mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

Basic Assessment Report
And
Closure Environmental Management Programme

Application for Environmental Authorisation in Support of the Proposed Decommissioning, Rehabilitation and Closure Activities at the Rand Uranium Cooke No. 1, 2 and 3 Shaft Operations

PART A: BASIC ASSESSMENT REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORISATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) (NEMA) AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 (ACT NO. 59 OF 2008) (NEM:WA) IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (ACT NO. 28 OF 2002) (MPRDA) (AS AMENDED).

Name of Applicant:	Rand Uranium (Pty) Limited
Tel no:	011 278 9770
Fax no:	-
Physical Address:	Libanon Business Park, 1 Hospital Street, Westonaria, 1780
File Reference Number SAMRAD:	(GP) 30/5/1/2/2 (07) MR and (GP) 30/5/1/2/5 (173) MR

This document has been prepared by Digby Wells Environmental.

Report Type:	Part A: Basic Assessment Report and Closure Environmental Management Programme
Project Name:	Closure of the Cooke No. 1, 2 and 3 Shaft Operations
Project Code:	SIB6297

Name	Responsibility	Signature	Date
Anita Gutu	Report Writer		October 2020
Mia Smith	Lead EAP Report Review		October 2020
Barbara Wessels	Senior Review Sign-off		October 2020

IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002 as amended) (MPRDA), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation (EA) can be granted following the evaluation of an Environmental Impact Assessment (EIA) process and an Environmental Management Programme (EMPr) report in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014 (GN R982 of 4 December 2014, as amended) (the *"EIA Regulations, 2014"*), any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17(1)(c), the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

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

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

OBJECTIVE OF THE BASIC ASSESSMENT PROCESS

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

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

EXECUTIVE SUMMARY

Introduction

The Cooke Operations are owned by Rand Uranium (Pty) Limited (Rand Uranium) which is a wholly owned subsidiary of Sibanye Gold Limited (Sibanye). The operations are located in the West Rand District Municipality (WRDM) and operate under two converted Mining Rights, namely (GP)30/5/1/2/2(07)MR (hereinafter *"07 MR"*) and (GP)30/5/1/2/5 (173)MR (hereinafter *"173 MR"*), associated with its underground and surface operations, respectively.

Broadly, the Cooke Underground Operations comprise three mine shaft complexes, namely Cooke No. 1, 2 and 3 Shafts (07 MR) for which Sibanye is seeking permanent closure; while the Cooke Surface Operations entail surface reclamation of historic gold Tailings Storage Facilities (TSFs). Gold recovery from reclaimed tailings material is undertaken through the Cooke Gold Plant (173 MR).

Sibanye is proposing to undertake various decommissioning, rehabilitation and closure activities across both Mining Right Areas which are subject to environmental approval. The environmental regulatory process comprises the following applications:

- An Application for Environmental Authorisation (EA) for trigged Listed Activities in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 4 December 2014, as amended) (the *"EIA Regulations, 2014"*), specifically Listing Notice 1 (GN R983 of 4 December 2014, as amended) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- A Heritage Resources Management (HRM) Process to comply with Section 38 of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) in support of the EA Application;
- An application for an Integrated Water Use Licence (IWUL) for identified Water Uses in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and associated application in terms of the Regulations on Use of Water for Mining and Related Activities aimed at the Protection of Water Resources (GN R704 of 12 February 2010); and
- A Closure Application in terms of Section 43(3) of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) and Regulation 57 of the MPRDA Regulations (GN R527 of 23 April 2004) (the *"MPRDA Regulations, 2004"*) for the underground MR (07 MR).

The Cooke Surface Operations' activities will be maintained while permanent closure is being sought for the Cooke Underground Operations. which will be maintained.

Digby Wells and Associates (South Africa) (Pty) Limited (trading as Digby Wells Environmental, hereinafter Digby Wells) was appointed to undertake these environmental regulatory processes.

This report constitutes the draft Basic Assessment Report (BAR) and Closure Environmental Management Programme (CEMPr) in support of the EA Application[1]. This report is being submitted to Interested and Affected Parties (I&APs) for a public commenting period between **16 October 2020 and 16 November 2020**. Following this commenting period, the report will be updated to include all comments received and subsequently submitted to the Department of Mineral Resources and Energy (DMRE) for final appraisal of the EA Application.

Note: The Closure Process for the Cooke Underground Operations is being executed in a phased approach. This Basic Assessment Process relates to Phase Two, encompassing closure implementation activities. Phase One (i.e. Regulation 37 EMPr Amendment Process) relates to closure planning activities and was submitted to the DMRE for final appraisal on 15 September 2020.

Project Applicant

Company name:	Rand Uranium (Pty) Ltd
Responsible person:	Grant Stuart – Senior Vice President
Contact person:	Simone Liefferink – Environmental Coordinator
Physical address:	Libanon Business Park 1 Hospital Street Libanon, Westonaria 1780
Telephone:	011 278 9770
Email:	simone.liefferink@sibanyestillwater.co.za

Environmental Consultants

Company name:	Digby Wells and Associates (South Africa) (Pty) Ltd, t/a Digby Wells Environmental
EAP representative:	Maria Smith – Divisional Manager: Environmental Services
Physical address:	Digby Wells House, Turnberry Office Park 48 Grosvenor Road Bryanston, Johannesburg 2191
Telephone:	011 789 9495
Email address	mia.smith@digbywells.com

[1] The BAR and CEMPr have been split into Part A and Part B respectively. This document constitutes Part A.

Approach and Methodology for the Public Participation Process

A Public Participation Process (PPP) was undertaken during Phase One of the Cooke Underground Closure Process (closure planning activities), from January to September 2020. It is important that stakeholders that may be affected by the project are given an opportunity to identify concerns and to ensure that local knowledge, needs and values are understood and taken into consideration as part of the impact assessment process.

The stakeholders' comments from Phase One have been duly considered in this BAR and responses have been refined accordingly as more information became available (refer to the appended Comment and Response Report (CRR)). This draft BAR has been submitted to I&APs for a public 30-day review and commenting period between **16 October 2020 and 16 November 2020**.

Due to the COVID-19 Pandemic and associated restrictions, no hard copies of this draft BAR were made available at public places. The report has been made available on various online platforms, namely:

- Digby Wells website (www.digbywells.com) under Public Documents;
- Ulwazi Platform Zero Data Portal (https://ulwazi.datafree.co/); and
- Ulwazi Platform USSD messaging service (***134*20042#**).

Presentations detailing the key outcomes of the investigations and resulting mitigation and management measures have been made available on the abovementioned online platforms. During this public commenting period, the need for focus group meetings will be determined on a case-by-case basis (either face-to-face for a limited number persons or online meetings). Requests for hard copies will also be fulfilled should any of the abovementioned platforms pose a concern to the I&APs. It should be noted that community training sessions on the use of the Ulwazi and USSD platforms were hosted during the Phase One PPP. The DMRE and DWS raised no objections to the way forward presented for the PPP.

Need and Desirability of the Project

Underground mining at Cooke No. 1, 2 and 3 Shafts ceased in May 2018. Sibanye has maintained the underground workings while investigating feasible plans to continue mining or sell the operations. No plans were found to be feasible, and as such, Sibanye is now seeking a permanent sustainable closure solution. This includes various decommissioning and final rehabilitation activities at these shaft complexes and associated infrastructure, as well as closure activities for the underground workings.

The Cooke Surface Operations are ongoing. In line with the Rehabilitation Plan, water resources (including wetlands and portions of the Wonderfonteinspruit) which have been contaminated by historic mining activities and/or the current operations are to be rehabilitated. Sibanye intends to undertake this as concurrent rehabilitation activities while maintaining surface operation activities.

To this end, decommissioning, rehabilitation and closure activities are proposed to be carried out across both Mining Right Areas. This is aimed to result in the permanent sustainable closure of the Cooke Underground Operations, while reducing longer term environmental risks and liabilities for the ongoing Cooke Surface Operations.

Project Overview

The proposed decommissioning, rehabilitation and closure activities include:

- Removal and decontamination of underground infrastructure containing hydrocarbons and other contaminants from the underground workings;
- Refurbishment of plugs between Cooke No. 3 Shaft and Cooke No. 4 Shaft (Ezulwini Gold Mine), as well as between Cooke No. 1 Shaft and Doornkop Mine (Harmony Gold Mine);
- Potential capping of the shaft barrel below the dolomitic aquifer, although it is noted that the Groundwater Report has found this to not be a requirement and the shafts will be capped on surface to prevent access to the shafts;
- Rewatering of underground workings;
- Decommissioning and removal of surface infrastructure at the shaft complexes (incl. water contaminant facilities and buried pipelines);
- Rehabilitation of all associated disturbed surfaces (incl. shaping landscape, soil amelioration and re-vegetating); and
- Rehabilitation of various mine affected wetlands as appropriate based on the specialist investigations across the Cooke Surface- and Underground Operations (incl. removal of impacted material which has accumulated in the water resources and/ or alien plant species, ripping soils and possible re-vegetation of indigenous plant species).

Purpose of this Report

The purpose of the BAR is to describe the proposed activities and identify potential environmental and socio-economic impacts (both positive and negative) that could arise from the execution of these activities. To achieve this, various environmental and socio-economic specialist investigations were carried out. From this, a CEMPr was developed to provide specific mitigation and management measures to avoid or minimise the significance of adverse impacts as far as possible.

Impact Assessment Summary

The majority of adverse impacts associated with the implementation of the proposed decommissioning and rehabilitation activities are expected to be of Minor or Negligible Negative significance. Possible impacts include sedimentation of nearby watercourses and wetlands as a result of erosion (water and wind) from bare surfaces following the removal of infrastructure, as well as soil and water resource contamination from hydrocarbon spillages/

leakages. This would consequently lead to reduced ecological integrity of the freshwater ecosystems which, as established in the Baseline Section, are already adversely impacted. Nuisance impacts in terms of increased noise and dust fallout may also be experienced by nearby receptors during the execution of these activities.

On the other hand, the proposed rehabilitation activities would entail the removal of existing contamination sources and alien invasive plant species from the landscape and wetlands, as well as profiling of disturbed areas and re-establishment of natural vegetation. If correctly implemented, positive impacts will be realised to terrestrial biodiversity and freshwater ecosystems and lead to the establishment of a sustainable post-mining land use for the Cooke Shaft Complexes, which will in-turn have socio-economic benefits.

The key legacy issue associated with gold mining in the area is Acid Mine Drainage (AMD) formation. A comprehensive hydrogeological numerical model was prepared to predict and quantify possible impacts to water resources as a result of the closure and rewatering of the Cooke No. 1, 2 and 3 Shafts. The model found that water in the shafts is not expected to decant to surface and therefore, the shafts are not regarded as contamination sources. Furthermore, geochemical modelling indicates that water in the shafts is expected to be of an acceptable standard. Therefore, even in the unlikely event that decant or contamination of the dolomitic aquifers occurs, water from the shaft is not expected to significantly contribute to deteriorating water quality to the surrounding water resources.

In the long-term, as the affected dolomite aquifers recover, water flow to the Wonderfonteinspruit is expected to occur as per pre-mining conditions. This water is expected to be of an acceptable standard for various downstream water users and associated freshwater ecosystems, and represent an improved quality from the current water quality discharged into the Wonderfonteinspruit. As such, a long term benefit rated to be of Moderate Positive significance is anticipated. It is however noted that the dormant Cooke TSF, located north of the shaft complexes, was deemed a potential source of contamination to the groundwater environment. The contamination plume is not expected to migrate to the nearest receptors and as such, deemed an impact of Minor Negative significance.

From a socio-economic perspective, positive impacts including job opportunities for the execution of decommissioning and rehabilitation activities; as well as the sale of salvageable items to local supply chain will be realised. In terms of potential negative socio-economic impacts, health, safety and security risks associated with illegal mining which is prevalent in the area could occur; as well as community unrest due to a perceived lack economic opportunities and unfulfilled promises is possible. Furthermore, the permanent closure of the Cooke Underground Operations has and will inevitably result in adverse socio-economic implications due to the loss in employment opportunities. As a result of the cessation of underground mining in 2018, significant retrenchments, loss of contracts and other induced benefits associated with the Cooke Underground Operations have occurred. As no feasible options to continue underground mining could be identified, these adverse effects will be permanent. The operations are located in an area where there is a prevalence of illegal mining activity. The rewatering, decommissioning and removal of mining infrastructure and any

associated viable surface sources will remove sources for illegal mining in the immediate area of Cooke but this in turn may lead to illegal miners targeting neighbouring mines, especially those abandoned and derelict as is already the case. This in turn presents community health, safety and security risks. This is deemed an impact of Major Negative significance. A Social Closure Planning (SCP) Process has been commissioned to appropriately and meaningful engage with stakeholders to address the potential direct and indirect socio-economic impacts associated with closure.

Conclusions and Recommendations

The findings of the Impact Assessment show that the majority of adverse impacts are expected to be of Minor or Negligible significance. With the implementation of the proposed mitigation measures, it is expected that the significance of all identified impacts can be reduced. This will result in the majority of adverse impacts for the implementation of decommissioning and rehabilitation activities being of Negligible significance. Ultimately, the activities are aimed at rehabilitating mine affected areas and water resources which, if successfully executed, should restore/ improve the environmental biophysical characteristics of the area and contribute to reducing the existing adverse cumulative impacts caused by current and historic mining activities in the West Rand.

The following key recommendations are made which should be considered as conditions for the EA:

- The mitigation/ enhancement measures contained in the CEMPr must be adhered to for the overall positive impacts of the project to be realised;
- An Environmental Control Officer must be appointed for and be present during the decommissioning and rehabilitation activities;
- An IWUL must be obtained prior to undertaking the proposed rehabilitation activities in, or in proximity to, water resources;
- As per the Geochemical Assessment, though a low risk in terms of leaching chemicals is expected, impacted areas outside of watercourses should be removed and disposed of as per the current approved disposal measures into the pits. Areas associated with the watercourses found to be contaminated should be further investigated for rehabilitation requirements once activities impacting these areas have ceased (i.e. discharge and deposition), while it is not recommended to disturb sediments with a low risk of leaching in functioning flowing river systems such as the Wonderfonteinspruit as this is more likely to lead to further impacts and degradation. Therefore, it is noted that removal and disturbance of sediment in the Wonderfonteinspruit has been specifically discouraged;
- The Hydrogeological Numerical Model must continue to be updated periodically as more information becomes available during closure implementation to refine the model predictions and additional monitoring boreholes should be drilled to assist in the monitoring and refinement of the modelling;

- The Decommissioning, Rehabilitation and Mine Closure Plan (2019) developed in terms of the Financial Provisioning Regulations, 2015 (GN R1147 of 20 November 2015, as amended) (the *"Financial Provisioning Regulations, 2015"*) must be updated on an annual basis, considering the progression of rehabilitation and closure activities, as well as the status of impact predictions;
- The planned SCP Process must be implemented to meaningfully engage with stakeholders and develop a practical plan to execute social closure;
- Environmental monitoring as prescribed under the CEMPr must continue throughout the implementation of proposed activities;
- Post-closure monitoring must be undertaken in line with the Decommissioning, Rehabilitation and Mine Closure Plan once the requirements are understood and detailed; and
- Specific rehabilitation plans must be developed for the targeted affected wetlands across both Mining Right Areas and be informed by the ecological state of these system as established in this BAR.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLANS

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

Abbreviation / Acronym	Description
07 MR	Refers to the approved Mining Right Area for the Cooke Underground Operations with the reference number: (GP) 30/5/1/2/2 (07) MR
173 MR	Refers to the approved Mining Right Area for the Cooke Surface Operations with the reference number: (GP) 30/5/1/2/5 (173) MR
ABA	Acid-Base Accounting
AIPs	Alien Invasive Plant Species
AMD	Acid Mine Drainage
ARC	Agricultural Research Council
BA	Basic Assessment
BAR	Basic Assessment Report
CARA	Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CEMPr	Closure Environmental Management Programme
Clidet EMPr	EMPr was issued to Clidet No. 726 (Pty) Ltd for the Cooke Operations dated March 2008 (approved July 2009)
CoJ	City of Johannesburg
COVID-19	Coronavirus Disease 2019
CRR	Comments and Response Report
CS	Cultural Significance
DEA	Department of Environmental Affairs
DI Test	Distilled Water Leachate Tests
Digby Wells	Digby Wells and Associates (South Africa) (Pty) Limited, trading as Digby Wells Environmental
DMRE	Department of Mineral Resources and Energy
DWAF	Department of Water Affairs and Forestry (now the DWS)
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EAPASA	Environmental Assessment Practitioners Association of South Africa
EIA	Environmental Impact Assessment

Abbreviation / Acronym	Description
EIA Regulations, 2014	(GN R982 of 4 December 2014, as amended) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998)
EIS	Ecological Importance and Sensitivity
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
ERA	Environmental Risk Assessment
Financial Provisioning Regulations, 2015	GN R1147 of 20 November 2015, (as amended) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998)
FWRDWA	Far West Rand Dolomitic Water Association
GeoSA	Council for Geoscience
GDP	Gross Domestic Product
GN	Government Notice
ha	Hectare
HGM Units	Hydro-geomorphic Units
HIA	Heritage Impact Assessment
HRM	Heritage Resources Management
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IWUL	Integrated Water Use Licence
IWULA	Integrated Water Use Licence Application
km	kilometres
m	Metres
mamsl	Metres Above Mean Sea Level
MCLM	Mogale City Local Municipality
MPRDA	Mineral and Petroleum and Resources Development Act, 2002 (Act No. 28 or 2002)
MPRDA Regulations, 2004	GN R527 of 23 April 2004 promulgated under the Mineral and Petroleum and Resources Development Act, 2002 (Act No. 28 or 2002)
MQA	Mining Qualifications Authority
NAG	Net Acid Generation
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)

Abbreviation / Acronym	Description
NEM:BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NGO	Non-Governmental Organisation
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NNR	National Nuclear Regulator
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PES	Present Ecological State
PPP	Public Participation Process
Rand Uranium	Rand Uranium (Pty) Limited holds the Mining Rights for the Cooke Operations. The Company is a wholly owned subsidiary of Sibanye Gold Limited.
RQOs	Resource Quality Objectives
RWCLM	Rand West City Local Municipality
RWD	Return Water Dam
SANS	South African National Standards
SCP	Social Closure Plan
SETA	Sector Education and Training Authority
SGA	Sibanye Gold Academy
SIA	Socio-economic Impact Assessment
Sibanye	Sibanye Gold Limited, a subsidiary of Sibanye-Stillwater Limited
SLP	Social and Labour Plans
SMS	Short Messaging Service
SPLP Test	Synthetic Precipitation Leaching Procedure Leachate Tests
SQRs	Sub-Quaternary Reaches
SS%	Sulphur-Speciation
SSC	Species of Special Concern
TCTA	Trans Caledon Tunnel Authority
TSF	Tailings Storage Facility
USSD	Unstructured Supplementary Service Data

Abbreviation / Acronym	Description
WRDM	West Rand District Municipality
XRD	X-ray Diffraction
XRF	X-Ray Fluorescence

1 Introduction

Digby Wells and Associates (South Africa) (Pty) Limited (trading as Digby Wells Environmental, hereinafter Digby Wells) was appointed by Sibanye Gold Limited (a subsidiary of Sibanye-Stillwater Limited, hereinafter Sibanye) to undertake an environmental regulatory process associated with proposed decommissioning, rehabilitation and closure activities at the Cooke No. 1, 2 and 3 Shaft Operations.

The proposed activities trigger Listed Activities in terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (GN R982 of 4 December 2014, as amended) (the *"EIA Regulations, 2014"*) and more specifically, Listing Notice 1 (GN R983 of 4 December 2014, as amended) which were promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). This requires that Environmental Authorisation (EA) be obtained through the undertaking of a Basic Assessment (BA) Process. The environmental regulatory processes also include the following:

- A Heritage Resources Management (HRM) Process to comply with Section 38 of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) in support of the EA Application;
- An application for an Integrated Water Use Licence (IWUL) for identified water uses during rehabilitation and closure activities in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and associated application in terms of the Regulations on Use of Water for Mining and Related Activities aimed at the Protection of Water Resources, 2010 (GN R704 of 12 February 2010); and
- A Closure Application in terms of Section 43(3) of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) and Regulation 57 of the MPRDA Regulations, 2004 (GN R527 of 23 April 2004) (the *"MPRDA Regulations, 2004"*).

This report constitutes the draft Basic Assessment Report (BAR) and Closure Environmental Management Programme (CEMPr) in support of the EA Application[2]. This report is being submitted to Interested and Affected Parties (I&APs) for a public commenting period between **16 October 2020 and 16 November 2020**. Following this commenting period, this report will be updated to include all comments received and subsequently submitted to the Department of Mineral Resources and Energy (DMRE) for final appraisal of the EA Application.

1.1 Project Background and Motivation

The Cooke Operations are owned by Rand Uranium (Pty) Limited (Rand Uranium), which is a wholly owned subsidiary of Sibanye. The operations are situated on the West Rand of the Witwatersrand Basin, namely in the West Rand District Municipality (WRDM), and operate

[2] Note: The BAR and CEMPr have been split into Part A and Part B respectively. This document is Part A.

under two converted Mining Rights: (GP)30/5/1/2/2(07)MR (hereinafter *"07 MR"*) and (GP)30/5/1/2/5(173)MR (hereinafter *"173 MR"*), associated with its underground and surface operations respectively.

The underground operations (referred to as the "Cooke Underground Operations") comprise three mine shaft complexes, namely Cooke No. 1, 2 and 3 Shafts. Underground mining at all three complexes ceased in May 2018. Sibanye has maintained the underground workings while investigating feasible plans to continue mining. No plans were found to be feasible and as such, Sibanye is now seeking a permanent sustainable closure solution. This includes various decommissioning and final rehabilitation activities at these shaft complexes as well as closure activities for the underground workings.

The surface operations (referred to as the "Cooke Surface Operations") are ongoing and entail the reclamation of historic Tailings Storage Facilities (TSFs) for gold recovery. In line with the Rehabilitation Plan, water resources (including wetlands and portions of the Wonderfonteinspruit) which have been contaminated by historic mining activities and/ or the current operations, are to be rehabilitated. Sibanye intends to undertake this as concurrent rehabilitation activities while maintaining surface operation activities.

To this end, decommissioning, rehabilitation and closure activities are proposed to be carried out across the 07 MR and 173 MR areas. This is aimed to result in the permanent sustainable closure of the Cooke Underground Operations, while reducing longer term environmental risks and liabilities for the ongoing Cooke Surface Operations.

1.2 Purpose of this Report

This BAR and CEMPr (Part B) has been compiled against the following objectives:

- To provide a clear description of the planned activities which are subject to EA;
- To describe and characterise the biophysical and socio-economic conditions of the project's footprint;
- To identify and quantify the potential negative and positive environmental and social impacts which may be caused by implementing the proposed activities; and
- To provide a consolidated CEMPr for planned activities across 07 MR and 173 MR with practical mitigation and management measures to address and/or minimise the identified potential impacts to the physical and socio-economic environment.

As the EMPr specifically details with decommissioning, rehabilitation and closure activities, it constitutes and is hereinafter referred to as a Closure EMPr (CEMPr). Latent and/or residual risks associated with the permanent closure of 07 MR that could result in adverse environmental or social impacts have also been considered and used to inform the CEMPr.

1.3 Structure of this Report

This report has been compiled based on the required contents of a BAR as specified under Appendix 1 of the EIA Regulations, 2014. The subsequent chapters have been chronologically aligned to Section 3(1) of Appendix 1 for ease of reference.

1.4 Closure Process for the Cooke Underground Operations

The Cooke Underground Operations' closure process is being undertaken in phases (Figure 1-1), namely:

- *Phase One:* Application for an Amendment to the approved EMPr in terms of Regulation 37 of the EIA Regulations, 2014;
- *Phase Two:* Application for EA and an IWUL; and
- *Phase Three:* Social Closure Planning (SCP) Process.

During *Phase One* an Amendment Process in terms of Regulation 36(2) and Regulation 37 of the EIA Regulations, 2014 (as amended) was undertaken to include closure planning activities into the approved EMPr. This comprises the partial rewatering of the Cooke No. 3 Shaft and dismantling of non-essential mine infrastructure. These activities were isolated and prioritised so as to prevent access by illegal miners to the underground workings (which presents an immediate health and safety risk) as well as to free up financial resources to invest in the proposed final decommissioning, rehabilitation and closure activities. The final Regulation 37 EMPr Amendment Report was submitted to the DMRE on 15 September 2020.

This BA Process forms part of *Phase Two* of the closure process. The aim is to specifically assess and authorise proposed final decommissioning, rehabilitation and closure activities associated with the final closure application for the Cooke Underground Operations and concurrent rehabilitation activities for the Cooke Surface Operations. These activities also trigger water uses in terms of Section 21 of the NWA, requiring an IWUL.

Subsequent to the completion of the environmental regulatory process for the closure of the Cooke Underground Operations, an SCP Process (i.e. *Phase Three*) will be undertaken. This is aimed to ensure that meaningful engagement with stakeholders can be undertaken and that the requirements for social closure in terms of NEMA and the MPRDA are fulfilled. Phase Three will look at post-mining opportunities and thus any environmental and/or water use activities will not be incorporated into the Rand Uranium Operations' environmental and water use authorisations but rather if required into independent authorisations to allow project continuation independently from the mining operations.

All three phases feed into the required ultimate Closure Application in terms Section 43(3) of the MPRDA. The approach to the Public Participation Process (PPP) is continual engagement through each phase of the Closure Process.

Public comments and engagement activities that have been carried out in Phase One have been duly considered in this BAR and Sibanye has committed to maintaining engagement beyond the environmental regulatory process until closure is reached.

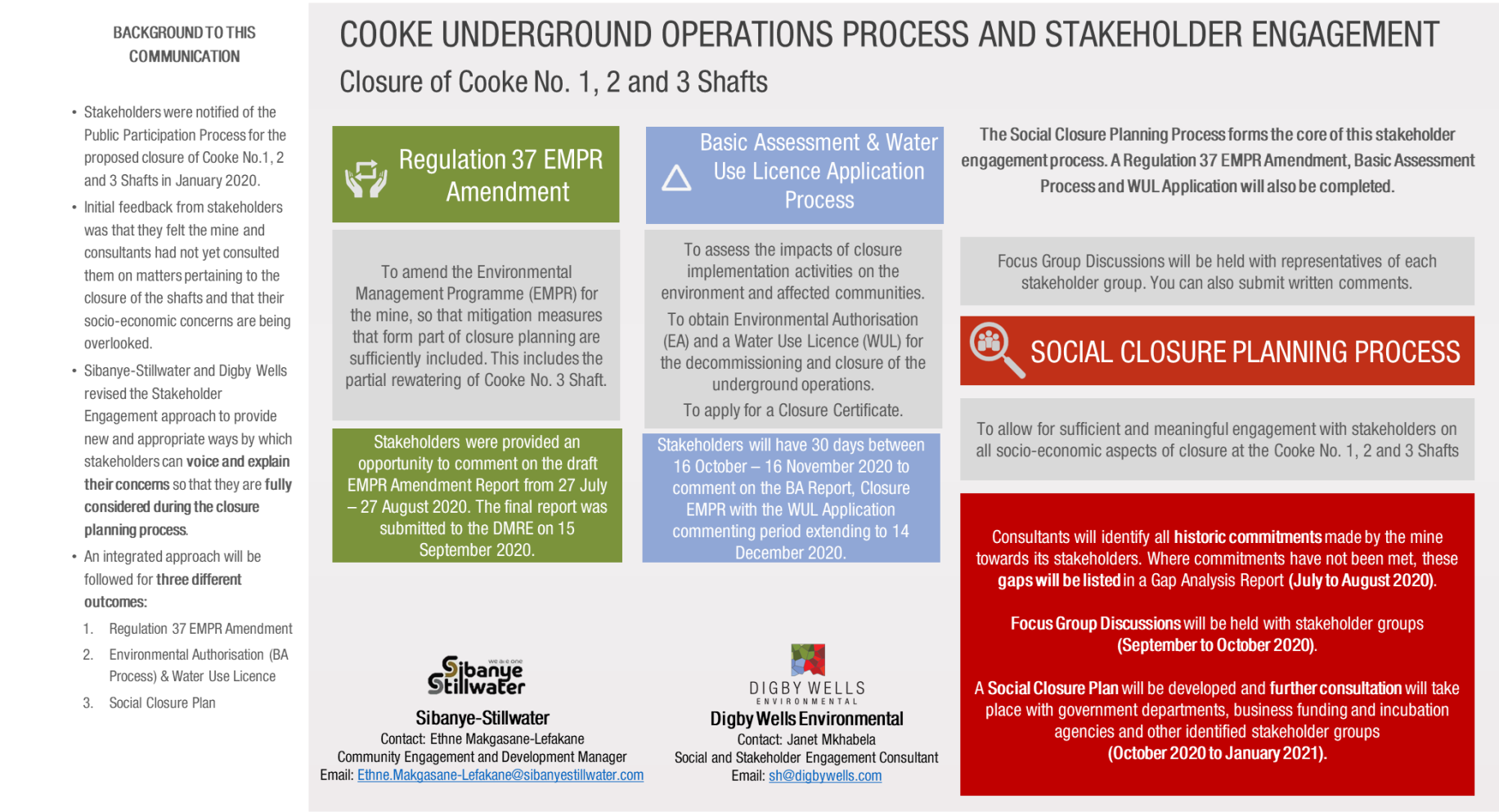


Figure 1-1: Phases of the Cooke Underground Operations Closure Process

2 Administrative Information

2.1 Details of the Project Applicant

The Cooke Operations are managed by Rand Uranium, a wholly owned subsidiary of Sibanye. Table 2-1 provides the relevant contact details for the applicant.

Table 2-1: Applicant Details

Company name:	Rand Uranium (Pty) Ltd
Responsible person:	Grant Stuart – Senior Vice President
Contact person:	Simone Liefferink – Environmental Coordinator
Physical address:	Libanon Business Park 1 Hospital Street Libanon, Westonaria 1780
Telephone:	011 278 9770
Email:	simone.liefferink@sibanyestillwater.co.za

2.2 Details of the Environmental Assessment Practitioner

Digby Wells has been appointed as the independent Environmental Assessment Practitioner (EAP) to undertake the environmental regulatory amendment process. Digby Wells is an independent environmental solutions provider with extensive experience in undertaking environmental regulatory processes within the mining industry. Table 2-2 provides the relevant contact details for the EAP.

Table 2-2: Contact Details of the EAP

Company name:	Digby Wells and Associates (South Africa) (Pty) Ltd, t/a Digby Wells Environmental
EAP representative:	Maria Smith – Divisional Manager: Environmental Services
Physical address:	Digby Wells House, Turnberry Office Park 48 Grosvenor Road Bryanston, Johannesburg 2191
Telephone:	011 789 9495
Email address	mia.smith@digbywells.com

2.3 Expertise of the EAP

2.3.1 The qualifications of the EAP and Past Experience

In accordance with section 24N(2)(b) of NEMA, the person responsible for putting together an EMPr must be qualified and competent. The Digby Wells representative EAP, Ms. Maria Smith, is a registered EAP with the Environmental Assessment Practitioners Association of South Africa (EAPASA) (Registration No. 2019/1282). She has completed a Master of Science degree specialising in Geography and Environmental Management through the University of Johannesburg and has over 12 years' experience in the field including compiling various EMPrs. Please refer to **Appendix A** for the EAP's qualifications and Curriculum Vitae (CV).

3 Location of the Overall Activity

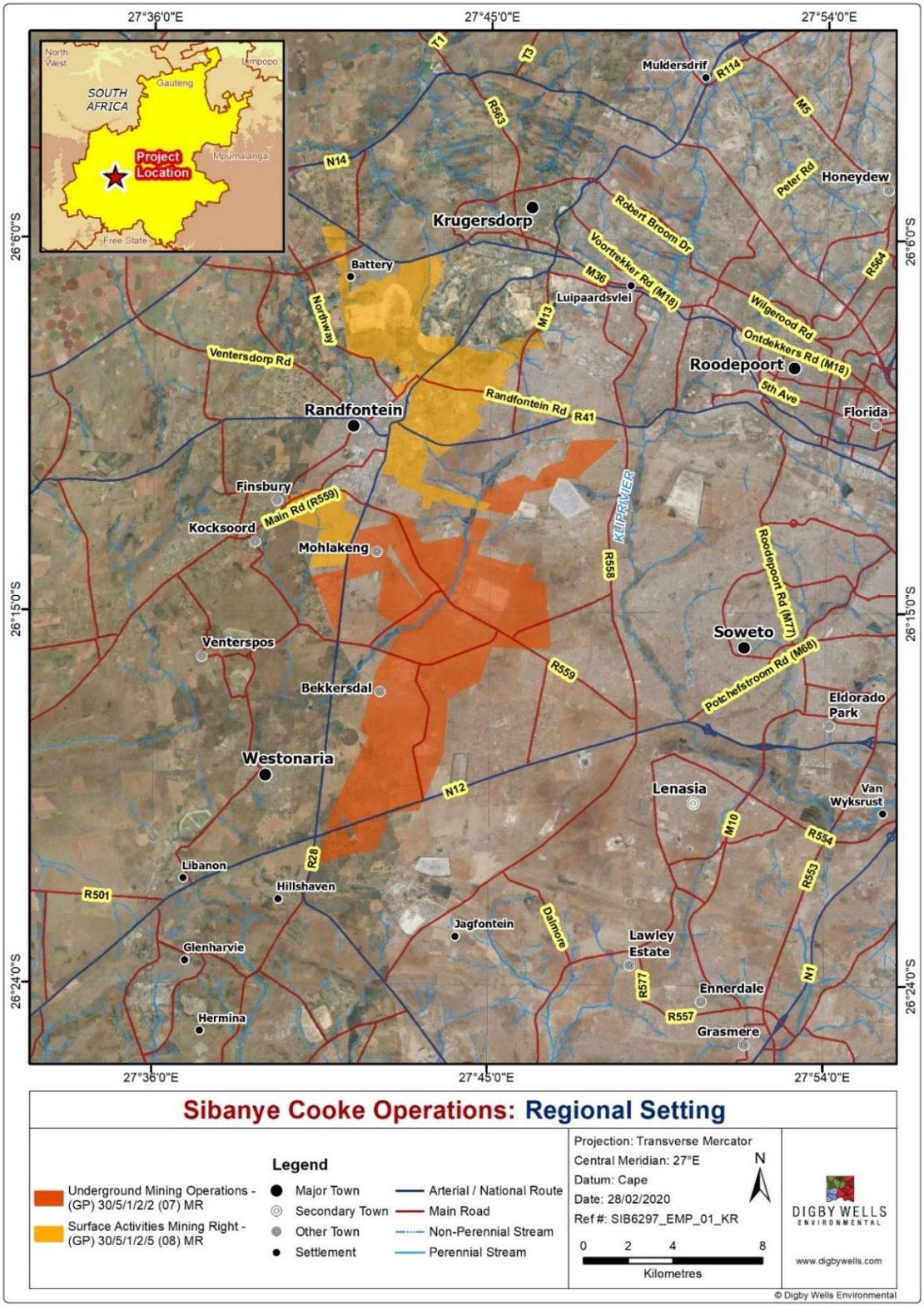
As indicated above, the Cooke Surface- and Underground Operations span over two Mining Right Areas in terms of the MPRDA (07 MR and 173 MR). These Mining Right Areas comprise various properties within the WRDM. The operations are approximately 30 km south-west of the Johannesburg city centre, 8 km south-west of the town Krugersdorp and 20 km north of Westonaria. Table 3-1 provides the property details associated with the Mining Right Areas.

Table 3-1: Property Details

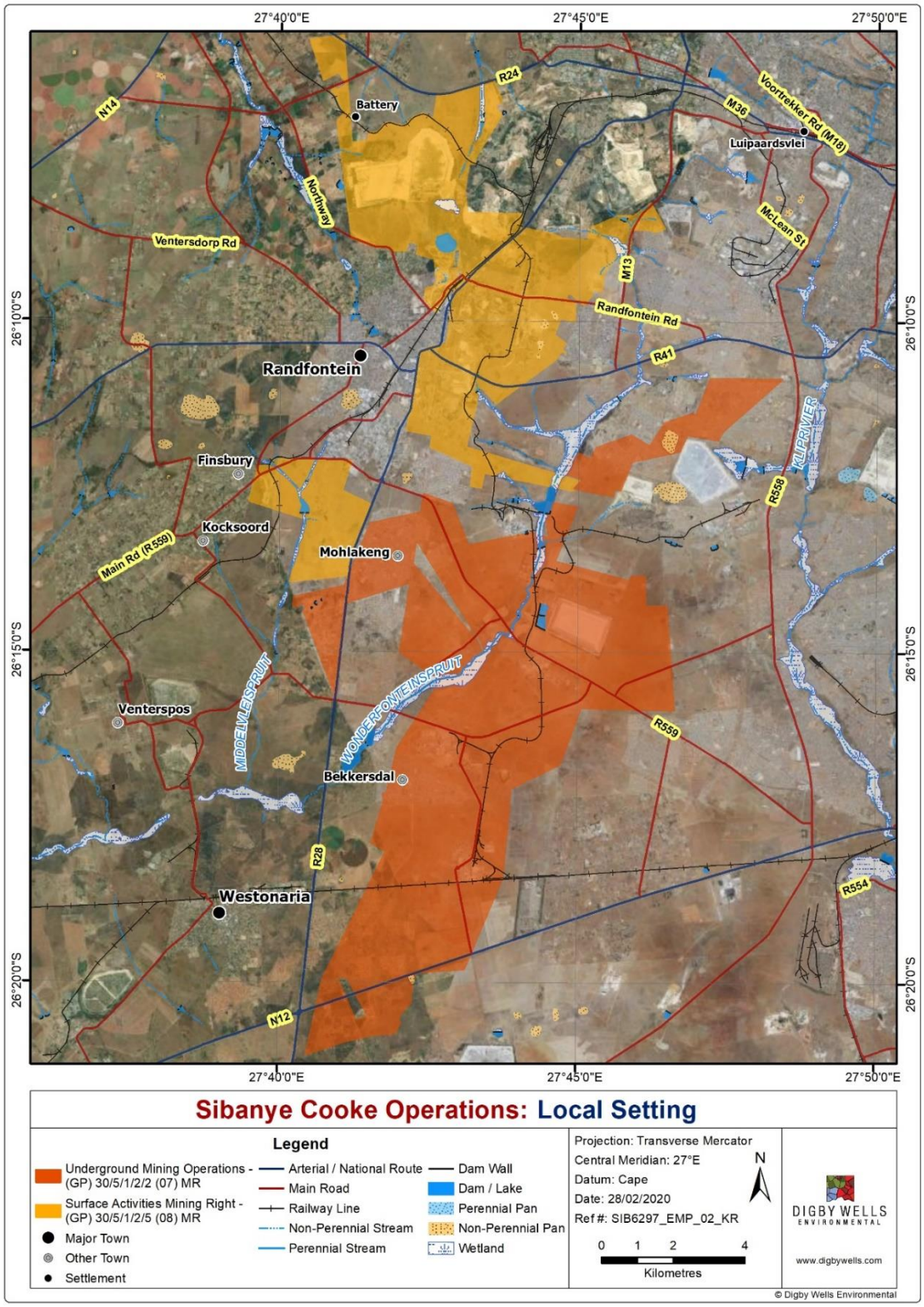
Farm Name:	Please refer to **Appendix B** for the full list of properties associated with 07 MR and 173 MR (including Land Tenure Plan).
Application Area (Ha):	• 07 MR – 7 575 ha • 173 MR – 4 564 ha
Magisterial District:	West Rand District Municipality
Distance and direction from nearest town:	The nearest major towns are Randfontein and Westonaria which are located approximately 10.5 km north-west and 9.4 km south-west of the centre point of the Mining Right Areas, respectively.
21 digit Surveyor General Code for each farm portion:	Please refer to the property details included in **Appendix B**.

4 Locality Map

The Regional and Local Settings of the Cooke Operations are depicted in Plan 1 and Plan 2 below.



Plan 1: Regional Setting



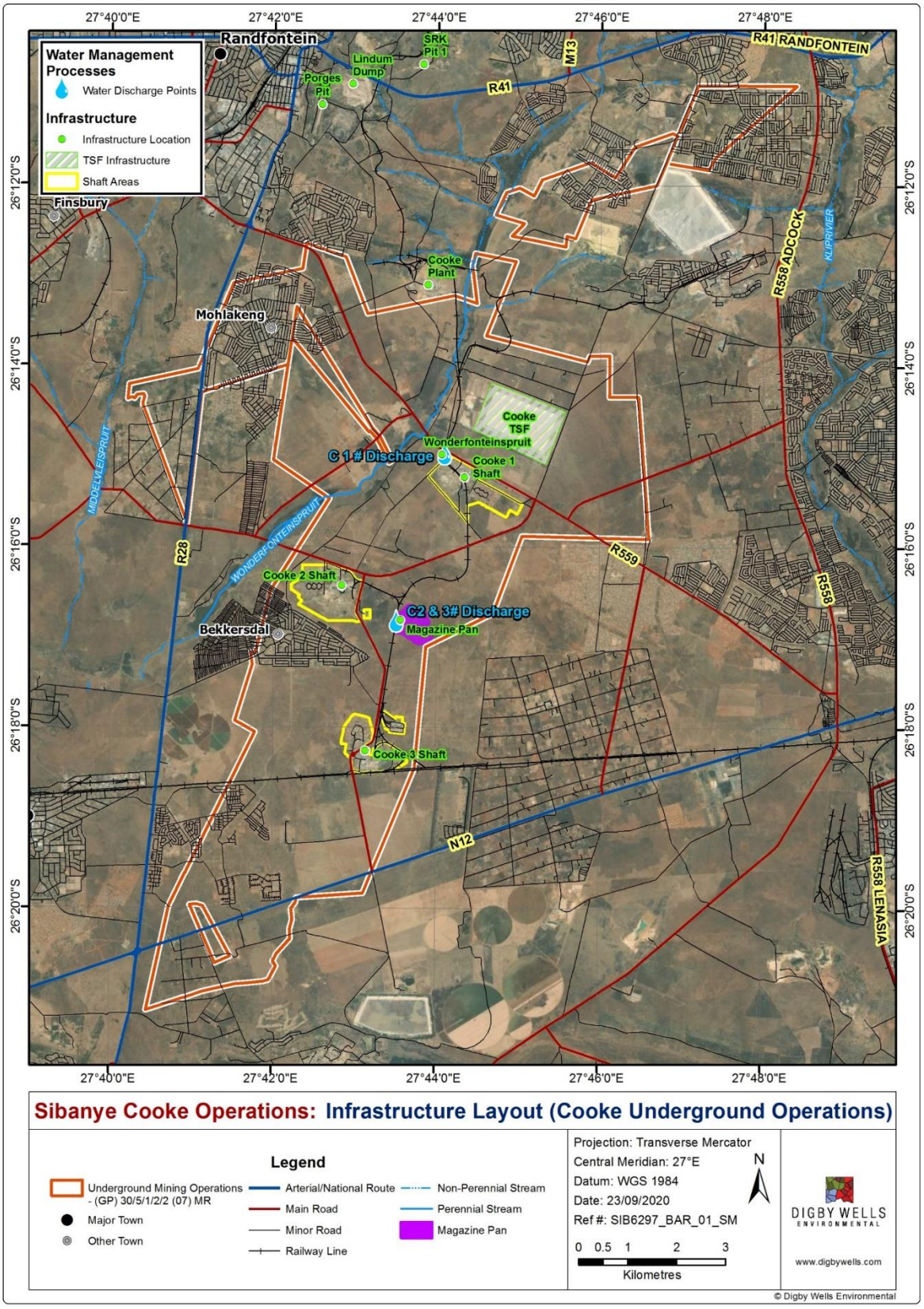
Plan 2: Local Setting

5 Description of the Scope of the Proposed Overall Activity

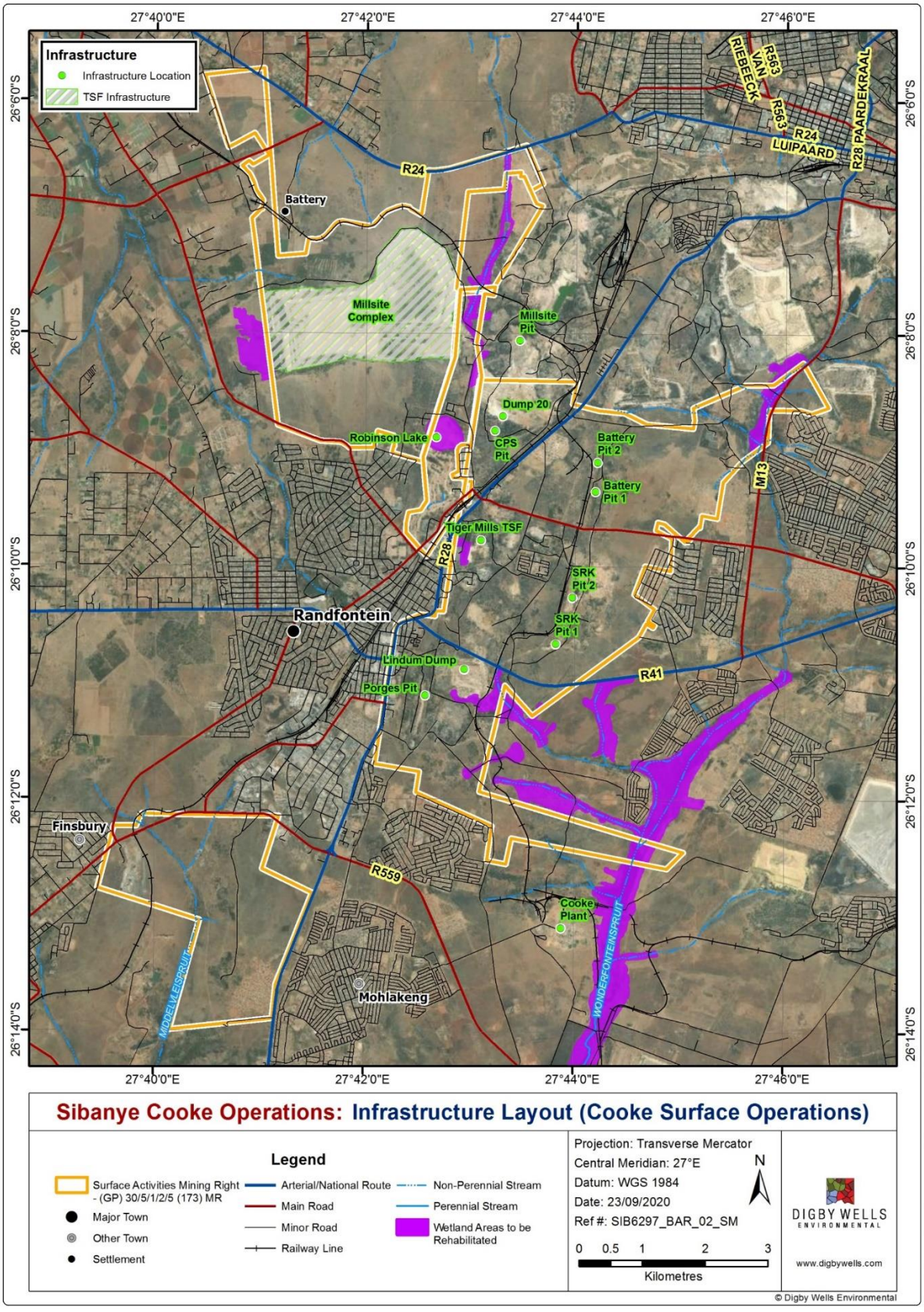
Sibanye intends to undertake decommissioning, rehabilitation and closure activities across the Cooke Surface and Underground Operation's Mining Right Areas. Plan 4 and Plan 4 below depict the areas targeted for these activities for the respective operations.

The current activities being undertaken are authorised in terms of an approved EMPr in terms of the MPRDA dated March 2008 (approved July 2009). The EMPr was issued to Clidet No. 726 (Pty) Ltd and is referred to as the Clidet EMPr, the EMPr has a number of associated amendments.

The existing approved activities and specific proposed activities are discussed in the subsections below for the respective operations.



Plan 3: Infrastructure Layout of the Cooke Underground Operations



Plan 4: Infrastructure Layout of the Cooke Surface Operations

5.1 Cooke Underground Operations

5.1.1 Existing Approved Activities

The Cooke Underground Operations comprise three underground mine shaft complexes, namely the Cooke No. 1, 2 and 3 Shafts. Various surface and underground infrastructure has been constructed at each complex and includes:

- Surface infrastructure:
  - Vertical and ventilation shafts;
  - Administrative, workshop and accommodation buildings;
  - Water management structures (incl. water storage infrastructure, trenches, berms etc.);
  - Waste storage areas; and
  - The Cooke TSF (application will be submitted for this to be incorporated into the 173 MR).
- Underground infrastructure:
  - Underground walkways and conveyors;
  - Storage areas (hazardous and non-hazardous substances); and
  - Water pumping and treatment systems (incl. clarifiers, attenuation and settling dams).

The Cooke Underground Operations entailed mining of approximately 1.2 million tonnes/ annum of gold ore from these shafts and treatment of the ore at the Cooke Plant. Initially, residue tailings from the plant were disposed to the Cooke TSF but subsequently disposal took place into open pits along with reclaimed material from surface resources. The Cooke TSF is currently dormant.

Underground mining of gold ore at Cooke No. 1, 2 and 3 Shafts ceased in 2018. Since then, Sibanye has maintained an extensive groundwater pumping and treatment scheme to continue access to the underground mine workings through the prevention of the rewatering of mining areas due to groundwater ingress. Extraneous water collected from underground is treated in a series of settlers after which it is transported to surface for further settlement, evaporation and discharge to the environment.

An overview of the process is described in Table 5-1 and depicted in Figure 5-1 below.

Table 5-1: Water Management Process at Cooke No. 1, 2 and 3 Shafts

Process step	Cooke No. 1 Shaft	Cooke No. 2 and 3 Shafts
Collection and treatment of extraneous underground water	Underground water from Cooke No. 1 Shaft is pumped to and treated through a series of settlers and stored in underground dams located at Cooke No. 1 Shaft.	Underground water from Cooke No. 3 Shaft is pumped and gravitated to Cooke No. 2 Shaft. The underground water is treated through a series of settlers and stored in underground dams located at Cooke No. 2 Shaft.
Surface treatment	From the underground dams, water is pumped to surface for settling of suspended solids as well as for attenuation purposes.	From the underground dams, water is pumped to surface for settling of suspended solids as well as for attenuation purposes.
Transport and end-destination	Water is discharged by means of a concrete canal into the Wonderfonteinspruit - a discharge point located below Cooke No. 1 Shaft.	Water is discharged through a short pipeline and a concrete channel into the Magazine Pan, an artificial depression wetland where evaporation and recharge to underground aquifers occurs.
Sediment disposal	The settled solids are disposed of in paddocks on surface at the shaft.	The settled solids are disposed of in paddocks on surface at the Cooke No. 2 Shaft complex.

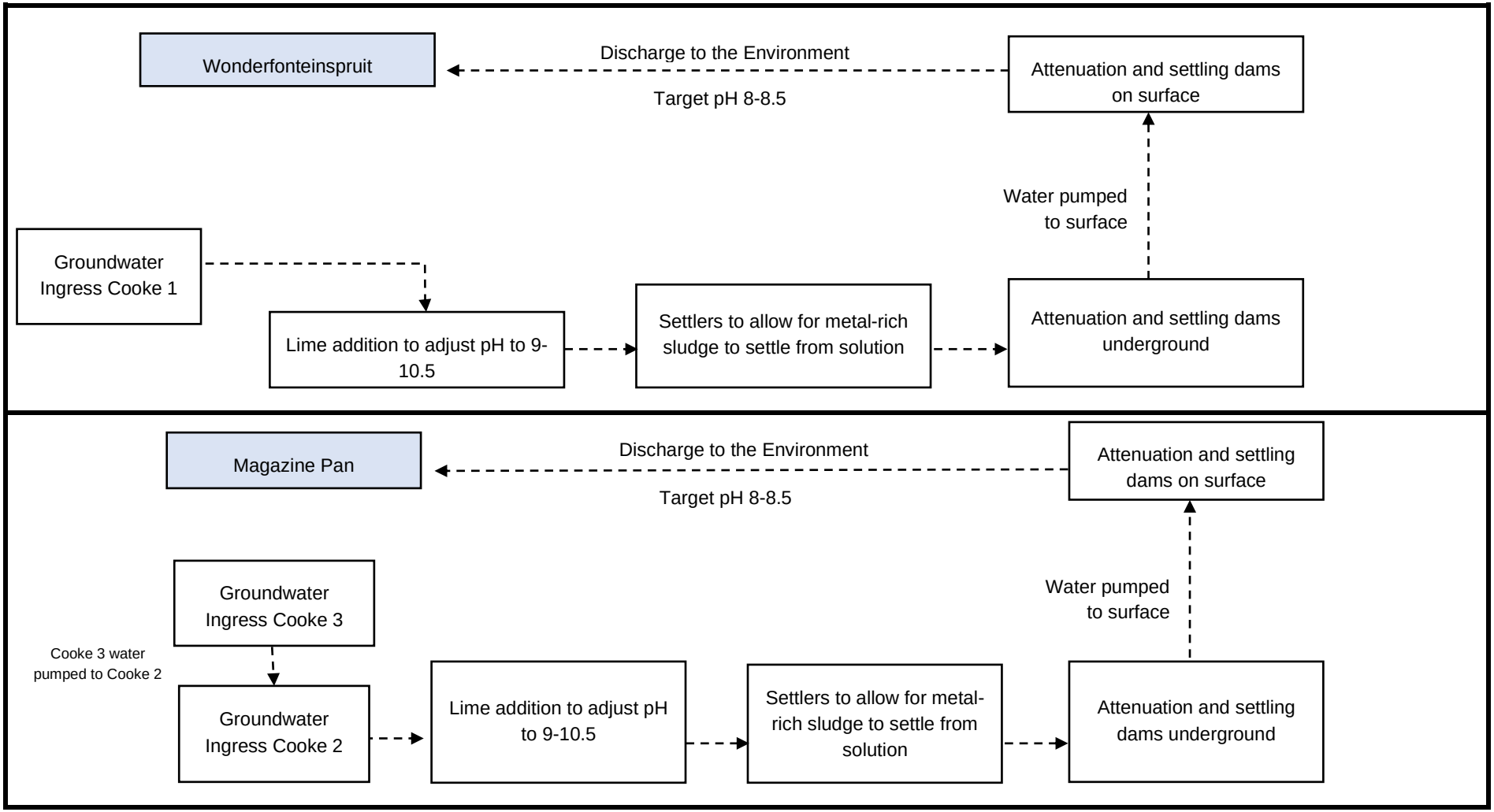


Figure 5-1: Water Management Process

5.1.2 Planned Activities

Following extensive investigations, no sustainable mining plans were found to be feasible and as such, a permanent closure solution is now being sought for the Cooke Underground Operations. A detailed account of the decision behind closure is provided in Section 7 below. This involves undertaking decommissioning, rehabilitation and closure activities as specified in Table 5-2 below.

Broadly, all surface infrastructure at the shaft complexes is proposed to be removed to reduce the risk of vandalisation and theft by illegal activities that are prevalent in the area, unless agreements can be reached with third parties, the Municipality in particular for this infrastructure to be used by surrounding communities. Sibanye intends to sell all salvageable items during decommissioning and to dispose of any remaining items as waste to appropriate facilities, depending on the waste type (hazardous/ non-hazardous). All remaining bare surfaces at the shaft complexes and along pipeline routes will be rehabilitated (ripping of soil, shaping and re-vegetating) as required. Impacted soils and residue deposits will be disposed of according to the current disposal measures via plant treatment and disposal into the pits as informed by waste classification assessments.

The main shafts will be capped and the underground workings will be allowed to rewater. The ventilation shafts are proposed to be backfilled with non-hazardous rock and/or rubble material to make the area safe and prevent access to underground workings.

It is expected that the dewatering will need to continue for an interim period until all underground decommissioning preparation has been completed, during this time Sibanye will investigate the need for additional water treatment requirements so as to improve on the current treatment implemented. As such this will not constitute a change from the current volumes and infrastructure used, but will aim to perform more treatment on surface using high-rate settlers so as to better control the current strategy implemented underground. Discharge volumes will remain the same to the same receiving water bodies and thus no further activities are triggered.

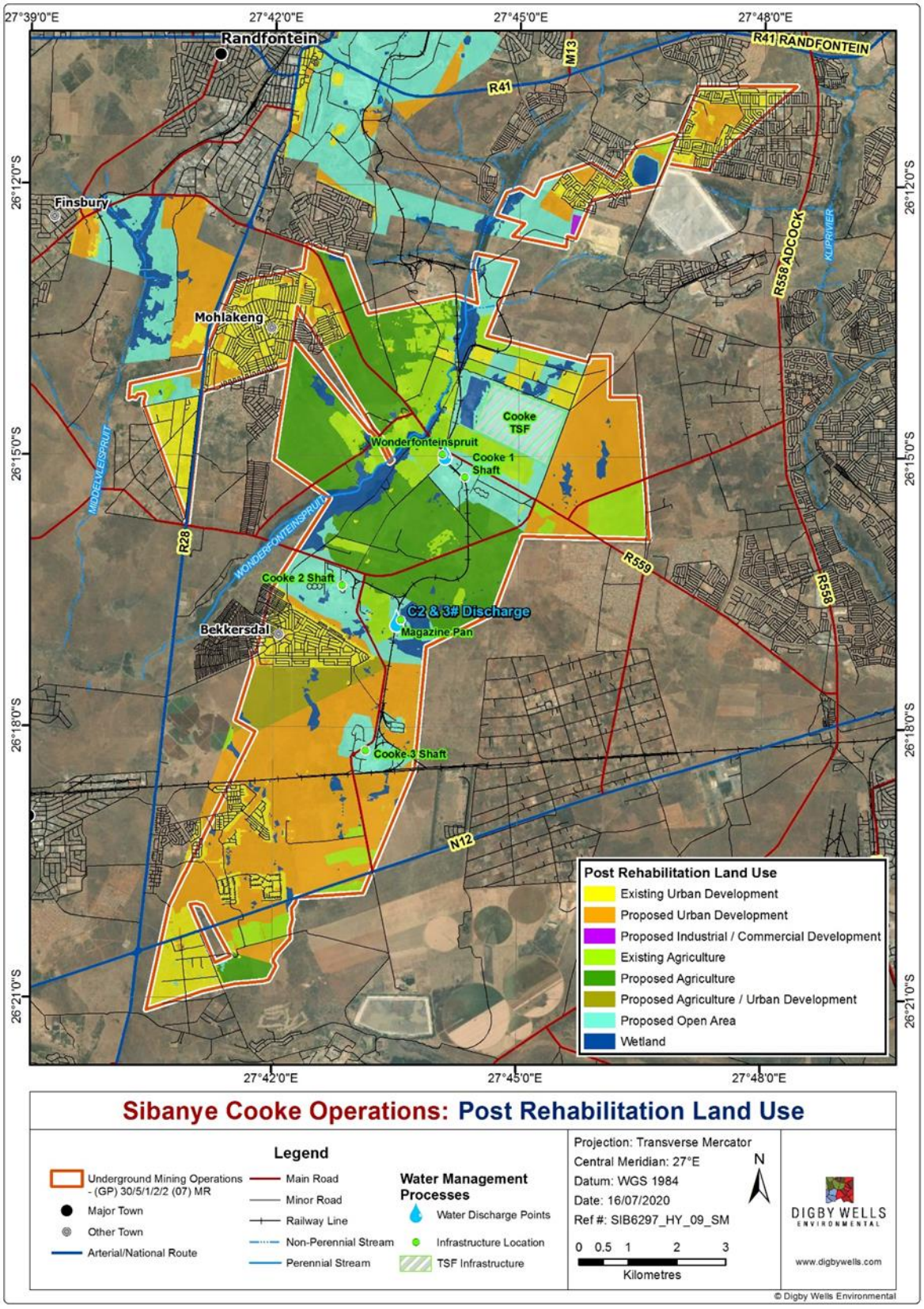
Table 5-2: Planned Activities at the Cooke Underground Operations

Decommissioning Activities	Rehabilitation Activities	Closure Activities
• Removal and decontamination of underground infrastructure from the Cooke No. 1, 2 and 3 underground workings; • Decommissioning of surface infrastructure at the shaft complexes, including: • Shaft headgear; • Administrative and workshop infrastructure; and • Surface dams and removal of concrete channels and pipelines.	• Removal of settled solids from surface paddocks and mud ponds for processing through the Cooke Gold Plant and/or disposal into the Pits; • Rehabilitation of surface paddocks and mud ponds (incl. shaping, soil amelioration and re-vegetating); • Rehabilitation of surface dams and concrete channels footprints (incl. shaping, soil amelioration and re-vegetating); and • Rehabilitation of Magazine Pan, an artificial pan used for water management (incl. removal of settled solids, removal of Alien Invasive Plant Species (AIPs) and possible vegetation of indigenous plant species to improve ecosystem functionality).	• Possible refurbishment of plugs between Cooke No. 3 Shaft and Cooke No. 4 Shaft (owned by Ezulwini Mining Company (Pty) Ltd), as well as between Cooke No. 1 Shaft and Doornkop Mine (owned by Harmony Gold Mine (Pty) Ltd); • Potential capping of the shaft barrel below the dolomitic aquifer; • Capping of vertical shafts; • Backfilling and sealing of ventilation shafts; and • Cessation of underground water pumping and rewatering of underground workings.

The proposed post-mining land use within 07 MR after decommissioning and rehabilitation include the following:

- Agriculture:
  - Cultivation; and
  - Grazing.
- Renewable Energy production:
  - Biofuel.

Plan 5 below depicts the post rehabilitation land uses that are aimed to be achieved.



Plan 5: Proposed Post Mining Land Use

5.2 Cooke Surface Operations

5.2.1 Existing Approved Activities

The existing Cooke Surface Operations and involve the reclamation and processing of legacy Tailings Storage Facilities (TSFs), toll treatment of similar gold bearing material from other authorised areas outside of the Mining Right including waste rock and other gold bearing material. The reprocessed material (tailings residue) from the Cooke Gold Plant is deposited in various legacy open pits and voids and underground workings some of which formed part of the historic Lindum Reefs and Old Randfontein Operations. Backfilling of these pits, voids and underground workings with overburden, waste rock material (both from the Cooke Operations and other suitable similar sources) as well as general demolition waste aligns with the stated rehabilitation and closure objectives.

The Cooke Plant was commissioned in 1977 and was designed as a 250 000 tonnes/month gold and uranium plant. Uranium operations were ceased in 1989 and going forward the plant was known as the Cooke Gold Plant. Approximately 150 000 tonnes/month of tailings material is processed through the plant.

Following processing, residue material is deposited into several open mining pits (namely Millsite, Battery 1 & 2, Porges, SRK 2 & 3 and Training open pits). These pits form part of the historic Lindum Reefs Operations which were previously dormant and this activity serves as a rehabilitation solution for these pits. Previously, deposition also took place on the Cooke TSF which, as indicated above, is now dormant.

As a result of depleting resources in Dump 20 and Lindum Dump, Sibanye commenced with the reclamation of the Millsite TSF Complex during 2018 to supplement the surface operations. This was subject to a separate approval and was initiated to maintain the optimal operation of the Cooke Gold Plant as well as provide an additional backfill material for the open pit areas being rehabilitated.

These surface operations are ongoing. Additional *ad hoc* sources such as from rock material in railway embankments, historic stockpiles and impacted areas associated with historic sites are also included in the surface reclamation activities, with the main aim of reducing impacted areas and implementing rehabilitation. Furthermore, an application in terms of Section 102 of the MPRDA will be submitted to the DMRE to transfer the Cooke TSF to the Surface Operation's Mining Right, as the Cooke TSF may be reclaimed in future.

5.2.1.1 Western Basin Acid Mine Drainage Treatment Facility

The Witwatersrand has a long history of mining since the discovery of gold in 1886, resulting in numerous underground mine voids across the Western, Central and Eastern Basins of the Witwatersrand Gold Fields. This has led to the formation of Acid Mine Drainage (AMD) when sulphide minerals in the rocks in the discarded mining voids are exposed to water and oxygen. This water started to decant on surface in September 2002 from the Western Basin (WB) at Randfontein.

The Department of Water and Sanitation (DWS) was given the responsibility of managing AMD emanating from these basins to prevent a detrimental adverse impact on the country's water resources. In 2011, DWS issued the state-owned Trans Caledon Tunnel Authority (TCTA) with a directive to act as the agent to plan, design and implement the immediate and short-term measures to manage and control AMD in these basins and consequently the WB AMD Treatment Facility was constructed.

TCTA have appointed Rand Uranium, owned by Sibanye, as the operating agent for the WB AMD Treatment Facility. This forms part of the Cooke Surface Operations' operational activities in Randfontein, in addition to the primary reclamation and gold recovery activities.

5.2.2 Planned Activities

Various areas in the 173 MR area have been impacted on by the current Cooke Surface Operations or by historic mining activities. In line with the Rehabilitation Plan for the operation, Sibanye intends to concurrently rehabilitate several mine-affected water resources and/or their associated buffer areas. The specific activities are detailed Table 5-3 below.

Sibanye, in conjunction with the specialist studies conducted for this application, has identified the following as a priority for rehabilitation (please refer to Plan 4 for the location of these water resources):

- Three contaminated wetlands near Lindum Dump;
- Contaminated wetland near Millsite TSF;
- Robinson Lake;
- Tiger Mills wetland area; and
- Portions of the Wonderfonteinspruit and its associated buffer.

In addition, there are dormant coffer dams situated south of the Cooke Gold Plant and these are a potential source of contamination, which that also require rehabilitation.

Table 5-3: Planned Activities at the Cooke Surface Operations

Decommissioning Activities	Rehabilitation Activities	Closure Activities
Not applicable. All infrastructure associated with the surface operations will remain in use.	Depending on present state of the water resources, the following rehabilitation activities may be undertaken: • Removal of AIPs; • Removal of impacted material in the water resources and deposition into the pits if of acceptable quality[3]; • Ripping and amelioration of soils; and • Re-vegetation with indigenous plant species. Rehabilitation of coffer dams at the Cooke Gold Plant, which will include: • Removal of contaminated material; • Shaping and ripping of soils; and • Re-vegetation with indigenous plant species. Continued operation of the TCTA's WB AMD Treatment Facility and all other reclamation and rehabilitation activities associated the Cooke Surface Operations.	Not applicable. All operational activities associated with the Cooke Surface Operations will be ongoing.

5.3 Summary of Planned Activities

The intention of this application is to authorise planned decommissioning, rehabilitation and closure activities at the Cooke Operations. For the Cooke Underground Operations, these activities are aimed at achieving permanent sustainable closure; while for the Cooke Surface Operations, these activities serve as concurrent rehabilitation to reduce environmental risks and liabilities associated with current and historic mining activities.

All gold bearing material removed as part of rehabilitation activities within both Mining Right Areas is intended to be reprocessed through the Cooke Gold Plant and deposited into the Pits as part of the rehabilitation plan. Sibanye has generated a comprehensive waste, salvageable materials and hazardous substances inventory for the Cooke Underground Operations aimed to ensure that all decontamination and waste disposal requirements to achieve the desired closure objectives are met.

[3] Dependent on outcomes of further waste classification assessments to assess level of existing impact to the ecosystem. Where material is not deemed a high risk for contamination, it may be more sustainable to leave material in place as removal activities could result in further, more severe impacts. It should be noted that the material within the Wonderfonteinspruit in particular is not recommended for removal.

5.4 Listed and Specified Activities

Together with the EIA Regulations, 2014, the Minister published Regulations in terms of Sections 24 and 24D of the NEMA for Activities that require an EA prior to their commencement.

Activities identified in Listing Notice 1 (GN R983 of 4 December 2014, as amended) or Listing Notice 3 (GN R984 of 4 December 2014, as amended) requires a BA Process be followed when applying for EA. Activities identified in Listing Notice 2 require the Scoping and EIA Process to be undertaken. The proposed project involves activities which are identified in Listing Notice 1 and therefore, requiring a BA Process to be followed.

Table 5-4 provides the triggered Listed Activities associated with the proposed project requiring authorisation.

Table 5-4: Listed Activities Subject to this Application

Project Activity	Applicable Listing Notice	Listed Activity	Listed Activity Description	Aerial extent of the activity	Waste Management Authorisation
Application for the permanent closure of the Mining Right (GP) 30/5/1/2/5 (07) MR, including all related decommissioning, rehabilitation and closure activities[4]: a. Removal and decontamination of underground infrastructure/ equipment (per the waste disposal inventories kept by Sibanye) at the underground workings; b. Refurbishment of plugs between Cooke No. 3 and Cooke No. 4 Shafts (Ezulwini Gold Mine), as well as between Cooke No. 1 and Doornkop Mine; c. Potential capping of the shaft barrel below the dolomitic aquifer; d. Rewatering of underground workings (including installation of additional water volume and quality control infrastructure to control rewatering activity); e. Decommissioning of all shaft related infrastructure, including head gear, winder houses, pumping station, ventilation systems and infrastructure etc.; f. Decommissioning of surface dams and rehabilitation of dam footprints[5]; g. Removal of settled solids from surface paddocks and mud ponds for processing through the Plant and/or disposal into the Pits[6]; h. Rehabilitation of surface paddocks and mud ponds[7]; i. Decommissioning and rehabilitation of concrete channels; and j. Removal of shafts infrastructure, buildings and stockpiles around the shaft complexes; and rehabilitation of disturbed footprints.	GN R983 Listing Notice 1	X – 22	The decommissioning of any activity requiring – i. *a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002);* or ii. a prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure; but excluding the decommissioning of an activity relating to the secondary processing of a – a. mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource; or b. petroleum resource, including the refining of gas, beneficiation, oil or petroleum products; – in which case activity 31 in this Notice applies.	07 MR 7 575 ha	N/A
Rehabilitation of Magazine Pan (artificial pan), including the removal of AIPs. *(Activity associated with the closure of 07 MR)*	GN R983 Listing Notice 1	X - 19	*The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse*; but excluding where such infilling, depositing, dredging, excavation, removal or moving— (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or (e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.	±8 ha	N/A

[4] The infrastructure and activities associated with the Cooke Underground Operations were approved in terms of the Clidet EMPr under the MPRDA prior to the promulgation of Listed Activities under NEMA. Therefore application for closure under Activity 22 of Listing Notice 1 of 2014 (as amended) encompasses all activities, services and infrastructure directly related to underground mining at the Cooke Operations.

[5] Activity 19 of Listing Notice 1 (GN R 983 as amended) has been excluded as this is deemed a maintenance activity which is excluded under subsection (b) of Activity 19.

[6] Ibid.

[7] Ibid.

Project Activity	Applicable Listing Notice	Listed Activity	Listed Activity Description	Aerial extent of the activity	Waste Management Authorisation
Rehabilitation of wetlands (including the removal of AIPs) in the vicinity of mining activities (under 173 MR) which have been affected, including: 1. Three contaminated wetlands near Lindum Dump; 2. Contaminated wetland near Millsite TSF; 3. Portions of the Wonderfonteinspruit; 4. Robinson Lake; and 5. Tiger Mills wetland area.	GN R983 Listing Notice 1	X - 19	*The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse,* but excluding where such infilling, depositing, dredging, excavation, removal or moving— (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or (e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.	±8 ha per wetland	N/A
Decommissioning and rehabilitation of impacted water pipelines & canals for the transport of sewage, process water, return water, effluent and tailings/backfill as well as storage facilities for hazardous substances and waste.[8] *(Activity associated with the closure of 07 MR)*	GN R983 Listing Notice 1	X - 31	The decommissioning of existing facilities, structures or infrastructure for— (i) *any development and related operation activity or activities listed in this Notice, Listing Notice 2 of 2014 or Listing Notice 3 of 2014;* (ii) any expansion and related operation activity or activities listed in this Notice, Listing Notice 2 of 2014 or Listing Notice 3 of 2014; (iii) any development and related operation activity or activities and expansion and related operation activity or activities listed in this Notice, Listing Notice 2 of 2014 or Listing Notice 3 of 2014; (iv) any phased activity or activities for development and related operation activity or expansion or related operation activities listed in this Notice or Listing Notice 3 of 2014; or (v) any activity regardless the time the activity was commenced with, where such activity: (a) is similarly listed to an activity in (i) or (ii), or (iii) above; and (b) is still in operation or development is still in progress; excluding where— (aa) activity 22 of this notice applies; or (bb) the decommissioning is covered by part 8 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies.	07 MR	N/A
Removal of impacted material associated with maintenance activities of the water containment facilities and wetland rehabilitation activities through the Cooke Gold Plant and deposition into the pits.	N/A	N/A	Not Listed.	07 MR; 173 MR	N/A
Rehabilitation of coffer dams at the Cooke Gold Plant.	N/A[9]	N/A	Not Listed.	Cooke Gold Plant	N/A

[8] Infrastructure associated with the Cooke Underground Operations was approved in terms of the Clidet EMPr (2008) under the MPRDA prior to the promulgation of Listed Activities under NEMA. Therefore no specific Listed Activities are prescribed for the operations and therefore this trigger pertains to existing pipelines which would trigger Activity 9 and Activity 10 of Listing Notice 1 of 2014 (as amended) and hazardous storage facilities which would trigger Listing Notice 14 of Listing Notice 1 of 2014 (as amended).

[9] Activity 19 of Listing Notice 1 (GN R983 as amended) has been excluded as this is deemed a maintenance activity which is excluded under subsection (b) of Activity 19.

6 Policy and Legislative Context

An application in terms of NEMA to obtain an EA has been submitted simultaneously with the release of this BAR to the DMRE for the Listed Activities provided in Section 5.4 above. Various policy and legislative requirements are applicable to the EA Application and assessment process as detailed in Table 6-1 below.

Table 6-1: Policy and Legislative Framework

Applicable legislation and guidelines used to compile the report	Reference where applied
The Constitution of the Republic of South Africa, 1996 (the Constitution) Under Section 24 of the Constitution it is clearly stated that: *Everyone has the right to -* *(a) an environment that is not harmful to their health or well-being; and* *(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that -* *(i) Prevent pollution and ecological degradation;* *(ii) Promote conservation; and* *(iii) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*	Sibanye is undertaking this BA process to identify and determine the potential impacts associated with the proposed decommissioning, rehabilitation and closure activities. Mitigation measures recommended will aim to ensure that the potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution. For the Cooke Underground Operations, the aim is to achieve sustainable closure and reduce the risk for latent/residual adverse impacts to occur.
NEMA and EIA Regulations, 2014 NEMA, as amended, was set in place in accordance with Section 24 of the Constitution. Certain environmental principles under NEMA have to be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.* The EIA Regulations, 2014 together with the amended Listing Notices 1, 2 and 3.	Activities associated with the proposed activities trigger Listed Activities in Listing Notice 1 (GN R983 of 4 December 2014, as amended) and therefore require EA prior to being undertaken. This BA Process has been duly informed by the requirements of the NEMA and EIA Regulations, 2014 thereunder.

Applicable legislation and guidelines used to compile the report	Reference where applied
MPRDA The MPRDA sets out the requirements relating to the development of the nation's mineral and petroleum resources. It also aims to ensure the promotion of economic and social development through exploration and mining related activities. The MPRDA ensures that environmental management principles as set out in the NEMA are applied to all mining operations. The MPRDA serves as a guideline for interpretation, administration and implementation of environmental requirements and ensures that mineral resources are exploited in a sustainable manner to serve both present and future generations.	The proposed activities are associated with mining-related activities and Mining Rights; therefore, the provisions set under the MPRDA will be duly observed.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA) On 29 November 2013, the list of waste management activities published under GN R718 of 3 July 2009 was repealed and replaced with a new list of waste management activities under GN R921 of 29 November 2013. Included in the new list are activities listed under Category A, B and C for which a Waste Management Licence (WML) may be required.	The proposed activities do not trigger activities listed under NEM:WA and therefore a WML is not applicable. However, the activities do involve waste management and therefore the provisions of this Act as well as associated norms and standards have been duly considered.

Applicable legislation and guidelines used to compile the report	Reference where applied
NWA The NWA provides for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, and that a person can only be entitled to use water if the use is permissible under the NWA. GN R704 was published in June 1999 and aims to regulate the use of water for mining and related activities for the protection of water resources and states the following: ▪ Regulation 4: No residue deposit, reservoir or dam may be located within the 1:100 year flood line, or less than a horizontal distance of 100 m from the nearest watercourse. Furthermore, person(s) may not dispose of any substance that may cause water pollution; ▪ Regulation 5: No person(s) may use substances for the construction of a dam or impoundment if that substance will cause water pollution; ▪ Regulation 6 is concerned with the capacity requirements of clean and dirty water systems, and ▪ Regulation 7 details the requirements necessary for the protection of water resources.	An IWUL Application and an associated Integrated Water and Waste Management Plan (IWWMP) are required in terms of Section 21 of the NWA. The IWUL Application and IWWMP is being applied concurrently with this Application for EA and submitted to the DWS as the decision-making authority. The water uses under Section 21 of the NWA which is relevant to this project is Section 21 (c) and (i) for the planned rehabilitation activities within water resources (wetlands and portions of the Wonderfonteinspruit). Existing water uses in the current WULs will continue to remain.

Applicable legislation and guidelines used to compile the report	Reference where applied
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA) The NEM:BA regulates the management and conservation of the biodiversity of South Africa within the framework provided under NEMA. This Act also regulates the protection of species and ecosystems that require national protection and also takes into account the management of alien and invasive species. The following regulations which have been promulgated in terms of the NEM:BA are also of relevance: • Alien and Invasive Species Lists, 2014 published (GN R599 in GG 37886 of 1 August 2014); • National Environmental Management: Biodiversity Act, 2004: Threatened and Protected Species Regulations; and • National list of Ecosystems Threatened and in need of Protection under Section 52(1) (a) of the Biodiversity Act (GG 34809, GN R1002, 9 December 2011).	As part of the proposed rehabilitation activities, natural vegetation will be restored on disturbed footprints. The provisions of NEM:BA with respect to the preservation of biodiversity will be duly considered.
NHRA The NHRA is the overarching legislation that protects and regulates the management of heritage resources in South Africa. The Act requires that Heritage Resources Agency's in this case the South African Heritage Resources Agency (SAHRA) and Provincial Heritage Resources Authority of Mpumalanga (MHRA), be notified as early as possible of any developments that may exceed certain minimum thresholds. This act is enforced through the National Heritage Regulations (GN R548 of 2 June 2000, as amended).	An HRM Process has been undertaken for the proposed project with the specific aim of detailing identified heritage resources within the site-specific area which may be disturbed. The pre-disturbance survey determined that no heritage resources are associated with the project, although several resources were identified in proximity of infrastructure areas.

Applicable legislation and guidelines used to compile the report	Reference where applied
Financial Provisioning Regulations, 2015 The Financial Provisioning Regulations, 2015 (GN R1147 of 20 November 2015) prescribe methods for determining the quantum of financial provision for rehabilitation and mechanisms for providing for it. Section 41 (1) of the MPRDA has been repealed and Section 24P of the NEMA, as amended, which provides that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts. The financial provision must guarantee the availability of sufficient funds.	A Decommissioning, Rehabilitation and Closure Plan as compiled for closure requirements evaluated in 2019 has been compiled for the Cooke Underground Operations. This plan provides a preliminary assessment of closure requirements, which will be refined pending approval of this environmental regulatory process and thereafter, with the progression on implementation of decommissioning, rehabilitation and closure activities. The plan, including financial provision, has been prepared in accordance with the Financial Provisioning Regulations, 2015. As the Application is associated with closure, an Environmental Risk Assessment (inclusive of a management plan) based on possible residual/ latent risks has been included with the objective of achieving sustainable closure. The concurrent rehabilitation proposed for 173 MR has been considered in this report.
Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) CARA aims to provide for the conservation of the natural agricultural resources of the country through the maintenance of the production potential of land, by combatting and preventing erosion and the weakening of water sources. In addition, this Act aims to protect vegetation, while combatting weeds and invader plants.	Section 12 of the CARA details the maintenance of soil conservation in which every land user will be responsible for the maintenance and conservation of soil. The mitigation measures recommended as part of this BAR aim to prevent the compaction, erosion and degradation of the soil resources. This will contribute to achieving the post-mining land use.

Applicable legislation and guidelines used to compile the report	Reference where applied
Integrated Development Plans (IDPs) and Environmental Management Frameworks (EMFs) An IDP (West Rand City IDP, 2019/2020) and EMF (2013) have been developed which are applicable to the WRDM. According to the EMF Regulations, 2010 (GN R547 of 18 June 2010) promulgated under NEMA, an EMF is defined as "a study of the biophysical and socio-cultural systems of a geographically defined area to reveal where specific land uses may best be practiced and to offer performance standards for maintaining appropriate use of such land." These frameworks are designed to facilitate ease of access to up-to-date environmental information so as to enable decision making related to environmental management principles. An EMF has been developed for the WRDM which delineates environmentally sensitive areas and areas favoured for development within a region. An IDP provides an overall framework for development. This is aimed to promote sustainable functional and integrated human settlements, maximise resource efficiency, and enhance regional identity and unique character of a place. An IDP for the West Rand City was developed for the 2016/17 to 2020/21 period.	The applicable EMF and IDP recognise that the WRDM experiences extreme pressure between mining, agriculture and tourism in terms of biodiversity, heritage, air quality, water availability and quality, and geological constraints. The development plans and delineated environmental sensitivities were duly considered to inform rehabilitation requirements and sustainable post-mining land uses.

7 Need and Desirability of the Proposed Activities

Underground mining at the Cooke No. 1, 2 and 3 Shafts ceased in 2018 due to the operations not being economically viable for Sibanye. Since then, Sibanye has maintained the underground workings and shaft complexes while plans to continue mining were investigated. However, no feasible plans were found and as such, a permanent sustainable closure solution is being sought. The decommissioning, rehabilitation and closure activities under application are the only way to achieve sustainable closure. The following provides more detail behind the decision taken to at first cease mining at the Cooke Underground operations and then thereafter apply for decommissioning and closure of these shafts:

- Prior to the decision to undertake a Section 52 process as per the MPRDA a detailed consideration of the profitability of the underground mining operations was undertaken. Despite higher than average gold prices at the time of assessment, which were used in the projections, the current and future underground mining operations were still found to be significantly loss making, with an expected loss of thousands of millions of Rands;
- The above considerations around profitability are also essential to understand how Sibanye responsibly undertakes peripheral support services which also require significant resources. A profitable mine will influence the ability of the mine to deliver essential services including health, safety, social and environmental obligations. The ongoing losses inevitably result in inability to continue to support these imperatives, as has been demonstrated in the numerous, more than 6,000 ownerless and derelict mining sites across South Africa. This then becomes the States responsibility and invariably burden on tax payer;
- In an attempt to address the issues above numerous additional undertakings were made to find a sustainable way forward for mining these areas, namely:
    - The establishment of a task team to ensure a reduction in expenditure, focussing only on absolutely necessary expenditure and reduction of all other costs;
    - Conducting extensive consultation with organised labour;
    - Off-setting against other operations, including the surface operations, which in turn resulted in the impact on the profitability and sustainability of these operations;
    - Investigation of various engineering, mining and cost reduction improvements to optimise productivity. However, the production levels remained below what is required to ensure a sustainable and profitable mining operation;
    - Intensifying efforts in curbing the impact of illegal mining, such as through the implementation of food bans;
    - Restructuring processes to consolidate management across operations as well as reduction in contracted labour were implemented to reduce costs; and
    - Restructuring at other operations, such as Kloof and Driefontein, was also implemented as a strategy to support the continuation of underground mining.

Unfortunately, the abovementioned considerations and efforts could not drive underground sustainability and resulted in the cessation of the underground mining operations, although surface operations being able to continue. The portability of the operations was further influenced by illegal strike actions, despite the extensive engagement performed as part of eight forum meetings.

As a final consideration Sibanye investigated the sale of the underground operations, however no viable investors or purchasers were found that could support the responsible continuation of mining.

Therefore the closure of the underground operations did not merely take into consideration the economic profitability of the operations as a function of the production of gold from the underground operations, but rather as an integrated detailed understanding of the complex requirements associated with the responsible execution of mining taking into consideration all aspects of the safe mining environment and life-cycle. These factors cannot be excluded as this may lead to the risk of unscheduled and poorly planned mine closure, which ultimately this process of closure of the underground mining right aims to mitigate. Mining by its very definition is an extractive process of non-renewable resources. Therefore it is a finite process and the activity will reach an end.

The planned activities aim to “clean-up” the 07 MR footprints, removing existing contamination sources to allow for sustainable post-mining land uses. All waste and other potential sources of contamination is planned to be removed from the underground workings and shaft complexes. From a social perspective, it is acknowledged that the permanent closure of 07 MR will have a socio-economic impact. Sibanye has commissioned a SCP Study to address the issues related to employees and community development post-mine closure.

In terms of the Cooke Surface Operations, past mining and ore processing methods have produced vast volumes of tailings or residues resulting in many TSFs and other contamination scattered around residential and agricultural areas, such as Randfontein. Through the reclamation of these TSFs and subsequent deposition of resultant residue tailings material into open pit areas, the Cooke Surface Operations contribute to the rehabilitation of these historic mining areas. The concurrent rehabilitation activities planned for 173 MR aim to further reduce longer term environmental risks for the ongoing operations, with specific respect to affected water resources by improving the ecological functionality of surrounding water resources which will in turn better sustain biodiversity and human uses.

As part of this BA Process, specialist studies were conducted to identify and quantify potential impacts associated with the proposed decommissioning, rehabilitation and closure activities. From this the CEMPr (Part B) was developed, in line with the Mitigation Hierarchy, to ensure the overarching objective to create remediated land in an environmentally sound manner is achieved through the proposed activities.

8 Motivation for the Overall Preferred Site, Activities and Technology Alternative

The project pertains to proposed decommissioning, rehabilitation and closure activities for existing operations. This overall site is determined by the location of infrastructure and pollution sources requiring rehabilitation. The activities are the only means to achieve the objective of sustainable closure for the Cooke Underground Operations and to reduce the environmental liabilities for the Cooke Surface Operations.

8.1 Full Description of the Process Followed to Reach the Proposed Preferred Alternatives within the Site

The role of alternatives is to find the most effective way of meeting the need and purpose of a proposed project, either through enhancing the environmental benefits of the proposed activity; and/or through reducing or avoiding potentially significant negative impacts. According to the DEA Criteria for Determining Alternatives in the EIA Guideline (2004), there are various types or categories of alternatives, including:

- Location alternative – alternative project sites in the same geographic area;
- Process/design alternative – alternative process/design/equipment;
- Activity alternative – consideration of different means to achieve the same project objective;
- Routing alternative – consideration of different routes for linear infrastructure;
- Site layout alternative – consideration of the different options to place project infrastructure; and
- No-go alternative – the proposed project/activity does not proceed, implying that the current situation or status quo remains.

Based on the scope of activities proposed through this EA Application, only Activity Alternatives and No-go Alternative were considered applicable. These are discussed in the subsections below.

8.1.1 Activity Alternatives

Preferred Alternative: Sibanye is seeking a sustainable closure solution for the Cooke Underground Operations for reasons detailed in Section 7 above. The preferred alternative is to decommission and remove all infrastructure at the shaft complexes. Once this is completed, the underground workings will be rewatered and all disturbed areas on surface will be rehabilitated. The operations are located in an area where illegal mining and general crime is high partly due to the large amount of dormant mining areas and related infrastructure. The complete removal of infrastructure and access to the workings is thus deemed most appropriate from a health and safety perspective. The rewatering of the underground workings

was always intended as part of sustainable closure, as detailed in the approved EMPr (Shangoni, 2008).

Alternative 2: An alternative to the permanent closure of the Cooke Underground Operations is to maintain the underground workings and shaft complex infrastructure for any future mining. Since the cessation of mining in 2018, Sibanye has investigated economically viable scenarios to continue mining (including commercial agreements with interested parties); however, no feasible options were found. Maintaining the underground workings involves an extensive groundwater pumping and treatment scheme at a high cost which impacts upon the feasibility of other mining operations. Furthermore, existing environmental, health and safety risks maintain their *status quo*. This alternative was therefore discarded and in fact, was never contemplated as a closure objective for the operation as it results in a higher environmental, health and safety risk while also reducing company resources to invest and implement a sustainable closure plan.

8.1.2 No-Go Alternative

The no-development alternative implies that the proposed decommissioning, rehabilitation and closure activities are not implemented. For the Cooke Operations this would mean Sibanye would continue to maintain the underground workings and shaft infrastructure. This, as discussed above, is not desirable as it results in higher environmental, health and safety risks. Furthermore, high costs are incurred through the extensive groundwater pumping and treatment which will serve as a limiting factor to the company resources in future to implement a sustainable closure plan.

In terms of the Cooke Surface Operations, not implementing the proposed rehabilitation activities will maintain the *status quo* of the targeted water resources. A Wetland Impact Assessment was undertaken as part of this EA Application which confirmed that the ecological health and sensitivity of wetlands in 173 MR have been impacted by surrounding land uses including mining. The proposed rehabilitation aims to remove sources of contamination caused by mining activities (historic and current) and improve the ecological functionality of these systems. Without this, the systems will remain in their current degraded state. Concurrent rehabilitation is preferred as it contributes to minimising environmental risk and limits the need and cost for rehabilitation at closure.

Ultimately the no-go alternative means the Duty of Care Principle as specified under Section 28 of NEMA will not be realised. Sibanye has the responsibility to take measures to prevent pollution and environmental degradation from continuing and/ or recurring.

9 Details of the Public Participation Process Followed

A PPP is undertaken in terms of the regulatory requirements set out in Regulation 44 and 45 of the EIA Regulations, 2014 and as required in terms of Chapter 5 of NEMA. The PPP aims to provide I&APs with information regarding the proposed project as well as obtain input from I&APs to ensure informed decision-making that highlights the concerns and opinions of the

surrounding communities are duly considered. I&APs for this Application were grouped into the following categories:

- *Local Government:* National, provincial, district and local authorities;
- *Landowners:* Directly affected and adjacent landowners;
- *Communities:* Directly affected land occupiers and surrounding communities;
- *Parastatals:* Such as Eskom and the South African National Roads Agency Limited (SANRAL);
- *Non-Governmental Organisations (NGOs):* Environmental and social organisations; and
- *Business:* Small and medium enterprises, mining, agricultural and industrial companies.

A stakeholder database has been compiled which was updated throughout the environmental regulatory process (please refer to **Appendix C**).

9.1 Public Participation Media

Considering the legislative requirements and good practice the following methods have been implemented to make project and information applicable to the BA Process available to stakeholders (refer to **Appendix C**).

- *Project Announcement Letter:* The announcement letter included a project description, information about the required legislation, the competent authorities and details of the appointed EAP was distributed during Phase 1. The letter was also accompanied by a registration and comment form for stakeholders to register as I&APs or to submit comments.
- *Newspaper advertisement:* A newspaper advertisement was placed in a local newspaper (the Star) during Phase 1 with a brief project description, information about the required legislation, the competent authorities, details of the appointed EAP, registration process for I&APs. A further advertisement was placed in The Star indicating the availability of the draft BAR and Integrated Water and Waste Management Plan (IWWMP) (in support of the WULA) for the public review and commenting period.
- *Site notices:* Site notices were placed in public places around the project area which provide detail of the Basic Assessment and WULA Processes underway for the proposed activities.
- *SMS, WhatsApp and Email:* Messages were sent to all registered I&APs as announcement of availability of the BAR for the public commenting period.

9.2 Dissemination of Project Information

In light of the COVID-19 situation a need has been created to improve upon the traditional PPP as stipulated in the NEMA, so as to reduce the need for contact and therefore the potential spread of COVID-19. Alternative methods of conducting the PPP, in line with legal notice GN R555 published on 5 June 2020 relating to the Direction Regarding the Measures to Address, Prevent and Combat the Spread of COVID-19 have been developed to provide "reasonable opportunity is provided for public participation".

Sibanye has adopted technological applications, specifically the use of Unstructured Supplementary Service Data (USSD) messaging service and established a Zero Data Portal to access the Public Participation media detailed above, presentation, voice note messages and reports. This draft BAR and associated reports have also been sent to Government Organisations and other stakeholders via email where possible. Focus Group meeting as necessary have and will also be hosted, both in person within the scope of the COVID regulations and via electronic platforms.

This alternative process to PPP has been communicated to the Departments listed below and no objections have been received to date:

- DMRE;
- DWS;
- National Nuclear Regulator (NNR);
- Council for Geoscience (GeoSA); and
- The WRDM.

Selected Focus Group Meetings will be hosted and hard copy reports can be requested.

9.3 Public Consultation Activities Undertaken to Date

Table 9-1 provides summary of the PPP activities undertaken to date. All PPP material has been appended to this report in the Public Participation Chapter, **Appendix C**.

Table 9-1: Public Participation Impact Assessment Phase Activities

Activity	Details
Identification of stakeholders	The existing stakeholder database for Sibanye which represents various sectors of society, including directly affected and adjacent landowners, in and around the proposed project area was used for the project. The database was updated to ensure I&AP information was up to date. New I&APs were registered throughout the process.
Distribution of Announcement Letter	**Phase 1**: An announcement letter with registration and comment form was emailed to I&APs on 20 January 2020 (Phase 1). This included information which provided an overview of the various phases associated with the Cooke Closure Process. An SMS notification was sent out simultaneously informing registered I&APs of the regulatory process.

Activity	Details
Placing of newspaper advertisement	A newspaper advertisement was placed in the Star on 27 July 2020 for the availability of the Regulation 37 Amendment Report. A further advertisement was placed in the Star on 16 October 2020 indicating the draft BAR and IWWMP. (in support of the WULA) for the public review and commenting period.
Announcement of BAR	The draft BAR was made available on the following platforms: • Digby Wells website (www.digbywells.com) under Public Documents; • Ulwazi Platform Zero Data Portal (https://ulwazi.datafree.co/); and • Ulwazi Platform USSD messaging service (***134*20042#**). No hard copies of the report were made available in public places due to restrictions associated with the COVID-19 pandemic. Registered I&APs were notified of the availability of the draft BAR and associated reports on the abovementioned platforms via email, WhatsApp and SMS. Hard copies were also made available upon request.
Consultation with I&APs	Due to the COVID-19 pandemic, limited public or focus group meetings can be held for this Application. An externally facilitated public meeting will be held with representatives of the public, after which the need for focus group meetings will be determined (either face-to-face for limited persons or online meetings). A presentation summary of the key outcomes of the BAR and CEMPr has been uploaded to the Ulwazi Zero Data Portal and similar information is available via the USSD messaging service. I&APs have also been encouraged to contact Digby Wells telephonically throughout this commenting period or request a WhatsApp Voice Note summary should accessing information via the abovementioned means present a challenge.

9.4 Summary of Issues Raised by I&APs

As indicated in the sections above, the approach to PPP is continual engagement through the phases of the Closure Process. Public consultation commenced during Phase One (Regulation 37 Amendment Process) and various comments were received which not only pertained to the scope of the activities for Phase One (partial rewatering of Cooke No. 3 Shaft and dismantling of non-essential infrastructure), but to the Closure Process in its entirety.

For the latter comments, initial responses were provided pending the outcome of this BA Process. These comments have been refined accordingly included in an updated CRR (please refer to **Appendix C**). It is however noted that some comments pertaining to social closure aspects will be more thoroughly addressed as part of Phase Three as more information becomes available.

The CRR will be further updated following the public review commenting period of this BAR for review by contributing stakeholder and consideration by the DMRE.

10 The Environmental Attributes Associated with the Alternatives

This section provides a description of the baseline environment associated with the project area and region (where relevant). The purpose of understanding the environmental baseline conditions is to determine the *status quo* of the environment, to inform the extent of rehabilitation required and to inform potential impacts specifically associated with the proposed decommissioning, rehabilitation and closure activities.

A number of specialist studies were undertaken as part of the BA Process and are appended to this report, as shown in Table 10-1 below. In accordance with GN R 320 of March 2020 promulgated under NEMA a site sensitivity verification was undertaken in support of the Environmental Authorisation Application using the National Web based Environmental Screening Tool (commonly referred to as the "Screening Tool"). The specialist studies included below are found to align with the requirements of the Screening Tool Report.

Table 10-1: Specialist Reports and Associated Appendices

Specialist Study	Appendix
Wetland Assessment	**Appendix D**
Hydrogeological Assessment	**Appendix E**
Hydropedological and Surface Water Quality Assessment	**Appendix F**
Geochemical Assessment and Waste Classification	**Appendix G**
Heritage Assessment	**Appendix H**
Socio-economic Assessment	**Appendix I**
Decommissioning, Rehabilitation and Closure Plan (2019)	**Appendix J**

The environmental attributes of the 07 MR and 173 MR areas is provided in subsections below. Secondary data from previous specialist assessments in the project areas or ongoing environmental monitoring data have also been used to provide a comprehensive overview of the biophysical and socio-economic environment and is referenced accordingly.

10.1 Regional Climate

Meteorological data applicable to the Cooke Operations is summarised from the IWUL Application compiled by Digby Wells in 2017. The study considered a three-year period (2012-2014) for Westonaria to determine the prevailing weather conditions for the Cooke Operations. Table 10-2 below provides rainfall data for a three-year period. The annual totals, maximum and average of 1 065 mm and 591 mm were reported.

Table 10-2: Total Monthly and Average Precipitation Values (Digby Wells, 2016)

Precipitation (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Total Monthly Rainfall (Max).	204.2	115.1	70.9	46.2	6.9	4.1	0.5	8.6	53.1	178.3	148.6	228.1	1065
Average Total Monthly Rainfall	122.0	64.1	35.8	25.1	2.6	1.4	0.3	5.8	19.2	72.9	99.1	142.5	591

The monthly temperature maximum and average are given in Table 10-3. The monthly maximum temperatures range from 8.8°C in July to 18.2°C in January, with monthly average ranging from 2.4°C in July to 13.2°C in January. Annual maximum and mean temperatures for the area is given as 15.23°C and 8.1ºC, respectively.

Table 10-3: Monthly Average Temperature Values

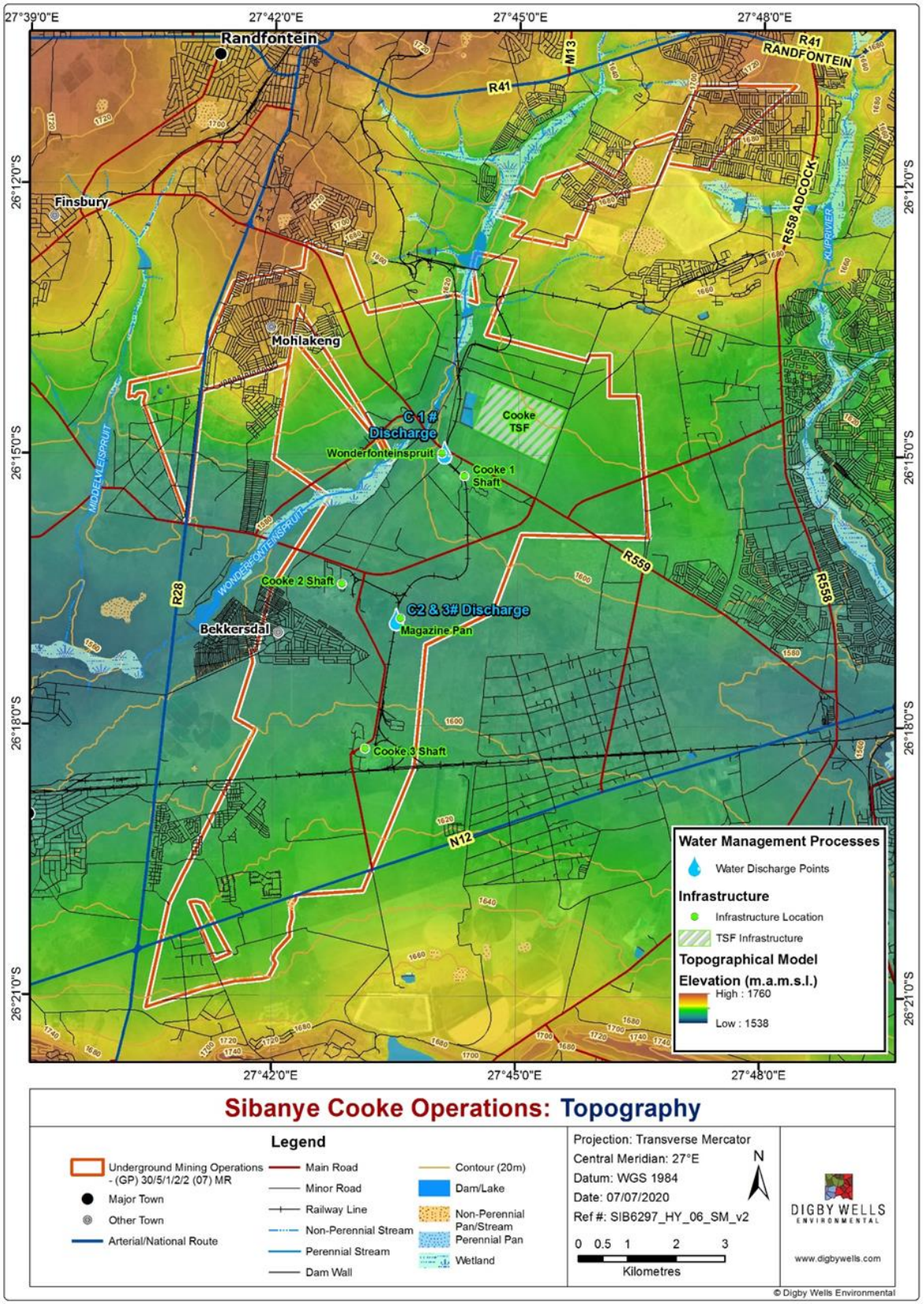
Temp(°C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	18.2	18.2	17.9	14.9	13.5	11.4	8.8	14.1	15.3	16.0	17.2	17.3	**15.2**
Monthly Average	13.2	12.8	11.6	6.9	4.8	3.2	2.4	4.0	7.4	9.1	9.5	12.4	**8.1**

The mean annual evaporation was investigated for the relevant quaternary catchment associated with the Cooke Operations (WRC, 2015). The mean annual evaporation is estimated as 1 385 mm and the average monthly evaporation is presented in Figure 10-1 below. The months with the highest evaporation are December, January and February, while July has the lowest value. The evaporation trend correlates to the rainfall trend but clearly higher evaporation is experienced than incident rainfall.

Figure 10-1: Average Monthly Evaporation for the Quaternary Catchment

10.2 Regional Topography

The topographical setting associated with 07 MR is depicted in Plan 6 below. The topography ranges between approximately 1 538 to 1 760 metres above mean sea level (mamsl).



Plan 6: Topographical Setting of 07 MR

10.3 Regional Geology

The geological setting for the Cooke Operation is displayed in Plan 7 below. The regional geology comprises four main supergroups, namely the Witwatersrand, Ventersdorp, Transvaal and Karoo Supergroups (Digby Wells, 2016). The characteristics of these geological groups are discussed, in their chronological order (oldest first), in the subsections below.

10.3.1 Witwatersrand Supergroup

The Witwatersrand Basin is a thick sequence of shale, quartzite and conglomerate. The average dip of the strata varies between 10º and 30° south, although localised dips of up to 80° have been encountered in mine workings closer to the reef outcrop. There are two main divisions, a lower predominantly argillaceous unit, known as the West Rand Group and an upper unit, composed almost entirely of quartzite and conglomerates, known as the Central Rand Group. The West Rand Group is divided into three subgroups namely the Hospital Hill, Government Reef and Jeppestown. These rocks comprise mainly shale, but quartzite, banded ironstones, tillite and intercalated lava flows are also present. The rocks were subjected to low - grade metamorphism causing the shale to become more indurated and slatey, and original sandstone was re-crystallised to form quartzite.

10.3.2 Ventersdorp Supergroup

The younger Ventersdorp Supergroup overlies the Witwatersrand rocks. Although acid lavas and sedimentary intercalations occur, the Ventersdorp is composed largely of andesitic lavas and related pyroclastics. The Ventersdorp Supergroup consists of the Platberg Group and the Klipriviersberg Group.

The Alberton Formation is composed of green-grey amygdaloidal andesitic lavas, agglomerates and tuffs with a total thickness of 1 500 m. The lack of sediments in this sequence indicates a rapid succession of lava flows, which probably came from fissure eruptions. Material of similar composition forms the oldest dykes that have intruded the Witwatersrand rocks. The abundant agglomerates provide indications of periodic explosive activity. The removal of huge volumes of volcanic material from an underlying magma chamber gave rise to tensional conditions and as a result a number of faulted structures, such as, horst and grabens formed.

10.3.3 Transvaal Supergroup

Overlying the Ventersdorp Lavas are the Black Reef Quartzite and dolomites of the Transvaal Supergroup. The Black Reef quartzite comprises coarse to gritty quartzite with occasional economically exploitable conglomerates (reefs). The entire area was peneplaned in post-Ventersdorp time and it was on this surface that the Transvaal Supergroup was deposited, some 2 200 million years ago. The deposition commenced with the Kromdraai Member with the Black Reef at its base. The Black Reef is formed from material that has been eroded from the Witwatersrand outcrop areas. As a result, the Black Reef contains zones (reefs) in which

gold is present. The occurrence of the gold is not as widespread as in the Witwatersrand and is mainly restricted to north-south trending channels. The Black Reef is overlain by a dark, siliceous quartzite with occasional grits or small pebble bands. The quartzite grades into black carbonaceous shale. The shale then grades into the overlying dolomite through a transition zone approximately 10 m thick.

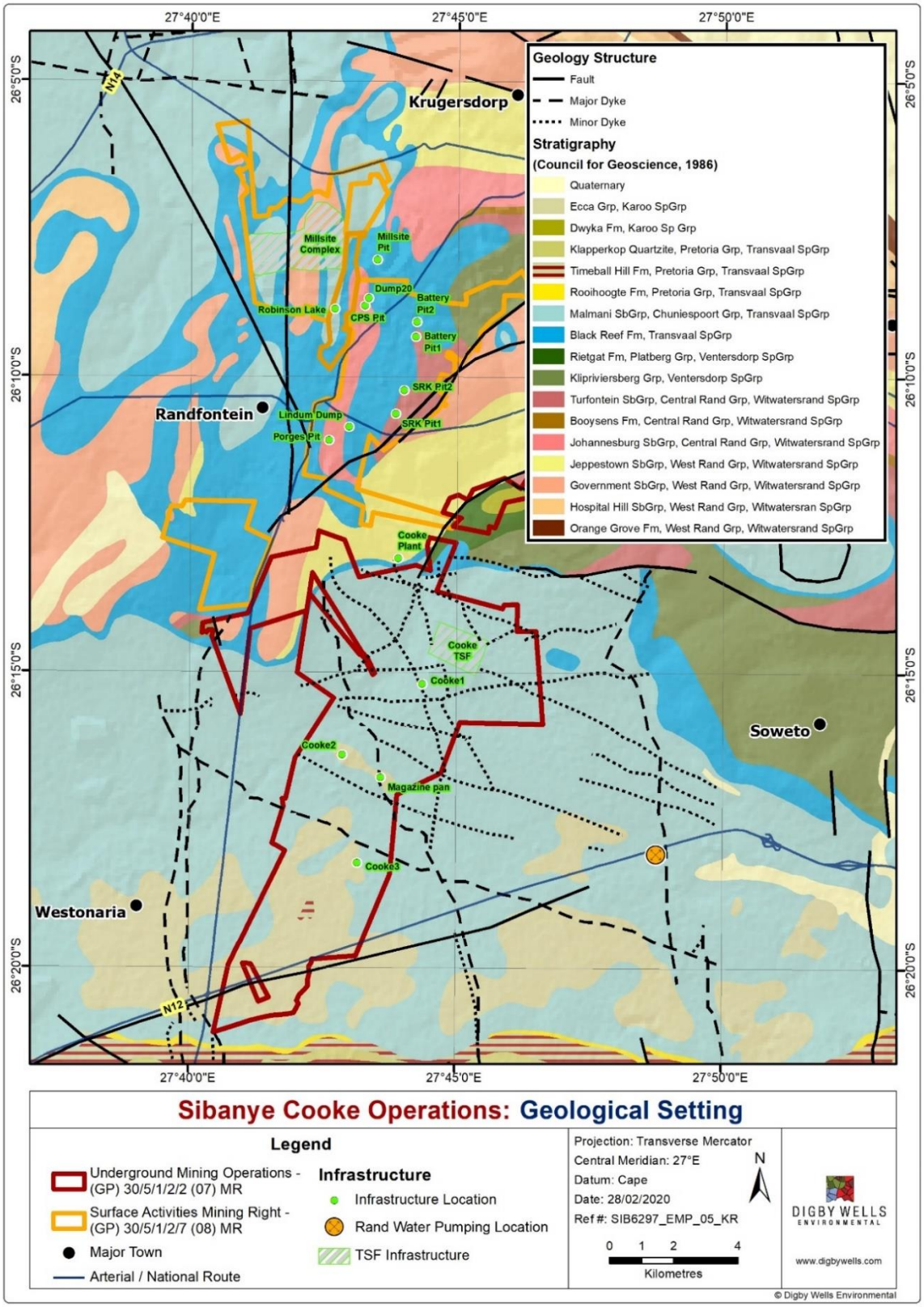
Overlying the Kromdraai Member is the dolomite of the Malmani Subgroup of the Chuniespoort Group. The dolomites that are 1 500 m thick are known for their huge water storage potential.

The dolomite also contains lenses and layers of chert. The dense, hard and fine-grained chert tends to stand out in relief. Chert (silica) replaces carbonate material.

The dolomites are overlain in the south by the Pretoria Group rocks. The Rooihoogte Formation forms the basal member of the Pretoria Group, consisting predominantly of shale and quartzite.

10.3.4 Karoo Supergroup

The Karoo Supergroup was deposited approximately 345 million years ago. It commenced with a glacial period during which most of South Africa was covered by a thick sheet of ice. This ice cap slowly moved towards the south, causing extensive erosion of the underlying rocks. The erosion debris was eventually deposited and formed the Dwyka tillite. The latter is only partially preserved in the study area, as are the younger sedimentary deposits the Karoo Supergroup, including mudstone, shale and sandstone.



Plan 7: Geological Setting of the Cooke Operations

10.4 Land Use

The Cooke Operations are situated in an area which comprises various land uses. This includes mining, old TSFs, industrial areas, residential areas and agricultural activities. It is noted that dormant mining infrastructure, including open pit areas and associated surface infrastructure, are also located on the landscape.

10.5 Biodiversity

The project area is comprised of various land uses which includes mining, old TSFs, industrial areas, residential areas and agricultural activities. This has altered biodiversity in the area over the years. The subsections below provide an overview of notable floral and faunal which are relevant to the area, as established through previous assessments.

10.5.1 Floral Characteristics

The Cooke Operations fall within two vegetation types, according to Mucina and Rutherford (2006), namely the Carletonville Dolomite Grassland and Soweto Highveld Grassland. According to the PRECIS (National Herbarium Pretoria (PRE) Computerised Information System) from the South African National Biodiversity Institute (SANBI, 2008), no Red Data species are expected to occur within the area. The Species of Special Concern (SSC) which are likely to occur on site are recorded in the table below.

Table 10-4: Plant Species of Special Concern Likely to occur

Plant species	Common Name	Status
Kniphofia typhoides	Bulrush poker	Near Threatened (confirmed)
Trachyandra erythrorrhiza	-	Near Threatened (confirmed)
Hypoxis hemerocallidea	Yellow star flower	Declining (confirmed)
Eucomis autumnalis subsp. clavata	Giant pineapple lily	Not Evaluated (confirmed)
Boophone disticha	Century plant/ poison bulb	Declining
Adromischus umbraticola subsp. umbraticola	Cliff adromischus	Near Threatened
Drimia sanguinea	-	Near Threatened
Khadia beswickii	Khadiwortel	Vulnerable

10.5.2 Faunal Characteristics

Due to the transformed landscape, limited mammal species are present. There is however suitable habitat for the occurrence of a number of different species of amphibians, including the Near Threatened Giant Bullfrog (*Pyxicephalus adspersus*). The avifaunal species expected to occur within the project area which fall within the Red Data species list and are detailed in the table below.

Table 10-5: Red Data Bird Species

Common Name	Scientific Name	Red Data Status
Maccoa duck	*Oxyura maccoa*	Near threatened
Lesser flamingo	*Phoenicopterus minor*	Near threatened
Grass owl	*Tyto capensis*	Vulnerable
Black winged pratincole	*Glareola nordmanni*	Near threatened
Blue Korhaan	*Eupodotis caerulescens*	Near threatened
European Roller	*Coracias garrulus*	Near threatened
Pallid Harrier	*Circus macrourus*	Near threatened
White Backed Vulture	*Gyps africanus*	Endangered
Cape Vulture	*Gyps coprotheres*	Vulnerable
Secretarybird	*Sagittarius serpentarius*	Vulnerable

10.6 Wetlands

A Wetland Specialist Assessment was undertaken and is appended to this report as **Appendix D**. Wetland assessments have previously been carried out across the 07 MR and 173 MR areas and therefore this assessment served to verify previous delineations and identify ecological changes to these systems to inform suitable rehabilitation practices.

One dry season field survey was carried out on 4 and 5 June 2020 at various known wetland points within the operational areas. The following methodologies were employed to the assessment:

- *Desktop Assessment* – Existing wetland assessments were reviewed to determine the extent of previous delineations and confirm any gaps, consequently informing the Terms of Reference of this assessment. Furthermore, the findings of these assessments were analysed to later understand/ identify the level of change to the systems.
- *Wetland Delineation* – During the site visit, wetlands and riparian delineation was carried out in accordance with guidelines established by the Department of Water and Forestry of South Africa (DWAF), 2005 using the terrain unit, soil form, soil wetness and vegetation indicators to delineate the boundaries of the wetland areas.
- *Wetland Integrity Assessment* – The wetland integrity was determined using the WET-Health tool, as prescribed by Kotze et al. (2007) to measure the Present Ecological State (PES). The Ecological Importance and Sensitivity (EIS) was derived using the DWAF, 1999 established methods in conjunction with Rountree and Kotze, (2012).

Further detail pertaining to the methodology of the assessment is provided in the specialist report, **Appendix D**.

10.6.1 Outcomes of the Assessment

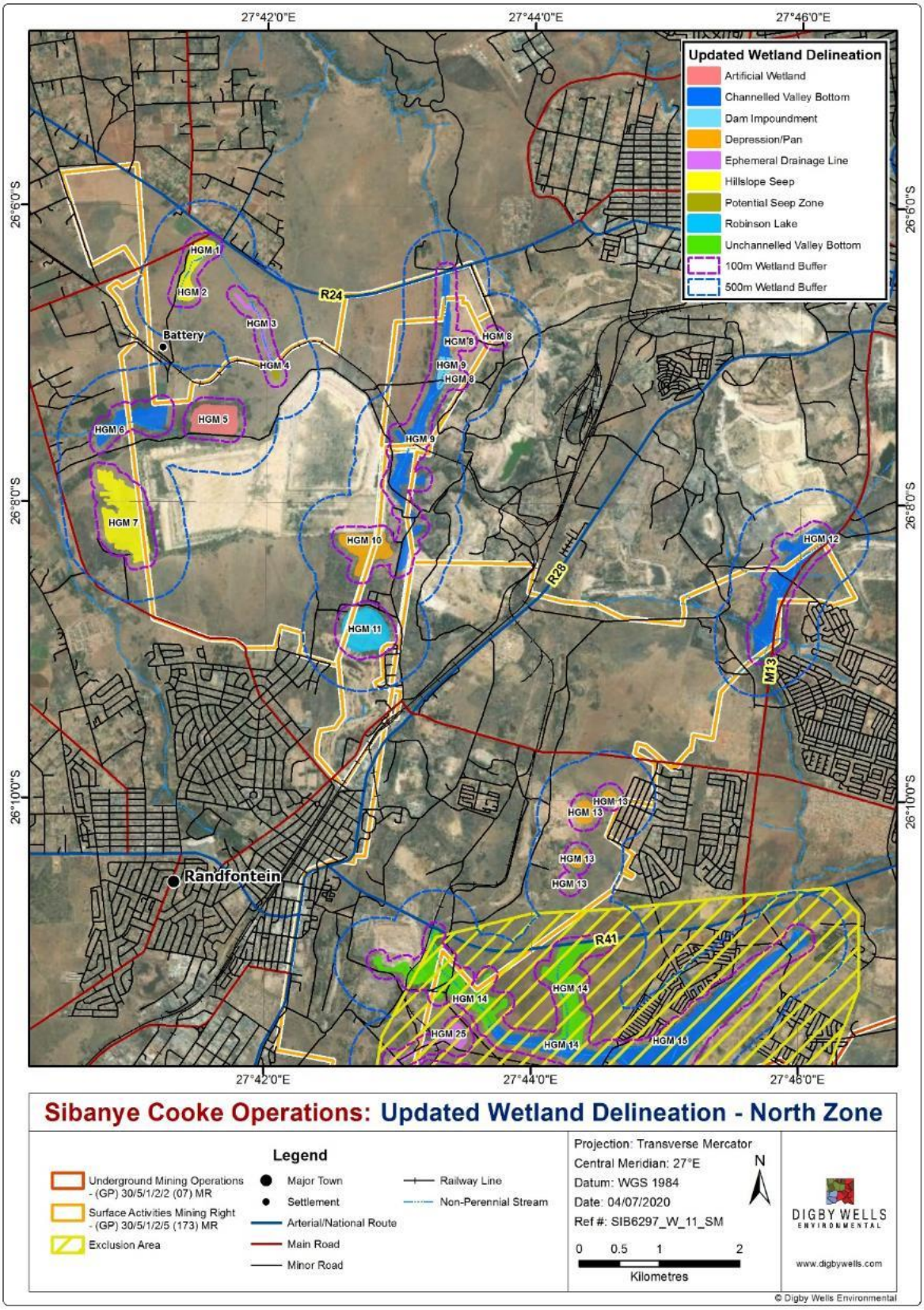
This section presents the combined delineation and classification findings of wetlands associated with the 07 MR and 173 MR areas (based on previous assessments and updated verifications). The delineations have been divided up into three different sections, namely the North, Central and South zones, as follows:

- *North Zone* – Covers the areas from Lindum Dump and SRK Pits moving North towards Robinson Lake and Millsite TSF. Historical delineations have been done with in the area associated with the Millsite reclamation project undertaken project undertaken by Digby Wells in 2017 as part of the ongoing Cooke Surface Operations.
- *Central Zone* – Located between the Lindum Dump, moving South, including the Cooke TSF and Cooke Gold Plant and Cooke No. 1 and 2 Shafts ending above Magazine Pan. The Central Zone includes a large portion of the Wonderfonteinspruit and associated tributaries.
- *South Zone* – Focuses on the areas from Magazine Pan, moving south to the Cooke No. 3 Shaft (Cooke Underground Operations) and just over the N12 highway.

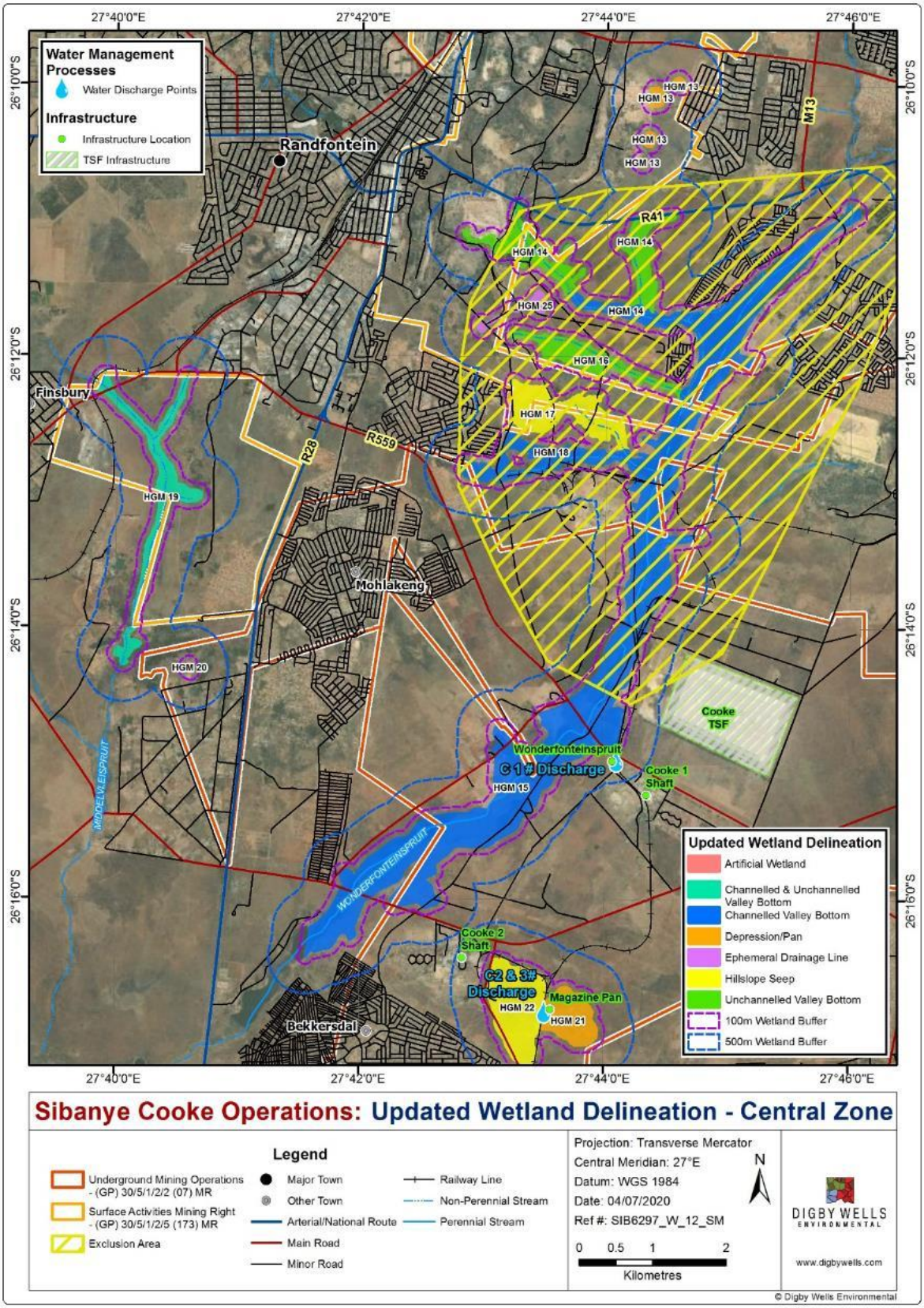
The results of the assessment are presented for each zone in the subsections below.

10.6.1.1 Wetland Delineation and Classification

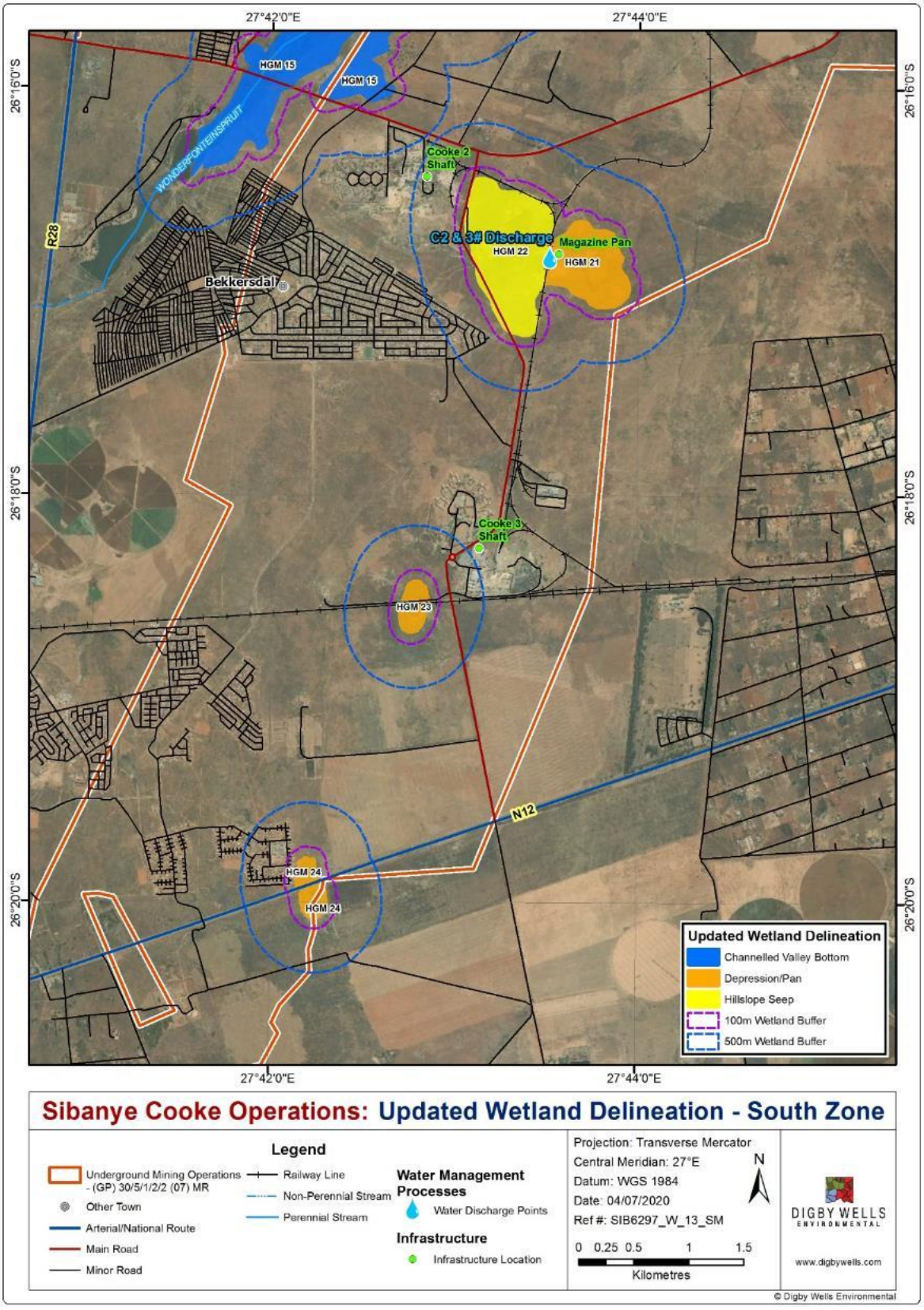
A total of 25 wetland Hydro-geomorphic (HGM) Units were delineated for the Cooke Operations as shown in Plan 8 (North Zone), Plan 9 (Central Zone) and Plan 10 (South Zone) below. Due to the undulating terrain, the areas are generally characterised by both channelled and unchannelled valley bottoms with pans present in flatter areas.



Plan 8: North Zone Delineation and Buffers



Plan 9: Central Zone Delineation and Buffers



Plan 10: South Zone Delineation and Buffers

10.6.1.1.1 Eco-Status of Wetlands

The specialist report, **Appendix D**, provides a detailed account of the PES and EIS determined for each HGM Unit delineated as well as photographs from the site visit.

The PES values for the delineated HGM Units range from C (Moderately Modified) to E (Seriously Modified). Wetlands across the 07 MR and 173 MR have been impacted on by surrounding land uses and associated sources of contamination, e.g. sewage effluent. In addition, road infrastructure has resulted in significant impact to wetland connectivity and hydrology. Open pit and underground mining activities, including the establishment of TSFs, has resulted in a direct loss of wetland habitat with significant quality impacts. However, it must also be noted that mining activities, specifically discharges from underground mining voids to surface water features, has been observed to contribute to increased wetland extent which is positive.

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, carbon storage, streamflow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity. In terms of ecological services, the EIS values for the delineated HGM Units ranged from Low to High with an average rating of ≥2.8 for ecoservices provided which is characterised as high. The predominant services provided are streamflow regulation, toxicant and phosphate removal and sediment trapping. For more intact wetlands, maintenance of biodiversity was scored high.

10.7 Surface Water Resources and Hydropedological Characteristics

The Cooke Operations are predominantly located within the Vaal Water Management Area (WMA) (quaternary catchment C23D) with the Millsite TSF Complex (associated with Cooke Surface Operations) occurring in the Limpopo WMA (quaternary catchment A21D). Plan 11 below displays the hydrological setting for the operations. Table 10-6 summarises the water attributes of these quaternary catchments.

Table 10-6: Surface Water Attributes of the A21D and C23D Quaternary Catchments

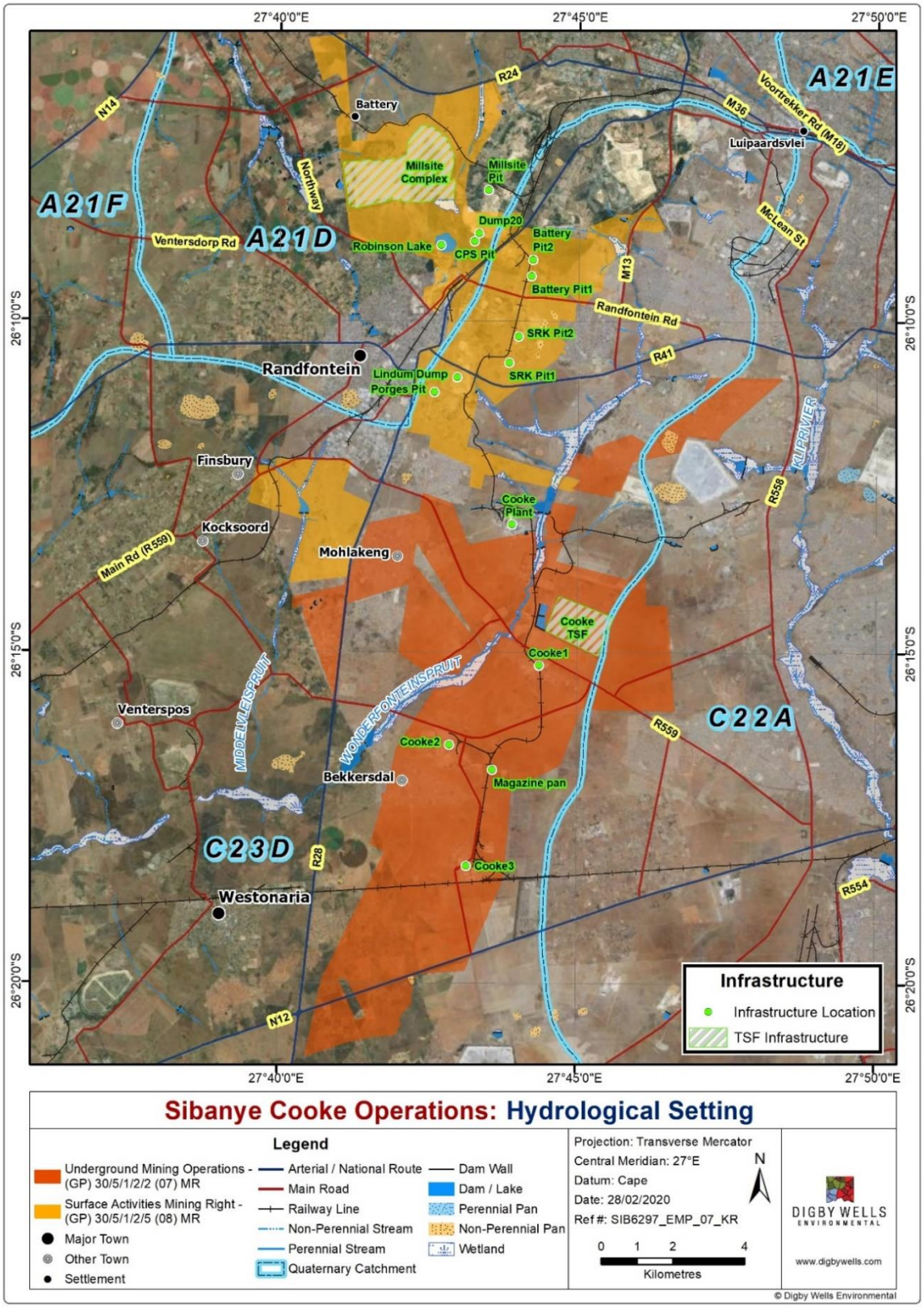
Quaternary Catchment	Total Area (km^2)	MAP (mm)	MAR (Mm^3)	MAE (mm)
A21D	372	714	11.27	1700
C23D	510	664	9.12	1650

10.7.1 Hydrological Setting

The main or perennial river within A21D quaternary catchment is the Bloubankspruit which flows from the south towards the north eastern side where the catchment outlet is situated. The Bloubankspruit is approximately 800 m from the Millsite TSF Complex with the Tweelopiespruit approximately 100 m from the complex.

The Wonderfonteinspruit is the main river within the C23D quaternary catchment. Runoff emanating from this quaternary catchment drains in a south westerly direction into the Wonderfonteinspruit. C23D quaternary catchment is a contributing catchment to C23E, and therefore all runoff from C23D eventually drains into Mooirivierloop of the C23E quaternary catchment.

This baseline summary focuses on the C23D quaternary catchment which is relevant to the Cooke Underground and majority of the Cooke Surface Operations. The A21D catchment has been considered in previous EMPr addendums.



Plan 11: Hydrological Setting of the Cooke Operations

10.7.2 Hydropedology

A Hydropedology Specialist Assessment was undertaken and is appended to this report as **Appendix F**. Broadly, hydropedology is an interdisciplinary field focused on the interactive relationship between soils, surface - and groundwater. The physical properties of soils play an important role in the interpretation of subsoil water residence in the soil profile, storage mechanisms and connectivity. For this BA Process, this was used to inform the potential impact to the downstream catchment based on the proposed rehabilitation and closure activities. To establish the relevant hydropedological characteristics, the following methodology was employed:

- *Desktop Assessment* – Existing assessments relating to soils, wetlands, hydrogeology and hydrology were reviewed to gain a better understanding of hydrological process within the 07 MR area.
- *In-field Assessment* – An infield assessment was conducted in May and June 2020 to verify the hillslope hydrology associated with 07 MR, determining the dominant water flow paths within the demarcated landscape units. The soil characteristics in terms water residence times and leach effects were identified simultaneously.
- *Hydropedological Classification* – The hillslope hydrology associated with 07 MR was delineated according to the methods described by Le Roux *et al.* (2011) and the conceptual hillslope hydrological behaviour determined.
- *Surface Water Quality Assessment* – Please refer to Section 10.7.4 below.

Further detail pertaining to the methodology of the assessment is provided in the specialist report, **Appendix F**.

10.7.3 Soil Characteristics

The land type associated with 07 MR is depicted in Plan 12 below. The land type is Ab7, as classified by the Agricultural Research Council (ARC) (2006). The area is dominated by red-apedal, well-drained soils and rocky soils, mainly Hutton and Mispah soil forms. The general terrain type within the Ab7 land type is presented in Figure 10-2 below. The Ab7 land type is dominated by terrain unit Type 4 which indicates a gentle slope. Terrain Unit 1 represents the crests, while Terrain Unit 5 represents the lowest point in the topography of the land type, which are the streams. These terrain units are correlated to the Land Type Inventory from which the distribution of the expected soil type within each terrain unit is given.

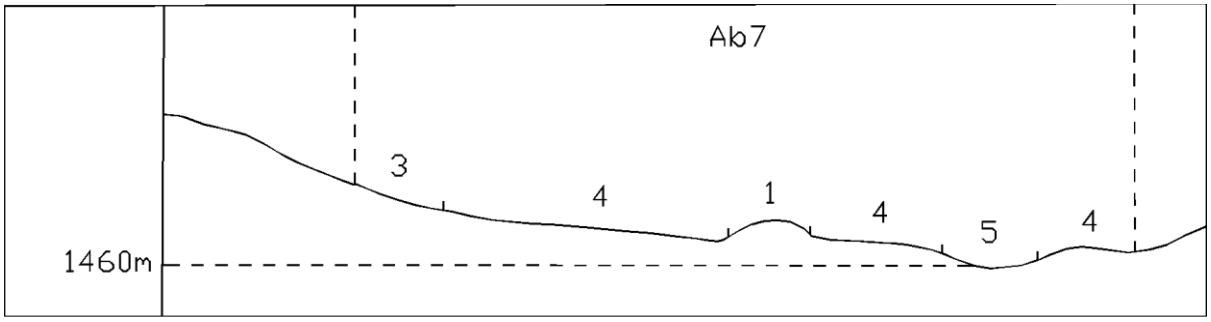
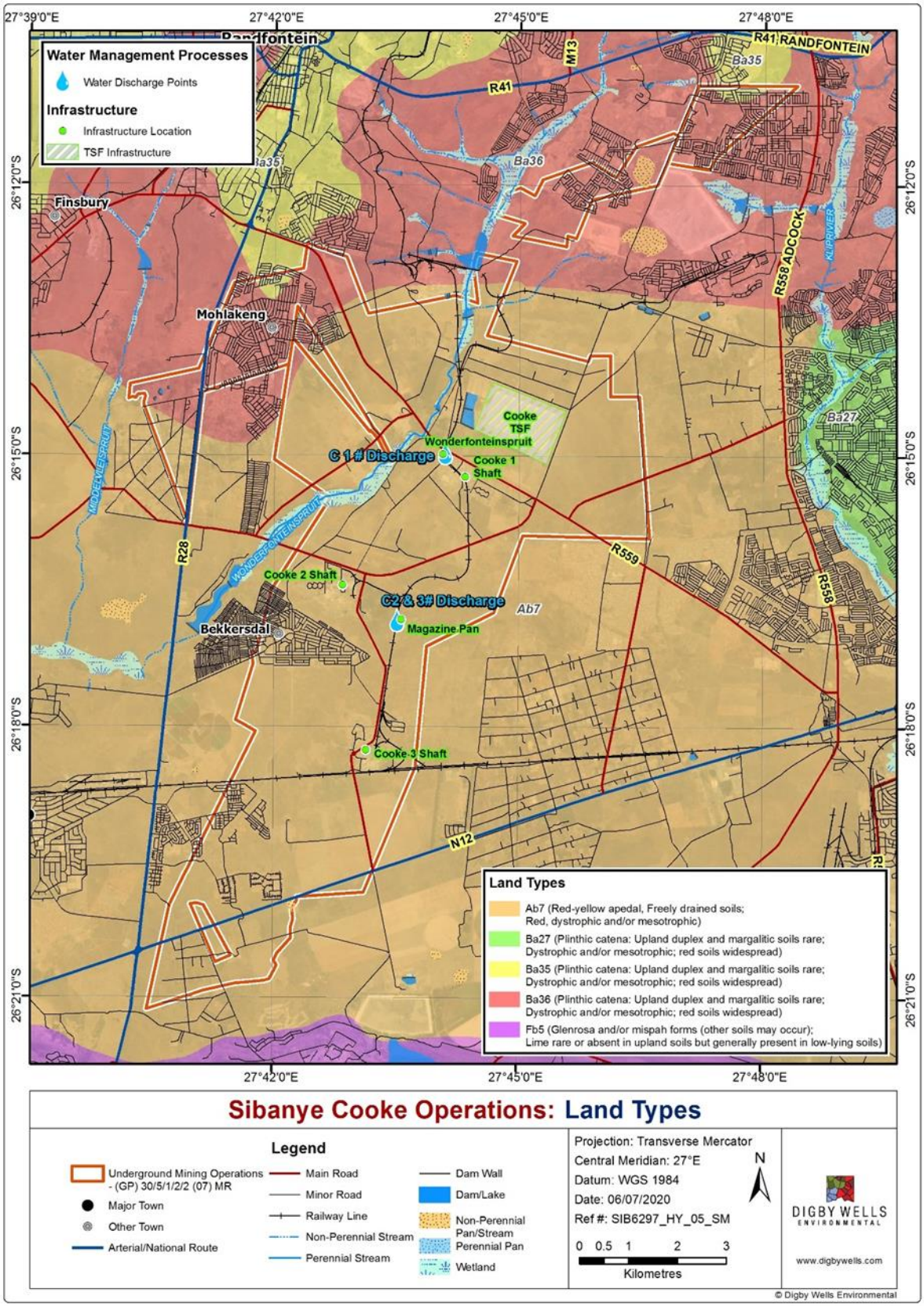


Figure 10-2: General Terrain Type for Land Type Ab7

Adapted from (Land Type Survey Staff, 1972-2006)



Plan 12: Land Type associated with 07 MR

10.7.4 Conceptual Hydropedological Responses within 07 MR

The dominant flow path at the Cooke Shaft complexes is interflow at the soil/bedrock interface. This is indicated by the dominance of the Oakleaf soil form, which is made up of an Orthic A and neocutanic B horizon, overlain by unspecified material (Soil Classification Working Group, 1991).

The subsections below detail the dominant flows for each of the respective shaft areas. This gives an indication of the mode in which pollutants will dominantly be transported into receiving water bodies.

10.7.4.1 Cooke No. 1 Shaft

Figure 10-3 depicts the dominant flow path at Cooke No. 1 Shaft. The dominant flow path upstream is through the soil/bedrock interface in which flow is predominantly occurring in a lateral direction. Responsive shallow soils, which cause overland flow after rain events and interflow soil through the A/B interface were also observed within at this shaft area. The Interflow (A/B) soils cause water flow in a predominantly lateral direction due to permeability differences (duplex soils) between the A and B horizons, allowing some temporary water storage within this interface and gravity flow downslope.

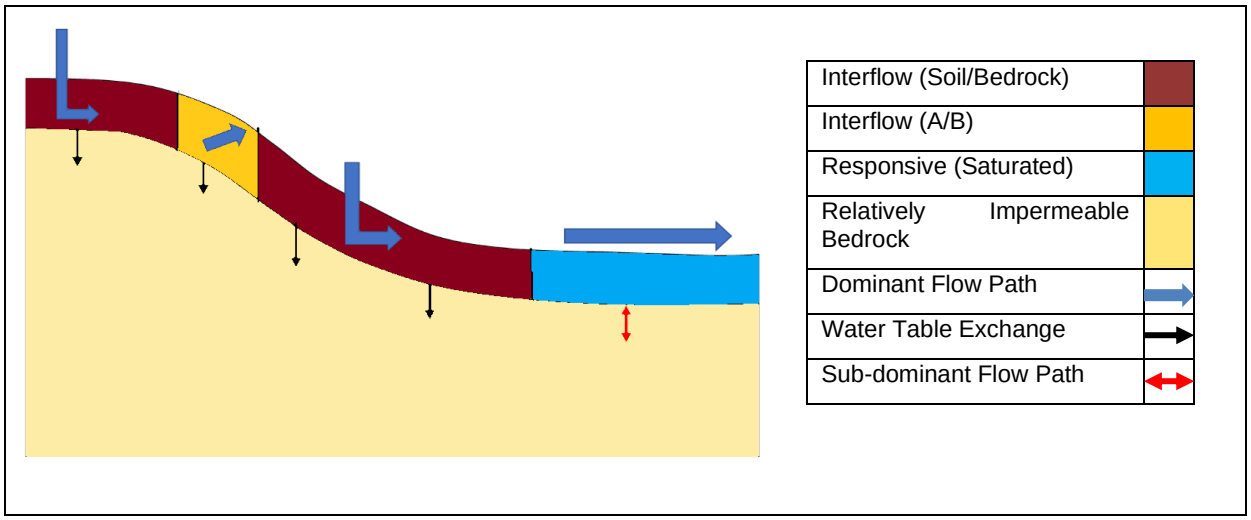


Figure 10-3: Conceptual Hydropedological Responses at the Cooke No. 1 Shaft Area

10.7.4.2 Cooke No. 2 Shaft

Figure 10-4 depicts the dominant flow path at Cooke No. 2 Shaft. The dominant flow is through the soil/bedrock interflow into the Wonderfonteinspruit. When the proposed rewatering of the Cooke No. 2 Shaft commences, this will result in greater contribution of flow into the Wonderfonteinspruit through groundwater ingress since the diversion of water into the magazine pan will cease as part of the closure process.

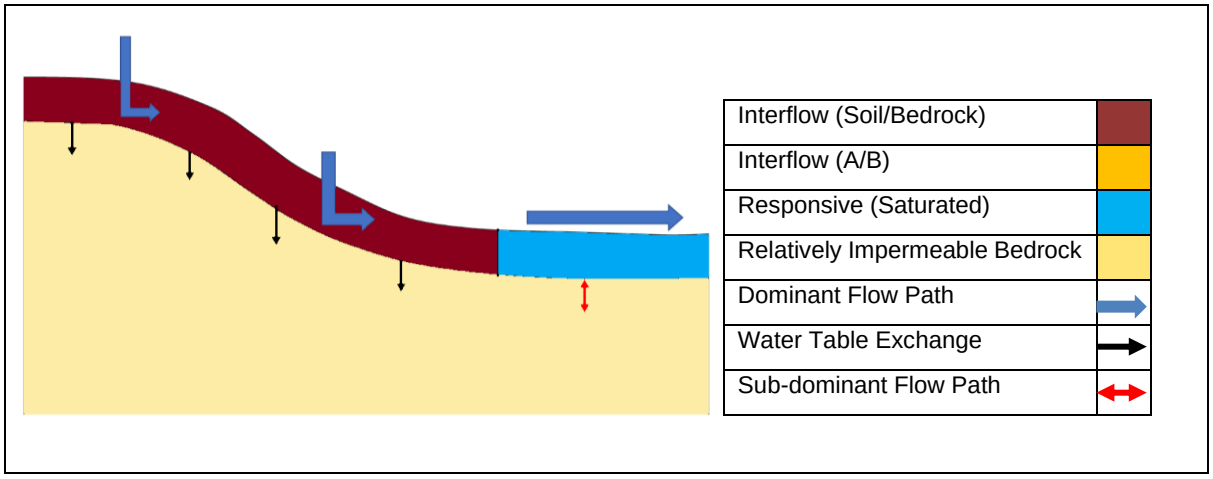


Figure 10-4: Conceptual Hydropedological Responses at the Cooke No. 2 Shaft Area

10.7.4.3 Cooke No. 3 Shaft

Figure 10-5 depicts the dominant flow path at the Cooke No. 3 Shaft area. The dominant flow path upstream is through the soil/bedrock interflow. Responsive shallow soils, which cause overland flow after rain events and interflow soils through the A/B interface were also observed within the Cooke No. 3 Shaft area.

The Interflow (A/B) soils cause water flow in a predominantly lateral direction due to permeability differences between the A and B horizons, allowing some temporary water storage within this interface and gravity flow downslope into the magazine pan. Minimal flow into the Wonderfonteinspruit from Cooke No. 3 Shaft is envisaged due to the residential development situated downstream of Cooke No. 3 Shaft, namely Bekkersdal. This development most likely interrupted natural flow into the Wonderfonteinspruit during development, which caused water diversion by municipal water infrastructure in place.

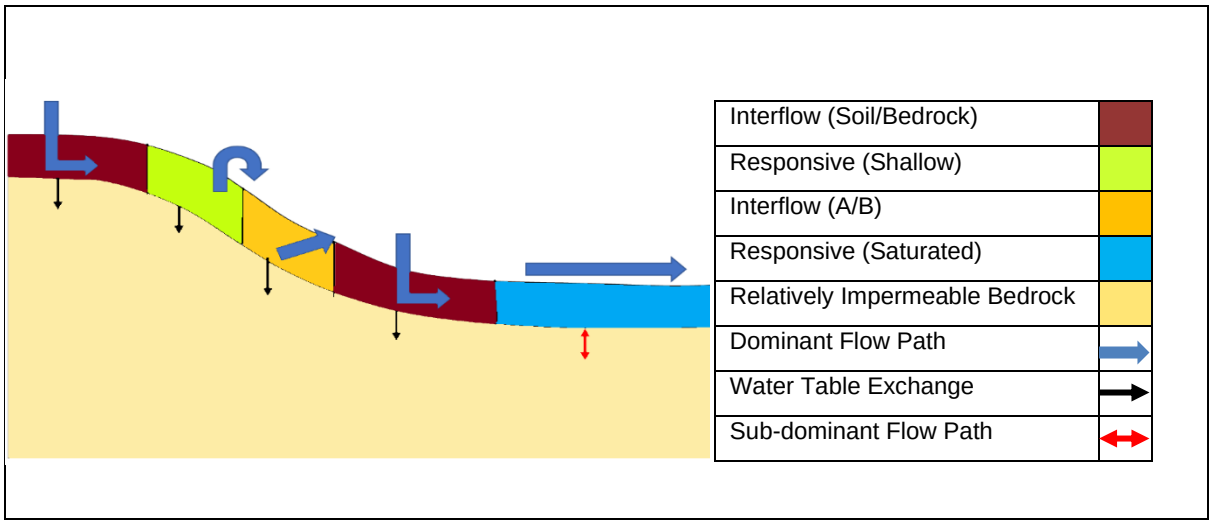


Figure 10-5: Conceptual Hydropedological Responses at the Cooke No. 3 Shaft Area

10.7.5 Water Quality

Sibanye has a surface water quality monitoring programme for the Cooke Operations (Plan 13) which was established in 2012. The Water Quality Assessment undertaken includes trend analysis over time and interpretation of current water quality.

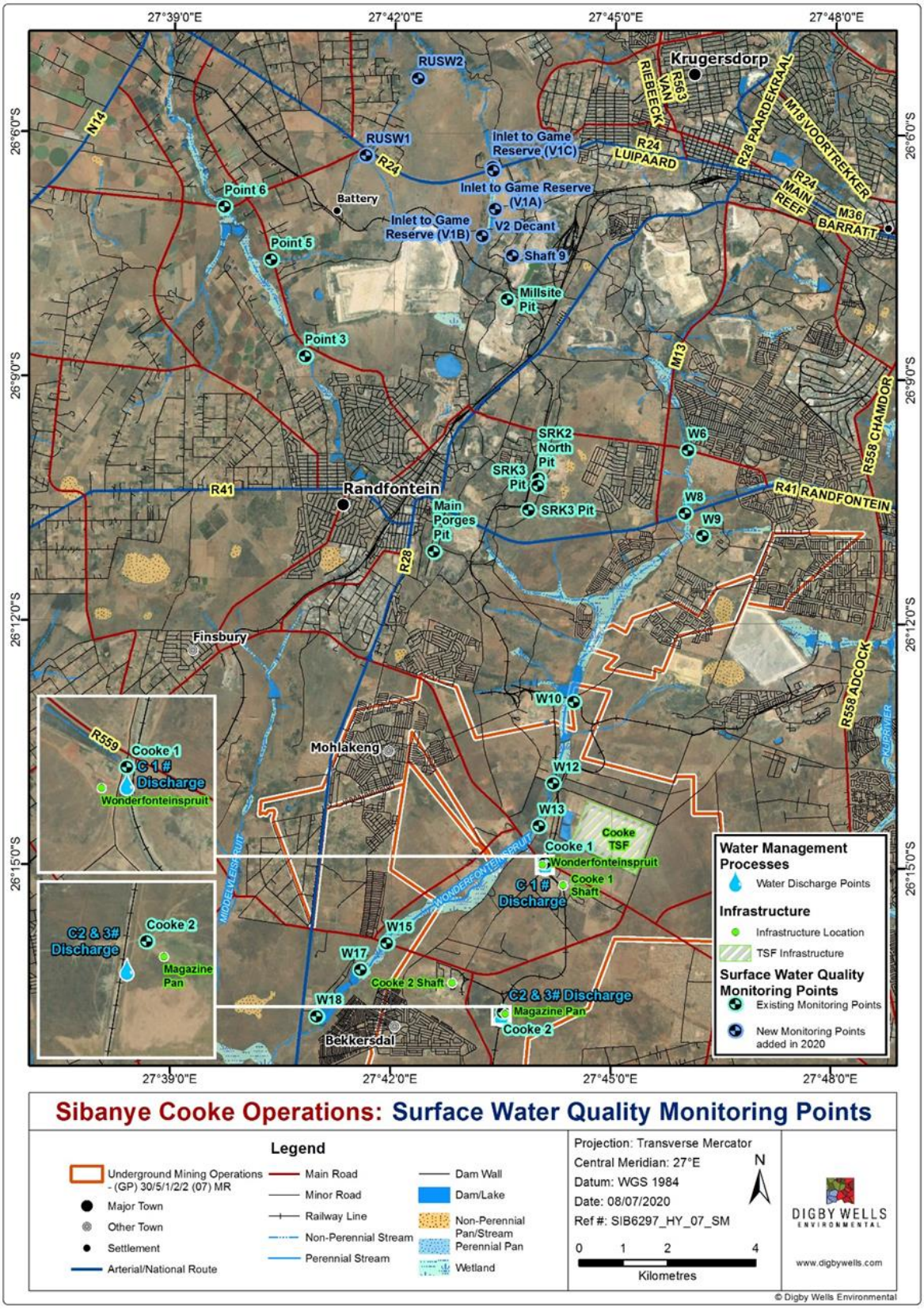
The assessment focuses on the Wonderfonteinspruit as the main receiving water body in C23D for the Cooke Operations. The operations are situated in a complex catchment that is influenced by several water users and land uses. This presents a challenge when quantifying impacts to the Wonderfonteinspruit. Furthermore, no Resource Quality Objectives (RQOs) have been set for C23D and therefore presenting a further challenge to assessing impacts against the end water user requirements.

To address this, Sibanye has developed a site-specific long-term plan of target quality compliance limits (known as the Limit Protective of Downstream Water Users) to inform post-closure requirements on downstream water users. This plan takes the following into account:

- All existing water quality data;
- Comparing upstream (before Sibanye's discharge) and downstream (after potential Sibanye-related impacts);
- Comparing water quality to the following standards, guidelines and limits:
    - IWUL limits for discharges from the Cooke Underground Operations to the Wonderfonteinspruit (Licence No.: 03/A21D/AFGJ/2382, dated 22 November 2013);
    - RQOs for the Mooi River Catchment, which is the nearest downstream catchment with available RQOs;
    - South African Target Water Quality Range for aquatic ecosystems, livestock watering, irrigation; and
    - Other limits from literature as applicable.

The findings of this investigation resulted in a range of water quality limits to be adhered to during the long-term implementation water quality monitoring to ensure that the potential liabilities associated with Sibanye's mining activities are adequately quantified. These limits were adopted in this study and benchmarked against water quality in the Wonderfonteinspruit. Please refer to the specialist report, **Appendix F** for further information regarding Sibanye's methodology in determining the long-term water quality compliance limits.

The subsections below provide a detailed overview of the historic (pre-mining) and current water quality based on long-term monitoring data as well as expected water quality scenario the permanent closure in the Wonderfonteinspruit Catchment.



Plan 13: Surface Water Monitoring Points (C23D Catchment)

10.7.5.1 Pre-mining Water Quality

Mining within the catchment area of the Wonderfonteinspruit commenced in the 1930s and there are no sources of pre-mining water quality. The catchment is characterised by a dolomitic aquifer (which is further discussed in the Groundwater baseline Section 10.8 below). The Zuurbekom compartment of this dolomitic aquifer is has been deemed the best available representation of the pre-mining water quality for the following reasons:

- Hydrogeological numerical modelling (MvB Consulting, 2020) indicates that historically water from this compartment contributed up to 51% of the water volume in the Wonderfonteinspruit. Although this neglects other possible sources of impact, it is not expected that the water quality would be worse than the dolomitic water quality pre-mining impacts due to the wetland nature of the upper reaches of the Wonderfonteinspruit (Javed, *et al*., 2019); and
- This compartment has not been dewatered (i.e. not considered to be impacted by mining for the period between 2018-2020). It is however noted that other sources of contamination from surrounding land uses may have occurred.

Table 10-7 details the water quality considered as an indicative representation of pre-mining qualities. This is based on the average quality taken from three boreholes in the Zuurbekom Compartment which is considered as not being impacted by mining for the period of 2018 to July 2020. It should be noted that other impacts may have occurred from the surrounding land uses including agriculture and municipal activities.

Table 10-7: Average Water Quality for the Zuurbekom Compartment for Jan 2018 to Jul 2020

Parameter	Unit	Average Quality
Cr	mg/L	0.008
NO_3	mg/L	1.587
PO_4	mg/L	0.319
NH_4	mg/L	0.479
pH	pH	7.983
EC	mS/m	27.828
TDS	mg/L	184.333
SS	mg/L	67.111
Ca	mg/L	27.011
Mg	mg/L	16.333
Na	mg/L	11.444
K	mg/L	1.659

Parameter	Unit	Average Quality
Cl	mg/L	2.243
SO_4	mg/L	14.944
Tot Hard	mg/L	134.683
NH_4 as N	mg/L	0.601
NO_3 as N	mg/L	0.895
PO_4 as P	mg/L	0.193
U	ug/L	4.111
Al	mg/L	0.033
Fe	mg/L	0.352
Cd	mg/L	0.003
Cu	mg/L	0.005
F	mg/L	0.220
Mn	mg/L	0.274
Ni	mg/L	0.015
Pb	mg/L	0.030
B	mg/L	0.009
Zn	mg/L	0.004

10.7.5.2 Current Water Quality

The specialist report, **Appendix F,** presents a detailed comparison of the average water quality at the Cooke No. 1 and 2 Shafts' discharge monitoring points for the period June 2019 to June 2020. Based on the comparison to the prescribed IWUL limits, exceedances in Electric Conductivity (EC), Total Dissolved Solids (TDS), SS, Copper (Ca), Sodium (Na), Chloride (Cl), Sulphate (SO_4), Fluorine (F), Uranium (U), Cadmium (Cd), Copper (Cu), Mn, Nickel (Ni) and Zinc (Zn) were observed. However, when compared with the established Limit Protective of Downstream Water Users, EC, TDS, SO_4, Cu, Mn and Ni were exceeded during the same period within Cooke 1 and Cooke 2 discharge points. Of these parameters, Cu, U and Ni were only slightly exceeded.

A trend analysis was undertaken for the parameters of concern to indicate fluctuations for the duration of the available data period. The parameters of concern at Cooke No. 1 and 2 Shafts' discharge points include Mn, SO_4, SS and Fe. Fluctuations of these parameters were observed throughout the monitoring period (2012-2020). The results indicate that, on average, the water quality for EC, TDS, SO_4 and Mn at the Cooke No. 1 Shaft discharge point exceeds the established Limit Protective of Downstream Water Users, while the same parameters were below these limits at Cooke No. 2 Shaft.

These fluctuations are not anticipated to cause significant impacts on downstream water users based on the improving water quality from the most upstream point to the most downstream point within the Wonderfonteinspruit. Furthermore, by comparing the water quality at Cooke No. 1 Shaft discharge point to points further downstream, an improvement in water quality is observed. This may be attributed to the dilution of the effluent as it enters the Wonderfonteinspruit.

Therefore, looking at the historical trend analysis, the Cooke Operations have had a limited impact on the downstream water users in the Wonderfonteinspruit. However, it should be noted that the potential impact of effluent discharge into the Magazine Pan on the underlying water table remains unquantified.

10.7.5.3 Expected Post-Mining Water Quality

As established throughout this report, Sibanye intends to cease the extensive groundwater pumping, treatment and discharge into the environment. This will reduce the volume of water to the Wonderfonteinspruit, however over time as the natural groundwater levels are restored, pre-mining flows will be re-established. The size of the Magazine Pan is expected to reduce and will likely become more reminiscent of an unchannelled valley bottom wetland as opposed to an open pan. Furthermore, the removal of infrastructure will contribute to the re-establishment of the shallow subsurface and stormwater flows.

In terms of water quality, these changes to the flow characteristics over the long term along with the associated expected good quality groundwater from the dolomitic aquifer will ultimately result in an increase in good quality water into the Wonderfonteinspruit. Despite the ultimate positive outcome of the discharge it should be noted that other water users impacting upon the catchment in the interim in terms of metals, salts, nutrients and pathogens will need to be carefully monitored and managed as the current dilution provided will be temporarily reduced due to the cessation of the Cooke No. 1 Shaft discharge.

10.7.6 Aquatic Biodiversity

The PES of the relevant extent of the Wonderfonteinspruit are categorised as mainly/extremely altered (class D/E) (Digby Wells, 2016). This is attributed to widespread habit alteration as a result of mining and other developments within the area, compounded by impacts on water quality. Further water quality impacts are also known to occur as a result of urban runoff, exacerbated by partial and untreated sewage effluent and solid waste disposal within the catchment. A desktop ecological characterisation of the Wonderfonteinspruit is summarised in Table 10-8. The aquatic ecosystem is described in the subsections below in terms of the ecological information available for the Upper and Lower Wonderfonteinspruit Sub-Quaternary Reaches (SQRs).

10.7.6.1 Upper Wonderfonteinspruit: C23D-01313

Within the Upper Wonderfonteinspruit a total of three fish species are expected to be present in this SQR. These expected taxa are tolerant to water quality modification but rely heavily on

the volumes of water currently in the SQR and as such their ecological importance is viewed as moderate. Due to the tolerance of the expected taxa, the sensitivity of the SQR is viewed as low. Water quality impacts are therefore seen as important factors to consider in this SQR.

10.7.6.2 Lower Wonderfonteinspruit: C23D-01384

The Lower Wonderfonteinspruit, otherwise known as the Mooirivierloop occurs after the confluence with the Rietfonteinspruit and the C23E-01266 SQR. The PES of the lower Wonderfonteinspruit is seriously modified (class E). This PES is largely attributed to industrial activities, waste water treatment works, townships and instream habitat modification (DWA, 2013). This SQR is also piped and therefore serious instream modification has occurred. Due to the presence of substantial impacts in the SQR the ecological importance and sensitivity is viewed as low. It is noted here that this SQR is also potentially affected by the western cluster. This reach is also significantly modified due to channelization, river and tributary diversions, discharges and damming.

Table 10-8: Desktop Ecological Information available for the Sub-Quaternary Reaches (DWA, 2013)

Component/Catchment	C23D-01313	C23D-01384
PES (Class)	E (Seriously modified)	E (Seriously modified)
Ecological Importance	Moderate	Low
Ecological Sensitivity	Low	Low

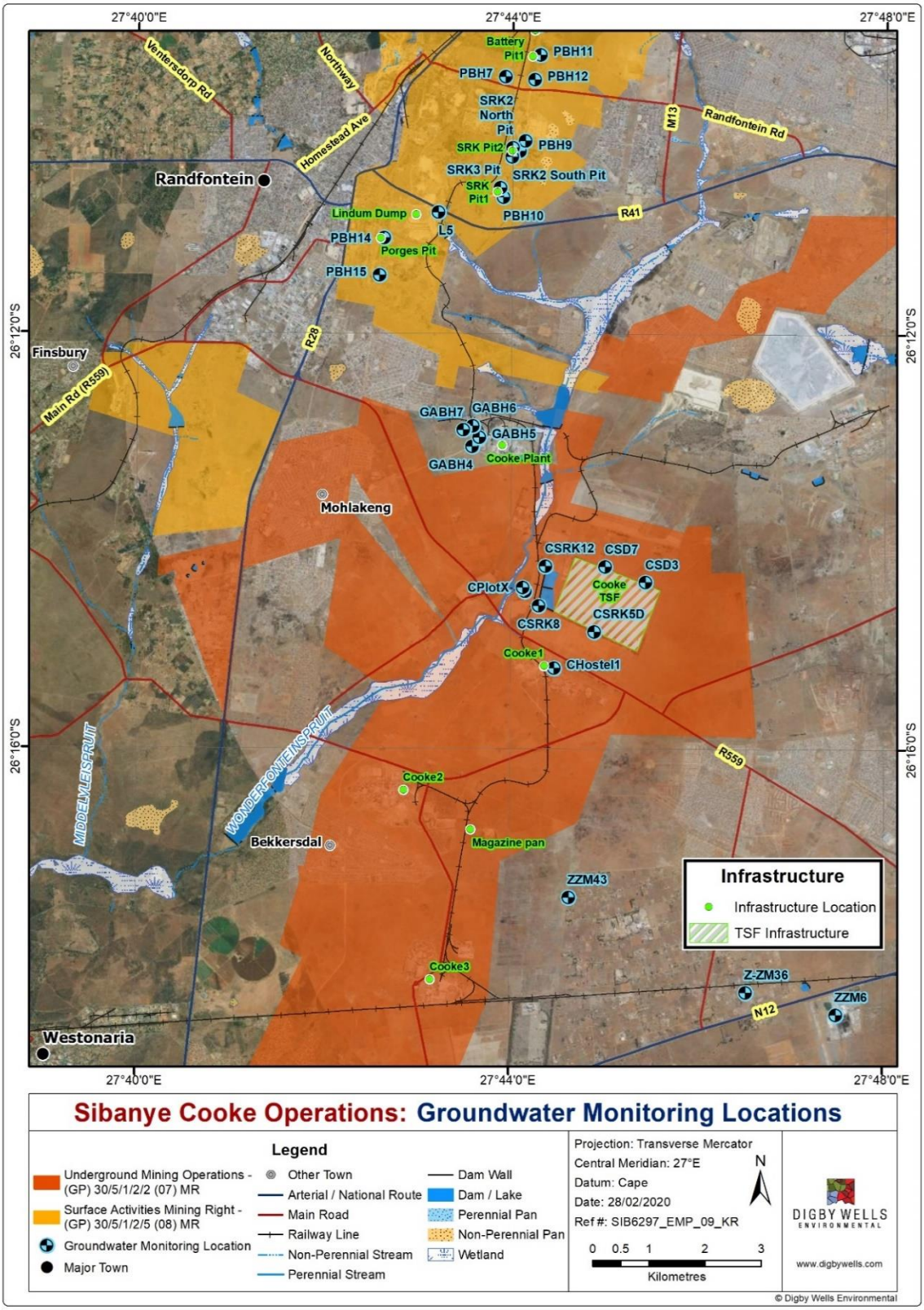
The findings for each potentially affected SQR indicate the majority of river systems are seriously modified. The modification is attributed to the location of the rivers' sources, which are in mining, urban and industrial areas. Existing instream impacts in the region are impoundments, water quality modification (industrial runoff), sewage effluent and solid waste disposal. Riparian impacts in the northern cluster are vegetation removal, channel and bed modification and urban/industrial encroachment. Overall, only moderately important and sensitive aquatic ecosystems are found (based on desktop information) with no Red Data aquatic taxa are expected to be present. It is further stated that the majority of the Wonderfonteinspruit exists within a pipeline which presents serious instream modification. Sibanye implements routine detailed biomonitoring throughout these reaches to inform management requirements.

10.8 Groundwater Resources

Sibanye commissioned MvB Consulting to conduct a Hydrogeological Specialist Assessment for the Cooke Underground Operations. This assessment is appended to this report as **Appendix E**.

Various hydrogeological numerical models have been undertaken over the years to better understand the groundwater regime and aquifer associated with the Cooke Underground Operations and broader Witwatersrand Basin in the context of the extensive mine voids that exist.

The hydrogeological setting described in the subsections below has been summarised from the specialist report, **Appendix E**, which was based on previous assessments undertaken for the operation, in conjunction with continuous monitoring data (refer to Plan 14 below) and limited field work. A hydrogeological model update was undertaken to specifically assess closure scenarios. This is discussed in further detail in the Impact Assessment, Section 10.9.1 below.



Plan 14: Groundwater Monitoring Points

10.8.1 Aquifer Characteristics

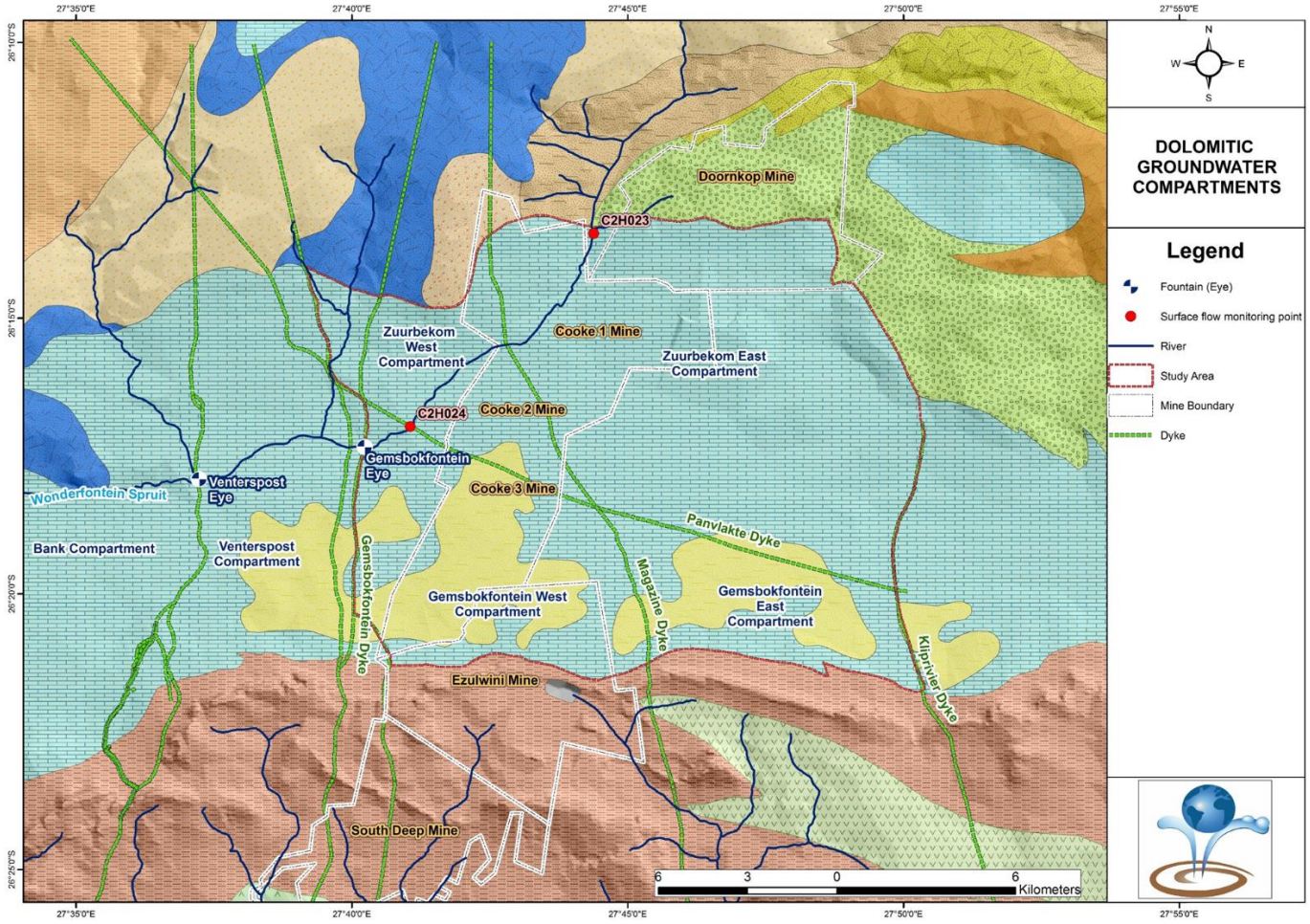
Table 10-9 summarises the aquifer characteristics which are relevant to the Cooke Operations. Groundwater occurrences in the Cooke area are predominantly restricted to the following types of terrains:

- Weathered and fractured rock aquifers in the Witwatersrand, Ventersdorp and Transvaal Formations;
- Dolomitic and Karst Aquifers; and
- Mine void aquifer.

Table 10-9: Aquifer Characteristics

Aquifer Characteristics	Characteristics
Weathered and Fractured Aquifers	Groundwater occurs in the weathered sedimentary deposits (quartzite and shale) of the Witwatersrand and Transvaal strata as well as in the lavas of the Ventersdorp Supergroup. Both rock types (sedimentary and igneous) have similar weathering characteristics and therefore aquifer characteristics. Groundwater occurrences are mainly restricted to the weathered formations, although fracturing in the underlying “fresh” bedrock may also contain water. Experience has shown that these open fractures seldom occur deeper than 60 m. These aquifers are classified as semi-confined. The two aquifers (weathered and fractured) are mostly hydraulically connected, but confining layers such as clay and shale often separate the two. In the latter instance the fractured aquifer is classified as confined. The aquifer parameters, which includes transmissivity and storativity is generally low and groundwater movement through this aquifer is therefore also slow.
Dolomitic Aquifers	Dolomite aquifers are known to contain large quantities of groundwater and are commonly associated with sustainable groundwater abstraction. Various Dolomite Compartments are applicable to the regional area including the Turffontein, Oberholzer, Bank, Venterspost, Ventersbok, Gemsbokfontein and Zuurbekom Compartments (Plan 15). Due to the underground inter-connectivity of the mines the Cooke Operations includes both the Gemsbokfontein and Zuurbekom Dolomite Compartments. Cooke No. 1 and 2 Shafts are located underneath the non-dewatered Zuurbekom Dolomite Compartment while a portion of the Cooke No. 3 Shaft is located in the partially dewatered Gemsbokfontein West Compartment, south of the Zuurbekom Dolomite Compartment. These compartments are divided by the Magazine Dyke, which also divides the Gemsbokfontein Compartment into western and eastern compartments. Historically, groundwater decanted from one dolomite compartment to the next, from east to west. Fountains or “eyes” developed where water overflows from one compartment to the next. Extensive underground mining on the

Aquifer Characteristics	Characteristics
	Witwatersrand Basin has breached the dykes that subdivide dolomite compartments, generally resulting in the compartments becoming watertight. No long-term records are available of the flow at the compartment's eyes, however according to Swart *et al.* (2003) the original flow volumes are estimated at 26.70 Mℓ/d and 8.64 Mℓ/d in the Zuurbekom and Gemsbokfontein West eyes respectively.
Mine Void Aquifers	Over 100 years of gold mining in the Randfontein and Krugersdorp area created an underground mine void, referred to as the West Rand Basin Mine Void. Pumping as much as 40 Megalitres per day (Ml/d) during mining was reported to lower the water levels at Randfontein and West Rand Consolidated Mines. When mining was discontinued, the defunct workings started to flood and, in September 2002, the mine water started to decant from a previously unknown Black Reef Shaft next to the Tweelopiespruit East. The decant point, referred to as the Black Reef Incline (BRI), is at an elevation of 1 662.98 mamsl. The water level in the mine void continued to rise even after the decant level was reached. This indicated that the BRI is restricted and that the outflow at that point does not represent the inflow into the void.



Plan 15: Regional Dolomitic Groundwater Compartments

Source: MvB Consulting, 2020

10.8.2 Groundwater Levels

Prior to mining, the groundwater levels in the respective dolomite compartments varied due to the impermeable nature of the compartments forming dykes. Dewatering has occurred in some compartments as illustrated by Enslin *et al.* (1976) (Figure 10-6).

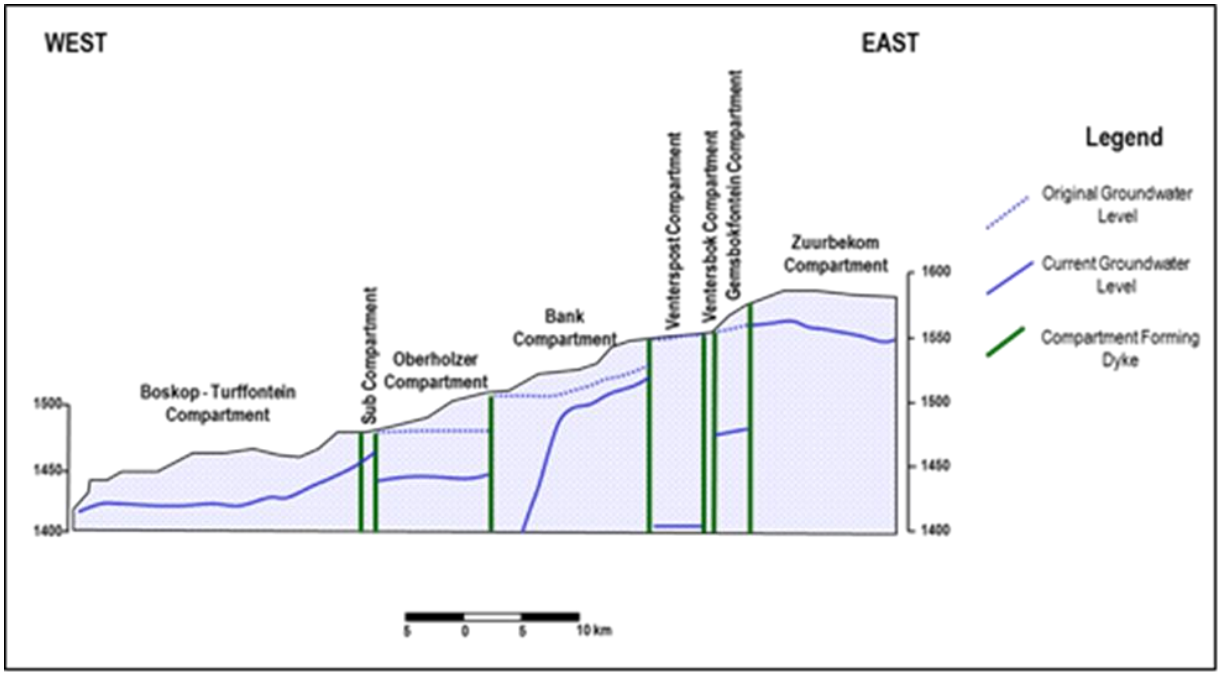


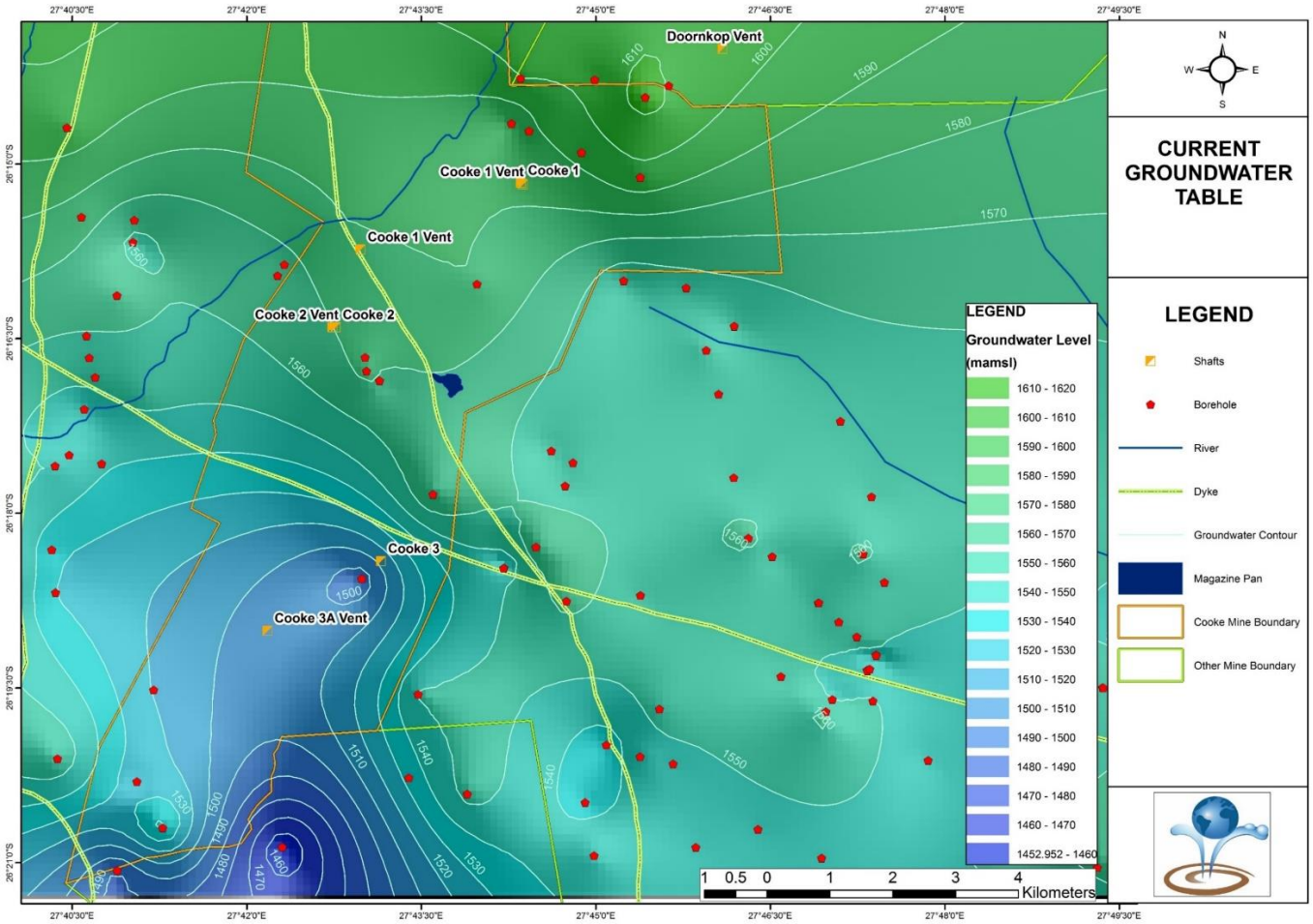
Figure 10-6: Cross-Section of Groundwater Levels in the Dolomite Compartments

Source: MvB Consulting, 2020

For the project-specific compartments, the depth of groundwater in the non-dewatered Zuurbekom Compartments ranges from 4 m to 40 m. Although no dewatering has occurred, available monitoring data indicates a slight drop in groundwater levels in the southern part of the compartment. This is as a result of depressed groundwater levels caused by the dewatering of the adjacent Gemsbokfontein West Compartment, affecting the groundwater flow patterns.

Active dewatering has been taking place in the Gemsbokfontein West Compartment since 1986 and continues now through the Cooke No. 4 Shaft (Ezulwini Gold Mine). Prior to this, water pumped from underground was recharged back into the compartment. Since 1986 the underground fissure water was pumped into the Leeuspruit and the Kleinwes Rietspruit and effectively left the compartment. Available monitoring indicates that there was an initial rapid response in the Gemsbokfontein West Compartment to dewatering activities; however, groundwater levels gradually stabilised into a pseudo-steady state with apparent climatic variations.

Plan 16 below depicts the current regional groundwater levels based on continuous monitoring data.



Plan 16: Regional Groundwater Levels

Source: MvB Consulting, 2020

10.8.3 Groundwater Quality

Sibanye has an established groundwater monitoring programme for the Cooke Operation (Plan 14 above). The water quality results summarised in this section are based on the assessment conducted by Digby Wells assessing groundwater quality between 2009 and 2017. Groundwater quality was compared to the IWUL Limits (Licence No.: 03/A21D/AFGJ/2382, dated 22 November 2013). Of note this assessment focussed on groundwater quality associated with the in-pit deposition activities (i.e. the West Rand Void) whereas the 2020 Study completed by MvB Consulting focusses on the underground operations (i.e. Zuurbekom and Gemsbokfontein Compartments).

The water quality assessment undertaken by Digby Wells revealed notable exceedances in terms of EC, pH, Calcium, Magnesium, Sulphate and metals (Manganese, Iron and Aluminium). With respect to pH values, steady increases from 2013 were observed in data which was attributed to in-pit deposition activities. The tailings deposited into the open pits has a pH of between 10 and 11. This is one of the positive impacts associated with the discharging of alkaline tailings into the pits, as this would mean that metals will precipitate. Similarly, Iron has been decreasing consistently since 2013 and could be linked with the deposition of tailings into the pits. However, Manganese and Sulphate have been decreasing since before the deposition started.

According to the 2020 Study by MvB Consulting, the dolomitic aquifer is chemically composed of Calcium and Magnesium carbonates. The observed exceedances in Calcium and Magnesium concentrations could be a result of the dissolution of the dolomite under natural conditions or enhanced by the interaction of the acid mine water (**Appendix E**, see page 79).

During the IWUL audit for the Cooke Operations in 2019, the groundwater quality between April 2018 and April 2019 generally showed compliance across all prescribed variable limits with the exception of Chloride.

In 2018, Sibanye commissioned SRK Consulting to assess the water chemistry of the Cooke Shafts. Water quality was benchmarked against the SANS 241:2015 Drinking Water Standard as well as the IWUL Limit for discharge into the Wonderfonteinspruit and Groundwater (Licence No.: 03/A21D/AFGJ/2382, dated 22 November 2013). The following was established through this study:

- pH results for the underground water samples range from a minimum pH of 3.3 – 3.8. This is lower than the lower limit of pH 5.0 set out in SANS 241:2015;
- The parameters that exceed the SANS 241:2015 limits included EC, TDS, SO_4, Aluminium (Al), Chromium (Cr), Fe, Mn, Ni, Na and U;
- The parameters that exceed the WUL discharge limits include EC, Cl, SO_4, Al, Ca, Cu, Fe, Magnesium (Mg), Mn, Ni, Na, U and Zn; and
- The parameters that exceed the WUL groundwater limits include EC, SO_4, Ca, Mg and Na.

Generally, the underground water can be classified as acid, high metal waters while the water type, as is Ca-Mg-Na-SO_4. Numerical and geochemical modelling was completed to predict post-closure scenarios for the shafts once rewatered. The detailed results are presented in Section 11 (Impact Assessment) below. Of note here is that the modelled results indicate that when the rewatering of the shafts is completed, the water in the shafts is expected to be of sufficient quality to meet the drinking water quality standard set out in SANS 241: 2015. The results of the modelling show that the chemistry of the water at year four after complete rewatering, would be of sufficient quality to meet Wonderfonteinspruit and wastewater discharge standard. This reflects the abundant dilution of any seepage entering the aquifers by the high recharge rate of the aquifers from surrounding non-mineralised sources.

10.8.4 Groundwater Use and Receptors

Groundwater usage in the area occurs on agricultural holdings and small farms, mainly for domestic purposes with some large-scale irrigation taking place from the Sterkfontein dolomite area. Farming operations to the west of the Wonderfonteinspruit utilise groundwater for stock watering and domestic purposes. Significant streams that could be impacted if the groundwater quality deteriorates include the Wonderfonteinspruit, Tweelopiespruit and Mooirivierloop. These streams are vulnerable to AMD seepage and salt loading as a result of tailings seepage in the shallow groundwater zone and decant of mine water through old shafts, though decant was not found to be likely to occur and the tailings sources are being removed through reclamation projects.

10.9 Geochemical and Waste Classification Assessment

Throughout the history of mining of the Cooke Operations, sediments have accumulated across the landscape. A Geochemical and Waste Classification Assessment was carried out to establish the waste type of accumulated sediment and slimes material. This assessment is appended to this report as **Appendix G**[10]. and the following methodology was employed:

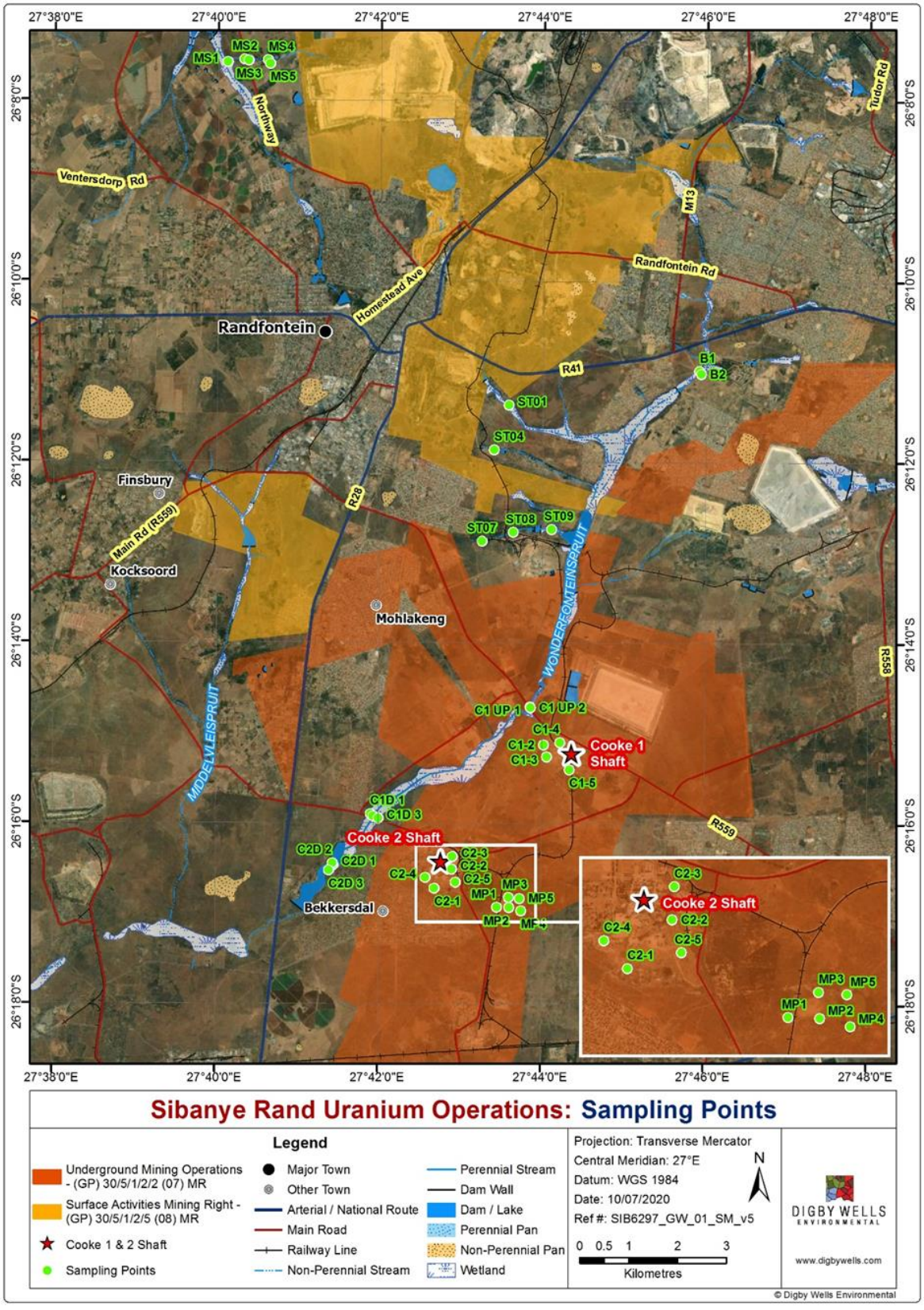
- *Sampling of sediments* – A total of 34 sediment samples were collected across the Cooke Underground- and Surface Operations (Plan 17). Targeted areas included historically impacted wetlands, the Wonderfonteinspruit riverbed, the shaft complexes (including slimes material in containment dams), surroundings of the Millsite TSF Complex as well as at the treated effluent discharge points which are assumed to be contaminated.
- *Geochemical testing* – Static testing was carried out at an accredited laboratory to determine the composition of the material and establish their acid generating potential. The test work included X-ray Diffraction (XRD), X-Ray Fluorescence (XRF), Acid-Base

[10] A geochemical assessment, relating to the Cooke underground workings was previously undertaken by SRK Consulting (2018). The results of this assessment were considered in the hydrogeological numerical model for the closure of the Cooke Underground Operations. This is presented in the Impact Assessment, Section 11 below.

Accounting (ABA), Net Acid Generation (NAG), Sulphur-Speciation (SS%) tests, Aqua regia digestion, and Distilled (DI) leachate tests.

- *Waste Characterisation* – Based on the total concentration and leachate test results, the sediments were classified in terms of waste type in accordance NEM:WA Regulations, specifically the National Norms and Standards for Assessment of Waste for Landfill Disposal (GN R 635 of 23 August 2013) and the National Norms and Standards for the Disposal of Waste to Landfill(GN R636 of 23 August 2013). The purpose of this was to determine alignment with current disposal into the pits, not to inform deposition onto waste facilities.

Further detail pertaining to the methodology and test work procedures for the assessment is provided in the specialist report, **Appendix G**. It is noted that the assessment does not constitute a Land and Soil Contamination Assessment, but rather, to classify accumulated surface material into waste types to determine whether the material is hazardous, the risk posed to the receiving environment and consequently recommend appropriate removal and disposal approaches as part of the planned rehabilitation.



Plan 17: Geochemical Assessment Sampling Points

10.9.1 Minerology

In terms of the rock mineralogy and chemical composition, quartz was found to be the most dominant mineral across all samples. This is the most common minerals on Earth and is characterised as highly resistant to chemical and physical weathering. Generally, secondary minerals found included pyrophyllite and kaolinite with smaller traces of goethite, hematite, chlorite and jarosite. These minerals are associated with the area's geology and related weathering processes.

Of note, varying amounts of calcite and dolomite were found in some of the samples collected at the Cooke No. 1 and 2 Shaft areas (both at the silt dams and treated effluent discharge points) which is a result of lime addition during the water treatment process. High sulphate concentrations at the discharge points are likely related to the presence of gold ore in the host rock containing sulphur minerals (such as pyrite).

10.9.2 Laboratory Results and Interpretation

The results of the geochemical assessment are discussed for each of the targeted areas shown in Plan 17 in separate subsections below. Five characteristics, namely paste pH, Neutralisation Potential (NP), Acid Generation Potential (AP) and Neutralisation Potential Ratio (NPR), were assessed to determine the acid-generating potential.

10.9.2.1 Historically Impacted Wetlands

Five samples were collected from historically impacted wetlands (ST01, ST04, ST07, ST08 and ST09) (Plan 17). The table below provides a summary of the interpretation of the test work results. The detailed results are presented in the specialist report, **Appendix G**.

Table 10-10: Geochemical and Waste Classification Results (Wetlands)

Result Type	Description of Result
Acid generating potential	All samples were found to have a sulphide sulphur and total sulphur concentration below 0.3% which indicates a low potential of acid formation. The NAG-pH results were however slightly acidic, i.e. a NAG pH below neutral. With the exception of ST01 which demonstrated a higher concentration of acid potential minerals per tonne to neutralising minerals (i.e. negative Net Neutralising Potential (NNP)), all other samples had a positive NNP. This was also confirmed by the neutralising potential ratio of all samples being above the value 2 excluding ST01 and ST09. With respect to ST09, there is uncertainty on whether the sediments are acid forming or neutralising due to the NRP. For both ST01 and ST09, any acid producing potential is deemed as short term due to the low sulphide sulphur content.

Result Type	Description of Result
Leachate Test and Total Elemental Analysis	The Total Concentration Threshold (TCT) results indicate the following exceedance of concentrations for each sample to the TCT0 limits: • ST01 – Arsenic (As) and Barium (Ba); • ST07 – Copper (Cu); • ST08 – As, Ba, Cu and Manganese (Mn); • ST09 – Ba, Cu, Nickel (Ni) and Lead (Pb); and • ST04 – B. All other concentrations, including Uranium, were below the TCT0 limits and no concentrations in any of the samples were found in exceedance of the TCT1 limits. Of note, As is an element commonly associated with gold bearing ore and geologies and for this reason can be enriched naturally in the soil and sediment profile. Cu is a metal associated with gold mining, both in terms of the geological setting and processing methods. Therefore the Cu can be a potential indication of natural weathering processes and/or Copper Sulphate reagents added to the gold processing circuit of sediments which have washed to wetlands. Similarly, Ni is commonly associated with mineral processing and is included as trace amounts in minerals associated with the gold bearing geology. Pb is not commonly found and this can be an indication of contamination from a different source than that of mining processes. In terms of Leachable Concentration thresholds (LCT), ST01 and ST09 indicate an acidic pH. Further their Mn and Ni concentrations exceed the LCT0 limits with Nitrate (NO_3) also exceeding this limit in ST09. All other samples were within all LCT limits. The Mn and Ni exceedances are a direct result of the dissolution of the Total Concentration of these elements while the exceeding NO_3 in ST09 is likely due to raw sewage discharge and/or residual cyanide. Agricultural and industrial practices as well as sewage from communities discharging into the streams in the area upstream of the mines can also potentially contribute to the NO_3 concentrations. ST01 and ST09 thus indicate target areas for further investigation to inform potential requirements for rehabilitation. Any upstream sources (Lindum TSF and municipal sewage sources) of contamination should first be addressed before further rehabilitation occurs.

10.9.2.2 Upstream of the Cooke Operations within the Wonderfonteinspruit Riverbed

Four samples were collected along the Wonderfonteinspruit riverbed (B1, B2, C1-UP1 and C1-UP2) (Plan 17). The table below provides a summary of the interpretation of the test work results. The detailed results are presented in the specialist report, **Appendix G**.

Table 10-11: Geochemical and Waste Classification Results (Wonderfonteinspruit Riverbed)

Result Type	Description of Result
Acid generating potential	With the exception of B2 sample which indicates a slightly acidic NAG pH, all other samples had a NAG pH of above 5.5 with the Sulphide Sulphur content in all samples being below 0.3%. B2 and C1-UP2 demonstrate a high concentration of acid potential minerals per tonne than acid-neutralising minerals hence demonstrates them to have potential to generate acid in the short term. These samples are located closer to the middle of the stream bed which may give reason for the higher level of potential contamination.
Leachate Test and Total Elemental Analysis	The TCT results indicate the following exceedance of concentrations for each sample to the TCT0 limits: • B1 –As, Ba, Cobalt (Co), Mn, Ni, Pb and Zinc (Zn); • B2 – As, Cu and Pb; • C1-UP1 – As; and • C1-UP2 – As and Pb. All other concentrations, including Uranium were, were below the TCT0 limits and no concentrations in any of the samples were found in exceedance of the TCT1 limits. In terms of LCT, B2 exceeded the LCT0 limit for Mn while C1 UP1 exceeded for As and Ni and C1-UP2 for Cadmium (Cd), Mn, Ni, Sulphate (SO_4) and pH. These sites represent background sediment qualities and it is notable that arsenic and manganese are present throughout the catchment.

10.9.2.3 Cooke Shaft Complexes

Nine samples were collected around the Cooke No. 1 and 2 Shaft areas. These comprised sediment and slimes samples as follows (Plan 17):

- Cooke No. 1 Shaft:
  - Sediment samples - C1-2 and C1-5; and
  - Slimes samples - C1-3 and C1-4.
- Cooke No. 2 Shaft:
  - Sediment samples - C2-1, C2-4 and C2 5; and
  - Slimes samples - C2-2 and C2-3.

The table below provides a summary of the interpretation of the test work results. The detailed results are presented in the specialist report, **Appendix G**.

Table 10-12: Geochemical and Waste Classification Results (Cooke Shaft Complexes)

Result Type	Description of Result
Acid generating potential	Samples C1-2, C1-3, C1-5, and C2-5 were found to have potential to generate acid in the short term due to the low NPR. However, none of these samples has a Sulphide Sulphur content above 0.3%, thus it is highly unlikely that any significant AMD potential still exists in these samples. This does give an indication that the origin of the samples is likely a by-product of mining (silt) which would have contained a high Sulphate concentration.
Leachate Test and Total Elemental Analysis	The TCT results indicate the following exceedance of concentrations for each sample to the TCT0 limits: • All silt samples – As, Ba, Co, Cu, Mn, Ni, Pb and Zn; and • All sediment samples – As, Ba, Co, Cu, Mn, Ni and Pb. Although similar exceedances were observed, it is noted that they were generally in lower concentrations in the sediment samples compared to the silt samples. Zn was only detected above the TCT0 limit in the silt samples. Vanadium (V) which is a common trace element in mining areas was detected above the TCT0 limit in sediment sample C2-4 only. In terms of LCT, elevated Ni was detected in C1-3 (silt) and C2-5 (sediment), SO_4 in C2-3 and C2-5 with elevated Mn also detected in C2-5. All other parameters in these and remaining samples were below the LCT0 limit. These areas should be targeted for removal and rehabilitation. As combined samples the overall sediment was still classified as a Type 3 waste.

10.9.2.4 Underground Water Discharge Points

Six samples were collected from the Cooke No. 1 and 2 Shaft discharge points (C1-D1, C1-D2, C1-D3, C2-D1, C2-D2 and C2-D3) (Plan 17). The table below provides a summary of the interpretation of the test work results. The detailed results are presented in the specialist report, **Appendix G**.

Table 10-13: Geochemical and Waste Classification Results (Discharge Points)

Result Type	Description of Result
Acid generating potential	No samples were found to indicate acid forming material and were all characterised by low Sulphide Sulphur content and high NPR values.
Leachate Test and Total Elemental Analysis	The TCT results indicate the following exceedance of concentrations to the TCT0 limit for all samples collected at the Cooke No. 1 and 2 discharge points: As, Ba, Cu, Mn and Pb. In addition, two respective samples from the discharge points (C1-D2, C1-D3 and C2-D2, C2-D3) also exceeded the TCT0 limit for Co, Ni and Zn.

Result Type	Description of Result
	In terms of LCT, Cr, Mn and Ni concentrations in C1-D2 were found to be above the LCT0 limit with Mn and Ni also above the limit for C1-D3. All other samples has no exceedances to LCT limits. As noted above the manganese and arsenic concentrations are elevated throughout the Wonderfonteinspruit and solely attributable to the Cooke Operations. Due to the low acid generating potential and adverse ecological impacts expected with disturbance of the sediment, removal is not recommended.

10.9.2.5 Magazine Pan

Five samples were collected from the Magazine Pan (MP1, MP2, MP3, MP4 and MP6) (Plan 17). The table below provides a summary of the interpretation of the test work results. The detailed results are presented in the specialist report, **Appendix G**.

Table 10-14: Geochemical and Waste Classification Results (Magazine Pan)

Result Type	Description of Result
Acid generating potential	The Sulphide Sulphur content in all five samples were below 0.3%, indicating a low possibility for AMD formation. With the exception of MP4 all samples displayed a positive NNP. Although the NNP for MP4 was found to be negative, the potential to generate acid is short-term and is not expected to pose a significant risk in terms of AMD in the long-term.
Leachate Test and Total Elemental Analysis	The TCT results indicate that all samples exceed the TCT0 limit for As. With the exception of MP6, all other samples exceeded the TCT0 limits for Ba, Cu and Pb with MP2 and MP3 also exceeding Co and Ni. In terms of LCT, MP2 and MP6 did not exceed any LCT limits. MP1 exceeded the LCT0 limit for Mn, MP3 for Cr, Mn, Ni and Pb while MP4 only exceeded the limit for Ni. Further investigation into amelioration vs. removal requirements is recommended.

10.9.2.6 Surroundings of the Millsite TSF Complex

Five samples were collected a wetland downstream of the Millsite TSF Complex (MS1, MS2, MS3, MS4 and MS5) (Plan 17). The table below provides a summary of the interpretation of the test work results. The detailed results are presented in the specialist report, **Appendix G**.

Table 10-15: Geochemical and Waste Classification Results (Millsite TSF Complex)

Result Type	Description of Result
Acid generating potential	The Sulphide Sulphur content in all five samples were below 0.3%, indicating a low possibility for AMD formation. Only sample MS5 indicated an uncertainty around acid producing potential due to a low NPR. However, if any acid formation does occur it is expected to be short-term with no significant risk posed to long-term AMD formation.
Leachate Test and Total Elemental Analysis	The TCT results indicate As, Ba, Cu, Mn and Pb above the TCT0 limit in all samples while MS1 is the only sample with a Co concentration below the TCT0 limit. In terms of LCT, MS3, MS4 and MS5 demonstrates Mn and Ni above the LCT0 limit with NO_3 exceeding the LCT0 limit in MS4. MS2 only exceeded the LCT0 limit for Ni and no exceedances to the limits were detected for MS1. Further investigation into amelioration vs removal requirements is recommended.

10.9.3 Summary of Findings

Table 10-16 presents the determined Waste Classification based on the geochemical results provided above. All sediment samples across the targeted assumed contaminated areas were found to be Type 3 wastes. One of the objectives of the assessment was, based on the classification, recommending appropriate disposal approaches in line with existing waste management and rehabilitation practices at the Cooke Surface Operations (i.e. disposal of residue material into open pits following reprocessing). This recommendation is also indicated in the table below.

Table 10-16: Waste Classification

Area/Material	Waste Type	Disposal of Materials into Pits
Historically Impacted Wetland	Type 3	Allowed
Wonderfonteinspruit Riverbed	Type 3	Allowed
Cooke No. 1 and 2 Shaft Complexes	Type 3	Allowed
Cooke No. 1 and 2 Discharge Points	Type 3	Allowed
Magazine Pan	Type 3	Allowed
Millsite TSF Complex Downstream Wetland	Type 3	Allowed

All samples indicate mineral content that correlate with the geological setting and weathering products of the various formations in the area. Although some samples showed the potential to form acid in the short-term, not enough significant mineral evidence or elevated Sulphide Sulphur content was present to conclusively indicate any potential for long-term AMD issues to result from the presence of this sediment in the assumed contaminated areas. It is most likely that these sediment samples and soils would have been washed out since their accumulation and any release of mobile metals and/ or acid forming reaction would have already taken place. Of note, the sampling points for which short term acid leachate potential

was indicated are upstream of the Cooke Operations, and samples taken downstream of the Cooke Operations did not indicate short term acid generating capacity.

The mineralogy and TCT results for the Cooke No. 1 and 2 Shaft areas (Section 10.9.2.3) shows contamination from the mining activities and in particular the of the silt dams in the complexes. The contaminated sediments show the same mineralogical and elemental characteristics as the silt samples and therefore deemed to require rehabilitation. The leachable concentrations, however, indicate lower levels of leachability. This possibly means that these silts and sediments have already weathered. This is also supported by the higher leachability of the impacted soils that would have accumulated any contamination from the silt dams and operations in the area.

The Geochemical and Waste Classification Assessment indicates that the removal of the contaminated sediments and silt material at the Cooke No. 1 and 2 Shaft complexes, reprocess through the Cooke Gold Plan and subsequent disposal of the residue material into the open pits, in line with the Cooke Surface Operations' activities, is a viable rehabilitation measure. It is further noted as more sustainable than stripping and discarding the material which would merely move the contaminant source from one area to the next.

In terms of all other sediments/ targeted areas sampled and assessed, this material occurs in watercourses that have already developed aquatic ecosystems despite being potentially contaminated. The low levels of contamination do not justify the removal of this material but would rather require further investigation to confirm the results presented here and require mitigation measures to limit or reduce current sources of pollution. The option of removal of sediments accumulated in the wetlands downstream of the Millsite (as this area is relatively dry) and the Magazine Pan (upon cessation of discharge) could be further investigated.

10.10 Heritage Resources

A HRM Process in compliance with the NHRA has been undertaken in support of the BA Process. This included a Heritage Impact Assessment (HIA) which is appended to this report as **Appendix H**. To characterise the cultural heritage landscape associated with the Cooke Operations, the following methodology was employed:

- *Desktop Assessment* – Information was gathered and reviewed relating to known archaeological and heritage resources within the study area. This included previous HIAs conducted, aerial imagery as well as published literature and databases.
- *Field survey* - A physical pedestrian survey was conducted during May 2020 with the aim of locating and describing heritage resources falling within and adjacent to the areas associated with the proposed activities.
- *Heritage Assessment* – The identified heritage resources were plotted to determine the relationship between such resources and the proposed activities. An assessment of the Cultural Significance (CS) was completed in terms of the heritage assessment criteria.

Further detail pertaining to the methodology of the assessment is provided in the specialist report, **Appendix H**.

10.10.1 Cultural Heritage Baseline Description

Geologically, the project area is largely underlain by dolomitic rock that has the potential for karst topography. Karst topography refers to landscapes formed from the dissolution of soluble rocks, including dolomite and limestone. Karst topography is characterised by underground drainage systems with sinkholes, dolines and caves. This geological phenomenon creates karst caves that can be filled with fine to coarse-grained alluvium during periodic flooding. The alluvium may be represented by bodies of breccia, sandstone and siltstone which have an increased potential to contain archaeological material.

Archaeologically, Stone Age and Late Farming Community sites have been recorded within the larger area under consideration. Stone Age lithics recorded have been found as surface scatters outside of any discernible context thereby limiting the information potential and overall significance of these resources. Late Farming Community sites within the region have primarily been identified as stone walled settlements classified as Type N and Klipriviersberg.

Within regional, local and site specific contexts the project is located in historically significant mining-industrial and agricultural-rural cultural landscapes. In terms of the mining landscape, there are several features and markers such as many of the historical TSFs created by the original mines established during the first half of the 20th century.

10.10.2 Results from the Field Survey

No heritage resources were identified in the project areas. Figure 10-7 presents the results of the historical layering. None of the infrastructure intended for demolition appears on the historical imagery at 1961.

Several heritage resources were identified in proximity to the project areas. Table 10-17 includes descriptions of these heritage resources identified during the pre-disturbance survey. Plan 18 presents the spatial distribution of these sites and includes the tracks, indicating the areas that were surveyed. Figure 10-8 below presents photographs of select heritage resources identified during the pre-disturbance survey.

Table 10-17: Heritage Resources Identified through the Pre-Disturbance Survey

Site Name	Description
BGG-001	Burial ground of eight visible graves. Of these graves, one grave has a headstone. This headstone belongs to the Matsididi family and dates to 1968. The other visible graves are marked by stone piles and do not have headstones. The burial ground is not fenced.

Site Name	Description
BGG-002	Burial ground of five visible graves. The burial ground is very overgrown and is not fenced. One of these graves is marked by a stone pile and does not have a headstone. Of the other four graves with headstones, only one had a visible date (1927). Three of the graves belong to the Du Toit, Prinsloo and Komen families. The fourth headstone did not have a visible name.
BGG-003	Burial ground of two visible graves, both with headstones. One headstone has a legible date (1946). The burial ground was fenced off with a palisade fence, although this has since been vandalised. Sibanye has appointed a contractor to install new fencing[11].
BGG-004	Burial ground of twelve visible graves in close proximity to the mine house. All graves are marked by stone piles and none have headstones. Grave goods are present, including a broken plate and glass. The burial ground is not fenced[12].
Mine House	Ruins of three structures and the cement foundations of one more structure. An additional structure is located in proximity. The Sibanye employee stated that these were used as mine houses in the past. None of these structures appear on the historical imagery and are therefore assumed to be younger than 60 years.
Potential Graves	An informant in the community identified this point as a burial ground. There were no surface dressings visible at the time of the inspection to confirm the presence of graves or indicate how many graves are located in this burial ground. This area must be considered a burial ground until proven otherwise.

[11] At the time of compilation of this report and subsequent to the field survey, this fencing has been erected.

[12] Sibanye intend to delineate the burial ground.

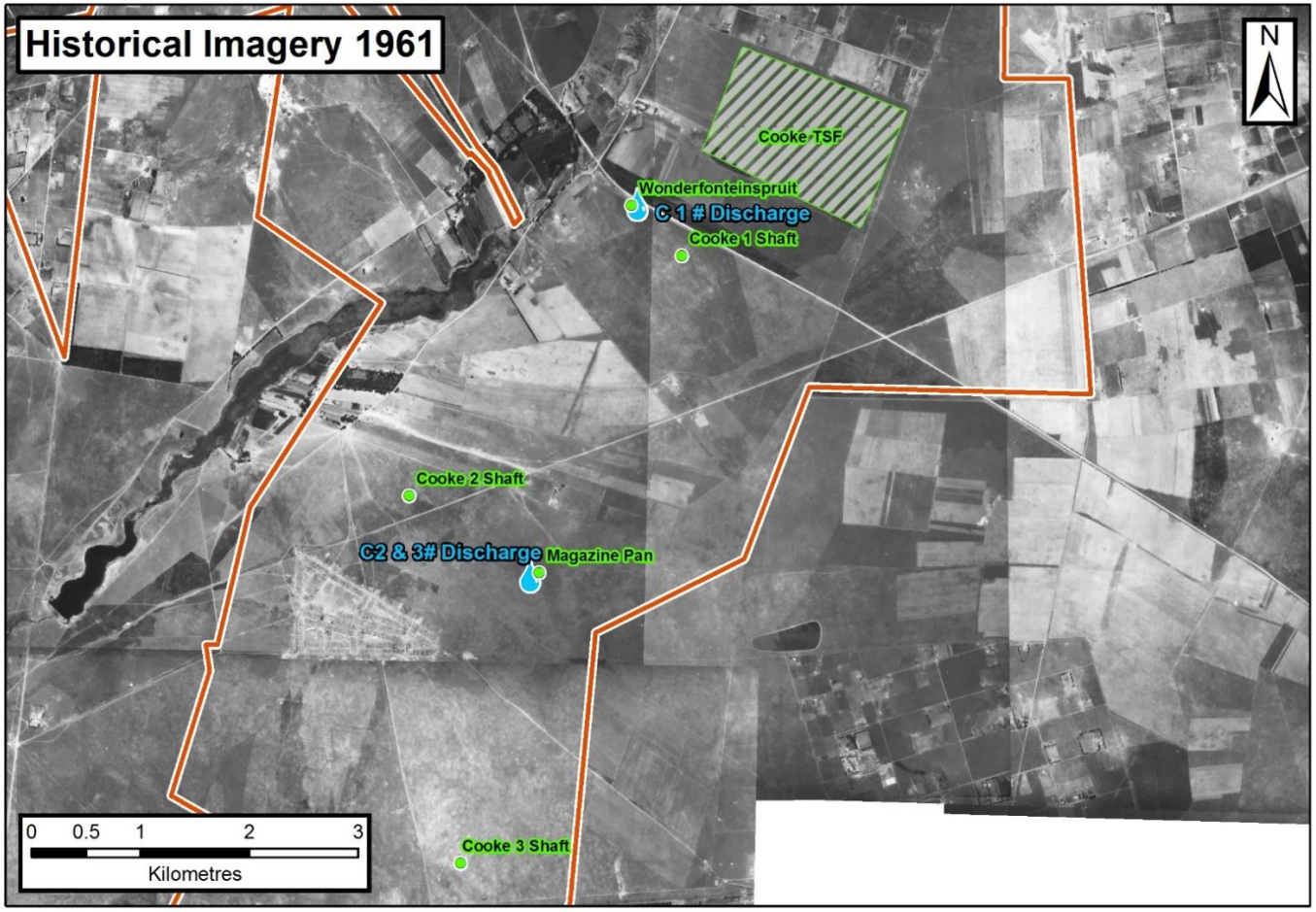
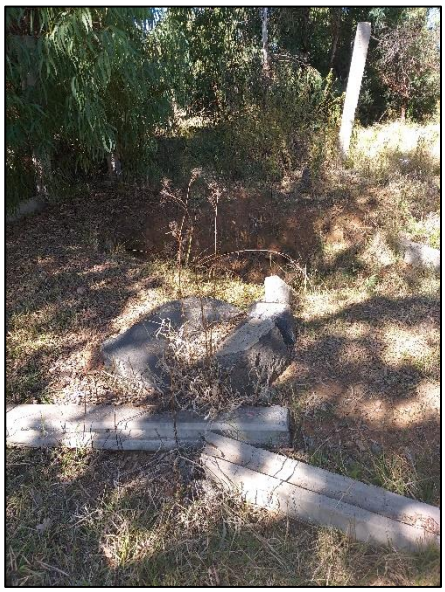


Figure 10-7: Historical Imagery showing the Project Area in 1961

Graves at BGG-001

Remains of Mine House

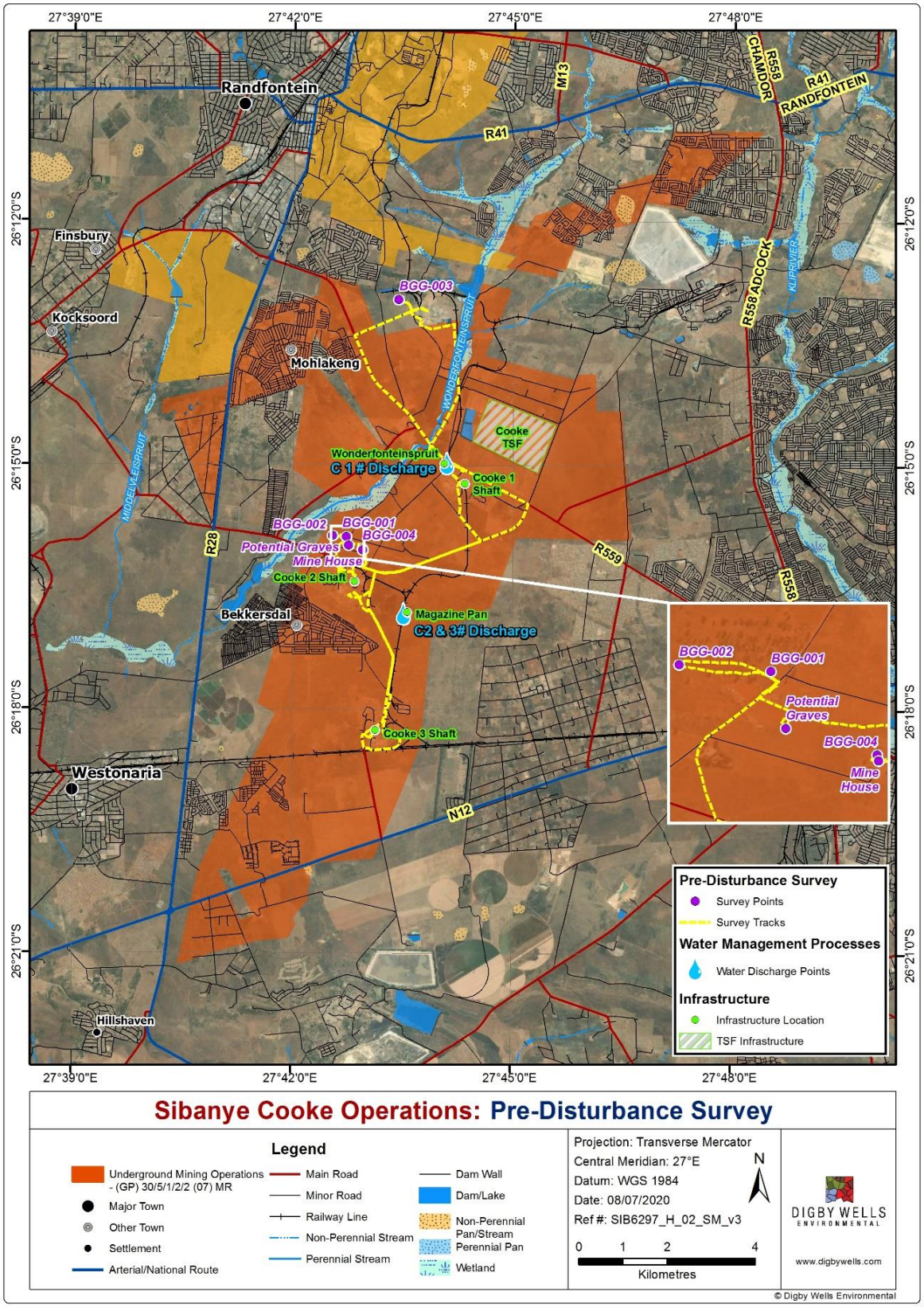
Graves at BGG-004 near the Mine House



Vandalised grave and fencing at BGG-003

Graves at BGG-002

Figure 10-8: Photographs of Heritage Resources Identified during the Survey



Plan 18: Results of the Field Survey

10.10.3 Cultural Significance of the Identified Landscape

Heritage resources are intrinsic to the history and beliefs of communities. They characterise community identity and cultures and are finite, non-renewable and irreplaceable. Considering the innate value of heritage resources, HRM acknowledges that these have lasting worth as evidence of the origins of life, humanity and society. Notwithstanding the inherent value ascribed to heritage, it is incumbent on the assessor to determine the significance of these resources to allow for the implementation of appropriate management. This is achieved through assessing the value of heritage resources relative to the prescribed criteria encapsulated in policies and legal frameworks.

This section presents a statement of CS as is relevant to newly-identified heritage resources and the greater cultural landscape of the site-specific study area. The statement of significance considers the importance or the contribution of the identified heritage resources and the landscape to four broad value categories: aesthetic, historical, scientific and social, to summarise the CS and other values described in Section 3(3) of the NHRA.

One category of heritage resources was recorded during the field survey of the site-specific study area. The identified heritage resources comprise four burial grounds and graves, and one additional potential burial ground. The assessment of the CS and Field Ratings demonstrated that the identified resources have a CS designation of very high. Table 10-18 presents a summary of this assessment. Sites of the same type that share the same CS have been grouped together.

Table 10-18: CS and Field Ratings of Newly Identified Heritage Resources within the Project Area

Resource ID	Type	Description	Aesthetic	Historic	Scientific	Social	INTEGRITY	Designation	Recommended Field Rating	Field Rating Description	Minimum Mitigation[13]
BGG-001 BGG-002 BGG-003 BGG-004 Potential Graves	Burial / grave	Burial Grounds & Graves	- Burial grounds and graves were not assessed against aesthetic criteria as defined in Section 3(3) of the NHRA.	- Burial grounds and graves were not assessed against historic criteria as defined in Section 3(3) of the NHRA.	- Burial grounds and graves were not assessed against scientific criteria as defined in Section 3(3) of the NHRA.	5 Burial grounds and graves have specific connections to communities or groups for spiritual reasons. The significance is universally accepted.	4 The integrity of burial grounds is considered to be excellent with both tangible and intangible fabric preserved.	Very High 20	Grade I[14]	Heritage resources with qualities so exceptional that they are of special national significance.	Project design must change to avoid the resource completely and resources must be included in Conservation Management Plan. A Grave Relocation Process (GRP) may be necessary should the project design not be changed.

[13] Please note: this recommended mitigation refers to the minimum mitigation requirements as encapsulated in the NHRA.

[14] The recommended field rating designates the level of governance associated with the resource. In this instance, the SAHRA Burial Grounds and Graves Unit is the designated competent authority responsible for the management of heritage resources contemplated in terms of Section 36 of the NHRA.

10.11 Socio-Economic Environment

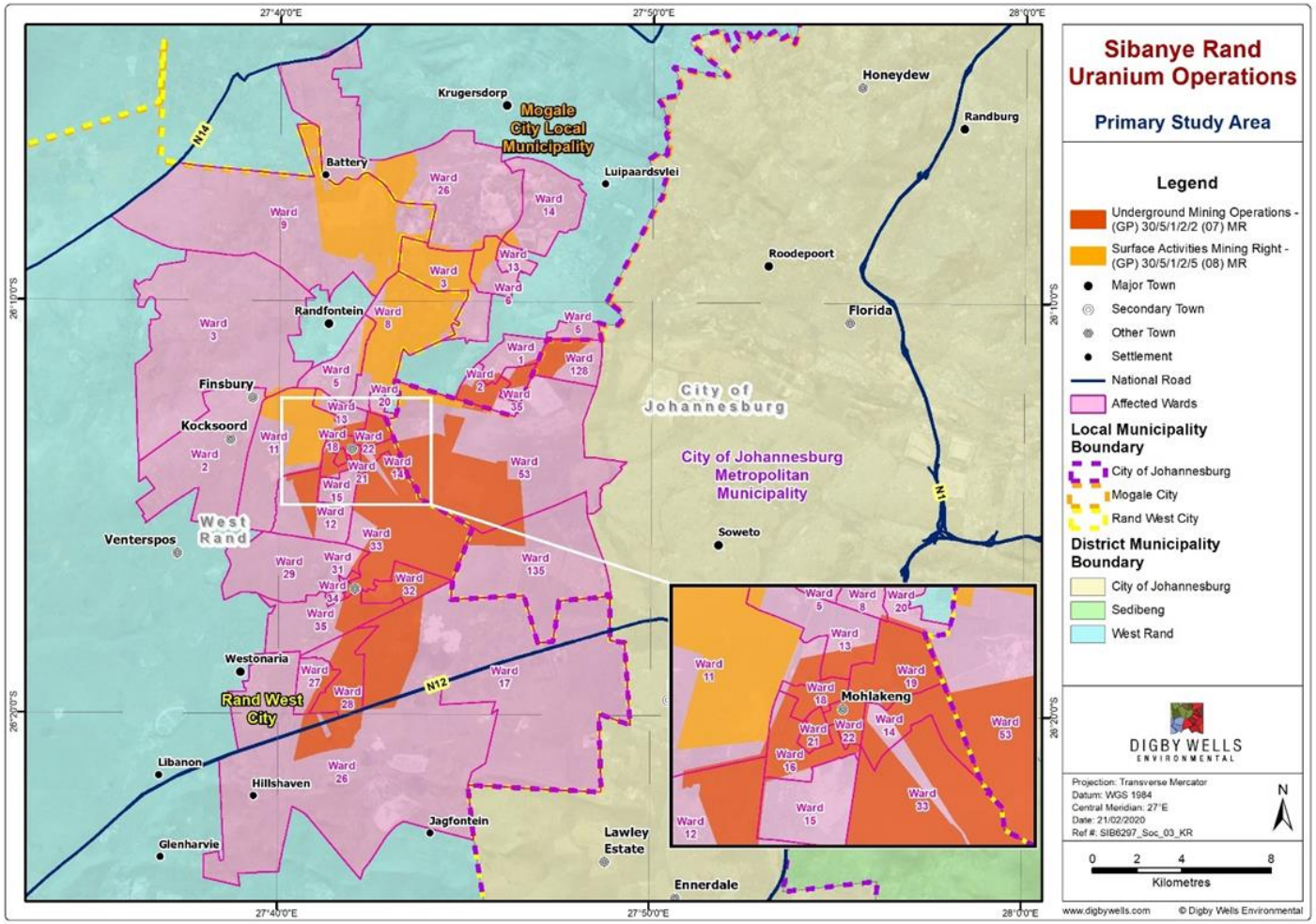
A Socio-economic Impact Assessment (SIA) was undertaken and is appended to this report as **Appendix I**. The assessment is based on secondary data collected from various online resources. It is envisioned that primary data will be collected during Phase Three of the Closure Process, namely the SCP process.

To describe the socio-economic characteristics of the baseline environment of the project area, information was collated from various sources which included previous SIAs; provincial, district and local municipal reports; and StatsSA census data from Wazimap. Sibanye's policy statements and reports such as Social and Labour Plans (SLPs) and sustainability reports were also reviewed and considered accordingly.

The socio-economic characteristics are discussed in terms of the secondary and primary study area as follows:

- *Secondary study area:* This comprises of WRDM and City of Johannesburg (CoJ) which experience the economic pull exerted by the Cooke Operations; and
- *Primary study area:* This area is defined as the extent of the land areas that fall within or are immediately adjacent to the project footprint. The area encompasses the entire Rand West City Local Municipality (RWCLM), Mogale City Local Municipality (MCLM) and Ward 53 and Ward 153 from the City of Johannesburg. Cooke 1, 2 and 3 traverses through 31 wards in two (2) local municipalities and one metropolitan area (Plan 19).

Information relating to the socio-economic characteristics of the regional study area (defined as the entire Gauteng Province inclusive of its two district municipalities and four (4) metropolitan areas) is also provided in the specialist report. Further detail pertaining to the methodology of the Assessment is provided in the specialist report, **Appendix I**.



Plan 19: Socio-Economic Primary Study Area

10.11.1 Overview of the Socio-economic Characteristics of the Secondary Study Area

The WRDM has a population 820 995 residing in 330 573 households. The majority of the population (66%) was reported to be of economically active age groups. Fifty two percent (52%) of the population were males. The predominantly spoken languages in the district were Setswana (32%), followed by 17% of the population that spoke Afrikaans, 14% isiXhosa and 10% spoke Sesotho.

Most people in the district (72%) have some or completed secondary schooling; while four percent (4%) have no schooling and seven percent (7%) have attained higher education. Half of the population in the district were reportedly employed and 18% were unemployed. Of those employed, 75% worked in the informal sector.

The mining is the most dominant economic sector in the district, followed by government services, manufacturing, finance and trade, among others. Even though mining is the predominant economic sector, however, it employs the least number of people while trade, finance, manufacturing, and government services employ the most people.

Households in the district with access to piped water equate to 92%, while 76% have access to grid electricity, 87% have access to flush or chemical toilets and 83% have their refuse collected regularly by a service provider. Households whose waste is not collected is disposed of in open spaces or burnt.

10.11.2 Socio-economic Characteristics of Primary Study Area

10.11.2.1 Demographic Characteristics

Mogale City has the largest share of the population compared to Rand West City. The predominant ethnic groups across the primary study area are Black African, followed by White, Coloured and least are Indian. Overall, there are slightly more males than females. The majority of the population are of economically active age groups with an average age of 30 across the primary study area. Figure 10-9 provides a summary of the population characteristics.

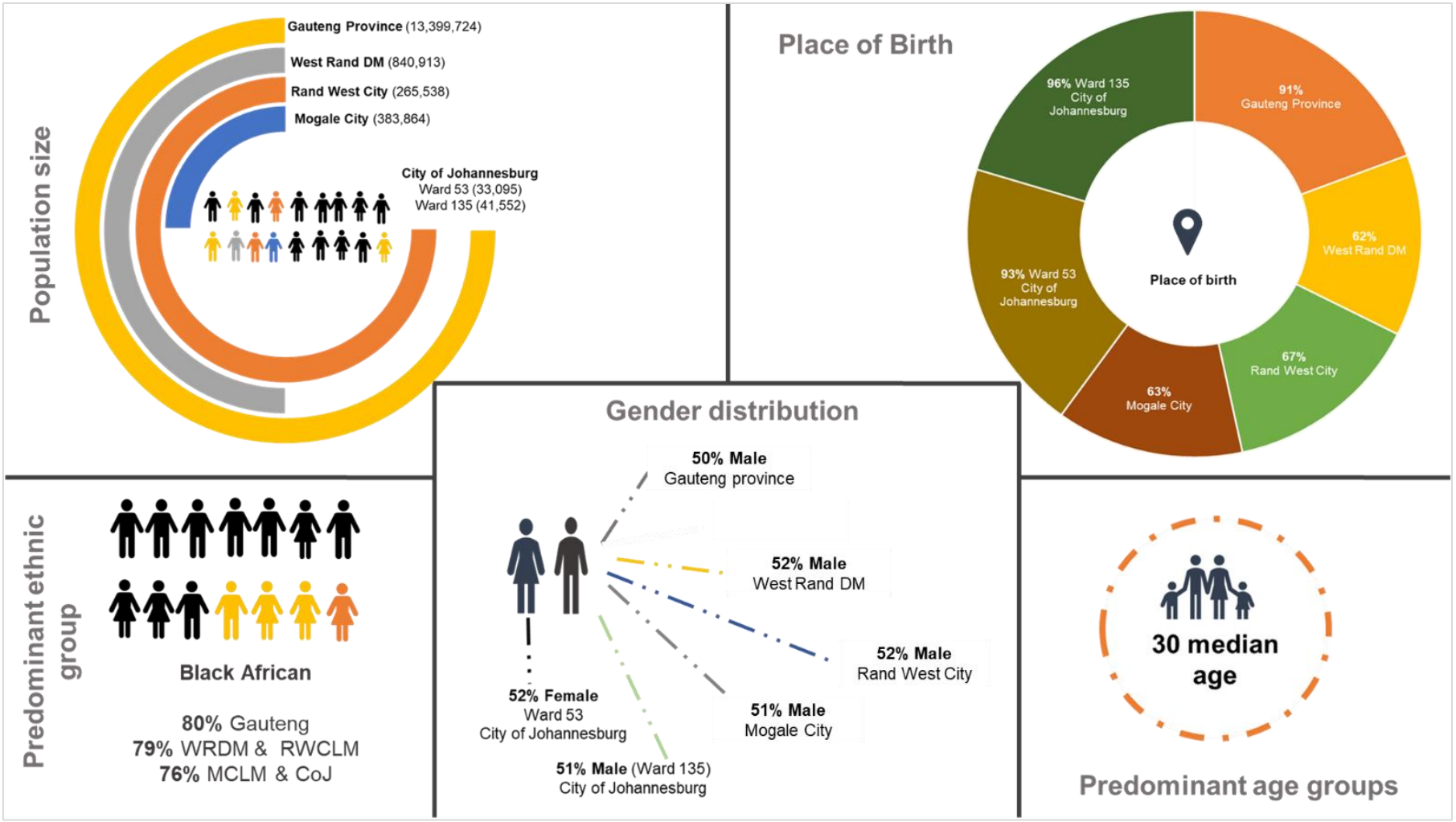


Figure 10-9: Summary of the Population Characteristics

10.11.2.2 Education Levels

Figure 10-10 below provides an overview of education levels in the primary study area. A third of the population, aged 20 and above, has attained Grade 12. The percentage of the population with no schooling averages 3% which is lower than the provincial level.

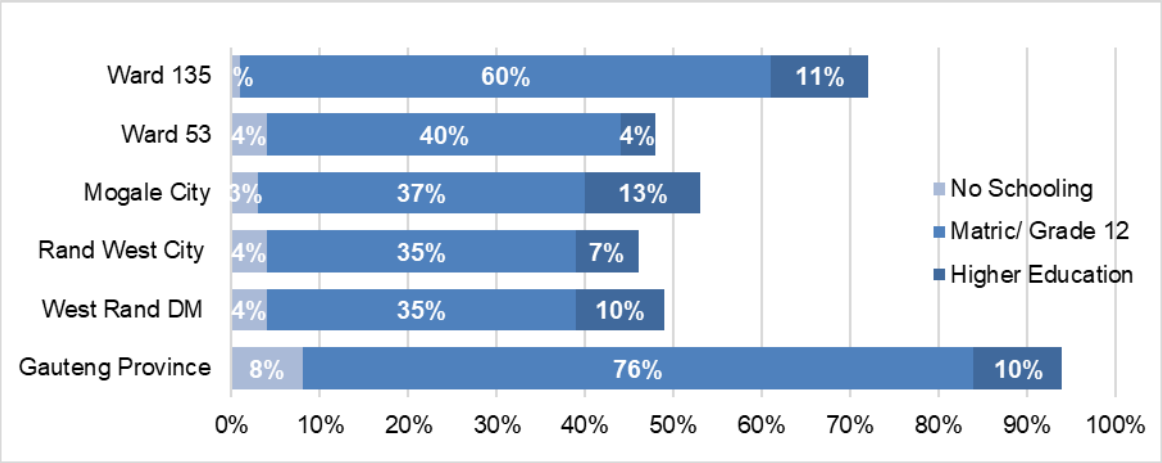


Figure 10-10: Education Levels of the Population in the Primary Study Area

10.11.2.3 Annual Household income

Figure 10-11 shows the average annual income for households across the primary study area. Forty-six percent (46%) of households in the RWCLM reportedly have no income, which is higher than the provincial and district levels and surrounding municipalities. Overall, household annual earnings were reportedly range between R 5,000 and R 290,000. This signifies that a large portion of households are living within the low bound and upper bound poverty line. This refers to the food poverty line plus the average amount derived from non-food items of households whose total expenditure is equal to the food poverty line.

Less than 10% of the households in the RWCLM reported middle- and high-income households compared to the other parts of the primary study areas which was also in line with its high percentages of households without income. Information regarding distribution of earning by gender are not readily available at provincial, district or local municipality levels. The Census 2011, however, reports that in South Africa, women are more likely than men to be found in the lower earning categories.

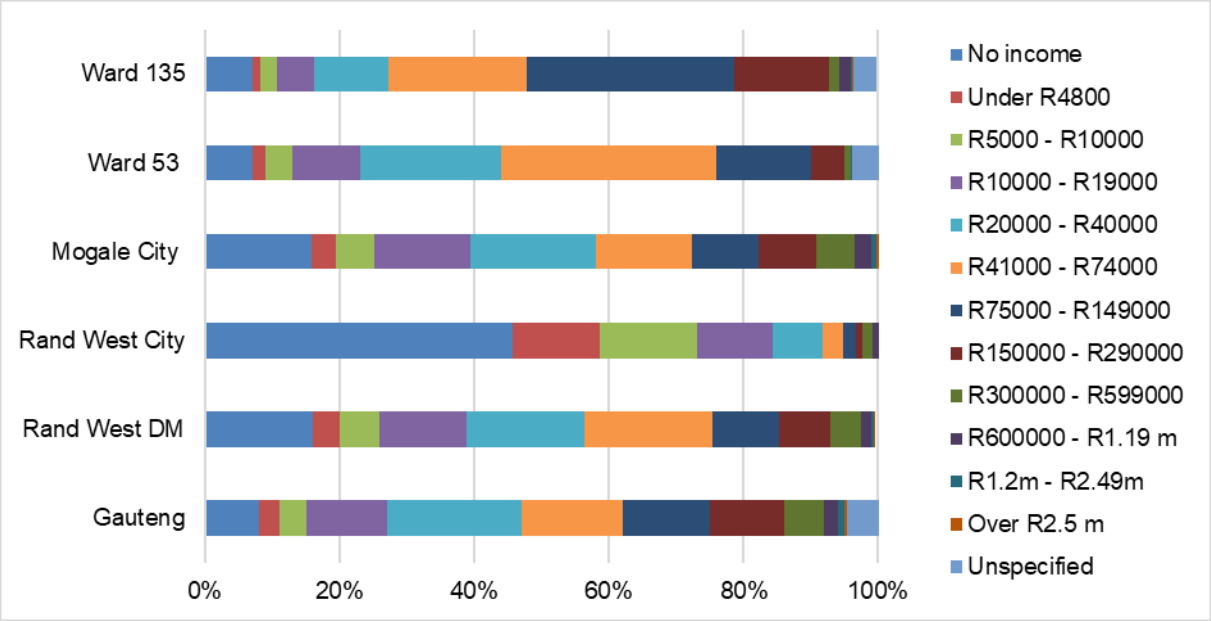


Figure 10-11: Annual Household Income

10.11.2.4 Household Characteristics

A summary of the households' characteristics within the primary study area is provided in Table 10-19. The households in the primary study area on average are comprised of three members or less. RWCLM has the highest effective dependency ratio[15] compared to the households in MCLM and CoJ which is evident in the high youth unemployment rates within RWCLM. It is also higher than the provincial and district's effective dependency ratios. A third of the households are female headed. Research indicates that female headed households tend to face greater social and economic challenges and are vulnerable to lower household incomes and higher rates of poverty[16].

Table 10-19: Summary of Household indicators

Indicator	Gauteng Province	WRDM	RWCLM	MCLM	CoJ
Household size	2.7	2.5	2.6	2.8	2.7
Female headed households	39%	32%	33%	32%	38%
Effective dependency ratio[17]	39	39	74	39	37

[15] The effective dependency ratio calculates the ratio of economically active workers to inactive persons, where activity is defined in relation to paid work to indicate the burden on the current workforce.

[16] https://www.econrsa.org/system/files/publications/working_papers/working_paper_761.pdf.

[17] Sourced from the Census 2011.

In line with Section 10.11.2.3 above, 15% the households of WRDM, are said to be living below the food poverty line[18] which is linked to the high-income inequalities in the population. The food poverty line is measured in terms of the number of people or households living below R561 per month or R18.70 per person per day (StatsSA, 2014). This is lower than that of the CoJ and provincial level at 20% and 29% respectively. The district reports attributed its high poverty levels to in-migration of people into the region in search of economic opportunities within the mining sector (West Rand City IDP, 2019/2020).

10.11.2.5 Economic and Livelihood Characteristics

The predominant economic sectors are shown in Figure 10-12. Mining is the predominant economic activity and contributor to the Gross Domestic Product (GDP) of the RWCLM compared to the other municipalities in the study area and at WRDM. Some of the prominent mining companies in the area are Anglo Gold Ashanti, Sibanye, Harmony Gold, Gold Fields and Pan African Resources. In turn, trade is the leading economic activity in MCLM and financial services in CoJ which are also the dominant economic activities at a provincial level.

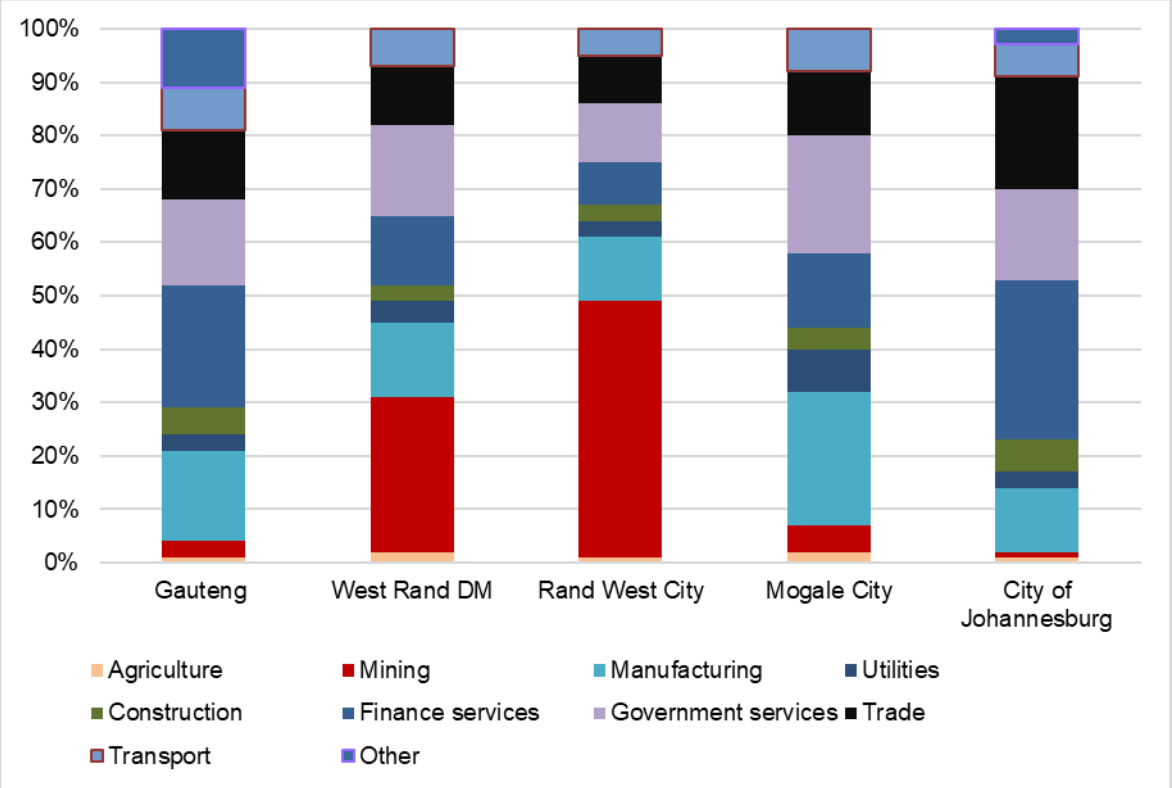


Figure 10-12: Economic Sectors

[18] Food poverty line refers to the amount of money that an individual will need to afford the minimum required daily energy intake of 2,100 calories per day.

As shown in Figure 10-13 below, although mining is predominant economic sector in the West Rand, it is not the predominant employer - the finance, manufacturing, trade and government services are the largest employers of the population.

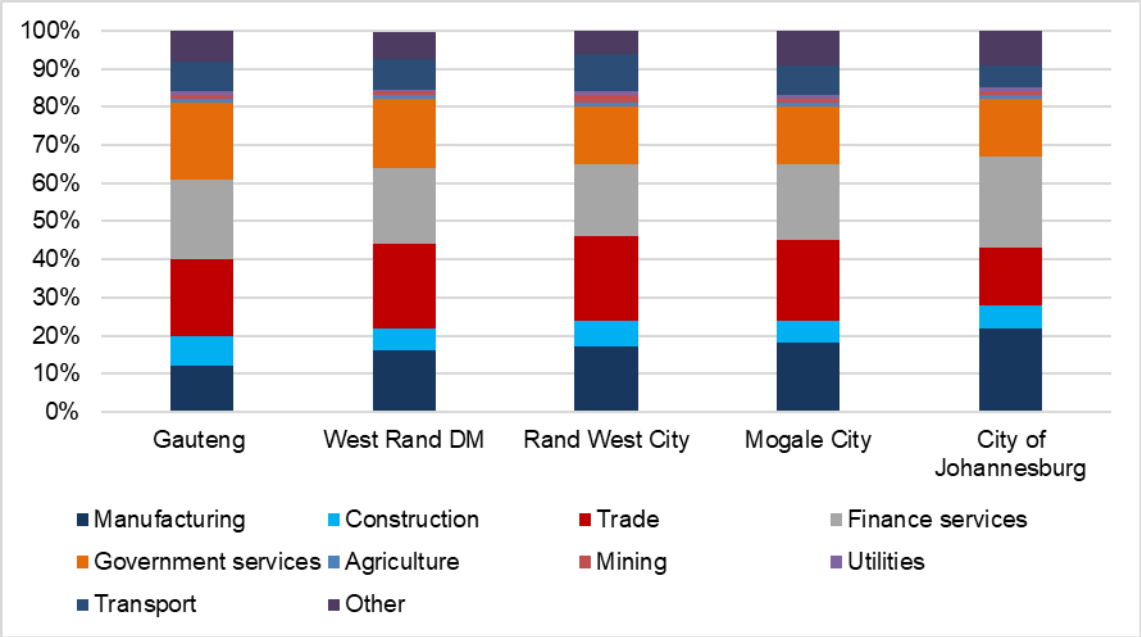


Figure 10-13: Sectors of Employment in the Study Area

10.11.2.6 Household Access to Public Services and Infrastructure

The availability and access to various basic services by the population is depicted in Figure 10-14 and displays the households' access to formal and informal housing, water sources, sanitation, electricity, as well as refuse collection. Notably, there are some households who do not have access to grid electricity especially in RWCLM and MCLM (20% and 11% respectively). In the CoJ, 20% of households are without toilets; while in both MCLM and CoJ still have households, whose refuse is not collected regular (4% respectively).

Figure 10-14: Summary of Household access to Public Services and Infrastructure

10.11.3 Overview of Socio-Economic Indicators of the Cooke Shaft Complexes

10.11.3.1 Employees

Since acquiring the Cooke Operations in 2013, the peak employment was reached in 2016 with 5,246 employees. Of this number, 33% were indirectly employed through the supply chain by contractors. The majority (92%) of the workforce were Black African and 76% were South African citizens and over a quarter of employees were from the Gauteng province. Over half (57%) of employees were recorded as unskilled, followed by 27% of semi-skilled employees, 15% skilled technicians and one percent (1%) in middle management. Furthermore, 13% of the total employees were women and less than one percent (>1%) of women were in senior / middle management occupations.

Throughout the operation, employees received training and development in line with the Human Resources Development (HRD) Framework of the Sibanye Gold Group, Social and Labour Plans (SLPs), the South African National Development Plan and the United Nations Global Goals for Sustainable Development. Employees also had access to the Sibanye Gold Academy (SGA), which is fully accredited by the Mining Qualifications Authority (MQA) and offered programmes approval in other Sector Education and Training Authority (SETA).

10.11.3.2 Financial Wellness Programs

During the operational phase, employees were offered financial wellness through the *Care for iMali* program which provided financial literacy and awareness. In 2015, another programme termed *Wellness Gateway* was introduced encompassing affordable home, vehicle finance and enforcing clear affordability rules for credit providers. The Wellness Gateway also offers savings products, including *TruSave Account* (helps to start a savings plan) and *target save account* (facilitates saving towards a specific goal).

The Care for iMali program was extended to the host communities within Westonaria and in the labour sending areas including Mozambique.

10.11.3.3 Supply Chain Development

Supply chain development initiatives throughout the operational phase. Figure 10-15 below provides an overview of the impact of supply chain development.

Figure 10-15: Summary of Impacts on the Supply Chain

10.11.3.4 Stakeholder Engagement

As part of Sibanye's efforts to improve stakeholder relations and engagement; it has developed and implemented a grievance management protocols and the set-up of Community Engagement Forums (CEFs), as depicted in the figure below. Additional initiatives are being investigated as part of the closure process to consider the potential gaps presented as a result of the COVID-19 situation.

Figure 10-16: summary of Stakeholder Engagement Headway

10.11.3.5 Social Development and Social Corporate Investment

Community development programs have been implemented throughout the operational phase through the SLPs. Community development initiatives have been aligned with the integrated development plans of the local municipalities and focused on social infrastructure, health, economic development and capacity building.

In the West Rand District, Sibanye has been supporting three homes for elderly and disabled people with an investment of R1.2 million in monthly food parcels over two and a half years. Sibanye also provided the same group of people with skills development to cultivate self-sustainable food gardens for their own consumption and generation income.

10.11.3.6 Social Closure Planning

A conceptual social closure framework was developed in 2018 which aligned with the regional IDPs as projects established as part of social closure planning will be driven and owned by the local municipalities. The first post-mine closure project, known as the Bokamoso Ba Rona Agricultural-Industrial Initiative, was introduced in 2018. The programme aims to facilitate the development of a large-scale agriculture and bio-energy Hub with the greater WRDM. The initiative is being undertaken in partnership between Sibanye, Far West Rand Dolomitic Water Association (FWRDWA), Gauteng Infrastructure Financing Agency and West Rand Development Agency. A second project, Rand West Industrial Park has also been initiated and will see the development of a Smart Bus Manufacturing Hub in Westonaria; which will create jobs in the area.

As part of Phase Three of the Closure Process, a stand-alone social closure planning process will be undertaken. The aim of the project will be to address gaps in previous commitments, action plans to bridge these gaps but most importantly identifying projects to allow for a sustainable post-mining landscape.

10.11.4 Stakeholder Issues as Identified by Sibanye

Over the years, Sibanye has commissioned several studies aimed at gaining insights the acknowledged strained relationship with its stakeholders. Table 10-20 presents the top five issues raised by stakeholders and actions taken by Sibanye to remedy the issues.

Table 10-20: Issues Identified by Stakeholders and Actions Employed

Issues	Description	Sibanye's Response
Perceived lack of engagement	The belief that mine does not respond to community grievances, particularly in relation to CSI, procurement and employment.	• Implementation of a complaints/ grievance procedure; • Formation of Community Engagement Forums; • Support CSI and environmental programmes identified by the communities; and • Focus on local employment.
Employment	Limited number of jobs being offered to local community members due to most applicants not able to pass the medical fitness tests, criminal and credit record checks.	• Inviting community leaders to bear witness of occupational health testing so that they can better understand health reasons for job applicants failing to secure employment opportunities with the mine. Explaining that these health and other screening checks are also essential to ensure projects are executed in a responsible manner in order to adhere to all legal requirements.
Legacy issues from acquired assets	On-going tensions between Sibanye and communities related to unresolved historic issues with the previous owners of current assets.	• Continuous engagement with the communities regarding the legacy issues, and collaborations to resolve some of these issues.
Lack of local procurement opportunities	Limited access to supply chain opportunities awarded to locally based businesses.	• Small, medium and micro enterprise (SMME) workshops; and • Establishment of enterprise and supplier development (ESD) centres across all operations.

Issues	Description	Sibanye's Response
Life after mining and avoiding the creation of ghost towns	A lack of forward planning to address socio-economic impacts related to mine closure.	• Collaborate and strategize with municipalities, district and local, to identify economic activities that will endure post-mining. The plans, aligned with regional IDPs, will be driven and owned by the municipalities. Commissioning of the Social Closure Planning Projects.

11 Impacts and Risks Identified

This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation. The potential impacts identified in this section are informed by the baseline investigations presented in Section 10 above. The identified potential impacts are therefore a result of both the environment in which the project activity takes place, as well as the activity itself.

Section 11.1 below details the methodology employed to quantify the identified potential impacts which are subsequently presented in Section 11.2.

11.1 Methodology used in Determining and Ranking Potential Environmental Impacts and Risks

The significance rating process follows the established impact/risk assessment formula:

Significance = CONSEQUENCE X PROBABILITY X NATURE

Where

Consequence = intensity + extent + duration

And

Probability = likelihood of an impact occurring

And

Nature = positive (+1) or negative (-1) impact

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 11-1. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in this BAR. The significance of an impact is then determined and categorised into one of eight categories (The descriptions of the significance ratings are presented in Table 11-2).

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, (i.e., there may already be some mitigation included in the engineering design). If the specialist determines the potential impact is still too high, additional mitigation measures are proposed.

Table 11-1: Impact Assessment Parameter Ratings

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or **highly** sensitive environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
2	**Minor loss and/or effects** to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 11-2: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

11.2 Identified Potential Impacts and Possible Mitigation Measures

The potential impacts are discussed separately in the subsections below according to each phase of the project i.e. the Decommissioning, Rehabilitation, Closure and Post Closure Phases.

Detailed descriptions of the quantification of the impact matrix are provided in each specialist report. The subsections below provide a summary of this quantification and description of the identified potential impact. The impact matrix abbreviations used are provided in Table 11-3 below.

Table 11-3: Impact Matrix Abbreviations

Abbreviation	Definition
D	Duration
E	Extent
I	Intensity
P	Probability

11.2.1 Decommissioning Phase

During the decommissioning phase the following activities will be undertaken:

- Removal and decontamination of underground infrastructure at Cooke Shafts No. 1, 2 and 3; and
- Decommissioning, dismantling and removal of surface infrastructure at the shaft complexes.

All surface infrastructure at the shaft complexes is proposed to be removed to reduce the risk of vandalism and theft by illegal activities which are prevalent in the area. Sibanye intends to sell all salvageable items during decommissioning and disposal of any remaining items as waste to appropriate facilities depending on the waste stream (hazardous/ non-hazardous).

Note: Digby Wells envisages no impact to the cultural heritage landscape, given the nature of the proposed activities and the location of identified heritage resources in relation to the proposed Project infrastructure. Should any infrastructure intended for demolition increase in age to older than 60 years during the Project lifecycle, the structure must be considered a heritage structure. Any alterations to these structures will be subject to a NHRA Section 34 permit application process.

Table 11-4 below provides a description and rating of the potential impacts against these activities. The key mitigation/ management measures recommended for each impact are also detailed.

Table 11-4: Impact Assessment Associated with the Decommissioning Phase

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
1. Removal and decontamination of underground infrastructure	Groundwater	Groundwater quality deterioration caused by possible hydrocarbon spillages during removal activities.	2	2	3	4	28 Negligible (negative)	• Hazardous substances must be kept in bunded areas at all times and removed timeously; • If spills or leaks occur, they must be cleaned up immediately to prevent interaction with groundwater once decommissioning activities are completed; and • Infrastructure must be decontaminated timeously once removed from the underground workings. Decontamination must take place in a contained area to prevent pollution of the environment.	2	2	2	2	12 Negligible (negative)
	Surface Water; and Wetlands	Spills and leaks from materials containing hydrocarbons resulting in deteriorated groundwater quality. These contaminants can impact surface water resources once the water is pumped and discharged into the Wonderfonteinspruit or Magazine Pan.	2	3	3	4	32 Negligible (negative)	• Hazardous substances must be kept in bunded areas at all times and removed timeously; • If spills or leaks occur, they must be cleaned up immediately to prevent interaction with groundwater once decommissioning activities are completed; • Water discharged into the environment must continue to be monitored; and • If any hydrocarbon contamination is noted suitable investigation must be performed to inform the required remediation measures in line with the Sibanye Occurrence Management Procedure.	2	3	2	2	14 Negligible (negative)
2. Decommission-ing, dismantling and removal of surface infrastructure	Wetlands	Reduced ecological functioning of wetlands due to: a. Possible hydrocarbon spillages; b. Release of accumulated solids; c. Sedimentation caused by erosion on bare surfaces once infrastructure is removed; and d. Possible changes to drainage patterns (possibility for soils to be compacted where infrastructure is removed leading to sheet run-off from these areas).	3	3	3	4	36 Minor (negative)	• Ensure that as far as possible all decommissioned infrastructure (including temporary storage of rubble, equipment etc.) are placed outside of wetland/riparian areas and their associated buffer zones (recommended buffer zone of 100m) where possible; • Limit the footprint area of the decommissioning activities to what is absolutely essential; • Avoid any further vegetation clearing and compaction of soils (all areas but critically so in wetland areas) to complete surface decommissioning activities. Only existing crossings must be used to access the areas associated with decommissioning and rehabilitation activities ; • All areas of increased ecological sensitivity (C class and above) should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel; • No material may be dumped or stockpiled within any rivers, tributaries or drainage lines in the vicinity of the proposed decommissioning footprint, stockpiling areas should be located in areas to prevent the contamination of downstream water resources; • If it is absolutely unavoidable that any of the wetland areas present will be affected, disturbance must be minimised and suitably rehabilitated; • Rehabilitation must be undertaken as soon as possible following the decommissioning, dismantling and removal activities. This will prevent the occurrence of soil erosion, soil compaction and/ or encroachment of AIPs which would lead to reduced ecological integrity of downstream water systems; • Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the wetlands further downstream; • All vehicles must be regularly inspected for leaks and refuelling must take place on a sealed surface area;	3	2	2	3	21 Negligible (negative)

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
								• All spills should be immediately cleaned up (or as soon as material has dried to prevent secondary contamination during clean-up) and treated accordingly; • Appropriate sanitary facilities must be provided for the duration of the decommissioning activities and all waste must be removed to an appropriate waste facility; and • Ongoing wetland monitoring and rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint areas and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, trends or improvements in the receiving environment.					
	Surface Water; and Aquatic Biota	Deterioration of water quality of receiving waterbodies due to: a. Possible spillages of hydrocarbon waste and other contaminants; and b. Siltation of waterbodies caused by runoff with higher amounts of suspended solids traversing bare surfaces once infrastructure is removed.	5	4	3	7	84 Moderate (negative)	• Clearing of vegetation should be limited to the decommissioning footprint area; • Once infrastructure is removed, revegetation of cleared areas must be undertaken as soon as possible; • Decommissioning activities should be prioritized during dry months of the year (May to October) where practical, though disturbed footprints should not be left un-rehabilitated for extended periods of time; • All leaks and spillages should be cleaned timeously and where the materials need to dry before collection, sufficient time should be allowed for collection and handling by accredited vendors; • Use of accredited contractors for removal or demolition of infrastructure is recommended; this will reduce the risk of waste generation and accidental spillages; • An appointed Environmental Control Officer (ECO) must always be available to ensure implementation of the recommended mitigation/management measures during the planned decommissioning of the project, the ECO must conduct regular inspections; • Rehabilitation of the areas surrounding the Cooke Shafts must be undertaken timeously to re-establish vegetation over bare areas. This will prevent soil erosion and compaction from occurring which would consequently impact surrounding water resources; and • The Soil Management Plan (compiled by Digby Wells in 2017) must be implemented to control potential contamination of receiving waterbodies as a result of erosion and compaction.	5	2	2	2	18 Negligible (negative)
3. Decommission-ing of surface dams and concrete channels	Soil; Wetlands; and Surface Water	Established water containment infrastructure diverted mine affected water from downstream watercourses. Once decommissioned, residue contaminants may enter into receiving waterbodies and pollute surrounding soils if runoff is not managed properly.	3	4	3	5	50 Minor (negative)	• Where practicable, the constructed stormwater management infrastructure should remain intact until rehabilitation is completed to ensure dirty water is captured and contained during removal of infrastructures; • Where stormwater management infrastructure cannot be kept, temporary measures (e.g. berms and sumps) should be put in place to prevent contaminants running off into receiving waterbodies and wetlands; • Ensure that the infrastructure (pipelines, fuel storage areas, pumps) are first emptied of all residual material before decommissioning; • Rehabilitation of the areas surrounding the Cooke Shafts must be undertaken timeously to ensure that contaminated sediments and or wastewater is not discharged into the Wonderfonteinspruit River; and • The Soil Management Plan (compiled by Digby Wells in 2017) must be implemented to control potential contamination of receiving waterbodies as a result of the mobility of potentially contaminated soil.	3	2	1	2	12 Negligible (negative)

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
3. General Decommissioning Phase activities	Socio-economic	Potential increase in dust fallout and noise levels associated with surface infrastructure decommissioning activities resulting in a nuisance impact to nearby receptors.	3	2	3	4	32 Negligible (negative)	• Decommissioning activities should be limited to the daytime; • Any machinery used for decommissioning activities must be switched-off when not in use to prevent unnecessary noise generation; and • Appropriate dust suppression measures must be implemented and dust fallout monitoring must continue.	2	2	2	3	18 Negligible (negative)
		Creation of temporary economic opportunities to carry out decommissioning activities.	3	5	1	5	45 Minor (positive)	• Ensure that local communities understand the Project's procurement and employment requirements in terms of skills and type of contracts and employment. This will be achieved using existing stakeholder communication channels and through the Sibanye's Stakeholder Relations office; • Targets must be set for local employment regardless of the size the work program and continue to report on these until closure is reached. Targets must include employment of youths and women from historically disadvantaged backgrounds; and continuously monitored; • Consider unbundling of contracts into small work programs to ensure that small and locally based businesses are able to benefit; • Propose and promote joint ventures between large and small Contractors to ensure equitable sharing of economic benefits and skills development; • All tender process must follow existing Sibanye SMME development strategies and programs; and • Projects which can involve community groups and ring-fencing of procurement opportunities where applicable must be identified.	3	5	2	6	60 Minor (positive)
		Workforce health, safety and security risks as a result of handling of hazardous substances.	3	2	3	4	32 Negligible (negative)	• All appointed Contractors and their employees should undergo Sibanye Environmental, Health and Safety (EH&S) induction and training; • All appointed Contractors should comply with Sibanye's EH&S policies and procedures. Failure to comply, a Contractor should be terminated or retake EH&S induction; • Ensure adequate Personal Protective Equipment (PPE) (inclusive of COVID-19 PPE) is provided to the workforce; • Hydrocarbon spill kits must be available during decommissioning activities at all locations where hydrocarbon spills could take place; • Material Safety Data Sheets (MSDSs) must be kept to inform and promote correct handling of hazardous substances; • Storage and disposal of hazardous materials to adhere to prescribed regulation; and • Ensure that all employees including Contractor workforce have access to onsite medical facilities available to the Sibanye workforce.	3	2	2	3	21 Negligible (positive)
		Illegal miners, who are often heavily armed, are prevalent in the area. Possible invasion of	6	4	6	6	96 Moderate (negative)	• The existing security controls and measures must continue to be implemented until all decommissioning and rehabilitation activities are completed; • Collaborate with local police services in managing the security of the mine shafts; and	6	4	5	5	75 Moderate (negative)

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
		underground workings and/ or shaft complexes during decommissioning activities poses a security risk for the workforce.						• The boundary fencing and any access routes to the underground operations must be inspected regularly, where damage is identified this must be repaired as soon as possible.					
		Value-add in the sale of salvageable goods to the local supply chain.	1	6	2	4	36 Minor (positive)	• Prior to the undertaking of decommissioning activities, an inventory of infrastructure and equipment which can be sold must be established; • Sibanye must collaborate with the target local businesses for the sale of mining infrastructure and equipment; • Priority must be placed on local businesses and communities who are interested buying any of the decommissioned infrastructure; and • Decommissioning and dismantling of infrastructure must be undertaken by a qualified contractor to ensure that infrastructure is correctly preserved for future sale.	4	6	3	4	52 Minor (positive)
		Community unrest due to a perceived lack economic opportunities and unfulfilled promises.	5	3	4	5	60 Minor (negative)	• Undertake ongoing consultation with local communities (including local authorities and traditional leadership) and clearly communicate project needs and schedule; • Encourage communities to utilise the existing grievance procedure to communicate their issues and ensure timeous response to all lodged complaints and grievances; • Utilise existing procurement and employment plans that promote transparent and fair recruitment and procurement for the undertaking of decommissioning activities; and • Ensure the development and implementation of the SCP.	4	3	3	4	40 Minor (negative)
		Decreased community health and safety due to inappropriate disposal of hazardous waste.	3	4	4	4	44 Minor (negative)	• Waste must be stored in a demarcated secured area until collection. The area should be clearly marked to warn off trespassers; • Adhere to the regulatory standards for disposal of hazardous waste generated from the decommissioning activities; • Ensure appointment of reputable Contractors to undertake the decommissioning and disposal of waste; • Ensure all records are kept of safe disposal of waste; and • The ECO at decommissioning sites must inspect waste areas, disposal and storage practices regularly (at least monthly).	2	4	2	4	32 Negligible (negative)
		Reduction in illegal mining activities through the removal of viable mine infrastructure in a crime prevalent area.	7	2	7	6	96 Moderate (positive)	• The existing security controls and measures must be maintained until the completion of decommissioning and removal activities; • Collaborate with local police services in managing the security of the capped mine shafts; and • Monitoring and mending of boundary fencing and underground access routes where ever affected must be implemented until the completion of decommissioning and removal activities.	7	2	7	6	96 Moderate (positive)

11.2.2 Rehabilitation Phase

During the rehabilitation phase the following activities will be undertaken:

- Removal of settled solids from surface paddocks, mud ponds and general areas at shaft complexes as well as from the coffer dams at the Cooke Gold Plant;
- Rehabilitation of surface paddocks, mud ponds at the shafts and the coffer dams at the Cooke Gold Plant;
- Rehabilitation of surface dams and concrete channels footprints as well as general areas at the shaft complexes once infrastructure is removed; and
- Rehabilitation of the Magazine Pan and other delineated wetlands (incl. portions of the Wonderfonteinspruit).

The proposed post rehabilitation land use for the Cooke Shaft Complexes is open areas, as depicted in Plan 5 above. Therefore, following the dismantling and removal of all infrastructure at the complexes and along all associated pipeline routes, the rehabilitation activities will include removing accumulated and possibly contaminated material, shaping, soil amelioration and re-vegetating on bare surfaces. It is noted that the post-mining land use will continue to be reviewed and refined as recommended in the Decommissioning, Rehabilitation and Mine Closure Plan (2019) (**Appendix J**). This may result in some buildings being left in place at the complexes if deemed beneficial for post-mining land users. This will also be informed by the outcomes of the SCP as well as additional specialist studies as closure and decommissioning progresses.

For water resources (i.e. wetlands and portions of the Wonderfonteinspruit across both 07 MR and 173 MR) rehabilitation is aimed to improve the ecosystem functionality. Rehabilitation activities will therefore include the removal of settled solids, removal of AIPs and revegetation of indigenous plant species.

All settled solids removed from the surface paddocks, mud ponds, water resources as well as accumulated material identified across 07 MR and 173 MR are proposed to be processed through the Cooke Gold Plant and/or disposed directly into the open pits which form part of the current Cooke Surface Operations' activities.

Table 11-5 below provides a description and rating of the potential impacts against these activities. The key mitigation/ management measures recommended for each impact are also detailed.

Table 11-5: Impact Assessment Associated with the Rehabilitation Phase

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
1. Removal of settled solids from surface paddocks, mud ponds and general areas at shaft complexes as well as from the coffer dams at the Cooke Gold Plant.	Hydropedo-logy	The material contained in the surface paddocks, mud ponds and coffer dams are characterised as metal rich sludge. If the removal of these settled solids is not properly managed, there is potential for the contamination of surrounding soils and adjacent waterbodies. This would consequently result in a deterioration of water quality[19].	6	4	5	4	60 Minor (negative)	• Stormwater management infrastructure must be maintained until the completion of this activities to prevent the spread of contaminants into receiving waterbodies and wetlands; • Where practicable, dust suppression measures must be implemented to prevent the spread of contaminants through atmospheric deposition, however runoff from dust suppression must be discouraged; and • All settled solids removed must not be stockpiled for extended periods of time but rather be timeously processed through the Cooke Gold Plant/ disposed into the open pits to remove the potential pollution source from the landscape.	1	2	1	2	8 Negligible (negative)
	Wetlands	There are several HGM Units located in proximity to Cooke No. 1 and 2 Shaft Areas (between 250 m – 600 m). If the removal of settled solids is not correctly managed, this could result in reduced ecological integrity of these nearby wetlands/ riparian areas. This would occur as a result of sedimentation through runoff or atmospheric deposition and associated water quality impacts.	3	4	3	4	40 Minor (negative)	• Stormwater management infrastructure must be maintained until the completion of this activities to prevent the spread of contaminants into receiving waterbodies and wetlands; • Where practicable, the paddocks should be maintained, i.e. the same impacted footprints should be used, until the rehabilitation activities are complete, and thereafter they may be removed. This will prevent the creation of additional dirty areas and the further alteration of the catchment; and • Ensure that sediment that is removed from these footprints is not stored within the buffer zones and that it is removed offsite timeously and appropriately.	3	2	2	3	21 Negligible (negative)
2. Rehabilitation of surface paddocks, mud ponds and the coffer dams; and 3. Rehabilitation of surface dams, concrete channels and general areas	Hydropedo-logy	The rehabilitation of disturbed areas will be undertaken to establish a sustainable post-mining land use (preliminarily indicated as open areas suitable for agriculture and/or biofuel energy production). If correctly implemented this will result in: a. The removal of all sources of contamination to soil resources[20]; and b. Restored drainage of runoff into the Wonderfonteinspruit,	7	4	2	6	78 Moderate (positive)	• Soil contamination testing must be undertaken as part of rehabilitation to ensure that soil at the surface paddocks, mud ponds and coffer dams is free of any heavy metals or mine contaminants. This will inform any further rehabilitation requirements in terms of soils and immediate surroundings to meet the post-mining land use (agriculture); • Land must be shaped with the aim for a free draining profile, avoiding the potential for water ponding to occur; and • Ongoing monitoring of surface and groundwater for early detection of any deviations from the RQOs of the catchment area assess the effectiveness of the rehabilitation plan.	7	4	2	6	78 Moderate (positive)

[19] The Geochemical and Waste Classification Assessment (**Appendix G**) classified all accumulated sediments and slimes as Type 3 waste which could locally acidify over time, thus considered a potential source of contamination.
[20] The Geochemical and Waste Classification Assessment (**Appendix G**) classified all accumulated sediments and slimes as Type 3 waste which could locally acidify over time, thus considered a potential source of contamination.

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
at the shaft complexes once infrastructure is removed.		although the natural flow paths will now be altered.											
	Terrestrial Biodiversity	As established in the baseline, terrestrial biodiversity in the 07 MR and 173 MR areas is under pressure from several land uses. If rehabilitation is successfully implemented, this will result in the restoration on natural vegetation (open areas) which would also provide suitable habitat for faunal species.						• Rehabilitation must be carried out timeously following the decommissioning and removal of infrastructure; • Bare surfaces must be seeded with indigenous vegetation as prescribed in the Rehabilitation Plan; and • The success of the rehabilitation efforts must be monitored for a period of three to five years/ until post-mining land use is implemented. Where impacts such as infestation of AIPs is identified corrective measures must be implemented timeously.					
	Wetlands	Reinstatement of natural drainage will in turn lead to improved ecological functionality of wetlands overtime.						• Ensure rehabilitation is done according to a plan and monitoring of these areas is undertaken for a period of three to five years; and • Land must be shaped with the aim for a free draining profile, avoiding the potential for water ponding to occur.					
4. Rehabilitation of the Magazine Pan and other delineated wetlands (incl. portions of the Wonderfontein-spruit).	Wetlands; and Terrestrial Biodiversity	Improved ecological integrity of wetlands/ riparian areas as a result of the removal of contamination sources[21], AIPs and re-vegetation of indigenous species. As established in the baseline, although wetlands across 07 MR and 173 MR have been impacted by surrounding anthropogenic land uses, these systems still offer vital ecological services including maintenance of biodiversity. Restoring the ecological integrity will have a beneficial effect to surrounding terrestrial biodiversity.	7	4	2	6	78 Moderate (positive)	• Specific rehabilitation plans should be developed for each HGM Unit targeted for rehabilitation based on the current WET-Health of the system; • The rehabilitation plan should take into account the impact of the changes in flow paths that is anticipated for the Magazine Pan to preserve the wetland area and the associated ecological functioning of the pan; • Monitoring of wetland rehabilitation activities must be undertaken both during the rehabilitation phase and post closure; and • If monitoring determines that additional rehabilitation actions are required, ensure that these are implemented as soon as possible to stop further degradation occurring.	7	4	2	6	78 Moderate (positive)

[21] The Geochemical and Waste Classification Assessment (**Appendix G**) found that the accumulated sediments in historically impacted wetlands, the Magazine Pan and portions of the Wonderfonteinspruit are low risk for residual contamination and aquatic ecosystems have developed despite any potentially negative impacts from these sediments. Therefore, further waste classification work and related studies (wetland, hydropedology, aquatic ecology and surface water) must be consulted before any stream or wetland material is removed and/or rehabilitated. This is aimed at preventing further impacts that could potentially result to the ecosystem as a result of removing the sediments (i.e. doing more harm than any potential impact from the observed, low levels of leachable constituents).

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
5. General Rehabilitation Phase activities	Socio-economic	Creation of temporary economic opportunities to carried out rehabilitation activities.	4	5	3	4	48 Minor (positive)	• Ensure that local communities understand the Project's procurement and employment requirements in terms of skills and type of contracts and employment. This will be achieved using existing stakeholder communication channels and through the Sibanye's Stakeholder Relations office; • Targets must be set for local employment regardless of the size the work program and continue to report on these until closure is reached. Targets must include employment of youths and women from historically disadvantaged backgrounds; and continuously monitored; • Consider unbundling of contracts into small work programs to ensure that small and locally based businesses are able to benefit; • Propose and promote joint ventures between large and small Contractors to ensure equitable sharing of economic benefits and skills development; • All tender process must follow existing Sibanye SMME development strategies and programs; and • Projects which can involve community groups and ring-fencing of procurement opportunities where applicable must be identified.	4	3	6	5	65 Minor (positive)
		Potential increase in dust fallout and noise levels associated with surface rehabilitation activities resulting in a nuisance impact to nearby receptors.	3	2	3	4	32 Negligible (negative)	• Rehabilitation activities should be limited to the daytime; • Any machinery used for decommissioning activities must be switched-off when not in use to prevent unnecessary noise generation; and • Appropriate dust suppression measures must be implemented and dust fallout monitoring must continue.	2	2	2	3	18 Negligible (negative)
		Improvement of the ambient environmental health due to the removal of potential pollution sources and rehabilitation of disturbed footprints as well as improved visual amenity.	6	3	6	6	90 Moderate (positive)	• The prescribed mitigation and rehabilitation measures outlined in this report and associated Environmental Specialist Studies must be implemented accordingly for this positive impact to be realised; and • Radiological monitoring must continue and used to inform any mitigation measures where deemed necessary.	6	3	6	6	90 Moderate (positive)

11.2.3 Closure Phase

During the closure phase the following activities will be undertaken:

- Possible refurbishment of plugs between Cooke No. 3 and Cooke No. 4 (Ezulwini Gold Mine) Shafts, as well as between Cooke No. 1 and Doornkop Mine;
- Potential capping of the shaft barrel below the dolomitic aquifer (although not deemed a requirement based on the outcome of the Hydrogeological Study) and sealing on surface (to prevent access into the workings);
- Backfilling and sealing of ventilation shafts; and
- Rewatering of underground workings.

Once all decommissioning and surface rehabilitation activities are completed, the underground workings are intended to be capped and allowed to rewater while the ventilation shafts will be backfilled with non-hazardous rock and/or rubble material. It should be noted that some of the activities listed above will occur prior to the completion of decommissioning and rehabilitation as appropriate. A Hydrogeological Numerical Model was carried out to identify and quantify possible impacts that could occur as a result of these activities. The outcomes of the model are presented in the subsection below.

The underground workings are overlaid with dolomitic rock formations, which are notorious for sinkhole formation. As such dolomite stability has been considered as part of the Geohydrological report and continued monitoring will be implemented as currently in place at Sibanye.. Plug repairs have been undertaken in preparation of the partial rewatering of Cooke No. 3 Shaft (i.e. Phase One). The Hydrogeological Study indicates that capping of the shaft barrel below the dolomitic aquifer is not required based on the expected water quality in the shaft. However this activity may be a requirement by regulators or more detailed studies with updates to the numerical model and as such has been included as a *potential* activity.

11.2.3.1 Hydrogeological Numerical Model Results

A hydrogeological numerical model was carried out to predict potential impacts related to groundwater quality and mine decant associated with the proposed rewatering of the underground water. Please refer to the specialist report, **Appendix E**, for details relating to the model set-up, boundaries and methodology.

To address the objective of the study, the following scenarios were simulated[22]:

- *Contaminant seepage into the dolomite aquifer*: The potential that the mine water in the shafts can seep into the dolomite aquifer was investigated;

[22] The Hydrogeological Assessment also considered and modelled scenarios related to the disposal of tailings in the underground workings. This has been excluded from this BAR as it is not a proposed activity under assessment for authorisation.

- *Contaminant seepage into the dolomite aquifer, affecting baseflow to surface water:* The model simulations assumed a worst-case scenario where seepage is unobstructed into the dolomite aquifer via recharge; and
- *Flow to the Wonderfonteinspruit*: Historically the Wonderfonteinspruit was the receiving stream from the Zuurbekom Compartment. A scenario was modelled to investigate the potential for flow to the Wonderfonteinspruit once the mine voids have re-watered.

The results of the numerical model, which were used to quantify the potential impacts as a result of the rewatering are discussed separately in the subsections below.

11.2.3.1.1 Potential Contaminant Flow from Shafts

The underground workings are interconnected, with the entire mine void divided into three compartments (i.e. Cooke No. 1, 2 and 3 Compartments). These compartments are connected through holings at 128 Level (Cooke 2/3 at 560 mamsl) and 101 Level (Cooke 1/2 at 818 mamsl) as depicted in Figure 11-1 below.

For the purpose of the mine void model, it was assumed that the plugs between Cooke No. 1 and Doornkop as well as between Cooke No. 3 and Cooke No. 4 (Ezulwini Gold Mine) are in place and that these connections are effectively sealed.

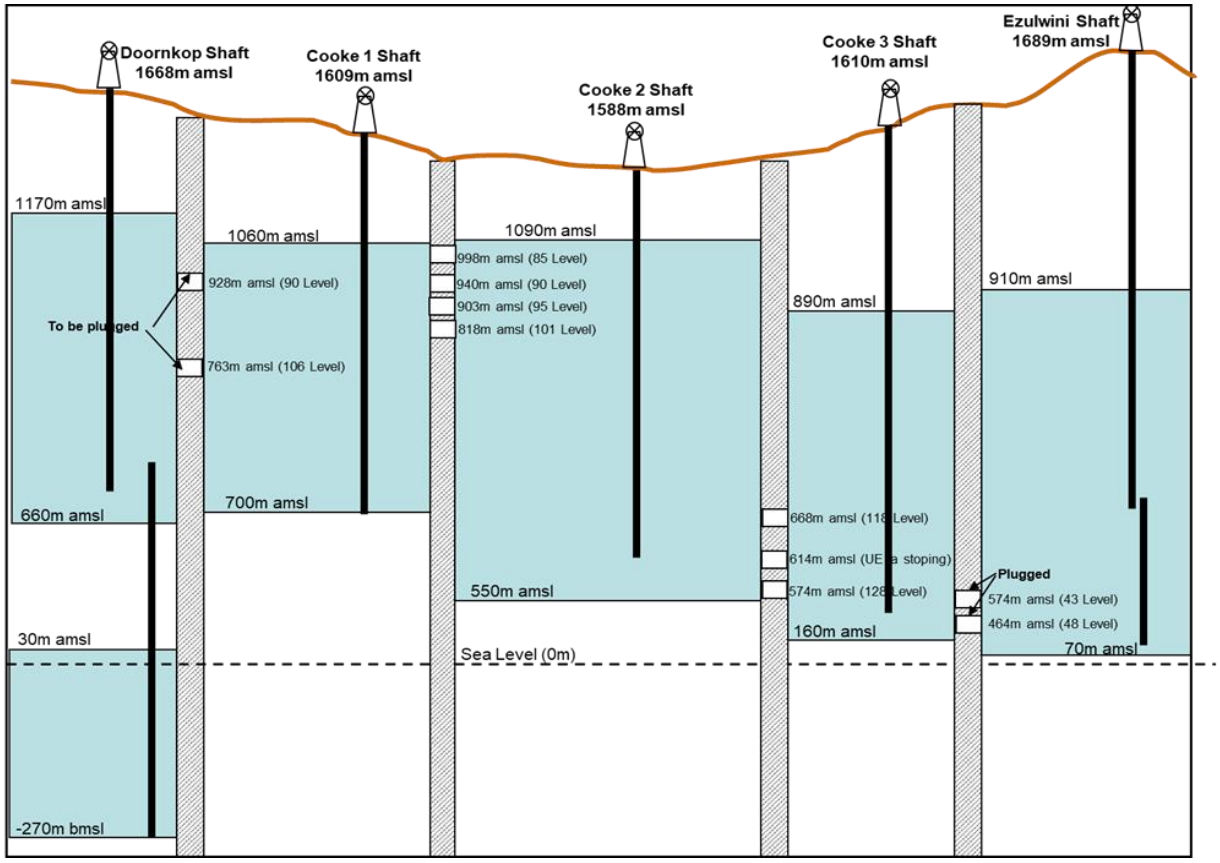


Figure 11-1: Conceptual Representation of the Cooke Mine Void

Source: MvB Consulting, 2020

Sibanye proposed to rewater the underground workings in three stages over a total period of eight years. These stages for rewatering based on these elevations are as follows (MvB Consulting, 2020):

- *Stage One*: Rewater Cooke No. 3 at a rate of 6.8 Mℓ/day while continuing to pump at Cooke No. 2 (8.2 Mℓ/day) and Cooke No. 1 (20 Mℓ/day). Water at Cooke No. 3 will elevate up to the 128 Level (574 mamsl) over a ten months period, where flow from Cooke No. 3 to Cooke 2 will occur. During this phase, the overflow from Cooke No. 3 will once again be pumped to surface at Cooke No. 2 until Cooke No. 2 is to be re-watered;
- *Stage Two*: Rewater Cooke No. 2 at a rate of 15 Mℓ/day while continuing to pump at Cooke No. 1 (20 Mℓ/day). Water at Cooke No. 2 will elevate up to 101 Level (818 mamsl) where flow from Cooke No. 2 to Cooke No. 1 will occur over a 35 month period; and
- *Stage Three*: Rewater Cooke No. 1 at a rate of 34 Mℓ/day. No pumping will take place during this phase. Critical Elevation is the pre-mining dolomite groundwater level (1 570 mamsl) and Donaldson Dam Eye (1 560 mamsl). It will take 54 months to reach this point.

Reverse pumping options were also considered as detailed in the specialist report, **Appendix E.** Ultimately the mine void model simulation indicates that as the mine is rewatered in these various stages, water level in the shafts will rise to an expected final groundwater level of 1 570 mamsl at Cooke No. 2 Shaft which is the lowest lying shaft. No surface decant from the shafts, or the mine void is expected.

Geochemical modelling was undertaken by SRK in 2018 entitled *"Geochemistry of Cooke Shafts and Implications of Re-Flooding"*. The study aimed to investigate the expected mine quality that could potentially decant once the mine is completely rewatered as AMD. Please refer to Section 5 of the Hydrogeological Assessment, **Appendix E**, for a detailed summary of the methodology and outcome of this model. The modelled results indicate that there is expected to be abundant dilution of any seepage entering the underlying aquifers by the high recharge rate of the aquifers from surrounding non-mineralised sources. The chemistry of the water, once rewatering is complete, is expected to meet the Wonderfonteinspruit and prescribed wastewater discharge standard. No parameters are expected to exceed the SANS 241: 2015 Drinking Water Standard parameter limits.

Therefore, even though no surface decant is expected to occur from the shafts, or the mine void, the water quality in the shafts is expected to meet the SANS 241: 2015 Drinking Water Standard and as such the shafts were not included as a potential contamination source in the numerical modelling.

11.2.3.1.2 Potential Contaminant Flow from Surface Infrastructure

The potential groundwater contaminant sources from surface considered in the numerical model are include the following:

- The Cooke TSF;
- The Cooke TSF Return Water Dams (RWDs);
- The Cooke No. 1, 2 and 3 Waste Rock Dumps (WRDs); and
- The Cooke No. 1 and 2 Mud Ponds.

The Cooke TSF and associated RWDs are dormant and planned to remain *in situ* for possible future reclamation while the WRDs and mud ponds at the shaft complexes are planned to be removed as part of the proposed rehabilitation and closure activities. A worst-case scenario, assuming remaining contamination in the soil profile of WRDs and mud ponds was simulated as being diluted by rainfall recharge while the Cooke TSF and associated RWDs were simulated as constant potential contamination sources.

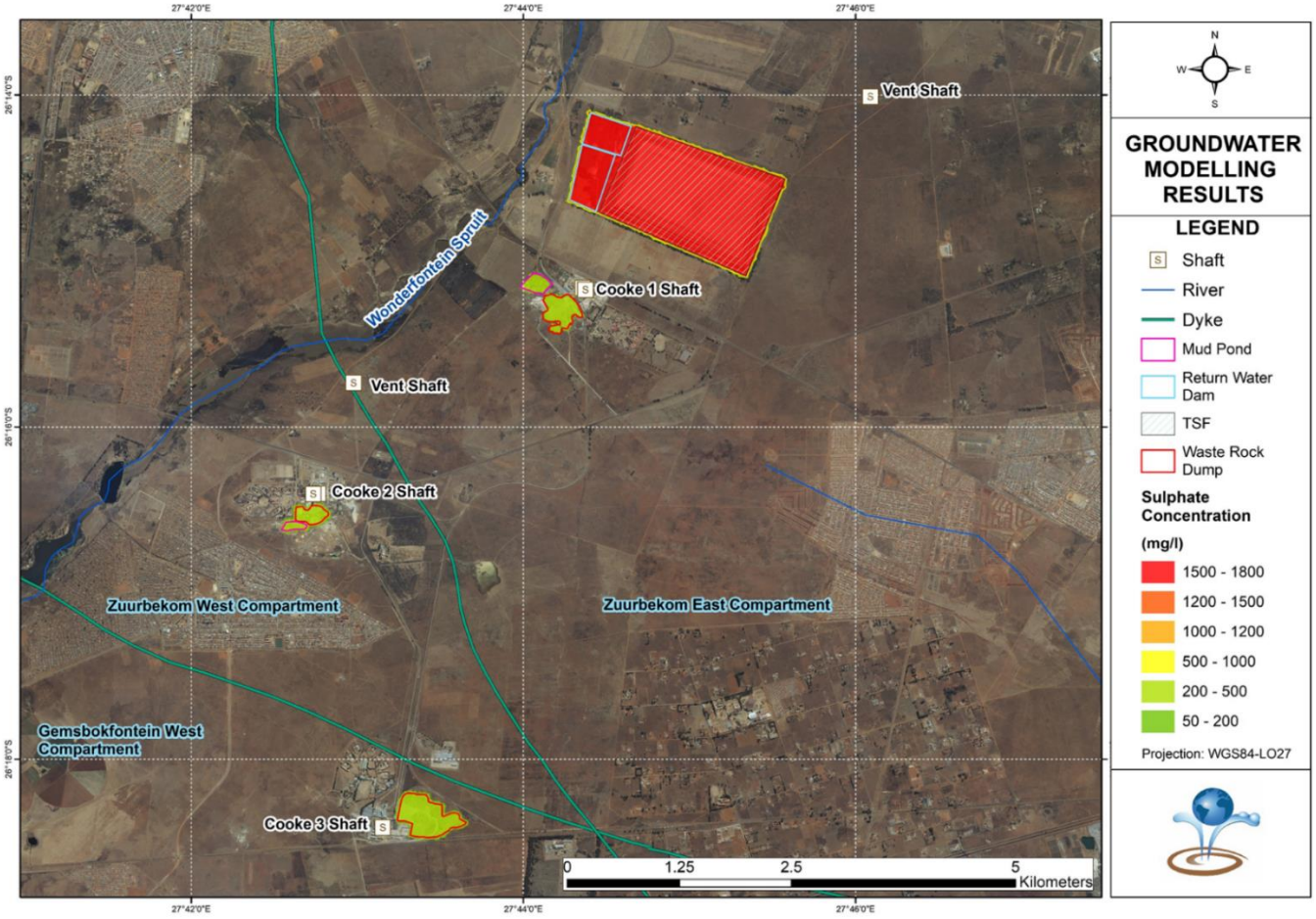
Geochemical modelling was undertaken by Geochemical Dynamics Systems in 2020 which was aimed at assessing the potential for AMD and to characterise the source concentration in terms of the volumes and quality of the leachate that may enter the groundwater regime from these facilities. The detailed findings of this model is included in the Hydrogeological Assessment, **Appendix E.**

The modelled results indicate that it is unlikely that AMD conditions will form as a result of waste rock material or RWD material leachate. Although there is a low risk for AMD formation from sludge material in the mud ponds, the leachate is likely to contain dissolved solids loads as well as leachable concentrations of aluminium, As, Cobalt (Co), Cr, Cu, Ni and Lead (Pb) which may pose a risk to the local environment. With respect to the Cooke TSF, the model indicates that AMD conditions are likely to occur from the tailings material. The main contaminants shown to be a risk of leaching from the tailings material in concentrations that may pose an environmental risk are TDS, Al, As, Co, Cr, Cu, Mn, Ni, Pb, Zn, Fe and SO_4. Though the modelled plume for SO_4 is expected to be greater than any of the metals.

Plan 20 and Plan 21 below present the simulated contamination plume currently and over time respectively. Sulphate is considered a conservative tracer and indication of gold mining impact, and was therefore used to simulate groundwater and contaminant migration.

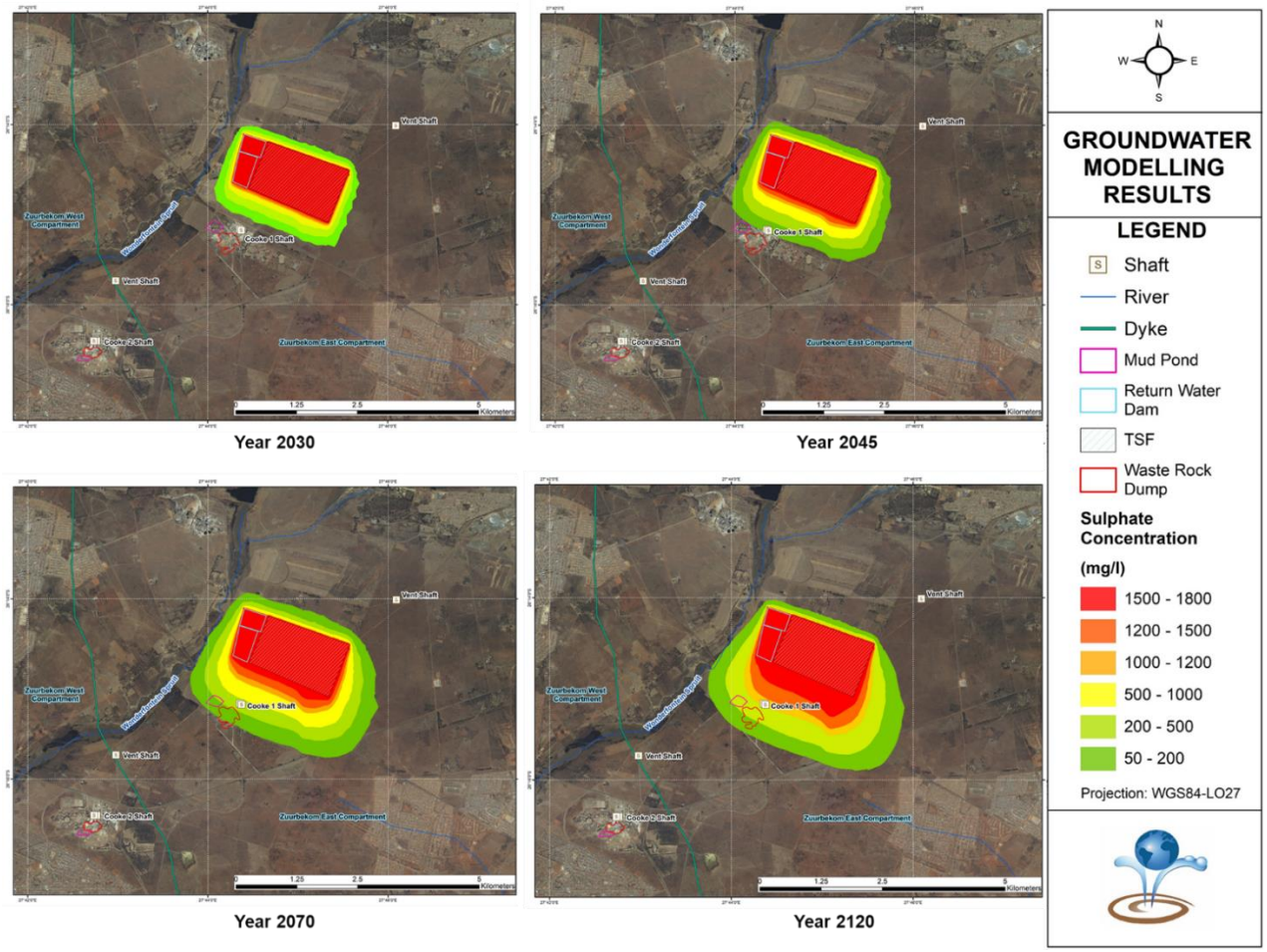
The contaminant transport model indicates that the contamination footprints of the WRDs and mud ponds are likely to be lower than 250 mg/ℓ within 10 years after closure (based solely on leachate results as these facilities plan to be completely removed). Therefore, no impacts are likely to result from these facilities. In terms of the Cooke TSF and associated RWDs, sulphate contamination is in excess of 250 mg/ℓ is likely up to 100 years after closure. However, there are no receptors in the predicted flow path and the environmental impacts is expected to be minimal. There is also potential that this facility will be reclaimed as part of the Cooke Surface Operations or the West Rand Tailings Retreatment Project in future.

Potential contamination flow from surface infrastructure is therefore not expected to cause significant impact to the groundwater environment.



Plan 20: Current Sulphate Contaminant Plume

Source: MvB Consulting, 2020



Plan 21: Simulated Contamination Plume Over Time

Source: MvB Consulting, 2020

11.2.3.1.3 Potential Impact on the Wonderfonteinspruit

The Cooke Operations are located in the Gemsbokfontein and Zuurbekom Dolomite Compartments and are inter-connected. As discussed in the Baseline, Section 10.8.2 above, the Zuurbekom Compartment has not been dewatered as part of the underground mining activities, however, the groundwater level has dropped in places as a result of dewatering of the adjacent Gemsbokfontein West Compartment, affecting the groundwater flow patterns in both Compartments (refer to Figure 10-6 above). Historically, the Wonderfonteinspruit was the receiving stream whereas now it likely loses water to the underlying groundwater environment.

Once the mine void is rewatered, the groundwater level in the Zuurbekom Compartment is expected to recover. However, due to inter-connected nature of the mine voids and Compartments, leakage to the Gemsbokfontein West Compartment will first occur. Only once the Gemsbokfontein West Compartment has fully recovered will the groundwater level in the Zuurbekom Compartment's be able to recover.

The recovery of the Gemsbokfontein West Compartment is also dependent on the cessation of pumping at Cooke No. 4 Shaft (Ezulwini Gold Mine) which lies adjacent to the Cooke No. 3 Shaft. To this end, the following chain of events is necessary for changes to the Wonderfonteinspruit to be noticeable:

- Closure and re-watering of Cooke No. 4 Shaft (Ezulwini Gold Mine). This mine will take approximately 12 months to fully rewater following closure (Jones & Wagener, 2017);
- After filling the Cooke No. 4 Shaft (Ezulwini Gold Mine) void the overlying dolomite aquifer will start to recover and the Gemsbokfontein Eye is expected to start flowing again 66 months later (Jones & Wagener, 2017);
- The flow at the Gemsbokfontein Eye will gradually increase over a period of 15 years before it reaches steady-state flow of 13 Mℓ/day (Jones & Wagener, 2017); and
- At this point the groundwater levels in the Zuurbekom West will recover and flow to the Wonderfonteinspruit restored.

Figure 11-2 presents the simulated flow in the Wonderfonteinspruit overtime. It is expected that flow will increase over a 10 year period (following the full recovery of the Gemsbokfontein West Compartment) until it reaches a steady state. The expected additional flow to the Wonderfonteinspruit after this period is 2.5 Mℓ/day. The expected contaminant load to the Wonderfonteinspruit was modelled by Jones & Wagener in 2013, as presented in the Table 11-6 below.

To this end, flow to the Wonderfonteinspruit from the dolomitic aquifer is expected in the long-term which, as discussed in the Baseline Section 10.7.5.3 above, is expected to ultimately result in good quality water into the Wonderfonteinspruit. The estimated salt load from the flow points indicated below are not expected to contribute to deteriorating water quality in the stream.

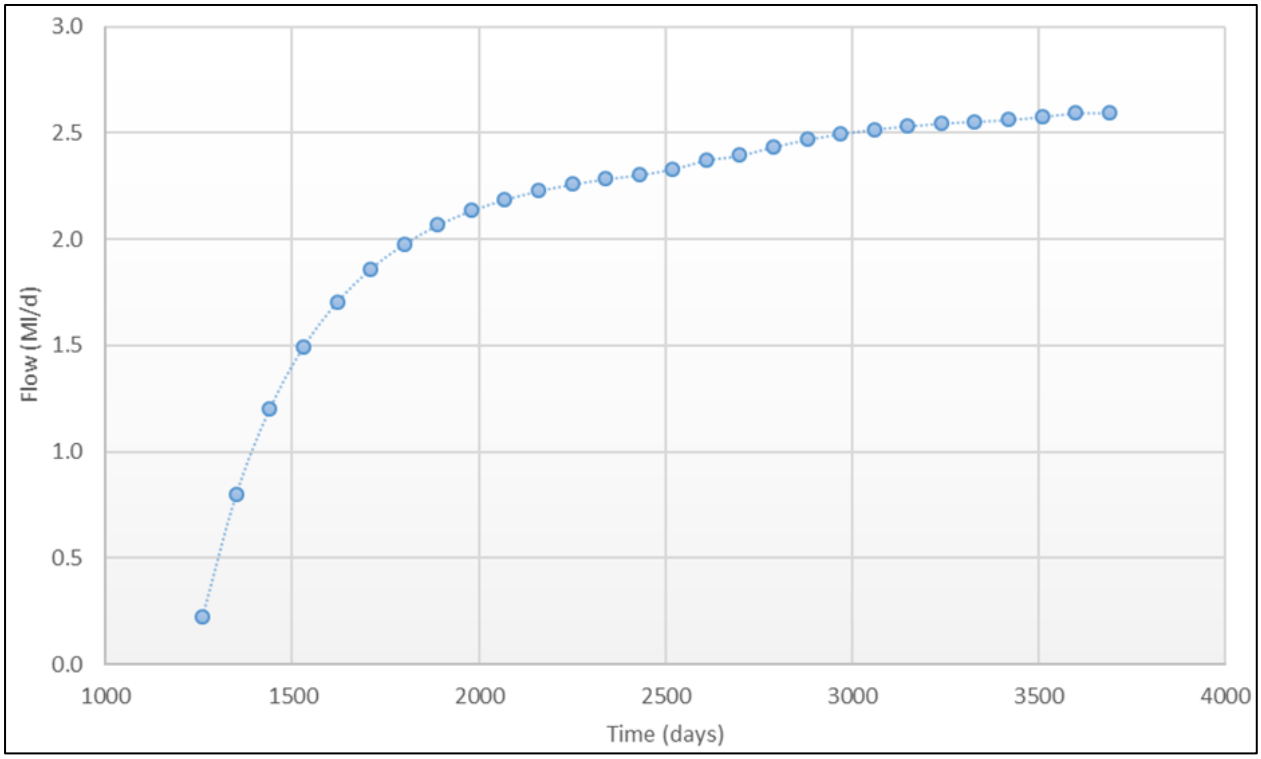


Figure 11-2: Simulated Increased Flow to the Wonderfonteinspruit After Closure

Table 11-6: Estimated Salt Load to the Wonderfonteinspruit

Flow Point	Volume (Mℓ/day)	TDS (mg/ℓ)	Sulphate (mg/ℓ)	Load TDS (tons/day)	Load Sulphate (tons/day)
C2H023 – Luipaardsvlei Dam outlet	28	492	127	14	3.5
Cooke Inflow	20	1 313	819	26	16
Groundwater Inflow	2.5	120	15	0.3	0.04
C2H024 – Donaldson Dam	72	742	322	53	23

11.2.3.2 Significance Rating

Table 11-7 below provides a description and rating of the potential impacts against the activities associated with the closure phase. The key mitigation/ management measures recommended for each impact are also detailed.

Table 11-7: Impact Assessment Associated with the Closure Phase

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
1. Possible refurbishment of plugs between Cooke No. 3 and Cooke No. 4 Shafts, as well as between Cooke No. 1 and Doornkop Mine	-	No impacts have been identified for this activity.	-	-	-	-	-	• The plugs between Cook No. 3 Shaft and Cooke No. 4 Shaft (Ezulwini Gold Mine) must be inspected by a relevant qualified engineer. Where it is determined that plug repairs are required, this must be carried out accordingly prior to rewatering. This has been completed as per the Phase 1 submissions.					
2. Potential capping of the shaft barrel below the dolomitic aquifer	-	No impacts have been identified for this activity.	-	-	-	-	-	• The ongoing ground stability monitoring must continue and be used to inform any requirements to cap of the shaft barrel if deemed necessary.					
3. Backfilling and sealing of ventilation shafts	-	No impacts have been identified for this activity.	-	-	-	-	-	• As planned, ventilation shafts must only be backfilled with non-hazardous rock material and/ or non-contaminated rubble material to avoid potential water pollution.					
4. Rewatering of underground workings	Surface water	Rewatering of the underground workings will result in the cessation of the current groundwater pumping, treat and discharge regime into the environment. This would result in a reduction of flow in the Wonderfonteinspruit downstream of the discharge point. This will likely affect downstream water uses/ users.											
		As established in the Surface Water Quality Assessment, the current discharge into the Wonderfonteinspruit provides dilution effects as an improvement in water quality is observed downstream of the discharge point compared to points upstream of the discharge. The cessation of discharge will negate these effects and an interim deterioration in water quality in terms of metals, salts, nutrients and pathogens may occur.	7	4	3	7	98 Moderate (negative)	• Water quality monitoring downstream of the Cooke No. 1 Shaft discharge point into the Wonderfonteinspruit must continue into the post-closure phase; and • Where significant adverse changes are detected to water quality, mitigation measures must be investigated and implemented accordingly	7	4	3	7	98 Moderate (negative)
	Wetlands	Possible shrinking of the Magazine Pan and wetland sections along the Wonderfonteinspruit as a response to the change in surface water flow patterns (reduction) caused by the cessation of discharge. These wetland sections are expected to dry up, with particular emphasis placed on Magazine Pan as this	7	4	3	7	98 Moderate (negative)	• Consideration to the rehabilitation options that should be considered for Magazine Pan even though this is an artificial system that has been created, there is an opportunity to maintain this system as a wetland and improve the functionality of the system and overall the biodiversity despite reduced inflows; • Ongoing groundwater monitoring and modelling to determine if there is the potential that additional decant points would occur	7	2	4	5	65 Minor (positive)

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
		is an artificial system currently. It is debatable that this would potentially indicate a return to the pre-mining state of these systems. However, it is deemed an adverse impact against the current baseline as wetland habitat which now exists would disappear.						over time to ensure that the appropriate mitigation measures are implemented to protect water resources in the event that decant does occur; • Investigate and determine prefeasibility treatment options for integration into the larger closure strategy for the region, if necessary based on monitoring data; • Ongoing monitoring of the Wonderfonteinspruit system, its water quality, wetlands (Wet-Health) and aquatic biota to detect changes that would occur as a result of the cessation of pumping activities. Sibanye will address impacts only directly associated with its activities and no other water users' activities and all findings will be communicated to the DWS to action further for other water users; • Adopt remedial action if required if there is an overall reduction in ecological functionality of the system were possible; • Monitor geomorphology of all systems for subsidence, erosion and incision; and • Ongoing wetland rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint areas and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, trends or improvements in the receiving environment.					
		Reduced ecological integrity of downstream wetlands due to adverse water quality impacts caused by the cessation of pumping into the Wonderfonteinspruit which provided dilution effects to water from the upstream reaches of the Wonderfonteinspruit which has experienced impacts from surrounding land uses.	7	4	3	7	98 Moderate (negative)		7	4	4	5	75 Moderate (positive)
	Surface Water; and Wetlands	Based on the outcome of the hydrogeological numerical model, in the longer term once the Zuurbekom Compartment fully recovers, pre-mining flow from this Compartment into the Wonderfonteinspruit is expected. This is expected to increase the quantity and improve the quality of water reporting downstream. This will also be beneficial to the ecological integrity of wetlands along the Wonderfonteinspruit.	7	4	4	5	75 Moderate (positive)	• No enhancement measures are proposed.					
	Hydropedo-logy	The recharging of Cooke No. 3 Shaft will allow flow into the Magazine Pan pre-dominantly through the soil/bedrock interface as water flow will be restored. It is anticipated that the flow volumes into Wonderfonteinspruit will also benefit in the long-term through groundwater recharge based on the outcome of the hydrogeological numerical model.	7	4	3	6	84 Moderate (positive)	• Ongoing monitoring of surface and groundwater for early detection of any deviations from the RQOs of the catchment area assess the effectiveness of the rehabilitation plan.					

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
		The effluent from Cooke No. 2 and 3 Shafts will no longer be discharged to the Magazine Pan and this is expected to improve water quality at the pan. It is envisaged that the Magazine Pan will be recharged through surface flows from restored landscape and through predominantly the soil/bedrock interface as a result of the observed shallow groundwater and surface water interactions within the Cooke Complexes. Although the Magazine Pan is likely to reduce in size, the rehabilitation will likely cause close to pre-mining conditions in the pan over time and the post mine land users will benefit from the magazine pan functionality.	7	3	3	6	78 Moderate (positive)						
	Groundwater	Mine re-watering resulting in the recovery of the groundwater table. Based on the geochemical model of the underground workings, it is expected that the mine water quality in the shafts will be uncontaminated based on the SANS 241: 2015 Drinking Water Standard	7	3	3	6	78 Moderate (positive)	• Water quality monitoring must continue until rewatering is complete to ensure this positive impact is realised.					
		Contamination plume migration as a result of seepage from the Cooke TSF and associated RWDs into the underlying aquifer.	6	3	4	3	39 Minor (negative)	• The WRDs and mud ponds at the shaft complexes must be removed as planned; • Sibanye must continue to investigate the possibility to reclaim the Cooke TSF; and • Groundwater monitoring around the Cooke TSF must continue as part of the Cooke Surface Operations.	5	3	3	3	33 Negligible (negative)
		Possible mine decant from the underground workings once fully rewatered. Based on the outcome of the hydrogeological numerical model, this is unlikely to occur as the underground workings are >1km deep and decant only possible through the shafts. The mine water level expected to stabilise below the collar elevation of the lowest-lying shaft and the shaft barrels are concrete lined, therefore expected to contain any contamination in the shaft.	6	3	4	3	39 Minor (negative)	• Rewatering should be monitored until groundwater levels in the shafts have fully recovered; and • As more information becomes available, the numerical model should be updated as part of the post closure phase. This should be used to inform any additional mitigation measures.	5	3	3	3	33 Negligible (negative)

Activity	Aspect	Impacts	D	E	I	P	Significance (Pre-Mitigation)	Mitigation Measures	D	E	I	P	Significance (Post Mitigation)
5. General closure of the Cooke Underground Operations	Socio-economic	The permanent closure of the Cooke Underground Operations will result in the loss of economic opportunities associated with the mine, including direct, in-direct and induced employment and supply chain contracts.	7	5	6	7	126 Major (negative)	• The SCP must be developed and implemented in partnership with other mines in the greater West Rand region and government to enhance non-mining based economic activities.	4	5	5	6	90 Moderate (negative)
		Possible increase in illegal mining activities in surrounding mines due to the loss of economic opportunities associated with the Cooke No. 1, 2 and 3 Shafts.	6	4	6	6	96 Moderate (negative)	• Inform neighbouring miners and authorities of the Cooke No. 1, 2 and 3 closure and likely peak of illegal mining activities.	6	4	5	5	75 Moderate (negative)
		As part of this closure implementation process, Sibanye has commissioned Digby Wells undertake a SCP Process which will investigate the progression and requirements to fulfil social commitments as well as identify social programmes/ community development projects to be implemented. Please refer to the SIA, Appendix I, for further detail pertaining to the SCP Process. This is deemed a positive outcome of the closure implementation process as, if correctly implemented, result in local community development.	6	3	5	5	70 Minor (positive)	• Sibanye should ensure full participation of communities in the development of post closure socio-economic planning. This should include the following: • Development of the stakeholder engagement plan for social closure planning to be shared with stakeholders; • Where applicable, Sibanye should engage communities through existing Community Engagement Forums; and • Full participation of Sibanye personnel) in stakeholder consultation process (including attendance of consultation meetings. • Sibanye should ensure full transparency and sharing of information with stakeholders; • Sibanye to provide stakeholders with well researched feedback to unfeasible programs and Projects proposed by community members (including the use of locally based case studies); and • Early formation of joint ventures and partnerships with stakeholders who will assist in the implementation of social closure programs.	7	3	6	6	96 Moderate (positive)
		If rehabilitation is correctly implemented this will result in the creation of open areas (as per the preliminary post-mining land use plan) at the Cooke Shaft complexes which will be ceded for alternative sustainable land uses. This will in turn present socio-economic opportunities.	7	3	7	7	119 Major (positive)	• Consult with all relevant stakeholder including government and local communities regarding future land uses; and • All stakeholder inputs regarding future land uses must be considered against the previous land uses during mining in order to ensure that communities do not access land parcels which are not safe for human presence.	7	3	7	7	119 Major (positive)

11.2.4 Post-Closure Phase

According to the Decommissioning, Rehabilitation and Mine Closure Plan compiled by Golder Associates Africa (Pty) Ltd (2020), which is included as **Appendix J**, decommissioning and rehabilitation activities are expected to not exceed a period of three years. This will be followed by a period of post-closure performance monitoring, nominally five years.

This performance monitoring will have to continue until it can be demonstrated that the site relinquishment criteria have been successfully achieved. Monitoring of various environmental features and site inspections will be undertaken during this phase, for which no additional impacts have been identified. However, where rehabilitation efforts are found to not be unsuccessful and/ or unforeseen events that hinder the relinquishment of the site occur, corrective measures must be undertaken.

11.3 Risk Assessment

An Environmental Risk Assessment (ERA) has been compiled as part of the Closure Application requirements in terms of the MPRDA. This assessment aimed at identifying possible residual risks that could be realised post-closure that could consequently lead to environmental/ socio-economic impacts.

Residual risks are defined as risks that remain following the implementation of risk controls. The proposed decommissioning, rehabilitation and closure activities serve as measures against long term adverse environmental and socio-economic implications following the closure of the Cooke Underground Operations. However, residual risks are still possible.

Table 11-8 below presents and quantifies potential residual impacts determined for activities which were identified in the Decommissioning, Rehabilitation and Closure Plan (**Appendix J**) as having potential to result in residual impacts. The quantification of these impacts is in line with the methodology presented in Section 11.1 above. Mitigation measures, in addition to those listed above for the proposed activities, have also been recommended to reduce the likelihood of the residual impacts to be realised. These measures have been considered in the CEMPr (Part B).

Residual environmental and socio-economic impacts are also associated with financial and reputational risks. In the event that such risks and consequent impacts are realised, Sibanye is likely to incur recurring cost to rectify/ repair damage as well as reputational damage/ litigation. It is therefore imperative that the closure objectives are achieved, ultimately leading to a sustainable post-mining environment.

Table 11-8: Environmental Risk Assessment

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
1. Decommis-sioning and removal of buried pipelines	Possibility of failure to identify and remove all buried pipelines or a decision is made to not remove certain buried pipelines.	Soil, Land Capability and post-mining Land Use	Possible soil contamination from gradual release of impacted water which may have remained in the pipelines. This will lead to reduced land capability and loss of post-mining land use potential.	2	2	-2	-6	4	-24	• All known buried pipelines should be removed as part of the decommissioning and closure activities. Prior to removal, these pipelines should be adequately drained to the approved discharge points (Wonderfonteinspruit or Magazine Pan); • A detailed site investigation must be carried out with the aim of identifying unknown buried pipelines. This includes reviewing available information from historic operational activities and/or targeted ground surveillance (where practicable) where pipelines may be expected to occur; • Stormwater management measures must be implemented during pipeline removal to ensure any spills that occur can be adequately contained; and • In the event that a spill occurs, rehabilitation of the affected soil must be undertaken as soon as possible. This may include waste classification before disposal of contaminated soils to ensure appropriate and legally compliant disposal.	2	2	-2	-6	2	-12
		Ground-water	Possible groundwater quality deterioration from gradual release of impacted water which may have remained in the pipelines.	2	2	-2	-6	3	-18	• All known buried pipelines should be removed as part of the decommissioning and closure activities. Prior to removal, these pipelines should be adequately drained to the approved discharge points (Wonderfonteinspruit or Magazine Pan); • A detailed site investigation must be carried out with the aim of identifying unknown buried pipelines. This includes reviewing available information from historic operational activities and/or targeted ground surveillance (where practicable) where pipelines may be expected to occur; • Stormwater management measures must be implemented during pipeline removal to ensure any spills that occur can be adequately contained; and • In the event that a spill occurs, rehabilitation of the affected area must be undertaken as soon as possible.	2	2	-2	-6	1	-6
		Social	Possible theft of buried pipelines and consequent contamination impacts.	2	2	-2	-6	4	-24	• All known buried pipelines should be removed as part of the decommissioning and closure activities and the areas adequately rehabilitated; • A detailed site investigation must be carried out with the aim of identifying unknown buried pipelines. This includes reviewing available information from historic operational activities and/or targeted ground surveillance (where practicable) where pipelines may be expected to occur; • Post-closure monitoring will be undertaken for a period of at least 3 years. The property must be inspected during this time to identify	2	2	-2	-6	2	-12

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
										areas where unknown buried pipelines may have been stolen. In the event that this impact occurs, the trenches of the pipeline (s) must be appropriately rehabilitated as soon as possible; and • If this impact occurs, a further detailed inspection must be carried out in the vicinity of the stolen pipelines with the aim of identifying any more unknown pipelines.						
2. Rehabilitation of disturbed areas (following removal of surface infrastructure at the shaft)	Possibility that there will not be enough soil resources for rehabilitation activities.	Soil, Land Capability and post-mining Land Use	Insufficient soil resources resulting in inadequate cover of disturbed areas and consequently, unsuccessful vegetation establishment. This will lead to reduced land capability and loss of post-mining land use potential.	3	2	-3	-8	5	-40	• A volumetric assessment to quantify the amount of soil needed to adequately rehabilitate disturbed areas must be undertaken as part of the post-mining landform design which is integrated with the stormwater management plan; and • The determined end land use must be revisited and refined based on the outcomes of the post-mining landform design, volumetric assessment and actual material availability.	3	2	-3	-8	4	-32
		Surface Water	Alteration of hydrological landscape (lower than natural elevation) which may lead to reduced water quantity reporting to the downstream catchment.	3	3	-5	-11	6	-66	• Integrate the post-mining storm water planning as part of the landform design to align the surface water runoff with the site wide natural drainage framework; and • Rehabilitation must aim for a free draining profile. Construction of internal blind catchments must be avoided.	3	3	-5	-11	3	-33
	Possibility for inadequate rehabilitation resulting in unsuccessful re-vegetation.	Soil, Land Capability and post-mining Land Use	Erosion on bare surface (where re-vegetation is unsuccessful) and consequent loss of soil resources. This will lead to reduced land capability and loss of post-mining land use potential.	3	2	-4	-9	7	-63	• Construct suitable slope gradients and additional storm water measures as required based on detailed post mining landform designs integrated hydrological and erosion modelling; • Continue the maintenance of stormwater management infrastructure throughout the decommissioning and rehabilitation phase to ensure effective functioning; and • Ameliorate soils based on dedicated fertility sampling and analysis. Establish vegetation as soon as possible and apply follow-up amelioration to avoid unsuccessful re-vegetation and potential erosion.	3	2	-4	-9	4	-36
		Terrestrial Biodiversity	Reduced potential for restored ecological functionality and consequent loss of fauna and flora species.	3	2	-3	-8	5	-40	• Ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; • Suitable habitat must be created based on surrounding landforms; and • Post-closure monitoring will be undertaken for a period of at least three years. During this time, the sites must be monitored for vegetation establishment. Where vegetation is failing to establish an assessment must be undertaken by a qualified ecologist to determine practical corrective measures that can be implemented.	3	2	-3	-8	3	-24

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
			Infestation and spread of AIPs.	3	3	-4	-10	7	-70	• Ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; • Post-closure monitoring will be undertaken for a period of at least three years. During this time, the sites must be monitored for AIPs. Where AIPs are identified, these must be removed as soon as possible; and • In the event that certain AIPs are deemed beneficial to terrestrial biodiversity, the required permits must be obtained to leave/ plant these species in rehabilitation areas.	3	3	-3	-9	5	-45
		Air Quality & Visual	Generation of fugitive dust on bare surfaces resulting in a nuisance and health impacts for nearby receptors.	3	2	-3	-8	6	-48	• Dust monitoring must be undertaken until vegetation re-establishes on all bare surfaces; • Where dust generation is occurring, appropriate dust suppression measures must be investigated and implemented accordingly; and • Ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes.	3	2	-3	-8	4	-32
		Fresh-water Ecosystems	Deterioration in surface water quality caused by water erosion (increasing suspended solids in run-off) due to bare surfaces. Water quality impacts will also adversely impact wetland habitat and sensitive aquatic biota (loss/ deterrence from immediate reaches).	5	3	-5	-13	6	-78	• Post-closure water quality, wetland and biomonitoring must be undertaken to detect impacts; and • If impacts are detected, appropriate corrective measures must be investigated and implemented accordingly.	5	3	-5	-13	4	-52
	Possibility for "legacy" contamination sources (hydrocarbon) to remain which may not be fully understood at the time of closure, or unidentified historical sources of contamination.	Fresh-water Ecosystems	Deterioration of surface water quality as a result of contaminants being carried by stormwater run-off over areas with legacy contaminant sources. This will also affect sensitive aquatic biota (loss/ deterrence from immediate reaches).	5	3	-5	-13	3	-39	• All known sources of contamination must be removed at rehabilitation; • The sites be inspected for any unknown hydrocarbon spillages. If identified, this must be removed as soon as possible and disposed of appropriately and in in accordance with legal requirements; • Soil contamination assessments must be carried out during rehabilitation. Where contaminated soils are identified this must be removed and disposed of appropriately and in accordance with legal requirements; and • Stormwater management structures must be maintained throughout rehabilitation to prevent contaminants being carried by run-off.	5	3	-5	-13	1	-13

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
	Possibility for historical holings to remain after mine closure if not identified/ being re-opened by illegal miners.	Soil, Land Capability and post-mining Land Use	Compromised post-mining land use potential.	5	1	-3	-9	4	-36	• A comprehensive site assessment must be undertaken of all known holings and survey to locate potential additional holings during the decommissioning and rehabilitation phase; • An action plan to appropriately seal and rehabilitate all known holings must be developed and implemented accordingly during the decommissioning and rehabilitation phase; and • Post-closure monitoring will be undertaken for a period of at least 3 years. The property must be inspected during this time to identify any illegal re-opening of holings and/or identify unknown holings. In the event that this impact occurs, the holing must be appropriately sealed and the surroundings rehabilitated.	5	1	-2	-8	2	-16
		Ground-water	Potential for inter-basin contamination of groundwater.	5	3	-3	-11	4	-44	• A comprehensive site assessment must be undertaken of all known holings and survey to locate potential additional holings during the decommissioning and rehabilitation phase; • An action plan to appropriately seal and rehabilitate all known holings must be developed and implemented accordingly during the decommissioning and rehabilitation phase; and • Post-closure monitoring will be undertaken for a period of at least 3 years. The property must be inspected during this time to identify any illegal re-opening of holings and/or identify unknown holings. In the event that this impact occurs, the holing must be appropriately sealed and surrounding rehabilitated.	5	3	-2	-10	2	-20
		Social	Increased health and safety risk to human and animals as well as illegal activities.	5	1	-3	-9	4	-36	• A comprehensive site assessment must be undertaken of all known holings and survey to locate potential additional holings during the decommissioning and rehabilitation phase; • An action plan to appropriately seal and rehabilitate all known holings must be developed and implemented accordingly during the decommissioning and rehabilitation phase; and • Post-closure monitoring will be undertaken for a period of at least 3 years. The property must be inspected during this time to identify any illegal re-opening of holings and/or identify unknown holings. In the event that this impact occurs, the holing must be appropriately sealed and the surrounding rehabilitated.	5	1	-2	-8	2	-16
3. Rehabilita-tion of impacted water management	Possibility that contamination sources are inadequately removed and rehabilitated	Soil, Land Capability and post-mining Land Use	Possible soil contamination from remaining contamination sources. This will lead to reduced land capability and loss of post-mining land use potential.	7	1	-5	-13	6	-78	• All sources of contamination must be identified and removed as part of rehabilitation and disposed of in an appropriate manner as informed by the waste classification of the material; • Integrate the post-mining storm water planning as part of the landform design to align the surface water runoff with the site wide natural drainage framework and incorporate the mass earthworks	7	1	-5	-13	2	-26

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
facilities (dams, paddocks and Magazine Pan)	resulting in continued release of pollutants.									• and soil requirements into the site-wide volumetric assessment and materials balance; • Rehabilitation must aim for a free draining profile. Construction of internal blind catchments must be avoided; • Revisit and refine the end land use based on the outcomes of the post-mining landform design, volumetric assessment and actual material availability; and • Construct suitable slope gradients and additional storm water measures as required based on detailed post-mining landform designs integrated hydrological and erosion modelling.						
		Surface Water & Ground-water	Possible leaching of pollutions to surface water and groundwater sources.	6	3	-4	-13	6	-78	• All sources of contamination must be removed from impacted water management facilities as part of rehabilitation and disposed of in an appropriate manner as informed by the waste classification of the material; • Stormwater management structures must be maintained throughout rehabilitation activities to prevent contaminants reporting to nearby water resources; and • Post-closure surface- and groundwater quality monitoring must be undertaken to detect impacts. Where impacts are detected, appropriate corrective measures must be investigated and implemented.	6	3	-4	-13	2	-26
		Terrestrial Biodiversity	Reduced potential for restored ecological functionality and consequent loss of fauna and flora species.	3	2	-3	-8	5	-40	• Following soil cover, ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; • Suitable habitat must be created based on surrounding landforms; and • Post-closure monitoring will be undertaken for a period of at least three years. During this time, the sites must be monitored for vegetation establishment. Where vegetation is not occurring an assessment must be undertaken by a qualified ecologist to determine practical corrective measures which can be implemented.	3	2	-3	-8	2	-16
			Infestation and spread of AIPs.	3	3	-4	-10	7	-70	• Following soil cover, ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; • Post-closure monitoring will be undertaken for a period of at least three years. During this time, the sites must be monitored for AIPs. Where AIPs are identified, these must be removed as soon as possible; and	3	3	-4	-10	4	-40

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
										• In the event that certain AIPs are deemed beneficial to terrestrial biodiversity, the required permits must be obtained to leave/ plant these species in rehabilitation areas.						
		Air Quality & Health	Generation of fugitive dust on bare surfaces resulting in a nuisance and health impacts (radioactive material) for nearby receptors.	6	3	-3	-12	5	-60	• Dust monitoring must be undertaken until vegetation re-establishes on all bare surfaces; • Where dust generation is occurring, appropriate dust suppression measures must be investigated and implemented accordingly; and • Ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes.	5	3	-3	-11	2	-22
		Social	Increased health and safety risk to human and animals when water is present in the facilities.	3	1	-5	-9	5	-45	• All sources of contamination must be identified and removed as part of rehabilitation and disposed of in an appropriate and legally compliant manner as informed by the waste classification of the material; • A survey must be undertaken following contaminants removal activities to ensure all material has indeed been removed; and • Access control must be maintained until areas are fully rehabilitated.	3	1	-5	-9	2	-18
	Possibility for "legacy" contamination sources (slimes) to remain which may not be fully understood at the time of closure, or unidentified historical sources of contamination.	Fresh-water Ecosystems	Deterioration of surface water quality as a result of contaminants being carried by stormwater runoff over areas with legacy contaminant sources. This will also affect sensitive aquatic biota (loss/ deterrence from immediate reaches).	5	3	-6	-14	3	-42	• All known sources of contamination must be identified, quantities and removed at rehabilitation; • The sites should be inspected for any unknown hydrocarbon spillages. If identified this must be removed as soon as possible and disposed of appropriately; • Soil contamination assessments must be carried out during rehabilitation. Where contaminated soil is identified this must be removed and disposed of appropriately; • Stormwater management structures must be maintained throughout rehabilitation to prevent contaminants being carried by run-off; and • Develop a materials balance for the site during the post mining landform design to quantify suitable materials for rehabilitation purposes and availability for potential contingency measures.	5	3	-6	-14	2	-28
	Possibility for inadequate rehabilitation resulting in unsuccessful re-vegetation.	Soil, Land Capability and post-mining Land Use	Erosion on bare surface (where re-vegetation is unsuccessful) and consequent loss of soil resource. This will lead to reduced land capability and loss of post-mining land use potential.	3	1	-5	-9	5	-45	• Construct suitable slope gradients and additional storm water measures as required based on detailed post mining landform designs integrated hydrological and erosion modelling; • Continue the maintenance of stormwater management infrastructure throughout the decommissioning and rehabilitation phase to ensure effective functioning; and • Ameliorate soils based on dedicated fertility sampling and analysis, establish vegetation as soon as possible and apply follow up	3	1	-5	-9	2	-18

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
										amelioration to avoid unsuccessful re-vegetation and consequent erosion.						
		Surface Water	Alteration of hydrological landscape (lower than natural elevation) which may lead to reduced/ increased water quantity reporting to the downstream catchment.	3	2	-4	-9	6	-54	• Integrate the post-mining storm water planning as part of the landform design to align the surface water runoff with the site wide natural drainage framework; and • Rehabilitation must aim for a free draining profile. Construction of internal blind catchments must be avoided.	3	2	-4	-9	3	-27
4. Rehabilita-tion of ventilation shafts	Possibility for inadequate rehabilitation resulting in unsuccessful re-vegetation and potential for insufficient soil resource.	Surface Water	Alteration of hydrological landscape (lower than natural elevation) which may lead to reduced water quantity reporting to the downstream catchment.	3	3	-5	-11	6	-66	• Integrate the post-mining storm water planning as part of the landform design to align the surface water runoff with the site wide natural drainage framework; and • Design the post-mining landform integrated with the stormwater management plan, compile a volumetric assessment to quantify the amount of soil needed to adequately rehabilitate disturbed areas; • Revisit and refine the end land use based on the outcomes of the post-mining landform design, volumetric assessment and actual material availability; and • Rehabilitation must aim for a free draining profile. Construction of internal blind catchments must be avoided.	3	3	-5	-11	3	-33
		Soil, Land Capability and post-mining Land Use	Erosion on bare surface (where re-vegetation is unsuccessful) and consequent loss of soil resource. This will lead to reduced land capability and loss of post-mining land use potential.	3	2	-4	-9	7	-63	• Construct suitable slope gradients and additional storm water measures as required based on detailed post-mining landform designs integrated hydrological and erosion modelling; • Continue the maintenance of stormwater management infrastructure throughout the decommissioning and rehabilitation phase to ensure effective functioning; and • Ameliorate soils based on dedicated fertility sampling and analysis, establish vegetation as soon as possible and apply follow-up amelioration to avoid unsuccessful re-vegetation and consequent erosion.	3	2	-4	-9	4	-36
		Terrestrial Biodiversity	Reduced potential for restored ecological functionality and consequent loss of fauna and flora species.	3	2	-3	-8	5	-40	• Following soil cover, ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; • Suitable habitat must be created based on surrounding landforms; and • Post-closure monitoring will be undertaken for a period of at least three years. During this time, the sites must be monitored for vegetation establishment. Where vegetation is not occurring an assessment must be undertaken by a qualified ecologist to determine practical corrective measures which can be implemented.	3	2	-3	-8	3	-24

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
			Infestation and spread of AIPs.	3	3	-4	-10	7	-70	• Following soil cover, ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; • Post-closure monitoring will be undertaken for a period of at least three years. During this time, the sites must be monitored for AIPs. Where AIPs are identified, these must be removed as soon as possible; and • In the event that certain AIPs are deemed beneficial to terrestrial biodiversity, the required permits must be obtained to leave/ plant these species in rehabilitation areas.	3	3	-3	-9	5	-45
		Air Quality & Visual	Generation of fugitive dust on bare surfaces resulting in a nuisance and health impacts for nearby receptors.	3	2	-3	-8	6	-48	• Dust monitoring must be undertaken until vegetation re-establishes on all bare surfaces; • Where dust generation is occurring, appropriate dust suppression measures must be investigated and implemented accordingly; and • Ameliorate soils based on dedicated fertility sampling and analysis, establish vegetation as soon as possible and apply follow-up amelioration to avoid unsuccessful re-vegetation and consequent erosion.	3	2	-3	-8	4	-32
		Fresh-water Ecosystems	Deterioration in surface water quality caused by water erosion (increasing suspended solids in run-off) due to bare surfaces. Water quality impacts will also adversely impact wetland habitat and sensitive aquatic biota (loss/ deterrence from immediate reaches).	5	3	-5	-13	6	-78	• Post-closure water quality, wetland and biomonitoring must be undertaken to detect impacts; • If impacts are detected, appropriate corrective measures must be investigated and implemented accordingly; • Construct suitable slope gradients and additional storm water measures as required based on detailed post-mining landform designs integrated hydrological and erosion modelling; • Continue the maintenance of stormwater management infrastructure throughout the decommissioning and rehabilitation phase to ensure effective functioning; and • Ameliorate soils based on dedicated fertility sampling and analysis, establish vegetation as soon as possible and apply follow up amelioration to avoid unsuccessful re-vegetation and consequent erosion.	5	3	-5	-13	4	-52
	Possibility for ineffective backfilling and sealing of the ventilation shafts	Social	Increased risk for illegal mining if not adequately backfilled and sealed, consequently resulting in human and animal health and safety risks.	3	1	-5	-9	5	-45	• Compile a site-wide materials balance to quantify availability of suitable material for rehabilitation purposes. If existing material is found to be insufficient, additional non-hazardous material must be sourced to supplement addition material to ensure backfill is completed (potential sources include the demolition rubble from the planned removal of the surface infrastructure);	3	1	-5	-9	2	-18

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
										• Once backfilled reinforced concrete shaft plugs should be constructed based on detailed engineering designs to prevent access to the underground workings; • Access control must be maintained until rehabilitation is fully completed; and • Rewatering (as intended) is key to preventing access to the underground workings.						
5. Rehabilita-tion of WRDs and overburden stockpiles which are to be left in-situ at the shaft complexes	Possibility that there will not be enough soil resource to rehabilitate WRDs if left in-situ.	Soil, Land Capability and post-mining Land Use	Insufficient soil resource resulting in inadequate cover of WRDs and overburden stockpiles.	3	2	-3	-8	5	-40	• All WRDs are currently being reprocessed and resulting residue will be used as backfill for the shafts. Remaining WRDs will also be utilised as backfill for remaining cavities and voids due to infrastructure demolition and removal. Note: waste classification should be confirmed to ensure backfilling operations are aligned with legal requirements; • Design the site-wide post-mining landform integrated with the stormwater management plan, compile a volumetric assessment to quantify the amount of backfill material and soil needed to adequately rehabilitate disturbed areas. WRD material and cleared WRD footprint areas requiring rehabilitation must be quantified as part of this process; • In the event that WRDs are to be left in-situ, the post-mining landform design should quantify the earth works required to meet the end land use criteria and cover requirements based on available material; and • Revisit and refine the end land use based on the outcomes of the post-mining landform design, volumetric assessment and actual material availability.	3	2	-3	-8	4	-32
		Surface Water	Alteration of hydrological landscape (lower than natural elevation) which may lead to reduced water quantity reporting to the downstream catchment.	3	3	-5	-11	6	-66	• Surface water modelling must be included as part of the landform design to inform a desired hydrological landscape to avoid impacts to the downstream catchment; • Integrate the post-mining storm water planning as part of the landform design to align the surface water runoff with the site-wide natural drainage framework; • Construct suitable slope gradients and additional storm water measures as required based on detailed post mining landform designs integrated hydrological and erosion modelling; and • Rehabilitation must aim for a free draining profile, avoiding the potential for water ponding to occur.	3	3	-5	-11	3	-33
	Possibility for the eventual failure of the WRD vegetation	Soil, Land Capability and post-mining Land Use	Erosion on bare surface (where re-vegetation is unsuccessful) and consequent loss of soil resource. This will	3	2	-4	-9	7	-63	• All WRDs are currently being reprocessed and resulting residue used as backfill for the shafts. Remaining WRDs will also be utilised as backfill for remaining cavities and voids due to infrastructure demolition and removal. Note: waste classification should be	3	2	-4	-9	4	-36

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
	cover and associated degradation of the soil cover due to erosion (climate change), inappropriate WRD configuration or inappropriate final WRD landform design resulting in ineffective stormwater control.		lead to reduced land capability and loss of post-mining land use potential.							confirmed to ensure backfilling operations are aligned with legal requirements; • Design the site wide post-mining landform integrated with the stormwater management plan, compile a volumetric assessment to quantify the amount of backfill material and soil needed to adequately rehabilitate disturbed areas. WRD material and cleared WRD footprint areas requiring rehabilitation must be quantified as part of this process; • In the event that WRDs are to be left in-situ, the post-mining landform design should quantify the earth works required to meet the end land use criteria and cover requirements based on available material; • In the event that WRDs are to be left in-situ, stormwater management infrastructure must continue to be maintained while WRDs are being rehabilitated to prevent the loss of soils through run-off; • Construct suitable slope gradients and additional storm water measures as required based on detailed post-mining landform designs integrated hydrological and erosion modelling; • Continue the maintenance of stormwater management infrastructure throughout the decommissioning and rehabilitation phase to ensure effective functioning; • Ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix (include tree stations on in situ WRD rehabilitation as required) and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; and • Post-closure monitoring will be undertaken for a period of at least 3 years. During this time, the sites must be monitored for vegetation establishment. Where vegetation is not occurring an assessment must be undertaken by a qualified ecologist to determine practical corrective measures which can be implemented.						
		Terrestrial Biodiversity	Reduced potential for restored ecological functionality and consequent loss of fauna and flora species.	3	2	-3	-8	5	-40	• All WRDs are currently being reprocessed and resulting residue used as backfill for open pits. Remaining WRDs will also be utilised as backfill for remaining cavities and voids due to infrastructure demolition and removal. Note: waste classification should be confirmed to ensure backfilling operations are aligned with legal requirements; • Design the post-mining landform for the cleared footprint or in situ WRD integrated with the stormwater management plan and considering opportunities to restore ecological functionality and cohesiveness with the surrounding systems;	3	2	-3	-8	3	-24

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
										• In the event that WRDs are to be left in-situ, the post-mining landform design should quantify the earth works required to meet the end land use criteria and cover requirements based on available material; • In the event that WRDs are to be left in-situ, suitable habitat must be created based on surrounding landforms; and • Construct suitable slope gradients and additional storm water measures as required based on detailed post-mining landform designs integrated hydrological and erosion modelling; • Ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix (include tree stations on in situ WRD rehabilitation as required) and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; and • Post-closure monitoring will be undertaken for a period of at least 3 years. During this time, the sites must be monitored for vegetation establishment. Where vegetation is not occurring an assessment must be undertaken by a qualified ecologist to determine practical corrective measures which can be implemented.						
			Infestation and spread of AIPs.	3	3	-4	-10	7	-70	• Following soil cover, ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; • Post-closure monitoring will be undertaken for a period of at least 3 years. During this time, the sites must be monitored for AIPs. Where AIPs are identified, these must be removed as soon as possible; and • In the event that certain AIPs are deemed beneficial to terrestrial biodiversity, the required permits must be obtained to leave/ plant these species in rehabilitation areas.	3	3	-3	-9	5	-45
		Air Quality & Visual	Generation of fugitive dust on bare surfaces resulting in a nuisance and health impacts (radioactive material) for nearby receptors.	3	2	-3	-8	6	-48	• Rehabilitate disturbed / cleared surfaces as soon as possible; • Dust monitoring must be undertaken until vegetation re-establishes on all bare surfaces; • Where dust generation is occurring, appropriate dust suppression measures must be investigated and implemented accordingly; and • Ameliorate soils based on dedicated fertility sampling and analysis, establish vegetation as soon as possible and apply follow up amelioration to avoid unsuccessful re-vegetation and consequent erosion.	3	2	-3	-8	4	-32
		Fresh-water Ecosystems	Deterioration in surface water quality caused by water erosion (increasing suspended solids in run-off) due to bare	5	3	-5	-13	6	-78	• All WRDs are currently being reprocessed and resulting residue used as backfill for open pits. Remaining WRDs will also be utilised as backfill for remaining cavities and voids due to infrastructure	5	3	-5	-13	4	-52

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
			surfaces. Water quality impacts will also adversely impact wetland habitat and sensitive aquatic biota (loss/ deterrence from immediate reaches).							demolition and removal. Note: waste classification should be confirmed to ensure backfilling operations are aligned with legal requirements; • Design the site wide post-mining landform integrated with the stormwater management plan, compile a volumetric assessment to quantify the amount of backfill material and soil needed to adequately rehabilitate disturbed areas. WRD material and cleared WRD footprint areas requiring rehabilitation must be quantified as part of this process; • In the event that WRDs are to be left in-situ, the post-mining landform design should quantify the earth works required to meet the end land use criteria and soil cover requirements based on available material; • Construct suitable slope gradients and additional storm water measures as required based on detailed post-mining landform designs integrated hydrological and erosion modelling; • Continue the maintenance of stormwater management infrastructure throughout the decommissioning and rehabilitation phase to ensure effective functioning; • Rehabilitate disturbed / cleared surfaces as soon as possible; • Ameliorate soils based on dedicated fertility sampling and analysis, seed all disturbed areas with a suitable indigenous species mix (include tree stations on in situ WRD rehabilitation as required) and conduct follow-up soil amelioration and maintenance of rehabilitated areas based on monitoring outcomes; • Post-closure water quality, wetland and biomonitoring must be undertaken to detect impacts; and • If impacts are detected, appropriate corrective measures must be investigated and implemented accordingly.						
6. Plugging of shafts and rewatering of underground workings	Possibility for groundwater contamination as recharge occurs in the mine voids consequently requiring management/ potentially pump and treat mine water after closure to prevent groundwater contamination.	Ground-water	Potential contamination of groundwater resulting from the interaction of water with the exposed rock and any remaining sources of contamination in the underground workings. Geochemical modelling (SRK, 2018) predicts that water (quality over time, once cease) in shafts is not expected to be similar to that of the dolomitic aquifer (no parameters exceeding the SANS 241 Drinking Water Standards). Note: Sediments in the underground settler dams are not considered as a source of contamination due to the lime dosing that takes place in the dams and this material	6	3	-3	-12	4	-48	• A detailed waste and hydrocarbon sources inventory of the underground workings must be kept. All waste and hydrocarbons must be removed from the underground workings as part of decommissioning and rehabilitation activities; • The workings must be thoroughly inspected for any hydrocarbon spillages. If identified, this must be cleaned up prior to rewatering taking place; and • Hydrocarbon monitoring should be undertaken post-rewatering to ascertain the predicted water quality modelled. In the event that water is deemed to be a potential source of contamination, treatment measures must be investigated and implemented accordingly.	4	3	-3	-10	2	-20

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
			making up a negligible percentage of the reactive area underground. It is therefore not deemed necessary for the present sediments to be removed.													
	Potential for mine water in the shafts to seep into the dolomite aquifer as recharge occurs, consequently extending the possible contamination plume.	Ground-water	Potential decant from the underground workings once rewatered. Hydrogeological numerical modelling predicts that water level in shaft will rise to a final groundwater level of 1,570 mamsl at Cooke 2 (which is the lowest lying shaft) therefore, no surface decant from the shafts or the mine void is expected. Note: based on the outcome of the underground geochemical modelling the shafts are not expected to be potential contamination sources (MvB Consulting, 2020).	7	2	-2	-11	3	-33	• Although geochemical modelling does not expect the shafts to be potential sources of contamination (SRK, 2018) it remains essential that water in the shafts is contained as a precautionary measure (i.e. not allowing surface decant), this does not necessarily require capping as explained in the Geohydrological Specialist report; • Rewatering must be monitored to ascertain the hydrogeological modelling predications; • The hydrogeological modelling should be updated as more information becomes available during rewatering to more accurately determine the possibility for decant; • In the event that decant is expected, measures to cap the shafts must be investigated and implemented prior to the completion of rewatering; and • Water quality must be monitoring within the underground workings, if deemed to be inappropriate treatment options must be considered accordingly.				0		0
	Possibility for decant to occur in the Wonderfonteinspruit (long-term) as a result of the rewatering of the underlying mine voids (refer to hydrogeological numerical model results Section 11.2.3.1.3)	Surface Water (quality)	**Short Term**: Until such a time as natural decant occurs from the Zuurbekom Compartment (expected to take a minimum of 15 years) an adverse water quality impact is expected to result from the cessation of discharge into the Wonderfonteinspruit from the Cooke Underground Operations. This will be caused by high metal and nutrients inputs from upstream which are currently diluted by Sibanye's discharge. Furthermore, there are sediments in the Wonderfonteinspruit downstream of the Cooke discharge point. Once discharge is ceased there is an increased potential for oxidation and subsequently the release of metals during rainfall events (between Cooke No. 1 Shaft and Donaldson Dam).	4	3	-5	-12	6	-72	• Waste characterisation of the existing instream sediment must be undertaken and rehabilitation must be informed based on the outcomes; • Water quality monitoring a must be undertaken downstream of the Cooke No. 1 discharge point following the cessation of water discharge to detect if the any impacts are realised;	4	3	-5	-12	4	-48
			Long term: Once natural decant occurs from the Zuurbekom Compartment (expected at least 15 years after closure and on condition that Ezulwini Gold Mine is	7	3	4	14	5	70	• No enhancement measures are proposed.	7	3	4	14	5	70

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
			also rewatered) an improvement in water quality is expect as dilution takes place with cleaner water from the dolomite aquifer.													
		Surface Water (quantity)	**Short term**: Decreased flow to the Wonderfonteinspruit downstream of the Cooke No. 1 Shaft discharge point for the period between the cessation of discharge and when natural decant occurs from the Zuurbekom Compartment (expected to take a minimum of 15 years). This will adversely impact downstream water uses and sensitive aquatic biota (loss/ deterrence).	7	4	-4	-17	7	-105	• No mitigation measures are proposed.	7	4	-4	-17	7	-105
			Long term: Increased flow to the Wonderfonteinspruit (estimated additional flow of 2.5Ml/d) as a result of gradual decant from the Zuurbekom Compartment once it recovers to the pre-mining water levels. Note: flow will increase over a 10 year period while the groundwater levels recovers, until it reaches a steady state.	7	5	5	17	5	85	• No enhancement measures are proposed.	7	5	5	17	5	85
	Possibility for sinkhole formation/ surface subsidence due to rewatering.	Groundwater	Potential contamination of groundwater (increase in suspended solids from subsidence event and potential underground pollution sources e.g. pipelines). Note: based on the outcomes of the Stability Assessment, subsidence is not expected.	5	2	-2	-9	3	-27	• Subsidence monitoring must be undertaken until rewatering is complete; and • Water quality monitoring must continue to be undertaken to detect any impacts which may be related to subsidence. If impacts are detected, corrective measures must be undertaken as soon as possible.	5	2	-1	-8	3	-24
		Fresh-water Ecosystems	Potential collection of surface water runoff in areas of subsidence/ sinkholes. This will reduce amount of water reporting to surrounding surface water features (incl. wetlands) and consequently may affect aquatic biota.	2	2	-3	-7	3	-21	• Subsidence monitoring, using aerial imagery, must be undertaken until rewatering is complete; • In the event that subsidence occurs, corrective measures depending on the extent of the impact must be undertaken as soon as possible; and • Ecological monitoring must be undertaken following the implementation of corrective measures to assess ecological functionality. Where adverse impacts persist, appropriate restoration measures must be investigated.	2	2	-1	-5	2	-10
		Terrestrial Biodiversity, land	Surface instability resulting in compromised ecological functionality and	2	2	-3	-7	3	-21	• Subsidence monitoring must be undertaken until rewatering is complete;	2	2	-3	-7	3	-21

Activity	Risk Description	Aspect Affected	Possible Impact	Pre-mitigation:						Mitigation Measures	Post-mitigation:					
				D	E	I	C	P	S		D	E	I	C	P	S
		use and land capability	consequently the post-mining land use in areas of subsidence/ sinkholes.							• In the event that subsidence occurs, corrective measures depending on the extent of the impact must be undertaken as soon as possible; and • Ecological monitoring must be undertaken following the implementation of corrective measures to assess ecological functionality. Where adverse impacts persist, appropriate restoration measures must be investigated.						
		Social	Higher health and safety risk for humans and animals.	2	2	-3	-7	3	-21	• Subsidence monitoring must be undertaken until rewatering is complete; and • In the event that subsidence occurs, corrective measures depending on the extent of the impact must be undertaken as soon as possible.	2	2	-3	-7	3	-21
			Damage to existing buildings and infrastructure.	2	2	-3	-7	3	-21	• Subsidence monitoring must be undertaken until rewatering is complete; and • In the event that subsidence occurs, corrective measures depending on the extent of the impact must be undertaken as soon as possible.	2	2	-3	-7	3	-21

11.4 Cumulative Impacts

Cumulative effects are caused by the accumulation and interaction of multiple stresses affecting the parts and the functions of ecosystems. Of particular concern is the knowledge that ecological systems sometimes change abruptly and unexpectedly in response to apparently small incremental stresses. For purposes of this report, cumulative impacts have been defined as “the changes to the environment caused by an activity in combination with either past, present, and reasonably foreseeable human activities”.

As established throughout this BAR, the 07 MR and 173 MR areas are associated with various land uses and activities which have contributed to environmental and socio-economic impacts. In terms of mining, activities date back to over a century and remnants of historic mining infrastructure and TSFs across the landscape.

The proposed decommissioning, rehabilitation and closure activities across both Mining Right Areas is aimed to reduce/ remove persistent environmental impacts associated with the Cooke Surface- and Underground Operations. The overall impacts of the proposed activities are expected to result in long-term water quality improvement and restoration of natural ecological characteristics. This will reduce the existing cumulative impacts of mining in these areas and expected to be beneficial on a regional scale.

The impacts identified for the proposed activities, including potential nuisance impacts and adverse impacts to freshwater resources (hydrocarbon contamination, siltation and sedimentation) are expected to be localised and not significantly contribute to cumulative impacts to those existing.

From a socio-economic perspective, mining remains the predominant economic activity and contributor to the GDP of the RWCLM. The closure of the Cooke Underground Operations will contribute to the cumulative impact of increased income poverty, unemployment and possibly illegal mining activities which are already prevalent in the greater West Rand area. However the implementation of the measures recommended in the SCP will mitigate this impact and will result in long term sustainable economic solutions.

12 Summary of Specialist Reports

Specialist studies were undertaken to inform this BAR as listed in Table 10-1 above. The specialist input included the baseline environment, potential impacts and the recommended mitigation measures. Table 12-1 provides a summary of the key recommendations of the studies.

Based on the impact assessment, all studies generally found that the project will have a long-term environmental and socio-economic benefit. This depends on mitigation measures being correctly implemented as well as undertaking and implementing the planned SCP Process to achieve sustainable closure.

Table 12-1: Specialist Studies undertaken for the Basic Assessment

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations included in this report	Reference to applicable section of report where specialist recommendations have been included
Wetland Impact Assessment	This study determined that over time it is anticipated that affected wetland areas in 07 MR could return to pre-mining conditions an improvement of ecological functionality could be realised from the rehabilitation of affected wetland in 173 MR. To achieve this, the following recommendations are provided: • Monitoring of surface water resources, wetland systems and aquatic biota undertaken within the Wonderfonteinspruit is critical to identify changes in water quality and quantity over time to understand the overall impacts that would occur to this system as a result of the proposed activities; • A rehabilitation plan needs to be compiled, based on the current PES and EIS for Magazine Pan and implemented accordingly; • The required water authorisation in terms of the NWA must be obtained prior to rehabilitation activities within wetlands and their 500 m buffer zones; • Groundwater numerical modelling must be updated as information changes/becomes available to ensure the potential for decant is better understood and can be managed accordingly; and • Water treatment options must be considered for the longer term closure scenario, if required.	X - All recommendations have been considered and included in this BAR.	Mitigation and management measures included in these reports were recommended by the represent Specialists, as well as the monitoring programmes. This includes the impact assessment and mitigation measures as discussed in Section 11, as well as the recommendations and monitoring programme provided in the CEMPr (Part B).
Hydrogeology Impact Assessment	Through a numerical model, the hydrogeological study determined that the shafts are not expected to be a contamination source for the surrounding environment as there is a low probability for water to decant from the workings and water quality in the shafts is expected to be of an acceptable standard. The Cooke TSF was however determined to be a potential contaminant source, with a limited contamination migration plume (i.e. are no receptors in the predicted flow path). Over time water flow from the dolomitic aquifer to the Wonderfonteinspruit is expected which will result in improved water quality in the stream. The following recommendations have been made to optimise rehabilitation and closure: • Due to a number of geohydrological variables it is very important to have an accurate monitoring system in place prior to closure. The aim of the monitoring is to verify the model predictions and to make adjustments were necessary. The monitoring network will provide an early warning system that will alert the mine to unexpected changes in the groundwater levels and/or quality. It is recommended that five new boreholes be drilled in this regard (please refer to the Monitoring Programme in the CEMPr (Part B) for further detail); • Surface water flow monitoring in the Wonderfonteinspruit must be reinstated to verify the model predictions (please refer to Monitoring Programme in the CEMPr (Part B) for further detail); • It is recommended that six additional groundwater monitoring boreholes be drilled to monitor groundwater levels at strategic points in the Zuurbekom West Compartment; and groundwater quality down-gradient from the potential contaminant sources (including shafts) to determine potential contaminant migration and sub-surface mine water decant after closure (please refer to the Monitoring Programme in the CEMPr (Part B) for further detail); and • Sibanye must continue to investigate the feasibility to reclaim the Cooke TSF as part of the Cooke Surface Operation as a rehabilitation measure.		

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations included in this report	Reference to applicable section of report where specialist recommendations have been included
Hydropedological and Surface Water Quality Impact Assessment	This study determined that it is anticipated that the potential positive impacts will outweigh negative impacts in the long term and thus the associated closure activities would ultimately be beneficial for the receiving water environment in the long term in terms of water and soil quality and the overall water flow regime to receiving water bodies. The following recommendations have been made to optimise rehabilitation and closure: • Ongoing water quality monitoring of surface and groundwater monitoring is imperative during the decommissioning, rehabilitation and post closure phases to allow for early detection of potential contaminants that may cause unforeseen negative impacts on the receiving environment; • A detailed rehabilitation plan must be developed for the Magazine Pan considering reprofiling the terrain close to natural drainage conditions and the potential impacts of the reduction of the wetland area due to ceased pumping of partially treated mine effluent into the pan; • The recommendations made in the soil management plan compiled by Digby Wells (2017) must be revisited and implemented during rehabilitation and post closure to ensure minimal soil contamination, preservation of land capability and to maximise on the benefits of post mining land use; • Care should be exercised to ensure that no disruptions of flow paths occur during the decommissioning and rehabilitation processes, with guidance from the identified hydrological responses at specific sites; and • Despite the ultimate positive outcome of the discharge it should be noted that other water users impacting upon the catchment in the interim in terms of metals, salts, nutrients and pathogens will need to be carefully monitored and managed as the current dilution provided will be temporarily reduced due to the cessation of the Cooke No. 1 Shaft discharge.		
Geochemical and Waste Classification Assessment	Mining activities across 07 MR and 173 MR have resulted in the accumulation of sediments across the landscape, including in sensitive freshwater features. All samples were classified as Type 3 waste against the NEM:WA Regulations. Although some of the samples collected showed the potential to form acidic leachates in the short term, there was not enough mineralogical evidence or high sulphide sulphur content in the samples to conclusively indicate any potential long-term AMD issues. In addition, the sampling points for which short term acid leachate potential was indicated are upstream of the Cooke Operations, and samples taken downstream of the Cooke Operations did not indicate short term acid generating capacity. The following recommendations were made to inform rehabilitation activities: • Dust suppression and runoff capture/clean water diversion during the ongoing reclamation and rehabilitation activities at the Lindum TSF, Cooke Gold Plant area, Cooke TSF and return water dams, Millsite TSF and the Cooke No. 1 and 2 Shaft areas is recommended to prevent further spread of materials and/or dust/sediments; • Discharge of treated water to the Magazine Pan should be halted as soon as possible; • Continued surface water quality monitoring is recommended for the historically impacted wetlands and associated watercourses, the Millsite TSF Complex and the current monitoring points in the Wonderfonteinspruit River; • In addition, a borehole located between the Cooke TSF and the Wonderfonteinspruit (refer to the recommendations as part of the Groundwater Impact Assessment) should be monitored once drilled and constructed to detect any seepage from the Cooke TSF flowing towards the Wonderfonteinspruit; • The reprocessing of sediments and silt material from the Cooke Shaft 1 and 2 areas is supported and more sustainable than stripping and discarding the material which will just move the contaminant source from one area to the next. The reprocessing may have a potentially positive effect on the composition and leachability of these materials, as the pH will be more neutral and metals concentrations could be reduced. Reprocessed materials will be sampled to confirm the average composition before backfilling and can confirm the positive effect, if any; • Waste classification on additional sediment samples along the eastern bank of the Wonderfonteinspruit Riverbed is recommended, including just upstream of the Donaldson Dam to confirm the current results and allow comparison with		

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations included in this report	Reference to applicable section of report where specialist recommendations have been included
	Wonderfontein River water quality results as these should reflect the sediment sample results. In addition, sediment sampling after cessation of any discharges would be recommended to enable access to currently flooded areas and to assess the sediment quality post-discharge cessation; • The sediments have accumulated in the historically impacted wetlands and associated streams, Wonderfonteinspruit, Magazine Pan and wetland downstream of the Millsite TSF complex in which aquatic ecosystems have developed despite any potentially negative impacts from these sediments. It is likely that the accumulated sediments were fully weathered and may have developed different characteristics under the waterlogged conditions of the wetland and stream systems. In addition, the impacts of the disturbance of these sediments and of the established ecosystems during any removal of sediments will likely do more harm than any potential impact from the observed, low levels of leachable constituents. The following future studies on these above-mentioned areas are recommended: • Additional sampling in a grid format of specifically the areas in which sediments have accumulated in the historically impacted wetlands/streams, the Wonderfonteinspruit (including the reach between Cooke 1 shaft discharge point and location of Donaldson dam), the Magazine Pan and the wetland downstream of the Millsite TSF complex. Specific grid spacing and sampling locations to be confirmed prior to the additional sampling; • Enough sample material from these sites be taken to do additional waste classification work to determine if materials could aid land amelioration, or indicate if there is any need for sediments to be removed and disposed of, although as stated above this would be discouraged; and • Wetland, hydropedology, aquatic ecology and surface water impact assessments should be consulted before any stream or wetland material is removed and/or rehabilitated. • If any material is stripped/excavated for the purpose of disposal it should be handled and disposed of in accordance with the disposal methods as currently in place on-site.		
Heritage Impact Assessment	Five heritage resources, all burial grounds and graves, were identified across 07 MR. Based on the understanding of the proposed activities and given the location of the heritage resources, no direct or indirect impacts against cultural heritage resources identified during the pre-disturbance survey are envisioned. As noted in the existing Clidet EMPr, the three Cooke shafts came into operation during the late 1970s. It is therefore unlikely that the project will impact heritage resources afforded general protection under Section 34 of the NHRA. To minimise unplanned direct impacts to unidentified heritage resources, Sibanye must develop a Chance Find Protocol (CFP) which must be approved by the relevant Heritage Resource Agencies (HRAs) and which must be implemented prior to the commencement of the proposed activities.		
Socio-economic Impact Assessment	The closure of the Cooke Underground Operations will inevitably have adverse socio-economic effects. This study determined that a prudent approach can be developed to management and monitoring socio-economic impact, not only for the proposed activities but to achieve sustainable social closure through the planned SCP Process. The key recommendation of this SIA is therefore that the planned SCP Process be carried out as part of Phase Three of the closure process.		
Rehabilitation and Closure Plan	A Decommissioning, Rehabilitation and Closure Plan as compiled for closure requirements evaluated in 2019 has been compiled for the Cooke Underground Operations. This plan provides a preliminary assessment of closure requirements, which will be refined pending approval of this environmental regulatory process and thereafter, with the progression on implementation of decommissioning, rehabilitation and closure activities. This plan will be reviewed and updated annually, to include new information made available through new studies and improved understanding of operations and the planned transition to closure. The ERA identified potential residual and/or latent risk that may require management after the sites are ceded for post-mining land uses. The following recommendations were made to reduce the probability of occurrence of residual and/or latent risks:		

List of studies undertaken	Recommendations of specialist reports	Specialist Recommendations included in this report	Reference to applicable section of report where specialist recommendations have been included
	• Screening level contaminated land assessments of all shaft and infrastructure areas (incl. WRD and dam footprints) must be conducted to inform rehabilitation requirements; • Radiation assessments are recommended to be conducted to develop appropriate management plans for the shaft complexes and other mine infrastructure areas to be rehabilitated – this work is currently in progress; • A prioritised AIP control programme is recommended to be developed, focussing on watercourses and areas of densest infestation – this work is currently in process; • Sibanye must continue to investigate the feasibility to reclaim the Cooke TSF as part of the Cooke Surface Operation/ West Rand Tailing Retreatment Project as a rehabilitation measure; • It is recommended that a regional climate change impact assessment be conducted to determine the potential impacts of long-term climate change on rehabilitated mine areas, and to identify additional rehabilitation and aftercare requirements; • Decant groundwater and surface water quality monitoring once decant manifests must be performed, in addition to routine post-closure water quality monitoring to be conducted as part of implementation of the closure plan; • The current indications are that no mine water decant will occur, only dolomitic water. However, it is deemed necessary that a comprehensive, regional post-closure water management strategy be developed in consultation with the relevant government departments; • Subsidence/ crack monitoring must continue as presently undertaken and it is recommended that a related complaints reporting framework be developed in consultation and agreement with the GeoSA to ensure future issues can be raised and further investigated. • Annual (or suitable frequency) sinkhole and subsidence monitoring must be performed for a 10-year period during and after initial re-watering of the mine; • In consultation with the local municipality and other relevant stakeholders, an inventory of infrastructure that may potentially be transferred to third parties for post-closure use, and associated repurposing feasibility assessments must be determined – this work is currently in process; and • A closure-focussed consultation with key stakeholders from time to time must be conducted, to ensure that closure planning conducted and implemented by the mine remains aligned with governmental requirements, and community expectations, as appropriate – this work is currently in process (SCP Process in Phase Three).		

13 Environmental Impact Statement

13.1 Summary of the Key Findings of the Environmental Impact Assessment

The Impact Assessment, as informed by specialist studies, determined that the proposed decommissioning, rehabilitation and closure activities for 07 MR as well as 173 MR will result in longer term environmental benefits.

There are impacts specifically associated with the decommissioning and rehabilitation activities proposed and the broader impacts associated with the closure of the Cooke Underground Operations. The subsections below summarise the findings of the Impact Assessment for these separately.

13.1.1 Impacts Associated with the Proposed Activities

The majority of adverse impacts associated with the implementation of the proposed decommissioning and rehabilitation activities are expected to be of Minor or Negligible Negative significance. Possible impacts include sedimentation of nearby watercourses and wetlands as a result of erosion (water and wind) from bare surfaces following the removal of infrastructure as well as soil and water resource contamination from hydrocarbon spillages/ leakages. This would consequently lead to reduced ecological integrity of the freshwater ecosystems which, as established in the Baseline Section, are already adversely impacted. Nuisance impacts in terms of increased noise and dust fallout may also be experienced by nearby receptors during the execution of these activities.

On the other hand, if the planned rehabilitation activities are correctly implemented, various positive impacts will be realised and establish a sustainable post-mining land use (preliminarily indicates as open areas suitable for agriculture and/or biofuel energy production). This would entail the removal of existing contamination sources and AIPs from the landscape and wetlands as well as profiling of disturbed areas and re-establishment of natural vegetation. This will be beneficial to terrestrial biodiversity and freshwater ecosystems at a regional scale as it is currently under pressure from multiple land uses. Although impacted, the wetland systems assessed indicate a high provision of ecological services. Therefore, the planned rehabilitation of affected wetlands across 07 MR and 173 MR is deemed an impact of Moderate Positive significance. Furthermore, these activities will restore pre-mining drainage of runoff into the Wonderfonteinspruit.

If rehabilitation is not correctly implemented, adverse residual impacts could occur post-closure. These impacts include contamination from remaining infrastructure (such as unidentified buried pipelines) or unremoved contaminated material/ sediments, loss of soil resource through erosion on bare surfaces where vegetation cover is inadequate and consequent potential for sedimentation of watercourses as well as encroachment of AIPs.

From a socio-economic perspective, job opportunities will be available for the execution of decommissioning and rehabilitation activities. As established in the Baseline Section, a large

portion of households in the RWCLM live within the low bound and upper bound poverty line. Therefore, the creation of job opportunities, particularly for unskilled labour within the primary study area is a notable benefit. The presence of mining infrastructure at the shaft complexes presents a security risk in the area where illegal mining activity is already prevalent. Therefore, the complete removal of infrastructure will have a beneficial effect as security risks will be reduced while the sale of salvageable material will also be beneficial, to relevant local supply chain, businesses and interested members of community.

It is however noted that health, safety and security risks will still be present throughout the execution of the decommissioning and rehabilitation activities with specific respect to illegal mining. Furthermore, community unrest due to a perceived lack economic opportunities and unfulfilled promises is possible.

13.1.2 Impacts Associated with the Closure of the Cooke No. 1, 2 and 3 Shafts

Gold mining in the West Rand has a long history with ongoing mining activities as well as remnants of historic mining infrastructure and an extensive mine void. As such, residual environmental and socio-economic impacts are existing with a notable concern regarding impacts to water resources. The TCTA's AMD Treatment Project, which is currently and will continue to be operated by Sibanye, is one of the ways legacy water contamination issues is being addressed.

A comprehensive hydrogeological model was carried out to inform potential impacts of closure on water resources. The model simulations indicate that groundwater within the shafts as it rewaters as well as the larger mine void is not expected to decant to surface. Based on results of geochemical modelling of the underground workings, groundwater quality within the shafts once rewatered is expected to be of acceptable quality. Therefore, even in the unlikely event that decant does occur, water from the shafts is not regarded as a contamination source.

The Cooke TSF and its associated RWDs, together with mud ponds located at the shaft complexes have however been identified as contamination sources through the leaching of contaminants such as TDS, aluminium, arsenic, cobalt, chromium, copper, manganese, nickel, lead, zinc, iron and sulphate. The mud ponds planned to be removed as part of the proposed activities. For the Cooke TSF, the modelled contamination plume indicates that there are no receptors in the predicted flow path. Based on this, potential contamination flow from surface infrastructure is therefore not expected to cause significant impact to the groundwater environment and as such deemed an impact of Minor Negative significance.

Over time as the mine void (inclusive of Cooke No. 4 Shaft) is allowed to rewater following the cessation of mining activities, it is expected that water levels in the affected Dolomite Compartments will recover. This will eventually lead to the return of pre-mining water flow into the Wonderfonteinspruit via the Gemsbokfontein Eye. This water is expected to be of acceptable quality and as such will result in a water quantity and quality improvement for the catchment, associated freshwater ecosystem and downstream water users. This has been rated as an impact of Moderate Positive significance.

Until this time however, a reduction in water flow in the Wonderfonteinspruit downstream of Cooke No. 1 Shaft will occur as the current discharge will be ceased. This will affect downstream water users in terms of water availability but also is expected to result in a deterioration in water quality as the current discharge into the Wonderfonteinspruit provides dilution effects to water impacted upstream by municipal and other activities. To this end, an interim negative impact of Moderate Negative significance will be realised which is unavoidable.

In terms of socio-economic impact, the permanent closure of the Cooke Underground Operations will inevitably result in an adverse effect to the surrounding local economy and possibly the broader region. This specifically relates to the direct loss of jobs and induced benefits that results from the operations. It is noted that following the cessation of underground mining in 2018, approximately 98% of the associated workforce was retrenched in line with the process for downscaling and retrenchment as committed to in the operation's SLP. The remaining 2% of the workforce either remained at the operations for maintenance activities or were redeployed to other operations. It has been reported that some of the retrenched workforce remained in the broader primary study area in anticipation of recommencement of mining. Mining will however not resume at the Cooke Underground Operations and all economic benefits associated with the mine will be permanently lost. In addition, 41 contractors who were part of the supply chain had their contracts terminated as part of the cessation of underground mining.

In the absence of formal employment, illegal mining creates an avenue for people to earn relatively significant sums of money. This will likely affect neighbouring mines in the area as well as increase health, safety and security risks as illegal miners will attempt to access the capped shafts until they are fully rewatered. This impact may extend in the long-term and possibly create a wider community safety risk if economic activity remains relatively low in the study areas.

13.2 Final Site Map

The site layout is shown in Plan 4 with the proposed post-mining land use for 07 MR shown in Plan 5 above.

13.3 Summary of the Positive and Negative Implications and Risks of the Proposed Activity and Identified Alternatives

Please refer to Section 13.1 for a summary of the potential positive and negative implications as well as risks associated with the proposed activities. These have been determined based on the preferred alternatives presented in Section 8.1 above.

Based on the nature of the proposed activities and the operations, the considerations of alternatives were limited.

14 Proposed Impact Management Objectives and the Impact Management Outcomes for Inclusion in the EMPR

The CEMPr (Part B) seeks to achieve a required end state which for 07 MR will allow for permanent mine closure and the land to be ceded for other sustainable land uses; while for 173 MR, it will reduce the risk of long-term environmental liabilities associated with existing impacts to wetlands. The key objectives of the CEMPr therefore are:

- To minimise the extent of an impact during the proposed decommissioning, rehabilitation and closure activities;
- To ensure appropriate restoration of areas affected by the Cooke Operations; and
- To prevent long term environmental degradation.

15 Aspects for Inclusion as Conditions of Authorisation

The EAP recommends the following conditions for the DMRE to consider for inclusion into the Authorisation:

- The mitigation and enhancement measures contained in the CEMPr (Part B) must be adhered to for the overall positive implication of the project to be realised;
- An ECO must be appointed for and be present during the decommissioning phase;
- An IWUL must be obtained prior to undertaking the proposed rehabilitation activities to wetlands;
- Based on the outcomes of the Geochemical and Waste Classification Assessment, additional waste classification work is required in the historically impacted wetlands/streams, sections of the Wonderfonteinspruit, the Magazine Pan and the wetland downstream of the Millsite TSF Complex to determine if materials could aid land amelioration, or indicate if there is any need for sediments to be removed and disposed of;
- The Hydrogeological Numerical Model must continue to be updated periodically as more information becomes available during closure implementation of the Cooke Underground Operation to refine the model predictions;
- The Decommissioning, Rehabilitation and Mine Closure Plan must be updated on an annual basis, considering the progression of rehabilitation and closure activities as well as the status of impact predictions;
- The planned SCP Process must be implemented to meaningfully engage with stakeholder and develop a practical plan to execute social closure;
- Environmental monitoring as prescribed under the CEMPr (Part B) must continue throughout the implementation of proposed activities;
- Post-closure monitoring must be undertaken in line with the Decommissioning, Rehabilitation and Mine Closure Plan once determined;

- A comprehensive Rehabilitation Plan must be developed for the Magazine Pan, other ley identified impacted watercourses and implemented accordingly
- The rehabilitation plans should be updated and developed in a step-wise manner, i.e. source of impact mitigated, impacted sediments and soils removed/ ameliorated as needed and final rehabilitation in terms of landscaping and vegetation developed and implemented; and
- Specific rehabilitation plans must be developed for the targeted affected wetlands across 07 MR and 173 MR which are informed by the ecological state of these system which has been established in this assessment.

16 Description of any Assumptions, Uncertainties and Gaps in Knowledge

The following general assumptions are applicable to this BAR:

- The specialist studies and impact assessment have been based on the proposed decommissioning, rehabilitation and closure activities identified by Sibanye;
- The findings of the Impact Assessment presented are based on professional experience, supported by literature, and extrapolated from the data collected from various sources including ongoing environmental monitoring data and stakeholder engagement material supplied by Sibanye; and
- Representative sampling methods were employed for the studies conducted and therefore the possibility of gaps in the data gathered exists.

Table 16-1 below presents the assumptions, uncertainties, limitations and knowledge gaps relevant to the various specialist studies undertaken.

Table 16-1: Specialist Studies Assumptions, Uncertainties and Gaps

Specialist Study	Assumptions, uncertainties and gaps
Wetlands	• This wetland assessment report is based on previous assessments that have been undertaken across 07 MR and 173 MR; • The wetland delineation for areas that could not be accessed was based on a desktop assessment and would need to be verified in future; • The focus of the assessment was to confirm changes to existing wetlands that had been delineated based on the desktop review, identification of any potential new wetlands areas that may have been omitted from previous assessments or not identified; • A large portion within the Cooke Mining Right Areas could not be visited as a result of security and safety reasons, thus the previous wetland specialist reports and other existing spatial information was utilised for these areas; and

Specialist Study	Assumptions, uncertainties and gaps
	• Township areas were excluded from this assessment.
Hydropedology	The quantification of the potential impact of Sibanye's activities in the Wonderfonteinspruit catchment presented a challenge for Sibanye since the complex catchment does not have end user requirements (i.e. Resource Quality Objectives) set by the Government. Therefore, Sibanye developed a site-specific long-term plan of target water quality limits to be adhered to in order to inform post closure requirements on downstream water users. These guidelines were applied in the study to assess compliance with historical water quality. It was assumed that the methodology applied to derive these guidelines is acceptable as the approach includes consideration of downstream water users, water use licence limits and resource quality objectives for the Mooi River Catchment. This furthermore takes into consideration the guidelines outlined in the Mine Closure Series in terms of water quality management (DWAF 2008).
Hydrogeology	A numerical groundwater model is a representation of a real system. It is therefore at most an approximation, and the level of accuracy depends on the quality of the data that is available. This implies that there are always errors associated with groundwater models due to uncertainty in the data and the capability of numerical methods to describe natural physical processes. To develop the numerical model for the Cooke Underground Operations, the following assumptions were made: • The water inflow into the underground mine comes from the overlying dolomitic aquifer through interconnecting geological structures between the dolomitic and Witwatersrand aquifers, and not from the Witwatersrand aquifers themselves; • The system is initially in equilibrium and therefore in steady state, even though natural conditions have been disturbed; • No abstraction boreholes were included in the initial model; • The boundary conditions assigned to the model are considered correct; and • The impacts of other activities (e.g. agriculture) have not been considered.
Geochemical Assessment and Waste Classification	• Comparisons were made with existing geochemical assessments of materials sampled as part of the hydrogeological assessment to determine the potential sources of the material; • The mineral names in this report may not reflect the specific mineral identified, but rather the mineral group; • Due to preferred orientation and crystallite size effects as well as small sample amounts, results may not be as accurate as shown; and • Amorphous phases, if present, were not taken into account during quantification.

Specialist Study	Assumptions, uncertainties and gaps
Heritage	• The cultural heritage baseline is considered accurate but may not include new data or information which may not have been made available to the public or was not contained in the specialist reports conducted by Sibanye; • It is assumed the previously recorded heritage resources are accurate and true; • The reviewed literature, previously completed heritage assessments and the results of the field survey are in themselves limited to surface observations; • Subsurface tangible heritage are unknown and may be impacted upon; and • Previously unidentified heritage resources may be encountered.
Socio-economic	• The Impact Assessment based on secondary data collected via online resources only; and • Some of the data may be outdated owing to the last official census conducted in 2016.

17 Reasoned Opinion as to whether the Proposed Activity should or should not be Authorised

17.1 Reasons why the Activity should be Authorised or Not

Various specialist studies were undertaken to inform this BAR with the objective of identifying and weighing anticipated impacts and risks associated with the proposed project activities.

The findings of the Impact Assessment show that the majority of adverse impacts are expected to be of Minor or Negligible significance. With the implementation of the proposed mitigation measures, it is expected that the significance of all identified impacts can be reduced. This will result in the majority of adverse impacts for the implementation of decommissioning and rehabilitation activities being of Negligible Significance. Ultimately, the activities are aimed at rehabilitating mine affected areas and water resources which, if successfully executed, should restore and improve the environmental biophysical characteristics of these area and contribute to reducing the existing adverse cumulative impact caused by current and historic mining activities in the West Rand.

Mining at the Cooke No. 1, 2 and 3 Shafts ceased in May 2018. Sibanye has maintained the underground workings as investigations were carried out to determine options to continue mining. No options could be identified and as such, a permanent sustainable closure solution is required. Once all underground infrastructure and all potential contamination sources are removed, it is proposed that the workings be sealed and rewatered. Based on the outcomes of the hydrogeological numerical model, adverse impacts associated with this closure plan are expected to range between Moderate and Minor Negative significance. The most significant

of which are caused by the cessation of discharge of treated effluent from the shafts into the Wonderfonteinspruit which are unavoidable.

In the long term, water flow into the Wonderfonteinspruit is expected to recover and the shafts are not expected to be a contamination source to the environment. To this end, all specialist studies deem that the implementation of decommissioning, rehabilitation and closure activities as proposed will meet the desired closure objectives. Furthermore, the activities are expected to be beneficial to the receiving environment when compared to the no-go alternative. The no-go alternative would maintain the status quo which presents existing impacts and increased risk for residual and/or latent impacts to occur.

From a socio-economic perspective, potential negative impacts with respect to health, safety and security risks could be realised during the execution of the proposed activities. However, temporary economic opportunities will be created to carry out rehabilitation activities.

To this end, the implementation of the proposed mitigation measures for the proposed activities as well as those determined to reduce the probability for residual and/or latent impacts is imperative to achieve the objective of this rehabilitation and closure project. It is therefore recommended that the project proceeds.

17.2 Conditions that must be included in the Authorisation

The recommended conditions for inclusion in the EA are listed in Section 15 above.

18 Period for which the Environmental Authorisation is Required

Ultimately, the duration of the project and consequently the validity period of the EA will be determined by issuance of the Closure Certificate.

The Decommissioning, Rehabilitation and Mine Closure Plan, **Appendix J**, indicates that decommissioning and rehabilitation activities are expected to take up to three years to execute. In line with best practices, post-closure monitoring should take place for a between three to five years.

It is however noted that the rewatering of the underground workings and other post-closure impacts assessed are long term (in excess of five years after closure). This will need to be considered in the refinement of the closure plan as rehabilitation and closure activities progress to determine the most practical way to monitor such impacts.

19 Financial Provision

The detailed financial provision for the proposed project is provided in the Decommissioning, Rehabilitation and Mine Closure Plan, **Appendix J**. A comprehensive Closure Cost Report for the Cooke Underground Operations was compiled in 2019. The costing (considered scheduled and unscheduled closure) which were calculated at **R 335 million and R 423 million** respectively.

Table 19-1: Cooke Underground Operations Closure Costs, as at December 2019

Closure Components		Unscheduled Closure (2019)	Scheduled Closure (2035)
1	Infrastructural aspects	R 199 765 019.64	R 199 981 160.13
2	Mining aspects	R 92 266 865.00	R 34 885 889.09
3	General surface rehabilitation	R 47 707 995.73	R 44 556 276.51
4	Surface water reinstatement	R 0.00	R 0.00
	Sub-total 1	**R 339 739 880.37**	**R 279 423 325.73**
5	**Additional Allowances**		
5.1	Preliminary and general	R 20 384 392.82	R 16 765 399.54
5.2	Contingencies	R 26 673 190.92	R 22 070 656.34
5.3	Additional studies	R 6 321 485.29	R 0.00
	Sub-total 2	**R 53 379 069.03**	**R 38 836 055.89**
6	**Post-Closure Aspects**		
6.1	Surface water monitoring	R 1 419 736.45	R 1 419 736.45
6.2	Groundwater monitoring	R 631 859.20	R 631 859.20
6.3	Rehabilitation monitoring	R 721 192.28	R 956 848.91
6.4	Care and maintenance	R 10 373 296.92	R 13 762 873.17
6.5	Contingencies for post-closure aspects	R 0.00	R 0.00
	Sub-total 3	**R 29 885 207.16**	**R 16 771 317.72**
	Grand Total Excl. VAT. (Sub-total 1 + 2 + 3)	**R 423 004 156.56**	**R 335 030 699.34**

Source: Golder Associates Africa (Pty) Ltd., 2020

In terms of financial provisioning for identified residual and/or latent risks, the full nature and extent of potential long-term residual and/or latent impacts are still uncertain. Until they are better understood, a sensible provision for managing the long-term liabilities cannot be made. As indicated and recommended above the Decommissioning, Rehabilitation and Mine Closure Plan updated on an annual basis. As more information becomes available the provision for residual and/or latent impacts can be better estimated ahead of full site relinquishment.

However, cost allowances for the following aspects have been made, to both develop a better up-front understanding of the potential requirements in this regard, as well as to monitor the potential occurrence of these risks after mine closure:

- Performing decant groundwater and surface water quality monitoring for a period of 15 years after decant commences, in addition to an initial five-year monitoring period after implementation of the closure plan;

- Continuation of subsidence/ crack monitoring as well as the development of a related complaints reporting framework to raise future issues in subsidence risk areas;
- Performing annual sinkhole and subsidence LIDAR monitoring for a 10-year period during and after initial rewatering of the mine;
- Conducting a radiation assessment for all shaft complexes; and
- Conducting a site-wide climate change impact assessment, to determine the potential impacts of long-term climate change on rehabilitated mine areas, and to identify additional rehabilitation and aftercare requirements.

The proposed rehabilitation of affected wetlands associated with 173 MR will form part of the operational cost. The existing financial provision of these operations have therefore not been considered in this assessment.

19.1 Explain how the Aforesaid Amount was Derived

The approach followed for the Closure Cost Calculate is summarised as follows:

- Gather of initial background information to inform the 2019 gold mines' closure planning and costing update;
- Set unit rates and benchmark these against industry rates through consultation with demolition contractors and rehabilitation practitioners;
- Conduct a site visit to the key areas at operations (21 August 2019);
- Assess the available information related to changes that occurred at the mine;
- Re-measure and/or confirm quantities/allowances and key assumptions, to be aligned with those adopted for the other operations;
- Update sum allowances as applicable;
- Review and update the closure costing spreadsheets by incorporating the above changes as well as include additional narratives for the assumptions and qualifications made for each cost item; and
- Compile the closure cost report based on the findings of the update of the closure costs for the operations.

The estimated closure costs were reviewed and verified by Ernest & Young.

19.2 Confirm that this Amount can be Provided for from Operating Expenditure

Sibanye contributes annually in the form of financial guarantees for its operations. The determined costs will be assessed annually as part of the Annual Rehabilitation Plan update.

20 Specific Information Required by the Competent Authority

20.1 Impact on the Socio-economic Conditions of any Directly Affected Person

The SIA undertaken for the proposed activities is included as **Appendix I**. The proposed decommissioning and rehabilitation activities may result in health, safety and security risks for the labour force. Mitigation and management measures have been proposed to mitigate these possible impacts. However, with the existing prevalence of illegal mining in the area this has been rated am impact of Moderate Negative significance even with mitigation in place. Nuisance impacts (noise and dust) to nearby receptors are also possible during the execution of decommissioning and rehabilitation activities, however, these impacts would be negligible against the current baseline.

The permanent closure of the Cooke Underground Operations will inevitably result in adverse socio-economic implications. An SCP Process has been commissioned to appropriately and meaningful engage with stakeholders to inform a comprehensive SCP. This will address the potential direct and indirect socio-economic impacts associated with closure.

20.2 Impact on any National Estate referred to in Section 3(2) of the National Heritage Resources Act

Five heritage resources, all burial grounds and graves, were identified across 07 MR. Based on the understanding of the proposed activities and given the location of the heritage resources, no direct or indirect impacts against cultural heritage resources identified during the pre-disturbance survey are envisioned. An HRM Process in terms of NHRA is being followed as part of this environmental regulatory process.

21 Other Matters Required in terms of Sections 24(4)(a) and (b) of the Act

Section 24(4)(b)(i) of the Act requires proof of investigation and motivation if no reasonable or feasible alternatives, as contemplated in sub-regulation 22(2)(h), exist. Alternatives have been assessed under Section 8. Due to the nature of the project, limited alternatives could be assessed.

The Cooke Operations are existing, and the proposed activities serve to reduce longer-term environmental liability through the implementation of decommissioning, rehabilitation and closure activities.

22 Undertaking

The EAP herewith confirms:-

- The correctness of the information provided in the reports
- The inclusion of comments and inputs from stakeholders and I&APs ;

- The inclusion of inputs and recommendations from the specialist reports where relevant; and
- The acceptability of the project in relation to the finding of the assessment and level of mitigation proposed.

Signature of the Environmental Assessment Practitioner:	
Name of Company:	Digby Wells and Associates (South Africa) (Pty) Ltd
Date:	October 2020

23 References

City of Johannesburg, 2020. Final Integrated Development Plan Review 2020/21. https://www.joburg.org.za/Pages/A-Z.aspx?filter=I

Digby Wells Environmental, 2016. Environmental Impact Assessment for the West Rand Tailings Retreatment Project, Surface Water Assessment Report

Digby Wells Environmental, 2017: Environmental Impact Assessment and Environmental Management Plan NEMA Regulation 31 Amendment Report for Amendments to Licenced Activities Associated with the Sibanye-Stillwater Limited Cooke and Millsite Operations

Digby Wells Environmental, 2018: Integrated Water Use Licence Application for the Sibanye-Stillwater Rand Uranium/Cooke Operations

DWAF, 1999. Determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). Version 1.0. 24 September 1999.

DWAF. 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Pretoria: Department of Water Affairs and Forestry.

Enslin JF and Kriel JP, (1959). Some Results Obtained from a Hydrological Study of a Dolomitic Catchment Area in the Transvaal, Union of South Africa. DWAF Technical Report No. GH 3727. Department of Water Affairs. Division of Hydrological Research, Pretoria (unpublished).

Hodgson FDI, Usher BH, Scott R, Zeelie S, Cruywagen, LM and de Necker, E. (2001). Prediction Techniques and Preventative Measures Relating to the Post-Operational Impact of Underground Mines on the Quality and Quantity of Groundwater Resources. Water Research Commission Report No. 699/1/01.

Javed, M., Tanwir, K., Akram, M. & Lindberg, S., 2019. Phytoremediation if Cadmium-Polluted Water/Sediment by Aquatic Macrophytes: Role of Plant-Induced pH Changes, Cadmium Toxicity and Tolerance in Plants. In: Cadmium Toxicity and Tolerance in Plants from Physiology to Remediation. United Kingdom: Elsevier Academic Press, p. 495.

Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.C., and Collins, N.B. 2007. A Technique for rapidly assessing ecosystem services supplied by wetlands. Mondi Wetland Project.

Land Type Survey Staff, 1972-2006. Land Types of South Africa: Digital map (1:250 000 scale) and soil inventory databases, Pretoria: ARC- Institute for Soil, Climate and Water.

Le Roux, P. et al., 2011. Hydropedological Interpretations of the Soils of Selected Catchments with the Aim of Improving the Efficiency of Hydrological Models, Pretoria: Water Research Commission.

Mogale City Local Municipality, 2020/21. Integrated Development Plan Review, 2016-21. https://www.mogalecity.gov.za/idp/

Mucina, L. & Rutherford, M. C., 2010. The Vegetation of South Africa, Lesotho and Swaziland. CD Edition ed. Pretoria: South African National Biodiversity Institute (SANBI).

Rand West City Local Municipality, 2020/21. Integrated Development Plan 2016/17 to 2020/21. http://www.randwestcity.gov.za/docs/key-docs/2016-2021%20IDP.pdf

Rountree, M.W., H. Malan and B. Weston (editors). 2012. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study.

SANS 241-2. (2015). South African National Standard. Drinking Water – Part 2: Application of SANS 241-1.

Shangoni Management Services (Pty) Ltd, 2008. Clidet No 726 (Proprietary) Limited Environmental Management Program, Shangoni Management Services (Pty) Ltd: Unpublished report prepared for Clidet No. 726 (Proprietary) Limited .

Sibanye -Stillwater, August 2017. Health and Safety: Policy Statement. https://thevault.exchange/?get_group_doc=245/1564000994-SS-policy-statement-health-safety.pdf

Sibanye -Stillwater, no date. Stakeholder Relations Policy Statement.

Sibanye -Stillwater, 2019. Social Upliftment and Community Development. https://www.sibanyestillwater.com/sustainability/community/

Sibanye -Stillwater, December 2018. Care For iMali Taking Care of Personal Finance: Fact Sheet 2018. https://www.sibanyestillwater.com/sustainability/community/

Sibanye -Stillwater; 2018, Bokamoso Ba Rona Initiative, West Rand Agri-Industrial Programme. https://www.sibanyestillwater.com/sustainability/community/

Statistics South Africa (Stats SA), 23 June 2020. Quarterly Labour Force Survey: Quarter 1: 2020. http://www.statssa.gov.za/publications/P0211/P02111stQuarter2020.pdf

Statistics South Africa (Stats SA), Labour market dynamics in South Africa, 2018. Report No. 02-11-02 (2018). http://www.statssa.gov.za/?s=Labour%20Market%20Dynamics&sitem=statistics%20by%20theme

Statistics South Africa (Stats SA), 2018. Provincial profile: Gauteng: Community Survey 2016. Report number 03-01-09. http://cs2016.statssa.gov.za/?portfolio_page=community-survey-2016-provincial-profile-gauteng-2016

Statistics South Africa (Stats SA), 2011. Gender statistics in South Africa 2011. http://www.statssa.gov.za/publications/Report-03-10-05/Report-03-10-052011.pdf

Statistics South Africa (Stats SA), 2018. National Poverty Lines. http://www.statssa.gov.za/publications/P03101/P031012018.pdf

Soil Classification Working Group, 1991. Soil Classification - A Taxonomic System for South Africa, Pretoria: Department of Agriculture.

Wazimap, 2017. Wazimap. [Online] Available at: https://wazimap.co.za/ [Accessed 7 July 2020].

West Rand District Municipality, 2018/19. Integrated Development Plan Draft 2016/17 to 2020/21 As Revised In 2018/19. http://www.wrdm.gov.za/idp/

West Rand District Municipality, 2019/20. Integrated Development Plan 2016/17 to 2020/21, as Revised in 2019/20. http://www.randwestcity.gov.za/

WRC, 2015. Water resources of South Africa 2012 study, Pretoria: Water Research Commission.

Appendix A: EAP Qualifications and CV

DIGBY WELLS
ENVIRONMENTAL

Appendix B: Affected Farm Properties

DIGBY WELLS
ENVIRONMENTAL

Appendix C: Public Participation Chapter

DIGBY WELLS
ENVIRONMENTAL

Appendix D: Wetland Impact Assessment

DIGBY WELLS
ENVIRONMENTAL

Appendix E: Hydrogeological Impact Assessment

DIGBY WELLS
ENVIRONMENTAL

Appendix F: Hydropedological and Surface Water Quality Impact Assessment

DIGBY WELLS
ENVIRONMENTAL

Appendix G: Geochemical Assessment and Waste Classification

DIGBY WELLS
ENVIRONMENTAL

Appendix H: Heritage Impact Assessment

DIGBY WELLS
ENVIRONMENTAL

Appendix I: Socio-Economic Impact Assessment

DIGBY WELLS
ENVIRONMENTAL

Appendix J: Rehabilitation and Closure Plan (2019)