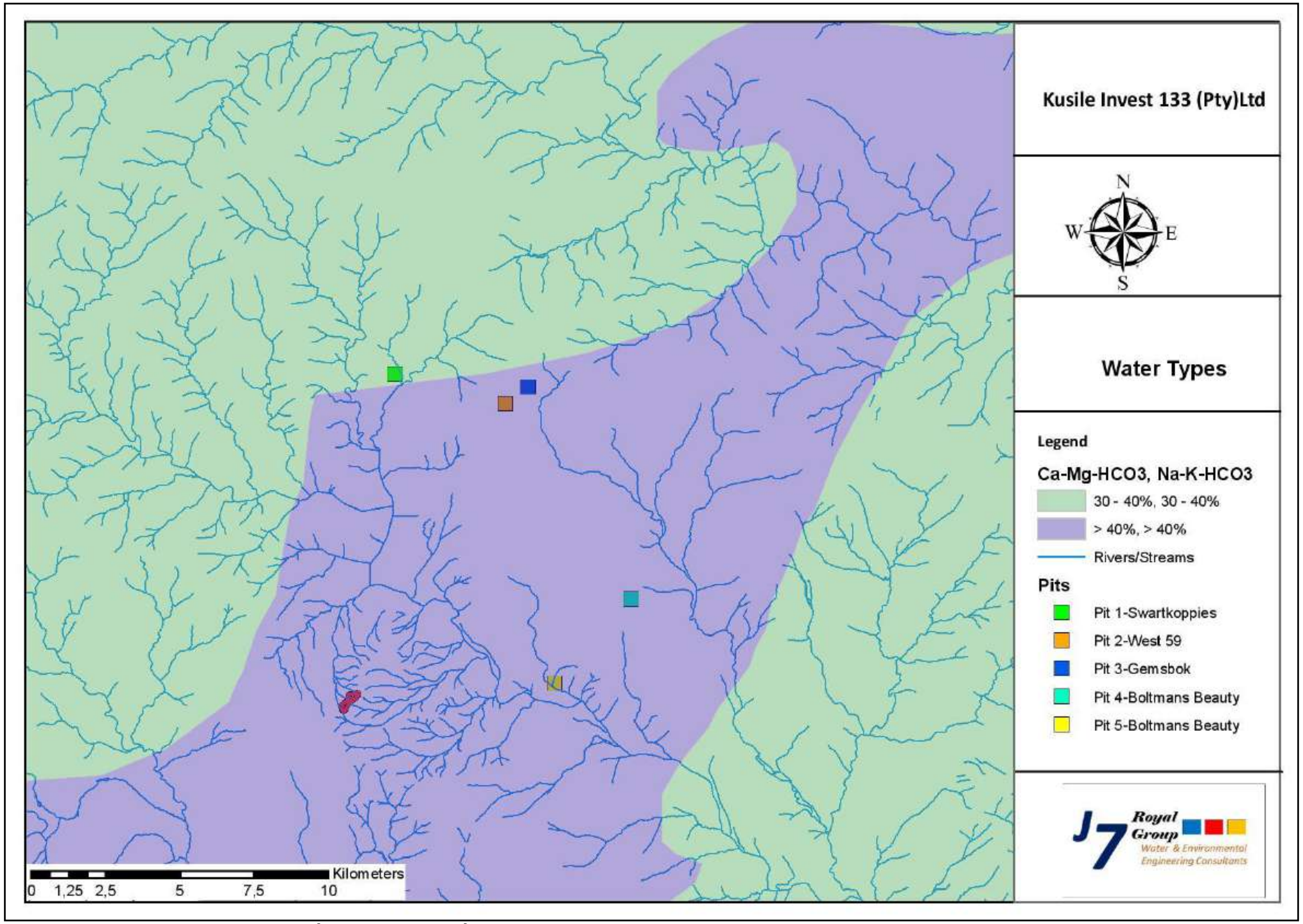


Figure 4-3 Water types (Ca-Mg-HCO_3)

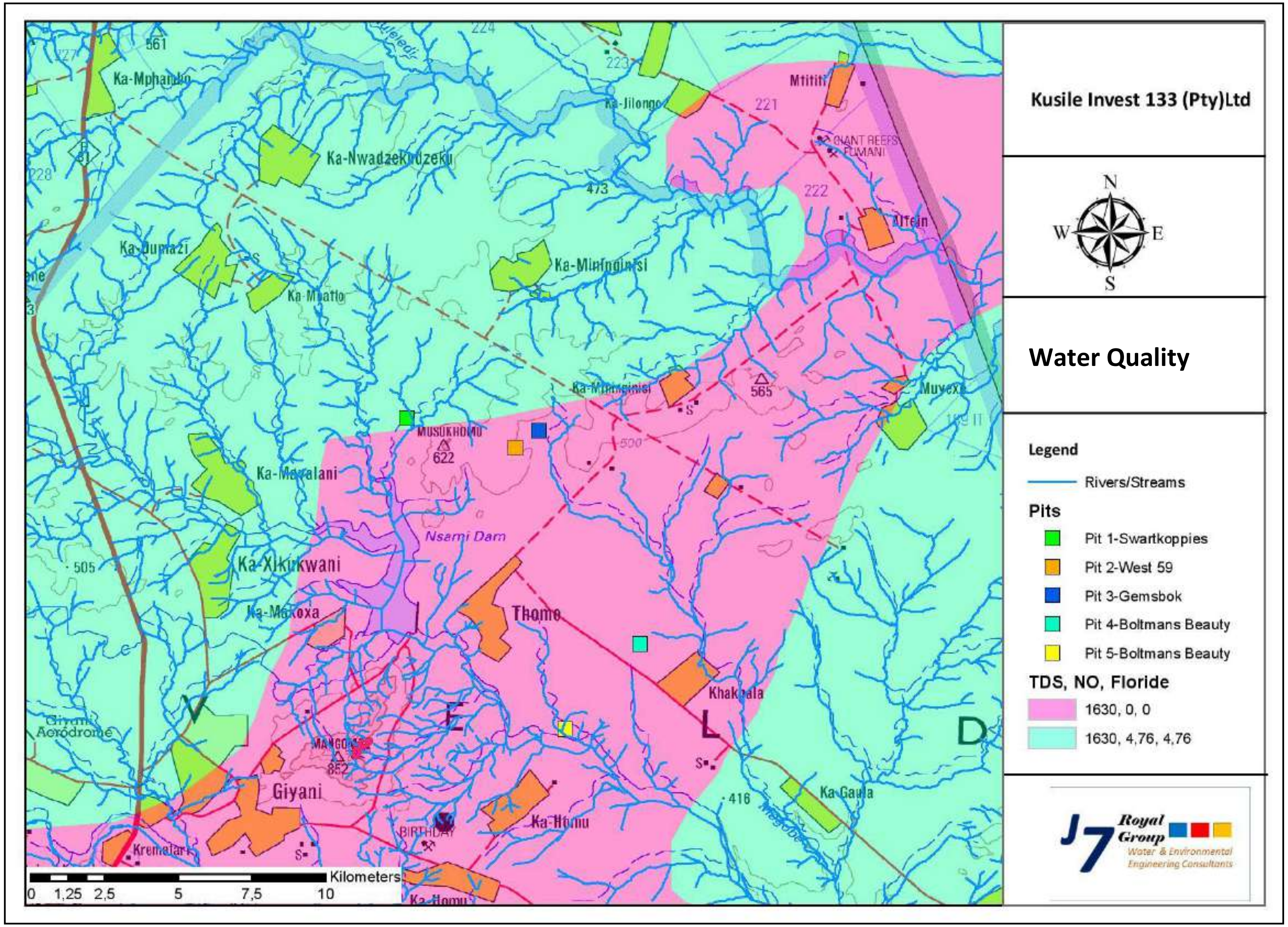


Figure 4-4 Water Quality

4.1 Water Quality Assessment (Hydrogeochemistry)

Characterisation of hydro geochemistry and risks to groundwater quality and knowledge of the processes that control natural water composition is a necessity for rational management of water quality. Hydrogeochemistry pursues to determine the origin of the chemical composition of groundwater and the relationship between water and rock chemistry as they relate to water resources and users. A basic and straightforward tool in hydrochemical studies used to summarize and present water quality data are graphical interpretation which are also used in this study.

4.2 Baseline Surface Water Quality

Water sample was collected and analysed by UIS Laboratories (Pty) Ltd Laboratories which is SANS accredited laboratory. An existing borehole(Pit 1 Area : Swartkoppies) water samples was submitted in the laboratory in March 2021.Water quality chemistry results was observed ,TDS is quite high for drinking water.The pH value remains in the neutral to slightly alkaline range, within the stipulated limits in the SANAS limits.

The water quality results was analysed using the different water quality software's which are computer program capable of displaying thematic maps with data and graphs depicting the data in a more specialized way. Specialized chemical diagrams included in this report are:

- Piper diagram (Piper, 1944)
- Durov Diagram
- Schoeller–Breakoff's diagram (Schoeller, 1962)
- Sodium Adsorption Ratio diagram (United States Salinity Laboratory, 1954)

Water quality is determined by several factors including temperature, colour or clarity, taste, suspended matter, dissolved matter, organisms, pH and radioactivity.

4.3 Hydrochemistry Modelling –Surface Samples

4.3.1 *Piper diagram –Groundwater Monitoring*

Piper Diagrams illustrates cations and anions shown by separate ternary plots. The apexes of the cation plot are calcium, magnesium and sodium plus potassium cations. The apexes of the anion plot are sulphate, chloride and carbonate plus hydrogen carbonate anions. The two ternary plots are then projected onto a diamond, where the water type is determined. In this project water samples were collected and analysed at the UIS Laboratories (Pty) Ltd whereby the results in piper diagram were obtained.

Characteristics of piper diagram:

- Normalizes the cations and anions, separately
- Does not show absolute concentrations: waters with the same relative concentrations will plot on top of each other, no matter how different the actual salinity is
- Helps identify water types
- Can show mixing lines between water types

Based on Figure 4-5 below, the water type table (Table 4-1) was generated as shown.

Table 4-1 : Water types from piper diagram

No.	Sample Name	Water Type
1	KUBH1	Ca-Mg-SO_4 waters typical of Domestic waste dumps/Natural saline waters – indicative of high levels of TDS

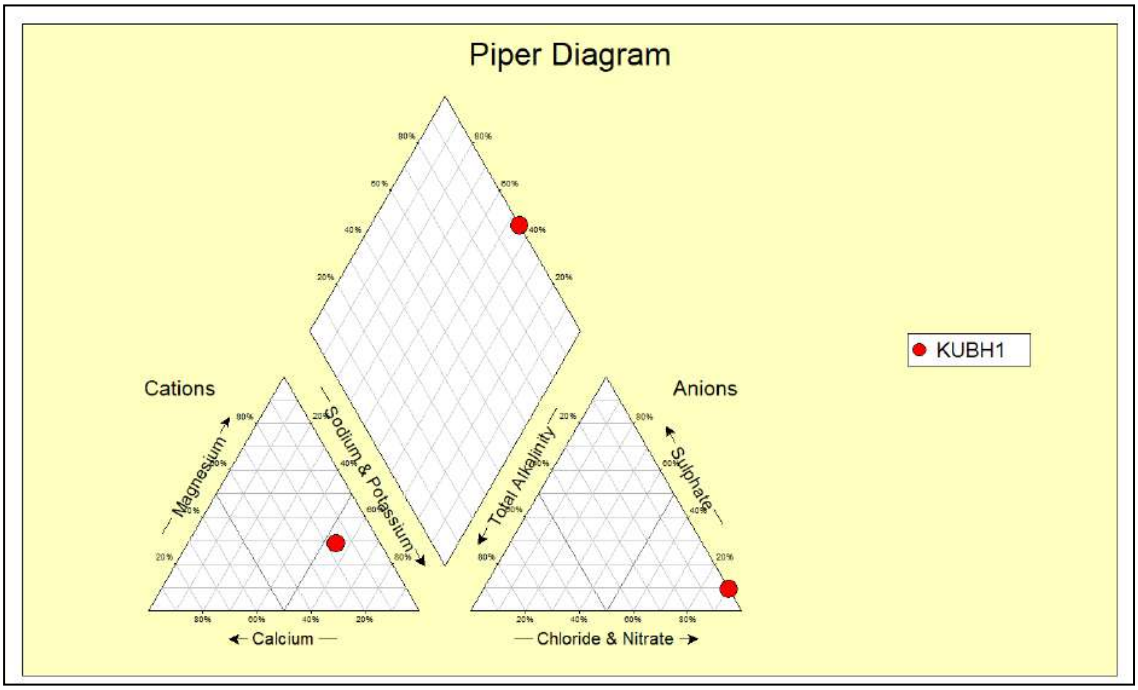


Figure 4-5 Piper Diagram Ground Water Plots 2021

Characteristics of Durov diagram:

The Durov diagrams (Figure 4-5) are basically the same as the Piper diagram with two extra legs allowing pH and EC to be included in the diagram.

Interpretation:

The table below interprets clearly the dominant water types in this Gold Mine hydrocensus program (Table 4-2 and Figure 4-6).

Table 4-2 : Water type sub-fields (Durov diagram)

No.	Dominance	Interpretation	Present study
1	HCO^{3-} and Ca^{2+} dominant	Commonly Indicates recharging waters	
2	HCO^{3-} dominant and Mg^{2+} dominant	Cations indiscriminant	**KUBH1**
3	HCO^{3-} and Na^{+} dominant	Ion exchange waters	
4	SO_4^{2-} dominant and Ca 2+ dominant	Anions indiscriminate, recharge/ mixed water	

No.	Dominance	Interpretation	Present study
5	No dominant anion or cation (Dissolution/ mixing)		
6	SO_4^{2-} dominant and Na^+ dominant	Anions indiscriminate, mixing influences	
7	$C\ell^-$ and Ca^{2+} dominant	Cement pollution or reverse ion exchange of $NaC\ell$ waters	
8	$C\ell^-$ dominant and no dominant cation	Reverse ion exchange of $NaC\ell$ waters	
9	$C\ell^-$ and Na+ dominant	End point water	

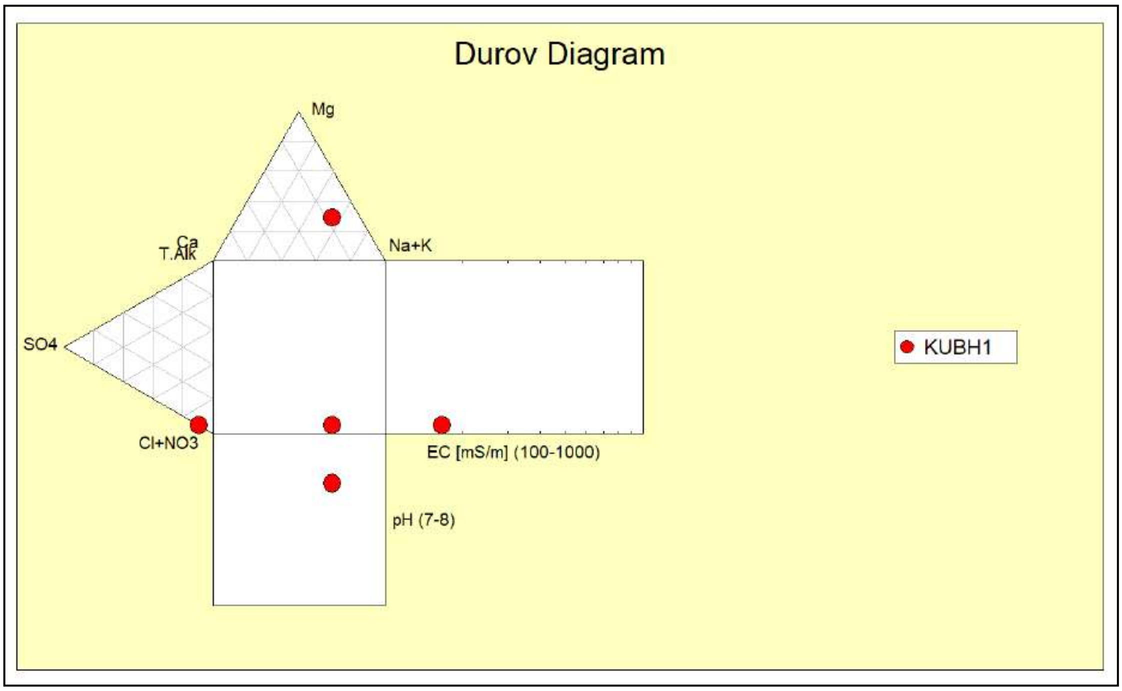


Figure 4-6 Durov diagram Ground Water Plots 2021

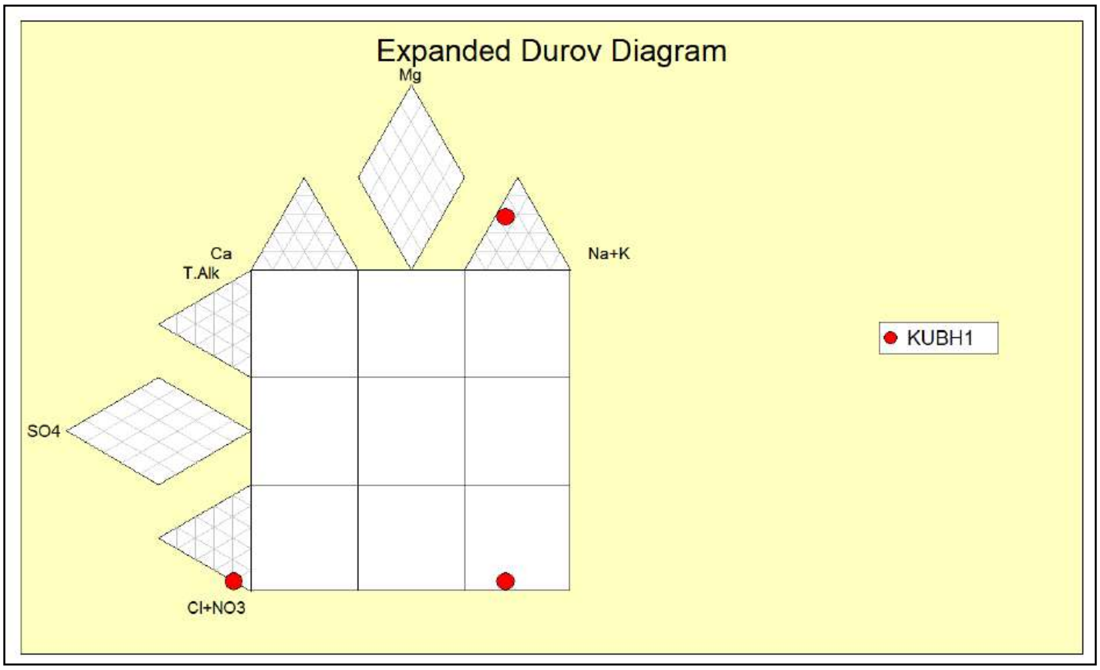


Figure 4-7 Expanded Durov diagram Ground Water Plots 2021

Expanded Durov Diagram(Figure 4-7) are a combined plot consisting of two (2) ternary diagrams (cations plotted against anions) or it uses the trilinear diagram, where two triangles are split into three areas each and projected to a rectangular area with nine different zones. This helps with the exploration of chemical compositions and total dissolved solids. It provides more understanding on the hydrochemical facies by assisting in the process to identify water types and shows geochemical processes that could assist in understanding and evaluating the quality of groundwater (Bosman, 2014).

From the assessment the Durov diagram indicates the following:

- **KUBH1 : -Indicates the Domestic Waste Dumps or Natural Saline Water , indicative of TDS**

4.3.2 *Schoeller-Berkaloff Diagram-Surface Monitoring*

Characteristics of piper diagram

Logarithmic diagrams of major ion analyses in **meq/ℓ** demonstrate different water types on the same diagram (Figure 4-8).

- Samples concentrations not ratios are displayed and compared

- Similar waters exhibit similar “fingerprints

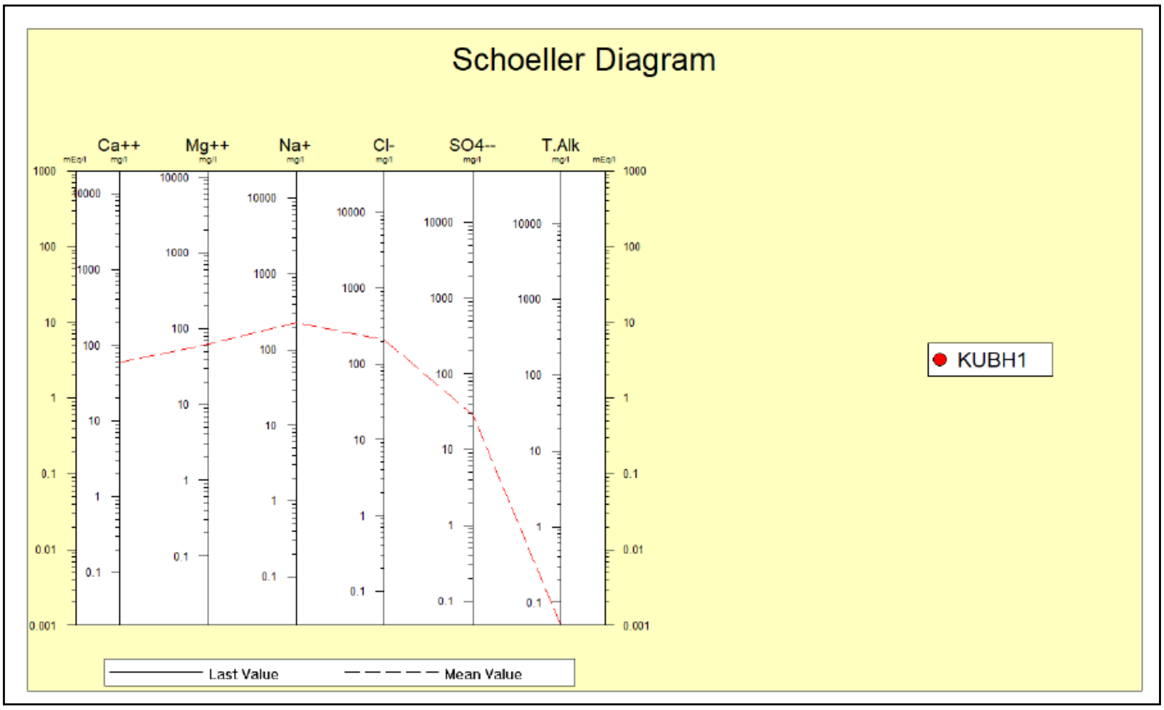


Figure 4-8 Schoeller-Berkaloff Diagram (DWAS, 2017)

4.3.3 *Sodium Adsorption Ration diagram (S.A.R)*

The SAR diagram (Figure 4-9) are used to determine if water is suitable for irrigation it uses the following equation (Driscoll, 1986):

SAR = Na / (Ca/2+Mg/2)0.5.

Where sodium, calcium and magnesium are in meq/l. Water with SAR values of 18 and above will result in an excess of sodium in the soil. Water with SAR values of 10 and below is safe and suitable for irrigation.

The KUBH1 samples for this project has SAR values are right on 10 which indicates water is unsafe and not suitable for irrigation.

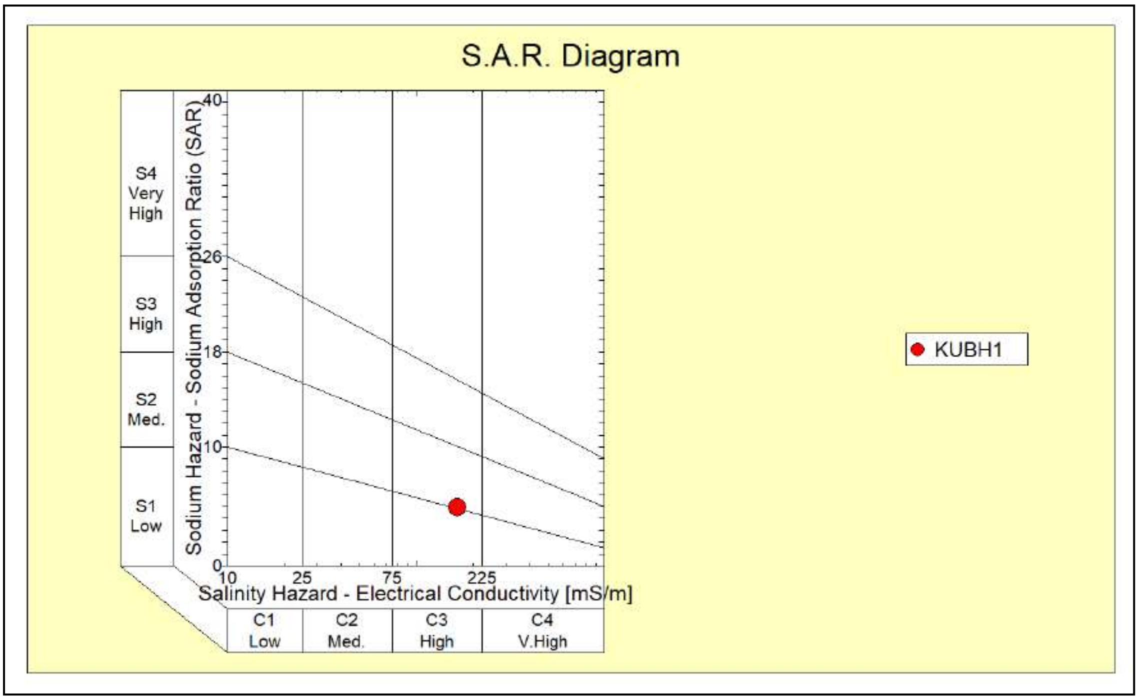


Figure 4-9 SAR diagram (DWS, 2017)

4.4 Hydrocensus Boreholes

A detailed hydrocensus in the area was first conducted by J7 Royal in February 2021 for the Doornrandje 386 farm .The area covers PPC Laezonia Gold and surrounding farms (Table 5-1).

Table 4-3 Hydrocensus boreholes

Type of pump	Equipped boreholes			Other Boreholes	
	Status of Boreholes	In use	Not in use	Not equipped	Destroyed
No pump	Monitoring		0	**0**	**0**
Electrical Submersible pump	Irrigation & Livestock	0	0		
Electrical Submersible pump	Domestic Water Supply	1	1		
Total		**1**		**0**	

4.5 Regional hydrogeology

The hydrology of Giyani area is mostly characterised by fracture-bound aquifers formed mainly within the rocks of Goudplaats Gneiss, the Giyani Greenstone Belt and to a smaller extent the Shamariri Granite and Schiel Alkaline Complex. Nsami is main major river in the study area which flows into easterly directions and the river forms part of the secondary drainage, which falls within the Letaba/Luvuvhu Water Management Area (WMA).

The Goudplaats Gneiss rocks have a moderate to good groundwater potential and the yield varies from 0.2 to 0.5 ℓ/s.The high yield groundwater in these rocks is associated with fractured zones, pegmatites, transitional zone between weathered and solid gneiss

4.6 Recharge Estimates from Cℓ mass balance method (CMB)

The chloride mass-balance method can provide, under certain conditions, a time-integrated technique for evaluation of recharge flux to regional aquifers that is independent of physical parameters. The chloride mass-balance (CMB) is economical and provides insights into the nature of recharge that are difficult and expensive to obtain with physical-based methods. Other recharge methods other than mentioned above were not applied because they require enough representative data. The method is based on the fact that, chloride is a conservative element and is not taken from the soil by vegetation in its simplest form structure; the chloride is represented by the following relationship,

$$RE = \frac{CLrain}{CLgw} Rf$$

Where RE = Recharge; $C\ell_{rain}$ = Chloride from rainfall; $C\ell_{groundwater}$ = Chloride in groundwater. For this study an average value of chloride in rainfall ($C\ell_{rain}$ = 1 mg/L) was used. Based on the chloride method of recharge estimation, the aquifer recharge is high as shown in (Table 5-2) and conservative recharge estimations were used in the model .An average recharge of 0,48% was adopted for the area

Table 4-4 : Statistical recharge calculated from the chloride concentrations

Parameter	**Chloride (Cℓ)**					
Statistical Analysis	Cℓ(mg/ℓ)	1/Cℓ(mg/ℓ)	**Recharge**			Rainfall
			%	**(mm/yr)**	**(mm/d)**	
KUBH1	209,00	0,005	0,48	8,360	0,023	400,000

5 Conceptual Model Approach

The core understating of any modelling exercises rests on the proper conceptual design of the model. This design should always incorporate all the information available on the system and simplifies it via several assumptions. In this way the system can be adequately summarized and different scenarios simulated. All relevant monitoring results, results from hydraulic tests, material analysis, natural topographical and geological characteristics, etc. was integrated into a conceptual model. Consequently, the following conceptualization for groundwater flow and mass transport within the Kusile Invest 133 (Pty) Ltd was done. The site layout is shown in Figure 5-1 and the conceptual model developed is displayed in Figure 5-2 below. For this assessment only five (5) pit were modeled to a depth of 60mbgl.

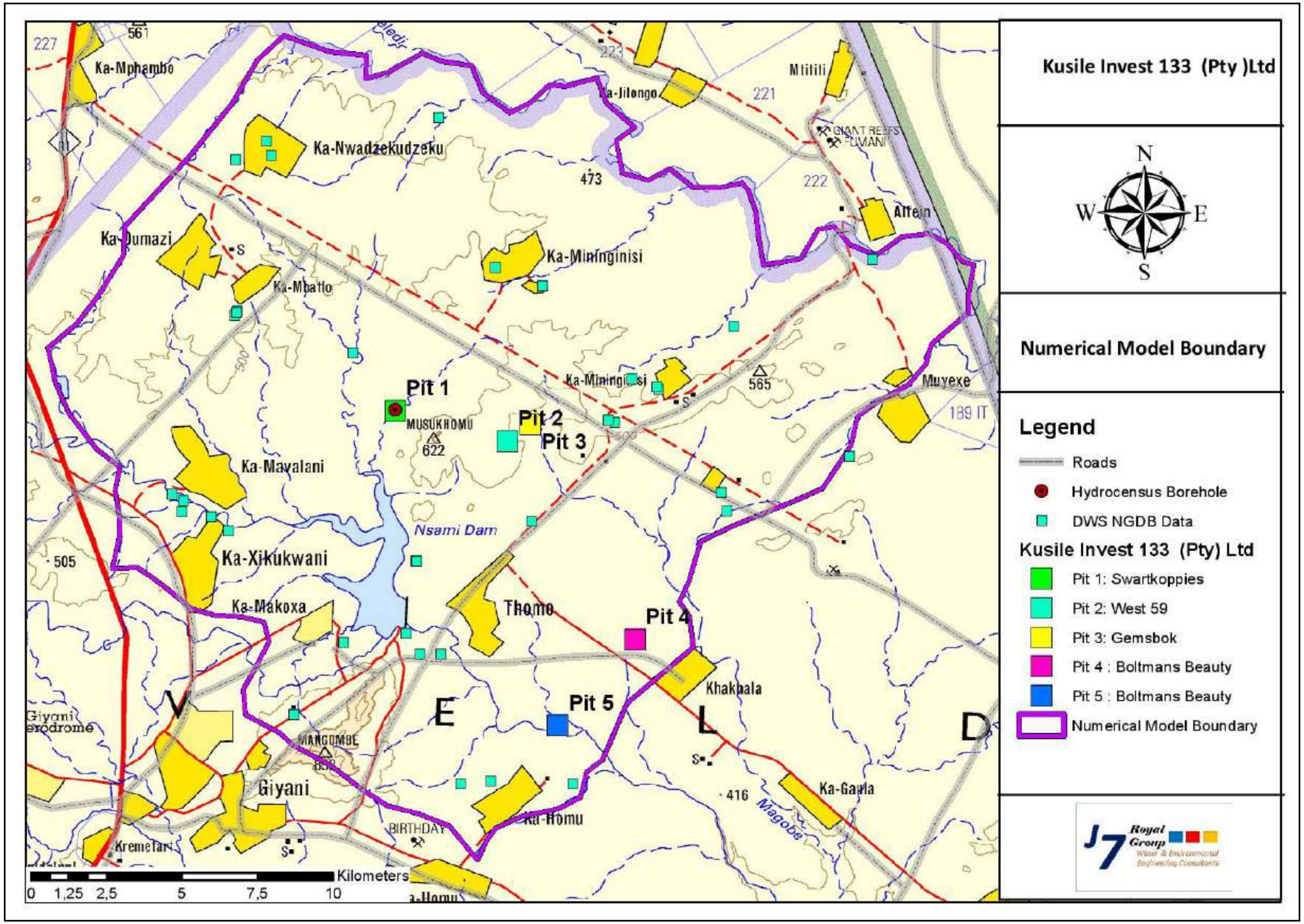


Figure 5-1 Model Boundary Map

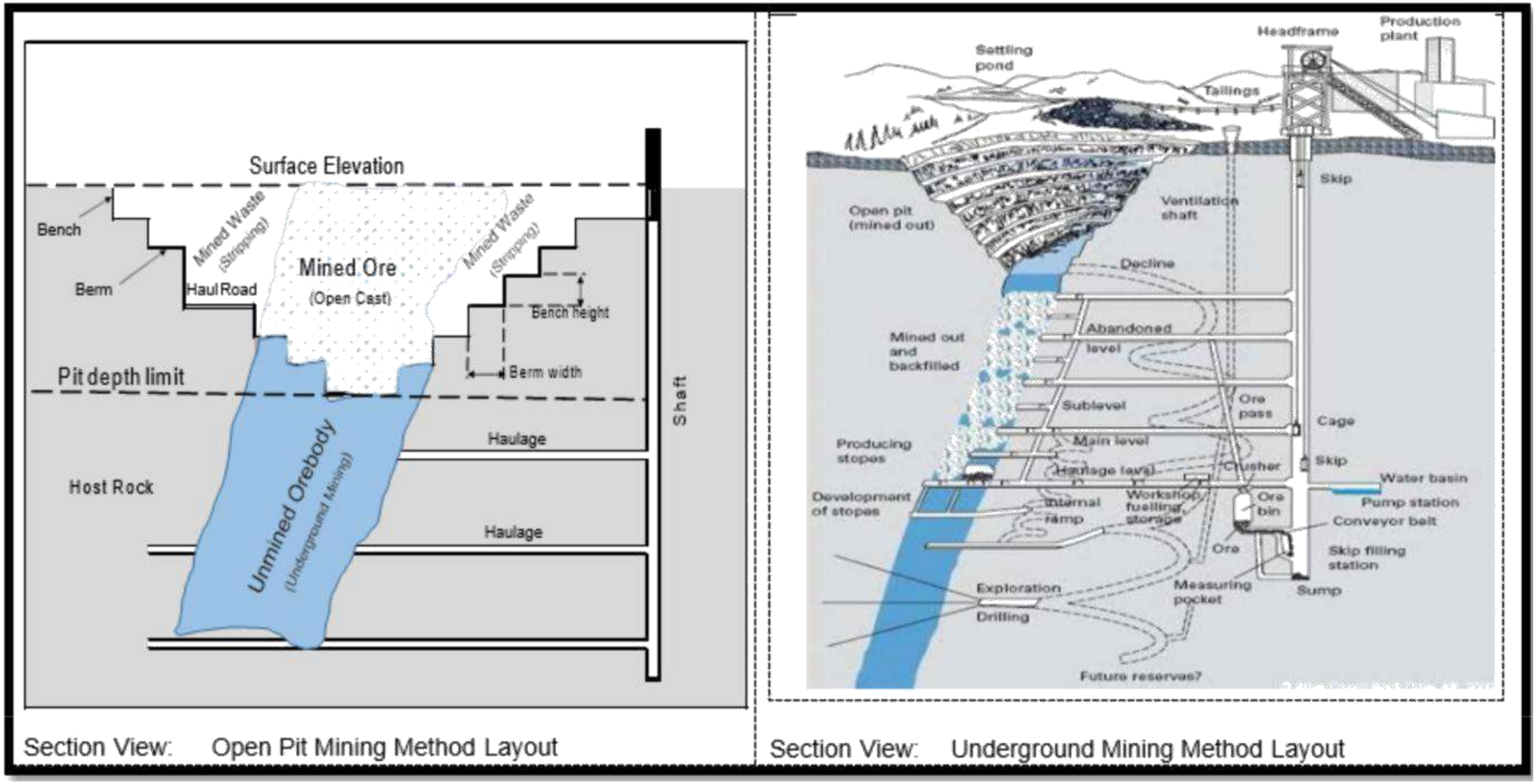


Figure 5-2 Conceptual model (Open Cast and Underground)

6 Numerical Model

Before the development of a flow model, the hydrology of the study area must be understood conceptually. A conceptual model includes planning and constructing an equivalent but simplified conditions. For a real world problem that are acceptable in view of the objectives of the modelling and the associated management problems. Transferring the real world situation into an equivalent model system, which can then be solved using existing program codes, is a fundamental step in groundwater modelling.

A model is a summary of:

- The known geohydrological features and characteristics of the area;
- The static water levels/piezometric heads of the study area;
- The interaction of the geology and geohydrology on the boundary of the study area;
- Any simplifying assumptions necessary for the development of a numerical model and the selection of a suitable numerical code; and
- A description of the processes and interactions taking place within the study area that will influence the movement of groundwater.

6.1 Model scale, context and accuracy

The regional model context and accuracy was based on existing 1:50 000 topographical GIS data with 1:250 000 scale geological data. The research was based exclusively on the assessment of existing information, the bulk of which was supplied by National Groundwater Database (NGDB) and National Groundwater Archives (NGA) of DWA. Geohydrological information was obtained from local and regional boreholes to provide an understanding of the groundwater regime.

A dynamic groundwater flow model was developed by applying the modelling package 2D-Dimensional Visual Modflow (WEN-Hsing Chiang and Wolfgang Kinzelbach, 1998). The latter will be used as planning and management tool for quantification and qualification of proposed open pit Gold activities on aquifer conditions. The model domain was delineated based on regional drainages as well as topographical highs i.e. discharge zones and no-flow zones and governed by a set of boundary conditions. The numerical model was used in steady-state and transient simulations to assess the groundwater flow directions, head gradients and flow velocity and transient simulation was then conducted after the calibration of the model. The data and assumptions used in the model are listed in Table 6-1.

Table 6-1 Model context, data, boundary conditions and assumptions

Input parameter	Scale	Source, parameter or assumption description
Topography (DTM)	1:50 000	The DTM was obtained from DWS NGA Data (Figure 2-3).
Rainfall (recharge)		Rainfall data was obtained from SAPWAT. Modelled data for the quaternary catchments the B82H
Rivers streams, drainages	1:50 000	Obtained from DWAF as GIS shape files.
Dams	1:50 000	Obtained from DWAF as GIS shape files.
Geology	1:250 000	Obtained from DWS as GIS raster image files and from the Client.
Recharge		Recharge was assumed to be 1-4.5 % of MAP for the aquifer deposits The general recharge was assumed at 2% of MAP
Boreholes and pumping rates		Data sourced from previous reports and Water level data was available for some few boreholes and all were used to calibrate the model to a 80 % level of assurance.

Input parameter	Scale	Source, parameter or assumption description
Boundary conditions		No flow represented by surface water shed
Transmissivity		Information regarding transmissivity was obtained reports provided and DWS Data.
Storativity		Assumption of 0.001 to 0.005 for aquifer zones. No field test data was available for storativity values.
Aquifer thickness		It was assumed that the deposits were 60m thick at the lowest elevation gradually decreasing as the elevation rises. The area is underlain by fractured rocks.

6.2 Methodology

The model was calibrated, groundwater quality and groundwater levels were used .Most of the data applied and used for the status groundwater quality was supplied by the Kusile Invest 133 (Pty) Ltd. A dynamic numerical model for the aquifer was constructed using the modelling package VISUAL MODFLOW PMWIN (WEN-Hsing Chiang and Wolfgang Kinzelbach, 1998). Considering an unconfined/confined aquifer, with a recharge to the aquifer only occurs once a year during rainy season for a period of four months.

6.3 Life of Mine (LoM)

The Gold life of mine (LoM) is 30 years. A numerical groundwater flow model was developed using the modelling package Visual MODFLOW. Details of this software are provided at Visual MODFLOW, which is a MODFLOW based software package. The detailed site layout map are shown below in Figure 6-1 to Figure 6-6 for all the pits that are modelled.

Figure 6-1 : Site layout map (Pit 1:- Swartkoppies area)

Figure 6-2 : Site Layout Pit1 Swartkoppies map

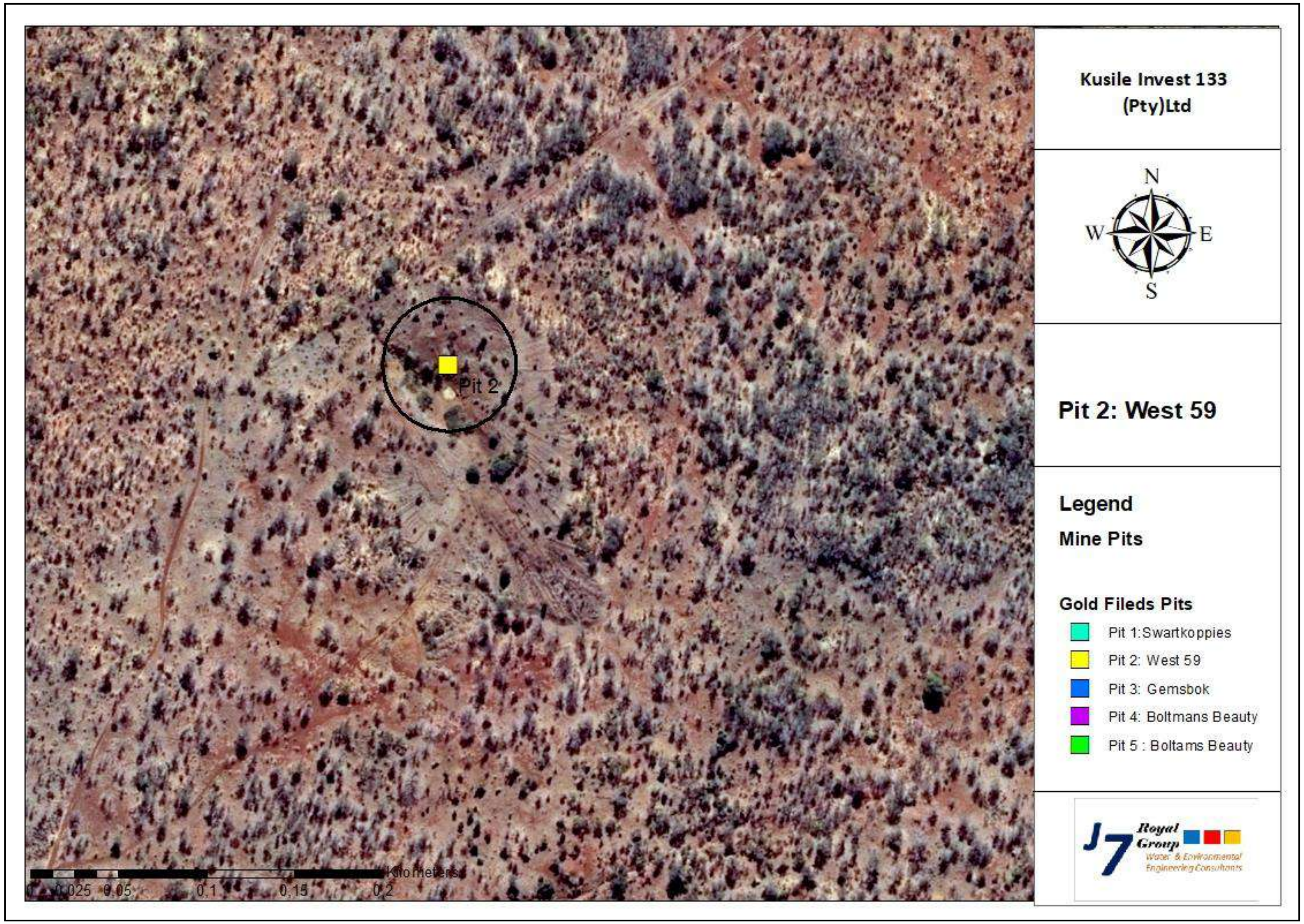


Figure 6-3 : Pit 2 Site layout map (West 59)

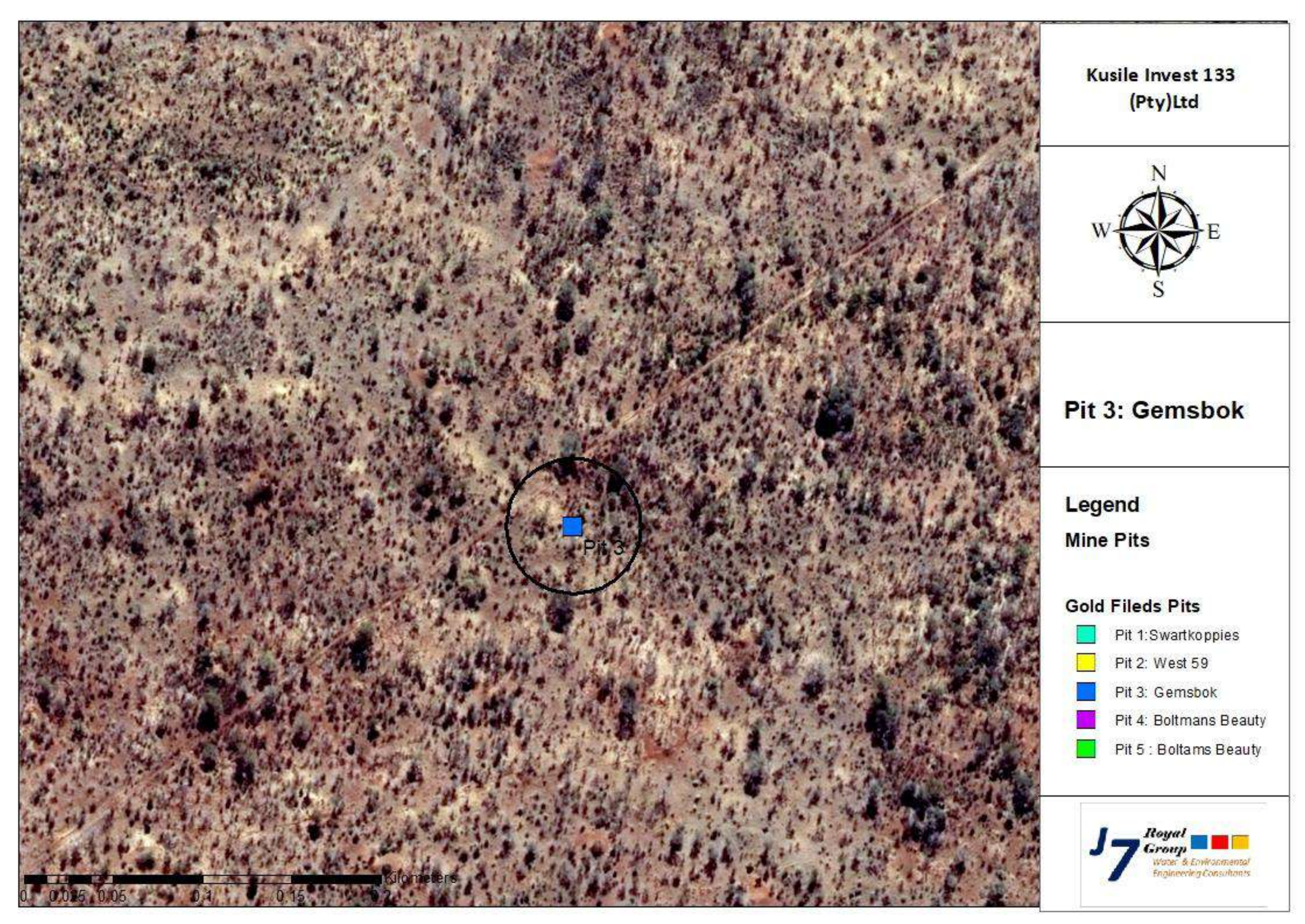


Figure 6-4 : Pit 3 Site layout (Gemsbok) map

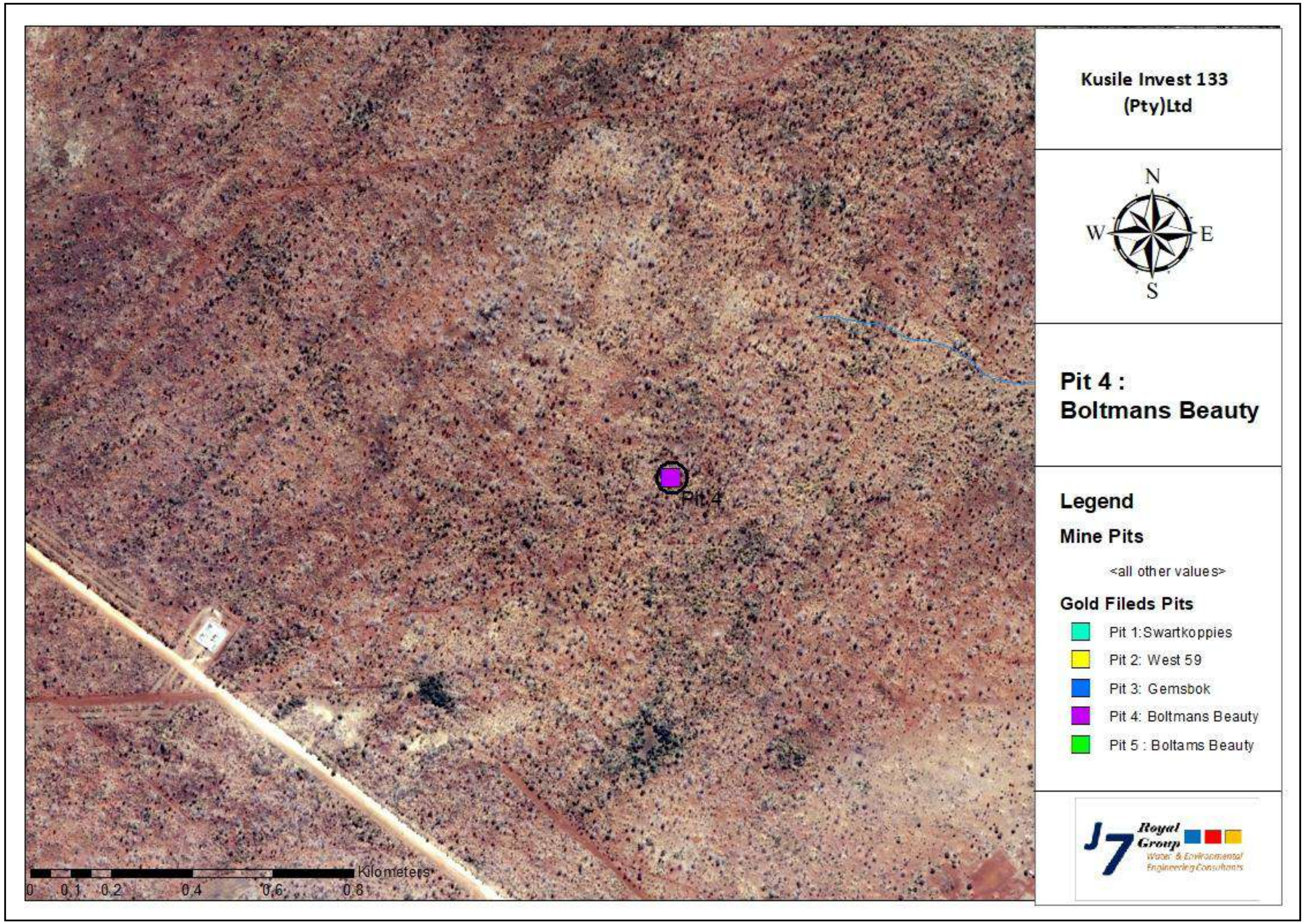


Figure 6-5 : Pit 4 Site layout (Boltmans Beauty) map

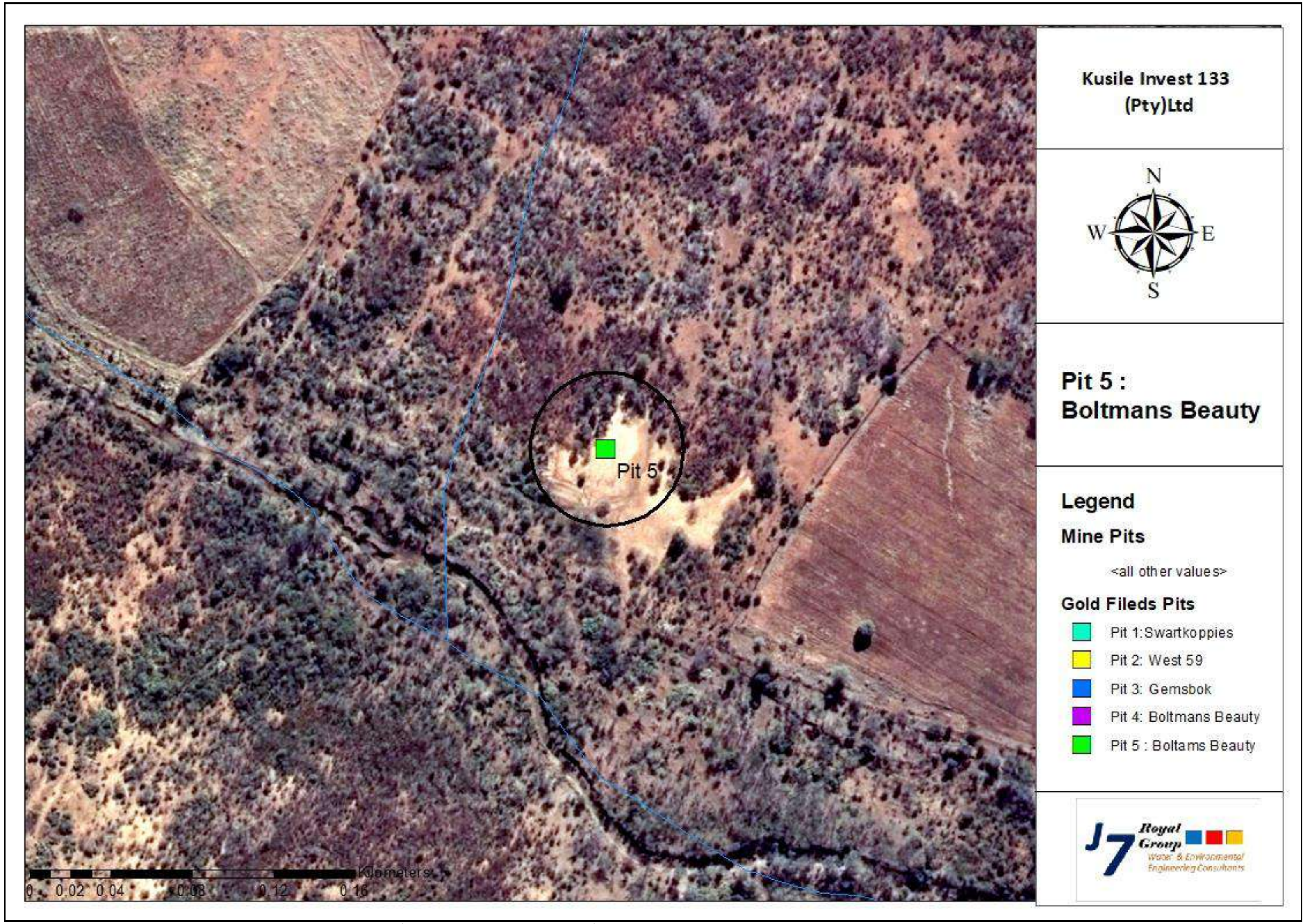


Figure 6-6 : Pit 5 Site layout map (Boltmans Beauty)

6.4 Modelling Software Selection

The modelling software selected for constructing and simulating the Kusile Invest 133 (Pty) Ltd Gold Mine model is VISUAL MODFLOW PMWIN (WEN-Hsing Chiang and Wolfgang Kinzelbach, 1998).MODFLOW was selected for construction of the model because it is a highly interactive groundwater modelling system capable of simulating flow in two or three dimensions for uncoupled, variably saturated, transient or steady state flow.

6.5 Generation of the Finite Difference Numerical Model (Model Setup)

A 2D numerical groundwater flow model was developed for the sub catchment using the modelling software MODFLOW .The model domain covers an area of 429,76km².The groundwater model was developed using 27200 rows and 28200 columns to generate a mesh that discretizes the model domain into a finite difference mesh (Figure 6-7).A regular grid space of 100m is used for each column and row. An aquifer thickness of 60m was also assumed for the model; hence this thickness will follow topography. The task is to assess the aquifer under the following conditions. Steady State, (with recharge rate):Steady state refers to an equilibrium condition whereby over long periods of time, hydrogeologic systems may achieve or approximate some non-changing conditions in which heads or concentrations do not change with further passage of time. Such systems are said to have achieved steady state. Models may deal with this in different ways. Some have "steady state" options, while others require the user to specify some long period of time and/or closure criterion beyond which changes in head are considered inconsequential.

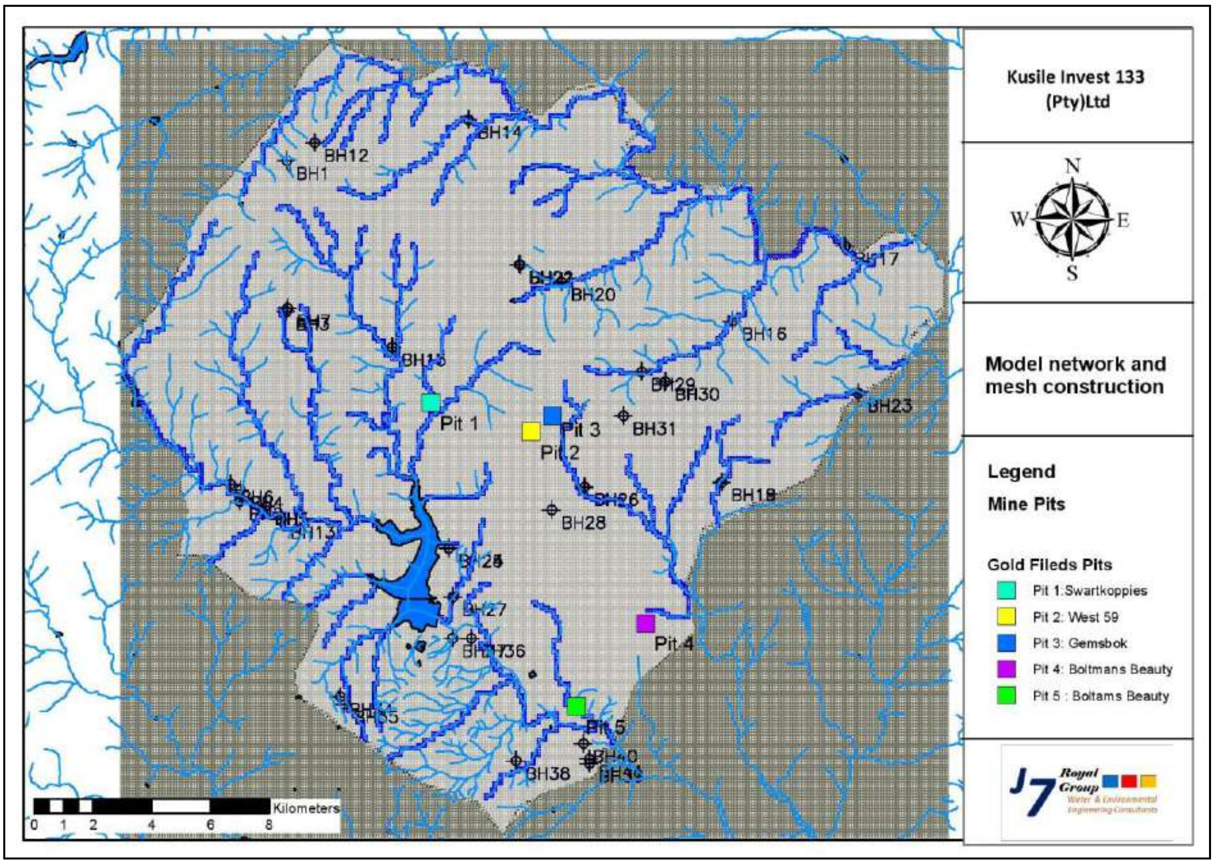


Figure 6-7 Model network and mesh construction

6.5.1 Model Limitations and Assumptions

The following assumptions were made with noted limitations:

1. The accuracy and scale of the assessment will result in deviations at specific points e.g. on the boundaries of mine layout areas however this effect is minimal and the selected mesh elements would represent the footprint of specific infrastructure.
2. For lithological units different than that of the immediate study area hydraulic parameters from literature were used for specific types of geology.
3. NGDB Data borehole data (water levels) and neighbourhood boreholes were only available around the area and the surrounding farms.
4. Sections of the model domain were therefore not thereby affecting the confidence level of the model.
5. Considering the spatial extent of the model domain and rainfall stations within the study area, rainfall data from a single station was used to represent entire study

area. Once the model was calibrated, the proposed Gold Mine were incorporated into the model by applying drains to discharge water from the aquifer system.

6. The stream was constrained such that no water leaked from the streams to the groundwater system. By constraining infiltration
7. When the modelling assumptions were made or reference values used, a conservative approach was followed such that the trend was to overestimate groundwater discharges from dewatering. This gives a worst-case scenario for designing the dewatering system and impacts to the receiving environment .It should be noted that dewatering volumes should be less than those simulated by the model.

6.5.2 Model base boundary condition

The model domain was assigned to extend vertically to a depth of 60m. It is assumed that the base of the model is impermeable.

The mine development stages were simulated as follows:

Scenario 1: Current steady state conditions and initial groundwater regime

Scenario 2: Transient dewatering from the proposed pit and zone of influence

Scenario : Transient mass plume transport

6.5.3 Scenario 1: Current steady state conditions and initial groundwater regime

The model was calibrated in steady state based on the known geological and hydraulic head distribution data for the project site. Calibration was accomplished iteratively by adjusting recharge and hydraulic conductivity values until a reasonable fit between the measured and simulated heads were obtained. The measured data consists of head elevation data from few existing boreholes around the site.

6.5.4 Model Calibration and Sensitivity Analysis

The objective of the model calibration process was to demonstrate that the model was capable of simulating hydraulic heads that match as close as possible the observed heads in Delmas proposed expansion open cast groundwater levels. The calibration process involved the continual adjustment of hydrogeological parameters including recharge, hydraulic conductivity and specific storage until the closest match between model predicted water levels and field measured water levels was obtained. Calibration was done into two (2) stages that is steady state calibration and transient state calibration. The aim of the steady state calibration was to represent the average (i.e. long term) groundwater conditions at the Kusile Invest 133 (Pty) Ltd aquifers. The resulting groundwater heads of the steady state model are used to initialise the transient groundwater models for transient calibration and predictions. The aquifer parameters and boundary conditions determined during steady sate calibration were applied to the transient state model for manual calibration. The transient state calibration satisfied an adequate match to observed groundwater levels affected by abstraction and any modifications to the model during transient calibration required a re-assessment of the steady state calibration. The numerical model was calibrated and adjusted in steady state by keeping the model complexity to minimum. The quality of the fit between simulated and observed water levels was visually evaluated based on the elevations of the simulated hydraulic heads and by means of a statistical analysis.

The three (3) statistical analysis expressions were used to indicate the errors in calibration

1) Mean Error (ME)

Mean difference between the measured and simulated water levels

2) Mean Absolute Error (MAE)

Mean of the absolute value of the differences between the measured and simulated heads

3) Root Mean Square Error (RMSE)

RMSE measures how much **error** there is between two data sets and in other words, it compares a simulated value and an measured/observed or known value. It's also known as **Root Mean Square** The Root Mean Squared Error (RMSE) is an important statistical calculation used to determine the difference between simulated values in a model and measured values from observations. If this difference is large the model is likely to be less accurate than if the difference is small; therefore, a modeller can calculate the RMSE and adjust other features until the RMSE is as small as possible to improve the model. The MAE addresses this problem by producing mean absolute values. However, the RMSE error is used most often by modellers in the industry to assess the adequacy of model calibration because the differences between observed and simulated water levels are normalized across the model domain. When the RMSE value is small, the errors are small relative to the overall water level and model response (Anderson and Woessner 1992).For this study, RMSE was used to assess the calibration of Tiara mining proposed open pit and RMSE error was evaluated as a ratio to the total water level change across the model domain.

For this simulation, the calibration indicators for the aquifers were 5,74 for the ME, 10,87 for the MAE on average and 5,97 for the RMSE. The RMSE value for the calibrated model is less than the typical range of **10%** used by most modellers as the threshold for a well calibrated model (Table 6-2).Based on this, the steady state model was determined to be adequately calibrated for use in adapting the model for predictive transient simulations to assess dewatering volumes and possible environmental impacts.

Table 6-2 : Statistical model calibration –simulated versus measured heads

No.	Component	Statistical Analysis	Observed Heads	Simulated Heads	Mean Error(m) ME	Mean ABS Error(m) MAE	Root Mean Square Error(m) RMS
1	Boreholes	**Max.**	495,17	484,53	23,72	23,72	562,70
2		**Min.**	398,73	419,74	-20,06	0,48	0,23
3		**Average**	448,84	454,59	5,74	10,87	168,59
4		**95th Percentile**	491,12	484,08	22,75	22,75	518,17
5		**5th Percentile**	399,15	422,31	-16,36	1,22	1,50
6		**Std.Dev**	27,60	19,47	11,90	7,26	178,34
7		**∑**			**137,84**	**260,86**	**4046,25**
8		**1/n**			**0,17**	**0,17**	**0,17**
10		**RMSE (Root Mean Square Error)**					**5,97**
11		**Correlation**	**0,93**				

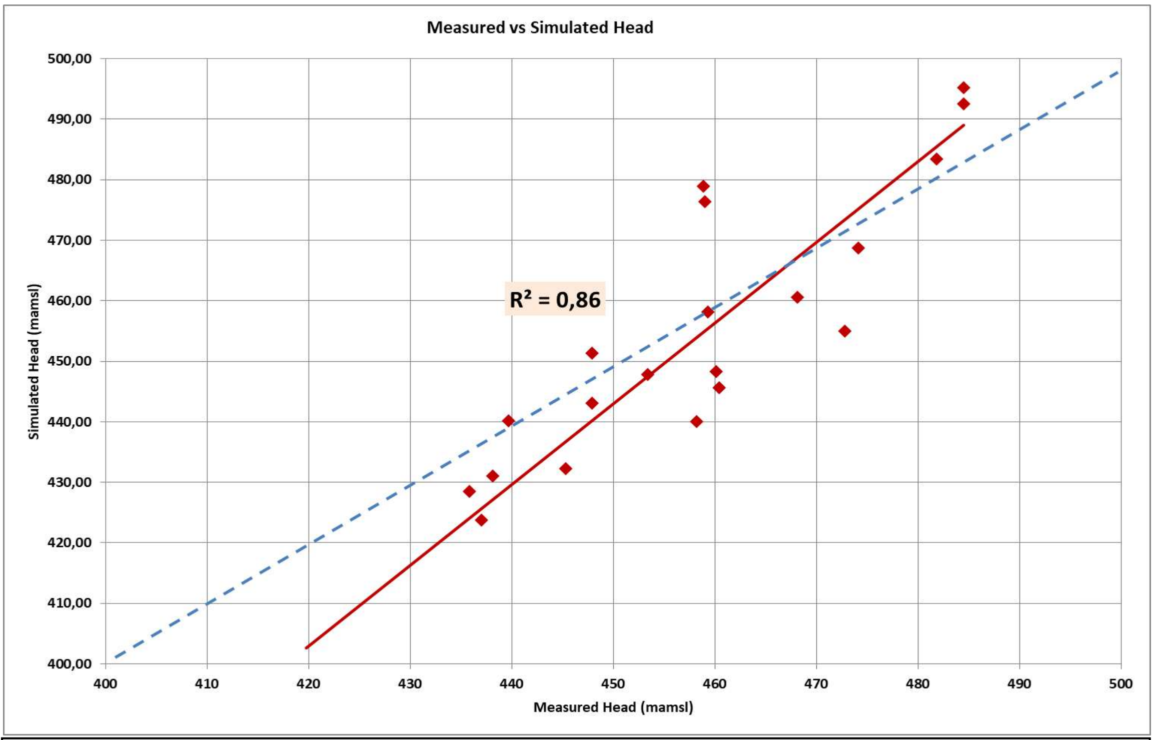
In Figure 6-8, the difference between observed and simulated heads from the calibration process is shown. A negative value indicates that the observed head is lower than the head predicted by the simulation and vice versa.

The variances are due to known and/or unknown complexity in the geological environment that is not captured in the model. Once dewatering of the hydrogeological system start, then the model will be updated to reflect the major responses in hydraulic heads. The head elevation data from hydrocensus observation boreholes were used to calibrate the steady-state flow model. The steady-state calibration of the measured and the simulated water levels resulted in an acceptable correlation of $\mathbf{R^2 = 0.86}$ for the boreholes. The model was calibrated in steady state with the parameters and the measured water levels were compared with simulated water levels to get an acceptable fit which would represent a realistic aquifer system as it might be in nature (Figure 6-8). Table 6-3 indicates the fitted data as observed at all boreholes with known water levels

A preliminary regional groundwater balance is presented for the various scenarios discussed in the previous section. There is an average of less 10 m^3/d flowing into the proposed Gold Mine Pits as defined as possible overall recharge (Table 6-3).

Table 6-3 Catchment Water Balance-Gold Dewatering

No	Component	Inflow (m^3/d)	Outflow (m^3/d)	Balance (m^3/d)
1	Catchment Recharge	2385		2385
2	Catchment Baseflow and Spring Flow		-1717	-1717
3	Mine Dewatering(LoM)			
a	Pit 1 :Swartkoppies		-180	-180
b	Pit 2: West 59		-190	-190
c	Pit 3: Gemsbok		-215	-215
d	Pit 4: Boltmans Beauty		-83	-83
e	Pit5:Boltmans Beauty			
4	**Total**	**2385**	**-2385**	**0**
5	**Imbalance (%)**			**0**



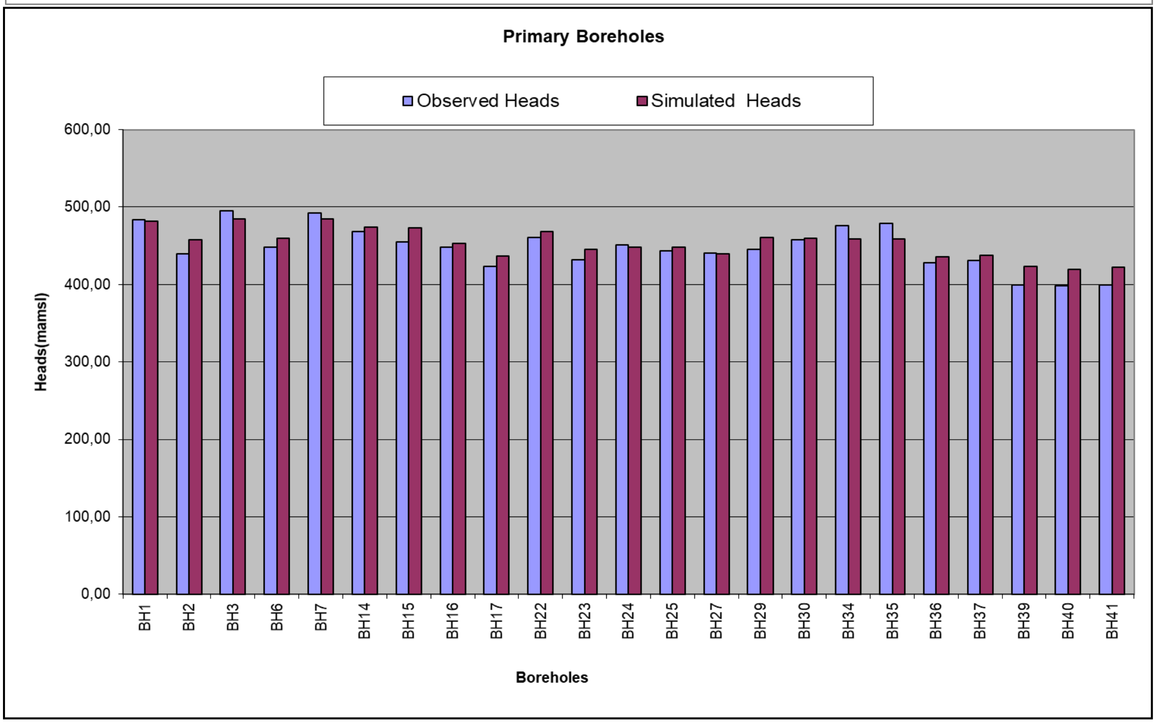


Figure 6-8 Simulated versus measured calibrated heads

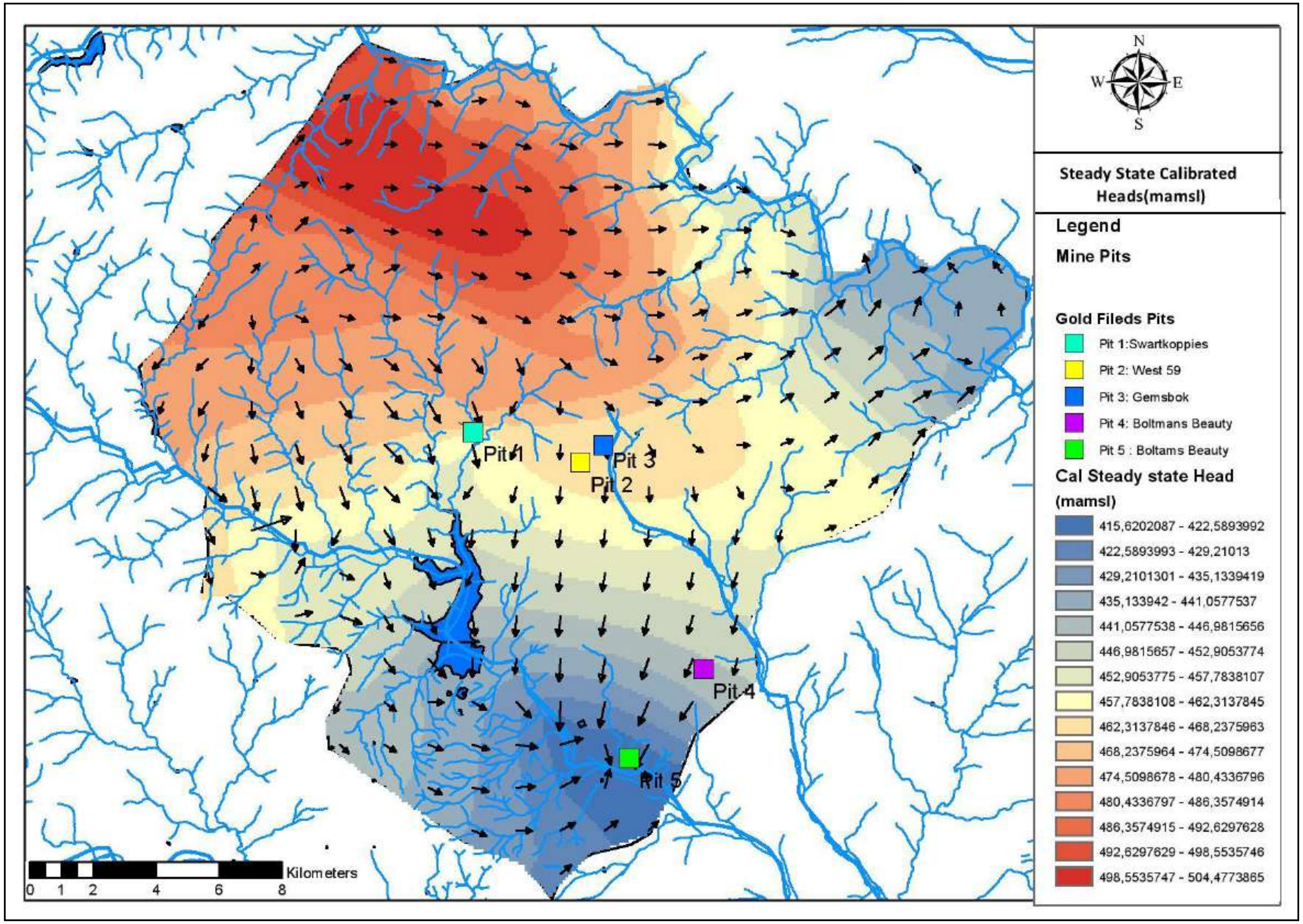


Figure 6-9 Regional steady-state piezometric heads and flow direction

6.5.5 Piezometric Heads and gradients

The piezometric heads and gradients for the calibrated model showed that the gradient and general flow follows the topography which is from north to east, via the perennial streams Nsami River and other non-perennial streams as shown in Figure 6-10.The general drainage direction is north to east direction in the study area and the groundwater drains in a northeren to eastern direction. The head constrained boundary conditions at both non-perennial and perennial streams influences groundwater to drain down gradient towards drainages.

6.5.6 Groundwater drawdown contours (Dewatering)

The level of detail provided in the mine plan was modelled as accurately as possible by dividing the model into stress periods, representing each mining strip per the mine plan .Drain cells were used to model inflows due to mining and the modelled drain elevations were set to the final pit floors and progressed through yearly increments. The LoM forecast drawdown impacts at the caused during open cast mining to a depth of 60mbgl are presented in Figure 6-10 to Figure 6-14 and cumulative impacts with respect to all five(5) proposed mines. Increases and final size in the footprint, depth and timing have indicated growth in the predicted drawdown cone resulting from the pit dewatering. The drawdown is contained within a zone of influence 1km from the centre of the mining pit and the drawdown and only small impacts are anticipated in this area.

The simulation indicated a maximum Zone of Influence (ZOI) depth located at the open pits approximately 60m in depth. The maximum lateral extent of the ZOI is approximately less than 1km from the centre positions of the pits. A cumulative impact was also considered where neighbouring mines were assumed active together the proposed mine and the impacts is still within the 1km radius of influence.

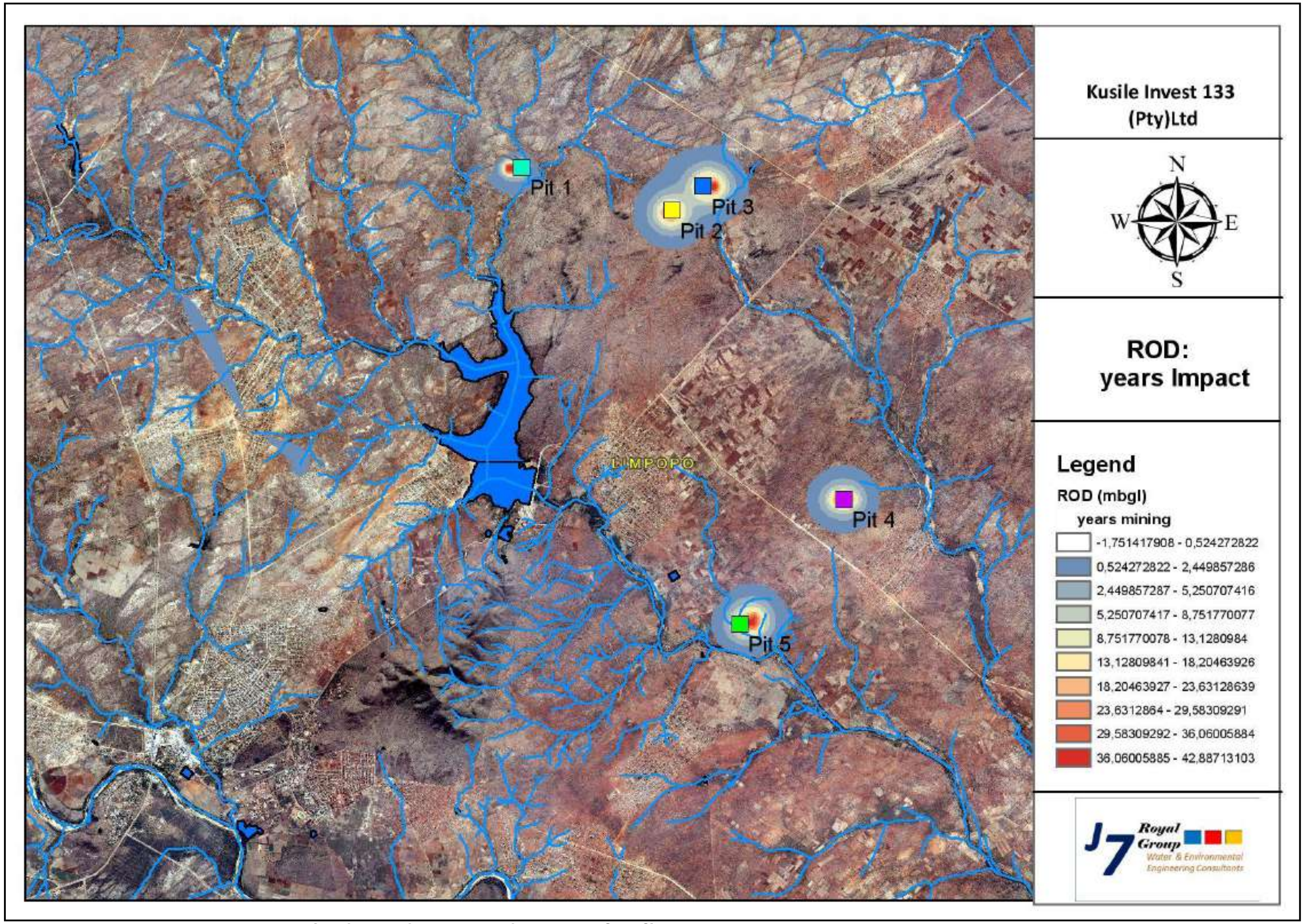


Figure 6-10 Water Levels drawdown and zone of influence

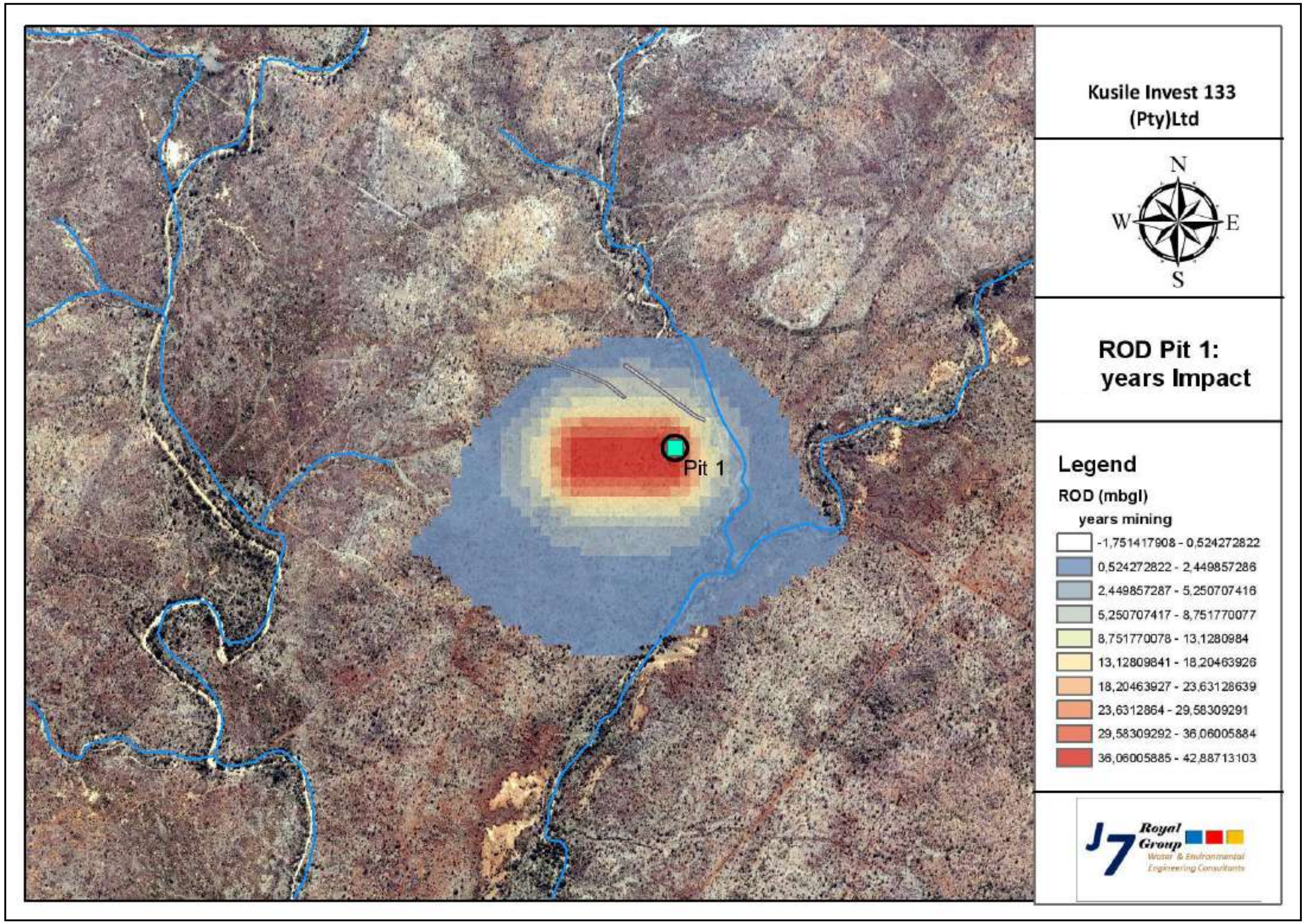


Figure 6-11 Pit 1 Water Levels drawdown and zone of influence

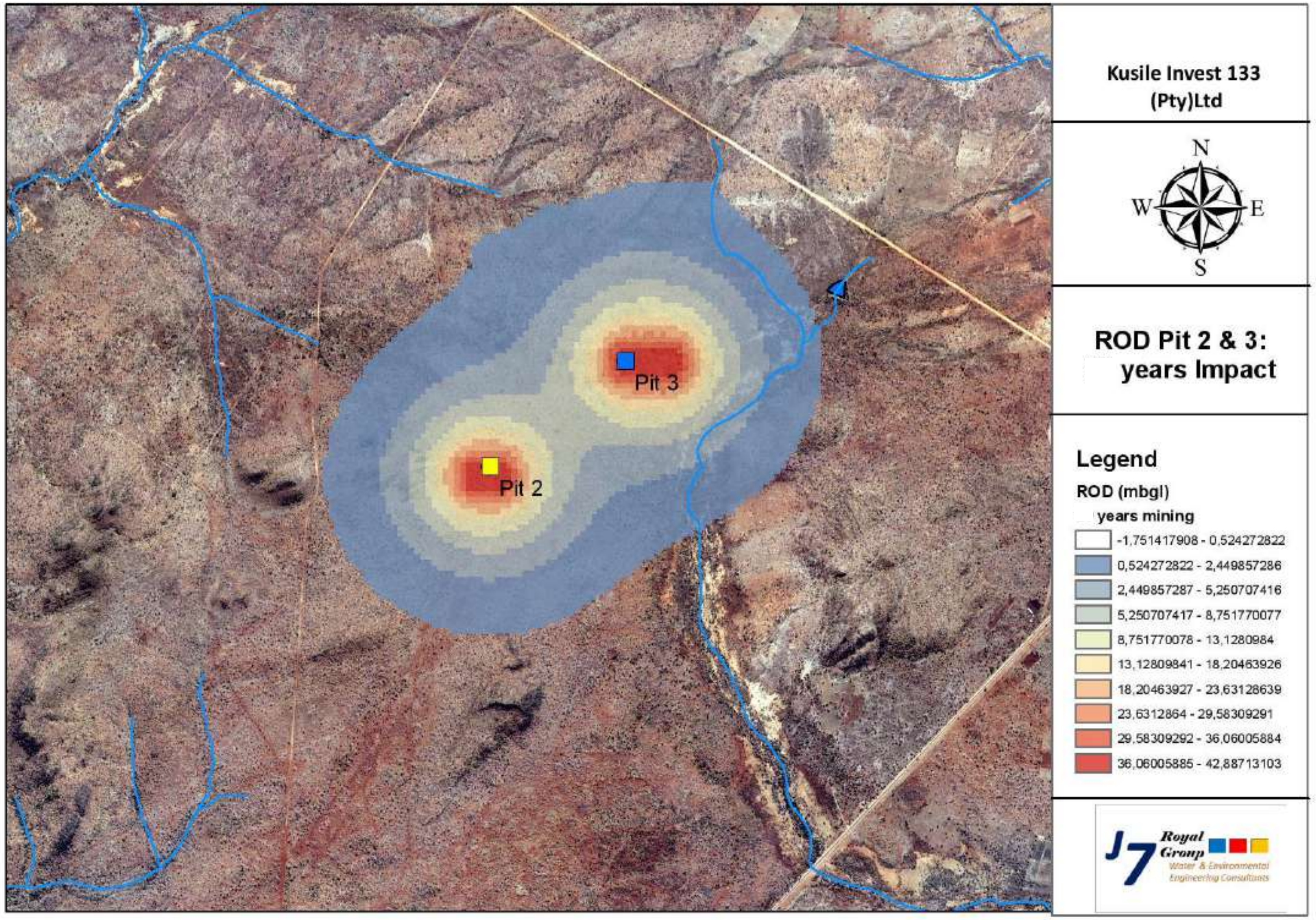


Figure 6-12 Pit 2 and Pit 3 Water Levels drawdown and zone of influence

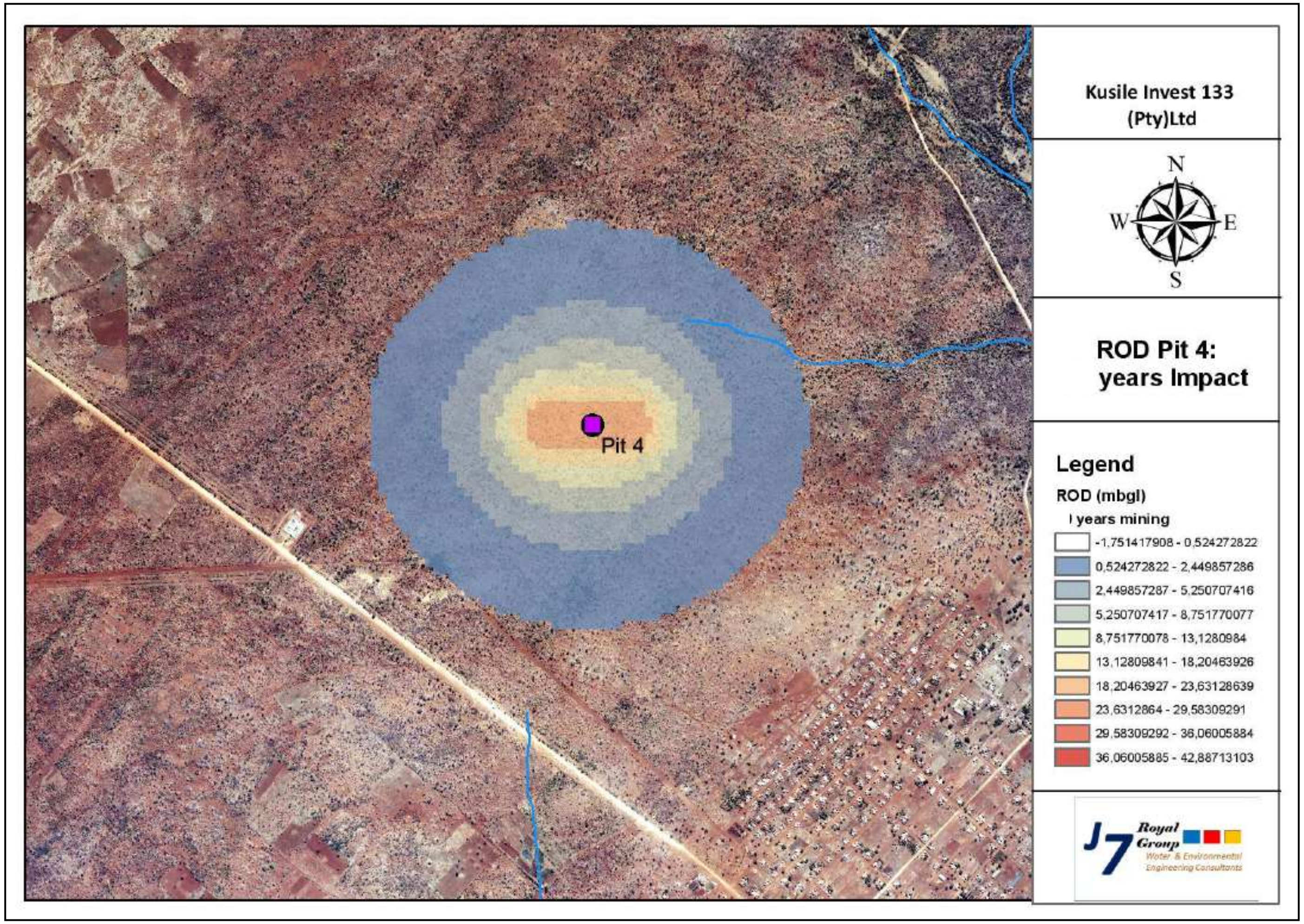


Figure 6-13 Pit 4 Water Levels drawdown and zone of influence

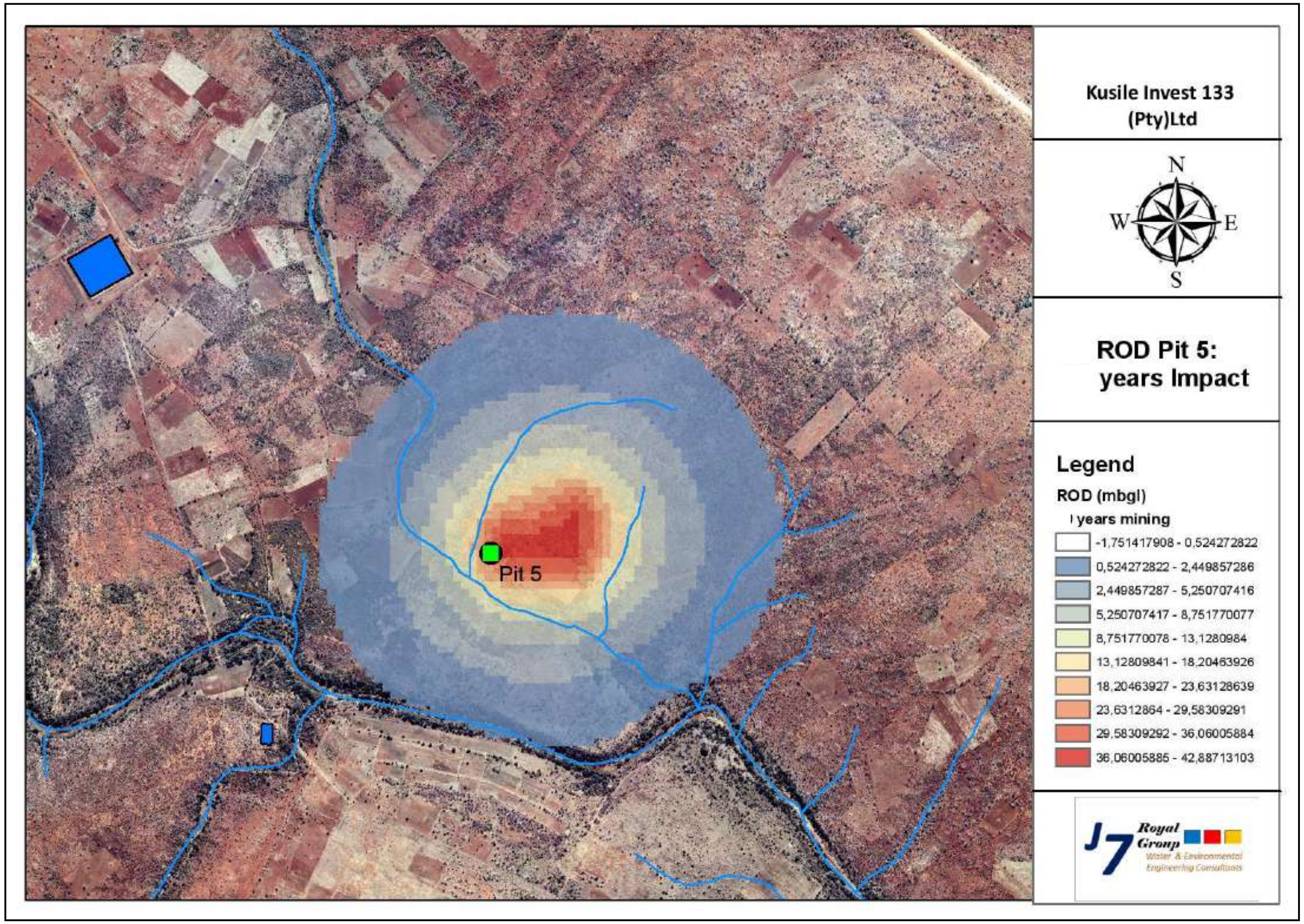


Figure 6-14 Pit 5 water Levels drawdown and zone of influence

7 Mass Transport with Simulated Dewatering

Following the potential post-operational water quality, the values quantified by UIS Laboratories was adapted and a conservative application of the data was applied with a TDS of 1160 mg/L (Table 7-1).

Table 7-1 : Tiara mine relative abundances of acid and buffer capacity

No	Variable	TDS(mg/L)	SO4(mg/L)
1	Values used in the Model	**1160**	**0**

It has been observed from the water quality analysis that TDS is identified as the main constituent from the water quality sample. Seepage concentration of 1000mg/ℓ for TDS; were observed and used for numerical simulation as the final accumulation concentration.

The mass transport model was conservatively simulated using advective transport with a regional porosity value of 2 - 3%.The background TDS concentration assigned to the regional area was 10 mg/ℓ .

The simulation results indicate a slow migration of mass from the TSF/WRD (Pit 1: Swartkoppies) and overburden stockpiles (Pit2 until Pit 5) and the following key observations:

- The TDS seepage from the TSF and overburden stockpiles is contained in the immediate facility of the rehabilitated pit,
- There is a tendency for the TDS to migrate towards the closest streams probably because of the groundwater movement directions along the drainages from the pit;
- The total migration distance towards the from TSF and overburden stockpiles is approximately 300m during the LoM and post-closure simulation. This would imply a migration rate of 0.001245m a day, without any seepage capturing methods implemented; and
- Groundwater monitoring boreholes should be drilled up gradient and down-gradient of the pit both shallow and deep boreholes to monitor the shallow and deep aquifer.
- Once monitoring data is available , numerical model must be updated

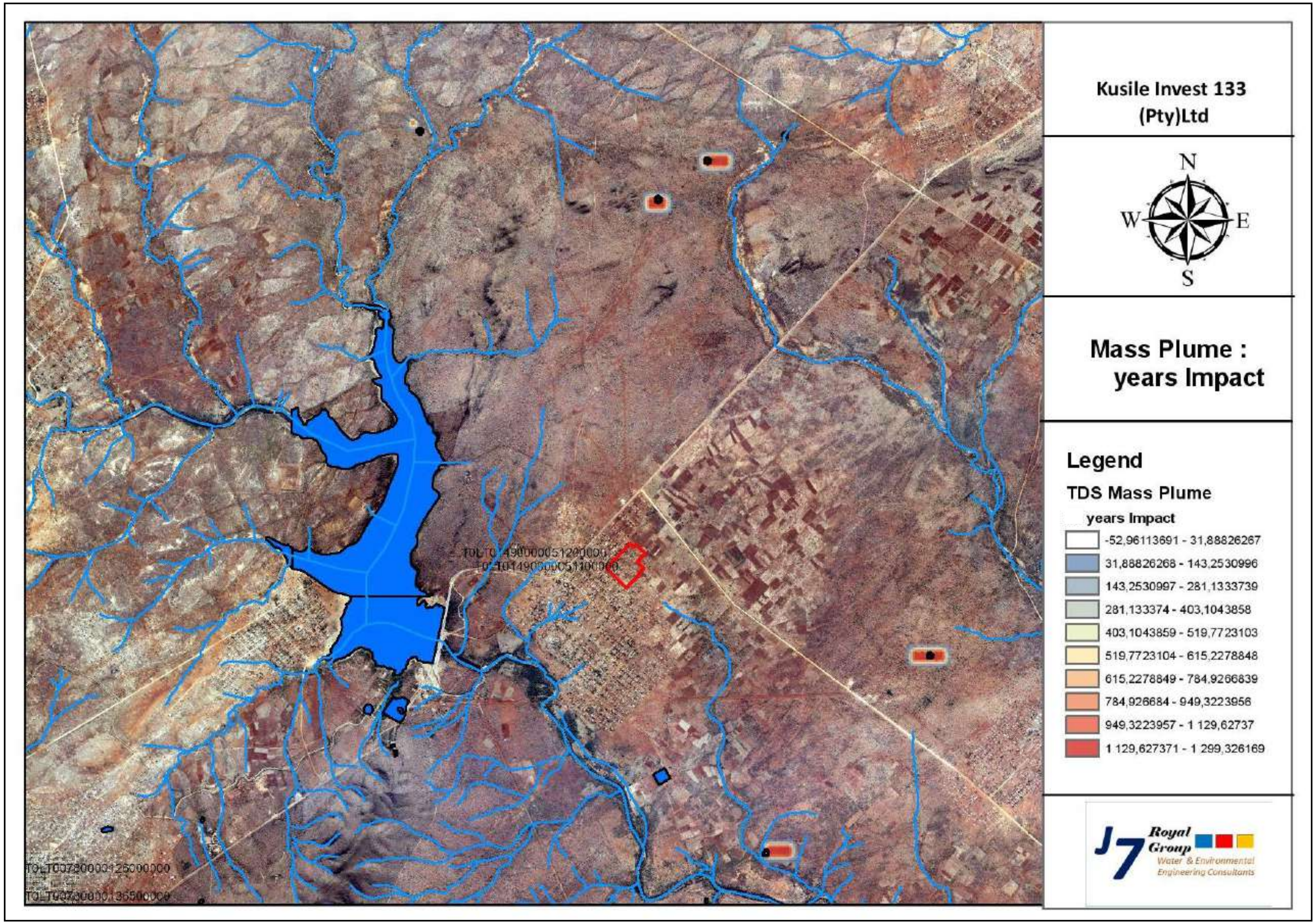


Figure 7-1 Cumulative TDS mass plume in 20 years impacts

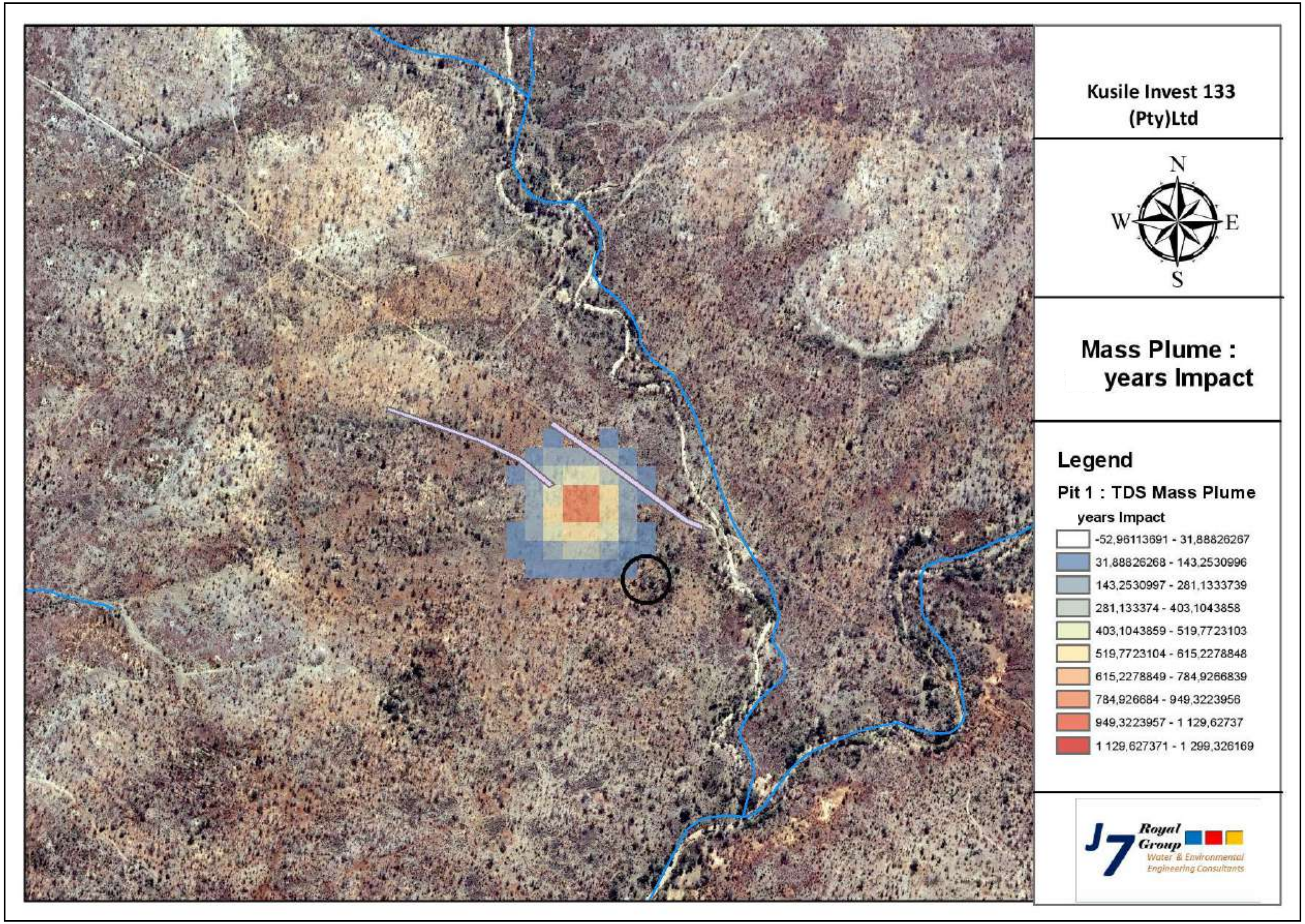


Figure 7-2 Pit 1 TDS mass plume in 20years impact

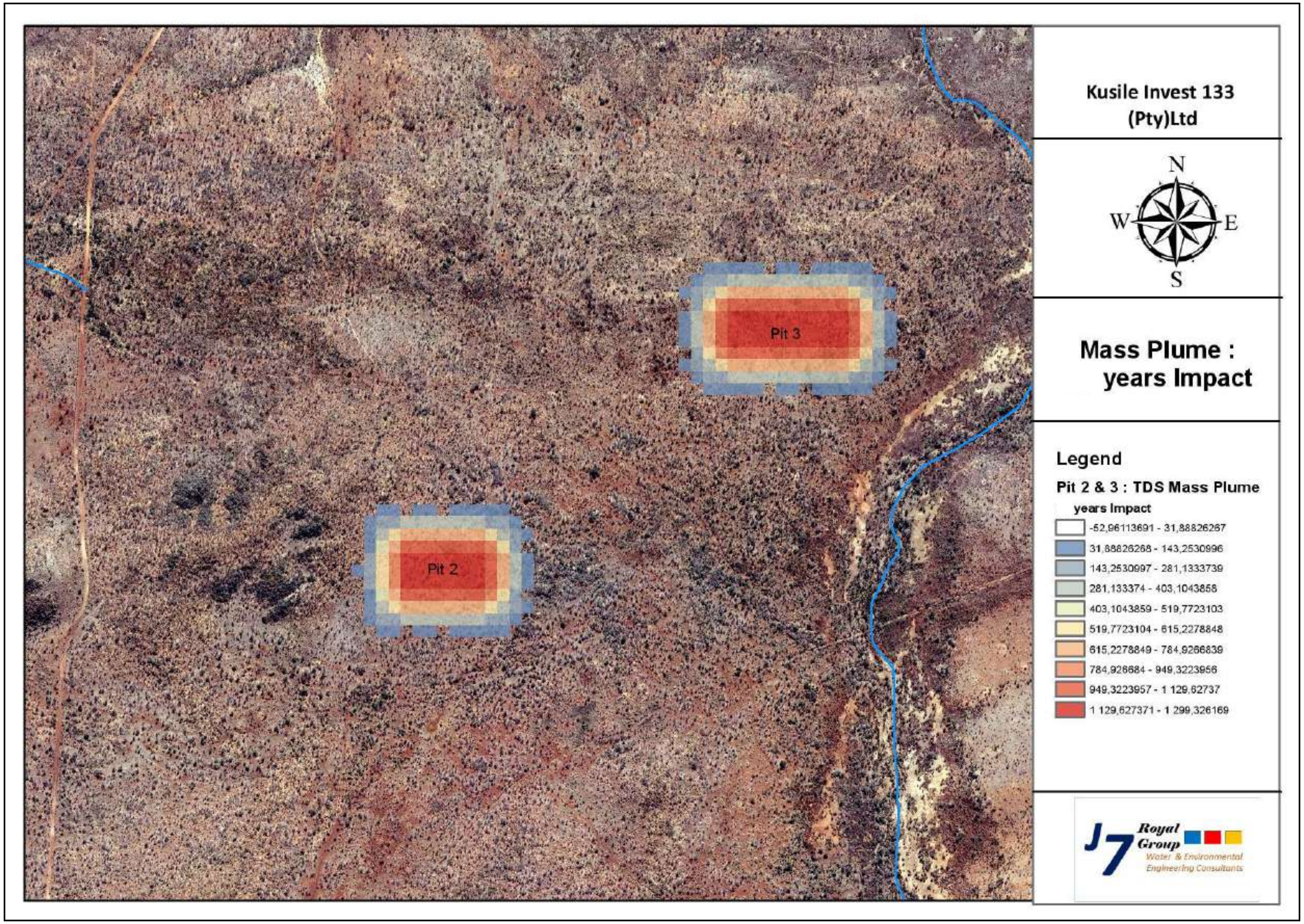


Figure 7-3 Pit 2 and Pit3 TDS mass plume in 20years impact

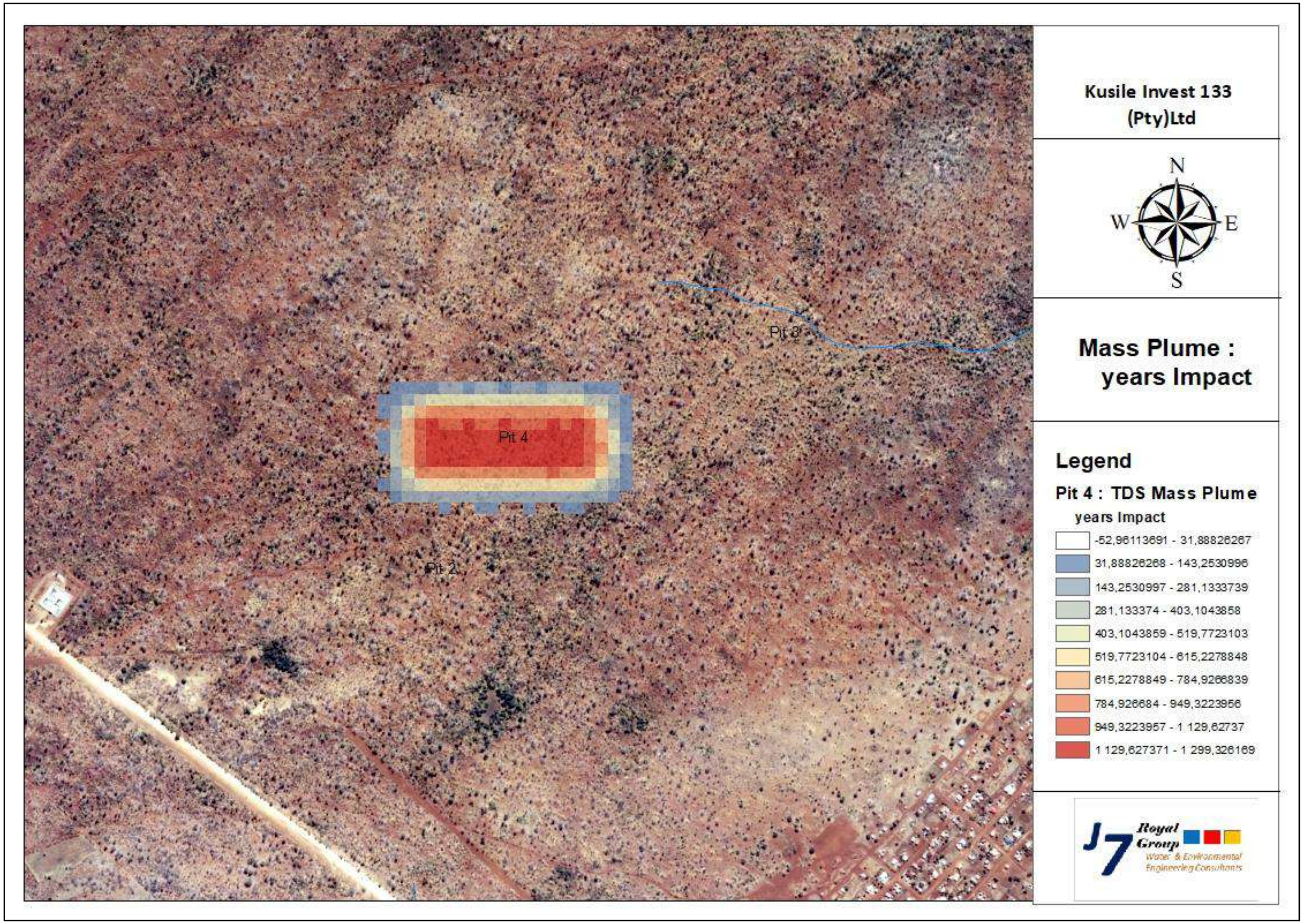


Figure 7-4 Pit 4 TDS mass plume in 20years impact

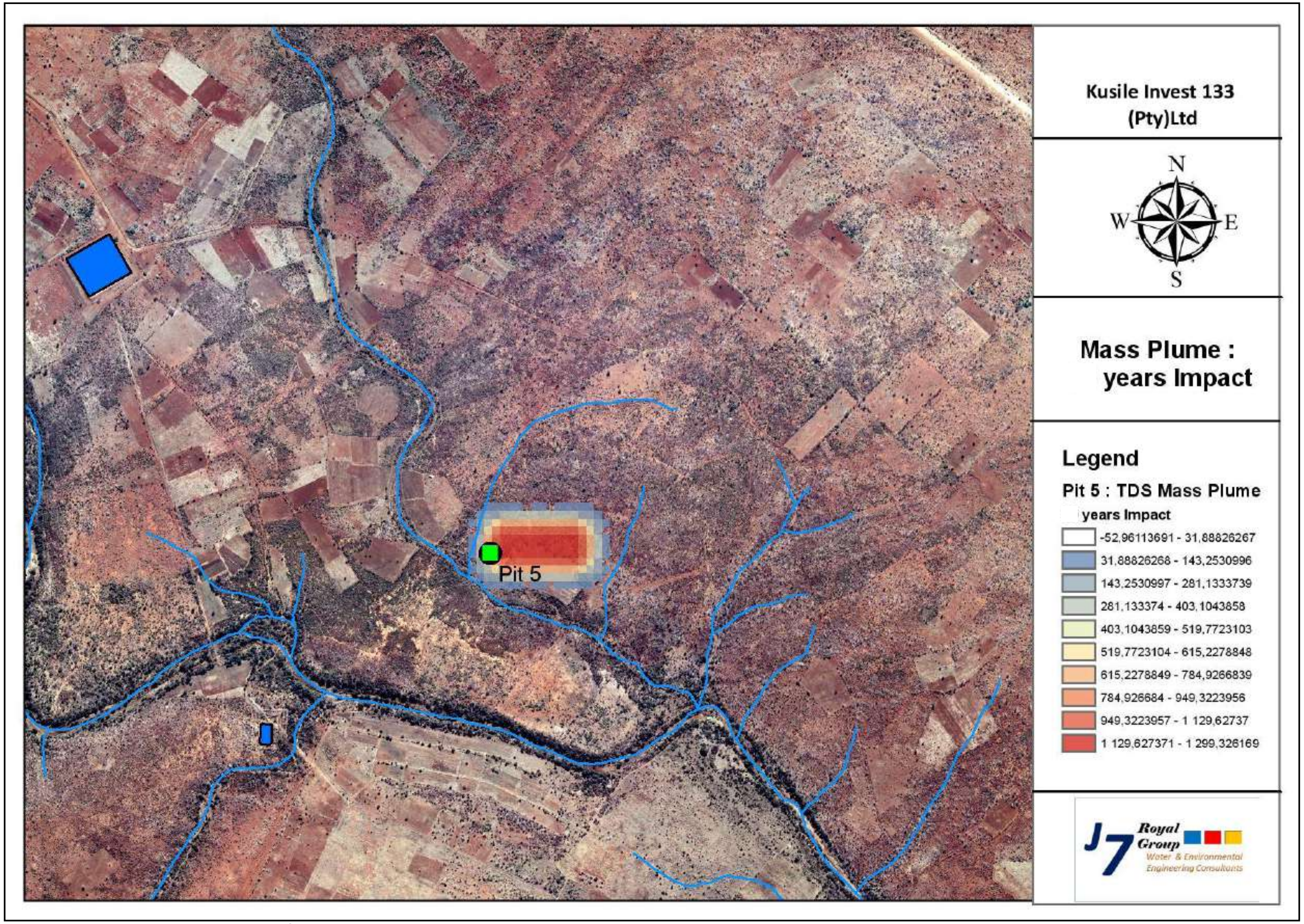


Figure 7-5 Pit 5 mass plume 20 years mining

8 Impact Assessment Methodology

8.1 Assessment Methodology

The first stage of risk/impact assessment is the identification of environmental activities aspects and impacts. This is supported by the identification of receptors and resources which allows for an understanding of the impact pathway and an assessment of the sensitivity to change? The definitions used in the impact assessment are given below:

- An **activity** is a distinct process or task undertaken by an organization for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organization;
- An **environmental** aspect is an 'element of organizations activities products and services which can interact with the environment'1. The interaction of an aspect with the environment may result in an impact;
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity for example disturbance due to noise and health effects due to poorer air quality. Receptors can comprise but are not limited to people or human-made systems such as local residents communities and social infrastructure as well as components of the biophysical environment such as aquifers flora and palaeontology. In the case where the impact is on human health or well-being this should be stated. Similarly where the receptor is not anthropogenic then it should where possible. be stipulated what the receptor is;
- **Receptors** comprise. but are not limited to people or man-made structures;
- **Resources** include components of the biophysical environment;
- **Frequency** of activity refers to how often the proposed activity will take place;
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor;
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact

(Increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards;

- Spatial scope refers to the geographical scale of the impact;
- Duration refers to the length of time over which the stressor will cause a change in the resource or receptor. The significance of the impact is then assessed by rating each variable numerically according to defined criteria as outlined in Figure 35. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15.
- The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix (Figure 8-1) and are used to determine whether mitigation is necessary.
- The assessment of significance should be undertaken twice. Initial significance is based only natural and existing mitigation measures (including built-in engineering designs).The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure and reinstatement and rehabilitation of land are considered post-mitigation.
- The model outcome of the impacts is then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 107 of 1998) in instances of uncertainty or lack of information by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations the model outcomes are adjusted.

Table 8-1 Criteria for assessing significance of impact

Criteria for assessing significance of impact

SEVERITY OF IMPACT	RATING	
Insignificant / non-harmful	1	
Small / potentially harmful	2	
Significant / slightly harmful	3	
Great / harmful	4	
Disastrous / extremely harmful	5	
SPATIAL SCOPE OF IMPACT	**RATING**	
Activity specific	1	
Mine specific (within the mine boundary)	2	
Local area (within 5 km of the Activity boundary)	3	**Consequence**
Regional	4	
National	5	
DURATION OF IMPACT	**RATING**	
One day to one month	1	
One month to one year	2	
One year to ten years	3	
Life of operation	4	
Post closure / permanent	5	

FREQUENCY OF ACTIVITY / DURATION OF	RATING	
Annually or less / low	1	
6 monthly / temporary	2	
Monthly / infrequent	3	
Weekly / life of operation / regularly / likely	4	
Daily / permanent / high	5	
		Likelihood
FREQUENCY OF IMPACT	**RATING**	
Almost never / almost impossible	1	
Very seldom / highly unlikely	2	
Infrequent / unlikely / seldom	3	
Often / regularly / likely / possible	4	
Daily / highly likely / definitely	5	

Significance Rating Matrix															
	CONSEQUENCE (Severity + Spatial Scope + Duration)														
LIKELIHOOD (Frequency of activity + Frequency of impact)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Figure 8-1 Significance rating matrix

Positive/Negative Mitigation Ratings				
Color Code	**Significance Rating**	**Value**	**Negative Impact Management Recommendation**	**Positive Impact Management Recommendation**
(red)	Very high	126-150	Improve current management	Maintain current management
(orange)	High	101-125	Improve current management	Maintain current management
(yellow)	Medium-high	76-100	Improve current management	Maintain current management
(green)	Low-medium	51-75	Maintain current management	Improve current management
(blue)	Low	26-50	Maintain current management	Improve current management
(grey)	Very low	1-25	Maintain current management	Improve current management

Figure 8-2 Positive/Negative mitigation ratings

8.2 Impact assessment

This section presents the environmental assessment for the effects of the proposed Gold mine project on groundwater resources. The information presented in this section meets the requirements of the terms of reference as well as the legislative requirements for the project and included details on:

- Components within each phase (construction. operation and closure) of the project that may influence or affect groundwater resources and/or groundwater quality;
- Impact assessment for the potential impact of the project on the groundwater system;
- Concerns that might be identified by stakeholders and regulators regarding groundwater impacts;
- Sustainability assessment for groundwater issues;

- Proposed mitigation measures to be considered during the construction. operation and closure phases of the project to minimize groundwater-related effects; and
- The monitoring program that will be used to identify and monitor project impacts on groundwater levels and quality.

This section also considers potential positive environmental impacts or opportunities that the proposed project will bring in the area. Given the location of the project specific emphasis was placed on the relevant environmental social and economic impacts that might be raised by the stakeholders. The identification of the significant potential impacts was guided by the professional judgement of the hydrogeological and EAP team.

The objectives of the specialist studies and further investigation by J7 Royals Group of each of the potential environmental impacts identified was to determine their significance and to promote mitigation measures to reduce the impacts to an acceptable level where required.

Each of the identified impacts was assessed in a separate section. Considering the general nature of the proposed project each section will take cognisance of the construction operational and closure phases as well as the different alternatives where possible. This is intended to:

- Allow the comparison of the various alternatives of the proposed project facilitate the comparison of the alternatives and to identify the preferred alternative during the decision making process.
- Enable stakeholders to understand the potential impact of the project in their specific area. All potential environmental impacts have been addressed in this section. according to the adopted methodology for assessing impacts as described in Section 8 and the impacts presented in Table 8-3.

Table 8-2 Impact Assessment

0POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES/ REMARKS	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION						
	Se	Sp	Du	Fa	Fi	Total	SP		Se	Sp	Du	Fa	Fi	Total	SP
Construction and Operation Phase Impacts															
Site construction and grading could cause changes in runoff and infiltration that could reduce groundwater recharge	2	1	4	1	3	28	Low(-)	Construction stage will be planned to minimise the removal of vegetation and opportunities for revegetation will be maximised.	1	1	4	1	2	18	Very Low (-)
Fuel & hydrocarbons leakages and spillages from the storage and transporting vehicles may cause groundwater contamination	2	1	4	1	3	28	Low (-)	All storage areas containing hazardous materials will have secondary containments capable of containing the volume of the largest tank or container plus 10%. Resort to immediate clean-up after accidental spillages. Divert run-off from haul roads that may contain hydrocarbons into lined pollution control dams	1	1	4	1	2	18	Very Low (-)
Open cast mining below the water table will result in pit inflows	2	2	4	4	4	64	Low Medium (-)	Pit inflows cannot be mitigated (required to enable a safe work environment). Provision needs to be made within the mine water balance for the reuse or treatment of pit inflows. In case the water should be discharged, treatment will be required before discharge	2	2	4	4	4	64	Low Medium (-)
Mine dewatering and groundwater abstraction for water supply purposes could reduce groundwater levels in the area	3	3	4	4	4	80	Med High (-)	Pit dewatering will cause a cone of drawdown which will less affect the neighbouring farms. The extent of the zone of influence will not extend beyond 1 km and the maximum drawdown in the affected areas will range between 1 and 15 m, thereby not expected to impact on the yields of any supply boreholes around the mining area. Possible mitigation against such an impact is temporary water supply by the mine	2	2	3	4	4	56	Low Medium (-)
Increased potential for groundwater contamination due to seepages from the overburden stockpiles	1	1	2	2	2	16	Very Low (-)	Compact footprint area of the overburden stockpiles to minimize groundwater infiltration. Stormwater run-off from the overburden stockpiles will be diverted into dirty water dams. A groundwater resources monitoring program will be implemented during to detect the groundwater contamination	1	1	2	2	2	16	Very Low (-)
Water contained in dirty water dams may impact on groundwater quality	2	1	4	4	4	56	Low Med (-)	Pollution control dams need to be lined and designed to comply with NEMA and NWA requirements (Act 36 of 1998). Manage any leakages and spills to prevent groundwater contamination. Implement groundwater monitoring to detect groundwater contamination	1	1	1	1	2	6	Very Low (-)
Post Closure Impacts															
Possible Salt Load contribution towards Nsami Dam /Streams or other streams	1	1	2	2	2	16	Very Low (-)	The dominant direction of migration of contaminants from the surface facilities will be towards the pits and any nearby streams won't be affected.	1	1	1	1	2	6	Very Low (-)
Aquifer contamination caused by backfill	4	3	5	5	4	108	High (-)	Pollution plume migration will be towards the mine pits and around the stockpiles areas and the plume won't affect the nearby farms. The final backfilled opencast topography should be engineered in such that runoff is diverted away from the opencast area.	3	3	5	5	4	99	Med High (-)
Rebound water levels within backfill material may cause decant	1	2	1	1	2	12	Very Low (-)	The water level will rebound but unlikely that it will decant, however, two of the three potential decant positions are located within the mining area. In case there is decant, an impermeable layer can be applied below the topsoil cover, which will need to be compacted to prevent the ingress of water. Install water monitoring boreholes closer to the decant points to monitor the water level and water quality.	1	1	1	1	2	6	Very Low (-)

9 Monitoring Programme

- Drilling of monitoring boreholes up-gradient and down-gradient of the operations. Baseline water level measurements and water quality assessments must be undertaken before commencement with the operations.
- Use monitoring programme to confirm/validate the predicted impacts on groundwater availability and quality during and after mine closure.
- The groundwater monitoring must include up-gradient and down-gradient boreholes, as well as water quality variables/parameters in the baseline assessment herein (section 4 and 9). Mineral elements associated with the geological formations may also be included.
- The Pollution Control Dam (PCD) must be designed, once the depth of the proposed pits is beyond 30mbgl to comply with regulations in Government Notice 704 of 1999 in regard to locality, capacity, protection of water quality and other requirements. The PCD and the entire storm water management measures for the mine should also prevent drainage of silt-laden run-off from the site.

10 Results and Discussion

The following conclusions were derived from the results of this investigations:

Surface water and catchment:

The study area is located in the Luvuvhu/Letaba Water Management area and falls within B82H quaternary catchments and is within drainage region and can be sub-divided into secondary drainage regions comprised of smaller catchment areas and streams. The surface topography is mainly consisting of a gently undulating plateau. Tributaries and streams of the Nsami River have their origin in this area. The drainage forms a dendritic pattern flowing north and north-east. The closest water resource is Nsami Dam which was planned to supply only agriculture water, but recently, most water to Giyani is from Nsami Dam for water supply. The proposed mine Pit 1, Pit 2 and Pit 3 are on the upper side of the Nsami Dam. The mine make-up water requirement will be sourced from the boreholes can also be sourced from existing water use entitlements within the surrounding privately owned farms.

Hydrocensus and groundwater use:

Historical boreholes data surveyed before were used to determine the groundwater potential of the area(DWS,NGDB Data) and the surveyed borehole data consists of one(1) water supply borehole in Pit 1 Mine (Swartkoppies) .This borehole is equipped and in use for processing plant and drinking.

Water Quality

The hydrochemistry of the water sources sampled can in overall be regarded as good as stipulated by the SANS 241:2015 standards. The groundwater from the sampled boreholes is neutral to slightly alkaline with pH ranging between 6.7 and 7.20.

The pH values are consistent remaining in the neutral to slightly alkaline range. The water quality is within the limits stipulated the SANS 241-1:2015 standard. TDS is main issues as it quite high above SANS 241-1:2015 Drinking water standard.

- From the piper diagram analysis indicates that the following boreholes (KUBH1), shows Ca-Mg-SO4 waters typical of Domestic waste dumps/Natural saline waters –indicative of high levels of TDS

Water levels:

Considerable site of this area is categorised as rural, tradition and usage of groundwater is high for most of the undertakings on the area and boreholes yields ranges between 0.2 to 0.5 ℓ/s for domestic supply, gardening and small scale industrial use. The area is mostly farming and agricultural with surrounding villages and old mines. The water levels in the area ranges between 37 to 70 meters below ground levels (mbgl).The site is underlain by an inter-granular and fractured aquifer system and can be classified as a minor aquifer according to the South African Aquifer System Management Classification (Parsons, 1995).

Groundwater modelling:

Piezometric heads and gradients: The piezometric head follows the topographic gradient and they are from south to north directions draining into perennial and non-perennial streams.

Groundwater modelling: Prospective case was simulated to determine the effectiveness of management and mitigation options:

- The model indicated that the groundwater recharge over the entire model domain is in the range of 2385 m^3/d
- No dewatering for the pits is anticipated (Mine depth ≈ 25 mbgl) as current case on site;
- Dewatering of the pit ranges (Mine Depth ≈ 60 mbgl) between 100-300m^3/d for the first three (3) months and then 100m^3/d LoM.

Drawdown due to mining operation

The predicted drawdown cones created by mining were determined during numerical modelling and the predicted monitoring borehole groundwater levels over time are illustrated in this report including the simulated hydraulic heads at end of mining and their groundwater level trends after mine closure.

Key aspects of the groundwater flow regime during and after mining are as follows:

- The severity of groundwater drawdown on groundwater users will depend on the distance between the groundwater user and the pits. Higher drawdowns will be experienced by groundwater users closer to the pit. In the proposed pit expansion, the deeper the floor is compared to the pre-mining groundwater levels the higher the drawdown will be;

- The mining will progress with concurrent rehabilitation and according to the mine plan; a maximum drawdown of 60 mbgl is predicted;
- The maximum lateral extent of the ZOI is approximately less than 1km from the centre positions of the pits. A cumulative impact was also considered where neighbouring mines were assumed active together the proposed mine and the impacts is still within the 1km radius of influence.
- The Pollution Control Dam (PCD) must be designed, once the depth of the proposed pits is beyond 30mbgl to comply with regulations in Government Notice 704 of 1999 in regard to locality, capacity, protection of water quality and other requirements. The PCD and the entire storm water management measures for the mine should also prevent drainage of silt-laden run-off from the site

11 Recommendations

The following actions are to be implemented:

- Drill monitoring boreholes up-gradient to lower gradient before operations starts, measure the water levels ; and
- Use monitoring programme to confirm/validate the predicted impacts on groundwater availability and quality during and after mine closure.
- Water levels in the surrounding boreholes must be measured on a monthly basis before and after mining commenced.
- Water levels in boreholes up to 1 km from the mine must be monitored on a monthly basis before and after mining activities commenced to determine the decrease in water level.
- Data must be used to update the numerical groundwater model
- The monitoring protocol and mitigation measures should be adhered to. The monitoring programme must include all the metal ions above total concentration threshold zero.
- Flow meters should be installed to obtain legal water supply and water use information.

12 References

1. Anderson, M.P. and Woessner, W.W., 1992. Applied Groundwater Modelling. Academic Press, Inc., San Diego, CA., 381 p.
2. Barnard, H. C., 2000. An explanation of the 1:500 000 general Hydrogeological Map. Johannesburg 2526.
3. Council of Geoscience geological map sheet and topographical map sheet 2528CC (1:250 000 and 1:50 000).
4. Department of Water Affairs and Forestry Directorate: National Water Resource Planning. 2004. Internal Strategic Perspective: Crocodile (West) and Marico Water Management Area.
5. Freeze, R. Allan, and John A. Cherry. 1979. Groundwater. Prentice Hall Inc., New Jersey.
6. Google Earth, 2017. 6.0.12032 Beta.
7. JR Vegter, DWS and WRC, 1995. Groundwater Resources of the Republic of South Africa.
8. Spitz, K. and Moreno, J., 1996. A Practical Guide to Groundwater and Solute Transport Modelling. A Wiley-Inter-science publication.
9. Umhlaba Environmental Consulting CC, 2018. Bundu Mining (Pty) Ltd Application for the expansion of an existing Mining Right & associated Waste Management License BID.s
10. WESST Consulting (Pty) Ltd,2018.Bundu Mining (Pty) Ltd Mining Right Expansion Activities Hydrogeological Impact Statement

ANNEXURE 3 - STORMWATER MANAGEMENT PLAN

GIYANI GOLD MINE STORMWATER MANAGEMENT DESIGN REPORT

Prepared for Kusile Invest 133 (Pty) Ltd
April 2021

SISIMO GROUP
BRIDGING THE INFRASTRUCTURE GAP

Office 45A, 1st floor, Vaalgate Shopping Centre
Cnr Attie Fourie and DF Malan Street
Vanderbijlpark, Gauteng, 1911
Cell: +27 (0) 74 159 3500
Tel.:+27 (0) 16 931 0355

Contents

Date issued	Approved by	
16/04/2021	Tendai Nezandonyi PrEng	

1 Introduction

Kusile Invest 133 (Pvy) Ltd is intends to establish a gold mine on an unsurveyed state land of the Greater Giyani 891 LT and a portion of potion 0 of the farm 246 located in Giyani, Limpopo province. The mine development will involve the establishment and installation of various mine infrastructure starting with the pit followed by shaft headgear and winders, service water, compressed air and power supply, a processing plant and appropriate ventilation. The gold mining will be carried out initially using opencast method which will be further developed for underground mining. The estimated life of the mine is 30 years at an estimated production rate of 12 00 ton per month.

Mining operations in this area will generate waste which needs to be handled or disposed in an environmentally suitable manner. There is also need to contain, dispose or use stormwater generated during precipitation events or water collected in the working opencast pits. There is therefore a need for a proper stormwater management plan and design for the mining area to achieve a suitable safe mining working area. This will also help to protect people, infrastructure, fauna and flora on the areas within or adjacent to the mining area or downstream of the mining area. Achievement of these targets ensures that the mining works comply with the required local and national legislation that applies to mining areas.

2 Locality

The proposed mine is located on unsurveyed state land of the Greater Giyani 891 LT and a portion of potion 0 of the farm 246 located in Giyani, Limpopo province (Appendix B). This is about 10 km north-east of Giyani town and approximately 140 km north-east of Polokwane. The total spatial extent of these properties is approximately 13894 hectares. The actual mining area is estimated at 1000 hectares with about 150 hectares set aside for supporting infrastructure.

3 Data/Information Requested

The following data was requested for:

i) Topographical Survey
ii) Geotechnical Report
iii) Hydrological data
iv) Geo-hydrological data
v) EMPR or EIAR
vi) DWAF Legislative documents
vii) Any other information that would be relevant.

4 Data/Information Received To Date

i) An electronic copy of the Topographical Survey was obtained from the Client.
ii) Geo-hydrological Assessment Report.
iii) Mining Work Programme

5 Scope of Proposed Stormwater Infrastructure

Stormwater drainage infrastructure was sized to accommodate a 24 hour 1:50 year peak flood flow and volume generated over various parts of the mine area of 1000 ha. The capacity of Pollution control dams was also checked for adequacy in containing 24 hour 1:100 peak flood flow. The proposed infrastructure will be as follows:

i) Pollution Control Dam (PCD) – Containing dirty stormwater runoff generated the plant area and adjacent areas enclosed by the dirty stormwater berm.
ii) Return Water Dam (RWD) - containing water from slurry/ slimes dam meant for re-use in the processing plant.
iii) Lined drains – these will be conveying all dirty stormwater to dirty water PCD.
iv) Unlined drains – these will be conveying clean stormwater in order to drain it to the surrounding natural ground.
v) Diversion earth berms – These will be used to separate sources of clean and dirty areas.
vi) Culverts – convey water under haul roads

6 Waste Characterisation and Classification

6.1 Stormwater runoff characterisation

The stormwater runoff generated from the mining area is generally characterised as dirty. Stormwater which has not reached the mining area is considered to be clean water

6.2 Stormwater runoff classification

Waste generated on the mine was group for waste classification in terms of the National Environmental Management: Waste Act, 2008 (**Act No. 58 of 2008**), **Regulation 36784 of 2013** and the **SANS 10234:2008**.The storm water runoff from open cast mine site, soft and hards stockpiles are given in the table below.

Samples	Waste Classification	Waste Type	Waste containment barrier class
Open Cast	Non-Hazardous	Type 3 Waste	Class C
ROM stockpile	Non-Hazardous	Type 3 Waste	Class C
Tailings Dam	Non-Hazardous	Type 3 Waste	Class C
Waste Rock Dump	Non-Hazardous	Type 3 Waste	Class C
Hards stockpile	Non-Hazardous	Type 3 Waste	Class C
Overburden / Topsoil stockpile	Non-hazardous – No contamination	Type 4 Waste	Class D

7 Design of stormwater infrastructure

7.1 Design of Main PCD

PCD collects dirty stormwater runoff generated from the catchment as shown in the appendices.

Conservative capacity of PCD 1 was calculated as follows:

PCD 1 Capacity = Gross Mean Monthly Runoff from PCD catchment + 1:50 peak flood flow

The evaporation rate of the mining area is generally higher than the volume of rainfall received every month. Hence it is assumed gross mean monthly runoff will be lost due to evaporation.

Mean Annual Runoff was obtained as 14.3 mm from runoff data for the quaternary catchment B82H in the Limpopo basin. Gross Mean Annual Runoff is the total runoff obtained from PCD catchment and is calculated as:

$$GMAR = Catchment\ Area\ (km^2) \times MAR\ (mm^2) \times 10^3,\ m^3$$

It is assumed that the stormwater carries about 3% of solids and an allowance for the loss in volume due to siltation will be done.

Peak flood volume was determined from peak flood flow obtained using the deterministic hydrological formula, the Rational Method given below: The method was used to determine the 24 hour 1:50 year flood from catchment covering North-West top region of the site (see Appendices).

Q = CIA as given in the appendix A

A 24 hour 1:50 year peak flood volume was calculated as **5 440 m^3**.

Total design **PCD** capacity provided is **6500 m^3**.

Although the dam is designed for a **1:50** year flood event the capacity provided can also contain a **1:100** year flood.

The **PCD** will be lined with a modified **CLASS C** lining as per **Regulation 36784**, a composite of HDPE and clay material so as to avoid exchange of flows between the dam and the environment. The **design life** of the **HDPE** lining is assumed at **20 years.** The liner is also protected from direct sunlight along the slopes by means of a **Geo-cell** filled with cement stabilised sand. The lining specifications must also satisfy the **GRI-GM 13.** The use and application of the HDPE lining must comply with **SANS 1526:2003** while the installation adheres to **SANS 10409:2004.**

The PCD allows for a 2 m unsaturated zone as geohydrological report that the shallow aquifer is at a depth between 4 – 12 metres. The PCD is also located more than 100 metres from the nearest non perennial stream.

7.2 Design of Return Water Dam

PCD collects dirty stormwater runoff generated from the Tailings Storage Facility (TSF) and the water drained from the slurry from the plant.

Conservative capacity of the RWD was calculated as follows:

RWD Capacity = Gross Mean Monthly Runoff from RWD catchment + 1:50 peak flood flow + Inflow from plant

The evaporation rate of the mining area is generally higher than the volume of rainfall received every month. Hence it is assumed gross mean monthly runoff will be lost due to evaporation.

Mean Annual Runoff was obtained as 14.3 mm from runoff data for the quaternary catchment B82H in the Limpopo basin. Gross Mean Annual Runoff is the total runoff obtained from PCD catchment and is calculated as:

$$GMAR = Catchment\ Area\ (km^2)\ x\ MAR\ (mm^2)\ x\ 10^3,\ m^3$$

It is assumed that the stormwater carries about 3% of solids and an allowance for the loss in volume due to siltation will be done.

Peak flood volume was determined from peak flood flow obtained using the deterministic hydrological formula, the Rational Method given below: The method was used to determine the 24 hour 1:50 year flood from catchment covering total TSF footprint (see Appendices).

Q = CIA as given in the appendix A

A 24 hour 1:50 year peak flood volume was calculated as **2 270 m^3**.

Total design **RWD** capacity provided is **3 000m^3** , which also caters for water which is extracted from the **RWD** for reuse in the plant (see Water balance - Appendices).

Although the dam is designed for a **1:50** year flood event the capacity provided can also contain a **1:100** year flood.

The **RWD** will be lined with a modified **CLASS C** lining as per **Regulation 36784**, a composite of HDPE and clay material so as to avoid exchange of flows between the dam and the environment. The **design life** of the **HDPE** lining is assumed at **20 years.** The liner is also protected from direct sunlight along the slopes by means of a **Geo-cell** filled with cement stabilised sand. The lining specifications must also satisfy the **GRI-GM 13.** The use and application of the HDPE lining must comply with **SANS 1526:2003** while the installation adheres to **SANS 10409:2004.**

The PCD allows for a 2 m unsaturated zone as geohydrological report that the shallow aquifer is at a depth between 4 – 12 metres. The PCD is also located more than 100 metres from the nearest non perennial stream.

7.3 Design of silt traps

Silt traps were designed to contain 3% of sediment in the stormwater runoff. It is assumed that the silt traps will be cleaned at most twice a year. The mean annual runoff of the area is 14.4 mm. The silt trap is also designed with a **Class C barrier type**.

7.4 Stockpile Containment Barriers

The site has 3 stockpiles, 2 dirty stockpiles and 1 clean stockpile. The two dirty stockpiles are *ROM stockpile and the waste rock dump*. The clean stockpile is the *overburden and topsoil stockpiles*. The dirty stockpiles will be lined with a **Class C barrier type** while the topsoil stockpile will be lined with a **Class D barrier type**.

7.5 Concrete lined / unlined drains

Concrete lined drains will be provided where there is high risk of erosion of the sides of the drains and for all dirty water conveyance. The drains will be designed to carry a 24 hour **1:50 year** peak flood flow.

The Unlined drains will direct clean stormwater away from the site. The channels will be installed with energy dissipaters at the outlets to reduce risk of erosion.

The peak stormwater flood flow is calculated using the deterministic Rational Method as shown in Appendix A.

7.6 Diversion earth berms

Diversion earth berms will be used to control flow of stormwater, guiding it to the collection point. It is also necessary in preventing mixture of clean and dirty stormwater. The Berms have been design to maintain separation of dirty and clean water even in the event of a **1:50 year** flood event. The minimum height of each berm will be **0.8m**.

8 Drawings

The following drawings were produced:

Drawing Title	Drawing Number
Stormwater General Arrangement	SG2021003/5/54/200
PCD Layout	SG2021003/5/54/201
Silt Trap	SG2021003/5/54/202
Drains and Berm	SG2021003/5/54/203
Culverts	SG2021003/5/54/204

9 Proposed Standards

9.1 Design Manuals

The following design manuals were used:

i) DWAF Documents.
ii) Drainage Manual from SANRAL.
iii) ICOLD dam manuals.

10 Construction

Construction of the works would need to be carried out by the reputable construction firm appointed by client. The appointed contractor will be required to submit a quality control plan for approval by the professional engineer. The construction and upgrade will be supervised by a registered professional engineer. The work will therefore be carried out in accordance with the approved quality control plan.

Appendix A

STORMWATER PCD AND DRAINAGE INFRASTRUCTURE CALCULATIONS

Q = CIA

where, Q = peak flow (m^3/s)
C = runoff coefficient (dimensionless)
I = average rainfall intensity over catchment (mm/hr)
A = effective area of catchment (km2)
3.6 = conversion factor

Recommended values of run-off factor C for use in the rational method

Rural (C1)					Urban (C2)	
Component	**Classification**	**Mean annual rainfall (mm)**			**Use**	**Factor**
		<600	**600-900**	**>900**		
	Vleis and pans (<3%)	0.01	0.03	0.05	***Lawns***	
Surface	Flat areas (3 to 10%)	0.06	0.08	0.11	Sandy, flat (<2%)	0.05 - 0.10
Slope	Hilly (10 to 30%)	0.12	0.16	0.20	Sandy, steep (>7%)	0.15 - 0.20
(Cs)	Steep areas (>30%)	0.22	0.26	0.30	Heavy soil, flat (<2%)	0.13 - 0.17
					Heavy soil, steep (>7%)	0.25 - 0.35
	Very permeable	0.03	0.04	0.05	***Residential areas***	
Permeability	Permeable	0.06	0.08	0.10	Houses	0.30 - 0.50
(Cp)	Semi permeable	0.12	0.16	0.20	Flats	0.50 - 0.70
	Impermeable	0.21	0.26	0.30		
					Industry	
					Light industry	0.50 - 0.80
	Thick bush and plantation	0.03	0.04	0.05	Heavy industry	0.60 - 0.90
Vegetation (Cv)	Light bush and lands	0.07	0.11	0.15	***Business***	
					City centre	0.70 - 0.95
	Grass lands	0.17	0.21	0.25	Suburban	0.50 - 0.70
	No vegetation	0.26	0.28	0.30	Streets	0.70 - 0.95
					Maximum floods	1.00

Adjustment factors for values of C_1

Return period	**100**	**50**	**20**	**10**	**5**	**2**
Factor (Ft) for steep and impermeable catchments	1.00	0.95	0.90	0.85	0.80	0.75
Factor (Ft) for flat and permeable catchments	1.00	0.88	0.67	0.60	0.55	0.50

For overland flow, Time of concentration Tc

$Tc = 0.604(rL/S^{0.5})^{0.467}$

where:

Tc = time of concentration
r = roughness coefficient from table 3.9 (Drainage Manual)
L = hydraulic length of catchment, measured along flow path from the catchment boundary to the point where the flood needs to be determined (km).
S = slope of the catchment, S = H/1000L (mm)
H = height of most remote point above outlet of catchment (m).

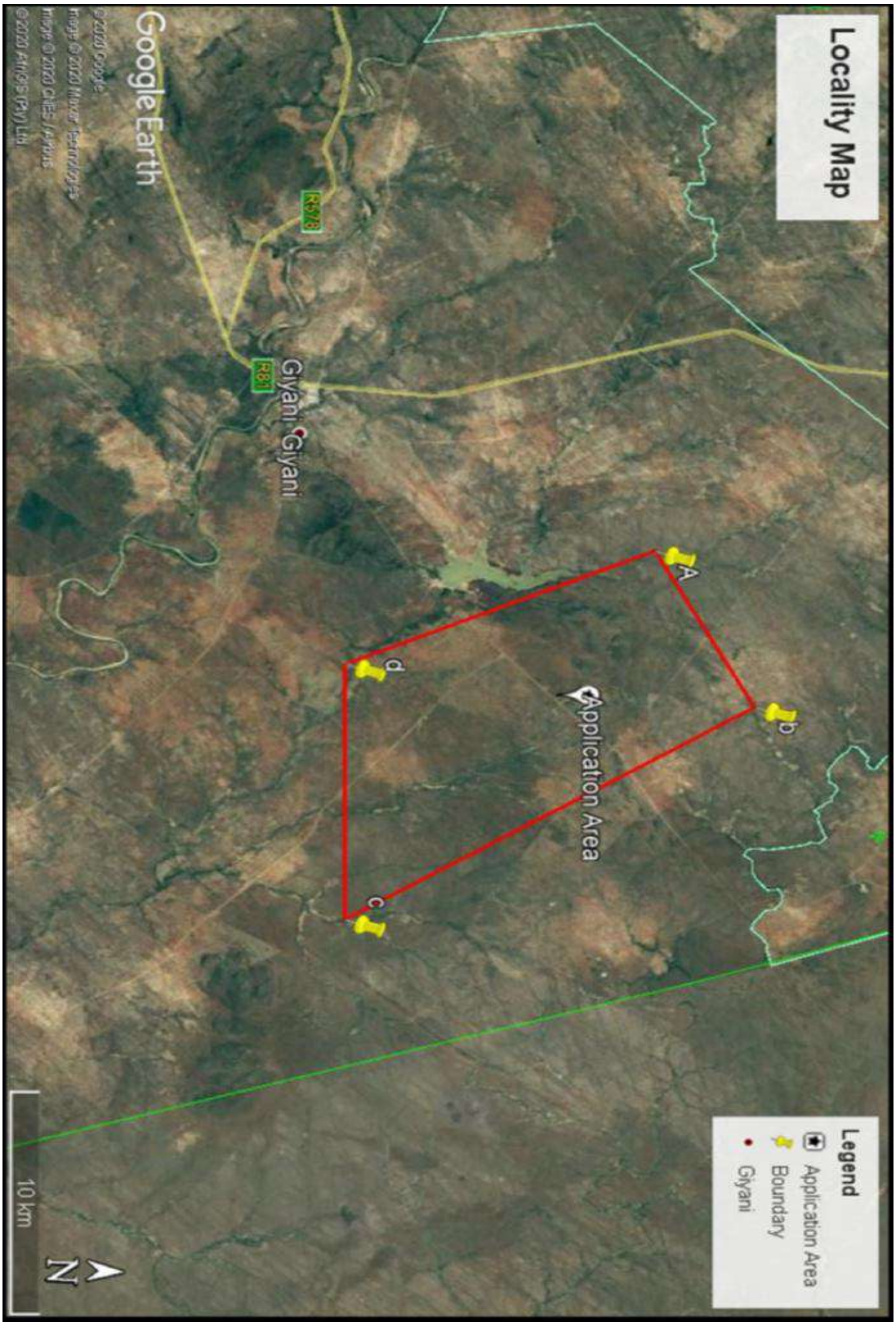
Recommended values of r

Surface description	**Recommended r value**
Paved areas	0.02
Clean compacted soil, no stones	0.1
Sparse grass over fairly rough surface	0.3
Medium grass cover	0.4
Thick grass cover	0.8

Description	Symbol	Formula	Units	DISCHARGE CATCHMENT AREAS		
Catchment area				MIINE AREA	TSF AREA	
Catchment area measured	A_m	State	km^2	0.06	0.025	
Catchment factor	C_f	State	Coeff.	1.00	1.00	
Length of flow (watercourse)	Lw	State	km	1.0	1.0	
Length of flow (overland)	Lo	State	km	0.35	0.35	
Most remote point height above catchment outlet (watercourse)	H (watercourse)	State	m	3.0	0.5	
Most remote point height above catchment outlet (overland)	H (overland)	State	m	3	0.5	
Catchment slope (watercourse)	S	State	m/m	0.0030	0.0005	
Catchment slope (overland)	S	State	m/m	0.0086	0.0014	
Return period	n	State	Years	50	50	
Mean Annual Rainfall	r	State	mm	668	668	
24 hour 1:50 year point rainfall	P_t		mm	155	155	
Roughness coefficient	r			0.3	0.3	
Time of concentration (for watercourse)	T_{cw}	$(0.87*L^2/1000*S)^{0.385}$	hours	0.6209	1.2377	
Time of concentration (for overland flow)	T_{co}	$0.604(rL/S^{0.5})^{0.467}$	hours	0.6406	0.9733	
Time of concetration (total)	Tt		hours	1.2615	2.2110	
Point Rainfall Intensity	Pi_T	P_t/Tc	mm/hr	122.87	70.10	
% rural	α			1.00	1.00	
% urban	β			0.00	0.00	
ϒ	ϒ			0.00	0.00	
Runoff coefficient due to average catchment slope, C_s	Vleis and pans (<3%)			0.03	0.03	
	Flat areas (3 to 10%)					
	Hilly (10 to 30%)					
	Steep areas (>30%)					
Runoff coefficient due to average catchment permeability, C_p	Very permeable					
	Permeable			0.08	0.08	
	Semi permeable					
	Impermeable					
Runoff coefficient due to average vegetation growth, C_v	Thick bush and					
	plantation					
	Light bush and					
	lands					
	Grass lands					
	No vegetation			0.28	0.28	
Runoff coefficient for rural	$C_{1(50)}$			0.39	0.39	
Runoff coefficient for urban	$C_{2(50)}$			0.00	0.00	
$C_{3(50)}$	$C_{3(50)}$			0.00	0.00	
Total run off coefficient	C_{50}	State	m/s	0.39	0.39	
Point Rainfall Intensity	I	State	mm/hr	122.87	70.10	
Effective Area	A	$A_{m\ x}$ S	km^2	0.06	0.03	
Runoff discharge	Q_p	(C x I x A)/3.6	m^3/s	0.80	0.19	
Volume		Qp*0.5*3*Tc	m^3	5441	2267	

Appendix B

LOCALITY MAP


Locality Map
Legend
Application Area
Boundary
Giyani
Giyani
Application Area
A
b
c
d
R81
Google Earth
10 km
N

Appendix C

WASTE CLASSIFICTION

Parameter	Unit	LCT0	LCT1	LCT2	LCT3	Composite 1	Composite 2	Composite 3	Composite 4
As, Arsenic	mg/l	0.01	0.5	1	4	<0.010	<0.010	<0.010	<0.010
B, Boron	mg/l	0.5	25	50	200	0.028	<0.025	0.035	<0.025
Ba, Barium	mg/l	0.7	35	70	280	0.415	0.175	<0.025	0.048
Cd, Cadmium	mg/l	0.003	0.15	0.3	1.2	0.005	<0.003	<0.003	<0.003
Co, Cobalt	mg/l	0.5	25	50	200	<0.025	<0.025	<0.025	<0.025
CrTotal, Chromium Total	mg/l	0.1	5	10	40	0.463	<0.025	<0.025	<0.025
Cr(VI), Chromium (VI)	mg/l	0.05	2.5	5	20	<0.010	<0.010	<0.010	<0.010
Cu, Copper	mg/l	2	100	200	800	0.024	0.019	<0.010	0.014
Hg, Mercury	mg/l	0.006	0.3	0.6	2.4	<0.001	<0.001	<0.001	<0.001
Mn, Manganese	mg/l	0.5	25	50	200	0.057	0.551	<0.025	<0.025
Mo, Molybdenum	mg/l	0.07	3.5	7	28	<0.025	<0.025	<0.025	<0.025
Ni, Nickel	mg/l	0.07	3.5	7	28	0.078	<0.025	<0.025	<0.025
Pb, Lead	mg/l	0.01	0.5	1	4	0.024	0.014	<0.010	<0.010
Sb, Antimony	mg/l	0.02	1	2	8	<0.020	<0.020	<0.020	<0.020
Se, Selenium	mg/l	0.01	0.5	1	4	<0.010	<0.010	<0.010	<0.010
V, Vanadium	mg/l	0.2	10	20	80	0.247	<0.025	<0.025	<0.025
Zn, Zinc	mg/l	5	250	500	2000	0.039	<0.025	<0.025	<0.025
Total Dissolved Solids*	mg/l	1000	12 500	25 000	100 000	338	418	84	154
Chloride as Cl	mg/l	300	15 000	30 000	120 000	3	9	<2	<2
Sulphate as SO4	mg/l	250	12 500	25 000	100 000	4	15	5	4
Nitrate as N	mg/l	11	550	1100	4400	<0.1	<0.1	<0.1	<0.1
Fluoride as F	mg/l	1.5	75	150	600	1	1	0.3	0.5
Total Cyanide as CN	mg/l	0.07	3.5	7	28	<0.05	<0.05	<0.05	<0.05

4.2.2 Classification

All of the samples are classified as Type 3 waste because the total concentration of one or more constituents is between the TCT0 and TCT1 threshold values, and the leachable concentrations of one or more constituents is below the LCT1 threshold value. Disposal is therefore required at a Class C or GLB- landfill, both of which would require a pollution control barrier system as defined in the *National Norms and Standards for Disposal of Waste to Landfill* (2013).

Appendix D

LINING SPECIFICATIONS AND GENERAL WARRANTY

CERTIFICATE OF WARRANTY
BY AQUATAN (PTY) LIMITED ("AQUATAN")

WARRANTY NO. :

EFFECTIVE DATE :

PURCHASER :

LOCATION OF INSTALLATION :

DESCRIPTION OF INTENDED USE :

Subject to the terms and conditions hereof, this undertaking shall remain in force for ………. years from the date upon which the Completion Certificate is signed by Aquatan ("the effective date") , whereafter it shall, ipso facto, be deemed to have lapsed and to be of no further force or effect.

Aquatan undertakes in favour of the Purchaser that, provided it is installed by Aquatan and used in strict compliance with Aquatan's Specification, the intended use and good Industry Practice, the ……………….. as installed at the abovementioned location ("The Product") will be free from defects in materials and workmanship for a period of 2 (two) years from the effective date and shall withstand the effects of weathering for a period of …….. years from the effective date. This warranty does not include, and Aquatan shall not be liable for, any damage caused to the product by windstorm, hail, explosion, fire, flood, soil, flying or falling objects, subsidence, sinkholes, harmful chemicals or other accidental casualty or other natural phenomena or damage caused to the product by a design error where Aquatan was not responsible for the design or damage caused to the product by improper use, including but not limited to, the exposure of the product to mechanical use by machinery, equipment, people, animals or vehicles.

It is an express condition of this undertaking that :-

1. Aquatan's sole obligation pursuant to the provisions of the above clauses will be limited to the re-application of or repairs to the product during the period of warranty.

2. The cost to Aquatan in effecting any re-application or repairs to the product pursuant to 1 above shall not exceed the contract price less ………….. (1/….th) thereof for each year during which the undertaking remains in force, provided that:

   (i) A certificate given under the hand of any Director of Aquatan as to its costs in effecting any re-application or repairs to the product shall be conclusive proof thereof and be final and binding.

Page 2

(ii) Any costs in excess of those for which Aquatan is liable in terms hereof shall be borne and paid by the Purchaser to Aquatan on demand.

3. The undertaking contained herein is the only undertaking given in respect of the product and there are no other undertakings, warranties, guarantees, representations, promises or the like in regard hereto.

4. The Purchaser shall ensure that prior to Aquatan effecting any re-application or repairs to the product, the surface to which the product has been applied is free from all foreign materials or structures and that the area is given over to Aquatan in a clean and dry condition.

5. Save for Aquatan's obligation to re-apply or replace the product in terms hereof, Aquatan shall not be liable for any damages or losses of whatsoever nature (whether direct, indirect or consequential) which may be caused to or suffered or incurred by any person whomsoever by reason of or arising from a breach of this undertaking or by reason of any latent defects or occasioned by any re-application or repairs to the product by Aquatan and in this connection the Purchaser shall be deemed to have indemnified Aquatan against any claim of whatsoever nature which may be brought against Aquatan.

6. Aquatan's liability in terms hereof shall be excluded if :

(i) Aquatan has not received notification in writing from the Purchaser of any defect in the application, performance or durability of the product within 21 (twenty-one) days of such defect having manifested itself.

(ii) The Purchaser is in breach of its obligations to Aquatan including but without limiting the generality of the aforegoing, failure to effect due payment of any amount owing to Aquatan by the Purchaser or his Contractor in respect of the Contract price due to Aquatan.

7. All costs or expenses of whatsoever nature which may be incurred by Aquatan pursuant to any claim made against it in terms hereof shall be for the Purchaser's sole account and expense should it transpire that Aquatan's liability in terms hereof is excluded, and such costs or expenses shall be paid to Aquatan by the Purchaser on demand.

FOR : AQUATAN (PTY) LTD

....

(Signature) **(Title) Managing Director**

FOR : PURCHASER

....

Signature) **(Title)**

AQUATAN
LINING SYSTEMS

HI-DRILINE® SMOOTH (HDPE) Product Data Sheet

HI-DRILINE® Smooth (HDPE) is a black, high quality, high density polyethylene geomembrane produced from specially formulated, virgin polyethylene resin. The polyethylene resin is designed specifically for flexible and durable geomembrane applications. HI-DRILINE® Smooth (HDPE) contains approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers. HI-DRILINE® Smooth (HDPE) has outstanding chemical resistance, mechanical properties, environmental stress crack resistance, dimensional stability and thermal aging characteristics. HI-DRILINE® Smooth (HDPE) has excellent resistance to UV radiation and is suitable for exposed applications. These product specifications (≥ 0.75 mm) meet or exceed GRI-GM 13.

Tested Property	Unit	Test Method	Values(*)				
Thickness (a)	mm	ASTM D 5199	0.5	0.75	1.0	1.5	2.0
Density	g/cm^3	ASTM D 792	≥0.94	≥0.94	≥0.94	≥0.94	≥0.94
Tensile Properties		ASTM D *638 / D* 6693;					
(each Direction)		type IV					
Strength at Yield	N/mm	50 mm/min	8 (7)	13 (11)	16 (15)	24 (22)	32 (30)
Elongation at Yield	%	1o = 33 mm	16 (13)	16 (13)	16 (13)	16 (13)	16 (13)
Strength at Break	N/mm	200 mm/min	17 (12)	26 (20)	33 (27)	49 (40)	66 (33)
Elongation at Break	%	1o=50mm	800 (700)	800 (700)	800 (700)	800 (700)	800 (700)
Tear Resistance	N	ASTM D 1004	70 (65)	100 (95)	140 (130)	205 (190)	275 (250)
Puncture Resistance	N	ASTM D 4833	240 (160)	340 (240)	420 (320)	560 (480)	980 (960)
Carbon Black Content	%	ASTM D 1603	2.0 – 3.0	2.0 – 3.0	2.0 – 3.0	2.0 – 3.0	2.0 – 3.0
Carbon Black Dispersion	Category	ASTM D 5596	1 / 2 (b)	1 / 2 (b)	1 / 2 (b)	1 / 2 (b)	1 / 2 (b)
Dimensional Stability	%	ASTM D1204 (120 °C/1h)	±2	±2	±2	±2	±2
(each Direction)							
		ASTM 0 1238					
Melt Flow Index (c)	g/10 min	(190 °C */5.0* kg)	≤3	≤3	≤3	≤3	≤3.0
		(190 °C */2.16 kg)*	≤1	≤1	≤1	≤1	≤1.0
Stress Crack Resistance (NCTL)	h	ASTM D 5397; Appendix	≥400	≥400	≥400	≥400	≥400
Reference Property	**Unit**	**Test Method**	**Values(*)**				
Low Temperature Brittleness	°C	ASTM D 746	-77	-77	-77	-77	-77
Oxidative Induction Time (OIT)	min	ASTM D 3895	≥100	≥100	≥100	≥100	≥100
UV Resistance (d)		(200°C; Pure 0_2; 1 atm)					
		GRI-GM11					
HP-OIT retained after 1,600 hours (e)	%	ASTM D 5885	≥50	≥50	≥50	≥50	≥50
Roll Width (approx.)	m	-	6.95		7.5 / 6.95		
Surface	–	-	Double-sided smooth				

(*): All values - unless otherwise noted - are nominal values. Values in brackets are minimum values within the 95% confidence interval.
(a): Tolerance:t 10%; 0.3 mm: Tolerance:t 15% - Special thickness available upon request.
(b): Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be category 1 or 2. No more than 1 view from category 3.
(c): Standard test conditions: 190°C 15.0 kg.
(d): Test-Conditions: 20 hours UV cycle at 75°C followed by 4 hours condensation *at* 60°C; total: 1,600 hours.
(e): UV Resistance is based on percent retained value regardless of the original High Pressure - OIT value.

PO Box 633, Isando 1600, South Africa
10 Diesel Road, Isando 1600, South Africa
Tel: +27 11 974 5271
Fax: +27 11 974 4111
E-mail: aqua@aquatan.co.za
Website: www.aquatan.co.za

ANNEXURE 4 – BIODIVERSITY ASSESSMENT

BIODIVERSITY ASSESSMENT

GIYANI MINE AND PROPOSED PIT AREAS, LOCATED

NEAR GIYANI IN THE LIMPOPO PROVINCE

APRIL 2021

Oasis Environmental Specialists (Pty) Ltd

Tel: 016 987 5033

Cell: 076 589 2250

Email: joppie@oasisenvironmental.co.za

Website: http://oasisenvironmental.co.za

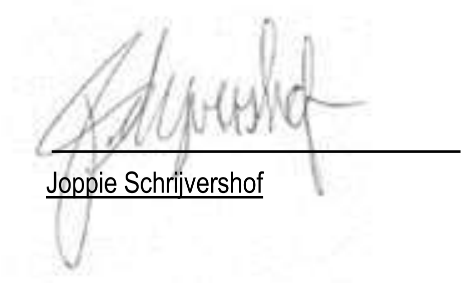
37 Oorbietjies Street, Lindequesdrift

Potchefstroom, 1911

DOCUMENT CONTROL		
Project Name:		**BIODIVERSITY ASSESSMENT FOR THE GIYANI MINE AND PROPOSED PIT AREAS, LOCATED NEAR GIYANI IN THE LIMPOPO PROVINCE**
Client:	**Person:**	**SW Minnaar**
	Company:	**Eco Elementum (Pty) Ltd**
	Position:	**Senior Environmental Consultant**
	Email:	sw@ecoe.co.za
	Cell:	**082 787 9914**
Compiled by:	**Person:**	**Joppie Schrijvershof**
		Pri Sci Nat: 115553
		MSc (NWU- Aquatic Science)
	Company:	**Oasis Environmental Specialists (Pty) Ltd.**
	Position:	**Aquatic and Ecological Scientist**
	Email:	joppie@oasisenvironmental.co.za
	Cell:	**076 589 2250**
Date:		**2021-04-26**
Reference Number:		**ECO-21-002**

I, **Jacob Schrijvershof,** declare that -

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist assessment relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998) (NEMA) and the National Water Act (Act 36 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this report are true and correct;
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B (1) of the National Environmental Management Act, 1998 (Act 107 of 1998); and
- I understand that any false information published in this document is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.



Joppie Schrijvershof

Executive summary

Oasis Environmental Specialists (Pty) Ltd in collaboration with Eco Elementum (Pty) Ltd was appointed to conduct a terrestrial ecological assessment report for the operating Giyani Gold mining activities and proposed pit areas, all located within the magisterial district of Mopani, Limpopo Province. The field assessment was conducted on the 21st of April 2021 in order to assess the current ecological conditions and to expand baseline data for future reference.

The aim of this study is to ensure compliance with the general legislative requirements as part of the Environmental Authorisation process prescribed by the National Environmental Management: Biodiversity Act (NEM:BA) (Act No 10 of 2004) and National Environmental Management Act (NEMA) (Act No 107 of 1998).

The scope of work entailed to the biodiversity study following:

- An examination of onsite, SANBI GIS databases on Endemic and Red Data faunal and floral species in the study area;
- A literature search on Red Data Book species predicted to occur in the study area;
- Identify potential negative impacts on any biodiversity from the mine operations and assess the significance of these impacts;
- Provide recommended mitigation measures for the identified impacts in order to avert or lower the significance of the negative impacts; and
- Identify any sensitive areas present on site.

The overall results for the biodiversity (faunal and floral) assessment concluded:

- The mining areas falls within the Lowveld Rugged Mopaneveld vegetation type as per Mucina and Rutherford (2006).
- According to the biodiversity datasets provided by SANBI (2021), the current mining area, Swartkoppies and the 2 western pit areas (West 59 and Gemsbok) falls within a Critical Biodiversity Area 2. These sections were confirmed to be Mopani forest and bushveld areas during the site visit.
- The two remaining eastern pit areas falls within an Ecological Support 1 area and the other within an Other Natural Areas. These areas had disturbance by informal settlements surrounding these areas.
- The mining areas does not overlap with any protected or endangered ecosystems.
- The proposed mining operations fall within close proximity to Important Bird Areas (IBAs), where the proposed mining area falls close to the Kruger National Park.
- Trees dominated the area and included *Combretum spp.*, *Vachellia robusta*, *Vachellia tortilis*, *Senegalia nigrescens* and *Colophospermum mopane.* However, *Cissus cornifolia, Albizia harveyi, Mundulea sericea, Terminalia sericea,*

Terminalia prunioides, Grewia bicolor, Dichrostachys cinerea, Sclerocarya caffra, Dalbergia melanoxylon, Peltophorum africanum, Strychnos madagascariensis and Commiphora africana are also abundantly present .

- Limited faunal species were observed and the majority was sites near game farms and private reserves and included communal spider nests, sociable weaver (*Philetairus socius*), Laughing dove (*Spilopelia senegalensis*), Ring-necked dove (*Streptopelia capicola*), Cape glossy starling (*Lamprotornis nitens*), Southern red-billed hornbill (*Tockus erythrorhynchus*), Bronze winged courser (*Rhinoptilus chalcopterus*), Golden Orb Spider (*Trichonephila spp*.).
- All expected faunal species are listed in **Appendix A** for QDS 2330BB and 2330BD and all floral species are listed in A**ppendix B** for the Giyani area.

A number of potential ecological impacts relating to proliferation of alien invasive species, loss of species of conservation concern, loss of indigenous vegetation, floral and faunal habitat and ecological structure of water resources and soil, loss of floral diversity and ecological integrity. The significance of potential impacts on biodiversity within the area were rated as **high significance without mitigation and moderate with mitigation** as the proposed areas lies in a bushveld area not owned by private game reserves.

Provided mitigation measures are to be implemented within an environmental management programme (EMPr) and the significance of any negative impacts reduced should the mining commence. Potential impacts associated with the construction and operational phase include:

- Increased sedimentation and water quality impairment due to runoff from waste dumps;
- Water quality contamination due to runoff or seepage from any tailings storage facility;
- Alteration of natural flow regime due to discharge of pit water;
- Increased utilisation of aquatic resources by local population; and
- Habitat loss associated with the stream diversion.

Should mining commence the following mitigation measures, aimed at minimising the afore-mentioned impacts, include (but are not limited to):

- Design and implementation of a suitable stormwater system;
- Rehabilitation of the disturbed areas;
- Limiting instream sedimentation;
- Minimising pollutants entering the channels;
- Implement a programme for the clearing/eradication of alien species including long term control of such species; and
- A 100 m buffer was implemented for the channel and river systems (Sensitive areas).

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

LIST OF ABBREVIATIONS AND ACCRONYMS

BGIS: Biodiversity Geographic Information System

CBA: Critical Biodiversity Areas

DWAF: Department of Water Affairs and Forestry

DWS: Department of Water Affairs and Sanitation

EA: Environmental Authorisation

EMPr: Environmental Management Program

ESA: Ecological Support Areas

GIS: Geographic Information System

IBA: Important Bird Areas

QDS: Quarter Degree Square

SANBI: South African National Biodiversity Institute

1 INTRODUCTION

1.1 Background

Oasis Environmental Specialists (Pty) Ltd in collaboration with Eco Elementum (Pty) Ltd was appointed to conduct the terrestrial ecological assessment report for the establishment of underground and open cast mining areas for the Giyani Gold Mine Project in respect of the Farm Greater Giyani 891 LT and a portion of portion 0 of the Farm 246 located within the town of Giyani, Limpopo Province (**Figure 1**). The application area is located approximately 10km North East town of Giyani and approximately 140 km north-east of Polokwane, accessible along the R81 road from the N1 National Road in Polokwane. The field assessment was conducted on the 21st of April 2021 in order to assess the current ecological conditions and to expand baseline data for future reference.

The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment, shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

Mining operations will commence from five open cast pits **(Figure 2**) which will later be developed into underground workings and expand into four working levels to reach the steady state production of 12 000 tons per month. Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas.

The open pit mine design shows the orebody being located centrally to the pit outer walls or pit shell. The waste surrounding the orebody will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the orebody and have enough area for movement of machinery inside the pit.

The sidewalls of the excavation, surrounding the orebody, referred to as Benches, will be excavated at intervals to a maximum depth 12 metres and must be slanted to ensure slope stability as per specifications determined by the project's Rock Engineering expert. The pit development will include the creation of Berms, representing the flat area or horizontal distance of approximately 5 metres in width, when measured from the bottom of the preceding or top bench to the edge of the next bench as the pit goes dipper. An access ramp and haul road will also be created from the top bench on the outer limits of the pit, traversing the lower benches in order to have mining equipment and personnel accessing the pit floor where excavating or blasting of the ore bearing rock will be conducted.

The pit will be excavated to an optimal operating final depth of 400 metres below surface level, thereafter, the conversion of the mining operation from open pit to underground mining operation will be affected. The timing for the development of the underground mining infrastructure will be scheduled to reach its completion such that the commencement of underground operations will overlap with the final phase of the open pit mining operation for a period of six months. The basic design or layout for the underground mining operation entails the conventional use of shafts and declines, with the development of footwall haulages, cross-cuts and raise-lines to establish conventional cut and fill mining panels.

1.2 Legal framework

1.2.1 National Environmental Management Act (Act No. 107 of 1998)

The EIA Regulations, promulgated under NEMA, focus primarily on creating a framework for co-operative environmental governance. NEMA provides for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by State Departments and to provide for matters connected therewith.

1.2.2 National Waste Act, 2008 (Act No. 59 of 2008)

The NEMWA aims at promoting sustainable waste management practices through the implementation of “Integrated Waste Management Planning”, where “Integrated Waste Management Planning is viewed as a holistic approach of managing waste, aimed at optimising waste management practises to ensure that the implementation thereof yields practical solutions that are environmentally, economically and socially sustainable and acceptable to the public and all relevant spheres of government”.

1.2.3 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)

The purpose of the Biodiversity Act is to provide for the management and conservation of South Africa’s biodiversity within the framework of the NEMA and the protection of species and ecosystems that warrant national protection. As part of its implementation strategy, the National Spatial Biodiversity Assessment was developed.

This Act is applicable to this application for environmental authorisation, in the sense that it requires the project applicant to consider the protection and management of local biodiversity. This report serves as an ecological assessment being undertaken to assess the flora and fauna for the proposed mining areas.

In terms of the Biodiversity Act, the “developer” has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not solely by listed activities as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated

environmental management of activities; thereby ensuring that all development within the area is in line with ecological sustainable development and protection of biodiversity.

- Limit further loss of biodiversity and conserve endangered ecosystems.
- A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7 of NEM: BA (Act No. 10 of 2004).
- Such activities include any that are "of a nature that may negatively impact on the survival of a listed threatened or protected species".

1.3 Scope of work

1.3.1 Ecological Assessment

The scope of work entailed to the Biodiversity Assessment following:

- An examination of onsite and SANBI GIS databases on Endemic and Red Data faunal and floral species in the study area;
- A literature search on Red Data Book species predicted to occur in the application area;
- Identify potential negative impacts on any biodiversity from the mining areas and assess the significance of these impacts;
- Provide recommended mitigation measures for the identified impacts in order to avert or lower the significance of the negative impacts; and
- Identify any sensitive areas.

1.4 Assumptions and Limitations

It is difficult to apply pure scientific methods within a natural environment without limitations, and consequential assumptions need to be made. The findings, results, observations, conclusions and recommendations provided in this report are based on the author's best scientific and professional knowledge as well as available information regarding the perceived impacts on the watercourses and biodiversity. It is important to note that although this report describes the regional vegetation, vegetation previously recorded for the area (POSA) and the conservation status of the project area, where some of the areas are private land, therefore limiting access to them.

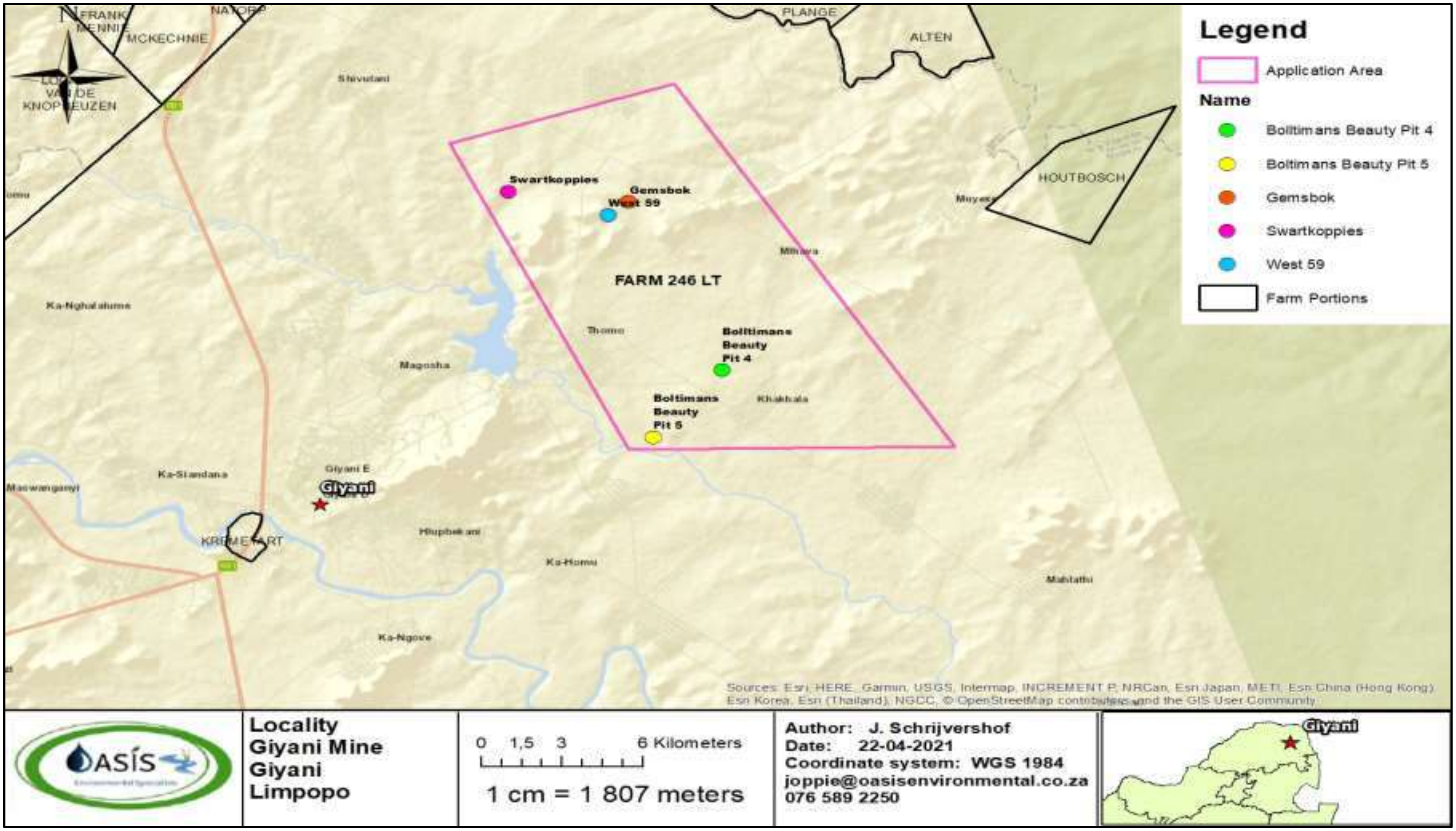


Figure 1: Locality of proposed Giyani Mine application area near Giyani in the Limpopo Province.

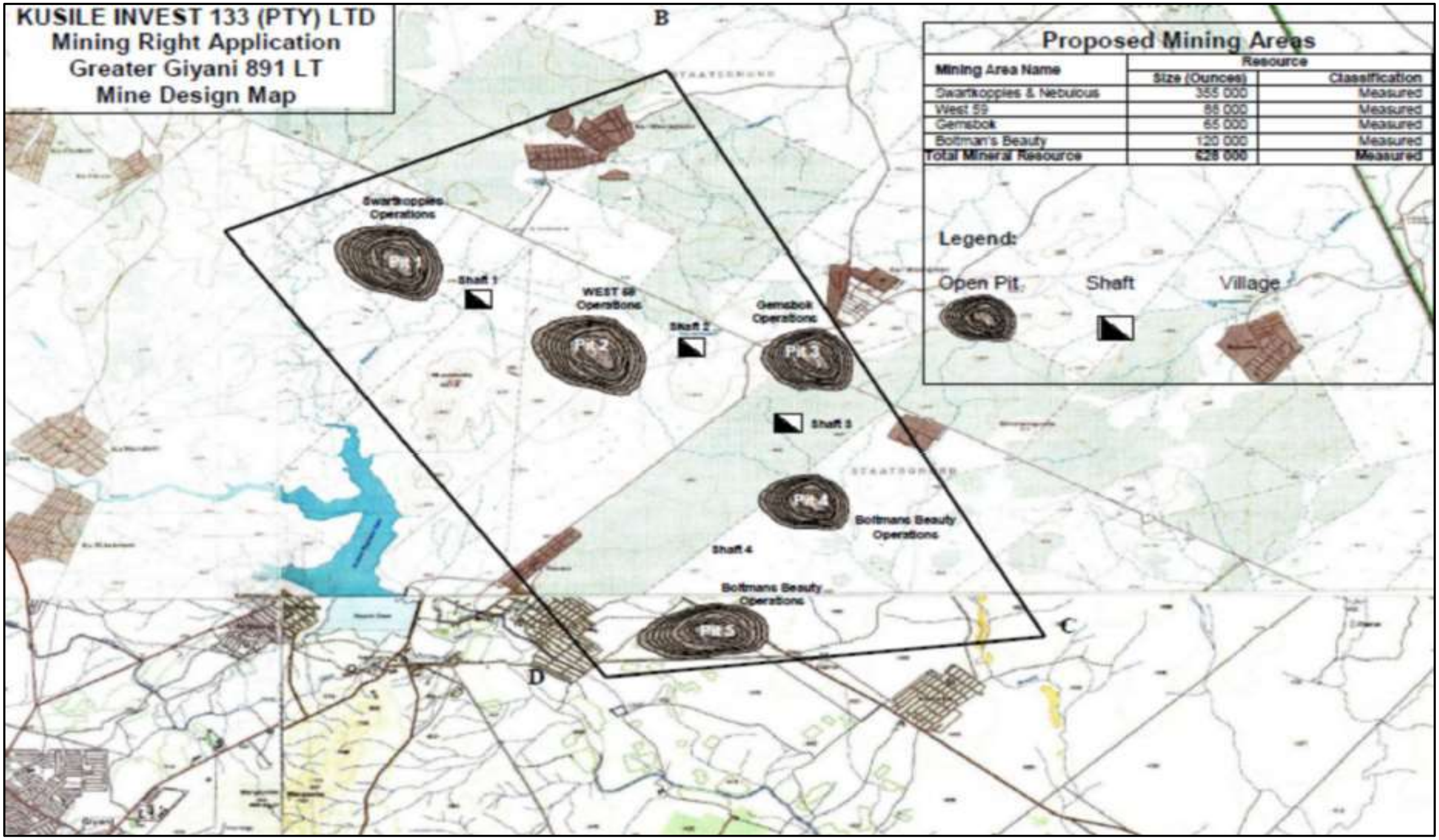


Figure 2: Layout of the proposed pit areas for the operating Giyani Gold Mine as per the scoping report provided by Archean Resources (2020).

2 METHODOLOGY

2.1 Ecological Desktop Assessment

It is important to note that many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have previously been disturbed. Assessing the impacts of the mine often requires evaluating the conservation value of the site relative to other natural areas in the surrounding area. Thus, the general approach and angle adopted for this type of study is to identify any potential faunal species that may be affected by the mine. This means that the focus of this report will be on rare, threatened, protected and conservation-worthy species.
Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the highest priority, the presence of which is most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National Legislation protecting environmental and biodiversity resources.

A desktop assessment was conducted to establish whether any potentially sensitive species/receptors might occur within the study area. The South African National Biodiversity Institute's online biodiversity tool, ADU (Animal Demography Unit) Virtual Museum was used to query a faunal species list (**Appendix A**) for the 2330BB and 2330BD Quarter Degree Squares (QDS) within which the study area is situated.

The South African National Biodiversity Institute's (SANBI) online biodiversity tool POSA (Plants of South Africa) was used to query floral species lists (**Appendix B**) for the area surrounding the project site. This was supplemented by researching all available books and peer reviewed websites.

The importance of a baseline study is to provide a reference condition to determine the current state of the environment and to draw comparisons between the potential of the area and current degradation from surrounding land uses. Aerial photographs and satellite imagery were used to delineate potential sensitive ecosystems or vegetation types and these areas were the focus during the field assessment.

To describe the overall site characteristics, and to identify points of interest within the site for evaluation, Google Earth Imagery and the 1:50 000 topographical maps were examined.

This was conducted by researching all available information resources including, but not limited to, the following:

- International Union for Conservation of Nature (IUCN) Red List of Threatened Species;
- The Endangered Wildlife Trust's Red List of Mammals of South Africa, Lesotho and Swaziland; and

- NEMBA List of Threatened or Protected Species (TOPS List);
- Animal Demography Unit (ADU) Virtual Museum;
- SANBI Biodiversity GIS tool; and
- Important Bird and Biodiversity Areas (IBAs) (Birdlife South Africa, 2020).

Biodiversity areas represent terrestrial and aquatic sites identified as Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESA), Other Natural Areas and No Natural Remaining Areas conducted by SANBI.

2.1.1 **Critical Biodiversity Areas**

Critical Biodiversity Areas are those areas required to meet biodiversity thresholds. CBA's are areas of terrestrial or aquatic features (or riparian vegetation alongside CBA aquatic features) which must be protected in their natural state to maintain biodiversity and ecosystem functioning (Desmet *et al*., 2013). According to Desmet *et al* (2013), these CBAs include:

i) Areas that need to be protected in order to meet national biodiversity pattern thresholds (target area);

ii) Areas required to ensure the continued existence and functioning of species and ecosystems (including the delivery of ecosystem services); and/or

iii) Important locations for biodiversity features or rare species.

2.1.2 **Ecological Support Areas**

Ecological Support Areas (ESA) are supporting zones required to prevent the degradation of Critical Biodiversity Areas and Protected Areas. An ESA may include an aquatic or terrestrial feature. ESAs can be further subdivided into Critical Ecological Support Areas (CESA) and Other Ecological Support Areas (OESA). Critical Ecological Support Areas are aquatic features, with their terrestrial buffers, which fall within priority sub-catchments, whose protection is required in order to support the aquatic and terrestrial CBAs. An example might be a river reach which feeds directly into a CBA. Other Ecological Support Areas are all remaining aquatic ecosystems (not classed as CESA or CBA), with their terrestrial buffers, which have a less direct impact on the CBA, e.g. a channel and river that is geographically isolated from a CBA, but contributes to ecological processes such as groundwater recharge, thereby indirectly impacting on a CBA downstream. (Desmet *et al.*, 2010).

2.1.3 Other Natural Areas

Other Natural Areas are areas of lesser biodiversity importance whose protection is not required in order to meet national biodiversity thresholds. Other Natural Areas may withstand some loss in terms of biodiversity through the conversion of their natural state for development. However, if all Critical Biodiversity Areas are not protected, certain Other Natural Areas will need to be reclassified as Critical Biodiversity Areas in order to meet thresholds. (Desmet *et al.*, 2010).

No Natural Remaining Areas are those areas that have been irreversibly transformed through urban development, plantation and agriculture and poor land management. As a result, these areas no longer contribute to the biodiversity of the region. However, in some cases transformed land may be classified as an ESA or CBA if they still support biodiversity (Desmet *et al.,* 2010).

2.1.4 Threatened Ecosystems

Ecosystem threat status outlines the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends (Driver *et al*., 2012). Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), based on the proportion of each ecosystem type that remains in good ecological condition (Driver *et al*., 2012).

2.1.5 Important Bird Areas

Important Bird Areas are areas that are important for the long-term survival of threatened, restricted avian species (Birdlife South Africa, 2021). BirdLife's Important Bird and Biodiversity Area concept has been developed and applied for over 30 years. Considerable effort has been devoted to refining and agreeing a set of simple but robust criteria that can be applied worldwide.

Important Bird and Biodiversity Areas (IBAs) are:

- Places of international significance for the conservation of birds and other biodiversity;
- Recognised world-wide as practical tools for conservation;
- Distinct areas amenable to practical conservation action;
- Identified using robust, standardised criteria; and
- Sites that together form part of a wider integrated approach to the conservation and sustainable use of the natural environment.

2.2 Vegetation Assessment

A comprehensive study was carried out to document all species recorded in the area and to predict vegetation characteristics. This was augmented by a site visit and comprised of the following:

A walkover field survey of the site verifying the presence or absence of species predicted to occur on the site included:

i. Identification and location of keystone or indicator species that may be impacted;
ii. Identify important habitats, including channel and rivers, grasslands and savanah;
iii. Identify areas of conservation and/or ecological importance;
iv. Consider invasive alien plant status and rehabilitation potential of natural areas; and
v. An overall condition of the vegetation found in the area, including an assessment of cover and vegetation structure and were classified as vegetation communities.

2.2.1 Conservation priority and Sensitivity

The vegetation types were evaluated in terms of conservation priority according to the following categories:

- **High:** Ecologically sensitive and valuable land with high species richness and/or sensitive ecosystems and/or red data species that should be conserved. No development is to be allowed.
- **Medium-high:** Land that is partially disturbed but that is generally ecologically sensitive to development / disturbances.
- **Medium:** Land on which developments with a limited / low impact on the vegetation / ecosystem can be considered. It is recommended that certain portions of the natural vegetation be maintained in open spaces.
- **Medium-low:** Land of which small sections could be considered to be conserved, but where the area in general has little conservation value.
- **Low:** Land that has little conservation value where development will have an insignificant or no impact on the vegetation.

Sensitivity Areas that are of High and Medium-high conservation priority are regarded as High sensitivity areas in which developments should not be allowed

Areas that fall in the Medium, Medium-low and Low conservation priority categories are regarded as Low sensitivity areas in which development may be allowed.

Areas where other environmental factors such as high erodibility and steep slopes that play a significant role are regarded as Moderate sensitivity areas. Developments can be allowed in these areas if suitable mitigation measures can be implemented.

2.2.2 Alien Invasive Plants

Invasive alien plants are described as species which are 'non-indigenous' to an area and which have been introduced from other countries either intentionally (for domestic or commercial use) or accidentally; furthermore, they have the ability to reproduce and spread without the direct assistance of people into natural or semi-natural habitats and are destructive to biodiversity and human interests (WESSA-KZN, 2008).

Notice 3 of the National Environmental Management: Biodiversity Act 2004 (Act No, 10 of 2004) lists 379 plant species that are legally declared invasive species. Each species is assigned to one of three categories based on the level of threat posed by the species and the legal status assigned to each:

- **Category 1a –** Plant species that must be combatted or eradicated.
- **Category 1b –** Plant species that must be controlled.
- **Category 2 –** Plant species that must not be allowed to spread outside any property.
- **Category 3 –** Plant species that when occurring in riparian areas must be considered to be category 1b Listed Invasive Species and must be managed according to regulation 3 of NEM:BA, 2014

Please review NEMBA (Act 10 of 2004) for details on these species.

2.3 Faunal Assessment

2.3.1 Avifaunal assessment

Generally, when predicting the impacts of the mine on birds, a combination of science, field experience and knowledge from the specialist is required. More specifically the methodology used to predict impacts of the mine was as follows:

- The various data sets discussed above under "sources of information", were collected/collated and examined with the aim of determining the focal species for this study.
- The data were examined to determine the location and abundance of species which may be susceptible to impacts from the mine including both Red Data and non-Red Data.
- The broader study area was visited during a day long site visit. The site was thoroughly traversed to obtain a first-

hand perspective of the mine, and to determine which bird micro habitats are present within the study site. This involved walking, taking photographs, and the use of bird call playbacks to identify bird life present within the study area. Further to this, the observation of feathers and nests were used as species identification tools.

- All opportunist sightings were recorded throughout the study area.
- Avian micro-habitats and sensitive habitats for avifaunal communities were identified and mapped.
- The impacts of the mine on the avifaunal populations were then predicted by analysing data on impacts on wildlife around mining areas throughout South Africa.

2.3.2 Faunal assessment

The faunal investigation was focused on mammals, reptiles and amphibians. The following methodology was applied:

- The data sets discussed above under "sources of information" were collected/collated and examined to determine the focus species for this study;
- The data was examined to determine the possible occurrence of any Red Data and non-Red Data species;
- The site was comprehensively assessed during a field investigation to determine fauna and faunal micro habitats present within the site. This included:
    - All animals (mammals, reptiles and amphibians) seen or heard; were recorded.
    - Use was also made of indirect evidence such as animal tracks (footprints, droppings and various burrow types) to identify animals.
    - The majority of amphibians identified were calling adults as well as incidentally observed adults (under rocks, logs etc).
    - Reptiles were actively searched for under suitable refuges such as loosely embedded flat rocks, logs and stumps and identified by actual specimens observed.
- Information was supplemented by historical records, personal accounts from residents within the study area and a comprehensive literature review; and
- The impacts of the mine on faunal species were predicted and mitigation measures were proposed.

2.4 Significance of Identified Impacts on Biodiversity

Significance scoring assesses and predicts the significance of environmental impacts through evaluation of the following factors; probability of the impact; duration of the impact; extent of the impact; and magnitude of the impact. The significance of environmental impacts is then assessed considering any proposed mitigations. The significance of the impact “without mitigation” is the prime determinant of the nature and degree of mitigation required. Each of the above impact factors have been used to assess each potential impact using ranking scales as seen in **Table 1**.

Impact scores given “with mitigation” are based on the assumption that the mitigation measures recommended in this assessment are implemented correctly and rehabilitation of the site is undertaken. Failure to implement mitigation measures during operation will keep impacts at an unacceptably high level.

Unknown parameters are given the highest score (5) as significance scoring follows the Precautionary Principle. The Precautionary Principle is based on the following statement: *When the information available to an evaluator is uncertain as to whether or not the impact of the mine on the environment will be adverse, the evaluator must accept as a matter of precaution, that the impact will be detrimental*. It is a test to determine the acceptability of the mine. It enables the evaluator to determine whether enough information is available to ensure that a reliable decision can be made.

Table 1: Significance scoring used for each potential impact.

Probability	Duration
1 - very improbable 2 - improbable 3 - probable 4 - highly probable 5 - definite	1 - very short duration (0-1years) 2- short duration (2-5 years) 3 - medium term (5-15 years) 4 - long term (>15 years) 5 - permanent/unknown
Extent	**Magnitude**
1 - limited to the site 2 - limited to the local area 3 - limited to the region 4 - national 5 - international	2 – minor 4 – low 6 – moderate 8 – high 10 – very high

Significance Points = (Magnitude + Duration + Extent) x Probability. The maximum value is 100 Significance Points.

Potential Environmental Impacts are rated as high, moderate or low significance as per the following:

<30 significance points = Low environmental significance

31-59 significance points = Moderate environmental significance

>60 significance points = High environmental significance

3 BACKGROUND INFORMATION

3.1 Vegetation

Lowveld Rugged Mopaneveld

Distribution ranges over Limpopo and Mpumalanga Provinces with broken veld from the area southeast of Giyani in the west to Shimuwini and Boulders Camps in the east as well as the rugged area of the Olifants River Valley south of Phalaborwa, from Grietjieberg in the west to the Maveni River tributary in the east (**Figure 3**). Altitude ranges between 250 m to 550 m. Climate has some summer rainfall with very dry winters. Mean Annual Precipitation ranges from about 400 mm to 600 mm. Generally a frost-free area, but frost sometimes occurs in the low-lying areas (Mucina and Rutherford, 2006).

Vegetation & Landscape Features are slightly too extremely irregular plains with sometimes steep slopes and a number of prominent hills. The area around the Olifants River has more dissected and steeper slopes than the northern part of this unit. Usually dense shrubs with occasional trees and a sparse ground layer. Woody plants can become particularly dense where fire is excluded by very rocky terrain, such as in the vicinity of the Olifants River. Vegetation is more open in the northeastern parts of this unit outside the Kruger National Park (Mucina and Rutherford, 2006).

Geology & Soils from the Goudplaats Gneiss and Makhutswi Gneiss underlie most of this area, with a smaller contribution from the ultramafic metavolcanics (rocks rich in chlorite, amphibole, talc and serpentine) and metasediments of the Giyani Greenstone Belt (all Swazian Erathem). Soils are red-yellow apedal, freely drained, but also shallow and stony, especially in the east. Soil forms are mainly Hutton, Mispah and Glenrosa. Land types Ae, Fb and Fa (Mucina and Rutherford, 2006).

Plant species as describer by Mucina and Rutherford (2006) occurring within the Lowveld Rugged Mopaneveld includes:

Tall Trees include: *Senegalia nigrescens, Sclerocarya birrea subsp. caffra*.

Small Trees: *Colophospermum mopane, Combretum apiculatum, Terminalia prunioides, Vachellia exuvialis, Vachellia nilotica, Boscia albitrunca, Commiphora mollis* and *Dalbergia melanoxylon.*

Tall Shrubs: *Combretum hereroense, Dichrostachys cinerea, Grewia bicolor, G. villosa, Rhigozum zambesiacum.*

Low Shrubs: *Commiphora africana, Melhania forbesii, M. rehmannii, Solanum panduriforme. Graminoids: Aristida congesta, Enneapogon cenchroides, Melinis repens, Sporobolus panicoides, Bothriochloa radicans, Digitaria eriantha subsp. pentzii, Fingerhuthia africana* and *Panicum maximum.*

Herbs: *Crabbea velutina, Heliotropium steudneri, Hemizygia elliottii, Hibiscus sidiformis, Phyllanthus asperulatus* and *Xerophyta retinervis.*

Conservation is least threatened with majority being in the Kruger National Park. At least an additional 5% conserved in private reserves, such as Klaserie, Letaba Ranch and Selati Game Reserve. Some transformed landscapes occur mainly by cultivation and some urban and built-up areas (**Figure 4**). This vegetation occurring outside the conserved areas is under pressure from high-density rural human population and associated urban sprawl and agricultural activities. Some areas experience moderate erosion. The southern part of this unit in the Kruger National Park contains a number of tree species that are relatively scarce elsewhere in the park, e.g. *Kirkia wilmsii* and *Hexalobus monopetalus* (Mucina and Rutherford, 2006).

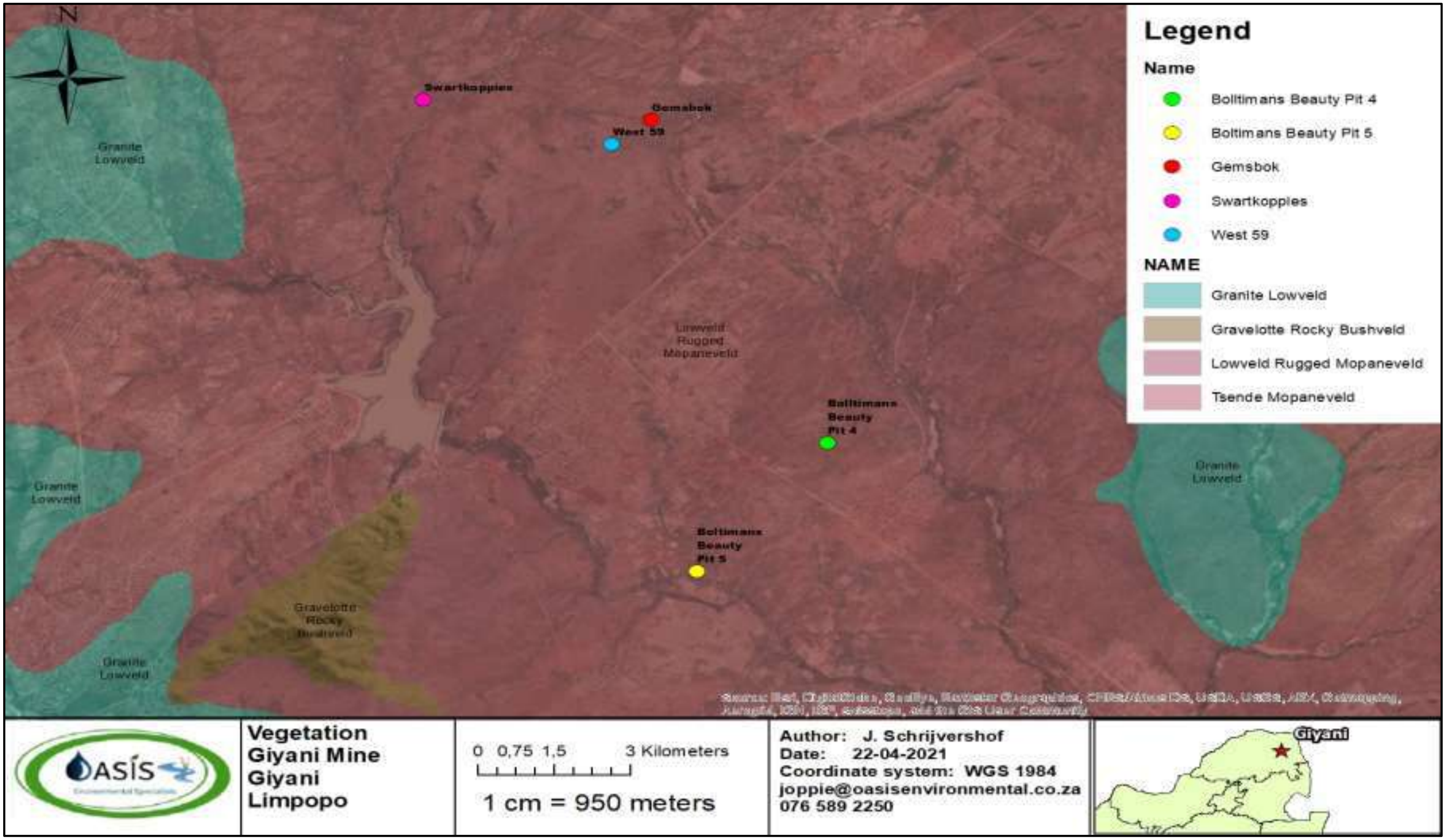


Figure 3: Giyani Mine - Vegetation map.

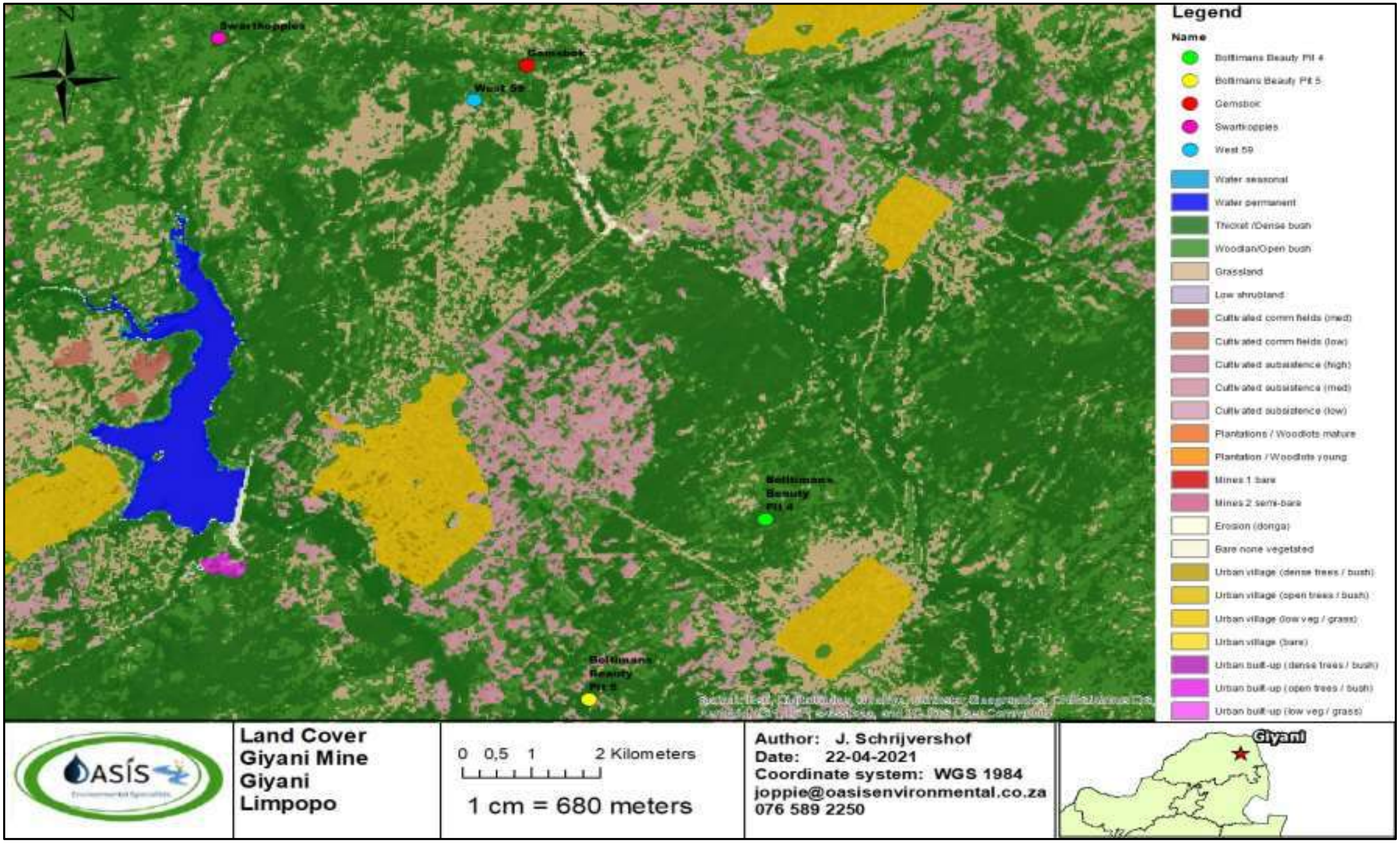


Figure 4: Giyani Mine - Land cover map.

4 RESULTS

4.1 Ecological Assessment

4.1.1 **Critical Biodiversity Areas**

According to the biodiversity datasets provided by SANBI (2021), the current mining area (Swartkoppies) and the 2 western pit areas (West 59 and Gemsbok) falls within a Critical Biodiversity Area 2 as seen in **Figure 5**. These sections were confirmed to be Mopani forest and bushveld areas during the site visit. The two remaining eastern pit areas falls within an Ecological Support 1 area and the other within an Other Natural Areas. These areas had disturbance by informal settlements surrounding these areas.

Critical Biodiversity Areas (2) (CBA 2) are classified as best design selected sites and are selected to meet biodiversity pattern and/or ecological process targets. Alternative sites may be available to meet targets. Ecological Support Areas (1) (ESA 1) Natural and/or near natural and degraded areas supporting CBAs by maintaining ecological processes. Other Natural Areas are classified as natural and intact but not required to meet targets, or identified as CBA or ESA. No natural habitat remaining areas are not significant to direct biodiversity value.

4.1.2 **Threatened Ecosystems and Protected areas**

The mining areas does not overlap with any protected ecosystems.

4.1.3 **Important Bird Areas**

The proposed mining operations fall within close proximity to Important Bird Areas (IBAs), where the proposed mining area falls close to the Kruger National Park (**Figure 6**).

The Kruger National Park is known to support more than 490 bird species, about 57% of the species found in the entire southern African subregion. The diversity of birds can be attributed to the numerous different habitats and the ecotonal nature of the area. There are several important populations of widespread species that do not thrive outside large protected areas. In addition, the riverine forests constitute habitat corridors that are used by some species of the Drakensberg escarpment to move down to the Lowveld to escape the severe escarpment winters. The riverine forests also provide habitat for secretive, river-dependent species such as Pel's Fishing Owl *Scotopelia peli*, White-backed Night Heron *Gorsachius leuconotus* and African Finfoot *Podica senegalensis* (Birdlife, 2020).

The rivers, floodplains, pans, dams and vleis are important for many watercourse dependent and associated birds, such as

Black Stork *Ciconia nigra* (which breeds in the gorges of the nearby Lebombo Mountains), Woolly-necked Stork *C. episcopus*, African Openbill *Anastomus lamelligerus*, Saddle-billed Stork *Ephippiorhynchus senegalensis* and White-crowned Lapwing *Vanellus albiceps*. When conditions are suitable, Pink-backed Pelican *Pelecanus rufescens*, Great White Pelican *P. onocrotalus*, Rufous-bellied Heron *Ardeola rufiventris*, Greater Flamingo *Phoenicopterus roseus*, Lesser Moorhen *Gallinula angulata*, Allen's Gallinule *Porphyrio alleni*, Lesser Jacana *Microparra capensis*, African Marsh Harrier *Circus ranivorus*, Chestnut-banded Plover *Charadrius pallidus* and Black Coucal *Centropus grillii* occur in small numbers. The seasonally flooded grasslands to the north of Shingwedzi hold Corn Crake *Crex crex* in summer (Birdlife, 2020).

Of the wide-ranging species that are rare outside South Africa's large national parks, Marabou Stork *Leptoptilos crumeniferus*, Hooded Vulture *Necrosyrtes monachus*, White-backed Vulture *Gyps africanus*, Lappet-faced Vulture *Torgos tracheliotos*, White-headed Vulture *Aegypius occipitalis*, Martial Eagle *Polemaetus bellicosus*, Bateleur *Terathopius ecaudatus*, Tawny Eagle *Aquila rapax*, Kori Bustard *Ardeotis kori* and Southern Ground-Hornbill *Bucorvus leadbeateri* are locally common in the KNP. Cape Vulture *Gyps coprotheres* regularly forages in the park. Pallid Harrier *Circus macrourus* and African Grass Owl *Tyto capensis* occur in low numbers (Birdlife, 2020).

The varied woodland communities host a plethora of small accipiters, cuckoos, owls, kingfishers, bee-eaters, rollers, hornbills, barbets, robins, cisticolas, flycatchers, shrikes, starlings, sunbirds, weavers, finches and waxbills. The thicket and forest areas support Brown-headed Parrot *Poicephalus cryptoxanthus* and Gorgeous Bush-Shrike *Chlorophoneus viridis*, which are restricted to the East African Coast biome. The small patches of sandveld in the far north-east hold low numbers of Pink-throated Twinspot *Hypargos margaritatus*, while the Lala palm savanna, also in the north-east, supports Lemon-breasted Canary *Crithagra citrinipectus* (Birdlife, 2020).

Near Pafuri, in the extreme north, many species reach the southern limit of their Afrotropical range and are consequently extremely rare within South Africa, although they are considerably more common and widespread just outside the country's borders. Such species include Dickinson's Kestrel *Falcobdickinsoni*, Racket-tailed Roller *Coracias spatulata*, Tropical Boubou *Laniarius major*, Mottled Spinetail *Telacanthura ussheri* and Böhm's Spinetail *Neafrapus boehmi*, as well as Grey-headed Parrot *Poicephalus fuscicollis*, which is found in the riparian forests and thickets of the far north. These species are of interest from a South African perspective, but are of little subregional or global conservation significance as the populations are small and peripheral (Birdlife, 2020).

Red-billed Oxpecker *Buphagus erythrorhynchus* is common and widespread, but Yellow-billed Oxpecker *B. africanus* was considered extinct until 1979. This species has recolonised the KNP naturally and is now considered an uncommon breeding resident, occurring throughout the park but especially in the northern half (Birdlife, 2020).

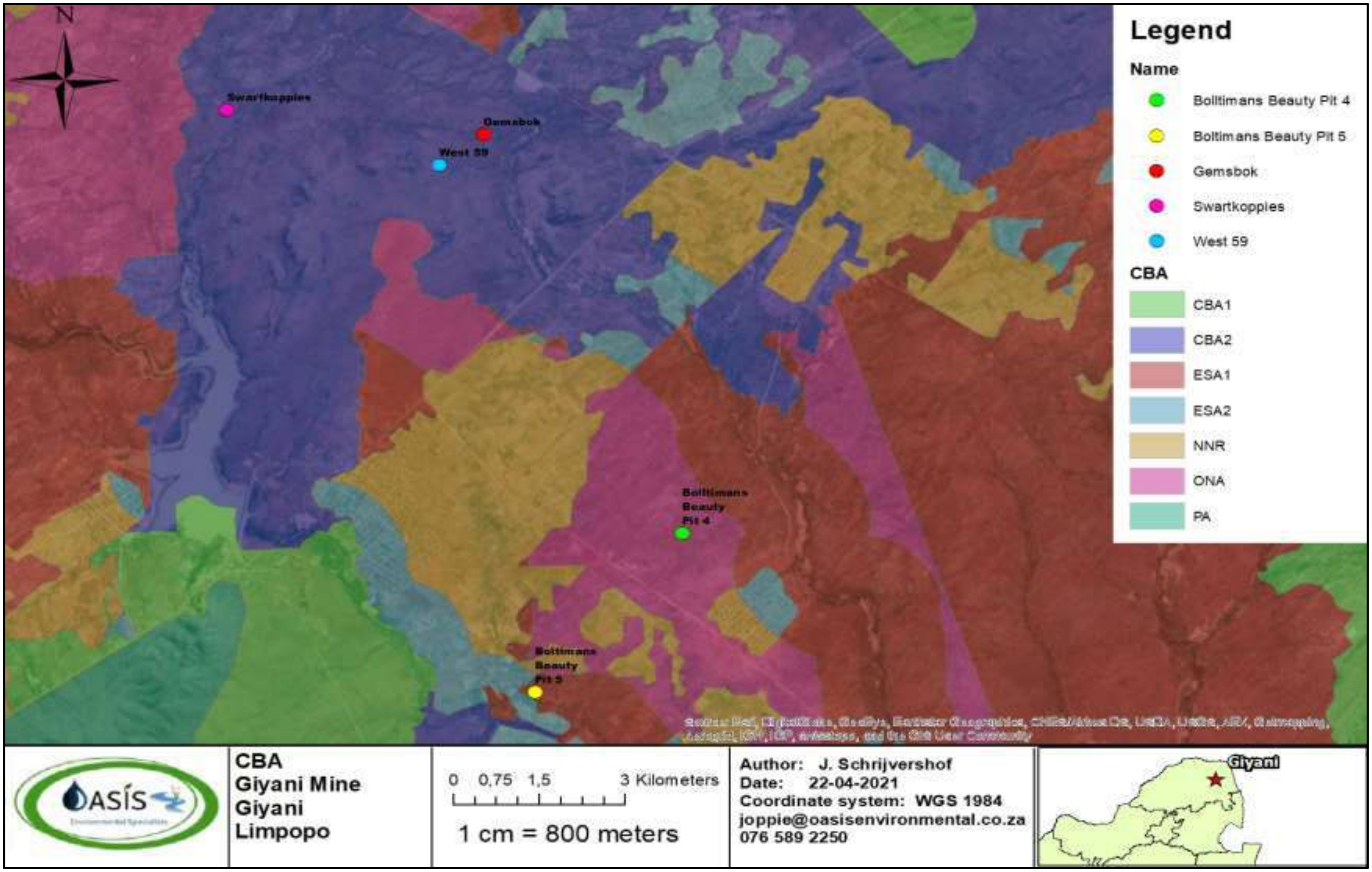


Figure 5: Giyani Mine - Critical Biodiversity Areas map.

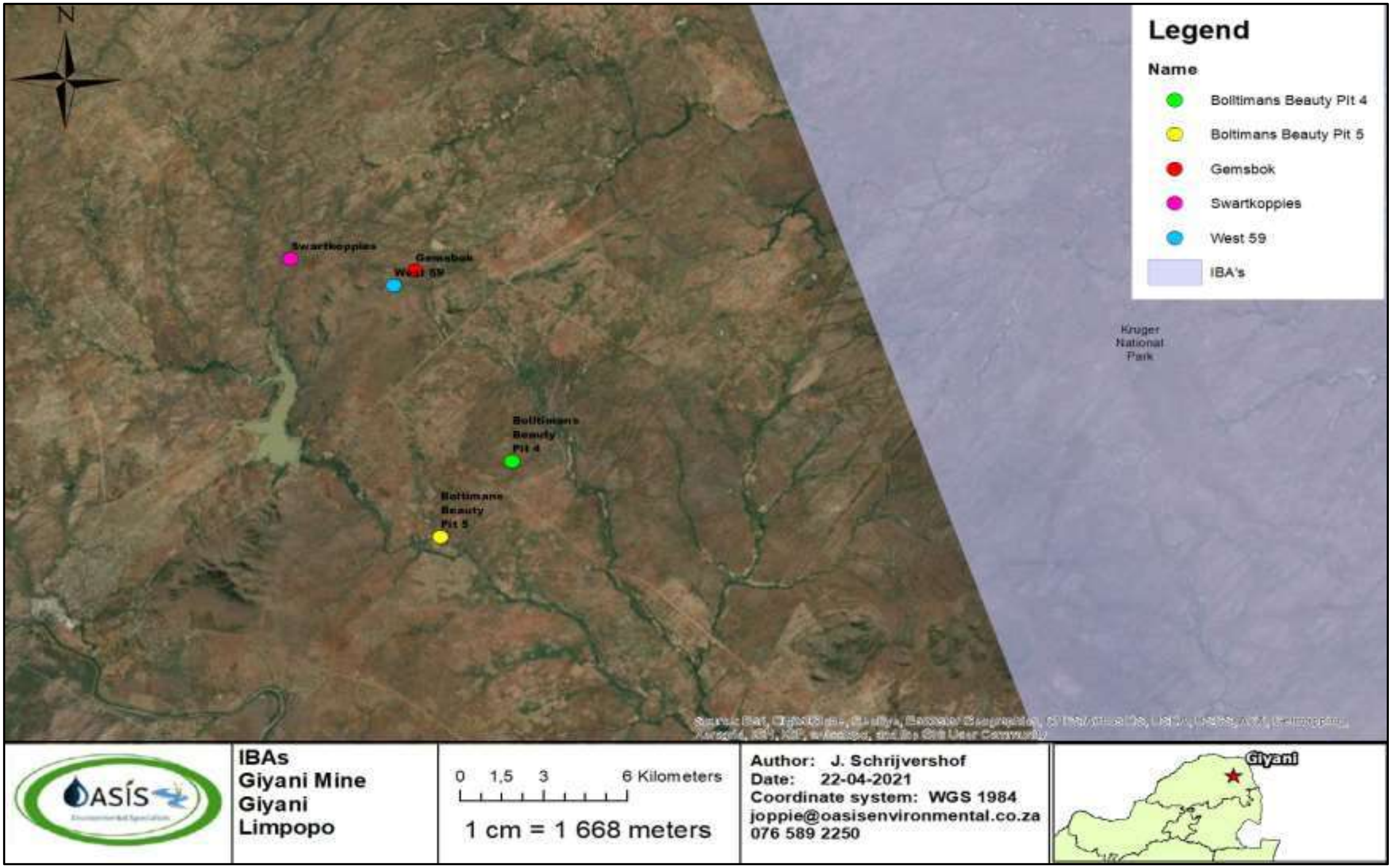


Figure 6: Giyani Mine - Important Bird Areas map.

4.1.4 Vegetation

The majority of the study site consisted of indigenous vegetation with some alien vegetation within the transformed areas, however vegetation normally associated with that area is listed in **Appendix B** depicted from SANBI's POSA list. Information on plant species recorded in that area was extracted from the POSA list, indicate that 221 plant species have been recorded in the area queried of which 211 are endemic species are known to occur within the area queried. (**Table 2**).

The field survey was planned to include all the different habitat types and to target threatened species that may occur in the proposed mining areas. Photographs of important features were taken and will be included in the report.

Vegetation near the road is very dense as a result of increased runoff from the hard surfaces. Some areas in the private reserves have vegetation in a good condition. There are a number of small non perennial streams that must be negotiated during construction and care must be taken to ensure the vehicles use existing roads. Erosion can increase if the heavy construction vehicles cross the streams and a rehabilitation plan must be in place prior to construction commences

Trees dominated the area and included *Combretum spp.*, *Vachellia robusta*, *Vachellia tortilis*, *Senegalia nigrescens* and *Colophospermum mopane.* However, *Cissus cornifolia, Albizia harveyi, Mundulea sericea, Terminalia sericea, Terminalia prunioides, Grewia bicolor, Dichrostachys cinerea, Sclerocarya caffra, Dalbergia melanoxylon, Peltophorum africanum, Strychnos madagascariensis and Commiphora africana* are also abundantly present (**Figure 7)**.

No IUCN red listed species is known occur within the Giyani area and was not observed during the site visit.

Table 2: Floral species summary for the area queried around the proposed Giyani Mine as per SANBI (2021).

Number of Families	Number of species	Endemic species	Exotic species	IUCN Red Listed Species
60	221	211	10	0

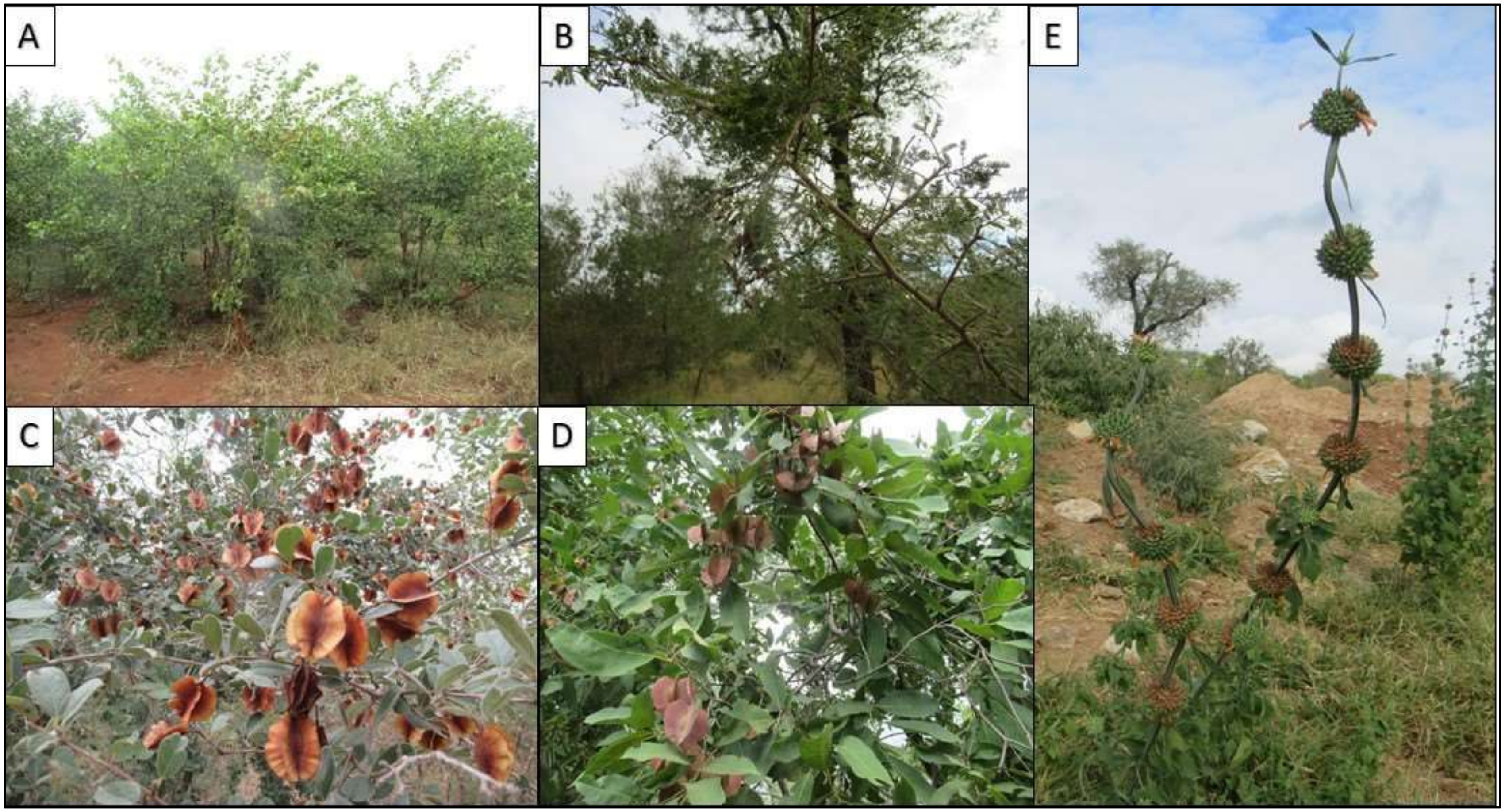


Figure 7: Giyani Mine – Some of the vegetation identified included: (A) Mopani Trees dominating the landscape (*Colophospermum mopane*), (B) Senegalia and Vachellia species w; (C) Russet Bushwillow (*Combretum hereroense.*), (D) Forest Bushwillow (*Combretum kraussii*) and (E) Lion's tail (*Leonotis leonurus*) found in the disturbed areas, these plants have medicinal properties used to treat tuberculosis, jaundice, muscle cramps, high blood pressure, diabetes, viral hepatitis, dysentery, and diarrhoea.

4.1.5 **Alien Invasive Vegetation**

National Environmental Management: Biodiversity Act (No. 10 of 2004) categories for invasive species according to Section 21 are as follows:

- Category 1a: Species requiring compulsory control;
- Category 1b: Invasive species controlled by an invasive species management programme;
- Category 2: Invasive species controlled by area, and;
- Category 3: Invasive species controlled by activity.

Certain species have different alien invasive categories for different provinces in South Africa. Very little alien species were identified on site. The only alien plant species observed were Morning Glory (*Ipomoea carnea*) (category 1b) and Rough Cocklebur (*Xanthium strumarium*) (not listed).

4.1.6 **Fauna**

The faunal component between the game farms/private reserves and open bushveld differs considerably. Within the open areas where deforestation of Mopani forest are occurring, very little evidence of faunal activity was noted as the proposed pit areas are being disturbed by anthropogenic activities such as illegal deforestation. Cattle and goats were noted grazing within these areas. Some spoor and droppings of mammals and some smaller rodents were seen.

Limited faunal species were observed and the majority was sites near game farms and private reserves and included: Communal spider nests, sociable weaver (*Philetairus socius*), Laughing dove (*Spilopelia senegalensis*), Ring-necked dove (*Streptopelia capicola*), Cape glossy starling (*Lamprotornis nitens*), Southern red-billed hornbill (*Tockus erythrorhynchus*), Bronze winged courser (*Rhinoptilus chalcopterus*), Golden Orb Spider (*Trichonephila spp.*) (**Figure 8**).The fauna expected to occur within that area is listed in **Appendix A**.

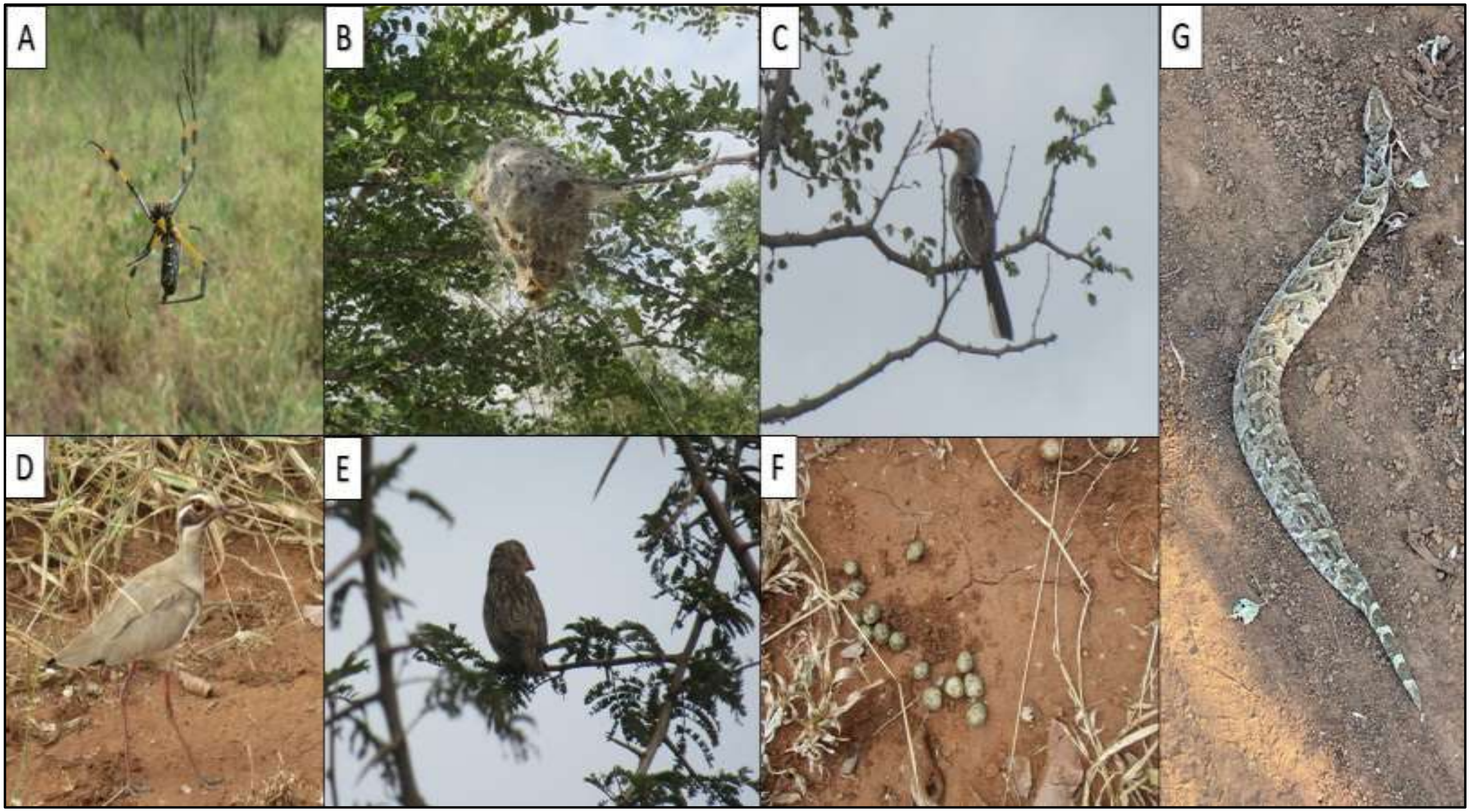


Figure 8: Giyani Mine – Identified fauna included: (A) Golden orb spider (*Trichonephila spp.*) (B) Communal spider nest; (C) Southern red-billed hornbill (*Tockus erythrorhynchus*); (D) Bronze-winged courser (*Rhinoptilus chalcopterus*); (E) Nesting areas with sociable weaver (*Philetairus socius*);) and (F) Mammalian droppings and (G) A Pufadder (*Bitis arietans*) observed a few months ago by Giyani Mine staff.

4.1.7 **Sensitivity Mapping**

All bushveld areas and watercourses still intact can be considered highly sensitive areas serves as a breeding and foraging habitat for a number of faunal species. These channel areas can be regarded as ecologically irreplaceable and covers a portion of the application area. It will be nearly impossible to imitate these areas after mining has been completed with a rehabilitation programme. Historical transformed Grasslands with cultivation which have been considered as moderately sensitive as they have been disturbed by surrounding anthropogenic activities, but some vegetation has started establishing again. Current transformed land by urbanisation and agriculture can be considered low sensitive and covers the majority of the area. These areas are illustrated in **Figure 9**.

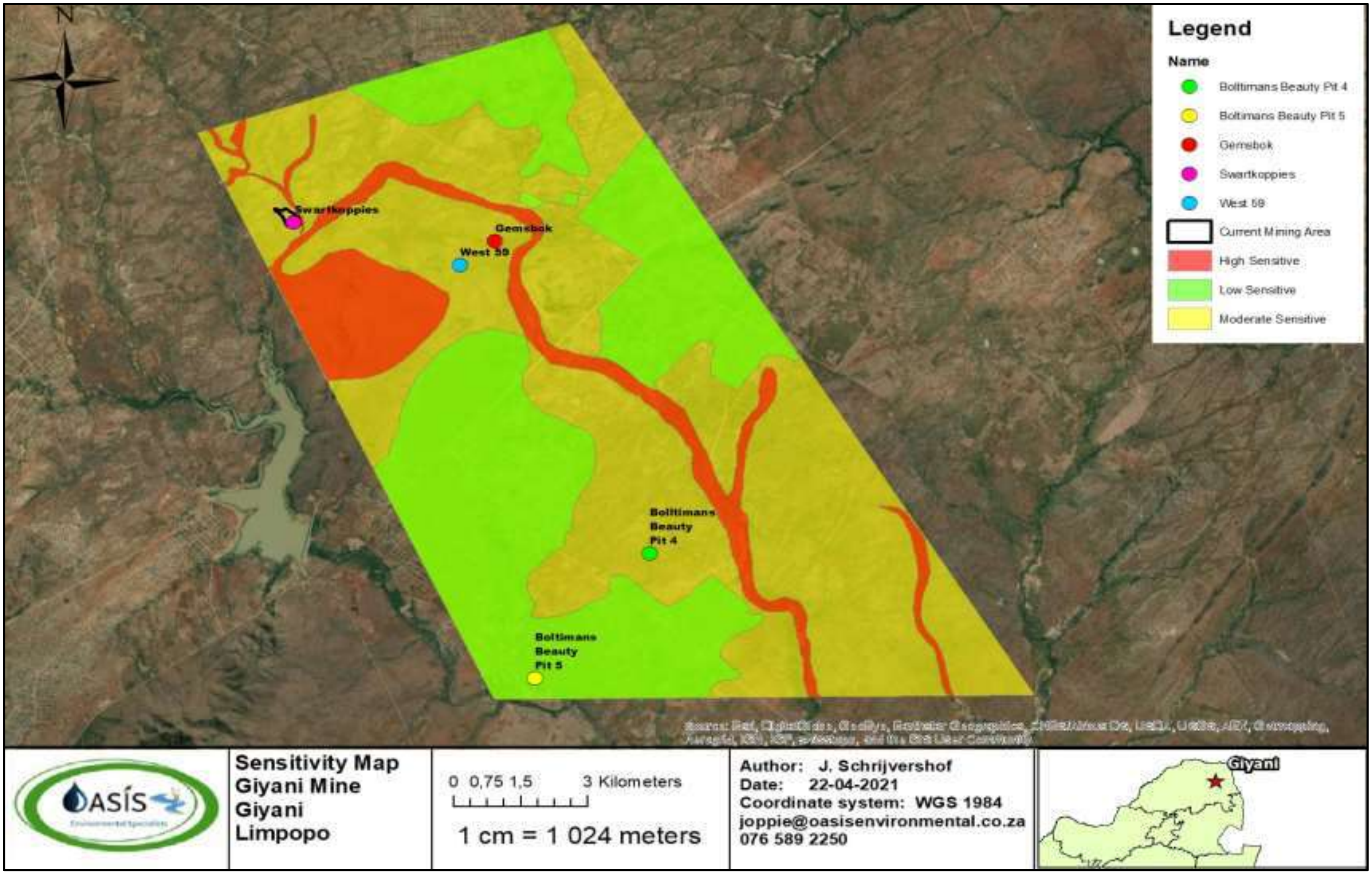


Figure 9: Giyani Mine - Sensitivity map.

5 IMPACTS ON BIODIVERSITY

Any development activity in a natural system will have an impact on the surrounding environment, usually in a negative way. The purpose of this phase of the study was to identify and assess the significance of the potential impacts caused by the proposed development and to provide a description of the mitigation required to limit the identified impacts on the biodiversity.

A number of potential impacts relating to the loss of indigenous vegetation, floral habitat and ecological structure, loss of floral diversity and ecological integrity, proliferation of alien invasive species, loss of plant species of conservation concern, loss of faunal habitat, direct faunal impacts and disturbance to fauna are predicted to occur as a result of the Giyani Mine. These impacts will cause permanent damage to the environment and can never be fully reversed or mitigated.

5.1.1 **Loss of Species of Conservation Concern**

Due to the removal of vegetation within the project area, loss of floral diversity is inevitable. There will be a resultant increase in the risk of alien plant species that colonise the area, subsequently decreasing the indigenous species richness and composition of the area. The loss of ground cover will also expose soil leading to soil desiccation.

The proposed mining development is likely to have a negative impact in terms of loss of ecological connectivity through the clearing of vegetation. This will result in habitat fragmentation. Loss of habitat and habitat fragmentation will disrupt ecological functioning, negatively affecting the ecological integrity of the area. Small fragments of vegetation may not be large enough to support viable populations of pollinators and seed dispersers, resulting in the decreased reproduction of plant species. Moreover, an extinction debt may be present in cleared or fragmented areas, whereby, as a consequence to reduced floral diversity and disturbance to population structure, future extinction of local populations is unavoidable.

From a faunal perspective, endemic species and species of concern have specific habitat requirements and the impacts of the proposed mine will have significant effects on these species. The reptile species are slow moving and will likely be targeted during the construction and operational phase.

Table 3: Impacts associated with the loss of species of conservation concern

Setting up infrastructure and moving onto site				
Probability	**Duration**	**Extent**	**Magnitude**	**Significance score**
5	4	2	8	**70 (High)**
Operational Phase				
Probability	**Duration**	**Extent**	**Magnitude**	**Significance score**
4	4	2	6	**48 (Moderate)**

5.1.2 **Loss of indigenous vegetation, floral and faunal habitat and ecological structure of water resources and soil**

The proposed mining operation will result in the destruction of vegetation, floral habitat and a complete loss of faunal habitats within the area. This will directly impact the ecological condition of natural vegetation and habitat availability. These activities will have an impact on foraging, breeding and roosting ecology of faunal species. Loss of vegetation generally affects nutrient cycles, removes the organic litter layer and results in habitat fragmentation and destruction of wildlife corridors.

The vegetation on the proposed mine site itself is regarded as intact and species diverse. Disturbance of soil and removal of vegetation will promote the establishment and of alien invasive species.

Cumulative impacts include a decrease in floral habitat and ecological structure will lead to the proliferation of alien invasive species, a potential loss of red listed plant species, habitat fragmentation and an overall decrease in species richness in the area. The large land surface alterations will also change the composition of the ecosystem on the edge of structures. This will result in a loss of cohesiveness between larger fragments of habitat limiting gene exchanges and resources between these areas.

Loss of vegetation, in the case of a mine is irreversible, and although rehabilitation will take place after the mine is closed, restoration of the natural habitat on site cannot be achieved. This is particularly significant in an area where endemism of both flora and fauna is considered high and in ecologically sensitive areas.

Table 4: Impacts associated with the loss of indigenous vegetation, floral and faunal habitat and ecological structure

Setting up infrastructure and moving onto site				
Probability	**Duration**	**Extent**	**Magnitude**	**Significance score**
5	4	2	8	**70 (High)**
Operational Phase				
Probability	**Duration**	**Extent**	**Magnitude**	**Significance score**
4	4	2	6	**48 (Moderate)**

5.1.3 Alien Invasive Species

Alien invasive species will quickly encroach into disturbed areas. Alien species generally out-compete indigenous species for water, light, space and nutrients as they are adaptable to changing conditions and are able to easily invade a wide range of ecological niches (Bromilow, 2010). Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs (Zedler, 2004). This negatively affects the ability of the disturbed area to maintain floral biodiversity.

Table 5: Impacts associated with the proliferation of alien invasive species

Setting up infrastructure and moving onto site				
Probability	**Duration**	**Extent**	**Magnitude**	**Significance score**
5	4	2	8	**70 (High)**
Operational Phase				
Probability	**Duration**	**Extent**	**Magnitude**	**Significance score**
4	4	2	6	**48 (Moderate)**

5.1.4 Mitigation

- The mining footprint should be kept as small and as linear as possible for the pit areas.
- During the construction phase, workers must be limited to areas under construction and access to the undeveloped areas must be strictly controlled.
- The boundaries of the development footprint areas are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area. No activities are to infringe upon any channels and/or rivers.
- Edge effects of all phases, such as erosion and alien plant species proliferation, which will affect faunal habitats adjacent to the development area, need to be strictly managed. This can be achieved through the chemically and mechanically removing alien invasive vegetation within the mining footprint. The removal of this vegetation will provide job opportunities for community members.
- Any natural areas beyond the development footprint, which have been affected by the construction activities, must be rehabilitated using indigenous plant species. Rehabilitation must take place concurrent to operations, and post-closure.
- The clearing of vegetation, during the construction phase, must be kept to a minimum and must be within the

project boundaries.

- Harvesting and collection of any flora must be strictly prohibited.
- Erosion control measures must be implemented in areas sensitive to erosion such as exposed soil, edges of slopes (including trenches cut for construction) etc. These measures include but are not limited to - the use of sand bags, hessian sheets, silt fences and retention or replacement of vegetation.
- Avoid known areas of faunal and floral species of special concern as indicated on the relevant maps.
- Avoidance of sensitive areas, as these areas are ecologically irreplaceable.
- Maintain top soil biological activity by stockpiling soils without compacting them. This keeps the seed bank in the topsoil viable if the topsoil is replaced within a year. This viable seedbank will create an effective basis for rehabilitated areas where these soils are used.
- Education and awareness campaigns on faunal species and their habitat are recommended to help increase awareness, respect and responsibility towards the environment for all staff and contractors.
- Disturbed areas must be rehabilitated immediately after construction has been completed in that area by planting appropriate indigenous plant species.
- If mining is permitted, rehabilitated areas must be monitored to ensure the establishment of re-vegetated areas to a ground of cover of at least 85%.
- Once pegged, a qualified botanist must walk the site to identify all conservation-important species. These species must be translocated to a suitable habitat outside of the construction footprint, prior to any construction activities.
- Plant permits must be obtained from the relevant authorities prior to any construction activities commencing.
- Any protected plants that are removed must be replaced at a ratio of 1:10 (10 plants must be planted for every 1 plant removed).
- It is highly recommended that a speed limit of 30km/h is implemented on all roads running through the proposed mining area during all phases in order to minimise risk to fauna from vehicles and that signage is erected to this effect. Should an animal be killed by a vehicle, the incident must be reported immediately to the ECO and to the Endangered Wildlife Trust (www.ewt.org.za), to monitor road kills. EWT Wildlife and Roads project has been set up to monitor and investigate the effects of road kills in South Africa.
- Any bird nests that are found during the construction period must be reported to the Environmental Control Officer

(ECO).

- It is essential that as transformation takes place on site, a qualified herpetologist must be present on site to identify and safely remove all reptiles or other slow moving species, should they occur on the proposed development site.
- No trapping or hunting of fauna is to take place. Access control must be implemented to ensure that no illegal trapping or poaching takes place.
- Where possible, species should be left in their natural environment.
- Should any Red Data faunal species be noted within the development footprint areas, these species must be relocated to similar habitat with the assistance of a suitably qualified ecologist.
- Any species directly threatened by the construction activities must be removed to a safe location by the ECO or qualified Ecologist. Floral species of special concern must be relocated or placed in a nursery.
- If the proposed Giyani Mine proceeds, it must contribute meaningfully to conservation in the region. Conservation of natural land and the creation of corridors in the area would aid ecosystems, and fauna and flora. Corridors and conservation areas should be identified by qualified ecologists for a Biodiversity Action Plan (BAP).
- Avoidance of river and channel areas as far as possible (100 m buffer), these areas are regarded as highly sensitive areas.
- Search and rescue for reptiles and other vulnerable species, before areas are cleared.
- Environmental induction for all staff and contractors on-site.
- Any disturbed areas should be rehabilitated in line with the rehabilitation guidelines, this includes the clearing of alien vegetation, following the guidelines of a suitable alien invasive plant management plan.
- The site must be regularly monitored for re-growth of alien invasive species, and any new seedlings etc. eradicated using methods appropriate for the particular species, whether mechanical, chemical or biological.
- Protect as much indigenous vegetation as possible.
- An alien invasive management programme must be incorporated into an Environmental Management Programme.
- Ongoing alien plant control must be undertaken in the disturbed areas as these areas will quickly be colonised by invasive alien species, especially in the riparian zone, which is particularly sensitive to AIP infestation.
- Herbicides must be carefully applied, in order to prevent any chemicals from entering the river. Spraying of herbicides within or near to the channel and river areas is strictly forbidden.

- Re-instate indigenous vegetation (grasses and indigenous trees) in disturbed areas directly after mining ceases so as to stabilise against erosion and sedimentation.

6 CONCLUSION & RECOMMENDATIONS

The mining areas falls within the Lowveld Rugged Mopaneveld vegetation type as per Mucina and Ritherford (2006). According to the biodiversity datasets provided by SANBI (2021), the current mining area (Swartkoppies) and the 2 western pit areas (West 59 and Gemsbok) falls within a Critical Biodiversity Area 2. These sections were confirmed to be Mopani forest and bushveld areas during the site visit. The two remaining eastern pit areas falls within an Ecological Support 1 area and the other within a Other Natural Areas. These areas had disturbance by informal settlements surrounding these areas.

Critical Biodiversity Areas (2) (CBA 2) are classified as best design selected sites and are selected to meet biodiversity pattern and/or ecological process targets. Alternative sites may be available to meet targets. Ecological Support Areas (1) (ESA 1) Natural and/or near natural and degraded areas supporting CBAs by maintaining ecological processes. Other Natural Areas are classified as natural and intact but not required to meet targets, or identified as CBA or ESA. No natural habitat remaining areas are not significant to direct biodiversity value.

The mining areas does not overlap with any protected or endangered ecosystems. The proposed mining operations fall within close proximity to Important Bird Areas (IBAs), where the proposed mining area falls close to the Kruger National Park

Trees dominated the area and included *Combretum spp.*, *Vachellia robusta*, *Vachellia tortilis*, *Senegalia nigrescens* and *Colophospermum mopane.* However, *Cissus cornifolia, Albizia harveyi, Mundulea sericea, Terminalia sericea, Terminalia prunioides, Grewia bicolor, Dichrostachys cinerea, Sclerocarya caffra, Dalbergia melanoxylon, Peltophorum africanum, Strychnos madagascariensis and Commiphora africana* are also abundantly present

Limited faunal species were observed and the majority was sites near game farms and private reserves and included: Communal spider nests, sociable weaver (*Philetairus socius*), Laughing dove (*Spilopelia senegalensis*), Ring-necked dove (*Streptopelia capicola*), Cape glossy starling (*Lamprotornis nitens*), Southern red-billed hornbill (*Tockus erythrorhynchus*), Bronze winged courser (*Rhinoptilus chalcopterus*), Golden Orb Spider (*Trichonephila spp.*). Leopard and African elephant listed as vulnerable are though to occur within this areas according to SANBI (2021), but is found within the Kruger National Park and is unlikely to occur within this area.

All expected faunal species are listed in **Appendix A** for QDS 2330BB and 2330BD and all floral species are listed in A**ppendix B** for the Giyani area.

A number of potential ecological impacts relating to proliferation of alien invasive species, loss of species of conservation concern, loss of indigenous vegetation, floral and faunal habitat and ecological structure of water resources and soil, loss of floral diversity and ecological integrity. The significance of potential impacts on biodiversity within the area was rated as **high significance without mitigation and moderate with mitigation** as the proposed areas lies in Mopani bushveld areas.

During construction it will be important to liaise with the landowners off the game farms and private reserves. Where dangerous animals are present, it will be important to ensure that game is moved to other camps where possible. A ranger from the farm must be present during construction to ensure the safety of man and animals.

Provided mitigation measures are to be implemented within an environmental management programme (EMPr) and the significance of any negative impacts reduced should the mining commence. Potential impacts associated with the construction and operational phase include:

- Increased sedimentation and water quality impairment due to runoff from waste dumps;
- Water quality contamination due to runoff or seepage from any tailings storage facility;
- Alteration of natural flow regime due to discharge of pit water;
- Increased utilisation of aquatic resources by local population; and
- Habitat loss associated with the stream diversion.

Should mining commence the following mitigation measures, aimed at minimising the afore-mentioned impacts, include (but are not limited to):

- Design and implementation of a suitable stormwater system;
- Rehabilitation of the disturbed areas;
- Limiting instream sedimentation;
- Minimising pollutants entering the watercourse;
- Implement a programme for the clearing/eradication of alien species including long term control of such species; and
- A 100 m buffer was implemented for the channel and river systems (Sensitive areas).

REFERENCES

Animal Demography Unit (ADU). Virtual Museum. http://vmus.adu.org.za. Date of Use: 2021/04/22.

BirdLife International (2020) Important Bird Areas factsheet: Amersfoort - Bethal - Carolina District. Downloaded from http://www.birdlife.org Date of Use: 2021/04/22.

Bromilow, C. 2010. Problem plants and alien weeds of South Africa. Briza.

Du Preez, L. and Carruthers V. 2009. A Complete Guide to the Frogs of Southern Africa. Struik Publishers, Cape Town. 488 pp.

International Union for Conservation of Nature (IUCN) Red List of Threatened Species. http://www.iucnredlist.org/. Date of Use: 2021/04/22.

Mucina, L. and Rutherford, M.C. (eds) 2006. Vegetation Map of South Africa, Lesotho and Swaziland, edn 2, 1:1 000 000 scale sheet maps. South African National Biodiversity Institute, Pretoria. ISBN 978-1-919976-42-6.

National Environmental Management Act No. 107 of 1998

National Environmental Management: Biodiversity Act 1998 (Act 108 of 1998): National list of ecosystems that are threatened and in need of protection. Government Gazette, 558(34809): 1 – 544, December 9, 2011.

Osman, S. M. 2014. "Save the Baobab". Practicalaction.org. ITDG Practical Action Sudan. Archived from the original on 2015-12-02.

Rutherford, M.C. and Westfall, R.H. 1994. Biomes of southern Africa: an objective categorization. Mem. Bot. Surv. S. Afr, (63).

South African National Biodiversity Institute (SANBI) Biodiversity GIS decision support tool. Municipal Biodiversity Summary Project. http://bgis.sanbi.org. Date of Use: 2021/04/21.

Zedler, J.B. and Kercher, S. 2004. Causes and consequences of invasive plants in channel and rivers: opportunities, opportunists, and outcomes. Reviews in Plant sciences, 23(5), pp.431-452.

APPENDIX A – FAUNAL SPECIES LIST FOR 2330BB AND 2330BD

INSECTA			
Hesperiidae	*Abantis paradisea*	Paradise skipper	Least Concern (SABCA 2013)
Nymphalidae	*Acraea caldarena caldarena*	Black-tipped acraea	Least Concern (SABCA 2013)
Lycaenidae	*Aloeides aranda*	Yellow russet	Least Concern (SABCA 2013)
Nymphalidae	*Amauris albimaculata albimaculata*	Layman	Least Concern (SABCA 2013)
Nymphalidae	*Amauris niavius dominicanus*	Southern friar	Least Concern (SABCA 2013)
Lycaenidae	*Anthene amarah amarah*	Black-striped ciliate blue	Least Concern (SABCA 2013)
Pieridae	*Belenois aurota*	Pioneer caper white	Least Concern (SABCA 2013)
Nymphalidae	*Byblia ilithyia*	Spotted joker	Least Concern (SABCA 2013)
Hesperiidae	*Caprona pillaana*	Ragged skipper	Least Concern (SABCA 2013)
Pieridae	*Catopsilia florella*	African migrant	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes brutus natalensis*	White-barred charaxes	Least Concern (SABCA 2013)
Nymphalidae	*Charaxes saturnus saturnus*	Foxy charaxes	Least Concern (SABCA 2013)
Lycaenidae	*Cigaritis ella*	Ella's silverline	Least Concern (SABCA 2013)
Lycaenidae	*Cigaritis mozambica*	Mozambique silverline	Least Concern (SABCA 2013)
Hesperiidae	*Coeliades forestan forestan*	Striped policeman	Least Concern (SABCA 2013)
Hesperiidae	*Coeliades pisistratus*	Two-pip policeman	Least Concern (SABCA 2013)
Pieridae	*Colotis auxo auxo*	Sulphur orange tip	Least Concern (SABCA 2013)
Pieridae	*Colotis evenina evenina*	African orange tip	Least Concern (SABCA 2013)
Nymphalidae	*Danaus chrysippus orientis*	African plain tiger	Least Concern (SABCA 2013)
Lycaenidae	*Deudorix dinochares*	Apricot playboy	Least Concern (SABCA 2013)
Pieridae	*Eronia cleodora*	Vine-leaf vagrant	Least Concern (SABCA 2013)
Lycaenidae	*Euchrysops osiris*	Osiris smoky blue	Least Concern (SABCA 2013)
Pieridae	*Eurema brigitta brigitta*	Broad-bordered grass yellow	Least Concern (SABCA 2013)
Pieridae	*Eurema hecabe solifera*	Lowveld yellow	Least Concern (SABCA 2013)
Hesperiidae	*Gegenes pumilio gambica*	Dark dodger	Least Concern (SABCA 2013)

Papilionidae	*Graphium antheus*	Large striped swordtail	Least Concern (SABCA 2013)
Papilionidae	*Graphium morania*	White lady	Least Concern (SABCA 2013)
Nymphalidae	*Hamanumida daedalus*	Guineafowl	Least Concern (SABCA 2013)
Lycaenidae	*Hemiolaus caeculus caeculus*	Azure hairstreak	Least Concern (SABCA 2013)
Nymphalidae	*Hypolimnas misippus*	Common diadem	Least Concern (SABCA 2013)
Lycaenidae	*Hypolycaena philippus philippus*	Purple-brown hairstreak	Least Concern (SABCA 2013)
Nymphalidae	*Junonia hierta cebrene*	Yellow pansy	Least Concern (SABCA 2013)
Nymphalidae	*Junonia natalica natalica*	Brown commodore	Least Concern (SABCA 2013)
Lycaenidae	*Lepidochrysops glauca*	Silvery giant cupid	Least Concern (SABCA 2013)
Lycaenidae	*Lepidochrysops patricia*	Patrician giant cupid	Least Concern (SABCA 2013)
Lycaenidae	*Leptomyrina gorgias gorgias*	Lilac-based black-eye	Least Concern (SABCA 2013)
Hesperiidae	*Metisella willemi*	Netted sylph	Least Concern (SABCA 2013)
Lycaenidae	*Myrina silenus ficedula*	Common fig tree blue	Least Concern (SABCA 2013)
Nymphalidae	*Neptis laeta*	Common barred sailer	Least Concern (SABCA 2013)
Papilionidae	*Papilio demodocus demodocus*	Citrus swallowtail	Least Concern (SABCA 2013)
Papilionidae	*Papilio nireus lyaeus*	Narrow green-banded swallowtail	Least Concern (SABCA 2013)
Nymphalidae	*Pardopsis punctatissima*	Polka dot	Least Concern (SABCA 2013)
Hesperiidae	*Sarangesa phidyle*	Small elfin	Least Concern (SABCA 2013)
Lycaenidae	*Tarucus sybaris sybaris*	Dotted pierrot	Least Concern (SABCA 2013)
Nymphalidae	*Telchinia serena*	Dancing telchinia	Least Concern (SABCA 2013)
Nymphalidae	*Vanessa cardui*	Painted lady	Least Concern (SABCA 2013)
Lycaenidae	*Zizeeria knysna knysna*	African grass blue	Least Concern (SABCA 2013)
Arachnida			
Theraphosidae	*Augacephalus junodi*	Golden Brown tarantula	Unknown
Theraphosidae	*Ceratogyrus darlingi*	Rear Horned Baboon Spider	Unknown
Hormuridae	*Hadogenes troglodytes*	Flat rock scorpion	Unknown
Theraphosidae	*Idiothele nigrofulva*	Blue Footed Baboon Spider	Unknown

Aranaeidae	*Nephila senegalensis*	Banded-legged golden orb-web spider	Not Listed
Hormuridae	*Opisthacanthus asper*	Yellow-legged Tree Scorpion	Unknown
Scorpionidae	*Opistophthalmus glabrifrons*	Shiny burrow scorpion	Unknown
Buthidae	*Parabuthus mossambicensis*	Mozambique Thicktail Scorpion	Unknown
Buthidae	*Parabuthus transvaalicus*	TransvaalL Fat-tailed Scorpion	Unknown
Buthidae	*Pseudolychas ochraceus*	Pygmy-Thicktail Scorpion	Unknown
Buthidae	*Uroplectes olivaceus*	Olive Lesser-Thicktail Scorpion	Unknown
Buthidae	*Uroplectes vittatus*	Striped Bark Scorpion	Unknown
Amphibia			
Arthroleptidae	*Leptopelis mossambicus*	Brownbacked Tree Frog	Least Concern
Pyxicephalidae	*Tomopterna marmorata*	Russetbacked Sand Frog	Least Concern
Brevicepitidae	*Breviceps adspersus*	Bushveld Rain Frog	Least Concern
Bufonidae	*Poyntonophrynus fenoulheti*	Northern Pygmy Toad	Least Concern
Bufonidae	*Sclerophrys garmani*	Olive Toad	Least Concern (IUCN, 2016)
Hemisotidae	*Hemisus marmoratus*	Mottled Shovel-nosed Frog	Least Concern
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	Least Concern
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	Least Concern
Microhylidae	*Phrynomantis bifasciatus*	Banded Rubber Frog	Least Concern
Phrynobatrachidae	*Phrynobatrachus mababiensis*	Dwarf Puddle Frog	Least Concern (IUCN, 2014)
Phrynobatrachidae	*Phrynobatrachus natalensis*	Snoring Puddle Frog	Least Concern (IUCN, 2013)
Ptychadenidae	*Hildebrandtia ornata*	Ornate Frog	Least Concern
Ptychadenidae	*Ptychadena anchietae*	Plain Grass Frog	Least Concern
Ptychadenidae	*Ptychadena mossambica*	Broadbanded Grass Frog	Least Concern
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	Least Concern (2013)

Pyxicephalidae	*Pyxicephalus edulis*	African Bull Frog	Least Concern
Pyxicephalidae	*Tomopterna cryptotis*	Tremelo Sand Frog	Least Concern
Rhacophoridae	*Chiromantis xerampelina*	Southern Foam Nest Frog	Least Concern (2013)
Reptilia			
Lamprophiidae	*Psammophis subtaeniatus*	Western Yellow-bellied Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Rhamphiophis rostratus*	Rufous Beaked Snake	Least Concern (SARCA 2014)
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern (SARCA 2014)
Colubridae	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake	Least Concern (SARCA 2014)
Colubridae	*Thelotornis capensis capensis*	Southern Twig Snake	Least Concern (SARCA 2014)
Scincidae	*Trachylepis margaritifera*	Rainbow Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis striata*	Striped Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis varia sensu lato*	Common Variable Skink Complex	Least Concern (SARCA 2014)
Varanidae	*Varanus niloticus*	Water Monitor	Least Concern (SARCA 2014)
Mammalia			
Bovidae	*Aepyceros melampus*	Impala	Least Concern
Bovidae	*Connochaetes taurinus taurinus*	Blue wildebeest	Least Concern (2016)
Bovidae	*Damaliscus lunatus lunatus*	Southern African Tsessebe	Vulnerable (2016)
Equidae	*Equus quagga*	Plains Zebra	Least Concern (2016)
Muridae	*Gerbilliscus leucogaster*	Bushveld Gerbil	Least Concern (2016)
Giraffidae	*Giraffa giraffa giraffa*	South African Giraffe	Least Concern (2016)
Bovidae	*Kobus ellipsiprymnus ellipsiprymnus*	Waterbuck	Least Concern (2016)
Muridae	*Lemniscomys rosalia*	Single-Striped Lemniscomys	Least Concern (2016)
Elephantidae	*Loxodonta africana*	African Bush Elephant	Vulnerable A2a (2008)
Muridae	*Mastomys natalensis*	Natal Mastomys	Least Concern (2016)

Muridae	*Mastomys natalensis*	Natal Mastomys	Least Concern (2016)
Felidae	*Panthera pardus*	Leopard	Vulnerable (2016)
Cercopithecidae	*Papio ursinus*	Chacma Baboon	Least Concern (2016)
Suidae	*Phacochoerus africanus*	Common Warthog	Least Concern (2016)
Suidae	*Potamochoerus porcus*	Red River Hog	Least Concern (2016)
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern (2016)
Muridae	*Rattus rattus*	Roof Rat	Least Concern
Muridae	*Rattus tanezumi*	Oriental House Rat	Least Concern
Rhinolophidae	*Rhinolophus darlingi*	Darling's Horseshoe Bat	Least Concern (2016)
Bovidae	*Sylvicapra grimmia*	Bush Duiker	Least Concern (2016)
Bovidae	*Syncerus caffer*	African Buffalo	Least Concern (2008)
Bovidae	*Tragelaphus scriptus*	Bushbuck	Least Concern
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern (2016)
Aves			
Anatidae	*Sarkidiornis melanotos*	Knob-billed Duck	Least Concern
Hirundinidae	*Riparia cincta*	Banded Martin	Least Concern

APPENDIX B – FLORAL SPECIES LIST ACCORDING TO SANBI'S PLANTS OF SOUTH AFRICA FOR THE GIYANI AREA (POSA).

Family	Genus	Species	IUCN	Ecology
Acanthaceae	*Barleria*	*elegans*	LC	Indigenous
Acanthaceae	*Ruellia*	*cordata*	LC	Indigenous
Agavaceae	*Chlorophytum*	*galpinii*	LC	Indigenous
Amaranthaceae	*Amaranthus*	*thunbergii*	LC	Indigenous
Amaranthaceae	*Amaranthus*	*spinosus*		Not indigenous; Naturalised
Anacardiaceae	*Ozoroa*	*paniculosa*	LC	Indigenous
Anacardiaceae	*Lannea*	*schweinfurthii*	LC	Indigenous
Annonaceae	*Hexalobus*	*monopetalus*	LC	Indigenous
Apiaceae	*Choritaenia*	*capensis*	LC	Indigenous; Endemic
Apocynaceae	*Ceropegia*	*nilotica*	LC	Indigenous
Apocynaceae	*Cryptolepis*	*capensis*	LC	Indigenous
Apocynaceae	*Gomphocarpus*	*tomentosus*	LC	Indigenous
Apocynaceae	*Ceropegia*	*crassifolia*	LC	Indigenous
Aponogetonaceae	*Aponogeton*	*junceus*	LC	Indigenous
Archidiaceae	*Archidium*	*ohioense*		Indigenous
Asparagaceae	*Asparagus*	*aspergillus*	LC	Indigenous
Asparagaceae	*Asparagus*	*cooperi*	LC	Indigenous
Asparagaceae	*Asparagus*	*bechuanicus*	LC	Indigenous
Asparagaceae	*Asparagus*	*exuvialis*	LC	Indigenous
Asphodelaceae	*Trachyandra*	*saltii*	LC	Indigenous
Asteraceae	*Eclipta*	*prostrata*		Not indigenous; Naturalised
Asteraceae	*Denekia*	*capensis*	LC	Indigenous
Asteraceae	*Parapolydora*	*fastigiata*		Indigenous
Asteraceae	*Senecio*	*pentactinus*	LC	Indigenous

Family	Genus	Species	IUCN	Ecology
Asteraceae	*Xanthium*	*strumarium*		Not indigenous; Naturalised; Invasive
Asteraceae	*Senecio*	*inaequidens*	LC	Indigenous
Asteraceae	*Tagetes*	*minuta*		Not indigenous; Naturalised; Invasive
Asteraceae	*Aspilia*	*mossambicensis*	LC	Indigenous
Asteraceae	*Linzia*	*glabra*	LC	Indigenous
Asteraceae	*Laggera*	*decurrens*	LC	Indigenous
Bignoniaceae	*Kigelia*	*africana*	LC	Indigenous
Boraginaceae	*Cordia*	*monoica*	LC	Indigenous
Boraginaceae	*Ehretia*	*amoena*	LC	Indigenous
Boraginaceae	*Trichodesma*	*zeylanicum*	LC	Indigenous
Capparaceae	*Maerua*	*angolensis*	LC	Indigenous
Capparaceae	*Cadaba*	*termitaria*	LC	Indigenous
Celastraceae	*Pristimera*	*longipetiolata*	LC	Indigenous
Cleomaceae	*Cleome*	*monophylla*	LC	Indigenous
Combretaceae	*Combretum*	*hereroense*		Indigenous
Combretaceae	*Combretum*	*apiculatum*	LC	Indigenous
Combretaceae	*Combretum*	*imberbe*	LC	Indigenous
Combretaceae	*Combretum*	*collinum*	LC	Indigenous
Combretaceae	*Combretum*	*erythrophyllum*	LC	Indigenous
Commelinaceae	*Commelina*	*africana*	LC	Indigenous
Convolvulaceae	*Seddera*	*suffruticosa*	LC	Indigenous
Convolvulaceae	*Evolvulus*	*alsinoides*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*dichroa*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*papilio*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*magnusiana*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*obscura*	LC	Indigenous

Family	Genus	Species	IUCN	Ecology
Convolvulaceae	*Merremia*	*palmata*	LC	Indigenous
Convolvulaceae	*Ipomoea*	*cairica*	LC	Indigenous
Crassulaceae	*Kalanchoe*	*lanceolata*	LC	Indigenous
Cucurbitaceae	*Coccinia*	*rehmannii*	LC	Indigenous
Cucurbitaceae	*Citrullus*	*lanatus*	LC	Indigenous
Cucurbitaceae	*Cucumis*	*melo*	LC	Indigenous
Cucurbitaceae	*Cucumis*	*myriocarpus*	LC	Indigenous
Cucurbitaceae	*Momordica*	*balsamina*	LC	Indigenous
Cucurbitaceae	*Cucumis*	*anguria*	LC	Indigenous
Cyperaceae	*Schoenoplectus*	*senegalensis*	LC	Indigenous
Cyperaceae	*Lipocarpha*	*micrantha*	LC	Indigenous
Cyperaceae	*Lipocarpha*	*rehmannii*	LC	Indigenous
Cyperaceae	*Cyperus*	*denudatus*	LC	Indigenous
Cyperaceae	*Pycreus*	*pumilus*	LC	Indigenous
Cyperaceae	*Fuirena*	*ciliaris*	LC	Indigenous
Cyperaceae	*Eleocharis*	*acutangula*	LC	Indigenous
Cyperaceae	*Schoenoplectus*	*patentiglumis*		Indigenous
Cyperaceae	*Schoenoplectus*	*corymbosus*	LC	Indigenous
Ebenaceae	*Diospyros*	*mespiliformis*	LC	Indigenous
Ebenaceae	*Euclea*	*divinorum*	LC	Indigenous
Eriocaulaceae	*Eriocaulon*	*abyssinicum*	LC	Indigenous
Euphorbiaceae	*Croton*	*megalobotrys*	LC	Indigenous
Euphorbiaceae	*Jatropha*	*zeyheri*	LC	Indigenous
Euphorbiaceae	*Croton*	*sylvaticus*	LC	Indigenous
Fabaceae	*Senna*	*septemtrionalis*	NE	Not indigenous; Naturalised; Invasive
Fabaceae	*Erythrina*	*humeana*	LC	Indigenous
Fabaceae	*Senna*	*italica*	LC	Indigenous
Fabaceae	*Crotalaria*	*monteiroi*	LC	Indigenous

Family	Genus	Species	IUCN	Ecology
Fabaceae	*Albizia*	*harveyi*	LC	Indigenous
Fabaceae	*Piliostigma*	*thonningii*	LC	Indigenous
Fabaceae	*Albizia*	*versicolor*	LC	Indigenous
Fabaceae	*Senna*	*petersiana*	LC	Indigenous
Fabaceae	*Pterocarpus*	*rotundifolius*	LC	Indigenous
Fabaceae	*Pterocarpus*	*angolensis*	LC	Indigenous
Fabaceae	*Vachellia*	*permixta*	LC	Indigenous
Fabaceae	*Xanthocercis*	*zambesiaca*	LC	Indigenous
Fabaceae	*Senegalia*	*schweinfurthii*	LC	Indigenous
Fabaceae	*Colophospermum*	*mopane*	LC	Indigenous
Fabaceae	*Decorsea*	*galpinii*	LC	Indigenous; Endemic
Fabaceae	*Peltophorum*	*africanum*	LC	Indigenous
Fabaceae	*Ormocarpum*	*trichocarpum*	LC	Indigenous
Fabaceae	*Vigna*	*sp.*		
Fabaceae	*Dalbergia*	*melanoxylon*	LC	Indigenous
Hyacinthaceae	*Ledebouria*	*burkei*	LC	Indigenous
Hydrocharitaceae	*Ottelia*	*ulvifolia*	LC	Indigenous
Hydrocharitaceae	*Lagarosiphon*	*verticillifolius*	LC	Indigenous
Icacinaceae	*Pyrenacantha*	*grandiflora*	LC	Indigenous
Kirkiaceae	*Kirkia*	*acuminata*	LC	Indigenous
Lamiaceae	*Ocimum*	*americanum*	LC	Indigenous
Lamiaceae	*Syncolostemon*	*elliottii*	LC	Indigenous
Lamiaceae	*Leonotis*	*nepetifolia*	LC	Indigenous
Lamiaceae	*Leonotis*	*glabrata*	LC	Indigenous
Lamiaceae	*Volkameria*	*glabra*	LC	Indigenous
Lentibulariaceae	*Utricularia*	*reflexa*	LC	Indigenous
Loganiaceae	*Strychnos*	*madagascariensis*	LC	Indigenous
Loranthaceae	*Plicosepalus*	*kalachariensis*	LC	Indigenous
Loranthaceae	*Erianthemum*	*ngamicum*	LC	Indigenous

Family	Genus	Species	IUCN	Ecology
Loranthaceae	*Agelanthus*	*crassifolius*	LC	Indigenous; Endemic
Lythraceae	*Rotala*	*filiformis*	LC	Indigenous
Lythraceae	*Ammannia*	*prieuriana*	LC	Indigenous
Malvaceae	*Grewia*	*olukondae*	LC	Indigenous
Malvaceae	*Hibiscus*	*micranthus*		Indigenous
Malvaceae	*Hermannia*	*boraginiflora*	LC	Indigenous
Malvaceae	*Sida*	*acuta*	LC	Indigenous
Malvaceae	*Dombeya*	*rotundifolia*	LC	Indigenous
Malvaceae	*Hibiscus*	*schinzii*	LC	Indigenous
Malvaceae	*Corchorus*	*confusus*	LC	Indigenous
Malvaceae	*Hibiscus*	*calyphyllus*	LC	Indigenous
Malvaceae	*Hibiscus*	*vitifolius*	LC	Indigenous
Malvaceae	*Grewia*	*flavescens*	LC	Indigenous
Malvaceae	*Gossypium*	*herbaceum*	LC	Indigenous
Malvaceae	*Grewia*	*monticola*	LC	Indigenous
Malvaceae	*Corchorus*	*tridens*		Not indigenous; Naturalised
Malvaceae	*Corchorus*	*asplenifolius*	LC	Indigenous
Malvaceae	*Abutilon*	*austro-africanum*	LC	Indigenous
Malvaceae	*Hibiscus*	*micranthus*	LC	Indigenous
Malvaceae	*Adansonia*	*digitata*	LC	Indigenous
Meliaceae	*Turraea*	*obtusifolia*	LC	Indigenous
Meliaceae	*Trichilia*	*emetica*	LC	Indigenous
Menispermaceae	*Cocculus*	*hirsutus*		Not indigenous; Naturalised
Moraceae	*Ficus*	*glumosa*	LC	Indigenous
Moraceae	*Ficus*	*thonningii*		Indigenous
Moraceae	*Ficus*	*capreifolia*	LC	Indigenous
Moraceae	*Ficus*	*abutilifolia*	LC	Indigenous

Family	Genus	Species	IUCN	Ecology
Olacaceae	*Ximenia*	*caffra*	LC	Indigenous
Oleaceae	*Jasminum*	*stenolobum*	LC	Indigenous
Onagraceae	*Ludwigia*	*adscendens*	LC	Indigenous
Onagraceae	*Ludwigia*	*octovalvis*	LC	Indigenous
Orobanchaceae	*Buchnera*	*reducta*	LC	Indigenous
Pedaliaceae	*Ceratotheca*	*triloba*	LC	Indigenous
Pedaliaceae	*Dicerocaryum*	*senecioides*	LC	Indigenous
Phyllanthaceae	*Bridelia*	*mollis*	LC	Indigenous
Phyllanthaceae	*Bridelia*	*cathartica*	LC	Indigenous
Plantaginaceae	*Limnophila*	*indica*	LC	Indigenous
Poaceae	*Chloris*	*roxburghiana*	LC	Indigenous
Poaceae	*Schmidtia*	*pappophoroides*	LC	Indigenous
Poaceae	*Setaria*	*nigrirostris*	LC	Indigenous
Poaceae	*Panicum*	*maximum*	LC	Indigenous
Poaceae	*Aristida*	*congesta*	LC	Indigenous
Poaceae	*Cenchrus*	*ciliaris*	LC	Indigenous
Poaceae	*Perotis*	*patens*	LC	Indigenous
Poaceae	*Eragrostis*	*rotifer*	LC	Indigenous
Poaceae	*Hyparrhenia*	*rufa*	LC	Indigenous
Poaceae	*Panicum*	*coloratum*	LC	Indigenous
Poaceae	*Pogonarthria*	*squarrosa*	LC	Indigenous
Poaceae	*Echinochloa*	*colona*	LC	Indigenous
Poaceae	*Paspalum*	*urvillei*	NE	Not indigenous; Naturalised; Invasive
Poaceae	*Trichoneura*	*grandiglumis*	LC	Indigenous
Poaceae	*Digitaria*	*eriantha*	LC	Indigenous
Poaceae	*Setaria*	*incrassata*	LC	Indigenous
Poaceae	*Ischaemum*	*afrum*	LC	Indigenous
Poaceae	*Sacciolepis*	*spiciformis*	LC	Indigenous

Family	Genus	Species	IUCN	Ecology
Poaceae	*Enneapogon*	*cenchroides*	LC	Indigenous
Poaceae	*Sporobolus*	*ioclados*	LC	Indigenous
Poaceae	*Eleusine*	*coracana*	LC	Indigenous
Poaceae	*Eragrostis*	*trichophora*	LC	Indigenous
Poaceae	*Aristida*	*adscensionis*	LC	Indigenous
Poaceae	*Leersia*	*hexandra*	LC	Indigenous
Poaceae	*Melinis*	*repens*	LC	Indigenous
Poaceae	*Sporobolus*	*pyramidalis*	LC	Indigenous
Poaceae	*Bothriochloa*	*insculpta*	LC	Indigenous
Poaceae	*Cynodon*	*dactylon*	LC	Indigenous
Poaceae	*Chloris*	*gayana*	LC	Indigenous
Poaceae	*Bothriochloa*	*radicans*	LC	Indigenous
Poaceae	*Sporobolus*	*nitens*	LC	Indigenous
Poaceae	*Eragrostis*	*superba*	LC	Indigenous
Poaceae	*Sorghum*	*versicolor*	LC	Indigenous
Poaceae	*Eragrostis*	*viscosa*	LC	Indigenous
Poaceae	*Aristida*	*canescens*	LC	Indigenous
Poaceae	*Urochloa*	*mosambicensis*	LC	Indigenous
Poaceae	*Heteropogon*	*contortus*	LC	Indigenous
Poaceae	*Themeda*	*triandra*	LC	Indigenous
Poaceae	*Andropogon*	*gayanus*	LC	Indigenous
Poaceae	*Eragrostis*	*rigidior*	LC	Indigenous
Poaceae	*Tragus*	*berteronianus*	LC	Indigenous
Poaceae	*Brachiaria*	*nigropedata*	LC	Indigenous
Poaceae	*Eragrostis*	*arenicola*	LC	Indigenous
Poaceae	*Enneapogon*	*scoparius*	LC	Indigenous
Poaceae	*Chloris*	*pycnothrix*	LC	Indigenous
Poaceae	*Eriochloa*	*stapfiana*	LC	Indigenous
Poaceae	*Eriochloa*	*meyeriana*	LC	Indigenous
Poaceae	*Hyparrhenia*	*tamba*	LC	Indigenous

Family	Genus	Species	IUCN	Ecology
Poaceae	*Brachiaria*	*deflexa*	LC	Indigenous
Poaceae	*Tragus*	*koelerioides*	LC	Indigenous
Polygalaceae	*Polygala*	*sphenoptera*	LC	Indigenous
Polygonaceae	*Persicaria*	*madagascariensis*		Indigenous
Polygonaceae	*Persicaria*	*hystricula*	LC	Indigenous
Portulacaceae	*Portulaca*	*kermesina*	LC	Indigenous
Rhamnaceae	*Berchemia*	*discolor*	LC	Indigenous
Ricciaceae	*Riccia*	*cavernosa*		Indigenous
Rubiaceae	*Empogona*	*kirkii*		Indigenous
Rubiaceae	*Vangueria*	*infausta*	LC	Indigenous
Rubiaceae	*Catunaregam*	*taylorii*	LC	Indigenous
Rubiaceae	*Breonadia*	*salicina*	LC	Indigenous
Ruscaceae	*Sansevieria*	*hyacinthoides*	LC	Indigenous
Salicaceae	*Flacourtia*	*indica*	LC	Indigenous
Santalaceae	*Viscum*	*combreticola*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia*	*huillana*	LC	Indigenous
Selaginellaceae	*Selaginella*	*kraussiana*	LC	Indigenous
Solanaceae	*Datura*	*stramonium*		Not indigenous; Naturalised; Invasive
Solanaceae	*Physalis*	*angulata*		Not indigenous; Naturalised; Invasive
Solanaceae	*Solanum*	*lichtensteinii*	LC	Indigenous
Solanaceae	*Solanum*	*campylacanthum*		Indigenous
Solanaceae	*Solanum*	*tomentosum*		Indigenous
Stilbaceae	*Nuxia*	*oppositifolia*	LC	Indigenous
Urticaceae	*Pouzolzia*	*mixta*	LC	Indigenous
Violaceae	*Afrohybanthus*	*enneaspermus*		Indigenous
Vitaceae	*Rhoicissus*	*revoilii*	LC	Indigenous

Family	Genus	Species	IUCN	Ecology
Vitaceae	*Rhoicissus*	*tridentata*	NE	Indigenous
Vitaceae	*Cyphostemma*	*humile*	LC	Indigenous

ANNEXURE 5 - ARCHAEOLOGICAL ASSESSMENT

PHASE 1 ARCHAEOLOGICAL IMPACT ASSESSMENT

for the Proposed Kusile Invest 133 Giyani Gold Mine Project on the demarcated portions of Un-Surveyed State Land of Greater Giyani 891 LT, Giyani, Limpopo

Author ©:
Tobias Coetzee, MA (Archaeology) (UP)

April 2021

A Phase 1 Archaeological Impact Assessment for the Proposed Kusile Invest 133 Giyani Gold Mine Project on the demarcated portions of Un-Surveyed State Land of Greater Giyani 891 LT, Giyani, Limpopo

For: Archean Resources (Pty) Ltd

5 Villa Serring

Wapadrand

Pretoria

0081

Report No: Kusile_3103211

Version: 1

Email: tobias.coetzee@gmail.com

- I, Tobias Coetzee, declare that –
- I act as the independent specialist;
- I am conducting any work and activity relating to the proposed Giyani Gold Mine Project in an objective manner, even if this results in views and findings that are not favourable to the client;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have the required expertise in conducting the specialist report and I will comply with legislation, regulations and any guidelines that have relevance to the proposed activity;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this declaration are true and correct.

Date: 12 April 2021

List of Abbreviations

AIA – Archaeological Impact Assessment

CRM – Cultural Resource Management

EIA – Environmental Impact Assessment

ESA – Early Stone Age

GGB – Giyani Greenstone Belt

GPS – Global Positioning System

ha – Hectare

HIA – Heritage Impact Assessment

km – Kilometre

LIA – Late Iron Age

LSA – Later Stone Age

m – Metre

MASL – Metres Above Sea Level

MEC – Member of the Executive Council

MSA – Middle Stone Age

NHRA – National Heritage Resources Act

SAHRA – South African Heritage Resources Agency

WMA – Water Management area

Executive Summary

The author was appointed by Archean Resources (Pty) Ltd to undertake a Phase 1 Archaeological Impact Assessment for Kusile Invest 133 (Pty) Ltd on six demarcated areas (**Table 1)** within the Greater Giyani Local Municipality and Mopani District Municipality in the Limpopo Province. The proposed project consists of six study areas falling on un-surveyed state land of Greater Giyani 891 LT. One area is demarcated for the mining plant and an associated opencast pit, while five additional areas are demarcated for opencast mining. The total proposed mining right area is approximately 13908 ha, while the proposed surface impacts amount to 14.25 ha. The study area is located approximately 9 km northeast of Giyani, 20 km south-southeast of Malamulele and 7 km west of the Kruger National Park border. The aim of the study is to determine the scope of archaeological resources that could be impacted by the proposed Giyani Gold Mine Project.

In terms of limitations, proposed Pits 02 and 03 could not be accessed due to dense vegetation, while access, free movement and visibility were also restricted at proposed Pits 04 and 05. The type of vegetation consisted of thick mopane tree cover, thorn bushes and grass cover.

The demarcated plant and Pit 01 area has been disturbed by contemporary mining activities and no sites of heritage importance were observed.

Sites of archaeological significance pertaining to historical mining activities were identified at proposed Pits 04, 05 and 06, while three graves and one potential grave were located to the west of the plant area.

Although proposed Pits 02 and 03 could not be accessed, it is likely that these areas are associated with historical mining activities. The vegetation at these areas should therefore be cleared and a qualified archaeologist must inspect the areas prior to any development.

Historical mining trenches were identified at proposed Pit 04, but determining the extent of these features were hampered by dense vegetation. The vegetation hampering site visibility should therefore be cleared and a qualified archaeologist must document and map the site prior to development.

Pit 05 is associated with vertical mining shafts and infrastructure dating to at least 1947. It is recommended that the dense vegetation hampering visibility and access be cleared and that a qualified archaeologist document and map the site. Also, the historical mining structures associated with this site should be fenced-off, avoided by development and must be monitored by the mine's ECO during the proposed mining development. If impact is observed or cannot be avoided, a destruction permit will have to be obtained from the relevant heritage authority.

The rehabilitated mining shafts associated with proposed Pit 06 might date to the 1980s, but some of the structures and features associated with this area most likely date to historical mining development and are considered significant from an archaeological perspective. Because this area has been disturbed by the rehabilitation process, the recording done during this study is regarded as sufficient. However, the historical mining structures associated with this site should be fenced-off, avoided by development and must be monitored by the mine's ECO during the proposed mining development. If impact is observed or cannot be avoided, a destruction permit will have to be obtained from the relevant heritage authority.

Three graves and one potential grave consisting of dilapidated stone cairns were observed during the site visit, but are located a significant distance from the plant area and are not at risk of being impacted by the proposed development (B01 – B04).

Table of Contents

List of Figures

List of Tables

1. Project Background

1.1 Introduction

Archean Resources (Pty) Ltd appointed the author to undertake a Phase 1 Archaeological Impact Assessment for Kusile Invest 133 (Pty) Ltd on six demarcated areas within the Greater Giyani Local Municipality and Mopani District Municipality in the Limpopo Province. The affected areas fall within un-surveyed state land of Greater Giyani 891 LT and are listed in **Table 1**. The proposed project consists of six areas: One plant area and an associated opencast pit, as well as five additional opencast pits. The study area is located approximately 9 km northeast of Giyani, 20 km south-southeast of Malamulele and 7 km west of the Kruger National Park border (**Figure 1**). The purpose of this study is to examine the demarcated portions in order to determine if any archaeological resources of heritage value will be impacted by the proposed Giyani Gold Mine Project, as well as to archaeologically contextualise the general study area. The aim of this report is to provide the developer with information regarding the location of heritage resources on the demarcated portions.

The following report discusses the implication for the expansion of the Giyani Gold Mine Plant and Pit 01, as well as the mining of five additional opencast pits on un-surveyed state land of Greater Giyani 891 LT with regard to heritage resources. The plant area and one opencast pit is located along the northern boundary of the mining right area, while two opencast pits are proposed 4 km to the southeast and one along the eastern border. One of the remaining opencast pits is proposed towards the south-western corner of the mining right area, while the other is proposed approximately 4 km to northeast thereof. The legislation section included serves as a guide towards the effective identification and protection of heritage resources and will apply to any such material unearthed during the proposed mining project.

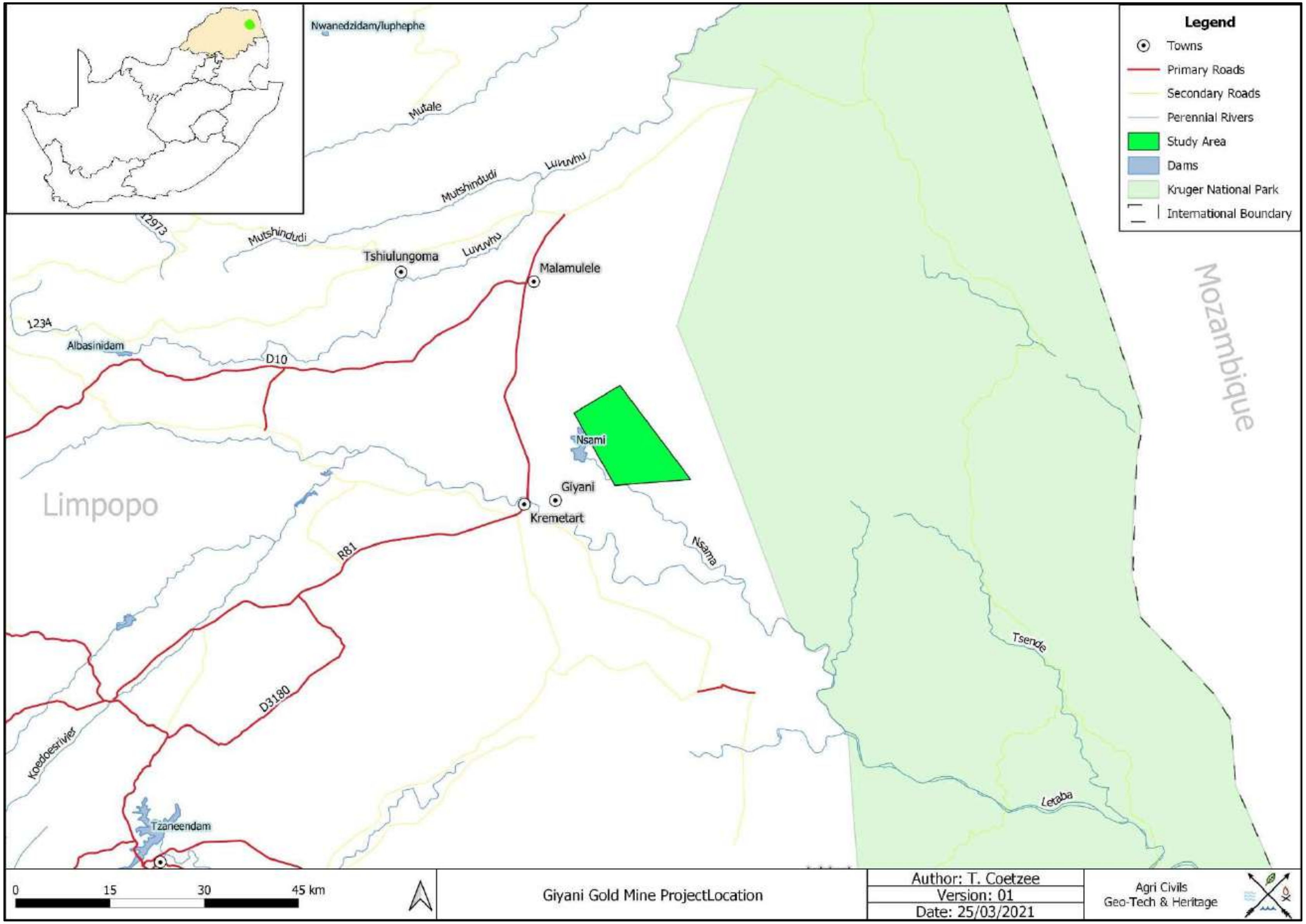


Figure 1: Regional and Provincial location of the study area.

1.2 Legislation

The South African Heritage Resources Agency (SAHRA) aims to conserve and control the management, research, alteration and destruction of cultural resources of South Africa and to prosecute if necessary. It is therefore crucially important to adhere to heritage resource legislation contained in the Government Gazette of the Republic of South Africa (Act No.25 of 1999), as many heritage sites are threatened daily by development. Conservation legislation requires an impact assessment report to be submitted for development authorisation that must include an AIA (Archaeological Impact Assessment) if triggered.

AIAs should be done by qualified professionals with adequate knowledge to (a) identify all heritage resources that might occur in areas of development and (b) make recommendations for protection or mitigation of the impact of the sites.

1.2.1 The EIA (Environmental Impact Assessment) and AIA processes

Phase 1 Archaeological Impact Assessments generally involve the identification of sites during a field survey with assessment of their significance, the possible impact that the development might have, and relevant recommendations.

All Archaeological Impact Assessment reports should include:

a. Location of the sites that are found;

b. Short descriptions of the characteristics of each site;

c. Short assessments of how important each site is, indicating which should be conserved and which mitigated;

d. Assessments of the potential impact of the development on the site(s);

e. In some cases a shovel test, to establish the extent of a site, or collection of material, to identify the associations of the site, may be necessary (a pre-arranged SAHRA permit is required); and

f. Recommendations for conservation or mitigation.

This AIA report is intended to inform the client about the legislative protection of heritage resources and their significance and make appropriate recommendations. It is essential to also provide the heritage authority with sufficient information about the sites to enable the authority to assess with confidence:

a. Whether or not it has objections to a development;

b. What the conditions are upon which such development might proceed;

c. Which sites require permits for mitigation or destruction;

d. Which sites require mitigation and what this should comprise;

e. Whether sites must be conserved and what alternatives can be proposed to relocate the development in such a way as to conserve other sites; and

f. What measures should or could be put in place to protect the sites which should be conserved.

When a Phase 1 AIA is part of an EIA, wider issues such as public consultation and assessment of the spatial and visual impacts of the development may be undertaken as part of the general study and may not be required from the archaeologist. If, however, the Phase 1 project forms a major component of an AIA it will be necessary to ensure that the study addresses such issues and complies with Section 38 of the National Heritage Resources Act (NHRA).

1.2.2 Legislation regarding archaeology and heritage sites

National Heritage Resource Act No.25 of April 1999

Buildings are among the most enduring features of human occupation, and this definition therefore includes all buildings older than 60 years, modern architecture as well as ruins, fortifications and Farming Community settlements. The Act identifies heritage objects as:

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1(xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives;
- any other prescribed category.

With regards to activities and work on archaeological and heritage sites this Act states that:

"No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority." (34. [1] 1999:58)

and

"No person may, without a permit issued by the responsible heritage resources authority:

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites." (35. [4] 1999:58)

and

"No person may, without a permit issued by SAHRA or a provincial heritage resources authority:

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority;

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) and excavation equipment, or any equipment which assists in the detection or recovery of metals." (36. [3] 1999:60)

On the development of any area the gazette states that:

"…any person who intends to undertake a development categorised as:

(a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site-

i. *exceeding 5000m² in extent; or*

ii. *involving three or more existing erven or subdivisions thereof; or*

iii. *involving three or more erven or divisions thereof which have been consolidated within the past five years; or*

iv. *the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;*

(d) *the re-zoning of a site exceeding 10000m² in extent; or*

(e) *any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development."* (38. [1] 1999:62-64)

and

"The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a): Provided that the following must be included:

(a) *The identification and mapping of all heritage resources in the area affected;*

(b) *an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;*

(c) *an assessment of the impact of the development on such heritage resources;*

(d) *an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;*

(e) *the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;*

(f) *if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and*

(g) *plans for mitigation of any adverse effects during and after the completion of the proposed development."* (38. [3] 1999:64)

Human Tissue Act and Ordinance 7 of 1925

The Human Tissues Act (65 of 1983) and Ordinance on the Removal of Graves and Dead Bodies (Ordinance 7 of 1925) protects graves younger than 60 years. These fall under the jurisdiction of the National Department of Health and the Provincial Health Departments. Approval for the exhumation and re-burial must be obtained from the relevant Provincial MEC (Member of the Executive Council) as well as the relevant Local Authorities. Graves 60 years or older fall under the jurisdiction of the National Heritage Resources Act as well as the Human Tissues Act, 1983.

2. Study Area and Project Description

2.1 Location & Physical Environment

Table 1 lists the demarcated project areas and intersecting land parcels.

Table 1: Property name & coordinates of the proposed study areas.

Development	Property	Map Reference (1:50 000)	Lat (y)	Lon (x)	Development Extent (ha)
Pit 01 & Plant	Greater Giyani 891 LT	2330 BB	-23.188625	30.766884	12
Pit 02	Greater Giyani 891 LT	2330 BB	-23.198572	30.801384	0.45
Pit 03	Greater Giyani 891 LT	2330 BB	-23.193576	30.808405	0.45
Pit 04	Greater Giyani 891 LT	2330 BD	-23.257804	30.839461	0.45
Pit 05	Greater Giyani 891 LT	2330 BD	-23.283369	30.816417	0.45
Pit 06	Greater Giyani 891 LT	2330 BD	-23.185126	30.839724	0.45
Total					**14.25**

The general study area is located 9 km northeast of Giyani, 20 km south-southeast of Malamulele and 7 km west of the Kruger National Park. The study area falls within the Greater Giyani Local Municipality and Mopani District Municipality in the Limpopo Province. Locally, the proposed mining right area is associated with five villages: Toma, Khakhala, Mininginisi, Mininginisi-2 and Mlhava. Toma intersects the western border of the proposed mining right, while Mininginisi intersects the north-eastern corner and Mininginisi-2 the eastern boundary. Mlhava is located further to the south along the eastern border, while Khakhala is located in the middle and towards the southern border of the proposed mining right. Pit 01 and the plant area is located 6 km north-northwest of Toma and 5.5 km west-southwest of Miningisini. Pits 02 & 03 are located 5.7 km north-northeast of Toma and 3.7 km south-southwest of Mininginisi. Pit 04 is located 1.5 km northeast of Khakhala and 4 km east of Toma, while Pit 05 is located in the south-western corner of the mining right area and approximately 3 km from Khakhala in the northeast and 3 km from Toma in the north-northwest. Pit 06 is located on the outskirts of Mininginsi-2. The R81 primary road runs north-south through Giyani to the west, while the D3840 secondary road runs approximately 9.5 km to the southwest and in a northwest-southeast direction.

In terms of vegetation, the study area falls within the Savanna Biome and Lowveld Bioregion. On a local scale, Granite Lowveld covers the south-eastern corner of the proposed mining right while the rest of the mining right, and therefore the demarcated pit and plant areas, falls on Lowveld Rugged Mopaneveld (Mucina & Rutherfords 2006).

The distribution of Granite Lowveld is described by Mucina & Rutherfords (2006) as:

"Limpopo and Mpumalanga Provinces, Swaziland and marginally also KwaZulu-Natal: A north-south belt on the plains east of the escarpment from Thohoyandou in the north, interrupted in the Bolobedu area, continued in the Bitavi area, with an eastward extension on the plains around the Murchison Range and southwards to Abel Erasmus Pass, Mica and Hoedspruit areas to the area east of Bushbuckridge. Substantial parts are found in the Kruger National Park spanning areas east of Orpen Camp southwards through Skukuza and Mkuhlu, including undulating terrain west of Skukuza to the basin of the Mbyamiti River. It continues further southward to the Hectorspruit area with a narrow westward extension up the Crocodile River Valley past Malelane, Kaapmuiden and the Kaap River Valley, entering Swaziland between Jeppe's Reef in the west and the Komati River in the east, through to the area between Manzini and Siphofaneni, including the Grand Valley, narrowing irregularly and marginally entering KwaZulu-Natal near Pongola"

Granite Lowveld is considered vulnerable with a conservation target of 19%. About 17% is statutorily conserved in the Kruger National Park and roughly the same amount in private reserves. More than 20% has already been transformed, mainly by cultivation and settlement development. Erosion is considered very low to moderate (Mucina & Rutherfords 2006).

Lowveld Rugged Mopaneveld is associated with the Limpopo and Mpumalanga Provinces and is distributed from the area southeast of Giyani in the west to Shimwini and Boulders Camps in the east. The rugged area of the Olifants River Valley south of Phalaborwa and from Grietjieberg in the west to Maveni River tributary in the east is associated with Lowveld Rugged Mopaneveld as well. In terms of conservation, Lowveld Rugged Mopaneveld is considered least threatened with a conservation target of 19%. About 34% is statutorily conserved in the Kruger National Park and roughly 5% in private reserves such as Klaserie, Letaba Ranch and Selati. About 20% has been transformed mostly by cultivation and urban built-up areas. The parts of this vegetation unit falling outside of protected reserves are under pressure from high-density rural human population and the associated urban sprawl and agricultural activities (Mucina & Rutherfords 2006).

The average elevation for Granite Lowveld varies between 250 and 700 MASL (metres above sea level), while Lowveld Rugged Mopaneveld varies between 250 and 550 MASL (Mucina & Rutherfords 2006). The average elevation for the proposed mining right is 470 MASL and slopes from the low-lying river areas near the eastern and western borders to the higher surrounding ground.

The study area falls within the summer rainfall region and the average annual rainfall is roughly 481 mm per year. The average maximum temperature for the study area is recorded during December when an average of 25.2 ºC is reached. The average minimum temperature is recorded during July when an average of 16.9 ºC is reached (Climate-data.org 29/03/2021).

The majority of the study area falls within the B82H Quaternary Catchment of the Letaba Water Management Area (WMA), while a small section of the north-eastern corner of the proposed mining right falls within the B90F Quaternary Catchment of the same WMA. The closest perennial river to the study area is the Nsama River that intersects the south-western corner of the proposed mining right area. Several non-perennial streams are located within the demarcated study area as well.

2.2 Project description

The proposed Kusile Invest 133 Giyani Gold Mine Project proposes to mine gold on the demarcated portions as indicated on **Figures 2 & 3**. The total extent for the plant and proposed opencast pits is approximately 14.25 ha. It should be noted that the five pits were initially identified as mentioned in the extract from the Project Scoping Report below, but another pit was subsequently identified. According to Mr Mzamani Mdaka from Kusile Invest 133, all the pit locations are based on previous mining activities dating the 1950s and 1980s. Surface indications of these early mining activities are generally indicated by trenches that are roughly 0.5 m wide and between one and two metres deep.

The following description was adapted from the Project Scoping Report (Archean Resources 2020):

"*Kusile Invest 133 (Pty) Ltd has appointed Archean Resources (Pty) Ltd, an independent consulting company, to conduct an Environmental Impact Assessment (EIA) process to evaluate the potential environmental and social impacts of the proposed project. The project is referred to as the Giyani Gold Mine Project. The applicant Kusile Invest has lodged a mining right on Un-Surveyed State land of Greater Giyani 891 LT and a portion of portion 0 of the farm 246 located within the town of Giyani, Limpopo Province and intends to establish an underground and open cast mine.*

The mine development activities will commence by establishing and installing the required mining infrastructure such as pit establishment, shaft headgear and winders, service water, compressed air and power supply, processing plant and installation of surface ventilations fans. The type and size of the mining infrastructure to be installed will be designed to support the proposed Life of Mine (LOM) production rate of 12 000 tons per month of Run of Mine material (ROM) for 30 (thirty) years.

Mining operations will commence from five open cast pits which will later be developed into underground workings and expand into four working levels to reach the steady state production of 12 000 tons per month. Additional working areas will be established for sustainability and to replace the depletion of ore reserves being mined from the start-up working areas.

The open pit mine design shows the orebody being located centrally to the pit outer walls or pit shell. The waste surrounding the orebody will be stripped, with topsoil stored separately from waste rock for re-use during rehabilitation of the pit at closure of mining operations. The stripping will include the removal of surrounding topsoil and waste rock to fully expose the orebody and have enough area for movement of machinery inside the pit.

The sidewalls of the excavation, surrounding the orebody, referred to as Benches, will be excavated at intervals to a maximum depth 12 metres and must be slanted to ensure slope stability as per specifications determined by the project's Rock Engineering expert. The pit development will include the creation of Berms, representing the flat area or horizontal distance of approximately 5 metres in width, when measured from the bottom of the preceding or top bench to the edge of the next bench as the pit goes dipper. An access ramp and haul road will also be created from the top bench on the outer limits of the pit, traversing the lower benches in order to have mining equipment and personnel accessing the pit floor where excavating or blasting of the ore bearing rock will be conducted.

The pit will be excavated to an optimal operating final depth of 400 metres below surface level, thereafter, the conversion of the mining operation from open pit to underground mining operation will be affected. The timing for the development of the underground mining infrastructure will be scheduled to reach its completion such that the commencement of underground operations will overlap with the final phase of the open pit mining operation for a period of 6 months. The basic design or layout for the underground mining operation, entails the conventional use of shafts and declines, with the development of footwall haulages, cross-cuts and raise-lines to establish conventional steep stoping and cut and fill mining panels."

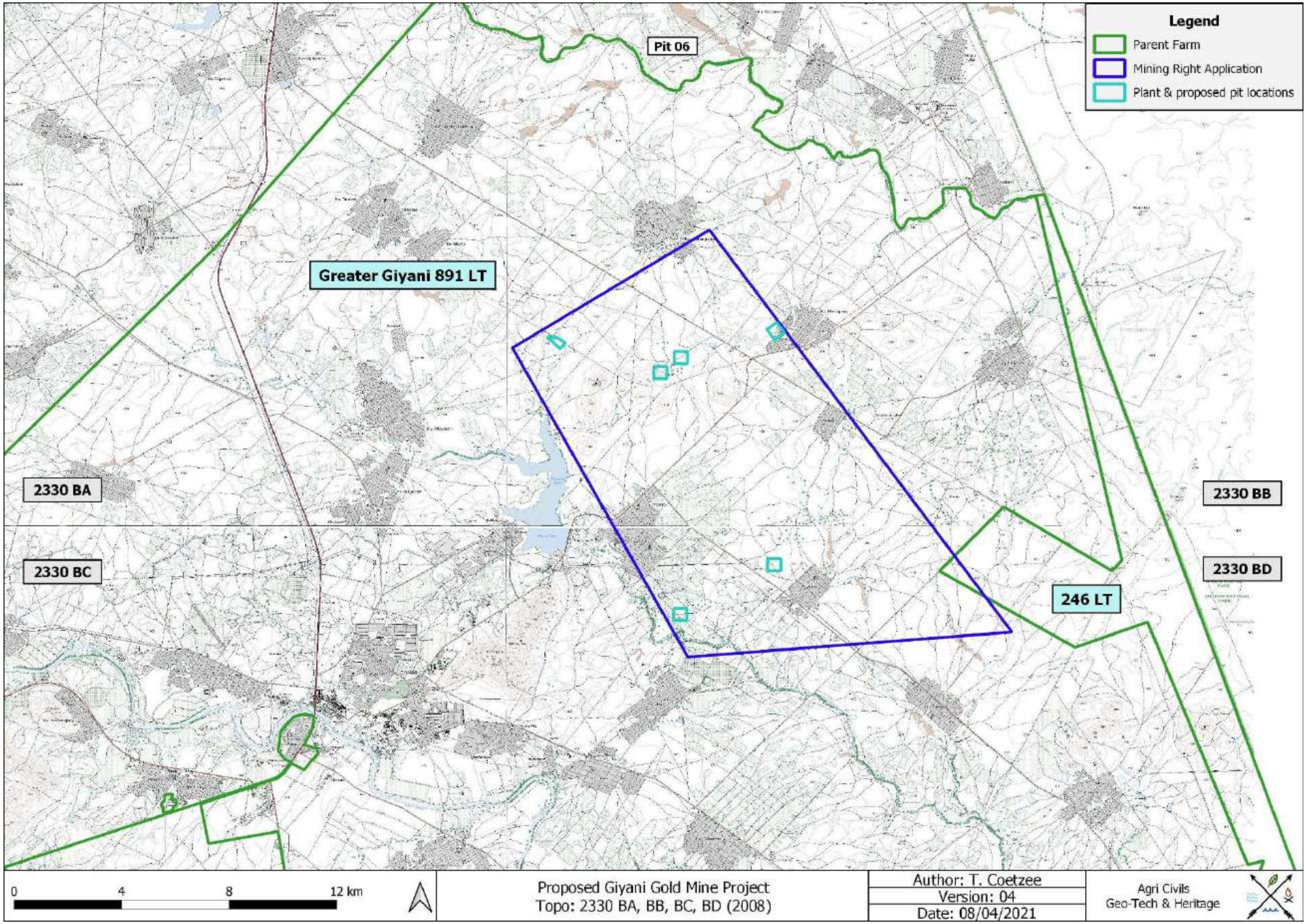


Figure 2: Segments of SA 1: 50 000 2330 BA, BB, BC & BD indicating the study area.

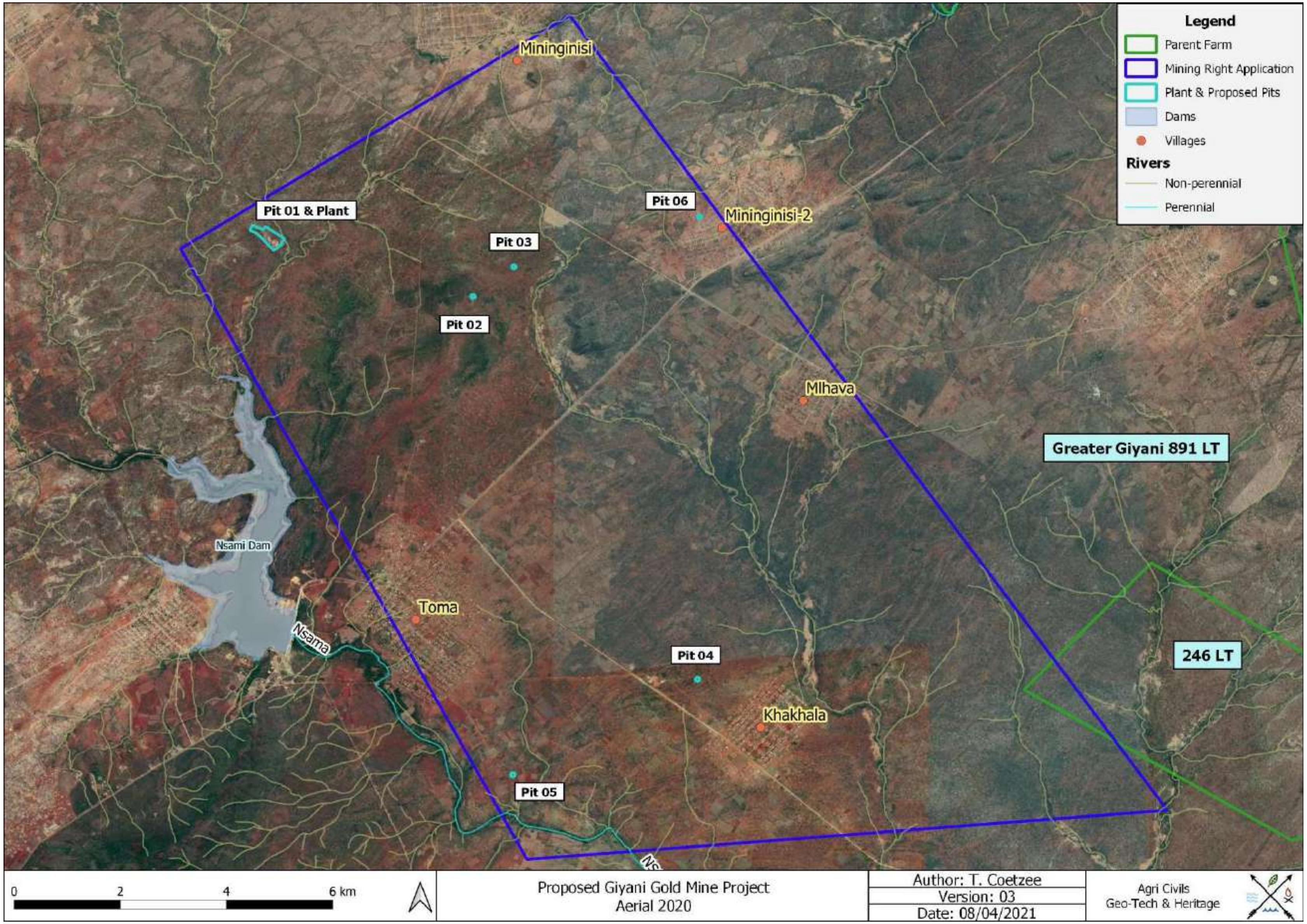


Figure 3: The proposed mining right, plant and pits indicated on a 2020 aerial backdrop.

3. Archaeological Background

Southern African archaeology is broadly divided into the Early, Middle and Later Stone Ages; Early, Middle and Later Iron Ages; and Historical or Colonial Periods. This section of the report provides a general background to archaeology in South Africa.

3.1 The Stone Age

The earliest stone tool industry, the Oldowan, was developed by early human ancestors which were the earliest members of the genus *Homo,* such as *Homo habilis*, around 2.6 million years ago. It comprises tools such as cobble cores and pebble choppers (Toth & Schick 2007). Archaeologists suggest these stone tools are the earliest direct evidence for culture in southern Africa (Clarke & Kuman 2000). The advent of culture indicates the advent of more cognitively modern hominins (Mitchell 2002: 56, 57).

The Acheulean industry completely replaced the Oldowan industry. The Acheulian industry was first developed by *Homo ergaster* between 1.8 to 1.65 million years ago and lasted until around 300 000 years ago. Archaeological evidence from this period is also found at Swartkrans, Kromdraai and Sterkfontein. The most typical tools of the ESA (Early Stone Age) are handaxes, cleavers, choppers and spheroids. Although hominins seemingly used handaxes often, scholars disagree about their use. There are no indications of hafting, and some artefacts are far too large for it. Hominins likely used choppers and scrapers for skinning and butchering scavenged animals and often obtained sharp ended sticks for digging up edible roots. Presumably, early humans used wooden spears as early as 5 million years ago to hunt small animals.

Middle Stone Age (MSA) artefacts started appearing about 250 000 years ago and replaced the larger Early Stone Age bifaces, handaxes and cleavers with smaller flake industries consisting of scrapers, points and blades. These artefacts roughly fall in the 40-100 mm size range and were, in some cases, attached to handles, indicating a significant technical advance. The first *Homo sapiens* species also emerged during this period. Associated sites are Klasies River Mouth, Blombos Cave and Border Cave (Deacon & Deacon 1999).

Although the transition from the Middle Stone Age to the Later Stone Age (LSA) did not occur simultaneously across the whole of southern Africa, the Later Stone Age ranges from about 20 000 to 2000 years ago. Stone tools from this period are generally smaller, but were used to do the same job as those from previous periods; only in a different, more efficient way. The Later Stone Age is associated with: rock art, smaller stone tools (microliths), bows and arrows, bored stones, grooved stones, polished bone tools, earthenware pottery and beads. Examples of Later Stone Age sites are Nelson Bay Cave, Rose Cottage Cave and Boomplaas Cave (Deacon & Deacon 1999). These artefacts are often associated with rocky outcrops or water sources. **Figures 4 – 6** below shows examples of stone tools often associated with the ESA, MSA and LSA of southern Africa.

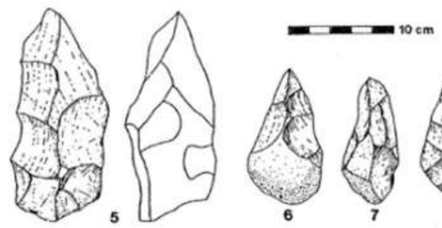


Figure 4: ESA artefacts from Sterkfontein (Volman 1984).

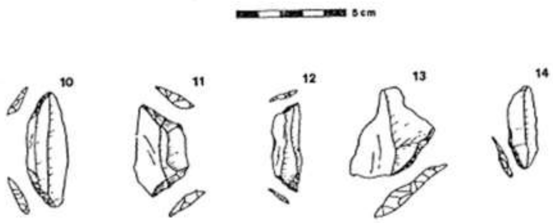


Figure 5: MSA artefacts from Howiesons Poort (Volman 1984).

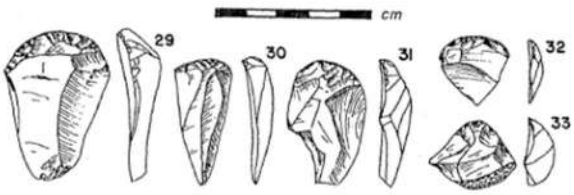


Figure 6: LSA scrapers (Klein 1984).

3.2 The Iron Age & Historical Period

The Early Iron Age marks the movement of farming communities into South Africa in the first millennium AD, or around 2500 years ago (Mitchell 2002:259, 260). These groups were agro-pastoralist communities that settled in the vicinity of water in order to provide subsistence for their cattle and crops. Archaeological evidence from Early Iron Age sites is mostly artefacts in the form of ceramic assemblages. The origins and archaeological identities of this period are largely based upon ceramic typologies. Some scholars classify Early Iron Age ceramic traditions into different “streams” or “trends” in pot types and decoration, which emerged over time in southern Africa. These “streams” are identified as the Kwale Branch (east), the Nkope Branch (central) and the Kalundu Branch (west). Early Iron Age ceramics typically display features such as large and prominent inverted rims, large neck areas and fine elaborate decorations. This period continued until the end of the first millennium AD (Mitchell 2002; Huffman 2007). Some well-known Early Iron Age sites include the Lydenburg Heads in Mpumalanga, Happy Rest in the Limpopo Province and Mzonjani in Kwa-Zulu Natal.

The Middle Iron Age roughly stretches from AD 900 to 1300 and marks the origins of the Zimbabwe culture. During this period cattle herding appeared to play an increasingly important role in society. However, it was proved that cattle remained an important source of wealth throughout the Iron Age. An important shift in the Iron Age of southern Africa took place in the Shashe-Limpopo basin during this period, namely the development of class distinction and sacred leadership. The Zimbabwe culture can be divided into three periods based on certain capitals. Mapungubwe, the first period, dates from AD 1220 to 1300, Great Zimbabwe from AD 1300 to 1450, and Khami from AD 1450 to 1820 (Huffman 2007: 361, 362).

The Late Iron Age (LIA) roughly dates from AD 1300 to 1840. It is generally accepted that Great Zimbabwe replaced Mapungubwe. Some characteristics include a greater focus on economic growth and the increased importance of trade. Specialisation in terms of natural resources also started to play a role, as can be seen from the distribution of iron slag which tend to occur only in certain localities compared to a wide distribution during earlier times. It was also during the Late Iron Age that different areas of South Africa were populated, such as the interior of KwaZulu Natal, the Free State, the Gauteng Highveld and the Transkei. Another characteristic is the increased use of stone as building material. Some artefacts associated with this period are knife-blades, hoes, adzes, awls, other metal objects as well as bone tools and grinding stones.

The Historical period mainly deals with Europe's discovery, settlement and impact on southern Africa. Some topics covered by the Historical period include Dutch settlement in the Western Cape, early mission stations, Voortrekker routes and the Anglo Boer War. This time period also saw the compilation of early maps by missionaries, explorers, military personnel, etc.

3.2.1 Mining history in the Giyani area

The Giyani Greenstone Belt (GGB), formerly known as the Sutherland Greenstone Belt, is known to host shallow economic sized gold deposits. The GGB is a north-eastern trending belt of approximately 70 km long and up to 17 km wide in some places. The northern-most portion of the GGB falls within the Kruger National Park, while the southern section divides into the Khavagari and Lwaji Limbs. The gold mineralization in the GGB occur in four settings: quartz veins with sulphide developments, banded iron formations, quartz and sulphide replacement veins, and carbonate veins. Free- and refractory gold are found in the area. Free gold refers to gold found in native form and is recovered using conventional gravity methods, while refractory gold is bound in sulphide gains and can be extracted using specialised metallurgical methods (Steenkamp & Clark-Mostert (2012).

The Sutherland Greenstone Belt goldfield was discovered by the prospectors Button and Sutherland in the 1870. The first gold was recovered from the Letaba- and Shingwedzi Rivers, but the gold rush in this area only started in 1886. Gold mining in the area was interrupted by the Anglo-Boer War and afterwards the rich goldfields of the Witwatersrand had surpassed the smaller deposits of the Eastern Transvaal. The gold ore in the GGB was found to be refractory and by 1928 most of the mines in the area had seized operations (Steenkamp & Clark-Mostert 2012).

According to Steenkamp & Clark-Mostert (2012), the historic workings were focused around outcrops of quartz veins, the most often encountered veins being Banded Ironstone Formation and schist. Exploration trenched were dug either parallel or into to the outcrop. Trenches that yielded encouraging results were further developed via opencast or underground operations. Minor opencast operations can be found along the general trend of the quartz veins, while underground operations developed along the dip of the quartz veins. Basic timber support is occasionally observed. A ball-mill seems to have been used to treat the ore on-site, while the fines were dumped on-site as well. Since smelting related infrastructure are not generally associated with these mines, it is suggested that the concentrate was sold or removed for further beneficiation elsewhere.

One of the main contributing factors to the decline of the Sutherland (Giyani) goldfield is ascribed to the discovery of the Witwatersrand goldfields around the same time. Another is the lack of technology to process and treat the ore. It should also be noted that the Limpopo is a dry area with limited water supply. Since both recovery of free gold by gravity separation methods and of refractory gold by milling and leaching require a significant amount of water, water availably is a major constraint (Steenkamp & Clark-Mostert (2012).

4. Methodology

Archaeological reconnaissance of the study area was conducted during April 2021 through a combination of unsystematic vehicular and pedestrian surveys of the proposed plant expansion and opencast pit areas. One area consists of the plant that is currently being expanded and an associated opencast pit, the remaining demarcated pit areas have not yet been mined. The project area was inspected beforehand on Google Earth, historical aerial imagery and topographical maps in order to identify potentially sensitive areas and heritage remains (**Figure 7 & Appendix A**). A sensitivity map indicating the hills associated with the study area, as well as a 500 m buffer area around perennial and non-perennial streams, were compiled (**Figure 7**). Significant sections of the study area also appear to have been disturbed by past cultivation and are indicated on **Figure 8.** The current layout of the demarcated plant and pit areas intersecting the sensitive areas are listed in **Table 2.** General site conditions were recorded via photographic record (**Figures 9 – 16**). Four sites were identified during the site visit through personal communication with Mr Mzamani Mdaka (**Table 3 & Figures 37)**, while past mining infrastructure were observed at proposed Pits 04, 05 & 06. It should be noted that the prefix '2330BB' is not used when referring to the site names due to the length of the name, but are recorded as such in **Tables 3 & 7.** The historical topographical datasets dating to 1967 and 1980, as well as the historical aerial photographs dating to 1963 and 1971 proved useful in terms of providing an indication of the location and age of some of the structures and features associated with the study area. The total mining right area inspected on historical topographical maps was roughly 13908 ha while the total proposed impact area inspected during the site visit was 13.45 ha. Two of the propped pits, 02 & 03, were not accessible due to dense vegetation. Dense vegetation also generally hampered free movement and visibility at the remaining sites.

The reconnaissance of the area under investigation served a twofold purpose:

- To obtain an indication of heritage material found in the general area as well as to identify or locate archaeological sites on the areas demarcated for development. This was done in order to establish a heritage context and to supplement background information that would benefit developers through identifying areas that are sensitive from a heritage perspective.

- All archaeological and historical events have spatial definitions in addition to their cultural and chronological context. Where applicable, spatial recording of these definitions were done by means of a handheld GPS (Global Positioning System) during the site visit, as well as by plotting the boundaries from aerial imagery and topographical maps.

Table 2: Development areas intersecting sensitive areas.

Area	Gradient buffer	500 m River buffer	Historical Building / Hut / Mine	Disturbed by past cultivation
Pit 01 & Plant	No	Yes	No	No
Pit 02	Yes	No	No	No
Pit 03	No	No	No	No
Pit 04	No	No	No	No
Pit 05	No	Yes	Yes	Yes
Pit 06	No	Yes	No	Partially

Table 3: Site coordinates & description

Abbreviated name	Site / Survey Point Name	Longitude	Latitude	Description	Current Status	Identification Source
B01	2330BB-B01	30.762321	-23.193135	Grave	Intact	Site visit
B02	2330BB-B02	30.762245	-23.193901	Grave	Intact	Site visit
B03	2330BB-B03	30.762404	-23.193272	Grave	Intact	Site visit
B04	2330BB-B04	30.762290	-23.192485	Potential Grave	Intact	Site visit

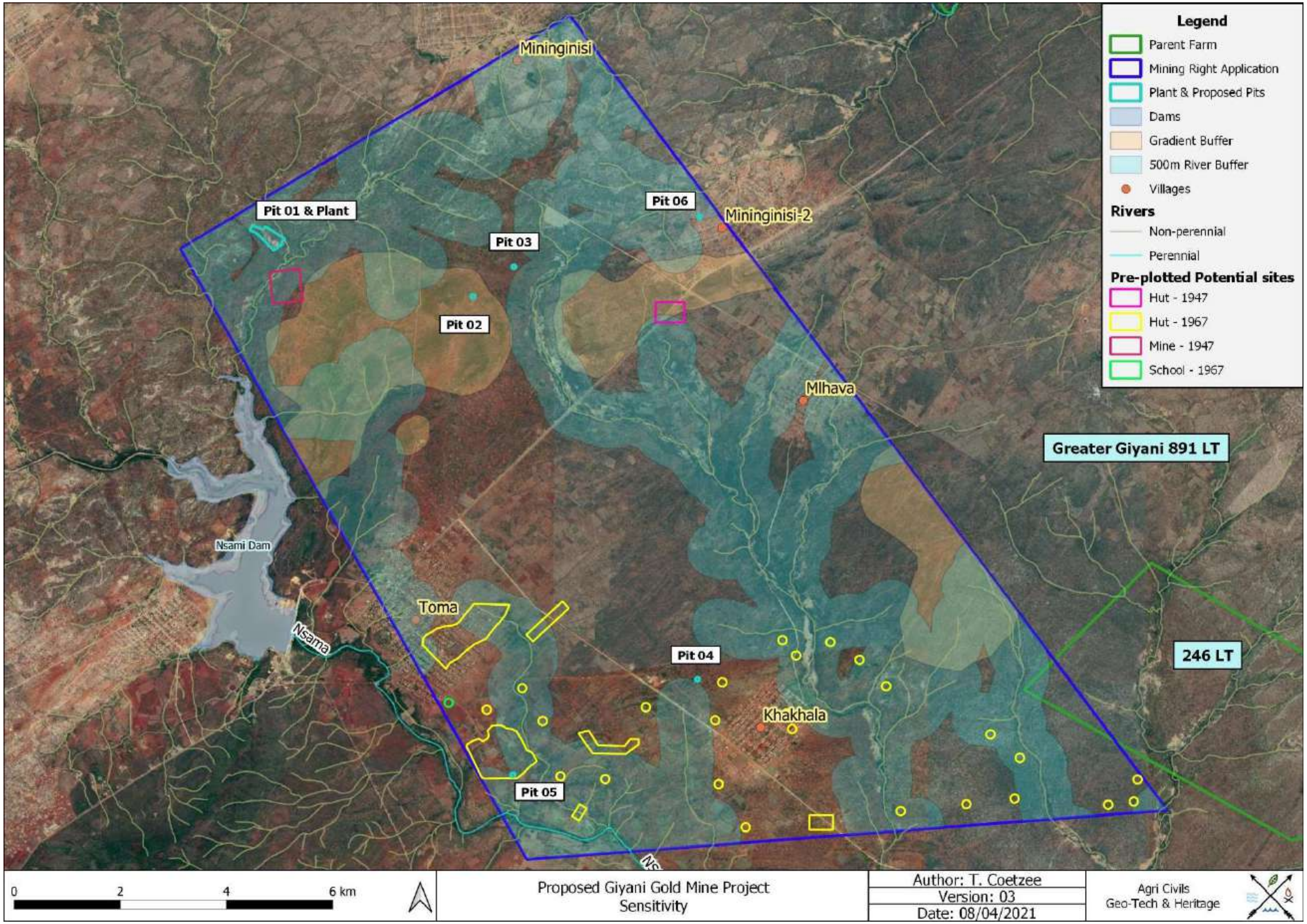


Figure 7: Heritage Sensitivity Map.

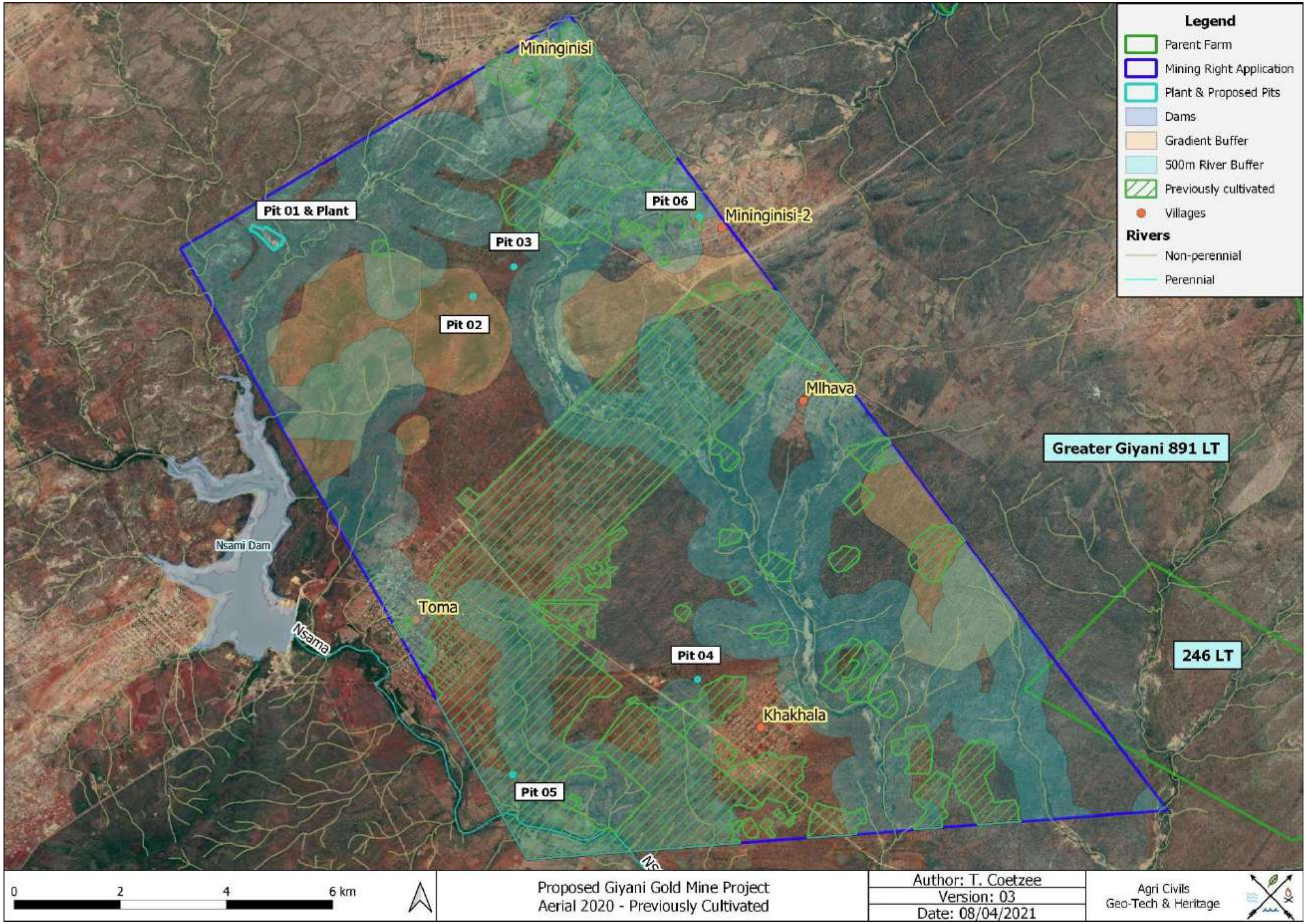


Figure 8: Proposed development and previously cultivated areas.

Figure 9: Undisturbed northern section demarcated for the proposed plant expansion.

Figure 10: Undisturbed southern section demarcated for the proposed plant expansion

Figure 11: Pit 01.

Figure 12: Plant area.

Figure 13: Environment Associated with proposed Pit 04.

Figure 14: Environment Associated with proposed Pit 05.

Figure 15: Environment Associated with proposed Pit 06.

Figure 16: Nearby houses at proposed Pit 06.

4.1 Sources of Information

At all times during the survey, standard archaeological procedures for the observation of heritage resources were followed. As most archaeological material occur in single or multiple stratified layers beneath the soil surface, special attention was paid to disturbances; both man-made such as roads and clearings, and those made by natural agents such as burrowing animals and erosion. Locations of archaeological material remains were recorded by means of a Garmin Oregon 750 GPS. These sites, as well as general conditions, were photographed with a Samsung S7 mobile phone.

A literature study, which incorporated previous work done in the region, was conducted in order to place the study area into context from a heritage perspective.

Personal communication with Mr Mzamani Mdaka from Kusile Invest 133 proved useful in locating potential heritage sites.

4.1.1 Previous Heritage Studies

Ngove village, Limpopo

A Heritage Impact Assessment (HIA) was done for a development on a small hill to the south of Ngove village, which is located south of Giyane. The study area is located about 12 km southwest of the proposed Kusile Invest 133 Giyani Gold Mine Project study area. The HIA recorded rudimentary stone-walling on a small plateau and suggested that the site was used for initiation. Accordingly, oral traditions are also associated with the hill (Van Schalkwyk 2006).

Nsami Dam upgrade

The HIA for the proposed upgrades of the Nsami Dam was done by eThembeni Cultural Heritage (2006). No specific details are mentioned regarding the upgrades of the dam, but it was noted that no sites of heritage significance were observed. The Nsami Dam is located approximately 300 m west of the Kusile Invest 133 Giyani Gold Mine Project study area.

McKechnie Vodacom Mast - Giyani

Archaeo-Info (2000) conducted an Archaeological Impact Assessment for the construction of a Vodacom mast at McKechnie, located approximately 11 km northwest of the Kusile Invest 133 Giyani Gold Mine Project study area. The study investigated a hill with a flat top and steep descending slopes. The hill measured approximately 100 m X 30 m and the majority of the hill was characterised by archaeological deposits, features and structures. Scattered concentrations of potsherds and slag were located along the top of the hill, while artefacts that include daga, animal bone and fresh water mollusca shells were identified between terrace walls on the slopes.

The terrace walling consisted of a single line of packed stones and it was noted that the terracing might be more extensive, but visibility was hampered by dense vegetation. Two vertically erected stones indicating the entrance to the site were also noted. According to the author, the potsherds belonged to the *Letaba* facies of the Kalundu tradition. The age of this facies is estimated to range between AD 1600 to 1840.

4.2 Limitations

The area associated with the plant that has already been developed was accessed without any constraints. The undeveloped sections of the plant area and Pit 01, as well as the remaining proposed Pits, are characterised by extremely dense vegetation that severely restricted free movement and visibility during the time of surveying (April 2021). The type of vegetation consisted of thick mopane tree cover, thorn bushes and grass cover (**Figures 17 & 18)**. The access road to proposed Pits 02 & 03 was completely inaccessible due to extremely dense vegetation (**Figure 19**). These proposed pits could therefore not be visited.

Figure 17: Thick tree cover.

Figure 18: Thorn trees and dense grass cover.

Figure 19: Closed access road to Pits 02 & 03.

5. Archaeological and Historical Remains

5.1 Stone Age Remains

No Stone Age archaeological remains were located within the demarcated study areas.

Although no Stone Age archaeological remains were located, such artefacts might occur in the area. These artefacts are often associated with rocky outcrops or water sources. **Figures 20 – 22** below are examples of stone tools often associated with the Early, Middle and Later Stone Age of southern Africa.

Archaeological studies done on the surrounding areas also did not locate material pertaining to the Stone Age.

According to Bergh (1999: 5 – 6), no major Stone Age archaeological sites are located in the direct vicinity of the study area, but rock art sites are found approximately 33 km to the northwest.

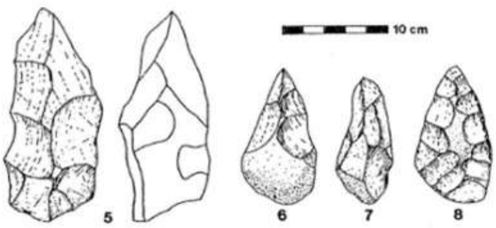


Figure 20: ESA artefacts from Sterkfontein (Volman 1984).

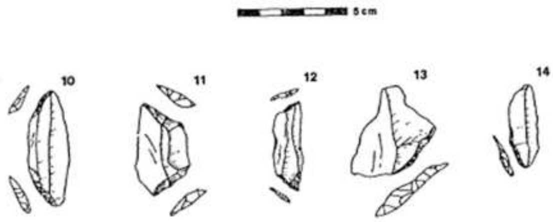


Figure 21: MSA artefacts from Howiesons Poort (Volman 1984).

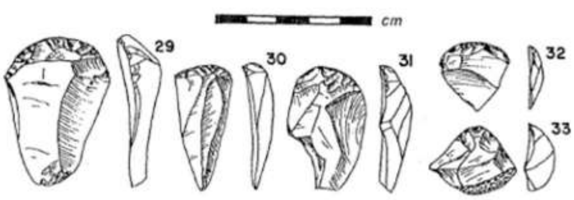


Figure 22: LSA scrapers (Klein 1984).

5.2 Iron Age Farmer Remains

No Iron Age Farmer archaeological remains were located within the demarcated study areas.

.

The heritage study done for the construction of the Vodacom Mast at McKechnie recorded archaeological deposits, features and structures that include potsherds, slag, daga, animal bone, fresh water mollusca and stone-walling on or near a hill (Archaeo-Info 2000).

5.3 Historical

Historical mining activity was observed at proposed Pits 04, 05 and 06 (**Figure 39 & Table 4**). Proposed Pit 04 is associated with at least three trenches that vary in length, but are generally one metre wide and 1.2 m deep (**Figure 23**). Dense vegetation, however, hampered determining the extent of these trenches. Also, no infrastructure or artefacts were observed at proposed Pit 04. It should be noted that the mine is not indicated on the topographical maps (**Appendix A: Figures 42, 46, 50 & 51**).

Proposed Pit 05 is associated with historical mining infrastructure that include a ball-mill mounting block, pieces of concrete and two very deep vertical shafts that pose a serious threat to people and animals (**Figures 24 – 27**). According to Mr Mzamani Mdaka (pers comm. 2021), the date '1947' was observed on one of the structures. During the site visit, however, this date could not be located. The mine is not indicated on the topographical maps, but the Boltmans Beauty Mine is indicated on the 1947 topographical map approximately 1 km to the northwest (**Appendix A: Figures 42, 46, 50 & 51**). Steenkamp & Clark-Mostert (2012), however, notes that Boltmans Beauty was operated prior to and around 1936.

Proposed Pit 06 consists of a relatively disturbed area close to Mininginisi-2 village. The infrastructure associated with this area include a ball-mill mounting block, two building foundations, and two rehabilitated mine shafts (**Figures 28 – 32**). The granite tops of the rehabilitated shafts, however, have been removed from the pedestals. The date of the mining infrastructure is unknown, but according to Mr Mzamani Mdaka (pers comm. 2021) this site dates to the 1980s. The mine is also not indicated on the topographical maps (**Appendix A: Figures 42, 46, 50 & 51**).

Table 4: Historical sites.

Name	Type	Source	Year	Status	Age	Estimated extent (ha)	Parcel
Pit 04	Historical mine	Survey	Unknown	Ruin	Historical	0.5	Greater Giyani 891 LT
Pit 05	Historical mine	Survey	1947	Ruin	Historical	0.5	Greater Giyani 891 LT
Pit 06	Historical mine	Survey	Unknown	Ruin	Historical	0.5	Greater Giyani 891 LT

The heritage study done by Van Schalkwyk (2006) for a development on a hill to the south of Ngove village recorded rudimentary stone-walling and noted a potential initiation site. The age of the site is unknown, but might date to historical times.

Figure 23: Historical mining activity at proposed Pit 04.

Figure 24: Ball-mill mounting block at proposed Pit 05.

Figure 25: Pieces of concrete at proposed Pit 05.

Figure 26: Vertical shaft at proposed Pit 05.

Figure 27: A second vertical shaft at proposed Pit 05.

Figure 28: Ball-mill mounting block at proposed Pit 06.

Figure 29: Building foundations at proposed Pit 06.

Figure 30: Granite top of rehabilitated shaft No 4.

Figure 31: Pedestal of rehabilitated shaft.

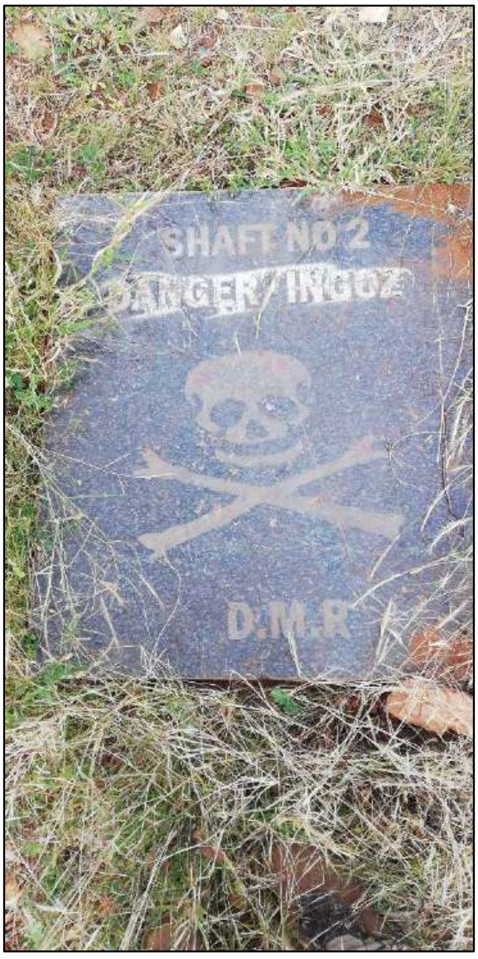


Figure 32: Granite top of rehabilitated shaft No 2.

5.4 Contemporary Remains

Some of the structures associated with proposed Pit 06, such as the rehabilitated mine shafts, might date to contemporary times.

Heritage studies done in the surrounding area did not record buildings or structures dating to contemporary times. See Archaeo-Info (2000), eThembeni Cultural Heritage (2006) and Van Schalkwyk (2006).

5.5 Graves

No graves or burial sites were located within the demarcated study areas. However, Mr Mzamani Mdaka pointed out three graves and one potential grave approximately 600 m to the southwest of the plant area (**Table 5 & Figures 33 – 36**). The graves consist of heavily overgrown stone cairns of which the orientation is unknown. The graves are not fenced-off and no inscriptions or grave good were observed. A painted stone is associated with Site B04, but it is unclear whether the site is associated with a burial site. Such painted stones are often used to indicate property and the stone cairn might have been used for this purpose.

Table 5: Graves.

Name	Type	Source	Year	Status	Age	Parcel
B01	Grave	Survey	Unknown	Intact	Unknown	Greater Giyani 891 LT
B02	Grave	Survey	Unknown	Intact	Unknown	Greater Giyani 891 LT
B03	Grave	Survey	Unknown	Intact	Unknown	Greater Giyani 891 LT
B04	Potential Grave	Survey	Unknown	Intact	Unknown	Greater Giyani 891 LT

Figure 33: Overgrown grave at B01.

Figure 34: Overgrown grave at B02.

Figure 35: Overgrown grave at B02.

Figure 36: Potential grave at B04.

Heritage studies done in the surrounding area did not record graves or burial sites. See Archaeo-Info (2000), eThembeni Cultural Heritage (2006) and Van Schalkwyk (2006).

6. Evaluation

The significance of an archaeological site is based on the amount of deposit, the integrity of the context, the kind of deposit and the potential to help answer present research questions. Historical structures are defined by Section 34 of the National Heritage Resources Act, 1999, while other historical and cultural significant sites, places and features, are generally determined by community preferences.

A fundamental aspect in the conservation of a heritage resource relates to whether the sustainable social and economic benefits of a proposed development outweigh the conservation issues at stake. There are many aspects that must be taken into consideration when determining significance, such as rarity, national significance, scientific importance, cultural and religious significance, and not least, community preferences. When, for whatever reason the protection of a heritage site is not deemed necessary or practical, its research potential must be assessed and if appropriate mitigated in order to gain data / information which would otherwise be lost. Such sites must be adequately recorded and sampled before being destroyed.

6.1 Field Ratings

All sites should include a field rating in order to comply with section 38 of the National Heritage Resources Act (Act No. 25 of 1999). The field rating and classification in this report are prescribed by SAHRA.

Table 6: Field Ratings.

Rating	Field Rating/Grade	Significance	Recommendation
National	Grade 1		National site
Provincial	Grade 2		Provincial site
Local	Grade 3 A	High	Mitigation not advised
Local	Grade 3 B	High	Part of site should be retained
General protection A	4 A	High/Medium	Mitigate site
General Protection B	4 B	Medium	Record site
General Protection C	4 C	Low	No recording necessary

Table 7: Individual site ratings.

Site / Survey Point Name	Type	Rating	Field Rating/Grade	Significance	Recommendation
Plant & Pit 01	Plant & opencast pit	General Protection C	4 C	Low	No recording necessary
Pit 04	Historical mining	General Protection B	4 B	Medium	Record site
Pit 05	Historical mining	General Protection B	4 B	Medium	Record site
Pit 06	Historical mining	General Protection B	4 B	Medium	Record site
2330BB-B01	Grave	Local	Grade 3 A	High	Mitigation not advised
2330BB-B02	Grave	Local	Grade 3 A	High	Mitigation not advised
2330BB-B03	Grave	Local	Grade 3 A	High	Mitigation not advised
2330BB-B04	Potential grave	Local	Grade 3 A	High	Mitigation not advised

7. Statement of Significance & Recommendations

7.1 Statement of significance

The study area: The six demarcated portions on un-surveyed state land of Greater Giyani 891 LT, Giyani, Limpopo

The proposed opencast pit areas (Pits 01 – 06) are based on the location of previous mining activity. In terms of mining, the general area has been exposed to mining activities since 1870. Mining activities appear to have continued until the 1980s, but were constantly interrupted, abandoned and reinvestigated over the years.

Given the significance of the larger cultural landscape and heritage sites located during previous heritage studies, the general area is considered sensitive from a heritage perspective. However, significant sections of the study area has been cultivated in past years that most likely disturbed the archaeological context. Also, due to extremely dense vegetation cover, the identification of culturally significant heritage sites was significantly hampered. The demarcated impact areas are indicated on **Figures 37 – 41**.

The demarcated plant area and Pit 01 has been disturbed by recent mining activity and no sites of heritage significance were observed within the demarcated boundary (**Figure 37**).

The area associated with proposed Pit 04 does not intersect the gradient or 500 m river buffer and no buildings or huts are indicated at this location on historical topographical maps (**Figure 39**). However, historical mining trenches of which the date is unknown, were located. No surface remains or infrastructure were noted at this site. Due to the potential age of the diggings, the site might be significant form an archaeological perspective and falls under the National Heritage Resources Act 25 of 1999.

Proposed Pit 05 intersects an area associated with huts as indicated on the 1967 topographical map (**Appendix A: Figure 46**), but has subsequently been disturbed by cultivation (**Figure 40**). The site is also located within the 500 m river buffer. Historical mining infrastructure associated with Pit 05 date to at least 1947 and are considered significant from and archaeological perspective. The site also falls under the protection of the National Heritage Resources Act 25 of 1999.

Proposed Pit 06 partially intersects an area marked to as previously cultivated, but mining remains found at the site might date to historical times (**Figure 41**). The rehabilitated shafts located at proposed Pit 06 might date to contemporary times, but it is likely that the initial mining activity and remaining infrastructure are much older and are considered significant from an archaeological perspective. Therefore, this site falls under the protection of the National Heritage Resources Act 25 of 1999 as well.

Although Pits 02 & 03 (**Figure 38**) could not be accessed as a result of dense vegetation, it is likely that these sites are associated with similar features and infrastructure as observed at proposed Pits 04, 05 and 06. A strong possibility, therefore, exists that these sites are significant from an archaeological perspective as well.

The graves and potential grave associated with Sites B01 – B04 consist of overgrown and dilapidated stone cairns without inscriptions or visible grave goods. These sites are located approximately 600 m southwest of the plant and Pit 01 area and fall within the 500 m river buffer. Although significant from a heritage perspective, no impact on the sites is envisaged.