EIMS | ENVIRONMENTAL IMPACT MANAGEMENT SERVICES

T 011 789 7170 E info@eims.co.za W www.eims.co.za

WULA TECHNICAL REPORT

SAVUKA 7A & 7B TAILINGS STORAGE FACILITY HEIGHT EXTENSION

JUNE 2025

DOCUMENT DETAILS

EIMS REFERENCE:	1657
DOCUMENT TITLE:	WULA Technical Report: Savuka 7a and 7b TSF height extension

DOCUMENT CONTROL

	NAME	SIGNATURE	DATE
COMPILED:	Monica Niehof	Sent Electronically	2025/06/17
CHECKED:	John von Mayer	Sent Electronically	2025/06/20
AUTHORIZED:	Liam Whitlow	Sent Electronically	2025/06/20

REVISION AND AMENDMENTS

REVISION DATE:	REV #	DESCRIPTION
2025/06/20	ORIGINAL DOCUMENT	WULA Technical Report - for Public Review

Table of Contents

List of Figures

List of Tables

Appendices

1 INTRODUCTION

Golden Core Trade and Invest (Pty) Ltd. - Mponeng Operations (Harmony) also referred to as the 'Applicant', own and operate a number of Gold Mines and Plants in the West Wits region in the Gauteng Province. The Savuka Plant currently deposits tailings onto the Savuka 7a & 7b Tailings Storage Facilities (TSFs). However, these facilities are approaching their final and approved height i.e. 60 metres above ground level (agl), and the current planned Life of Mine (LOM) for the West Wits region exceed the available deposition capacity of these TSFs. Accordingly, the applicant is undertaking a feasibility assessment to increase the height of the Savuka 7a & 7b TSFs. Slurry deposition is currently taking place on the Savukaa 7a & 7b TSFs and Harmony is proposing to extend the height of these TSFs by 5 to 10 metres, to a total height of not more than 70 metres agl.

Subsequently, Mponeng Operations has appointed Environmental Impact Management Services (Pty) Ltd (EIMS) as the Environmental Assessment Practitioner (EAP) to assist with undertaking the required environmental authorisation processes (including the statutory public participation), and to compile and submit the required documentation in support of applications for:

- Water Use Authorisation (WUA) in accordance with the National Water Act (Act 36 of 1998) – Section 21 Listed activities:
  - Section 21 (c).
  - Section 21 (g).
  - Section 21 (i).
- Environmental Authorisation (EA) in accordance with the National Environmental Management Act, 1998 (NEMA) EIA Regulations - Listed activities:
  - Listing Notice 1, Activity 34.
  - Waste Management License in accordance with the National Environmental Management: Waste Act 59 of 2008: Category A: 13.

The proposed extension of the Savuka 7a & 7b TSFs project falls within: Merafong City Local Municipality Wards 5 & 27 (West Rand District Municipality) administrative area. The project area is situated within 2 farm properties distributed between Portion 25 of the Farm Doornfontein 118 IQ and Portion 93 of the Farm Blyvooruitzicht 116 IQ (Figure 2).

1.1 ACTIVITY BACKGROUND

The Applicant holds an approved Mining Right (MR) and Environmental Management Programme (EMPr), in terms of the Minerals and Petroleum Resources Development Act (Act 28 of 2002, as amended) (MPRDA), for the mining of gold at various operations in the Carletonville area (Miniang Right Ref: ((GP) 30/5/1/2/2 (01) MR). Subsequently the Applicant also holds a Water Use License (WUL). The current WUL (08/C23E/AFGJCEI/12157) was issued in 2022 and replaced the WUL issued for the activity ian 2013.

Table 1: Applicant Details.

Applicant Details	
Applicant Name:	Golden Core Trade and Invest (Pty) Ltd. - Mponeng Operations
Contact Person:	Hlayiseko Mashaba
Postal Address:	Randfontein Office Park
	Corner Main Reef Rd and Ward Ave

Applicant Details	
	Randfontein
	Gauteng
	1759
Tel:	+27 78 329 3564
Email:	Hlayiseko.Mashaba@Harmony.co.za

1.2 REGIONAL SETTING AND LOCATION OF ACTIVITY

The study area is part of the Highveld region and has an average elevation of about 1600 metres above mean sea level (mamsl). The study area and surrounding area is flat with a gentle decrease in elevation to the east and north. The surrounding area is charaaacterised by more mining activities and associated tailings storage facilities, farmland and residential and business centres.

The Savuka 7a & 7b TSFs are located within quaternary catchment C23E, which is primarily drained by the Mooi River (Figure 1). The Mooi River forms the main and largest drainage feature in the region and is located approximately 18 km west of the TSFs. The Mooi River is a tributary of the Vaal River and part of the Vaal Water Management Area (WMA), one of nine WMAs of South Africa. The river originates near the town of Koster, approximately 80 kilometres Northwest of the study area in the Bojanala Platinum District and flows southwards. The Mooi River eventually discharges its water flow into the Vaal River approximately 15 kilometres East of Stilfontein.

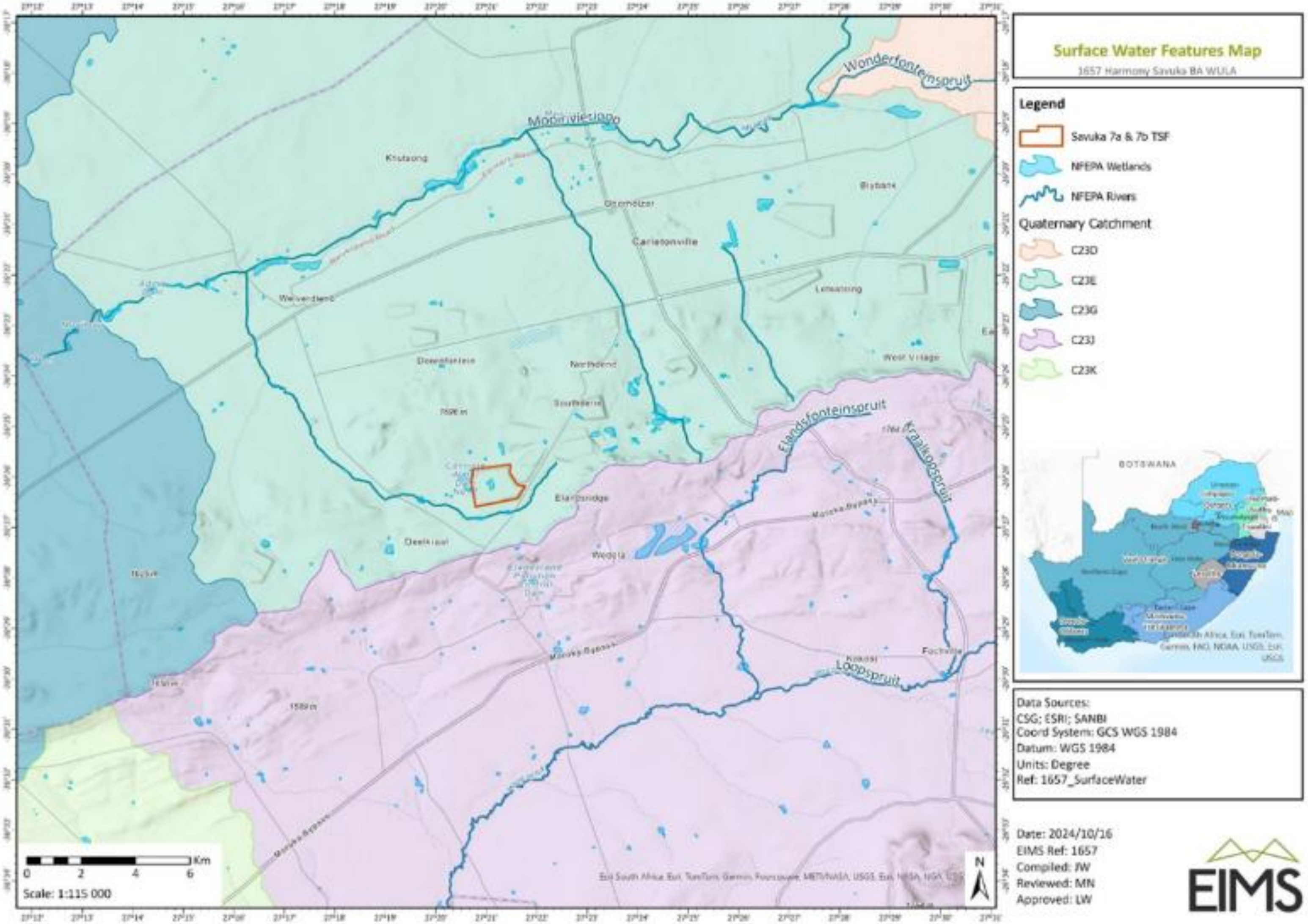


Figure 1: Surface water features in the region of Savuka 7a & 7b TSFs

1.3 PROPERTY DESCRIPTION

Table 2 indicates the farm portions that the project is located on including details on the project location as well as the distance from the proposed project area to the nearest towns.

Table 2: Locality details

<table>
<tr><td>Property</td><td colspan="4">The proposed project area is situated within 2 farm properties distributed between Portion 25 of the Farm Doornfontein 118 IQ and Portion 93 of the Farm Blyvooruitzicht 116 IQ.</td></tr>
<tr><td rowspan="3">Property Name, 21-digit Surveyor General Code and Ownership</td><td>Farm Name</td><td>Portion</td><td>LPI Code</td><td>Ownership Type</td></tr>
<tr><td>Farm Doornfontein 118</td><td>25</td><td>T0IQ00000000011800025</td><td>Applicant</td></tr>
<tr><td>Farm Blyvooruitzicht 116</td><td>93</td><td>T0IQ00000000011600093</td><td>Applicant</td></tr>
<tr><td>Application Area (Ha)</td><td colspan="4">The approximate sizes of the infrastructure are as follows:
• Existing Savuka 7a & 7b TSF footprint is approximately 270 ha.
• The height extension will be between 5 and 10 m on the same footprint. The current approved height is 60 m and the applicant proposes to extend the height with between 5 and 10 m to a total approved final height of not more than 70 m.</td></tr>
<tr><td>Magisterial District</td><td colspan="4">Development area falls within the Merafong City Local Municipality Wards 5 and 27 of the West Rand District Municipality administrative area.</td></tr>
<tr><td>Distance and direction from nearest towns</td><td colspan="4">Savuka 7a & 7b TSFs is located at 26° 26'09.83"S; 27°21'11.03” Carletonville. The proposed development site is located approximately 6.5km Southwest of Carletonville central business district area.</td></tr>
<tr><td>Surrounding land uses</td><td colspan="4">The site is mostly surrounded by mining activities. Existing TSFs are located to the north, east, south and west of the site. There are agricultural activities and residential settlements within the vicinity of the TSF.</td></tr>
</table>

The locality and extent of the Savuka 7a &7b TSF is shown in Figure 2.

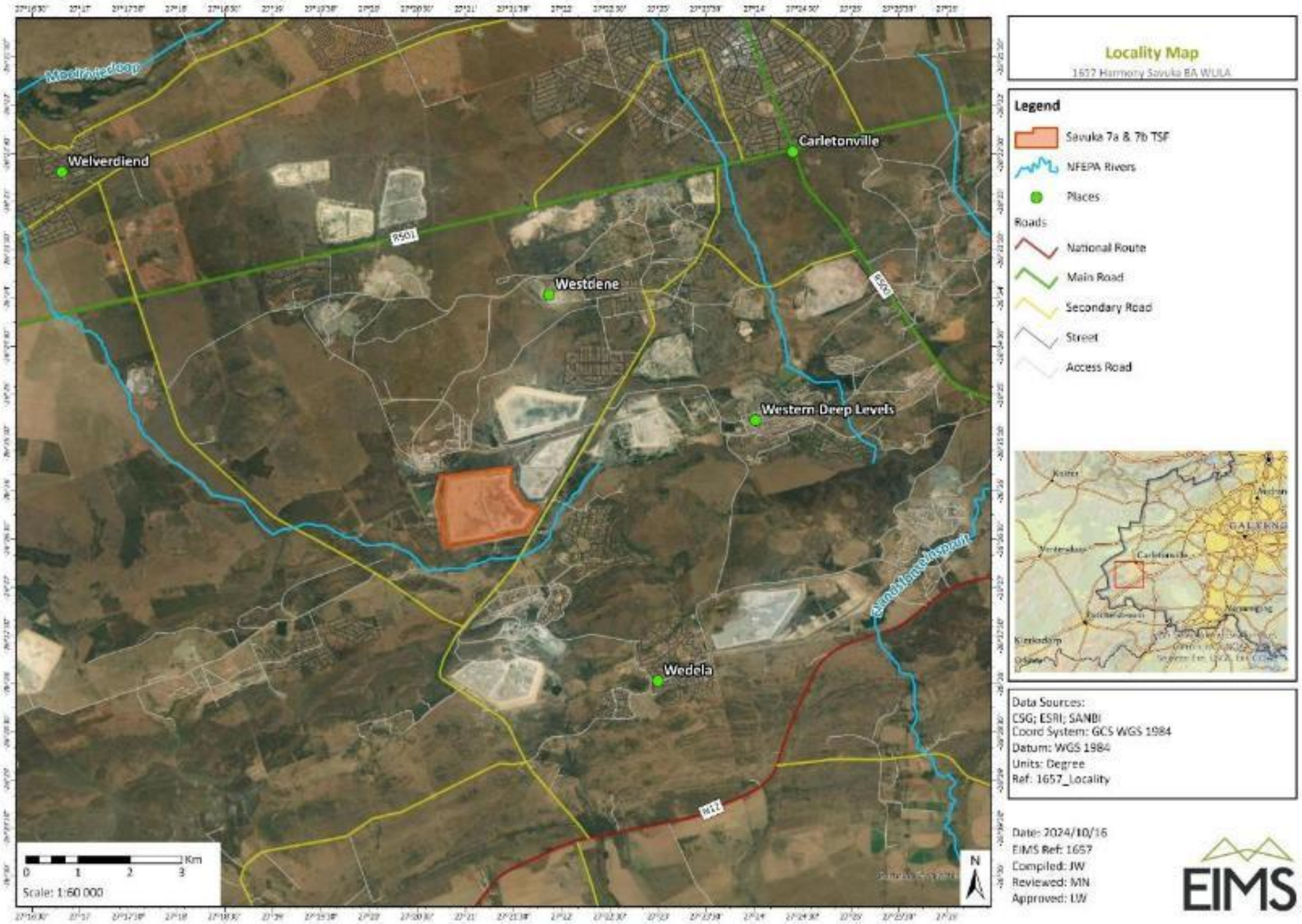


Figure 2: Locality map indicating the location of the Savuka 7a& 7b TSFs.

1.4 PURPOSE OF THE IWWMP

Although the requirement for the compilation of an Integrated Water and Waste Management Plan (IWWMP) was originally aimed at collating and rationalising the information submitted for Water Use Licence Applications (WULA) to the DWS, it has progressed beyond this purpose to:

- Provide the regulatory authorities with focused and structured information not only to meet their general information needs, but also to articulate the required management measures and actions to achieve the water and waste related performance on an on-going basis; and
- Provide direction and guidance to the water user on water and waste management of any activity.

The IWWMP should be used in conjunction with other guidelines developed by DWS, such as the External Guideline on the Water Use Authorisation Process and the series of Best Practical Guidelines for water resource protection in the Industries and Mines. The Department and/or relevant Catchment Management Agencies (CMA) implement the Integrated Water Resource Management (IWRM) at source, by means of an IWWMP.

The Department requires an IWWMP as a simple, feasible and implementable plan for water users based upon site specific programmes, also taking into account the National Water Resource Strategy (NWRS), Catchment Management Strategy (CMS), Resource Quality Objectives (RQOs) and sensitivity of the receiving water resource, upstream and downstream cumulative impacts of water use activities, external water use authorisation guidelines, as well as water use specific supplementary information requirements. The most important component of the IWWMP development process is the formulation of various strategies, goals and objectives for the water use or waste management of an activity, in accordance with the set philosophies and policies. The policies must address the four key areas related to IWWMP development, namely process water, storm water, groundwater and waste.

The purpose of this IWWMP is, therefore, as follows:

- Compilation of a site specific, implementable, management plan addressing all the identified water use and waste management related aspects (e.g., process water balances, storm water management, groundwater management, water re-use and reclamation, water conservation and demand management, waste minimization and recycling) of the specific activity, in order to meet set goals and objectives, in accordance with Integrated Water Resources Management principles;
- Provision of a management plan to guide a water user regarding the water and waste related measures which must be implemented on site in a progressive, structured manner in the short, medium and long term;
- Documentation of all the relevant information, as specified in this guideline, to enable the Department to make the decision regarding the authorisation of a water use;
- Clarification of the content of the IWWMP from the DWS officials and the water users, as the various regional offices of DWS might have different interpretations regarding the content of an IWWMP;
- Standardisation of the format of the supporting documentation which the Department requires during submission of a WULA;
- Provision of guidance on the content of information required in an IWWMP as part of the water use authorisation process and level of detail that the Department requires to enable them to evaluate the supporting documentation to make a decision on authorisation water use; and
- Ensuring that a consistent approach is adopted by the Department and the various Regional Offices and CMA’s with regards to IWWMPs.

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

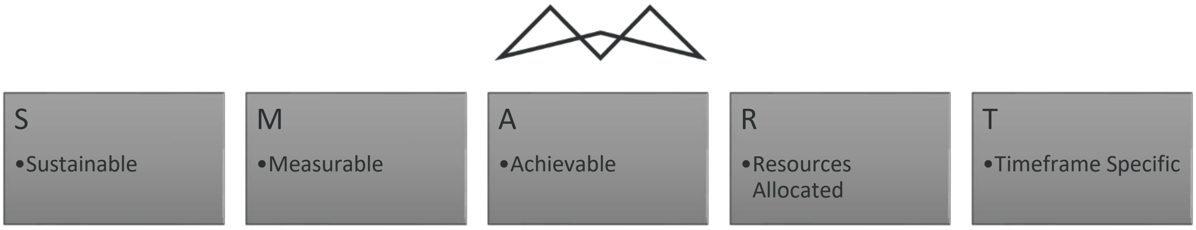


Figure 3: Diagram of the “SMART” Concept.

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

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

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

In line with the guidelines of the DWS Operational Guideline: Integrated Waste and Water Management Plan (2010) and GNR 267, Water Use Licence Application and Appeals Regulations (2017), Figure 4 provides a guide to the structure of the IWWMP.

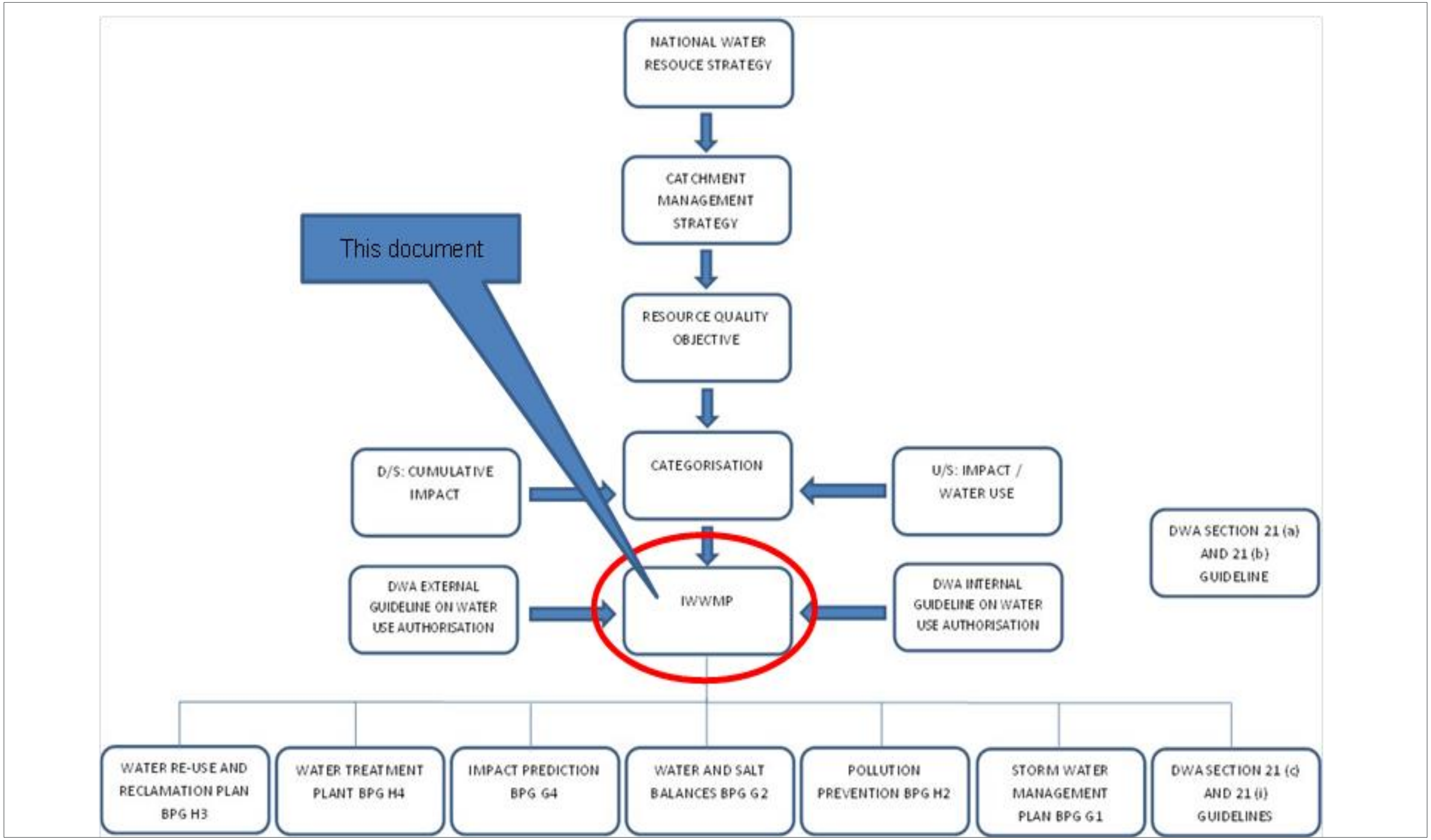


Figure 4: Schematic Layout of the IWWMP Approach

2 CONTEXTUALISATION OF THE ACTIVITY

The section below provides a detailed project description. The aim of the description is to indicate the activities that are performed at the TSF. Furthermore, the detailed project description facilitates the understanding of the activities taking place that will result in impacts on the environment and for which mitigation measures are in place or plans are in place to implement these mitigation measures.

2.1 DESCRIPTION OF ACTIVITY

Tailings are the mineral waste remaining after ore processing to extract mineral concentrates and are typically stored within an engineered containment structure known as a Tailing Storage Facility or TSF. Tailings is a common by-product of the metals and minerals recovery process. It usually takes the form of a liquid slurry made of fine metal or mineral particles and water – created when mined ore is crushed and finely ground in a milling process (refer to Figure 5).

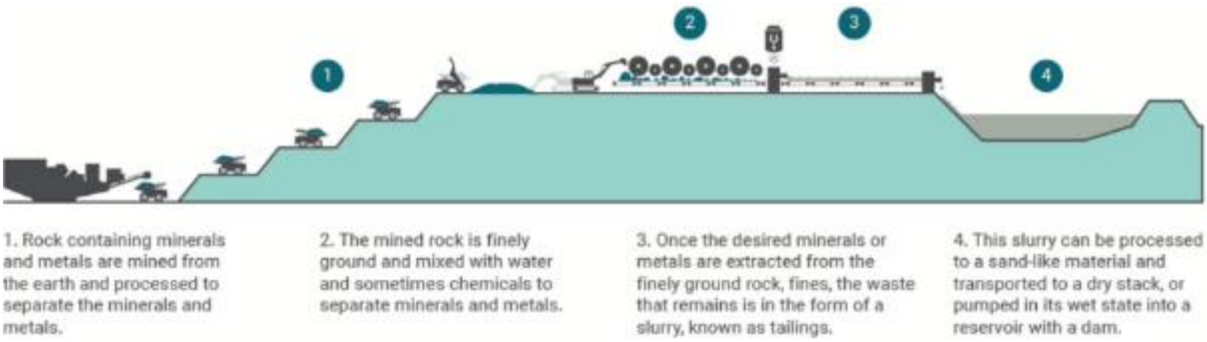


Figure 5: Tailings Storage Facility Process (International Council on Mining and Metals, 2023).

From the mill, the tailings is typically pumped to storage facilities which are commonly constructed using earth dams. As the sandy residue of tailings gradually drains and becomes compact and dry, grass and other vegetation can be planted to stabilise the environment through a reclamation process. Before the water in the tailings can be used again, or discharged into the local drainage system, it must be treated to remove harmful substances that would pollute the environment or risk the health and safety of local communities near the facility.

If not managed properly, tailings can have chronic adverse impacts on the environment and human health and safety, with pollution from effluent and dust emissions being potentially toxic to humans, animals or plants. Acute and potentially very damaging impacts can occur should a tailings storage facility physically fail. In such instances, flowable tailings materials can inundate and greatly impact the surrounding environment and even lead to loss of human life.

Tailings differ from overburden, which is the waste rock or material that overlies an ore or mineral body and is displaced unprocessed and stockpiled separately (or co-disposed with tailings) during mining. Tailings can be in the form of liquid, solid, or a slurry of fine particles. The Savuka 7a &7b TSFs are slurry TSFs (refer to Figure 6).

Figure 6: Aerial view of Savuka 5a & 5b TSFs in the foreground and 7a & 7b TSFs in the background at the Harmony West Wits Operations.

The Savuka 7a & 7b TSF site covers an area of approximately 270 ha. The active dams LoM Planned Storage Impoundment Volume planned for October 2027 for Savuka 7A is expected to be 33,347,799 m^3 and Savuka 7B 39,012,853 m^3, with a total capacity of 72, 360, 652 m^3.

The deposition rate is 3, 600, 000 tonnes per annum. The deposition rate will not increase, only the approved capacity of the TSFs.

2.1.1 DESIGN CONSIDERATIONS

The following is relevant to the design of the Savuka 7a & 7b TSFs.

- Total capacity: To be confirmed once the final designs is completed.
- Total additional deposition period at 300 000 tonnes per month: 2 – 3 Years.
- Maximum rate of rise (Basin): 3.3m/year
- Maximum rate of rise (Embankment): 5.3m/year
- Deposition method: The current method is drywalling deposition, to be converted to cyclone deposition.

The Geotech and designs are currently in progress and will be finalised prior to submission to the Competent Authority.

2.1.2 OPERATIONAL PHASE

Tailings will be deposited using cyclones. During cyclone tailings deposition, the total tailings stream is split into a coarse fraction (underflow) and fine fraction (overflow) by centrifugal separation. The coarse underflow is usually discharged as a flare or spray in the shape of an inverted cone (spray discharge). A continuous discharge with the appearance of a rope (roping discharge) must be avoided. The optimum split of underflow is usually achieved when the underflow is spraying, but just at the point between spraying and roping.

The cyclones will be supported on customised steel stands placed in such a manner that an underflow cone of about 1.2m high will be deposited. The cyclone and stand will then be moved to an adjacent position to deposit another underflow cone. The fine overflow will be discharged into the basin through an overflow pipe connected to the cyclone. During commissioning the overflow pipes must be long enough to discharge overflow directly into the basin area beyond the blanket drains.

2.1.3 DECOMISSIONING PHASE

The closure of TSFs will involve their rehabilitation. Contour walls will be constructed, after which additives will be applied in order that favourable conditions for plant growth can occur. Once this has been achieved, vegetation will be planted on top and on the sides of the tailings to stabilise the tailings against wind and water erosion. When the vegetation has been established maintenance and monitoring of the tailings dam will take place. The maintenance will take place over a period of three years, while the monitoring will take place over a period of five years on a quarterly basis by analysing samples for pollutants.

2.2 EXTENT OF THE ACTIVITY

The final tailings facility (compartments 7A and B) will have a footprint of approximately 270 Ha and a final approved height of up to 70 m.

2.3 KEY ACTIVITY PROCESSES AND PRODUCTS

Materials are being deposited on specialised drainage infrastructure, as such the only key product is the tailings being deposited from the Savuka Plant. As part of the tailings being deposited, wastewater are produced which follows the existing drainage infrastructure to return water dams.

2.4 ACTIVITY LIFE DESCRIPTION

The Savuka 7a& 7b TSF, is estimated to be feasible for use for another approximately 2 to 3 years from the end of 2025.

2.5 ACTIVITY INFRASTRUCTURE DESCRIPTION

For a full description of the technical aspects of the infrastructure for the Savuka 7a &7b TSFs, please refer to Section 2.2 of this report.

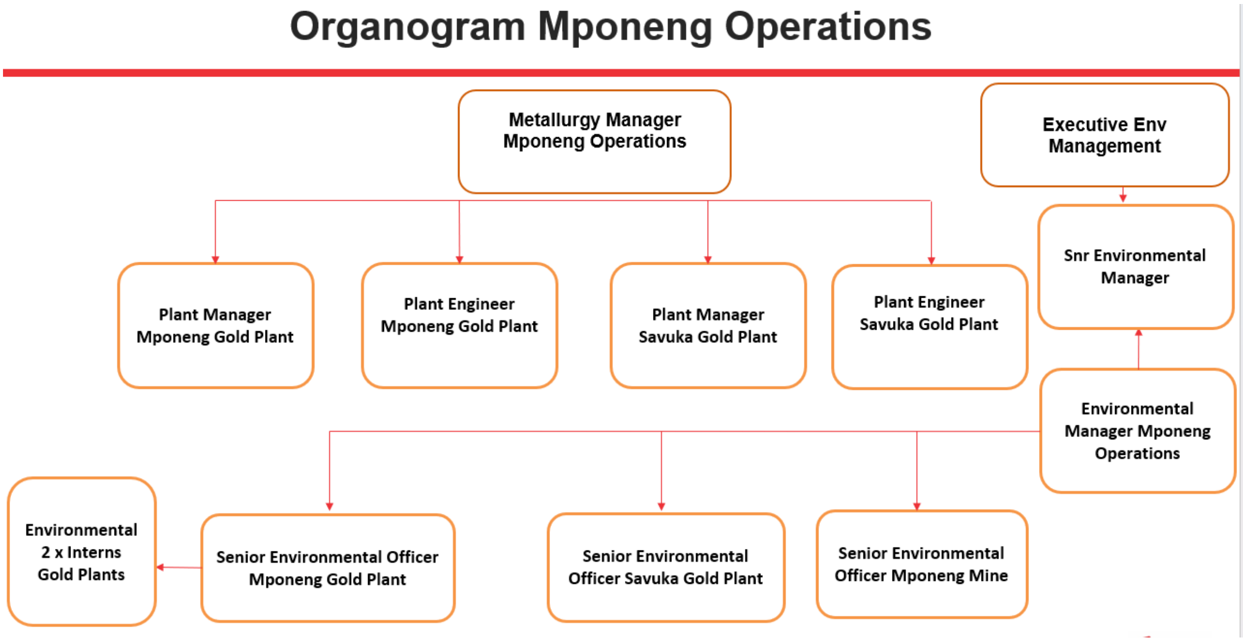
2.6 KEY WATER USES AND WASTE STREAMS

The following details are relevant to the current application, these are already licensed under the current WUL:

- Radioactive waste is handled and disposed of as per the requirements of the Certificate of Registration (COR - 58A 0192) issued in terms of the National Nuclear Regulator (NNR) Act, 1999 (Act No. 47 of 1999);
- TSF for storing of slimes affected water;
- Return Water Dam for re-use of water from the TSF operations; and
- Domestic Waste is sorted on site and disposed to a registered landfill site.

2.7 ORGANISATIONAL STRUCTURE OF ACTIVITY

The reporting structure/procedure for Mponeng Operations / Harmony in relation to environmental management is presented in Figure 7 below.



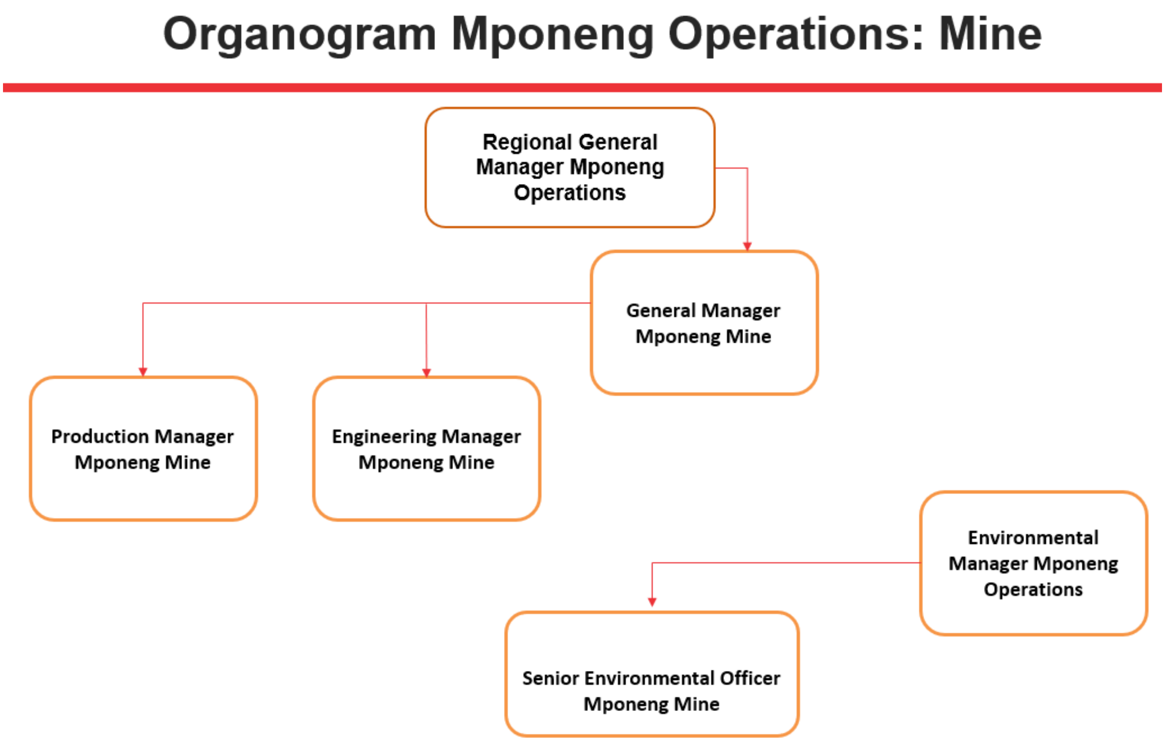


Figure 7: Environmental Organogram of Harmony Gold.

2.8 BUSINESS AND CORPORATE POLICIES

The applicable business corporate policy of the Applicant is the Health Safety and Environment Policy. The policy emphasises the company's commitment to:

- Conform to the Health, Safety and Environment Legislation;
- Manage and maintain an HSE and Quality System that is in line with internationally recognised quality management systems;
- Conduct business in a manner that safeguards its people and the environment from harm; and
- To communicate with employees, the community and authorities on issues that is relevant to the mine and the community.

3 REGULATORY WATER AND WASTE MANAGEMENT FRAMEWORK

This IWWMP forms part of the WULA amendment for the Savuka 7a & 7b height extension. This section will discuss the various regulatory requirements relevant to the IWWMP including the water uses being applied for, as well as details on the existing lawful uses and exemption to GN 704.

3.1 SUMMARY OF WATER USES

This section focuses on the water use activities to be applied for as part of the WULA. A summary of the water uses applied for is indicated in Table 3.

Table 3: Proposed amendment to the licensed water uses.

Water use	Description	Property Description	Coordinates	Volumes discharged per tonnes per annum / Storage capacity m³ and area m² OR Length in m
Current Water Use				
Section 21(g)	Savuka TSF	Portions 5, 6, 7, 8, 9 & 25 of the Farm Doornfontein 118 IQ and Portion 16, 17, 48 & 93 of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°25'18.213" Long: E 27°22'20.511"	Deposition rate: 3 600 000 t/a Height: up to 60 magl.
Proposed Amendment				
Section 21 (g)	G1 Savuka TSF	Portions 5, 6, 7, 8, 9 & 25 of the Farm Doornfontein 118 IQ and Portion 16, 17, 48 & 93 of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°25' 18.21" Long: E 27°22' 20.51"	Deposition rate: 3 600 000 t/a Capacity: To be confirmed by final design report. Area: To be confirmed by final design report. Height: up to 70 magl exact height to be confirmed by final design report.
Section 21 (g)	G2 Dust Suppression on the Savuka TSF from North Boundary Dam.	Portions 5, 6, 7, 8, 9 & 25 of the Farm Doornfontein 118 IQ and Portion 16, 17, 48 & 93 of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°25' 18.21" Long: E 27°22' 20.51"	1260 m^3 per day total of 459 900 m^3 per annum.
Proposed Addition to the WUL				
Section 21 (c) & (i) Proximity of the Savuka TSF Compartments 7A, 7B and associated infrastructure to	CI 1: Savuka TSF 7A, 7B and associated infrastructure	Portions 5, 6, 7, 8, 9 & 25 of the Farm Doornfontein 118 IQ and Portion 16, 17, 48 & 93	**Start:** Lat: S 26°25' 46.08" Long: E 27°21' 18.74" **End:**	1.591 km

Water use	Description	Property Description	Coordinates	Volumes discharged per tonnes per annum / Storage capacity m^3 and area m^2 OR Length in m
the Unchanneled Valley Bottom Wetland (HGM4)		of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°25' 53.14" Long: E 27°20' 22.15"	
Section 21 (c) & (i) Proximity of the Savuka TSF Compartments 5A, 5B, 7A and associated infrastructure to the Unchanneled Valley Bottom Wetland (HGM2)	CI 2: Savuka TSF 5A, 5B, 7A and associated infrastructure	Portions 5, 6, 7, 8, 9 & 25 of the Farm Doornfontein 118 IQ and Portion 16, 17, 48 & 93 of the Farm Blyvooruitzicht 116 IQ.	**Start:** Lat: S 26°25' 31.68" Long: E 22°22' 10.35" **End:** Lat: S 26°26' 18.82" Long: E 27°21' 48.04"	1,57702 km
Section 21 (c) & (i) Proximity of the Savuka TSF Compartments 5A, 5B, 7A, 7B and associated infrastructure to the Channelled Valley Bottom Wetland (HGM1)	CI 3: Savuka TSF 5A, 5B, 7A, 7B and associated infrastructure	Portions 5, 6, 7, 8, 9 & 25 of the Farm Doornfontein 118 IQ and Portion 16, 17, 48 & 93 of the Farm Blyvooruitzicht 116 IQ.	**Start:** Lat: S 26°25' 51.93" Long: E 27°22' 01.40" **End:** Lat: S 26°26' 25.00" Long: E 27°20' 37.75"	2.54 km
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM4)	CI 4: New Borehole (MB44)	Portion 24 of the Farm Doornfontein 118.	Lat: S 26°25' 43.84" Long: E 27°21' 09.96"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM4)	CI 5: Borehole (MB59)	Portion 24 of the Farm Doornfontein 118.	Lat: S 26°25' 49.67" Long: E 27°20' 28.80"	1 m^2
Section 21 (c) & (i) Location of Borehole to the	CI 6: New Borehole (RBH3)	Portion 31 of the Farm Buffelsdoorn 143 IQ.	Lat: S 26°26' 44.75" Long: E 27°20' 53.31"	1 m^2

Water use	Description	Property Description	Coordinates	Volumes discharged per tonnes per annum / Storage capacity m^3 and area m^2 OR Length in m
Channelled Valley Bottom Wetland (HGM1)				
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM1)	CI 7: New Borehole (RBH4)	Portion 31 of the Farm Buffelsdoorn 143 IQ.	Lat: S 26°26' 38.60" Long: E 27°21' 25.69"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM1)	CI 8: Borehole (MB64)	Portion 13 of the Farm Doornfontein 118 IQ.	Lat: S 26°26' 35.56" Long: E 27°20' 32.30"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM1)	CI 9: Borehole (MB42)	Portion 31 of the Farm Buffelsdoorn 143 IQ.	Lat: S 26°26' 35.69" Long: E 27°20' 53.60"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM1)	CI 10: Borehole (MB36)	Portion 25 of the Farm Doornfontein 118 IQ.	Lat: S 26°26' 29.10" Long: E 27°21' 24.30"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM1)	CI 11: Borehole (MB37)	Portion 25 of the Farm Doornfontein 118 IQ.	Lat: S 26°26' 29.18" Long: E 27°21' 23.71"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley	CI 12: Borehole (MB18)	Portion 25 of the Farm Doornfontein 118 IQ.	Lat: S 26°26' 23.56" Long: E 27°21' 42.43"	1 m^2

Water use	Description	Property Description	Coordinates	Volumes discharged per tonnes per annum / Storage capacity m^3 and area m^2 OR Length in m
Bottom Wetland (HGM1)				
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM1&2)	CI 13: Borehole (MB52S)	Portion 93 of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°26' 05.95" Long: E 27°21' 58.75"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM1&2)	CI 14: Borehole (MB52D)	Portion 93 of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°26' 05.75" Long: E 27°21' 58.96"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM2)	CI 15: Borehole (M45)	Portion 93 of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°25' 44.70" Long: E 27°22' 11.26"	1 m^2
Section 21 (c) & (i) Location of Borehole to the Channelled Valley Bottom Wetland (HGM2)	CI 16 : Borehole (MB31)	Portion 93 of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°25' 33.22" Long: E 27°22' 20.55"	1 m^2

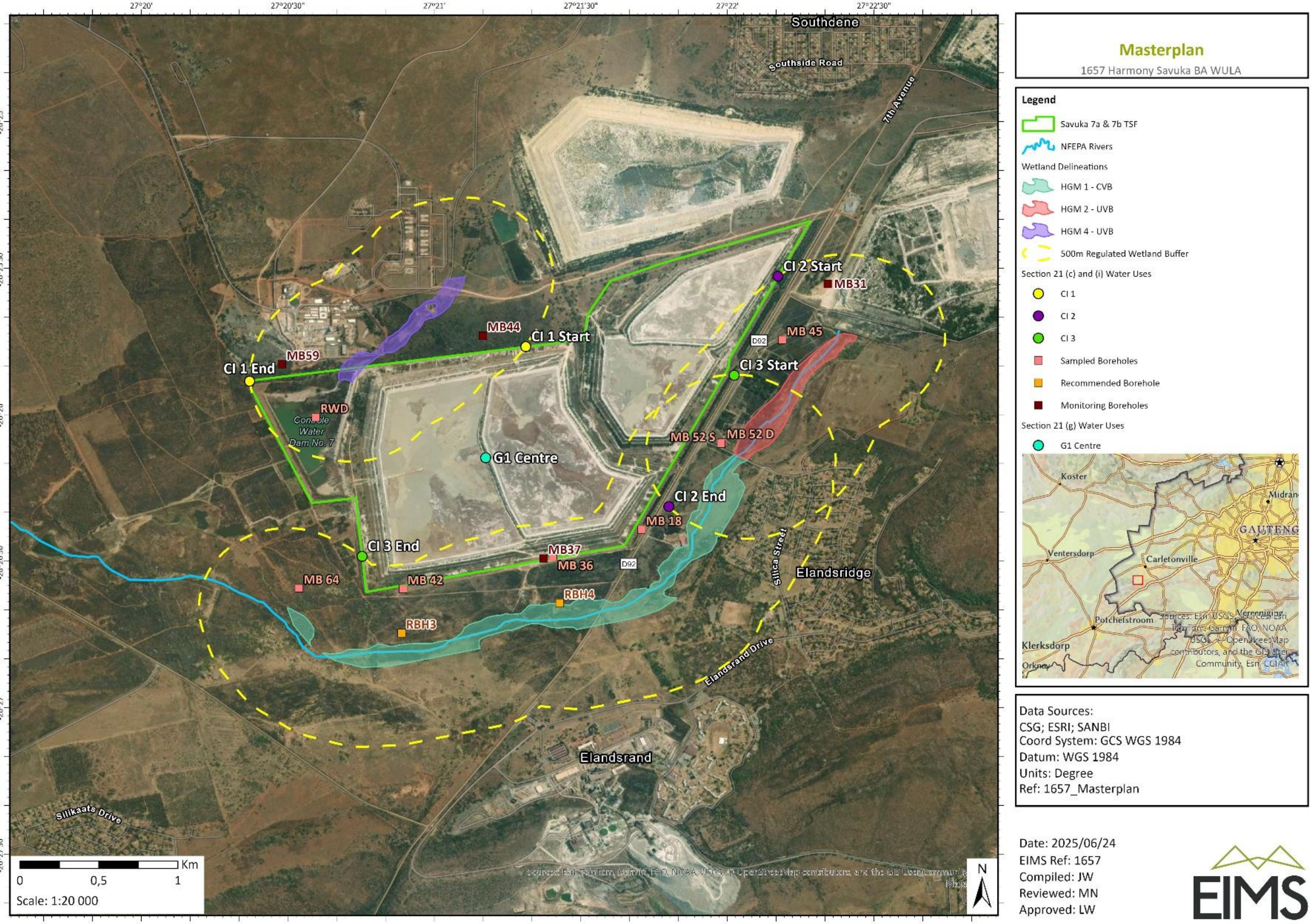


Figure 8: Geographical locations of water uses for the Savuka TSF

3.2 EXISTING LAWFUL USES

In terms of Section 32 of the NWA, an existing lawful water use is defined as follows:

"*Water use which has taken place at any time during a period of two years immediately before the date of commencement of the Act (1 October 1996 to 30 September 1998) and which was authorised by or under any law which was in force immediately before the date of commencement of this Act, or which has been declared an existing lawful water use in terms of Section 33 of the Act*".

The Applicant has various existing water uses for its operations in the greater West Wits region. These uses include but are not limited to plant activities, TSF facilities, pipelines, return water dams etc.

The Water Use License that is required to be amended is dated 27 September 2022 with license number: 08/C23E/AFGJCEI/12157. The existing water use to be amended is described in the table below.

Table 4: Existing licensed water use to be amended.

Water use	Description	Property Description	Coordinates	Volumes discharged – tonnes/annum
Section 21(g)	Savuka TSF	Portio 5, 6, 7, 8 & 9 of the Farm Doornfontein 118 IQ and Portion 16, 17, 48 & 93 of the Farm Blyvooruitzicht 116 IQ.	Lat: S 26°25' 18.213" Long: E 27°22' 20.511"	3 600 000 t/a

3.3 EXEMPTION TO THE REQUIREMENTS OF GN 704 OF 4 JUNE 1999

The Department of Water Affairs and Forestry (now the Department of Water and Sanitation), established General Notice (GN) 704 (dated 4 June 1999) to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. The conditions of GN704 relevant to this project are as follows:

- Condition 4 – Restrictions on locality – No person in control of a mine or activity may:

  (a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked;

- Condition 5 – Restrictions on use of material

No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource.

General Notice (GN) 704 (dated 4 June 1999) placed certain restrictions on mining and related activities for the protection of water resources. In terms of Regulation 3, the Minister may in writing authorise an exemption from the requirements of regulations 4, 5, 6 and 7 on his or her own initiative or on application, subject to such conditions as the Minister may determine. The proposed continuation of the deposition of tailings on the Savuka 7a & 7b TSF, will require exemptions from GN704 as listed above.

<u>Harmony currently holds no exemptions to the regulations of GN 704 for their Mponeng operations. Motivation for the requested exemptions related to this specific application for the height increase of the Savuka 7a&b TSFs, can be found in Section 3.8.</u>

3.4 GENERAL AUTHORISATION WATER USES

No general authorisations are currently in place.

3.5 NEW WATER USES TO BE LICENCED

Only the water uses being applied for in Table 3 are relevant to this application. The following water uses are applied for as part of this WULA:

- An amendment of the licence for an amendment to existing Section 21 (g) activity and an additional Section 21 (g) water use activity is required.
- A licence for the additional Section 21 (c) and (i) water use activities is required.

3.5.1 SECTION 21(G):

The following activity will be undertaken that falls within the ambit of a Section 21(g) water use activity:

Savuka 7a&b TSF.

3.6 WASTE RELATED AUTHORISATIONS

The Savuka TSF is by its nature a waste storage facility and as such authorisations will be required in terms of the National Environmental Waste Act, 2008 (NEMWA). Waste is accordingly governed by the provisions of the National Environmental Management: Waste Act, 2008 (NEMWA).

Section 16 of the NEMWA must be considered which states as follows:

1. A holder of waste must, within the holder's power, take all reasonable measures to-
    a. "Avoid the generation of waste and where such generation cannot be avoided, to minimise the toxicity and amounts of waste that are generated;
    b. Reduce, re-use, recycle and recover waste;
    c. Where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;
    d. Manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour, or visual impacts;
    e. Prevent any employee or any person under his or her supervision from contravening the Act; and
    f. Prevent the waste from being used for unauthorised purposes."

These general principles of responsible waste management will be incorporated into the requirements in the EMPR to be implemented for this project.

Waste can be defined as either hazardous or general in accordance to Schedule 3 of the NEMWA (2014) as amended. "Schedule 3: Defined Wastes" has been broken down into two categories – Category A being hazardous waste; and Category B being general waste. Under Category A (hazardous waste), the act makes allowance for, but not limited to, "wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal; oil wastes and wastes of liquid fuels; and construction wastes".

In order to attempt to understand the implications of these waste groups, it is important to ensure that the definitions of all the relevant terminologies are defined:

- Hazardous waste: means "any waste that contains organic or inorganic elements or compounds that may, owning to the inherent physical, chemical or toxicological characteristic of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles."
- Residue deposits: means "any residue stockpile remaining at the termination, cancellation or expiry of a prospecting right, mining right, mining permit, exploration right or production right."
- Residue stockpile: means "any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, mineral processing plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated within the mining area for potential re-use, or which is disposed of, by the holder of a mining right, mining permit or, production right or an old order right, including historic mines and dumps created before the implementation of this Act."
- General waste: means "waste that does not pose an immediate hazard or threat to health or to the environment and includes – domestic waste; building and demolition waste; business waste; inert waste; or any waste classified as non-hazardous waste in terms of the regulations made under Section 69."

NEMWA Planning and Management of Residue Stockpiles and Residue Deposits Regulations, 2015 (GNR 632):

The purpose of these Regulations is to regulate the planning and management of residue stockpiles and residue deposits from a prospecting, mining, exploration or production operation. The identification and assessment of environmental impacts arising from residue stockpiles and residue deposits must be done as part of the environmental impact assessment conducted in terms of the NEMA. A risk analysis based on the characteristics and the classification set out in Regulation 4 and 5 must be used to determine the appropriate mitigation and management measures. The pollution control barrier system shall be defined by the-

- National Norms and Standards for the Assessment of Waste for Landfill Disposal, 2013; and
- National Norms and Standards for Disposal of Waste to Landfill, 2013.

Waste related authorisations included in the IWUL are:

- The expansion of a waste management activity listed in Category A or B of this Schedule which does not trigger an additional waste management activity in terms of this Schedule.

Table 5: Applicable NEMWA Activities relevant to the proposed development.

Activity No(s):	Activity	Portion of the proposed project to which the applicable listed activity relates.
Category A, Activity 13	The expansion of a waste management activity listed in Category A or B of this Schedule which does not trigger an additional waste management activity in terms of this Schedule. *The TSFs to be extended will extend in height only and therefore, does not trigger any other additional waste management activity in terms of this Schedule*.	TSF operations - increase of 5 - 10 m in height on existing approximately 270 ha TSF to a total approved height of not more than 70 m above ground level.

3.7 OTHER AUTHORISATIONS

The MPRDA aims to "make provision for equitable access to, and sustainable development of, the nation's mineral and petroleum resources". The MPRDA outlines the procedural requirements that need to be met to acquire mineral and petroleum rights in South Africa. The MPRDA further governs the sustainable utilisation of South Africa's mineral resources. In the event that the proposed activities require material (e.g., sand, gravel, aggregate) for the purposes of construction then the provisions of the MPRDA may apply.

The Savuka 7A & 7B TSF height extension will trigger an Environmental Authorisation ("EA") for listed activities contained in the Environmental Impact Assessment Regulations Listing Notices of 2014, as amended and published in terms of sections 24(2), 24 (5), 24D, 44 and 47(A) (1) (b) of the National Environmental Management

Act, 1998 (Act No. 107 of 1998) ("NEMA"). For the EA application, a Basic Assessment process will be conducted in accordance with the NEMA and the Environmental Impact Assessment Regulations, 2014 (GN R982 of 4 December 2014) ("GN R982"), as amended. Such application was underway at the time of drafting this report.

The following listed activities are applied for as part of the above-mentioned application are indicated in Table 6 below:

Table 6: NEMA Listed activities being applied for

Activity No(s):	Activity	Portion of the proposed project to which the applicable listed activity relates.
GN983, Activity 34	**Tailings Storage Facility – Water Use License Amendment** The expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution, excluding— (i) where the facility, infrastructure, process or activity is included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies; (ii) the expansion of existing facilities or infrastructure for the treatment of effluent, wastewater, polluted water or sewage where the capacity will be increased by less than 15 000 cubic metres per day; or (iii) the expansion is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will be increased by 50 cubic meters or less per day. *The TSFs to be extended have an existing Water Use License (08/C23E/AFGJCEI/12157) and will require an amendment to that WUL through a Water Use License Application Process.*	TSF operations - increase of 5 - 10 m in height on existing approximately 270 ha to a total approved height of not more than 70 m above ground level.

3.8 APPLICATION FOR EXEMPTION TO REGULATION GN 704 OF JUNE 1999

The following GNR 704 exemptions are applied for as part of this application. The table below includes an impact assessment, a management plan and a monitoring plan in support of the exemption application.

Table 7: Exemption motivations to the GNR 704.

No.	GN 704 Regulation	Activity requiring exemption	Motivation and reason for exemption
1.	4a. Restrictions on locality No person in control of a Mine or activity may – Regulation 4(a): locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100-year flood-line or within a horizontal distance of 100 metres from any watercourse.	Savuka RWD and Savuka 5A, 5B, 7A&7B TSFs.	Impact assessment: The watercourses were delineated as part of the Wetland and Functional Impact Assessment for the Proposed extension in height of the Savuka 7a&b and 5a&bTailings Storage Facility (TSF). The impacts on the watercourses were assessed as part of the above-mentioned report that are attached as Annexure 3. The risk assessment is also included in Section 6.

No.	GN 704 Regulation	Activity requiring exemption	Motivation and reason for exemption
			<u>Management plan:</u> The Wetland and Functional Impact Assessment for the Proposed height extension of the Savuka 7a&b and 5a&b TSF, to minimise the impact on the watercourses. Refer to Section 6 for the assessment. <u>Monitoring plan:</u> Refer to Section 5.4 for the monitoring plan applicable to this application.

4 PRESENT ENVIRONMENTAL STATUS

This section of the report provides a description of the environment that may be affected by the proposed project. Aspects of the biophysical, social and economic environment that could be directly or indirectly affected by, or could affect the proposed development, are described. This information has been sourced from existing information available for the area as well as baseline information received from certain specialists assessments.

4.1 LOCATION

The proposed extension of the Savuka 7a & 7b TSFs project falls within: Merafong City Local Municipality Wards 5 & 27 (West Rand District Municipality) administrative area. The project area is situated within 2 farm properties distributed between Portion 25 of the Farm Doornfontein 118 IQ and Portion 93 of the Farm Blyvooruitzicht 116 IQ, which is located approximately 6,5 km Southeast of the Carletonville business centre. The study area falls within a landscape that contains pipelines and existing TSFs and associated return water dams, thus the area can be described as largely disturbed. The surrounding area is characterised by more mining activities and associated tailings storage facilities, farmland and residential and business centres. The locality map is included in Figure 2. The study area is serviced by a local road, running roughly from the N12 national highway in the South to the R501 provincial road in the North. Existing surrounding infrastructure includes mine infrastructure such as existing TSFs, substations and electricity transmission lines, telephone lines, fences and other recent structures.

4.2 TOPOGRAPHY

The north-western and western sections of the study area comprises gently undulating land that slopes to the west and south to drainage lines that flow to the west and northwest, as well as some Eucalyptus plantations. At the residential area associated with Deelkraal, the topography rises to low west-to-east-orientated savannah-covered hills that cross the southern sections of the study area. (Refer to Figure 9).

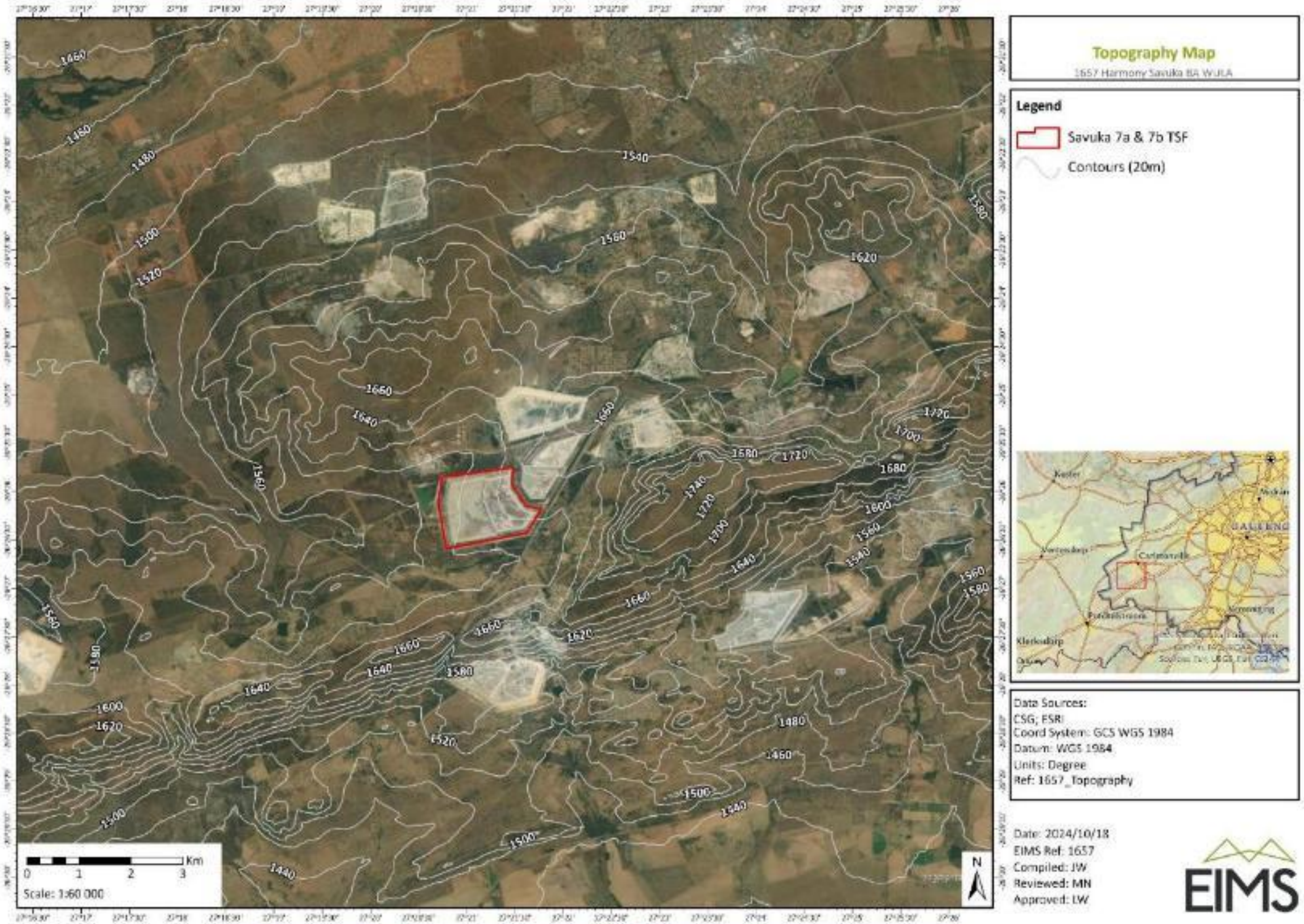


Figure 9: Topography in the region of Savuka 7a & 7b TSFs

4.3 GENERAL SITE CONDITIONS

The proposed Savuka 7a&b TSF height extension is situated within an area consisting mainly of mining activities and residential areas, some retail and businesses, waterbodies, wetlands and forested land are also located in the extended surrounding areas. The site is completely transformed and contains the Savuka 7 TSF a & b compartments. Figure 10 shows the existing Savuka TSF, with the 5A and 5B compartments in the foreground and the Savuka 7A and 7B compartments in the background. The photograph was taken from the North-east towards the Southwest.

Figure 10: Arial view of the Savuka TSF (7a&b in the background and 5a&b in the foreground).

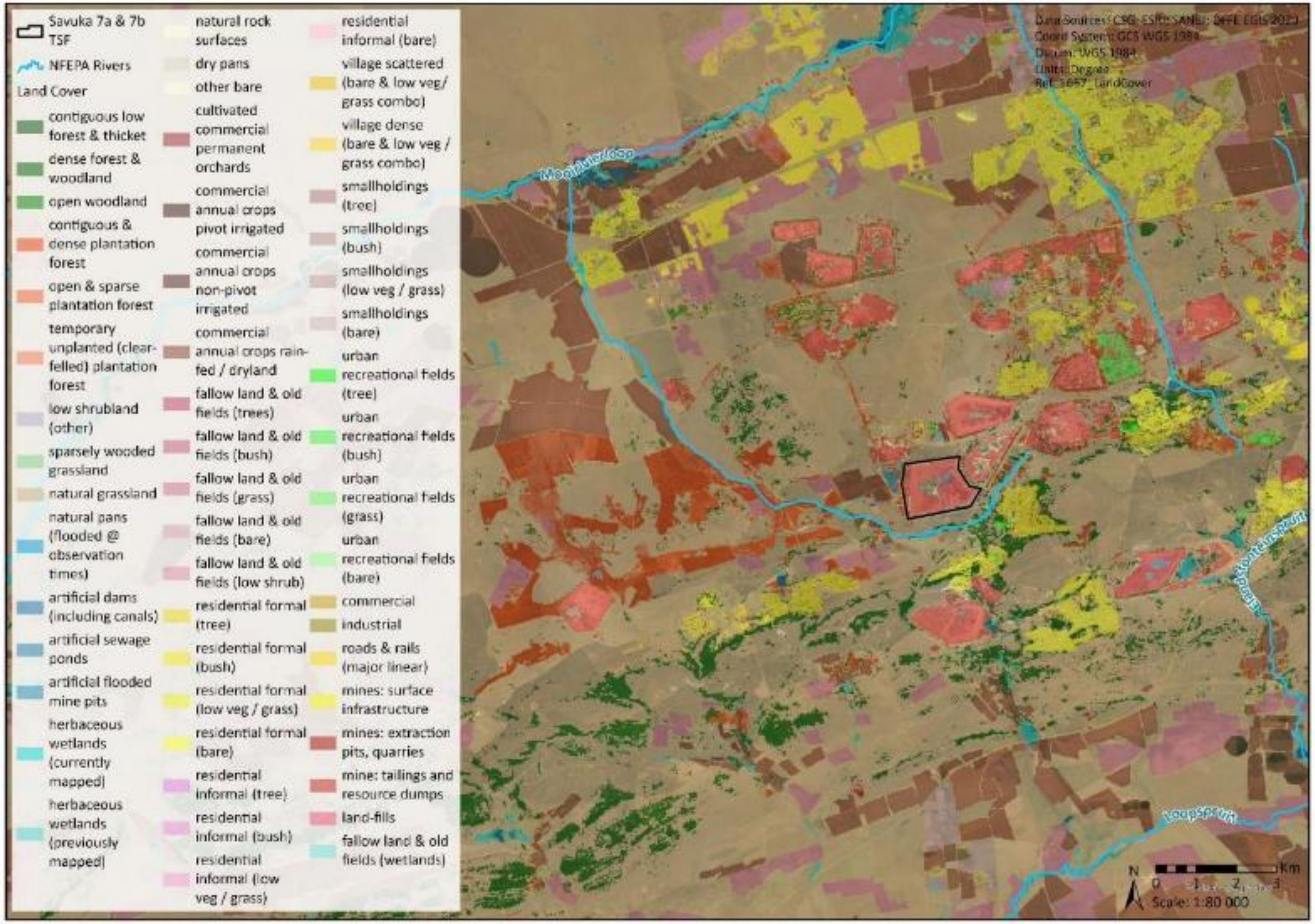


Figure 11: The adjacent land uses of the Savuka TSFs

4.4 CLIMATE

According to Köppen-Geiger Climate classification, Carletonville has a Subtropical steppe climate (Classification: BSh). The summers are long, warm, and mostly clear and the winters are short, cold, dry, and clear. Over the course of the year, the temperature typically varies from 2°C to 27°C and is rarely below -2°C or above 31°C (refer to Figure 12). Carletonville experiences significant seasonal variations in monthly rainfall, average monthly rainfall reaching 96 mm in January and being as low as 2mm in July.

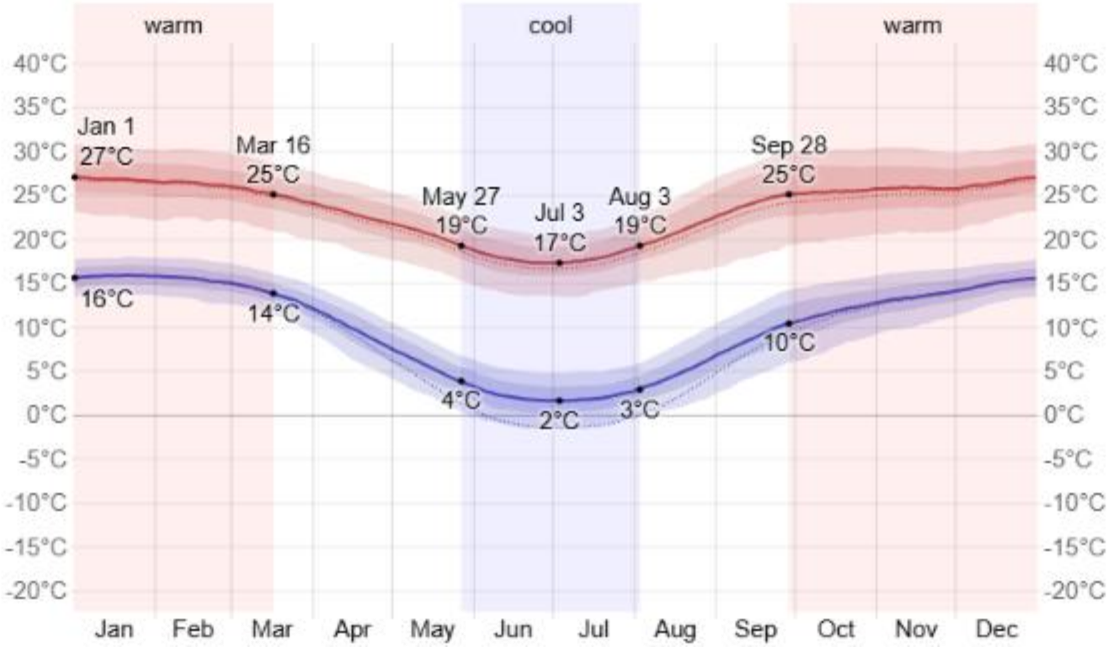


Figure 12: Graph showing average annual temperature Carletonville (Weatherspark, accessed 17/10/2024) https://weatherspark.com/y/94205/Average-Weather-in-Carletonville-Gauteng-South-Africa-Year-Round

4.5 GEOLOGY

This section is mainly informed by the background information supplied by the geohydrologist in the groundwater assessment for the proposed activity.

The study area is located within the Witwatersrand basin. The gold and uranium deposits of the Witwatersrand basin constitute one of the great metallogenic provinces of the world. The Witwatersrand sedimentary basin has been deposited over a granite-greenstone basement known as the Kaapvaal Craton (McCarthy and Rubidge, 2005). The accumulated sediments within the basin are collectively known as the Witwatersrand Supergroup and are made up of the West Rand Group (WRG) and the Central Rand Group (CRG). The lowermost sedimentary strata of the WRG, which attains a maximum thickness of 5 000 m, were deposited in a shallow sea environment and are mostly comprised shales and quartzites. The WRG is overlain by quartzites and conglomerates of the CRG. These sediments are an accumulation of riverine deposits, with high concentrations of gold and uranium associated with certain conglomerate layers (McCarthy and Rubidge, 2005). The Witwatersrand basin constitutes a Northeast to Southwest trending basin 350 km x 160 km, underlying southern Gauteng, North West and northern Free State Provinces.

The volcanic and sedimentary rocks are part of the Ventersdorp Supergroup (McCarthy and Rubidge, 2005). Rifting of the Kaapvaal Craton, followed by erosion and thereafter subsidence of the continent below sea level. The subsequent subsidence of the continent caused river systems to be drowned and buried by beach and shallow-water marine deposits, resulting in the deposition of the conglomerate, sandstone and mudstone deposits of the Black Reef Formation. Bacteria thrived in this shallow sea environment and bacterial growth resulted in the accumulation of >1 000 m thick dolomitic deposit as well as large amounts of iron and manganese, which precipitated as a result of oxygen release by cyano-bacteria (McCarthy and Rubidge, 2005). The dolomitic deposition that resulted constitutes the Malmani Subgroup Dolomites of the Chuniespoort Group and Transvaal Supergroup, which stretches from Johannesburg, to Carletonville and beyond to Orkney.

4.5.1 REGIONAL GEOLOGY AND MINERALOGY

The Far West Rand goldfields fall within a prominent semi-circular deposit of Transvaal Supergroup rocks, which stretches from the south of Johannesburg, beyond Carletonville to Orkney in the west.

The Far West Rand goldfields represent the southern limb of the asymmetrical Hartbeesfontein-anticline (also referred to as the Westrand-anticline). Small windows of Archaean granitoids and Black Reef Formation quartzites outcrop in the crest of the anticline. The Transvaal Supergroup, which forms the southern limb of the anticline, dip 6o to the south. This anticline represents an important watershed, which separates rivers draining to the north, i.e. towards the Limpopo River and onwards to the Indian Ocean, from those draining to the South, i.e. towards the Vaal and Orange Rivers, and thereafter the Atlantic Ocean. A north-south cross-section through the region shows that the Pretoria Group has been eroded along the edge of the Hartbeesfontein-anticline, exposing the Malmani dolomites of the Chuniespoort Group along the length of the Wonderfontein Spruit. The Pretoria Group sediments (Rooihoogte and Timeball Hill Formations), however, form prominent hills (Gatsrante) south of the dolomites and represent the southern boundary of the Wonderfontein Spruit catchment. Refer to Figure 13 for a map showing the regional geology.

4.5.2 SOILS AND LAND CAPABILITY

Agricultural potential are determined by a combination of soil, terrain and climate features. Land capability is defined by the most intensive long-term sustainable use of land under rain-fed conditions. At the same time an indication is given about the permanent limitations associated with the different land use classes. The land capability is determined by the physical features of the landscape including the soils present. The land potential or agricultural potential is determined by combining the land capability results and the climate capability for the region.

According to the DFFE screening tool, the soils in the TSF area are mostly medium potential agricultural soils with some low agricultural areas and a few spots of high agricultural potential soils. The natural vegetation of the site is classified as Gauteng Shale Mountain Bushveld (according to SANBI, 2018), although there is no to negligible natural vegetation on the site. The TSF covers the full extent of the immediate site and is surrounded by TSFs and other mining activities. Refer to Figure 14 for a map showing the soil types in and surrounding the study area and Figure 11 for a map showing land cover.

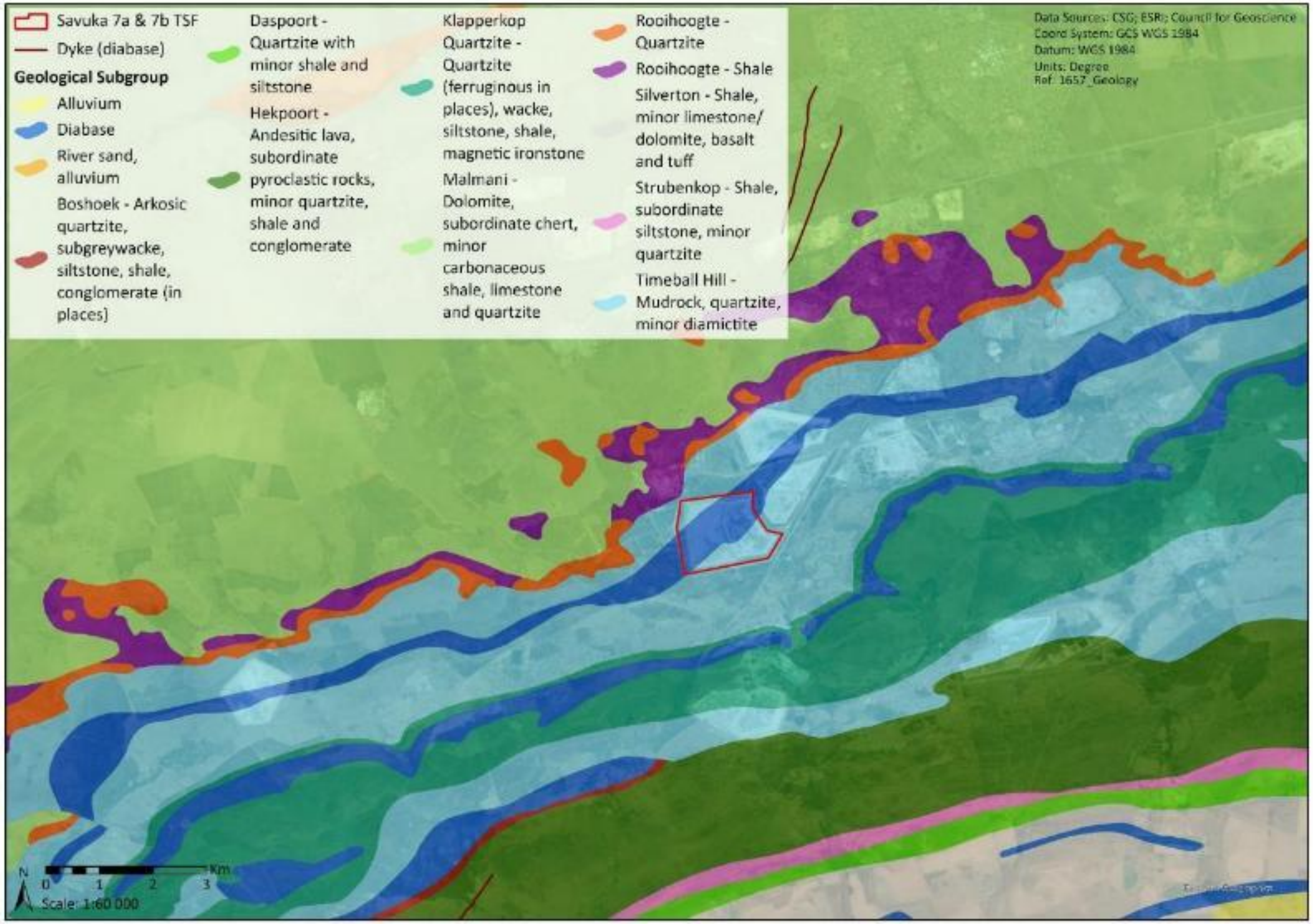


Figure 13: Regional geology

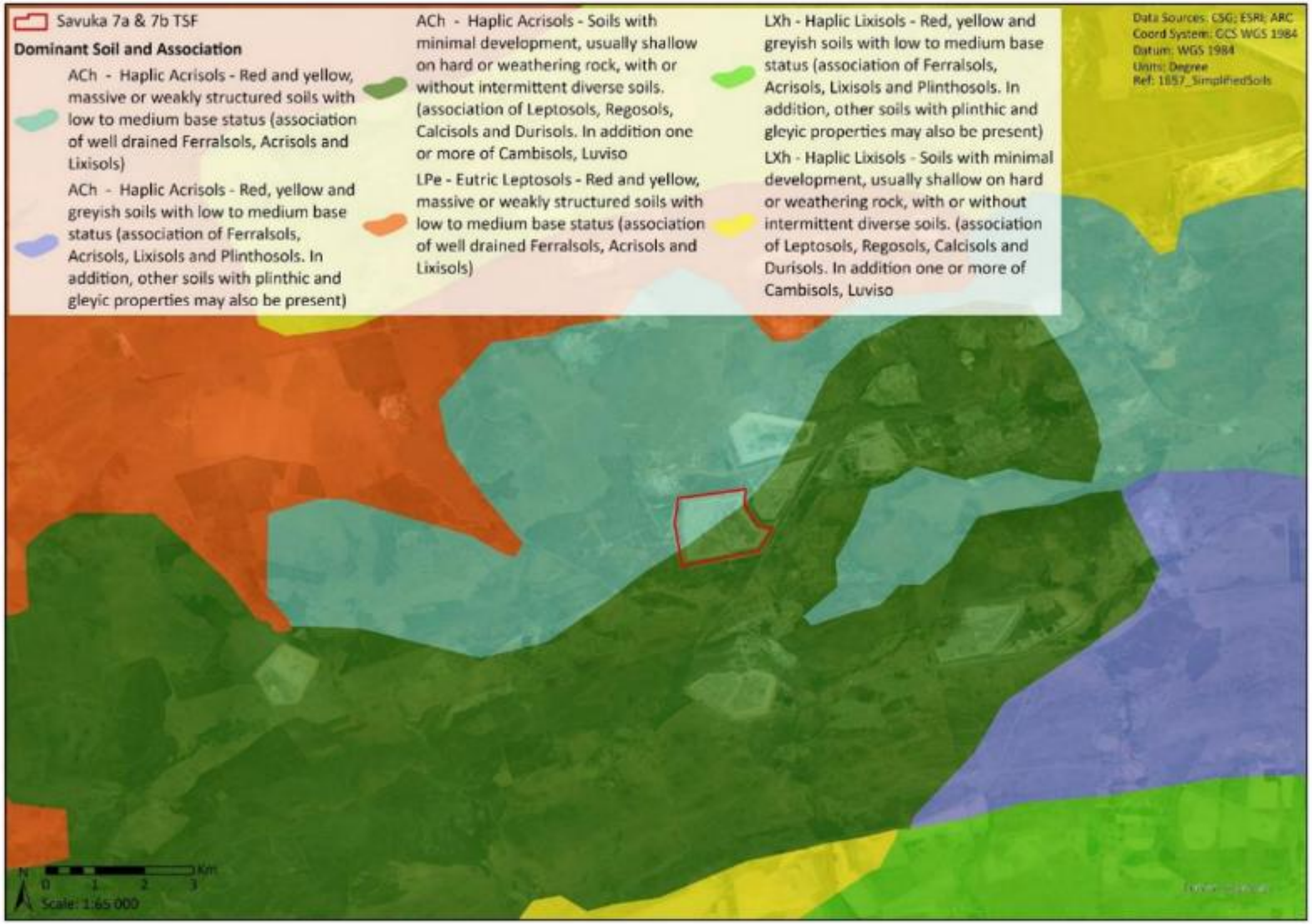


Figure 14: Simplified Soil

4.6 BIOLOGICAL ENVIRONMENT

The biological environment comprises the terrestrial and aquatic vegetation and habitats, as well as fauna living in these habitats.

4.6.1 FLORA

The project area is situated within the grassland biome. This biome is centrally located in southern Africa, and adjoins all except the desert, fynbos and succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include:

- Seasonal precipitation; and
- The minimum temperatures in winter (Mucina & Rutherford, 2006).

The grassland biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. The topography is mainly flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level.

Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees. The project area spans across the Gauteng Shale Mountain Bushveld Vegetation Type of this biome (refer to Figure 16).

There is negligible natural vegetation occurring on the study area, as the study area is mainly comprised of the TSFs. TSFs has been established decades ago and covers the entire study area. Most of the surrounding land uses are associated with mining. The complete study area and most of the directly adjacent area is already disturbed with mining activities such as the TSFs. During the site visit, the EAP did not encounter any terrestrial biodiversity sensitive features or species on the study area.

4.6.2 FAUNA

No fauna were observed during the site screening verification visit to the site. The TSFs have been established decades ago and covers the entire study area. Most of the surrounding land uses are associated with mining. The complete study area and most of the directly adjacent area is already disturbed with mining activities such as the TSFs. During the site visit, the EAP did not encounter any terrestrial biodiversity sensitive features or species on the study area.

4.6.3 HABITATS

4.6.3.1 WETLANDS

An aquatic impact assessment was conducted by The Biodiversity Company specialists that included a site visit. Four (4) Hydrogeomorphic (HGM) units were identified within the encompassing 500 m Savuka TSF Project Area Of Influence (PAOI). These were classified as; one (1) channelled valley-bottom, two (2) unchannelled valley-bottoms and one (1) artificial wetland. Several dams were identified within the PAOI, most of which were off-channel features. Furthermore, the one HGM unit has been identified as an artificial depression. In addition, two non-perennial drainage features were identified where one has connectivity to the larger perennial river, namely the Mooiriver. A summary of the wetland features is provided in the table below and photographic evidence in Figure 15.

Table 8: Summary of the identified Savuka 7a & 7b TSF watercourses Wetland Type

Wetland Type	Wetland Name
Channelled valley-bottom	HGM 1
Unchannelled valley-bottom	HGM 2 HGM 4
Artificial Wetland	HGM 3
Artificial watercourses	Artificial
Dams	Artificial Dams

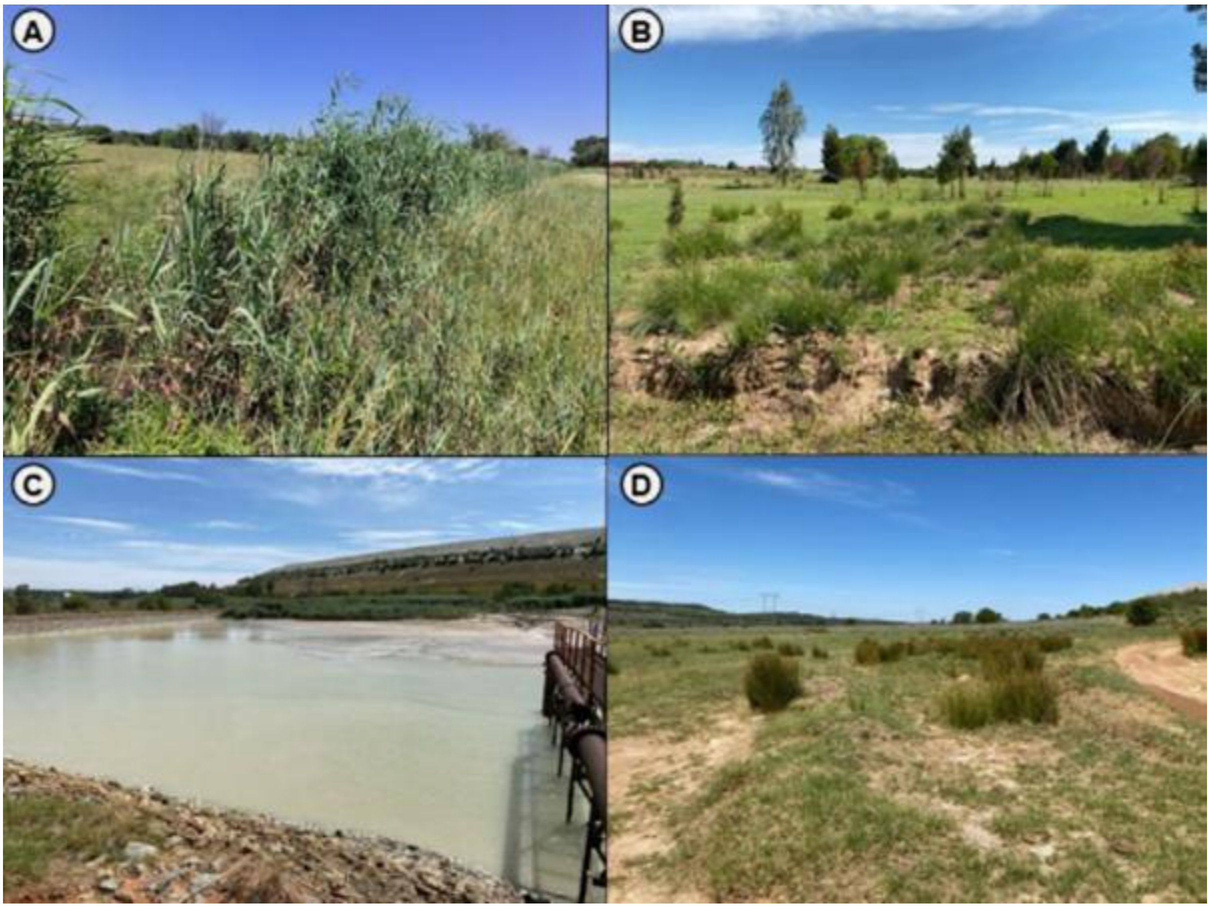


Figure 15: Representative photographs of the various freshwater features within the Savuka project area. A) Channelled valley-bottom (HGM 1); B) Unchannelled valley-bottom (HGM 4); C) Dam and D) Artificial Depression

HGM 4 is characterized as "at risk" from the development and the other delineated wetlands as "not at risk" from the proposed development.

The ecosystem services provided by the HGM units on site were assessed and rated using the WET-EcoServices method (Kotze et al., 2009). For Savuka 7a & 7b TSF, the average ecosystem scores ranged from "Moderately High" (HGM1) to "Intermediate" (HGM2 and HGM4). Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, provisioning of water for human use, erosion control, and the maintenance of biodiversity.

The wetlands exhibited different degrees of modification resulting from natural physical changes as well as anthropogenically induced impacts at both the local and catchment level. Resultingly, the wetlands have scored an average Present Ecological State (PES) score of either “D – Largely Modified”(HGM4) or “E – Seriously Modified” (HGM 1 and 2) PES class.

The Ecological Importance and Sensitivity (EIS) assessment was applied to the HGM units in conjunction with the ecosystem service scores in the preceding section, to assess the levels of sensitivity and ecological importance of the wetland. Various components pertaining to the protection status of a wetland is considered for the EIS, including Strategic Water Source Areas (SWSA), the NFEPA wet veg protection and threat status and the protection and threat status of the wetland type itself considering the NBA wetland dataset. It should be noted that where the dataset did not identify a wetland and one was identified on site, the closest wetland of the same type within the dataset was used to extrapolate findings for the purpose of this assessment. The wetlands average EIS scores were in the “B – High” EIS class.

The Recommended Ecological Category (REC) and Recommended Management Objective (RMO) for the wetland areas was determined from the results of the PES and EIS assessments. These assessments indicated that the wetland feature within the site, had underwent transformation as a result of historical and current impacts. Nevertheless, despite the altered ecological integrity of the systems, they are considered to provide ecological services. The REC for wetland units HGM 1 and 2 is E/F and for HGM 4 C/D. The RMO for both wetlands is to improve the current PES.

The buffer requirements for the wetlands were calculated using the Site-Based Tool: Determination of buffer zone requirements for wetland ecosystems (Macfarlane et al., 2014). The advised pre-mitigation buffer zone for all wetlands within the Savuka 7a & 7b TSF PAOI is 32 m, which is reduced to 15 m following mitigation measures. The buffers considered the sensitivity of the wetlands and the level of modification to the wetland’s periphery (buffer intactness) in relation to the type of development or proposed activities. Figure 17 indicates the delineated wetlands with recommended buffers and Figure 18 illustrates the freshwater sensitivity of the project area of influence.

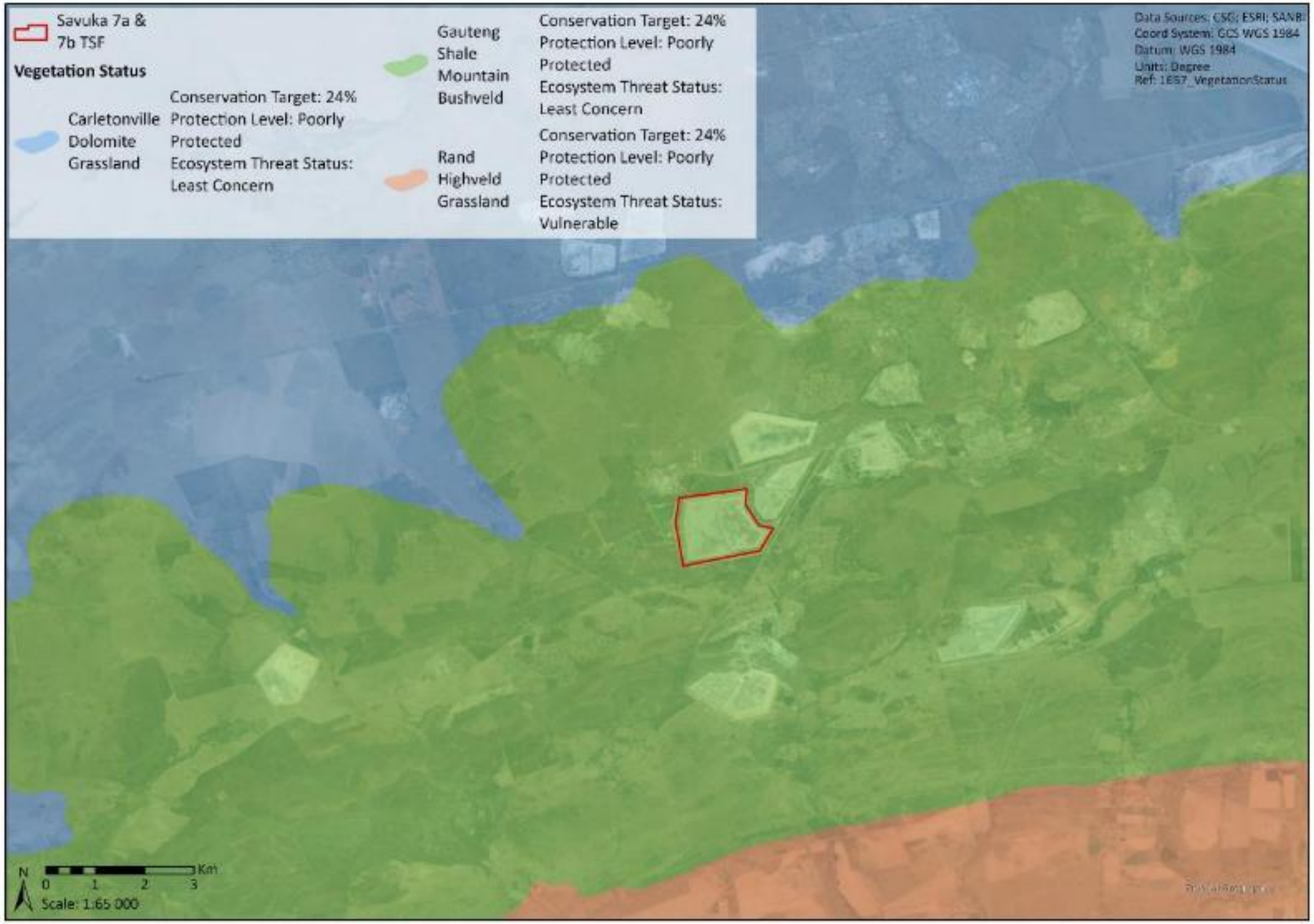


Figure 16: Map illustrating the vegetation type and status of the project area.

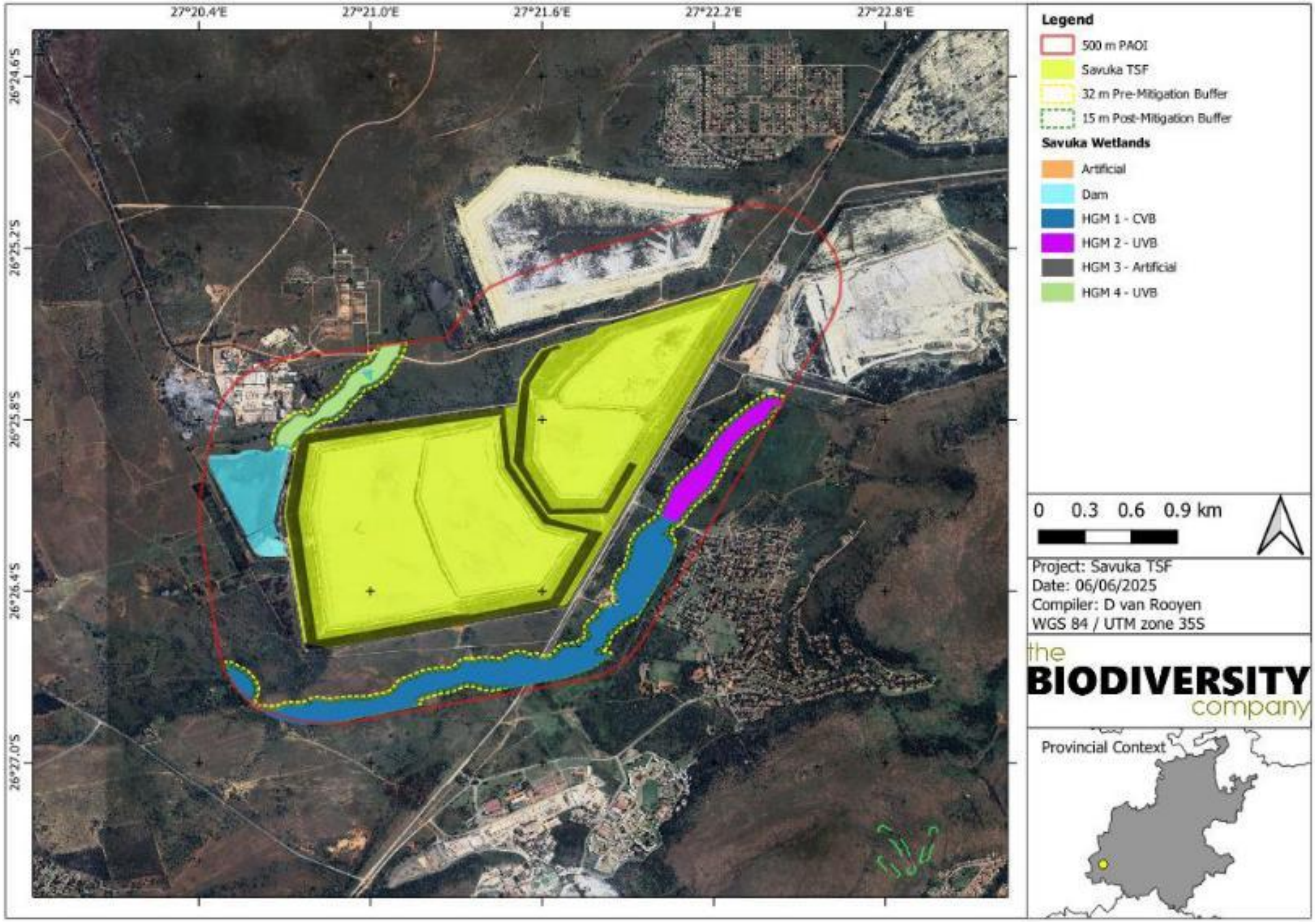


Figure 17: Map illustrating the delineated wetland units within the project area with recommended buffers.

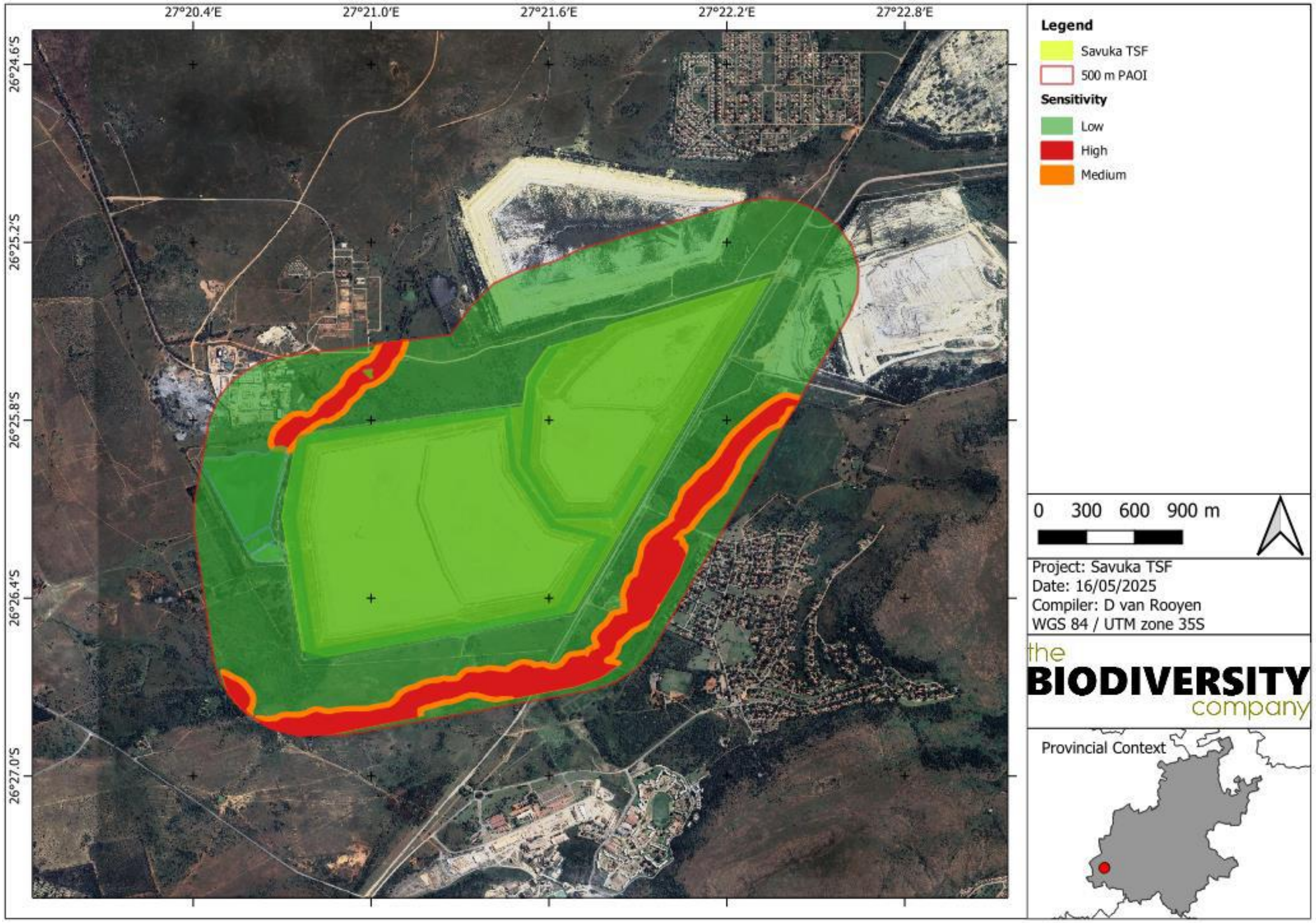


Figure 18: Map illustrating the freshwater sensitivity for the Savuka 7a & 7b TSF Project Area of Influence

4.7 SURFACE HYDROLOGY

A hydrological assessment was conducted by Hydrologic Consulting (Pty) Ltd for the study area and proposed activities applied for. This section outlines a summary of the hydrological baseline relevant to the hydrological assessment as provided with the report. The baseline assessment included sourcing of baseline climatic and hydrological data. This included the interrogation of rainfall data, site-specific design rainfall (depth/duration/frequency), evaporation, soils, and land use, as well as a regional and local hydrological assessment.

The site is positioned within quaternary catchments C23E (Figure 19). Rivers near the site are unnamed, with the National Geospatial Information (NGI)'s 1:50,000 topographical map data illustrating two non-perennial river systems to the north and south, both of which converge to the west of the site (refer to Figure 20 and Figure 21). The southern system is larger than the northern system, however, neither area is sufficiently sized to enable perennial flows (per the NGI's classification). The southern system is associated with a vlei and has upstream furrows directing runoff from part of the greater Mponeng Operation (south of the Old North Complex TSF). Two small dams are noted. The northern system is characterised by two larger dams, both of which appear to be return water dams when reviewing Google Earth imagery. A single non-perennial pan is noted to the north-east of the site. All hydrological features have been presented according to the NGI's 1:50,000 topographical map data and this report does not intend to alter their classification.

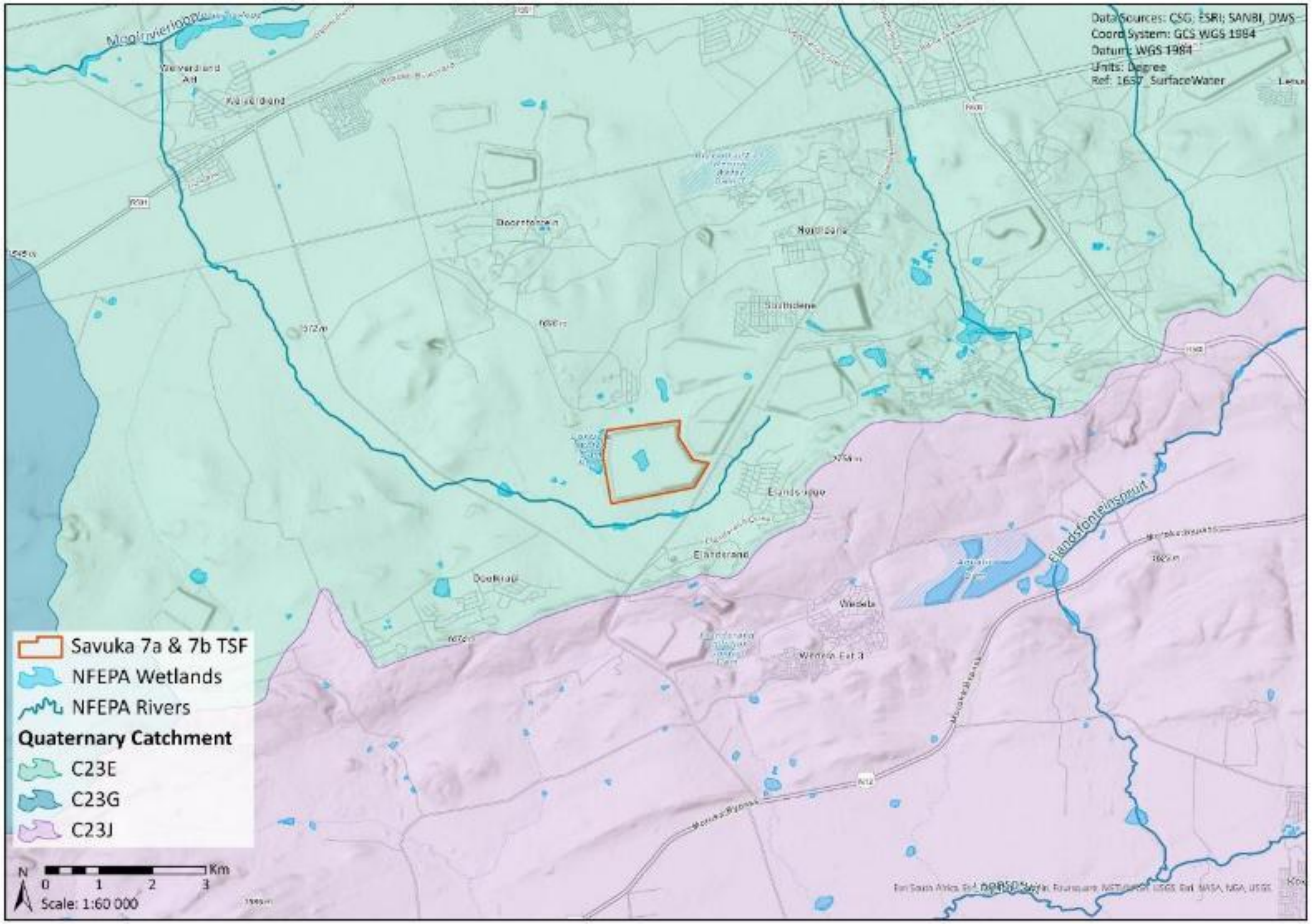


Figure 19: Surface Water Features

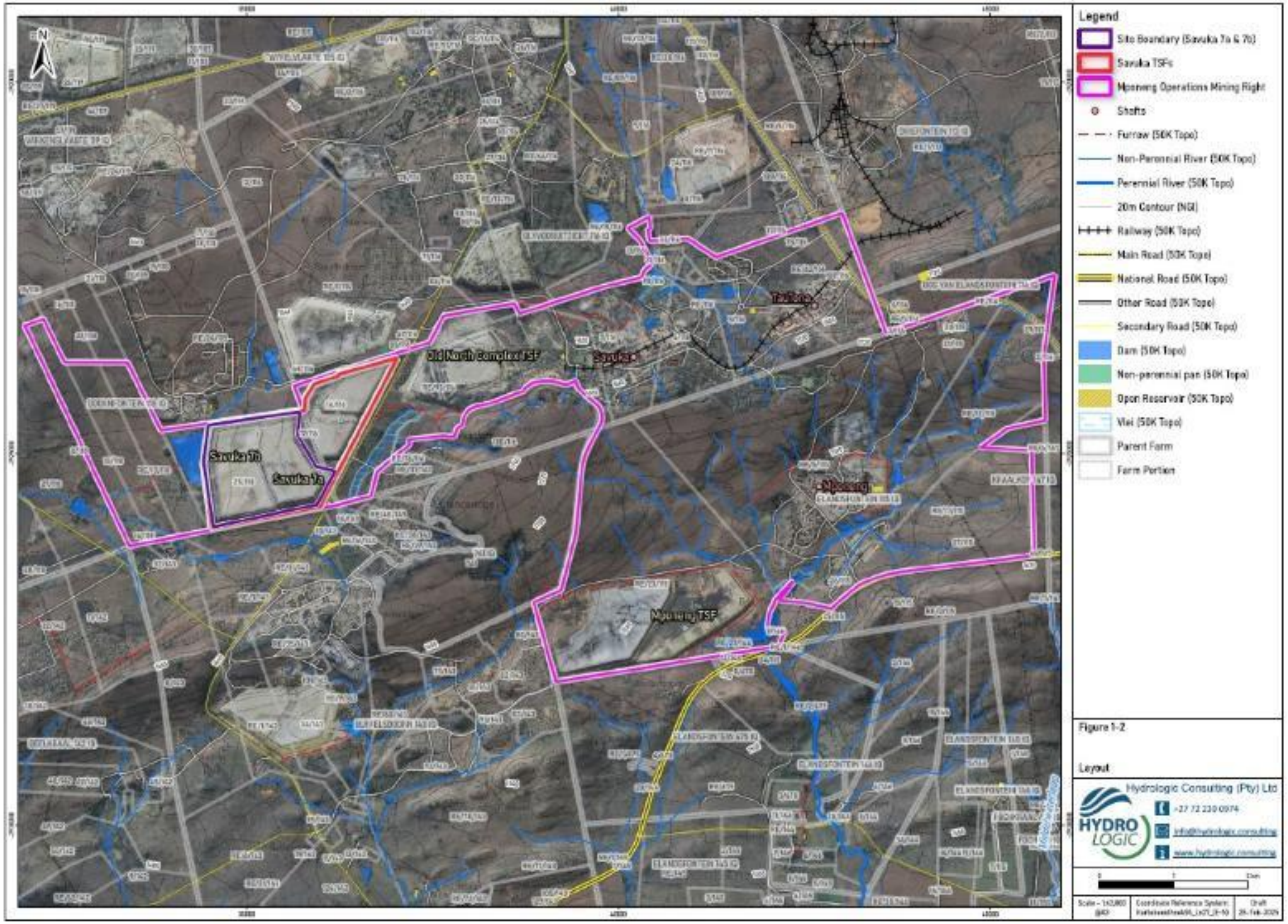


Figure 20: Terrain and Hydrology

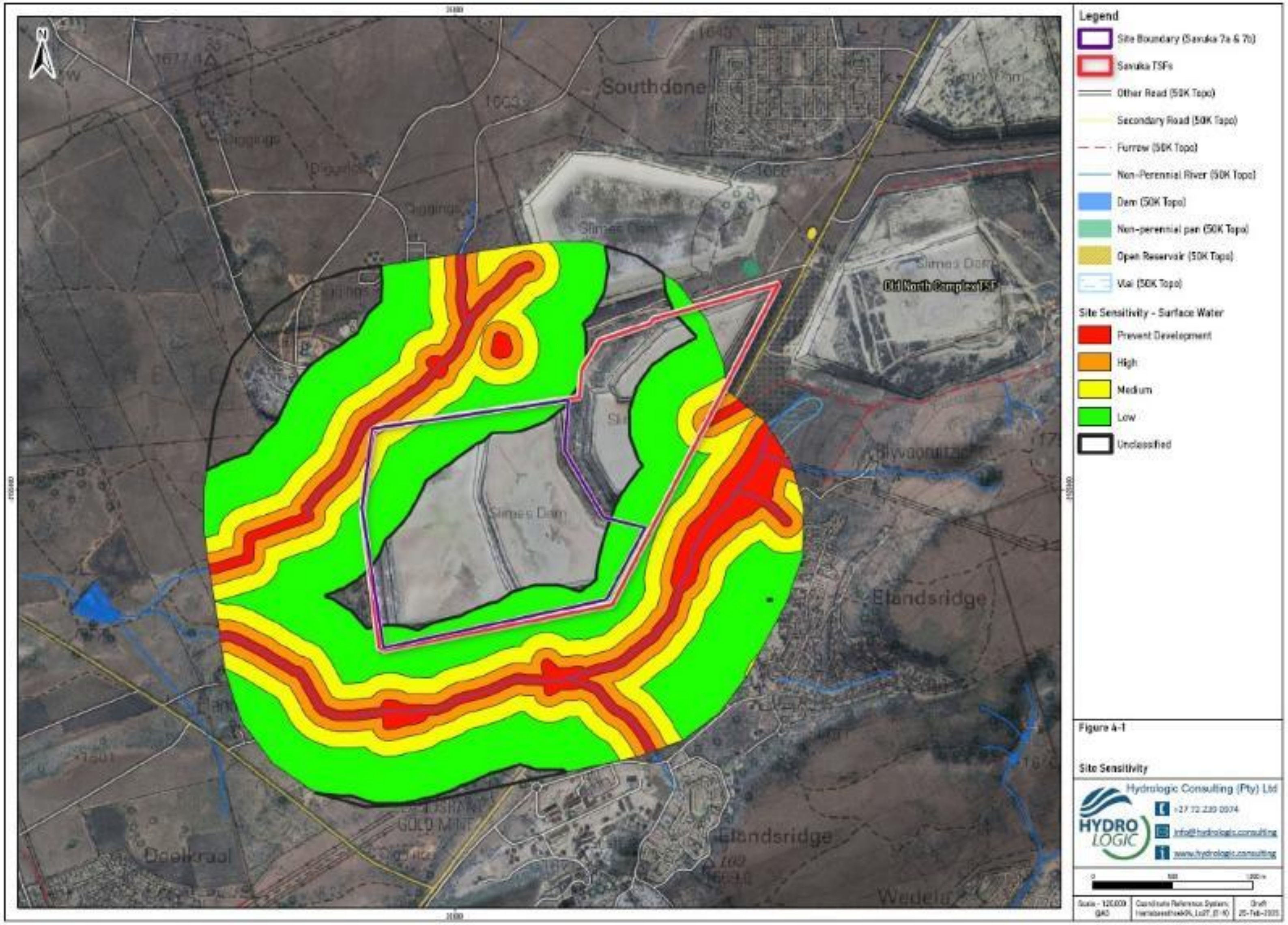


Figure 21: Site Hydrology Sensitivity

Sensitivity mapping was undertaken to identify sensitive features relating to the hydrological (surface water) environment within the site. A 1000 m buffer from the Savuka 7A & 7B TSFs was used as the area under consideration.

The Department of Water Affairs and Forestry (now the Department of Water and Sanitation), established Government Notice (GN) 704 to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. This includes the following condition:

Condition 4 – Restrictions on locality – No person in control of a mine or activity may:

e) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year flood-line or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on water-logged ground, or on ground likely to become water-logged, undermined, unstable or cracked.

The 100 m watercourse buffer is consequently one of the main guiding aspects in the assessment of site sensitivities given its relevance to GN 704, and its applicability to both flooding and the potential for contaminants to enter a watercourse (i.e. a wider river buffer is more likely to keep infrastructure/works outside of areas prone to regular or irregular flooding while enabling more time for containments within runoff, to settle out before entering the watercourse). A 100 m watercourse buffer distance is, however, limited in its application since the proposed activities will either fall within or without this buffer distance, with no grading in site sensitivity possible. An expanded approach to the 100 m river buffer was consequently adopted utilising a variation in buffer distances modelled flooding and contour analysis.

The proposed activities lie between two non-perennial river systems as defined per the 1:50,000 topographical map. There is also constructed drainage present (furrows). Where furrows appear to manage larger areas or are otherwise extensions of non-perennial rivers, they are assumed to fall within the conceptual definition of a watercourse insofar as having the potential to cause flooding and route pollutants downstream.

Watercourse buffers have consequently been derived from the 1:50,000 topographical map features inclusive of dams, furrows, the non-perennial river, non-perennial pans and vleis. Open reservoirs have been excluded on the basis that inflows are managed (and that there is no significant upslope catchment area of relevance). Watercourse buffers are technically applicable from the edge (top of the bank) of the watercourse and not from the centreline (as in the case of rivers, drainage canals and furrows). The absence of a river survey means that the river centreline has nevertheless been used to define buffers.

The following sensitivity bands were classified:

- Prevent Development
    - A 32 m watercourse buffer (also applicable to NEMA activities) was used to define the functional area of the watercourse.
    - This 32 m buffer factors in the potential error in the 1:50,000 topographical map dataset.
    - All development should be prevented in this area, unless water-compatible or otherwise crossing over a watercourse (with flood risk factored in).
- High
    - A 100 m buffer distance matches GN 704’s and DWS Notice 4167 of 2023 prescribed buffer distance and is the minimum distance to a watercourse requiring motivation if works/infrastructure are going to be permitted, including a written exemption from the Minister of the Department of Water and Sanitation.
    - There is a strong disincentive towards development within this area.

- Medium
    - A 200 m buffer distance was included as an intermediate buffer distance to the 100 m buffer distance above and the 500 m buffer distance below.
    - There is a medium disincentive towards development within this area.
- Low
    - A 500 m buffer distance is a reasoned maximum distance from a watercourse which in most instances will reflect the largest distance over which flooding would need to be considered.
    - DWS Notice 4167 of 2023 also outlines how a 500 m buffer distance is applicable to wetlands (which includes pans and vleis as present in this study area). The hydrologist, however, does not focus on wetlands and only considers the 1:50,000 topographical map rivers.There is a low disincentive towards development within this area.
- Remainder
    - There is no sensitivity classification for the remainder of the site.

GN 704 restricts development within 100 m of a watercourse (e.g. dam or river) and the above outline does not attempt to remove this restriction but is instead a high-level ‘scaled’ version of this buffer distance. This classification only partly considers the 500 m wetland buffer that applies. This wetland buffer was more comprehensively assessed as part of a wetland survey of the site (refer to Section 4.6.3) and not the higher-level datasets present with the NGI’s 1:50,000 topographical map dataset.

Figure 21 presents the results of the identified site sensitives as they relate to the surface water environment. As mentioned above, hydrological features have been defined according to the NGI’s 1:50,000 topographical map data and the hydrologist does not intend to alter their classification. However, two of the larger dams to the north of the site are known to act as return water dams. They have, consequently been excluded from the sensitivity analysis. Figure 21 illustrates that there are parts of the TSFs that are within sensitive areas. This primarily includes the influence of the northern and southern river systems adjacent to the TSFs, since the 1:100 RI flood event (medium sensitivity) falls out of the site.

4.8 GROUNDWATER

A geohydrological study and conceptual groundwater model was conducted by MvB Consulting for the Savuka TSF. This section describes the geohydrological setting and conceptual model of the study area. The geohydrological setting and conceptual model of the study area is described according to the following criteria:

- Borehole Information;
- Aquifer Type;
- Groundwater Use;
- Aquifer Parameters;
- Aquifer Recharge;
- Groundwater gradients and flow;
- Groundwater quality; an
- Aquifer Classification.

4.8.1 BOREHOLE INFORMATION

There are several groundwater monitoring boreholes in the vicinity of the Savuka TSFs. No private boreholes could be located within a 2km radius of the TSF. The localities of the available boreholes are shown in Figure 22.

Figure 22: Monitoring Boreholes Locations

4.8.2 AQUIFER TYPE

Groundwater occurrences in the study area are predominantly restricted to the following types of terrains: Weathered and fractured rock aquifer in the Ventersdorp and Transvaal Formations and Dolomitic and Karst Aquifers. Although the dolomite aquifer is the most prominent aquifer in the region, it does not play any role in the activities at the Savuka TSFs.

Within the weathered and fractured aquifer, groundwater occurs in the near-surface geology in the weathered and fractured sedimentary deposits (quartzite and shale) of the Transvaal strata. The lava of the Hekpoort Formation has similar weathering characteristics to that of the shale and is, therefore, deemed as the same aquifer. These formations are not considered to contain economic and sustainable aquifers, but localised high yielding boreholes may, however, exist where significant fractures are intersected. 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 60m. The base of the aquifer is the impermeable quartzite, shale and lava formations, whereas the top of the aquifer would be the surface topography. The groundwater table is affected by seasonal and atmospheric variations and generally mimics the topography. 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.

Dolomite aquifers in the region are known to contain large quantities of groundwater and are commonly associated with sustainable groundwater abstraction. The water that plaques the underground mining is primarily derived from the dolomite aquifer overlying the workings. The depth to groundwater in the region ranges from 4 m to 41 m below surface in the non-dewatered groundwater compartments (Zuurbekom and Boskop/Turffontein). This is in contrast to the groundwater levels in excess of 200 m in the dewatered compartments (Gemsbokfontein West, Venterspost, Bank and Oberholzer). The unsaturated zone in the dolomite aquifer ranges from weathered wad material and Karoo sediments within deep solution cavities or grykes (deeply weathered paleovalley within the dolomite) to relatively fresh fractured dolomite between major solution cavities and at depth. The shallow weathered dolomite aquifer has been formed because of the karstification which has taken place prior to the deposition of the Karoo sediments on top of the dolomites. There is general agreement that this aquifer is the significant source of water within the dolomite. The base of the weathered dolomite (aquifer) is irregular in nature and there are zones of deep weathering (grykes). The maximum depth to the base of this aquifer is in the order of 200 m below surface. The non-weathered dolomite approximates a traditional fractured rock aquifer at depth where dissolution has been less pronounced. It is extremely unlikely that any significant groundwater flow occurs below these depths except along intersecting structural conduits to the underlying mine workings.

In terms of the relationship between the weathered / fractured aquifer and the dolomite aquifer, evidence has shown that there is very little connectivity between the weathered / fractured aquifer and the underlying dolomite aquifer. Even in compartments where the dolomite aquifer is dewatered the groundwater levels in the weathered / fractured aquifer remains unaffected. Based on the exploration borehole information, it appears that the dolomite that that is covered by Transvaal strata is less karstified and the dolomite aquifer is therefore not as well developed. The mines situated south of the "Gatsrant" are generally dry mines with limited groundwater inflow, whereas the mines north of the "Gatsrant" is plagued by high groundwater inflow volumes. This is, in part, attributed to the well-defined karstification in the northern dolomites.

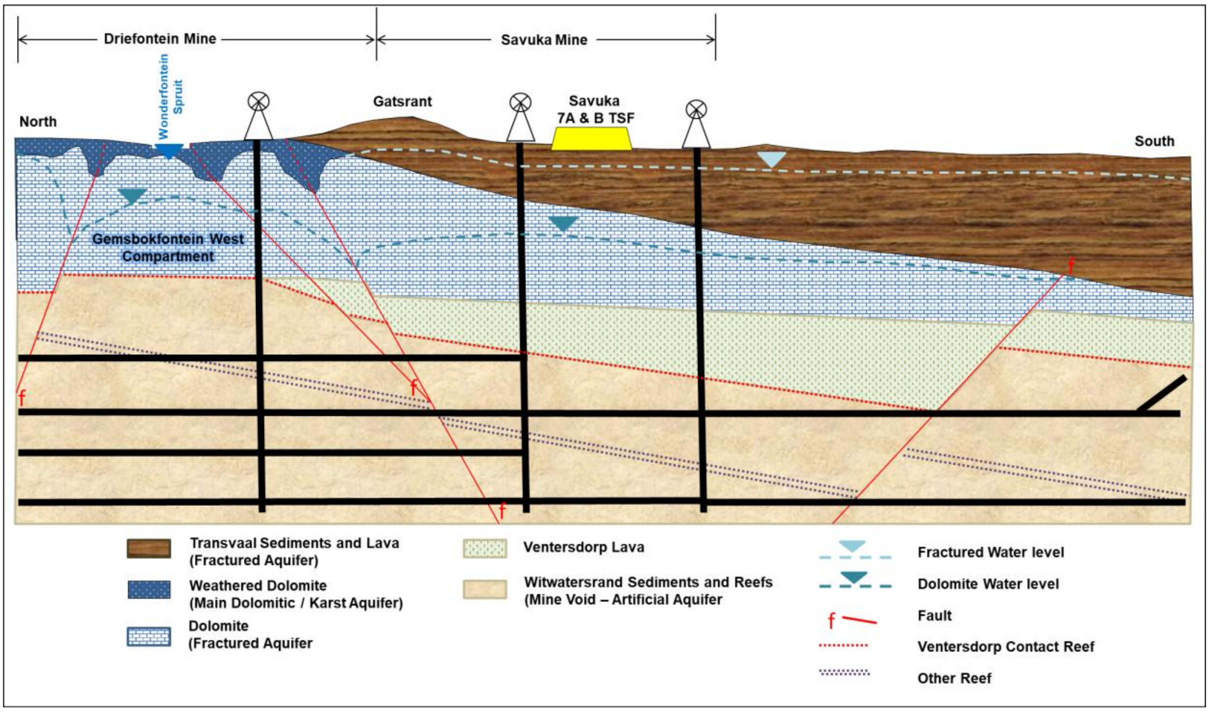


Figure 23: Schematic geological section showing the relationship between the aquifers in the study area (Van Biljon, 2018)

4.8.3 GROUNDWATER USE

There are no groundwater users downstream from the Savuka TSFs.

4.8.4 AQUIFER PARAMETERS

Important parameters that can be obtained from borehole or test pumping include Hydraulic Conductivity (K), Transmissivity (T) and Storativity (S). These parameters are defined as follows (Krusemann and De Ridder, 1991):

- Hydraulic Conductivity (K): This is the volume of water that will move through a porous medium in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. It is normally expressed in metres per day (m/day).
- Transmissivity (T): This is the rate of flow under a unit hydraulic gradient through a cross-section of unit width over the full, saturated thickness of the aquifer. Transmissivity is the product of the average hydraulic conductivity and the saturated thickness of the aquifer. Transmissivity is expressed in metres squared per day (m2/day).
- Storativity (S): The storativity of a saturated confined aquifer is the volume of water released from storage per unit surface area of the aquifer per unit decline in the component of hydraulic head normal to that surface. Storativity is a dimensionless quantity.

Pump testing that was undertaken in the region (Van Biljon and Glendinning, 2013) estimated the aquifer parameters in the weathered and fractured aquifer was taken into account. The geometric mean transmissivity was calculated to be 0.5 m^2/day and hydraulic conductivity 0.02 m/day.

4.8.5 AQUIFER RECHARGE

Recharge is defined as the process by which water is added from outside to the zone of saturation of an aquifer, either directly into a formation, or indirectly by way of another formation. Groundwater recharge (R) for the study area was calculated using the chloride method (Bredenkamp et al., 1995) and is expressed as a percentage of the Mean Annual Precipitation (MAP).

According to Vegter (1995) the recharge in the fractured aquifer is 31 mm / annum with water occurring in the shallow weathered zone and water bearing fractures only. This is equal to approximately 4% of mean annual precipitation. The average rainfall in the area is approximately 646 mm / annum. The average chloride in rainfall for areas inland is approximately 1.0 mg/L and the harmonic mean of the chloride concentration values in groundwater samples obtained from the mining area is 25.88 mg/L. The recharge value is calculated to be 3.9%, which corresponds with Vegter's value.

4.8.6 GROUNDWATER GRADIENTS AND FLOW

The first important aspect when evaluating the geohydrological regime and groundwater flow mechanisms is the groundwater gradients. Groundwater gradients, taking into consideration fluid pressure, are used to determine the hydraulic head which is the driving force behind groundwater flow. The flow governs the migration of contaminants, and a detailed assessment of the flow was required to determine subsurface flow directions from the TSF or any other potential contaminant source. In most geological terrains, the groundwater mimics the topography and to test if this is the case within the study area the available groundwater levels were plotted against the topography (represented by the borehole collar elevations). The result indicated a very good correlation (96%) between the topography and the groundwater level, which suggests that groundwater flow will follow the topographical gradient. This relationship is known as the Bayesian relationship, and where this exists, the regional topography can be used to interpolate (Bayesian interpolation) a regional groundwater gradient map. Figure 24 depicts the groundwater level elevations, which as expected to mimic the surface contours. Groundwater flow is perpendicular to the groundwater contours and flows predominantly towards the south-west.

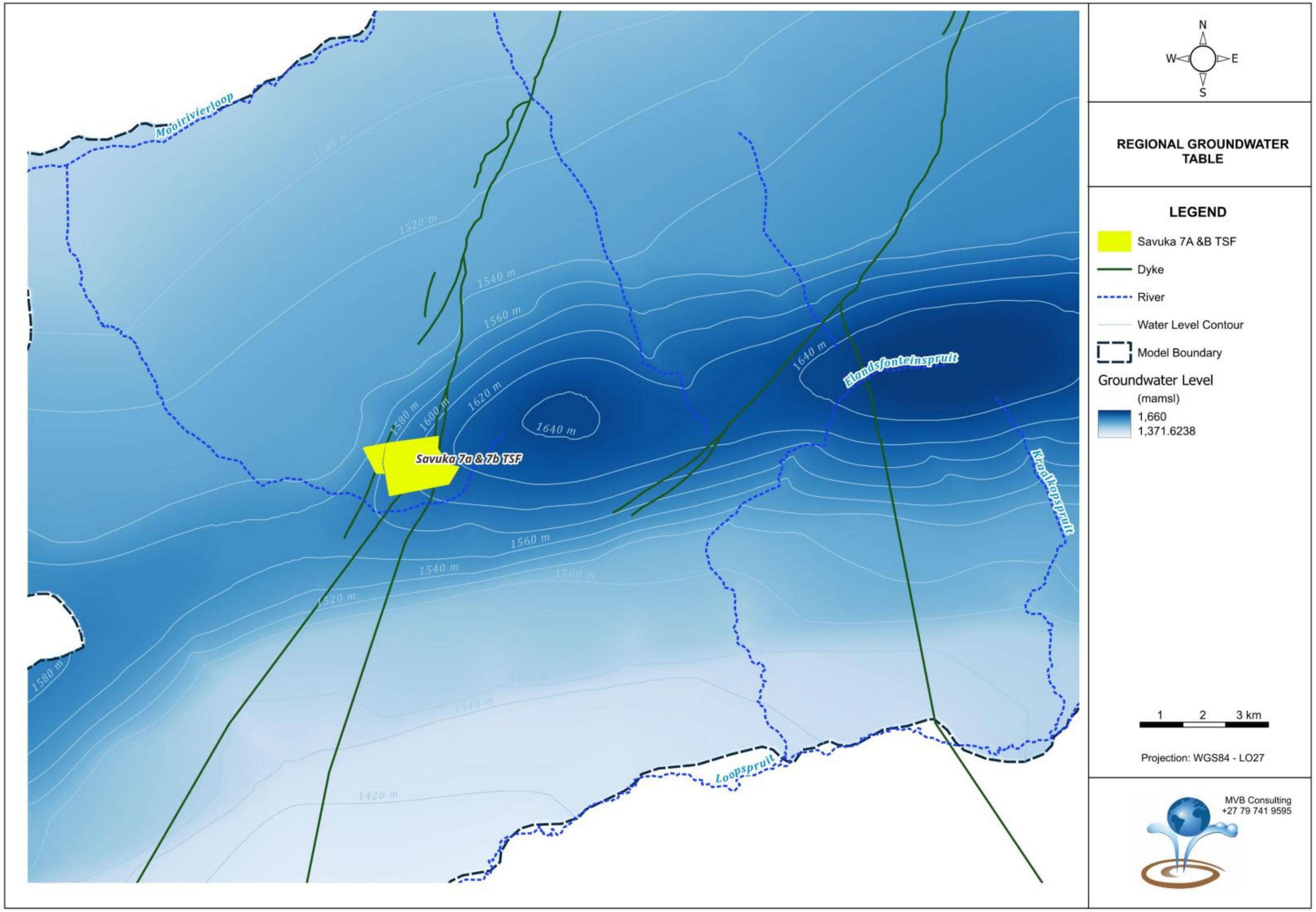


Figure 24: Regional Groundwater Gradient

4.8.7 GROUNDWATER QUALITY

Since there are no groundwater users downstream from the Savuka TSFs, the groundwater chemistry was compared to the South African Water Quality Guidelines (second edition) Volume 5: Agricultural Use: Livestock Watering (Department of Water Affairs and Forestry, 1996), as well as the SANS 241 (2015). The SANS 241 Drinking Water Specification is the definitive reference on acceptable limits for drinking water quality parameters in South Africa and provides guideline levels for a range of water quality characteristics. The SANS 241 (2015) Drinking-Water Specification effectively summarises the suitability of water for drinking water purposes for lifetime consumption. The guideline for livestock watering represents the target water quality specified in the guidelines. The target water quality guidelines were obtained from the Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines (second edition). Volume 5: Agricultural Use: Livestock Watering.

Selected monitoring boreholes were sampled to assess (in consultation with the mine monitoring data) the current groundwater quality in the vicinity of the TSF. From the results, the following was observed:

- The groundwater in the monitoring boreholes show a mining impact, with high Total Dissolved Solids (TDS) and sulphate concentrations.
- Several heavy metals exceed the SANS 241 and Livestock Watering guidelines. Apart from the Savuka 7a & 7b TSF's, there is also a larger impact from neighbouring tailings facilities.
- Borehole MB38 is anomalous and has much better quality than the other monitoring boreholes. This is attributed to this borehole being located within the phyto-remediation area.

4.8.8 AQUIFER CLASSIFICATION

An aquifer classification system provides a framework and objective basis for identifying and setting appropriate levels of groundwater resource protection. This would facilitate the adoption of a policy of differentiated groundwater protection.

Other uses could include:

- Defining levels of investigation required for decision making.
- Setting of monitoring requirements.
- Allocation of manpower resources for contamination control functions.

The aquifer classification system used to classify the aquifers is the proposed National Aquifer Classification System of Parsons (1995). This system has a certain amount of flexibility and can be linked to second classifications such as a vulnerability or usage classification. Parsons suggests that aquifer classification forms a very useful planning tool that can be used to guide the management of groundwater issues. He also suggests that some level of flexibility should be incorporated when using such a classification system.

The South African Aquifer System Management Classification is presented by five major classes:

- Sole Source Aquifer System.
- Major Aquifer System.
- Minor Aquifer System.
- Non-Aquifer System.
- Special Aquifer System.

The following definitions apply to the aquifer classification system:

- Sole source aquifer system: “An aquifer that is used to supply 50 % or more of domestic water for a given area, and for which there are no reasonable alternative sources should the aquifer become depleted or impacted upon. Aquifer yields and natural water quality are immaterial”.
- Major aquifer system: “Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good”.
- Minor aquifer system: “These can be fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although this aquifer seldom produces large quantities of water, they are both important for local supplies and in supplying base flow for rivers”.
- Non-aquifer system: “These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, groundwater flow through such rocks does occur, although imperceptible, and needs to be considered when assessing risk associated with persistent pollutants”.
- Special aquifer system: “An aquifer designated as such by the Minister of Water Affairs, after due process”.

After rating the aquifer system management and the aquifer vulnerability, the points are multiplied to obtain a Groundwater Quality Management (GQM) index.

After rating the aquifer system management and the aquifer vulnerability, the points are multiplied to obtain a Groundwater Quality Management (GQM) index. Based on the above, the aquifers in the study area are classified as follows:

Table 9: Aquifer Classification

Description	Aquifer	Vulnerability	Rating	Protection
Weathered Aquifer	Minor (2)	1	2	Low
Fractured Aquifer	Minor (2)	1	2	Low

4.9 SOCIO-ECONOMIC

The socio-economic baseline conditions relevant to the Project area are described in Equispectives (2015; 2020). The radiological health specialist (Aquisim Consulting), presented this report as a detailed summary of the conditions that serve as a basis for human behavioural conditions and their interaction with the environment, in his report, Radiological Impact Assessment (Appendix E). This information provides input into the definition of receptor groups and their behaviour within the public exposure conditions.

4.9.1 COMMUNITY TYPES

Communities can be classified as belonging to one of the following groups (Equispectives, 2024):

4.9.1.1 FORMAL RESIDENTIAL STRUCTURE COMMUNITIES

A formal dwelling can be described as “A structure built according to approved plans, i.e., house on a separate stand, flat or apartment, townhouse, a room in a backyard or rooms or flatlet elsewhere” (Statistics South Africa, 2012). In some areas, there may be a formal as well as an informal dwelling on a stand, creating a community with mixed dwelling types.

4.9.1.2 INFORMAL RESIDENTIAL STRUCTURE COMMUNITIES

An informal dwelling can be described as "A makeshift structure not approved by a local authority and not intended as a permanent dwelling. Typically built with found materials (corrugated iron, cardboard, plastic, etc.), and is contrasted with formal dwelling and traditional dwelling" (Statistics South Africa, 2012).

4.9.1.3 COMMERCIAL AGRICULTURAL COMMUNITIES

Commercial agriculture includes farms where the farmer earns a livelihood from agriculture, such as crop, livestock, or game farming. Areas with smallholdings are categorised according to their character. If the residents of the smallholdings practise agriculture, they are grouped with commercial agriculture; if they just reside in the area or have a business on the smallholding not related to agriculture, the area is classified as formal residential.

4.9.1.4 SMALL-SCALE SUBSISTENCE FARMING

Small-scale subsistence farming can be described as food gardening taking place on a large scale on a piece of land that is not in someone's backyard. The land is usually cultivated by different members of the community, and they may belong to a formalised group. Food gardens in the backyard of an organisation, like a school or crèche, would also be grouped in this category. Keeping livestock in the community or on the outskirts of the community would form part of this group.

Agricultural projects conducted as part of a Social and Labour Plan of a mine can contain characteristics of both commercial agriculture and subsistence farming. To classify these projects, the following guideline is used: if the projects have reached a stage where it is sustainable and function with minimal to no input from the mine, they are classified as commercial agriculture. However, if the mine is still heavily involved, it is classified as small-scale subsistence farming, as the Project has not yet proved its sustainability.

Figure 25 shows a 5 km radius around the Project surface infrastructure, as well as the potentially sensitive receptors within a 5 km radius. The following residential areas were identified in 2015 near the Project:

4.9.1.5 ANGLOGOLD ASHANTI RESIDENCES (NOW PART OF WEST WITS OPERATIONS)

The West Wits Operations had four residences for employees in 2015, namely Ntshonalanga, Matabong, Ekhayalihle and Numba Wani, which were converted to single rooms or family quarters. The family quarters were at Ekhayalihle and could host up to 25 people who became paraplegic after injuries on duty. Matabong housed employees from the TauTona mine, while Ntshonalanga housed employees who worked at the Savuka mine, which was integrated with the TauTona mine. Numba Wani hosted employees from the Mponeng mine. The operations also had facilities for visiting wives.

The TauTona and Savuka mines were placed in orderly closure in 2017, and as such, the only residence where the activity is expected is the Numba Wani residence. The Merafong City Local Municipality (LM) (2019/2020) has indicated that Mponeng has a good locality relative to the N12 that could be exploited once mine closure looms, and that there is possibly good potential for non-residential uses.

- West Wits Village

In 2015, the West Wits Village housed employees of AngloGold Ashanti. The 2019/2020 IDP of the Merafong City LM indicates that township establishment is underway. The municipality is looking into the feasibility of a Mining Industrial Park as part of the second phase of Mining Phakisa implementation. The re-use potential of the area is considered good, with the possibility of developing into a significant node.

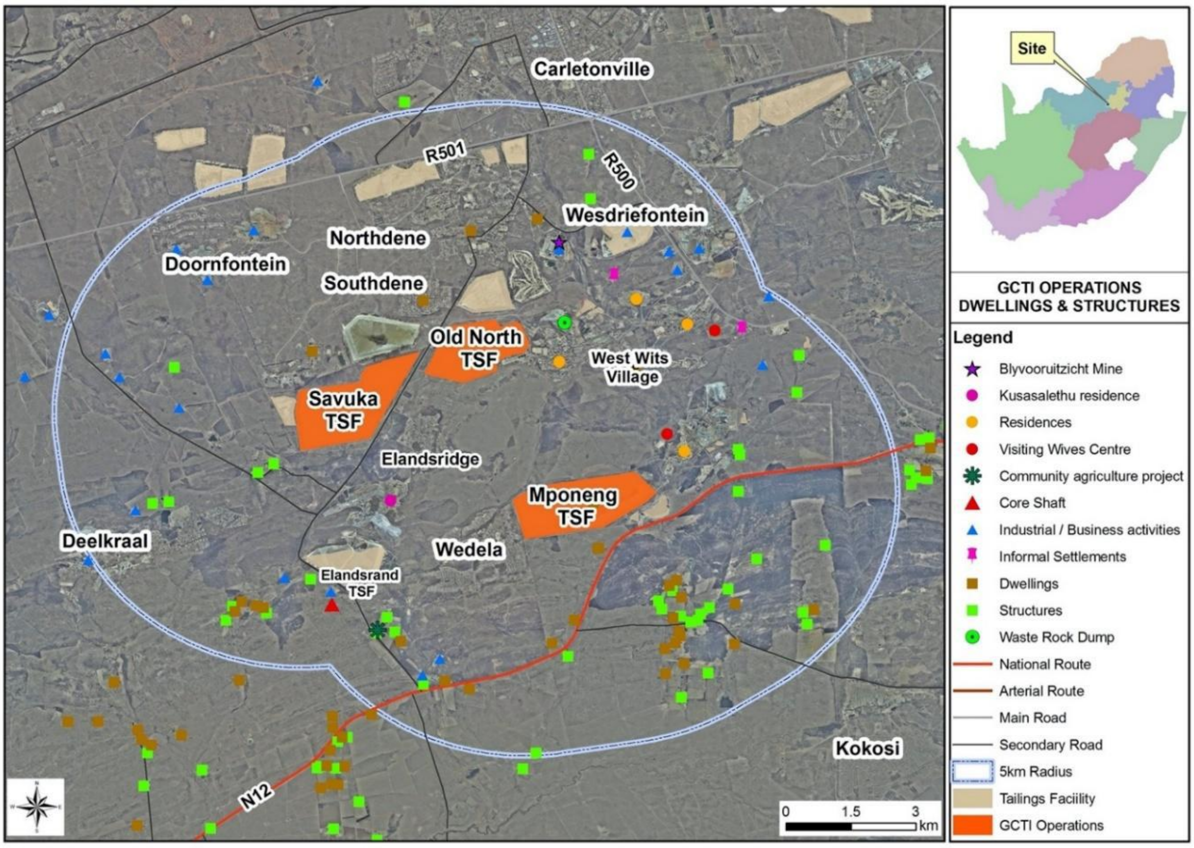


Figure 25: Map indicating the study area used for the Project Baseline Social and Land Use Assessment (Equispectives, 2020).

- Deelkraal Estate

Deelkraal Estate used to be a mining village, but was in private ownership in 2015, with the owners being in the process of having the estate declared as a township. In the 2019/2020 IDP document of the Merafong City LM, Deelkraal is still indicated as a mining village with limited supportive land uses and limited economic potential. Although most residences are in fair condition, the municipality anticipates that the market for rental or buying in Deelkraal to collapse within the next few years due to new rental options in Carletonville and Fochville, as well as the mineshaft closure at Kusasalethu mine. The municipality will not take over services in the area and anticipates that Deelkraal will be demolished and that the area will be rehabilitated.

- Elandsridge

Elandsridge/Elandsrand is a mining village where employees of Harmony's Kusasalethu mine reside. The Merafong City LM (2019/2020 IDP) has indicated that the Kusasalethu mine is expected to close within a few years, and if it does open again, it would be operated through mechanisation and automation. The municipality would not take over services, and the residential viability is regarded as low due to the lack of a new economic foundation, few facilities and the isolated location. It is anticipated that the area will be demolished and rehabilitated, possibly for agriculture or renewable energy.

- Wedela

Wedela is situated between Harmony's Kusasalethu Operations and the Mponeng tailings storage facility. It was established in 1978 and granted municipal status in January 1990. Wedela is mostly a formal settlement, but there is an informal settlement on the edge of Wedela, and many houses have backyard shacks. It is currently located close to mining operations that will not be sustained indefinitely.

- Mohaleshoek Informal Settlement

This informal settlement is located on private land adjacent to the R500, between the TauTona and Mponeng mines. Many residents are rumoured to be illegal immigrants. The Merafong City LM (IDP 2019/2020) has indicated that the informal settlements located at Blyvooruitzicht and Western Deep Levels can be accommodated at the West Wits township, either through subsidised housing or a CRU (Community Residential Units) project. The CRU programme aims to facilitate the provision of secure, stable rental tenure for lower-income individuals (www.gov.za).

- Farming Community

The farming community consists of farms and smallholdings that are located in the Deelkraal area as well as adjacent to the Mponeng mine. Farming activities consist of crop farming, livestock, game breeding and hunting. Some of the farms offer tourist activities. Some farms have workers residing on the farm, while the workers from other farms do not reside on the farm, but somewhere else in the vicinity.

- Residential areas around the Blyvooruitzicht mine

In 2015 people living in the area around the Blyvooruitzicht mine that was put in provisional liquidation in August 2013 lived in dire socio-economic conditions. The Merafong City LM (2019/2020 IDP) has indicated that the mine's gold mining component has been revived recently. According to the municipality, the village has significant potential to be integrated into Carletonville although buildings and infrastructure have been stripped and vandalised. The lawlessness that marked the area in 2015, seems to have been resolved by the new mine owner. There are dolomitic constraints in the area and the Housing Development Agency is conducting a feasibility study on the potential of reviving the village.

Figure 25 also shows the location of dwellings and structures relative to the Project that are not located in a town or a village. The number of dwelling groups has remained more or less the same, as observed through aerial photography. At some of the dwelling clusters, new buildings have been observed.

Table 10 presents the breakdown for households according to geo types as per Census 2011.

Table 10: Breakdown of households according to geo types (source: Census 2011) (Equispectives, 2020).

Geo Type	Merafong City LM	Mining Wards				Mixed Wards			
		Ward 5	Ward 11	Ward 14	Ward 27	Ward 12	Ward 20	Ward 22	Ward 23
Urban Area	68,199	2,431	3,586	4,575	3,827	1,475	3,234	2,040	2,402
Traditional Area	0	0	0	0	0	0	0	0	0
Farm Area	2,207	0	0	75	0	68	0	0	0
Total	70,406	2,431	3,586	4,650	3,827	1,543	3,234	2,040	2,402

It can be concluded that the land use near the Project is dominated by open grassland, agricultural (cultivated cropland), mining and residential land use conditions. Equispectives (2020) divided communities into those living in formal structures, communities living in informal structures, commercial agricultural communities, and small-scale subsistence farming communities.

4.9.2 DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

4.9.2.1 POPULATION AND HOUSEHOLD SIZE

The population in the Merafong City LM showed a decrease in population (from 197,520 to 188,843) of 4.39% and an increase of 19.83% in households (from 66, 624 to 79,834) between 2011 and 2016. This is much lower than on the provincial level, while average household sizes have decreased from 2.96 to 2.37%. This suggests an increased demand for housing and infrastructure, as well as open space that can be converted to residential areas. More people moved out of the area than moved into the area. According to the Merafong City LM IDP (2019/2020), this is due to the low quality of life and low economic growth in the area.

The research also shows that in most Wards, the majority of the population belongs to the Black population group. In Ward 12 more than half of the population belonged to the White population group, while in Ward 14 just over a third of the population belonged to the White population group. Ward 12 includes Deelkraal as well as Welverdiend (which is located outside the 5 km radius). Ward 14 includes West Wits Village, a portion of Fochville, the Numba Wani Residence and the Mohaleshoek Informal Settlement. Between 2011 and 2016, the proportion of residents belonging to the Black population group decreased in the Merafong City LM from 86.52% to 83.43% while the proportion for the White population increased from 11.79% to 15.07%.

4.9.2.2 SOCIO-ECONOMIC CONDITIONS

Census 2011 data shows that in 2011 the employment levels for the economically active part of the population (aged 15 to 64 years) varied. Ward 11, Ward 14 and Ward 27 (all three are mining wards) have the highest levels of employed people, higher than on local, district and provincial levels. It must be noted that large-scale retrenchments have taken place in the gold mining industry since 2012. Given the decline in employment in the gold mining industry over the past decade it is anticipated that the proportion of unemployed people in the area has increased since 2016.

4.9.2.3 POPULATION COMPOSITION, AGE, AND GENDER

Census 2011 data shows that in 2011, more than half of the households on provincial, regional, local and ward levels consisted of 1 to 2 people, except in Ward 12 and Ward 22, where the incidence was just under half. Ward 5 (64.85%), Ward 11 (68.34%), Ward 14 (71.55%) and Ward 27 (75.89%) had the highest incidence of households consisting of only one person. All these areas contain mining residences or mining villages. The proportion of single-person households decreased at all levels between 2011 and 2016. In Merafong City LM, it decreased from 40.11% to 30.72%. This can be indicative of people trying to cut their living expenses by sharing a dwelling, given the shrinking number of employment opportunities in the area. Average household sizes decreased between 2011 and 2016.

Census 2011 data also shows that more than two-thirds of households in Merafong City LM were headed by males. On a ward level, this proportion varied between two-thirds and more than 90%. Community Survey 2016 shows that between 2011 and 2016, the proportion of female-headed households remained more or less the same. Female-headed households are often financially less well-off than similar male-headed households and can be considered more vulnerable.

Census 2011 data shows a bias towards males on a district, local and ward level, except in Ward 12, Ward 20, Ward 22 and Ward 23, where the split between males and females was more or less equal. These are the wards that do not mainly consist of mining residences and villages and include Wedela, Deelkraal and farming areas. The split between males and females remained more or less the same between 2011 and 2016, with a slight increase in the proportion of females.

Census 2011 data presented in Figure 26 shows that Ward 5, Ward 14 and Ward 27 had the highest proportion of people older than 17 years of age, while Ward 22 had the lowest. Between 2011 and 2016, the proportion of people older than 17 years of age in Merafong City LM increased slightly, while the proportion of people under 2 years decreased slightly.

Child-headed households are considered extremely vulnerable as there is usually no adult who can provide them with food and other necessities, and often these households need to rely on the kindness of neighbours and other family members for survival. A child who heads a household often does not have the experience and maturity required to raise his or her siblings and often has to drop out of school to do this.

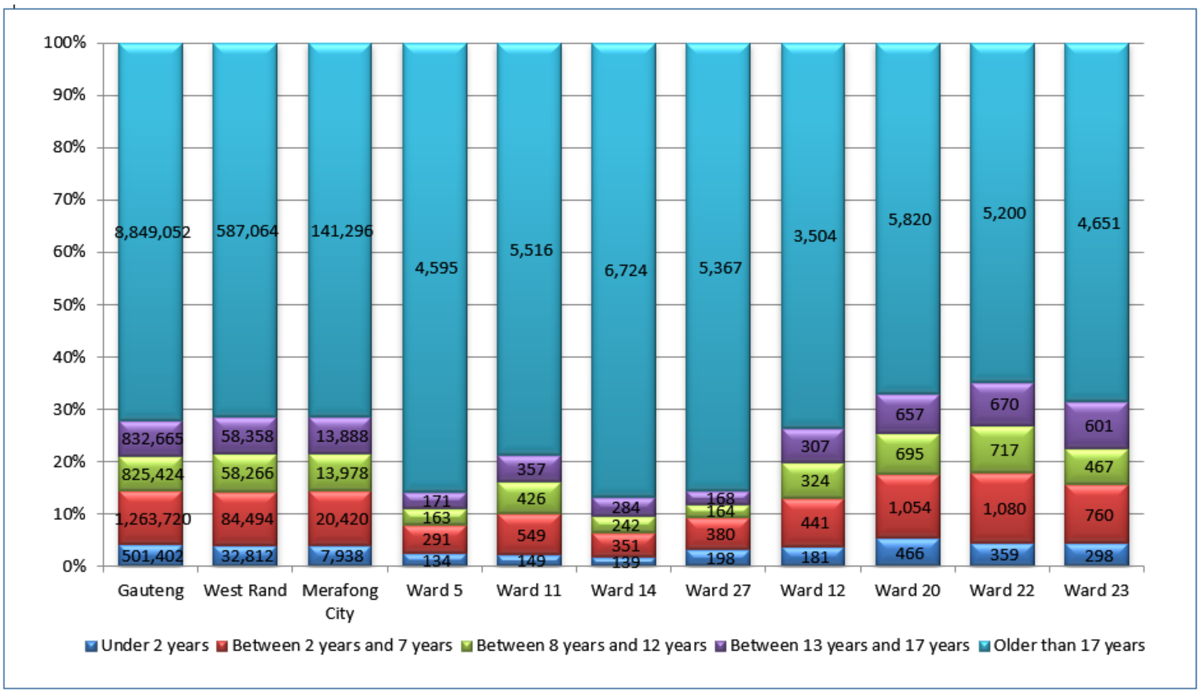


Figure 26: Age distribution of the population (shown in percentage; source: Census 2011) (Equispectives, 2020).

Census 2011 data shows that Ward 20 (1.1%), 22 (1.4%) and Ward 23 (1.2%) had the highest incidence of child-headed households with the age of the heads of household between 10 and 19 years. This was still slightly above the incidence on the municipal level for Merafong City LM (1%). The area with the highest incidence of heads of household that have reached retirement age was Ward 12 (9.7%) and Ward 22 (8.9%). Between 2011 and 2016, the incidence of heads of households that are 19 years or younger increased marginally, but the proportion of household heads that have reached retirement age (65+ years) in Merafong City LM increased from 6.4% to 7.9%. This suggests that many people stay in the area after they have retired.

4.9.2.4 HOUSEHOLD STRUCTURES

The different residential areas in the area can be grouped according to the settlement types and the housing structures present in each area. Table 11 summarises the settlement types and representative residential areas that are included in the discussions.

Table 11: A summary of community types and representative residential areas inside the study are identified for the Project.

Settlement Type	Representative Area
Formal Residential	Deelkraal, Elandsridge and Wedela
Informal Residential	Mohaleshoek informal settlement, Wedela
Mine Workers Residences	Anglo Gold Ashanti residences and West Wits village
Agricultural areas	The surrounding farming community and the Matlosana agricultural project

Census data shows that Ward 12 (90.1%) and Ward 20 (79.4%) had the highest incidence of households living in dwellings that are brick or concrete structures, such as a dwelling in a separate yard, a block of flats, a cluster house or townhouse in a complex, or a semi-detached house. Ward 22 (30.4%) and Ward 5 (11.3%) had the highest incidence of informal dwellings that were not in someone's backyard, while Ward 23 (21.0%) had the highest incidence of households living in informal dwellings in someone's backyard. Ward 11, Ward 14 and Ward 27 had the highest incidence of households living in a flat or apartment in a block of flats or a dwelling that could be described as ‘Other’. Given the high incidence of mining activities in these wards, these refer most likely to households living in mine residences.

Community Survey 2016 shows that the number of households living in formal dwellings or houses on a separate stand has increased in Merafong City LM from 59.7% in 2011 to 64.5% in 2016. The proportion of households living in any type of informal dwelling decreased between 2011 and 2016. In 2016, about a quarter (24.8%) of households in Merafong City LM indicated that they lived in RDP or government-subsidized dwellings. Almost two-thirds (61.3%) of those living in RDP or government-subsidized dwellings have rated the overall quality of the dwellings as good. According to the Merafong City LM IDP (2019/2020), the following urban developments are in the pipeline:

- Ward 12: Elija Barayi Village – west of Carletonville, next to Welverdiend. This development is planned to consist of about 8,150 RDP (Reconstruction and Development Programme)/BNG (Breaking New Ground) houses and 2,900 Gap houses.
- Ward 12: Khutsong South – expansions in the current Khutsong South area.
- Ward 14: Fochville Extension 7 – an undeveloped township area next to Fochville that is located on a hilltop and is regarded as more suited for high-income development.
- Ward 22, Ward 23: Wedela Extension 4 – undeveloped area next to Wedela (furthest away from mining infrastructure and located in the area where currently agricultural activities are taking place). This development will consider the need for additional business and institutional activities. A strip of multi-use business is envisioned, and the design and layout will focus on an ‘Agri village’ type of theme.
- Ward 27: West Wits Village Extension – forms part of the formalisation of West Wits Village and is intended to provide housing to informal dwellers within the area. Approximately 279 low-income (RDP/BNG) units are planned.

4.9.3 SOCIAL INFRASTRUCTURE AND SERVICES

Activities that take place in a community differ from community to community. Based on similar studies over time in other areas, people who live in areas where there are high levels of unemployment tend to spend more time outside. They socialise outside, children tend to play outside for most of the day, as many households in these areas cannot afford to send their children to daycare. Informal housing tends to be very cold in winter and hot in summer, and is usually quite small inside; as such, these residents prefer to be outside. In many lower-income areas, there are usually make-shift sports fields where residents can play soccer or other sports. Incidents of food gardens in areas with high levels of poverty and unemployment are usually higher than in other areas, as many residents do not have the means to buy all their food, and a higher proportion of people have time available to tend to a food garden.

In 2015, Equispectives (2015) stated that the residents of West Wits Village and the then AngloGold Ashanti residences were employed and would spend time outside when off duty. Those living in the residences would socialise or do chores like washing, while those in West Wits Village most likely spent more time outside over weekends for recreational purposes. In Deelkraal, people were observed outside, and there were some recreational facilities.

In Wedela, time spent outside depended to a great extent on individual circumstances. Some women spent the whole day outside with chores, while many small children were playing outside. Some people hunted in the fields around the township, where some religious activities also took place. Given the high levels of unemployment, many people in Mohaleshoek were outside during the day, some just sat outside and socialised. On the farms, the farmers and their workers would spend most of the day outside, while their family members either farmed with them or spent less time outside. Community Survey 2016 shows that 14.85% of Merafong City LM have indicated that they walk to their place of education. As a result of the downscaling activities in the gold mining industry, it is anticipated that in certain residential areas, the number of people spending time outside would have increased, as they are no longer employed.

Census 2011 data shows that more than 90% of households in the area have access to water from a regional or local water scheme that is operated by the municipality or other water services providers, except in Ward 22, where only 77% of households have access to water from a local or regional water scheme. Ward 22, which consists mostly of farms and smallholdings, has the highest incidence (13.5%) of households that access water through boreholes. Ward 5 (4.4%) and Ward 14 (2.7%) have the highest incidence of households getting their water from water tankers.

The data also shows that more than half of households had access to piped water inside their dwellings in 2011, except in Ward 14 (30.7%), Ward 22 (33.3%) and Ward 27 (28.0%). Ward 14 (3.4%) and Ward 22 (2.5%) had the highest incidence of households that did not have access to piped water. Community Survey 2016 2016 shows that the incidence of households with access to piped water inside the dwelling in Merafong City LM has increased from 51.0% to 62.1%.

In the Community Survey 2016, approximately 6.7% of households in Merafong City LM have indicated that they do not have access to safe drinking water, while about 12.6% of people rate the overall quality of water services as poor. Approximately 22.2% of households have indicated that they have experienced municipal water interruptions in the past three months, while 15.0% of households have indicated that they had water interruptions that lasted for longer than two days. In Merafong City, LM 40.8% of the households that experienced water interruptions have indicated that they used water from a water tanker, 22.6% an 'other' water source (it is not specified what the alternative sources are), and about 28% used no other alternative water source during interruptions. The majority of people (80.9%) who do not have access to piped water inside their dwellings or yards have access to a source of water within less than 200 m.

5 ANALYSIS AND CHARACTERISATION OF THE ACTIVITY

5.1 SITE DELINEATION FOR CHARACTERISATION

The Savuka 7A and 7B TSF compartments form part of the greater Savuka TSF, which includes the Savuka 5A and 5B TSF compartments and associated infrastructure. In terms of this application for an amendment of Section 21g) water use for the Savuka TSF (decrease in volume of deposition by 300 000 tonnes per year and increase in approved height of the 7A and 7B compartments, as well as the Section 21 c) and i) water uses for the Savuka TSF and associated infrastructure, the Savuka Mine / Area is described below for a complete context of the activity.

The following section give an overview of the water and waste-related practices observed in each of the abovementioned areas as received from the client.

5.1.1 SAVUKA AREA

The shaft at Savuka was demolished, and it was mentioned that the waste rock dump (WRD) was moved to another mine (Kusasalethu). The layout of the Savuka area, as discussed hereafter, is depicted in Figure 27. The Savuka TSF has four compartments, Savuka 7A, 7B, 5A and 5B compartments, together they operate as one TSF and share two return water dams (North and South) and an adjacent dirty stormwater dam, as well as other infrastructure. This application only focuses on the impact and management of the TSF increase in height (7A and 7B compartments and the addition of c) and i) water uses for the TSF and associated infrastructure.

The current infrastructure related to water and waste management associated with the Savuka TSF include the following areas:

- Tailings Storage Facilities (TSFs).
- Return Water Dams (RWDs).
- Storm Water Dam (SWD).
- Dirty Water Dams / Tanks.
- Wash Plant.

- Plant Sewage.
- Dirty runoff areas (Waste Rock Dump and Side Walls).

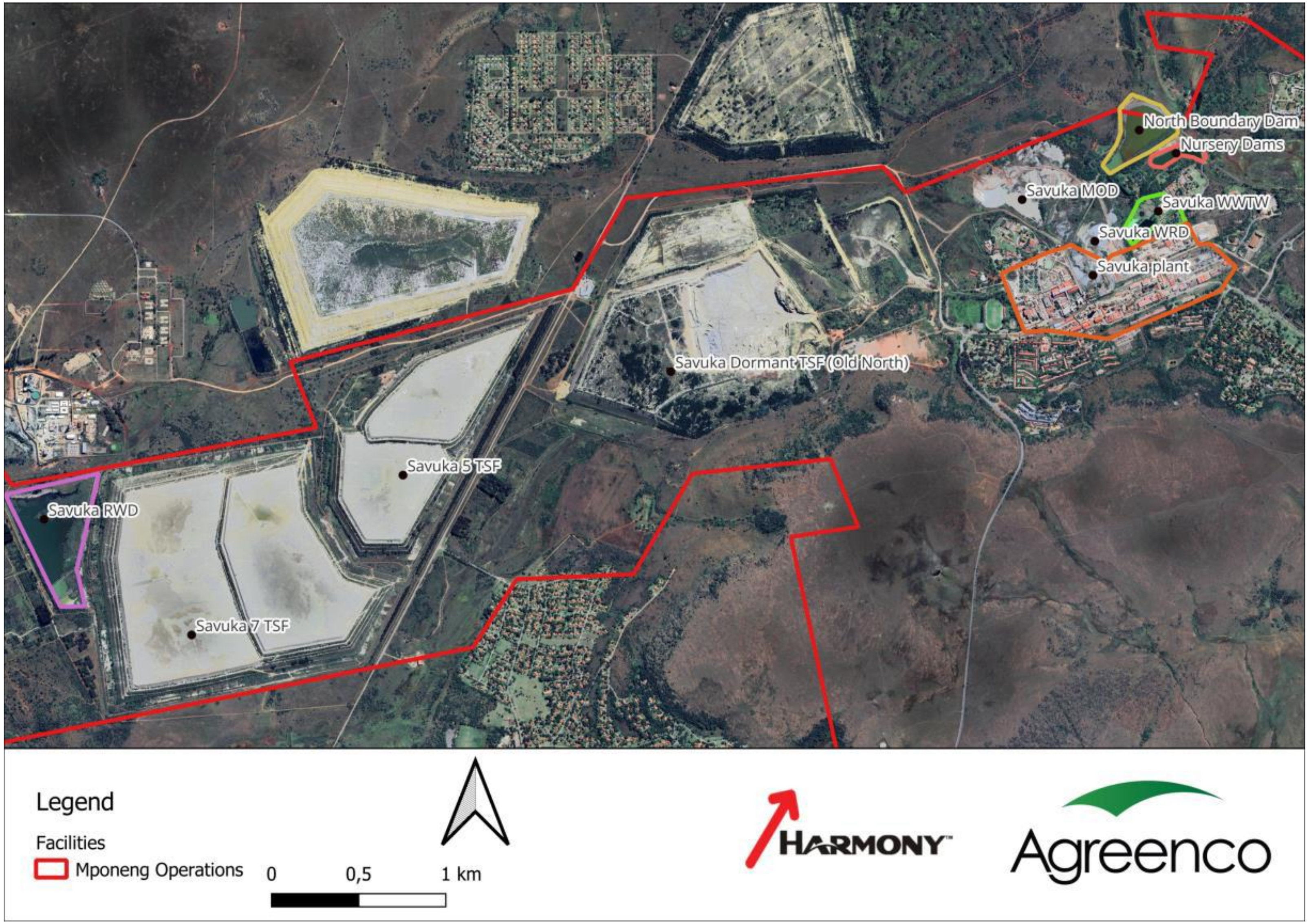


Figure 27: Savuka Area Layout

5.2 WATER AND WASTE MANAGEMENT

5.2.1 WATER BALANCE

According to the Department of Water Affairs and Forestry's (currently known as the Department of Water and Sanitation) Best Practice Guideline (2006, p.1), the water and salt balance models are undertaken to determine the following:

- To assist with the storage requirements and to ensure that dirty water containment facilities are still compliant to contain all dirty water inflows and to prevent any chance of the system spilling more than once in 50 years.
- To provide the required information to aid in the development and implementation of water management strategies.
- To assist in the decision-making process for water management by simulating and analysing various water management options prior to implementation.
- To identify and quantify excessive water consumption or waste locations, as well as pollution sources. When the balances are utilized as an auditing and assessment tool, seepage and leakage spots can also be found and quantified.

A dynamic water balance is fundamental to optimise water management and minimising raw water usage on the mine. Dynamic water balances enable instantaneous examination of the changing situation of a mining operation. They also allow the investigation of different rainfall scenarios, such as drought conditions, process changes or new developments, which are critical to the planning process. The purpose of the water balance is to demonstrate that a TSF will be able to manage all water in its operational area, including rainfall, through the different phases of the operational period. Dynamic water balances are thus an important operational and regulatory tool for water and pollution control as well as an essential part of life-cycle analysis for all current and future activities at the mine.

The water balance is, therefore, utilised as a management tool, for example, in simulating the effect of additional water management measures or the effect of expansion projects on the water management system. Assessment of the water balance will reveal the areas of concern for water management at the mine as well as non-compliance with the requirements of Regulation GN 704, dated 1999. It should be noted, however, that the increase in height of the TSF would not affect the water and salt balance as the deposition volume per annum will not increase.

The formulation of the water balance model was done to determine if the dirty water management systems are sized adequately to accommodate all dirty water inflows without the existing facilities spilling more than once in 50 years. The model was designed to provide the necessary data to assist in the decision-making process for water management, as well as to determine and quantify excessive water consumption or waste locations, including pollution sources. Additionally, the water balance model was conducted to ensure that the mine complies with the requirements as contained in the NWA, Regulation no. 7 of 1999 (GN 704).

The water balance model is a continuous stochastic model formulated using the GoldSim simulation software package. Figure 28 illustrates the interface, as well as an overview of the main elements used in the GoldSim Software for Savuka.

Figure 28: Goldsim Interface for Savuka Water Balance Model

The water balance model include / incorporate the following focus areas:

- Tailings Storage Facilities (TSFs).
- Return Water Dams (RWDs).
- Storm Water Dam (SWD).
- Dirty Water Dams / Tanks.
- Wash Plant.
- Plant Sewage.
- Dirty runoff areas (Waste Rock Dump and Side Walls).

According to the latest IWWMP (Agreenco, 2023), the Savuka TSF comprises of the Compartments 5A, 5B, 7A and 7B. Final treated pulp residue from the Savuka Gold Plant is pumped to the Savuka (New North) TSF where the solid particles settle out onto the tailings dam. Water is decanted using the penstocks at the centre of the facility and is piped into the return water dams (RWDs). The water in the RWDs is pumped back to the plant as process water via the Domain 3 Tanks. Excess water in the RWDs will be pumped to the Storm Water Dam (SWD).

The plant sources water from the dormant TSF (L19), which receives majority of its water from the Domain 3 tanks. Additional water at the plant is sourced from the White Tanks that obtain water from the nursery dams (North Boundary Complex).

For the full results, refer to the Harmony Savuka Water Balance Update Report by Eco Elementum (Pty) Ltd, dated April 2025 in Appendix A.

Following the findings and the results of the water balance model, it is clear that:

- The total capacity for dirty water containment on site is approximately 414,558 m^3, however, due to the dams being silted up, the mine loses approximately 30% of its total capacity to contain dirty water on site.

- Excess water in the Storm Water Dam (SWD) and Return Water Dam (RWD) is at risk of overflowing into the downstream environment (with the dam's current silted capacities), with the potential to degrade the surface and groundwater qualities of surrounding areas as the dams do not have adequate storm buffer capacity due to siltation.

- The North RWD and SWD need to be de-silted to ensure compliance with the requirements as contained in the NWA, Regulation no. 7 of 1999 (GN 704).

- The capacity of South RWD (29,313 m^3) is required at Savuka to allow for maximum storage capacity and plays a vital role in ensuring that none of the dams surpass its full supply level more than once in 50 years.

The following capacities for the RWDs and SWD would be sufficient to contain all dirty water inflows without the dams spilling more than once in 50 years:

- North RWD = 35,245 m^3.

- South RWD = 29,313 m^3.

- SWD = 350,000 m^3.

The table below summarises the average flows for the Savuka Operations where the dams are silted and for a simulation where the dams are restored to their full capacity.

Table 12: Water Balance Estimate Summary

Source	Destination	Silted Dams (ML pd)	Desilted Dams (ML pd)
White Tanks	Domain 3 Tanks	3.47	3.47
White Tanks	Savuka Plant	4.24	4.24
Domain 3 tanks	TSF L 19	7.18	7.15
TSF L19 – Dormant TSF	Savuka Plant	8.82	8.82
TSF 5 & 7	Return Flow	3.89	3.78
RSWD Complex	Domain 3 Tanks	3.71	3.68
TSF 5 & 7	Interstitial Storage	4.78	4.78
Entrained Tailings	TSF L19 – Dormant TSF	1.79	1.78
TSFs	Seepage	1.43	1.40
Savuka Plant	Water in Tailings	12.22	12.22
RSWD Complex	Overflows	0.15	0.00

Following the findings and the results of the overall update, the following is recommended to the client to ensure an accurate water balance model with a high confidence level:

- De-silt the dams at the Savuka operations to provide an additional 126,196 m^3 of stormwater buffer storage to contain dirty water inflows.

- Monitor rainfall data in daily rainfall increments.

- Accurately monitor flow meter data between the various dirty water flow streams to ensure an accurate water balance model.

- Verify / Calibrate flow meters to ensure correct figures are recorded.

- Record the levels of the RWDs and SWD on site in appropriate intervals to aid with the calibration of the water balance model, ensuring more accurate results.

- Update the stormwater management plan to obtain accurate dirty water runoff inflows and reduce the amount of clean water entering the mining operations.
- Monitor domestic/potable water usage on site.

5.3 OPERATIONAL MANAGEMENT

Procedures are in place at the Savuka TSF, to deal with potential polluting incidents (ISO 14001:4.1, 7.4.2 – 7.4.3/MHO/00/2018 and Harmony Risk Matrix – October 2019). The incident classification criteria are presented in Table 13 below.

Table 13: Harmony incident classification criteria (Harmony Risk Matrix – October 2019).

Severity Level	Mitigation Costs	Environmental Impact	Reputational Impact	Legal Impact
5	>R10 000 000	Irreversible damage on habitat or ecosystem	International condemnation	Potential director liability
4	<R10 000 000	Significant impact on habitat or ecosystem	National and international concern – NGO involvement	Very significant fines or prosecutions
3	<R5 000 000	Longer-term impacts & ecosystem compromised	Adverse media attention – locally/nationally	Breach of legislation and likely consequences from regulator
2	<R1 000 000	Moderate short-term effects but not affecting the eco-system function	Unresolved local complaints and possible local media attention	Minor breach of legislation
1	<R500 000	Localised affected area of low impact	Local complaints	No major breaches of legislation

Incidents classified as Level 3 and above are reported to DWS within 24 hours, initially via telephone, followed by a formal email or letter within five days of occurrence. The notifications sent to DWS contain the following information:

- Date and time of the incident.
- Description of the incident.
- Source of pollution.
- Risks/impact to safety, health, property or environment resulting from the incident.
- Remedial action taken or to be taken by the person in control, to remedy the effects of the incident and to prevent similar incidents in the future.

Formal incident investigations are undertaken by the relevant manager and the actions based on the investigations are uploaded to the business unit's Action Management System. A follow up action plan is submitted to DWS within 14 days of the incident occurring, which indicates the following:

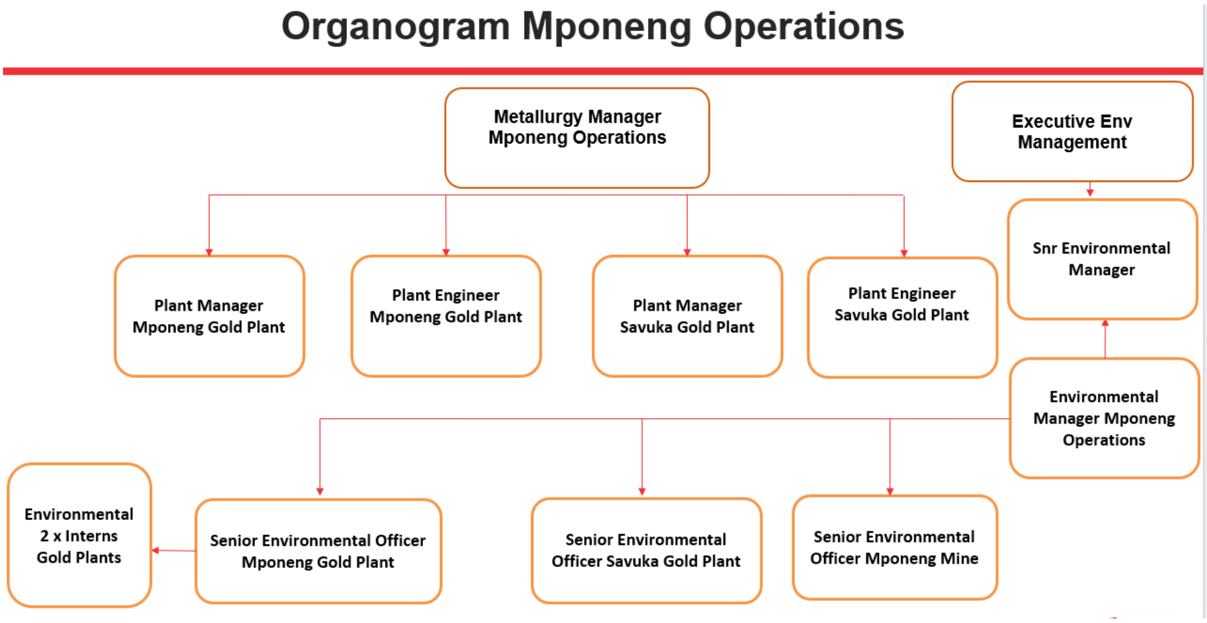
- Measures taken to correct the impact of the incident.
- Measures taken to correct further impacts from the incident.

- Measures taken to prevent the reoccurrence of a similar incident.

An environmental incident that has been classified as Level 1 or 2 is reported internally. A formal incident investigation is not undertaken for these incidents, unless the same incident has repeatedly occurred three or more times within three months.

5.3.1 ORGANISATIONAL STRUCTURE

The organisational structure of Golden Core Trade and Invest is presented in



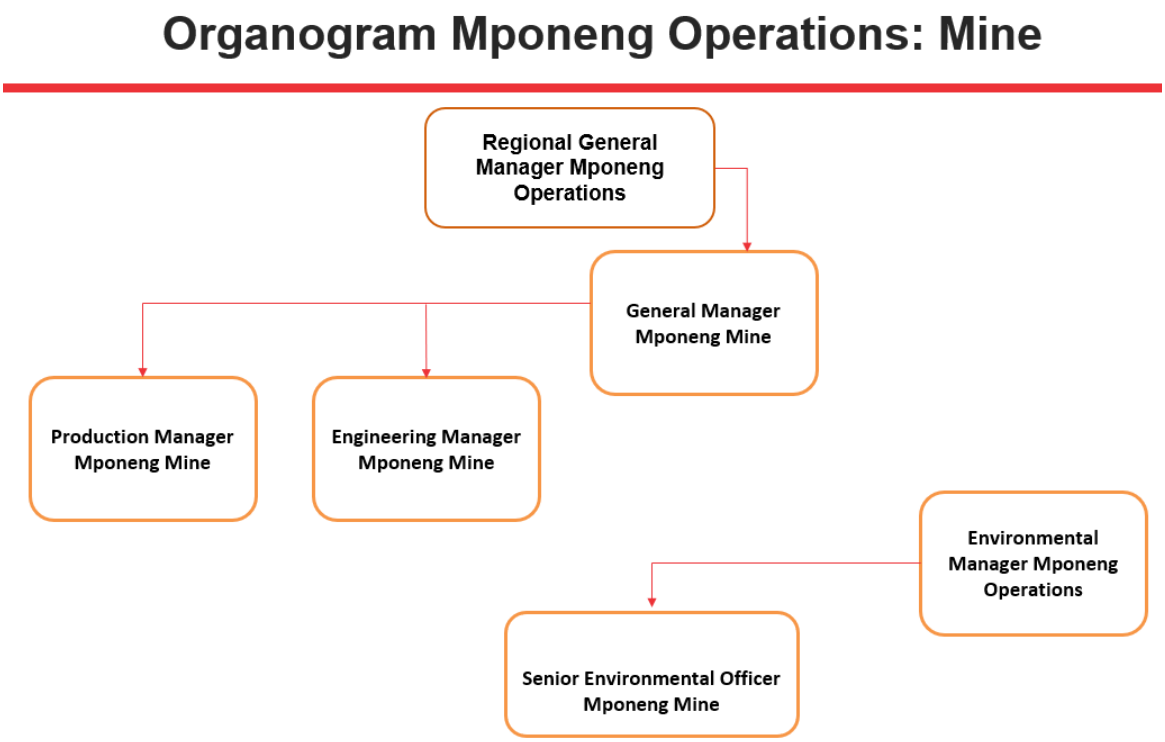


Figure 29: Organogram of the Environmental Department of Mponeng Operations: Mine

The below sections include a discussion of resources and competencies, as well as the internal and external communication processes that are implemented by the Applicant.

5.3.2 RESOURCES AND COMPETENCE

The environmental management commitments in the Environmental Management Plan (EMP) focus on the critical environmental impacts based on Golden Core Trade and Invest's strategic environmental plans and the recommendations made in technical studies and evaluations. Commitments have been classified into two tiers, namely (Harmony, 2020):

- General Environmental Management Commitments – based on the Golden Core Trade and Invest values, policy, corporate standards and strategic plans; and
- Specific Environmental Management Commitments – commitments related to specific environmental aspects of the operations.

The environmental management resources and systems at the Savuka TSF include:

- Infrastructure and equipment e.g., liner system, pipelines etc.;
- An environmental management system (EMS);
- Personnel including environmental officers, site engineers, and appointed external contractors and consultants;
- The inclusion of environmental training for all new staff;
- The promotion of environmental awareness amongst employees and contractors;
- Annual environmental auditing and reporting;
- Registers including an incident register;
- Maintenance of a complaints register, clearly stating actions taken on specified dates.

The Environmental Officers will be supported by the site engineers in the implementation of the WUL once issued.

5.3.3 SKILLS DEVELOPMENT, EDUCATION AND TRAINING

Competence training and awareness are addressed in procedure Competence, Training and Awareness, which describes the environmental training and awareness process applicable to the Environmental

Management Systems (EMS) of the South Africa Region Surface Operations, enabling persons performing tasks to be aware of:

- The importance of conformity with the Environmental Policy and Procedures;
- The requirements of the EMS
- The significant environmental aspects and related actual or potential impacts associated with their work and the benefits of improved environmental performance;
- Their roles and responsibilities in achieving conformity with the requirements of the environmental management system; and
- The potential consequences of departure from specific procedures.

Excluded from the procedure's scope are the Golden Core Trade and Invest human resources and training processes, which remain applicable during new appointments/placements, where newly appointees get job and business unit-specific induction and training.

Competence, training and awareness will be addressed through the following revenues – Induction, Awareness, Capability and Competency training and assessments. The Training Department will capture training on its EDUCOS/Training Matrix System (example), which the Training Department maintains. The training needs identification process followed at Golden Core Trade and Invest is depicted in Table 14 and the typical environmental competence and awareness methods in

Table 14: Training Needs (Harmony, 2020)

	Process	Notes	Responsibility/Who	When
Training Needs Identification	1. Job specification ↓ Identifying activities ↓ 2. Identify significant risks / impacts of activities on the environment ↓ 3. Training Needs identification ↓ 4. Nomination / Approval of Training	1. Identifying risks/ aspects/impacts from activities for all designation 2. Determine the potential risk from the identified activities (also use to identify training). Refer to Aspects Registers 3. Consider designations and their environmental training requirements / Identify training needs 4. Nomination and approval through Human Resource / Training Officer and / or Line Manager	1. Environmental Management 2. Environmental Management 3. Environmental Management 4. Nominated candidate/ Training Officer/ Relevant Line Manager	Annually

Table 15: Typical environmental Competence and Awareness Methods

	Process	Notes	Responsibility/Who	When
Typical Environmental competence and Awareness Methods	1. Induction ↓ Assessment ↓ Records 2. Awareness ↓ Records 3. Competency ↓ Nomination form ↓ Attend Course ↓ Assessment ↓ Certificate	1. Induction • New appointments, contractors, ex-leave personnel • Language and literacy level considered during induction • Review Induction material annually 2. Awareness • Environmental Policy, Quarterly topics on the notice boards and discussed at e.g. Production or Green area meetings (or other) • Significant aspects and impacts 3. Competency • Formal training e.g. tertiary institutions or service providers • Experience • Responding to emergency situations, • Performing internal audits and • Performing compliance evaluations	1. Training Officer (consult Environmental Department to update awareness material) 2. Training Officer / Environmental Department 3. Line Managers / service providers (environmental officers can be consulted and used on request); External Service Provider (s)	As and when required

5.3.4 INTERNAL AND EXTERNAL COMMUNICATION

5.3.4.1 INTERNAL COMMUNICATION

Water targets are reported on a monthly basis by the Environmental Management Department of Harmony Gold Limited. The results from the monitoring and comparison of actual water use to the targets are included in monthly water reports, which are distributed to all the responsible environmental personnel.

Annual surface and groundwater monitoring reports are compiled for all business units to assess their impacts on the natural water resources. The monitoring reports are communicated to the business units by the Environmental Management Department.

Environmental improvements, monthly inspection findings and incidents are included in monthly environmental management reports, which are distributed to all responsible environmental personnel. The internal communication process for environmental issues is presented in Table 16 below.

5.3.4.2 EXTERNAL COMMUNICATION

The reporting of incidents that have the potential to cause or have caused water pollution or pollution to the environment, health risks are undertaken. Records of all incidents and system malfunctions which may result in the pollution of the water resources are reported to DWS. The incidents are recorded by the individual business units and a summary report of all incidents is compiled and submitted to the Environmental Management Department on a monthly basis.

The external communication process for environmental issues is presented in Table 17 below.

Table 16: Internal communication procedure (ISO 14001:2015/7.4/00/2024 MPO (0-7)

	Internal Communication Process	Notes	Responsibility/Who	When
Internal Communication	**Internal Communication** 1. Significant environmental issue (s) ↓ 2. Review issue - Environmental Management ↓ 3. If required (if significant), investigate and report to affected personnel	1. Significant environmental issues are communicated through: • Quarterly or Monthly environmental topics/reports (environmental awareness, on notice boards) • Environmental Policy/EMS Procedures, Aspects • Legislation Notification or Changes • Roles and Responsibilities, KPI's • SHE Related Meetings • Management Meetings • Contractual obligations with interested parties e.g. contractors etc. 2. Review issue 3. If significant, investigate/report back to the affected personnel (e.g. via e-mail, section meetings)	1. Environmental Management 2. Environmental Management 3. Environmental Management	As and when required

Table 17: External communication process (ISO 14001:2015/7.4/00/2024 MPO (0-7)

	External Communication Process	Notes	Responsibility/Who	When
External Communication	**External Communication (excludes complaints)** 1. Receive communication ↓ 2. Refer communication to Environmental Manager ↓ 3. Log communication ↓ 4. Refer / Assign responsibility ↓ 5. Arrangement / Assess / Investigate and compile report ↓ 6. Respond to the interested party	1. Received communication on e.g. needs, expectations, etc. from interested parties e.g. Government Departments, Non-Governmental Organisations, etc. at e.g. Meetings, Forums, Community Events, EIA/ EMP Projects, etc. 2. Refer to Environmental Manager 3. Log communication details in External Communication Log 4. Refer/assign responsibility to relevant Environmental Manager in consultation with Senior Management 5. Investigate and determine opportunities for improvement, if required 6. Respond and/or report to interested Party in one or all the following methods: • Compile Letter or Report • Approve Letter or Report • Distribute letter/ report and or follow up in a forum to interested Party (where required)	1. Environmental Management 2. Environmental Management 3. Environmental Management (Environmental Library) 4. Environmental Management 5. Environmental Management / Operational Environmental Meeting MANCOM 6. Environmental Management	As and when required

5.3.5 AWARENESS RAISING

The environmental training and awareness process applicable to the EMS incorporates the following:

- The importance of complying with the Environmental Policy and Procedures.
- The requirements of the Environmental Management System (EMS);
- Significant environmental aspects and the associates actual or potential impacts, and the benefits of improved environmental performance;
- The roles and responsibilities in achieving compliance with the requirements of the EMS;
- The potential consequences from not following specific procedures.

Newly appointed employees receive job and business unit specific induction and training based on the Harmony human resources and training processes. Competence, training and awareness are addressed through the induction, awareness, capability and competency training and assessments.

5.4 MONITORING AND CONTROL

Surface and groundwater monitoring is conducted as part of the existing operations and include areas associated with the activities included in this WULA. The following monitoring is undertaken as part of the existing operations.

5.4.1 SURFACE WATER

The general objectives of surface water monitoring entail the following:

- To demonstrate legal compliance;
- To assess the impact of the mining operations on the surface water resources (if any);
- To detect operational spillages and early signs of deterioration of the surface water resource for the mine and upstream users; and
- To inform mitigation measures as necessary.

The Mponeng Operations WUL (Licence No: 08/C23E/AFGJCEl/12157 File No: 27/212/C523/12/1), dated 27 September 2022, lists several requirements in terms of surface water monitoring. The hydrologist recommended that this monitoring programme be maintained and no additions or amendments to the current programme is required.

5.4.2 GROUNDWATER

Groundwater water monitoring aims to assess the impact that the mine might have on the groundwater resources, ensure early intervention, and implement mitigation measures as necessary. The Best Practice Guidelines developed by the DWS (2006) state that most environmental management actions require data, and groundwater monitoring objectives are as follows:

- Assessment of compliance with set standards and legislation, such as WULs, EMPrs, etc.;
- Monitor water quality to demonstrate that the mining operations do not impact the receiving water resources;
- Compare groundwater quality in terms of groundwater's physical and chemical characteristics with baseline values to identify possible trends and/or changes in quality. Tracking contaminants of potential concern (CoPC) indicative of pollution and developing onsite environmental and water management plans to facilitate decision-making;
- To investigate possible groundwater contamination, which serves as an early warning system to allow remedial measures and subsequent actions to be taken; and
- Develop an understanding of changes in source chemistry that could affect groundwater receptors.

The Mponeng Operations WUL (Licence No: 08/C23E/AFGJCEl/12157 File No: 27/212/C523/12/1), dated 27 September 2022, list several requirements in terms of surface water monitoring. The geohydrologist recommended that this monitoring programme be maintained in additions to the following amendments: The exiting monitoring network is comprehensive and sufficient to quantify the impact from the RWD and the TSF. The boreholes are generally close to the TSF, referred to as source boreholes. It is important to drill monitoring boreholes further from the contaminant sources to be able to quantify plume migration, as well as close to the property boundary or receptors. These boreholes are referred to as compliance boreholes.

Four additional compliance borehole pairs (one shallow and one deep) are recommended as shown in Figure 30. The aim of these boreholes is to monitor the effectiveness of the phyto-remediation. Borehole MB38, which is located inside the phyto-remediation has much better quality than the other monitoring boreholes. Further down-gradient boreholes will confirm that this is because of the phyto-remediation. It is also important to distinguish between the weathered and fractured formations.

The following is recommended in terms of monitoring:

- Groundwater levels.
- Groundwater quality.
- Data should be stored electronically in an acceptable database.
- On the completion of every sampling run a monitoring report should be written.
- Any changes in the groundwater levels and quality should be flagged and explained in the report.
- A compliance report can be submitted to DWS once a year, if required.
- A comprehensive bi-annual analysis of the dedicated monitoring boreholes.
- Groundwater levels should be monitored monthly in the dedicated groundwater monitoring boreholes.
- Rainfall should be monitored daily.
- Samples should be submitted to a SANAS accredited laboratory. The following recommended parameters to be analysed for include:
    - pH.
    - Electrical Conductivity.
    - Total Dissolved Solids.
    - Total Alkalinity.
    - Anions and Cations (Ca, Mg, Na, K, NO_3, NH_4, Cl, SO_4, F, Fe, Mn, Al, Cr).

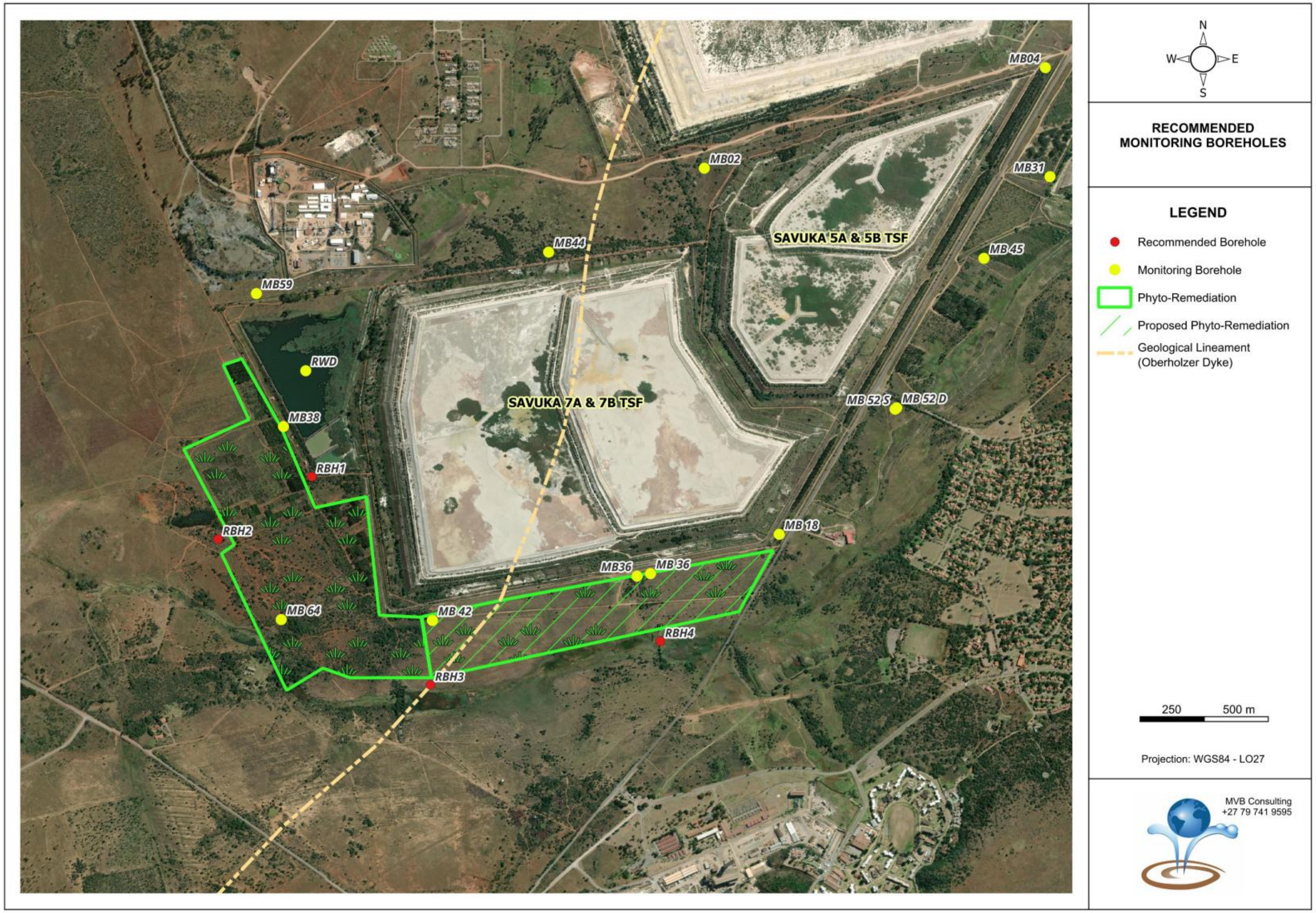


Figure 30: Recommended groundwater monitoring network

5.4.3 BIOMONITORING

A biomonitoring plan aims to monitor any changes to the aquatic environment and associated biota at identified sites associated with the mine. Generic objectives for biomonitoring are as follows:

- To characterise the biotic integrity of aquatic ecosystems;
- To assess the extent of the effects in terms of ecological indicators;
- To compare results to detect environmental trends in biotic integrity;
- To identify potential impacts and recommend suitable mitigation measures; and
- To identify sensitive or unique aquatic habitats which could suffer irreplaceable loss.

The Mponeng Operations WUL (Licence No: 08/C23E/AFGJCEI/12157 File No: 27/212/C523/12/1), dated 27 September 2022, list several requirements in terms of biomonitoring. The wetland specialist recommended that this monitoring programme be maintained and no additions or amendments to the current programme is required.

5.4.4 WASTE MONITORING

At the Mponeng Operations, different individuals are responsible for different waste stream monitoring. The current monitoring system should be continued. This application will not require any changs to the waste monitoring programme at Mponeng.

6 ENVIRONMENTAL IMPACT ASSESSMENT

This section will discuss the methodology and detailed impacts identified during the EIA process. The methodology used in assigning and assessing risk factors is also shown below.

6.1 IMPACT ASSESSMENT METHODOLOGY

The impact significance rating methodology, as provided by EIMS, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the significance (S) of an environmental risk or impact by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relating this to the probability/ likelihood (P) of the impact occurring. The S is determined for the pre- and post-mitigation scenario. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the S to determine the overall final significance rating (FS). The impact assessment will be applied to all identified alternatives.

6.1.1 DETERMINATION OF SIGNIFICANCE

The final significance (FS) of an impact or risk is determined by applying a prioritisation factor (PF) to the post-mitigation environmental significance. The significance is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and Reversibility (R) applicable to the specific impact. For the purpose of this methodology the consequence of the impact is represented by:

$$\boldsymbol{C} = \frac{(\boldsymbol{E} + \boldsymbol{D} + \boldsymbol{M} + \boldsymbol{R}) * \boldsymbol{N}}{\boldsymbol{4}}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 18 below.

Table 18: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	-1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. Highly localised, limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property or site boundary, or the area within a few hundred meters of the site)
	3	Local (i.e. beyond the site boundary within the Local administrative boundary (e.g. Local Municipality) or within consistent local geographical features, or the area within 5 km of the site)
	4	Regional (i.e. Far beyond the site boundary, beyond the Local administrative boundaries within the Regional administrative boundaries (e.g. District Municipality), or extends into different distinct geographical features, or extends between 5 and 50 km from the site).
	5	Provincial / National / International (i.e. extends into numerous distinct geographical features, or extends beyond 50 km from the site).
Duration	1	Immediate (<1 year, quickly reversible)
	2	Short term (1-5 years, less than project lifespan)
	3	Medium term (6-15 years)
	4	Long term (15-65 years, the impact will cease after the operational life span of the project)
	5	Permanent (>65 years, no mitigation measure of natural process will reduce the impact after construction/ operation/ decommissioning).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected)
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected, or affected environmental components are already degraded)
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; moderate improvement forgive impacts; or where change affects area of potential conservation or other value, or use of resources).
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease; high improvement for +ve impacts; or where change affects high conservation value areas or species of conservation concern)
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease, substantial improvement

Aspect	Score	Definition
		for +ve impacts; or disturbance to pristine areas of critical conservation value or critically endangered species)
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring very high time and cost.
	5	Irreversible Impact.

Once the C has been determined, the significance is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/ scored as per

It is noted that both environmental risks as well as environmental impacts should be identified and assessed. Environmental Risk can be regarded as the potential for something harmful to happen to the environment, and in many instances is not regarded as something that is expected to occur during normal operations or events (e.g. unplanned fuel or oil spills at a construction site). Probability and likelihood are key determinants or variables of environmental risk. Environmental Impact can be regarded as the actual effect or change that happens to the environment because of an activity and is typically an effect that is expected from normal operations or events (e.g. vegetation clearance from site development results in loss of species of concern). Typically the probability of an unmitigated environmental impact is regarded as highly likely or certain (management and mitigation measures would ideally aim to reduce this likelihood where possible). In summary, environmental risk is about what could happen, while environmental impact is about what does happen.

Table 19: Probability/ Likelihood Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

ER= C x P

Table 20: Determination of Environmental Risk.

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15

	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 21.

Table 21: Significance Classes.

Environmental Risk Score	
Value	Description
< 9	Low (i.e., where this impact is unlikely to be a significant environmental risk).
≥9 - <17	Medium (i.e., where the impact could have a significant environmental risk),
≥17	High (i.e., where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

6.1.2 IMPACT PRIORITISATION

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of: a

- Cumulative impacts; and
- The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 22: Criteria for Determining Prioritisation.

Cumulative Impact (CI)	**Low (1)**	**Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.**
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.

	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/ definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 22Table 22. The impact priority is therefore determined as follows:

Priority = CI + LR

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 1.5 (Refer to Table 23).

Table 23: Determination of Prioritisation Factor.

Priority	Ranking	Prioritisation Factor
2	Low	1
3	Medium	1.125
4	Medium	1.25
5	Medium	1.375
6	High	1.5

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 24: Final Environmental Significance Rating.

Significance Rating	Description
<-17	High negative (i.e., where the impact must have an influence on the decision process to develop in the area).
≥-17, ≤-9	Medium negative (i.e., where the impact could influence the decision to develop in the area).
>-9, < 0	Low negative (i.e., where this impact would not have a direct influence on the decision to develop in the area).
0	No impact
>0, <9	Low positive (i.e., where this impact would not have a direct influence on the decision to develop in the area).
≥9, ≤17	Medium positive (i.e., where the impact could influence the decision to develop in the area).
>17	High positive (i.e., where the impact must have an influence on the decision process to develop in the area).

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project. The assessment matrix relating to water and waste impacts can be seen in Appendix 5 and represented in Table 25.

6.2 IMPACT ASSESSMENT

The assessment matrix relating to water and waste impacts can be seen in Appendix 5 and represented in Table 25 below.

Table 25: Impact Scoring Summary

		Pre-Mitigation							Post Mitigation								Priority Factor Criteria			
Impact	Phase	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Pre-mitigation ER	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Post-mitigation ER	Confidence	Cumulative Impact	Irreplaceable loss	Priority Factor	Final score
Implementation of the NNR-approved decommissioning plan	Rehab and closure	1	2	5	4	5	4	16	1	2	5	4	5	4	16	Medium	1	1	1,00	16
Leaching and migration of radionuclides from the TSF during the post-closure phase	Rehab and closure	-1	3	5	1	3	2	-6	-1	3	5	1	3	2	-6	Medium	1	1	1,00	-6
Groundwater contamination	Operation	-1	4	4	4	4	4	-16	-1	2	3	2	2	2	-4,5	Medium	2	2	1,25	-5,625
Erosion of soils and sedimentation of surface water features	Operation, decommissioning, rehab and closure	-1	1	2	2	2	2	-3,5	-1	1	2	2	2	2	-3,5	Medium	3	1	1,25	-4,375
Pollutants entering the surface water environment	Operation, decommissioning, rehab and closure	-1	5	2	5	5	1	-4,25	-1	5	2	5	5	1	-4,25	Medium	3	3	1,50	-6,375
Decrease in run-off	Operation, decommissioning, rehab and closure	-1	1	1	1	1	5	-5	-1	1	1	1	1	5	-5	High	1	1	1,00	-5
Flood risk	Operation, decommissioning, rehab and closure	-1	4	1	5	5	1	-3,75	-1	4	1	5	5	1	-3,75	Low	1	3	1,25	-4,6875
Siltation of water resources	Operation	-1	2	4	1	2	3	-6,75	-1	1	4	1	1	2	-3,5	High	2	1	1,13	-3,9375
Erosion of water resources	Operation	-1	2	4	1	2	3	-6,75	-1	1	4	1	1	2	-3,5	High	2	1	1,13	-3,9375
Altering of Hydrological Regime	Operation	-1	2	4	1	3	2	-5	-1	1	4	1	2	2	-4	High	2	1	1,13	-4,5
Proliferation of Alien Vegetation	Operation	-1	2	4	1	3	3	-7,5	-1	1	4	1	2	2	-4	High	2	1	1,13	-4,5
Impaired Water Quality	Operation	-1	2	4	1	3	2	-5	-1	1	4	1	2	1	-2	High	2	1	1,13	-2,25
Wetland disturbance and decrease in functionality	Operation	-1	2	4	1	3	2	-5	-1	1	4	1	1	2	-3,5	High	2	1	1,13	-3,9375
Phytoremediation for Groundwater Pollution	Operation	-1	3	4	3	3	2	-6,5	-1	2	3	2	2	2	-4,5	High	2	1	1,13	-5,0625

6.3 DESCRIPTION AND ASSESSMENT OF IMPACTS AND MITIGATION MEASURES

This section describes each identified environmental impact in the context of the activity and associated aspect and provides reasons why specific ranking/ rating of the component attributes of the impact assessment are given.

6.3.1 RADIATION AND HEALTH (AQ)

The main objective of the radiological public safety assessment is to assess the potential impact on members of the public that may occur during the operational phase of the Projects, with due consideration of the impact that may occur during the post-closure phase. How members of the public are exposed to ionising radiation induced by the Projects may be different depending on the operational conditions and the specific point in time (either present or future).

Sources of radiation exposure to members of the public associated with mining and mineral processing facilities are often advertently induced. Although the key elements responsible for radiation exposure are naturally occurring radionuclides, human-induced conditions and activities may enhance concentrations of naturally occurring radionuclides in the accessible environment. Alternatively, the potential for human exposure to naturally occurring radionuclides in products, by-products, residues, and other wastes may be enhanced by moving these radionuclides from inaccessible locations to locations where humans can be subject to radiation exposure.

To pose a radiological risk to members of the public and the environment, the naturally occurring radionuclides must first be released from the sources of radiation exposure into the environment. As used here, sources refer to any entity that contains radioactivity and has the potential to release radioactivity into the environment. Release mechanisms can be generalised into the following natural and human-induced conditions:

- The release of radionuclides through natural conditions:
    - Solid release (e.g., windblown dust);
    - Water-mediated release (e.g., leaching through tailings storage facility); and
    - Gas-mediated release (e.g., radon gas exhalation).
- Direct gamma radiation; and
- Controlled or uncontrolled releases of radionuclides as solids or liquids into the environment.

Controlled releases are human-induced as part of the normal operating conditions, while uncontrolled releases are associated with accidents and incidents that are outside the scope of normal operating conditions (e.g., excessive water erosion, pipeline bursts, releases from storage dams overflowing their capacity, or the breaking of dam walls).

A distinction can be made between primary and secondary sources of radiation exposure. The primary sources are associated with physical features or entities at a mining and mineral processing operation, with the potential of naturally occurring radionuclides to be released into the environment. Examples of primary sources that are generally associated with mining and mineral processing operations include:

- Tailings Storage Facilities (TSFs), Waste Rock Dumps (WRDs) or any other stockpile facility used to store waste or other residue material on the surface, from which naturally occurring radionuclides may be dispersed in solid (dust), liquid (seepage), or gaseous (radon gas) form;
- Open pits that developed following open cast mining to extract rock or minerals from the orebody, from which naturally occurring radionuclides may be dispersed in solid (dust), liquid (seepage), or gaseous (radon gas) form;
- Mineral processing activities, where radioactive gasses and dust may be released from the commination (e.g., crushing, milling, and screening) and beneficiation of ore containing radionuclides;

- Water management facilities (e.g., return water dams, process control dams, and evaporation ponds), used to manage excess water generated through mining, mineral processing, and residue disposal activities, and where water may be released to the environment;
- Materials handling activities (e.g., the transfer of material containing naturally occurring radionuclides from one point or facility to another), during which radioactive dust may be released to the environment; and
- Mine ventilation shafts increase airflow in underground workings, where gasses and dust generated underground may be released with the outflowing air.

Radioactivity released from the primary sources into the environment may accumulate in the physical compartments of the environmental system (e.g., groundwater, surface water bodies, surface soils, sediments, etc.), potentially resulting in what can be termed secondary sources of radiation exposure. The following serve as examples of secondary radiation sources:

- Continuous deposition and accumulation of naturally occurring radionuclides associated with airborne dust or contaminated irrigation water on surface soils, resulting in the development of a secondary source at the soil surface;
- Continuous deposition of naturally occurring radionuclides associated with airborne dust in a surface water body, resulting in the development of a secondary source in the sediments and surface water body;
- Uncontrolled release of contaminated mine residue (e.g., tailings material) through surface water erosion of existing TSFs or other stockpile facilities;
- Uncontrolled release (e.g., spillage) of contaminated mine residue (e.g., tailings material) or water on surface soils from pipelines or storage dams, resulting in the development of a secondary source at the soil surface; or
- Uncontrolled release (e.g., spillage) of contaminated mine residue (e.g., tailings material) or water in a surface water body from pipelines or storage dams (as appropriate), resulting in the development of a secondary source in the sediments and surface water body.

Members of the public may potentially be subject to radiation exposure from both primary and secondary sources at a mining and mineral processing operation, with expected differences in modes and duration of exposure.

This section will only include the impacts that describe the groundwater contamination, relevant to this application. The air quality impacts are discussed and assessed in the Environmental Authorisation application.

6.3.1.1 OPERATIONAL PHASE IMPACTS

The radiological impact assessment for the operational phase considers the potential contribution through all three environmental pathways (i.e., surface water, groundwater and atmospheric). However, due to the slow-moving nature of any radionuclide contaminant plume that originates from the facilities through the groundwater system, the potential radiological impact through the groundwater pathway will only occur during the post-closure phase.

6.3.1.2 POST-CLOSURE PHASE IMPACTS

Before the actual closure of the proposed Savuka 7A and 7B TSF and as part of the anticipated licensing conditions and requirements, a decommissioning and closure plan will be prepared for submission to the regulatory authorities. Amongst others, this plan will define in detail all the activities that will be performed and how the associated radiological impact during the decommissioning and closure phase will be managed.

Considering that a decommissioning plan of the proposed Savuka 7A and 7B TSF is not available at present but will be defined and implemented, the following activities were identified that may result in a radiological impact on the receptors during the post-closure phase:

- Implementation of the decommissioning plan: implementation of the NNR-approved decommissioning plan will result in a positive impact in the sense that surface infrastructure that contained or that is contaminated with radionuclides is demolished, decontaminated (to the extent possible) and removed from the site and compliance with clearance criteria has been demonstrated. Generally, this would involve performing a gamma radiation survey supplemented with full-spectrum radio analysis of soil samples performed at the infrastructure sites, followed by appropriate rehabilitation and clean-up operations for conditional or unconditional clearance from the regulatory authority. However, in this case for the TSF that would remain at the surface during the post-closure period, the level of clean-up that can be performed is limited to areas outside the TSF footprint area that may have become contaminated during or because of operational activities. These areas outside the TSF footprint can still be rehabilitated and cleaned-up for conditional or unconditional clearance.
- From the commissioning of a TSF, radionuclides contained in the tailings material leach from the TSF to the underlying strata. The rate of leaching is controlled by complex geochemical and hydrological processes but generally is a slow process. Once in the underlying strata, migration of these radionuclides is equally slow along the groundwater flow path. Abstraction of groundwater for personal or agricultural purposes may result in a radiological impact on receptors through direct ingestion of water or the ingestion of crops and animal products as secondary pathways. The radiological impact along the groundwater pathway only manifests itself during the post-closure period hundreds to thousands of years after closure. Radionuclides will leach from the TSF into the underlying aquifer, after which they will migrate in the general groundwater flow direction. Abstraction and use of the contaminated water contribute to the total effective dose through the ingestion and possible external radiation exposure routes.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Implementation of the NNR-approved decommissioning plan (AQ4)	Decommissioning, Closure and Post-Closure	High	High	High
Leaching and migration of radionuclides from the TSF during the post-closure phase (GW1)	Post-Closure	Low	Low	Low
Potential cumulative/ confounding effects	The cumulative radiological impact associated with a mining operation can be considered at different levels. Firstly, the radiological safety assessment process considers the cumulative contribution from all relevant exposure pathways including the surface water, groundwater, and atmospheric pathways, as appropriate. This means that the radiological impact assessment includes the cumulative impact of the exposure pathways, as appropriate and justified. Secondly, the radiological safety assessment process considers the cumulative contribution from all relevant exposure routes and for each relevant exposure pathway. These include radon gas inhalation, dust inhalation, external gamma radiation (ground shine and cloud shine) as well as the ingestion routes for soil, water, crops, and animal products as appropriate and justified for each public exposure condition. This means that the radiological impact assessment includes the cumulative impact of the exposure routes, as appropriate and justified. Thirdly, the radiological safety assessment process considers the cumulative contribution from all relevant sources of radiation exposure associated with the proposed Savuka 7A and 7B TSF, such as the existing TSFs in the area. This means that the radiological impact assessment includes the cumulative impact of these sources, as appropriate and justified.			

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
	Finally, on a more regional scale, the assessment context makes provision for a cumulative impact from all contributing operations (or practices) in the area that may contribute to the total effective dose to members of the public. This is important since the public dose limit of 1,000 µSv.year-1 is from all contributing sources and operations. However, the scope of the assessment was limited to the Project and did not make provision for a regional assessment to evaluate cumulative effects from all contributing operations.			
Mitigation Measures				
Post-Closure Phase: *Leaching and migration of radionuclides from the TSF during the post-closure phase (GW1)* • The management objective would be to first ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint), and secondly to optimise the radiation protection by applying the ALARA principle. • The total effective dose from the ingestion of groundwater as a contribution from the TSF was hypothetically illustrated to be below the regulatory compliance criteria (i.e., dose limit), which means that from a compliance perspective, no additional management or mitigation measures are required. • From the optimisation of radiation protection perspective for the post-closure period, the following management/mitigation measures can be implemented if it is assumed that the facility remains at the surface: • Implementation of a passive groundwater remediation system downstream of the TSF to capture the contaminant plume. • Note that active remediation systems, such as cut-off trenches or a pump and treat system, might also be effective in the short to medium term. However, the timescales of concern are beyond what can be considered active institutional control periods. The Groundwater specialist, recommended phytoremediation. Refer to Section below.				

6.3.2 GROUNDWATER (GW)

6.3.2.1 GROUNDWATER CONTAMINATION - (ALTERNATIVE 3 MITIGATION - PHYTO-REMEDIATION), PARTICULARLY SULPHATES (GW2)

- ***Do Nothing Scenario***

According to records the Savuka TSF was commissioned in 1979 / 1980. The impact from the existing dams were therefore modelled, based on this assumption. The current impact is mainly to the south and west, towards the Wonderfonteinspruit tributary (Figure 31). Assuming that the existing facility is 44 years old, the average plume migration can be estimated based on Darcy’s law. Contaminants are transported in groundwater by advection, that is, the movement of a solute at the speed of the average linear velocity of groundwater (Anderson, *et. al*., 1992).

The hydraulic conductivity for the weathered aquifer is estimated as 0.231 m/day. The groundwater gradient averages 0.64 in the study area. The porosity of the aquifer material is estimated to be between 3 - 7%. Applying the above formula to the study area assuming a porosity of 5% it is calculated that the groundwater velocity averages a rate of 0.030 m/day or 10.79 m per annum. Over the 44-year period the plume migration is estimated at 475m, which is supported by the numerical modelling.

The current impact from the existing Savuka TSF was used as the base case and future impacts over 50-and 100-year periods were simulated as the “do-nothing” scenario. The impacts from adjacent tailings facilities were excluded for this assessment and focus was only on the Savuka TSF and RWD. The TSF and RWD are unlined for the do-nothing scenario. The results from these simulations are presented in Figure 32 and Figure 33.

Based on the modelling the impact from the TSF has already reached the Wonderfonteinspruit tributary, albeit still at low concentrations (Figure 31). The concentrations are expected to increase during the next 50 - 100 years if nothing is done. The tributary acts a groundwater boundary and the plume will not extent beyond the stream. Groundwater contributes to the baseflow of the stream and will therefore impact on the water quality in the stream.

Future impacts from the TSF are compared against the “do-nothing” scenarios.

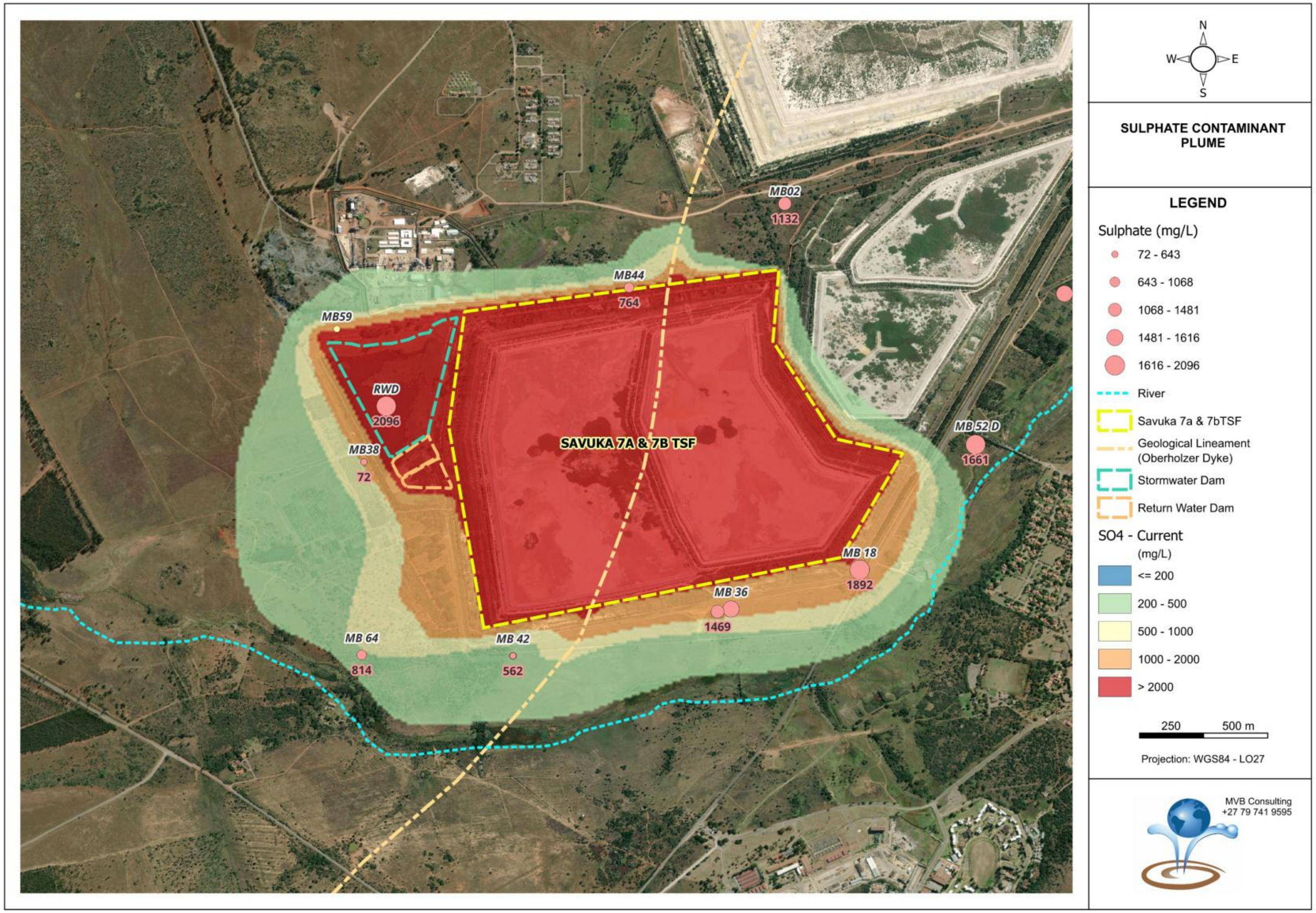


Figure 31: Current simulated plume compared to the measured SO_4 concentrations

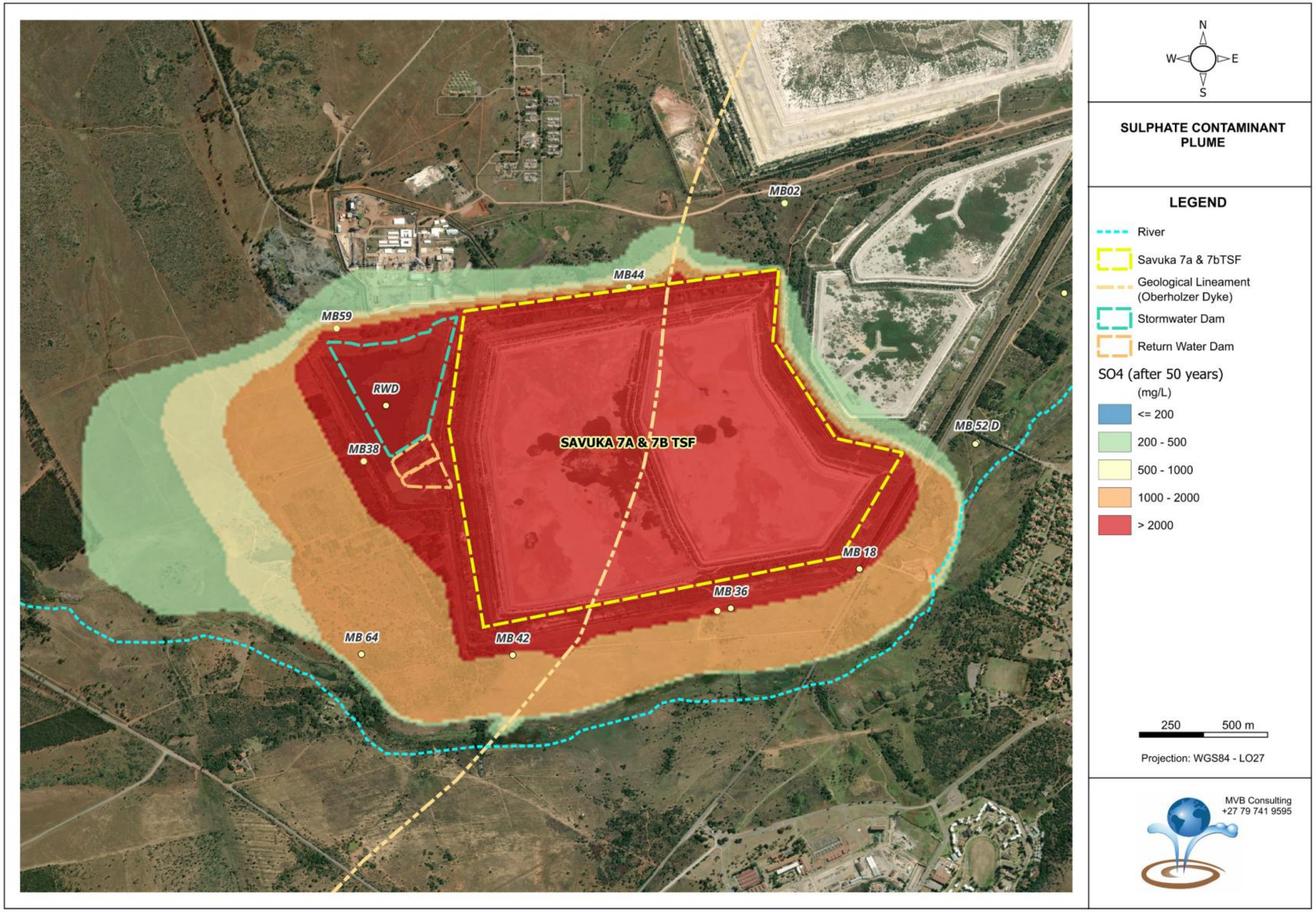


Figure 32: Simulated sulphate plume after 50 years

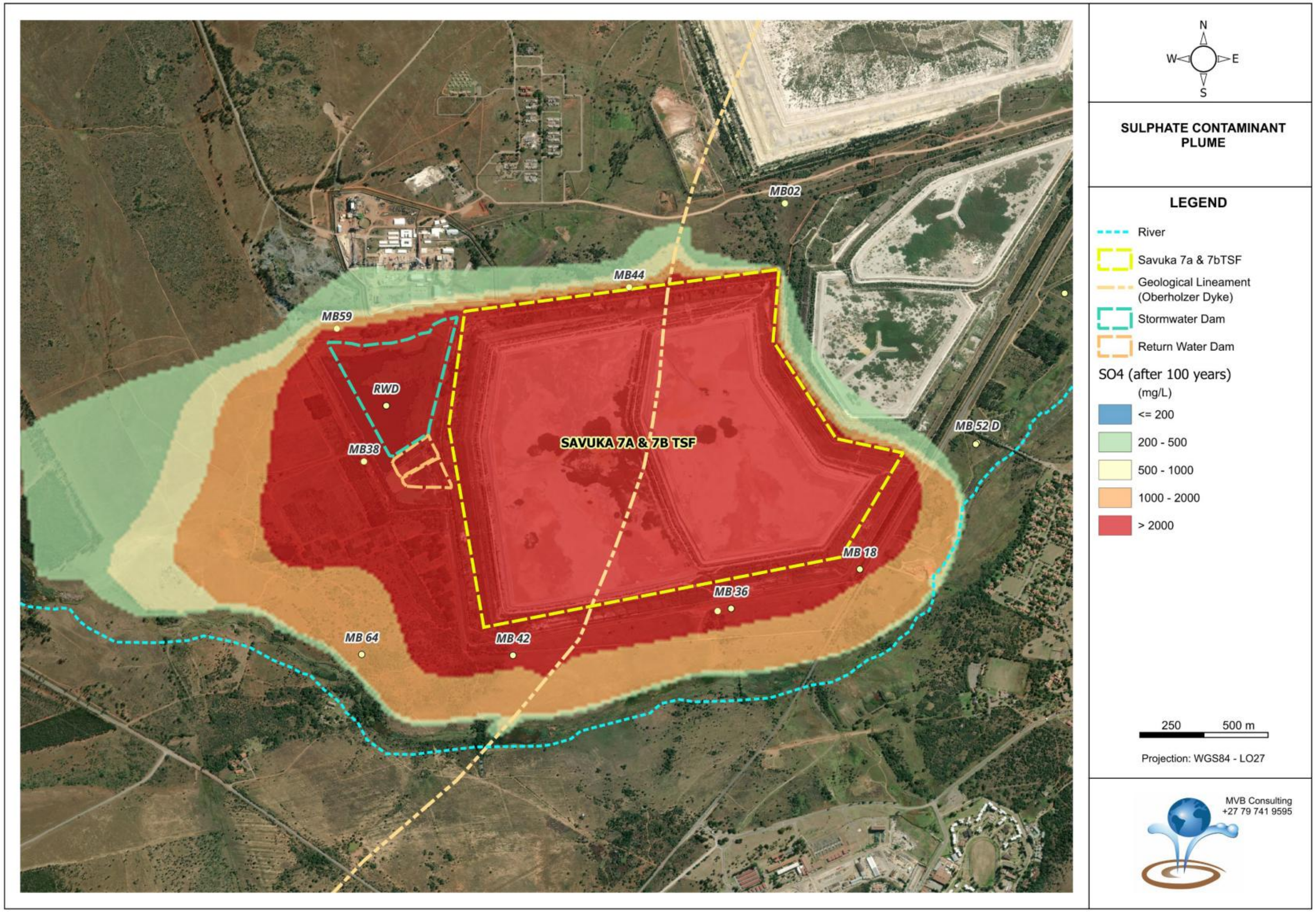


Figure 33: Simulated sulphate plume after 100 years

- ***Effectiveness of Potential Management Options***

The “do-nothing” scenario indicated that the contaminant plume from the RWD will migrate in a westerly direction towards the Wonderfonteinspruit tributary. The figures above do not include the phyto-remediation that is already in place. Based on the sulphate concentration in borehole MB64, the phyto-remediation is not yet as effective as it is in the vicinity of borehole MB38. As the plants grow it is expected that this remediation method will be very successful.

The numerical model was used to simulate the effectiveness of the following management options:

- Lining of the RWD. The TSF will remain unlined.
- Effectiveness of the existing and proposed phyto-remediation over time.
- Implementation of a containment system downgradient from the RWD. This includes interception boreholes, supplementing the phyto-remediation.
- The last option is supplementing the existing phyto-remediation with lining of the RWD.

The gold tailings are typically classified as a Type 3 waste in terms of the NEMWA Regulations 2013 requiring a Class C containment barrier performance. The Class C single composite barrier system comprises of underdrainage; a base preparation layer; a 300 mm thick compacted clay liner (CCL); a 1.5mm thick geomembrane; a dual purpose ballast and protection layer of at least 100mm thickness, and above liner drainage system. The performance of such a barrier is largely influenced by the design specifications and associated Construction Quality Assurance (CQA). The nature and extent of wrinkles influences the containment performance, with an expected seepage rate to be in the order of 140 litres / hectare / day (Legge, 2024).

By making use of an ”inverted barrier system” comprising of underdrainage and a base preparation layer; a 1.5mm thick geomembrane ; and covered tailings the barrier system performance is improved by (a) seepage losses are reduced from about 140 l/ha/day to about 3 l/ha/day due to the change from Bernoulli flow at discontinuities to D’Arcian flow controlled by the tailings permeability at these points (Legge, 2024).

The expected leakage rates through the “inverted barrier system” were included in the model and the impact simulated. Leakage will continue only during the operational phase. Thereafter the RWD will be rehabilitated.

The effectiveness of lining the RWD is illustrated in Figure 34. Plume migration from the TSF continues towards the south, but the westerly migration from the RWD, is contained and the existing impact dissipates over time.

Alternatives to a liner includes the phyto-remediation, with and without supplementary scavenger or interception boreholes. The simulations assumed the following:

- Each tree uses 5 litres / day and there are 1 333 trees / hectare.
- Each scavenger borehole is pumped at 1.5 lit / sec for 24-hours / day.

The effectiveness of the phyto-remediation is remarkable, and it contains the contaminant plume effectively (Figure 35). Supplementing the phyto-remediation with scavenger boreholes improves the effectiveness of the phyto-remediation, but with very small margins (Figure 36).

In addition, the effects of combining the lining of the RWD and the phyto-remediation on the pollution plume were modelled. Again, the lining of the RWD improved the effectiveness of the phyto-remediation, but only with very small margins (Figure 37). Consider the high costs of installing and maintaining a liner and or scavenger boreholes and comparing it to the very limited improvement in effectiveness, it is not a feasible option.

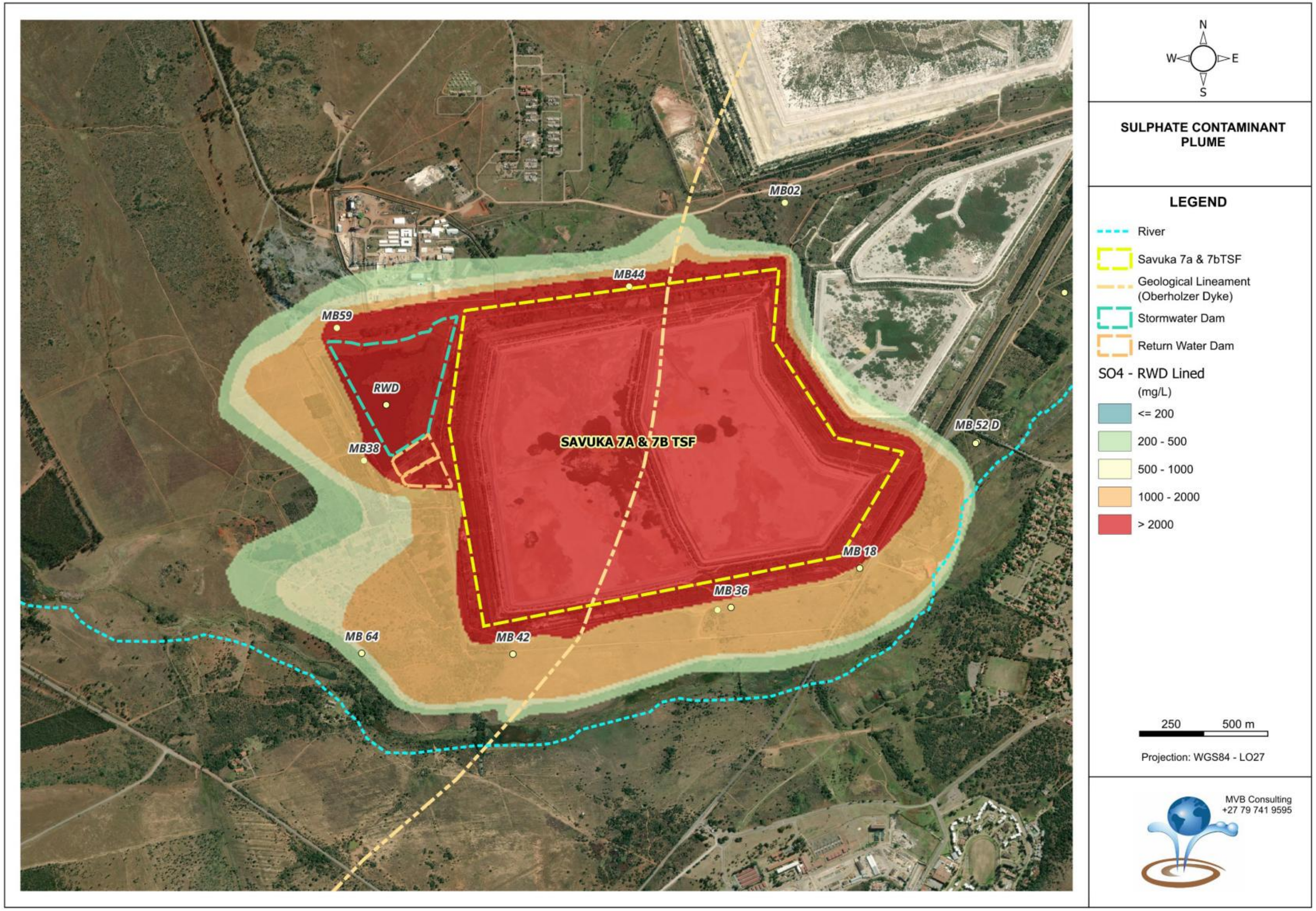


Figure 34: Simulated sulphate plume after 50 years with a liner in the RWD

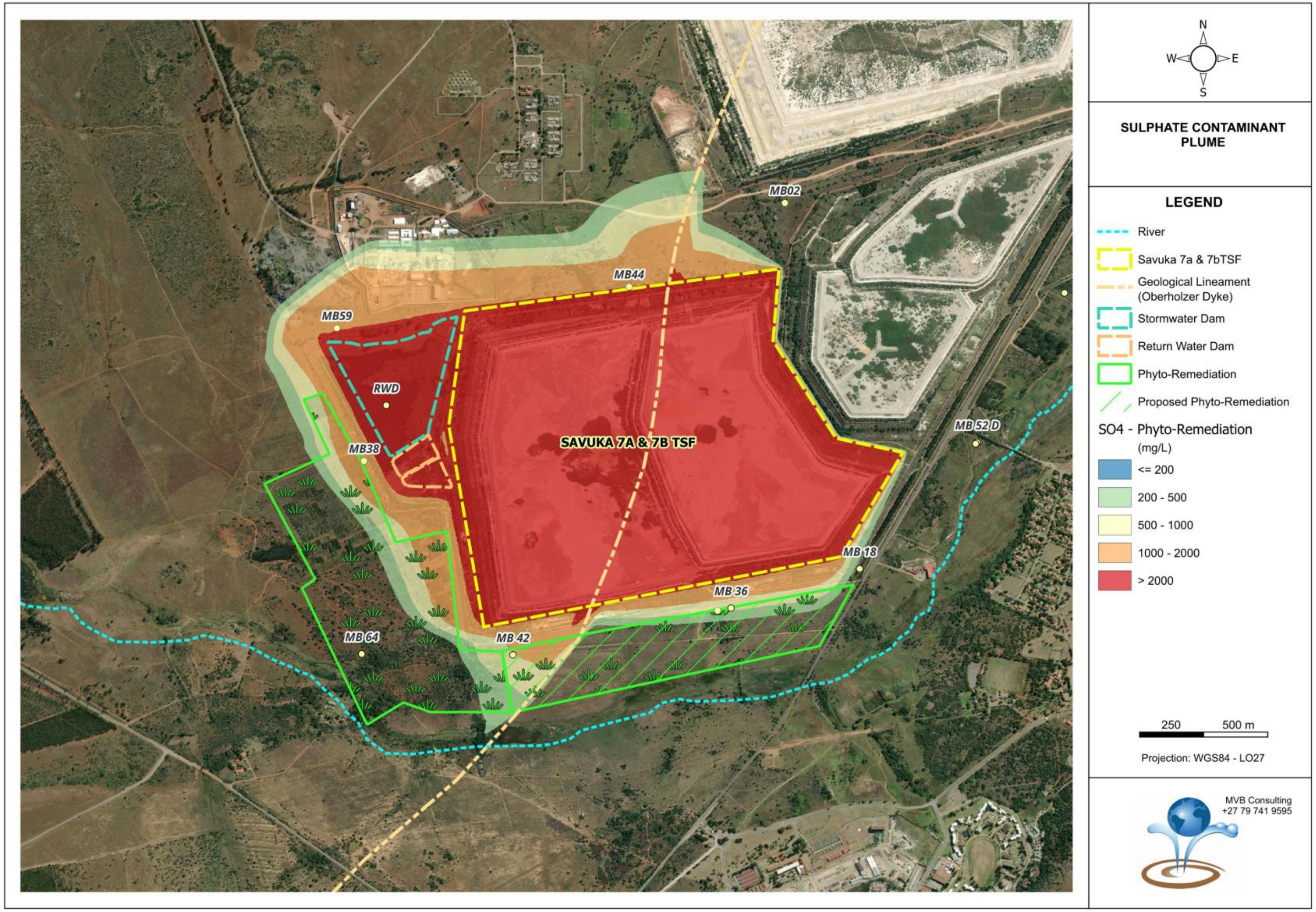


Figure 35: Simulated sulphate plume after 50 years with phyto-remediation fully functional

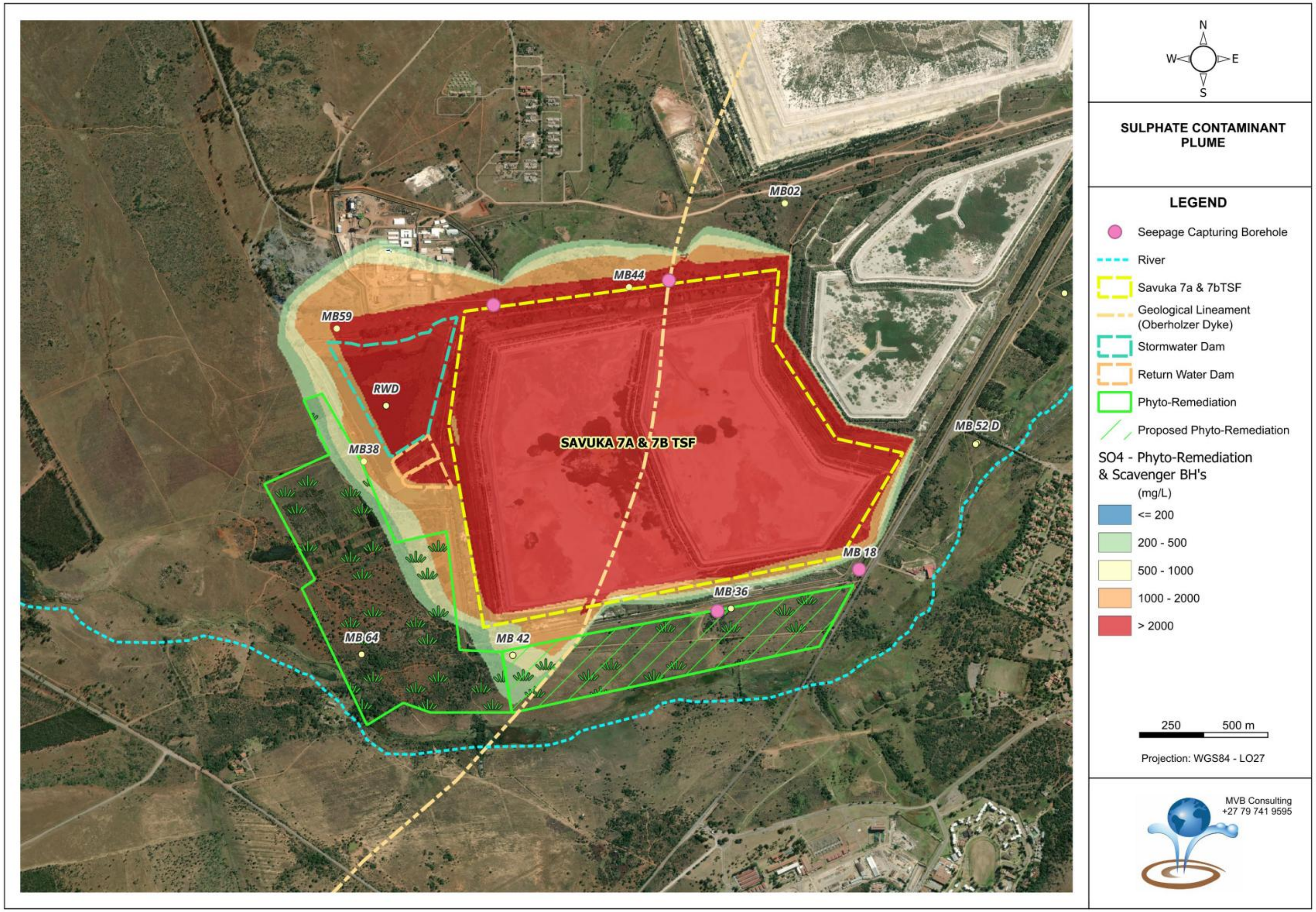


Figure 36: Simulated sulphate plume after 50 years with seepage capturing boreholes supplementing the phyto-remediation

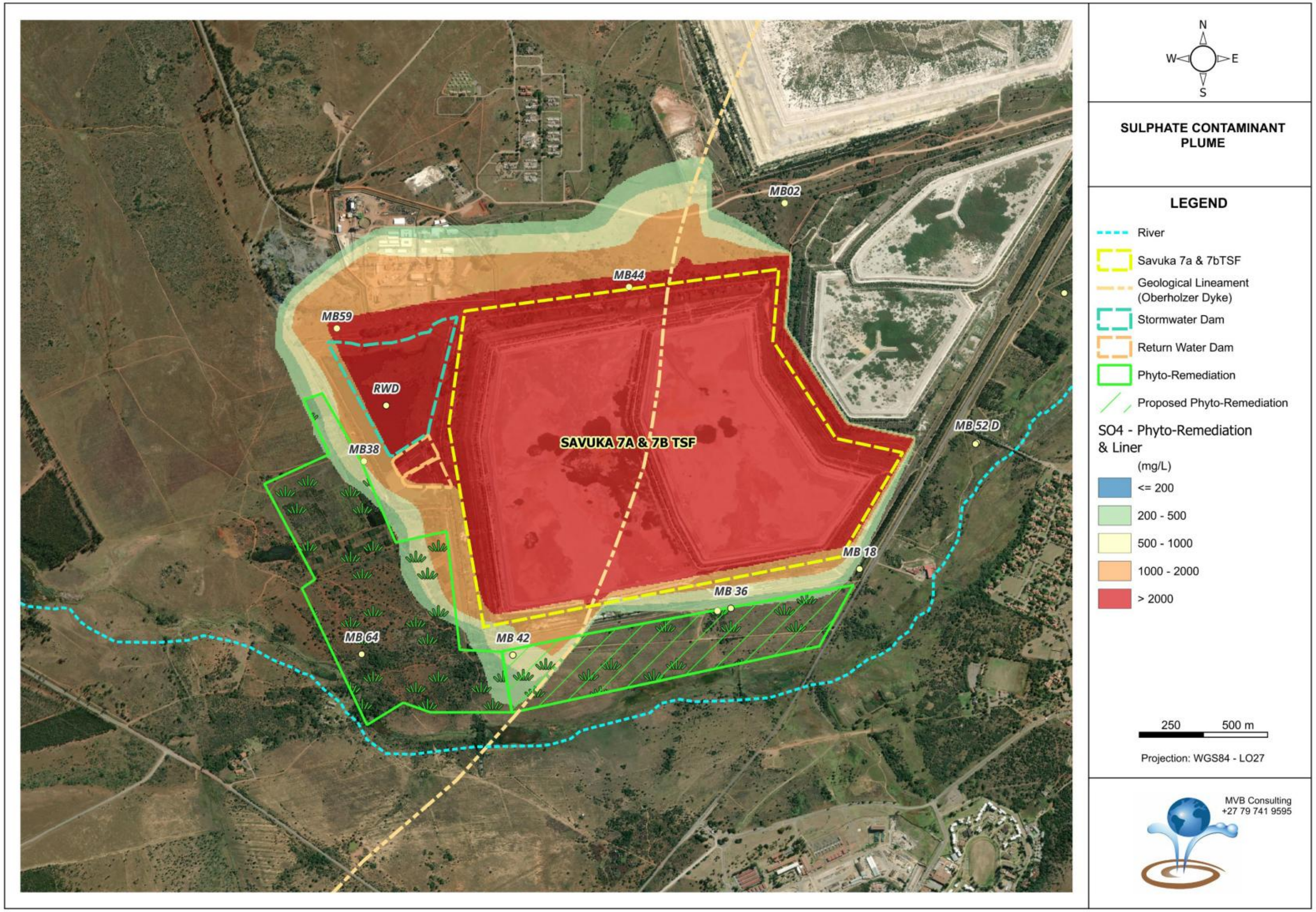


Figure 37: Simulated sulphate plume after 50 years with phyto-remediation fully functional and the RWD lined

The primary risk that this proposed project poses is the seepage of contaminants into the aquifer, and the migration of these contaminants into down-gradient receptors (Wonderfonteinspruit tributary).

The impact of the four scenarios were assessed using the EIMS impact assessment methodology by the specialist.

Mitigation measures for all scenarios:

- For the "do-nothing" option the TSF as well as the RWD remains unlined. The only mitigation is the rehabilitation and decommissioning of the RWD during the closure (decommissioning) phase.
- For the first alternative mitigation, TSF will remain unlined, but a liner in the RWD was considered. This option will change the risk from High Negative to Low Negative during the operational phase. After closure the RWD will be decommissioned and rehabilitated whereafter the risk rating improves marginally.
- For the second alternative mitigation scenario, which is the recommended mitigation, the TSF and RWD will remain unlined, but the existing and proposed phyto-remediation will be fully functional. This option will change the risk from High Negative to Low Negative during the operational phase. After closure the RWD will be decommissioned and rehabilitated whereafter the risk rating improves marginally. This option has the best rating and is the recommended long-term management option.
- For the third alternative mitigation, the phyto-remediation is supplemented with scavenger boreholes. This option will change the risk from High Negative to Low Negative during the operational phase. After closure the RWD will be decommissioned and rehabilitated whereafter the risk rating improves marginally. This option has a slightly lower rating than the previous option, mainly as a result of the higher maintenance costs associated with the borehole maintenance.
- A last option was also considered and modelled should the lining of the RWD supplement the phyto-remediation. This option will change the risk from High Negative to Low Negative during the operational phase. After closure the RWD will be decommissioned and rehabilitated whereafter the risk rating improves marginally. This option has a lower rating than the previous two options, mainly as a result of the high installation and maintenance costs associated with lining the RWD.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Groundwater Contamination (particularly sulphates) **(Alternative 3 - mitigation -phyto-remediation) (GW1)**	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Potential cumulative/ confounding effects	The cumulative impacts of the preferred method of mitigation is rated as low, which means considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.			
Mitigation Measures				
• Phyto-remediation as per identifier 3 above. This option will change the risk from High Negative to Low Negative during the operational phase. After closure the RWD will be decommissioned and rehabilitated whereafter the risk rating improves marginally. This option has the best rating and is the recommended long-term management option. • The exiting monitoring network is comprehensive and sufficient to quantify the impact from the RWD and the TSF. The boreholes are generally close to the TSF, referred to as source boreholes. It is important to drill monitoring boreholes further from the contaminant sources to be able to quantify plume migration, as well as close to the property boundary or receptors. These boreholes				

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance

are referred to as compliance boreholes. Four additional compliance borehole pairs (one shallow and one deep) are recommended as shown in Figure 30. The aim of these boreholes is to monitor the effectiveness of the phyto-remediation. Borehole MB38, which is located inside the phyto-remediation has much better quality than the other monitoring boreholes. Further down-gradient boreholes will confirm that this is because of the phyto-remediation. It is also important to distinguish between the weathered and fractured formations.

- The following is recommended in terms of monitoring:
  - Groundwater levels.
  - Groundwater quality.
  - Data should be stored electronically in an acceptable database.
  - On the completion of every sampling run a monitoring report should be written. Any changes in the groundwater levels and quality should be flagged and explained in the report.
  - A compliance report can be submitted to DWS once a year, if required.
- A comprehensive bi-annual analysis of the dedicated monitoring boreholes.
- Groundwater levels should be monitored monthly in the dedicated groundwater monitoring boreholes.
- Rainfall should be monitored daily.
- Samples should be submitted to a SANAS accredited laboratory. The following recommended parameters to be analysed for include:
  - pH.
  - Electrical Conductivity.
  - Total Dissolved Solids.
  - Total Alkalinity.
  - Anions and Cations (Ca, Mg, Na, K, NO3, NH4, Cl, SO4, F, Fe, Mn, Al, Cr).

6.3.3 SURFACE WATER/ WETLANDS (W)

6.3.3.1 EROSION OF SOILS AND SEDIMENTATION OF SURFACE WATER FEATURES (W1)

The current TSFs are surrounded by toe paddocks reporting to the return water dam (RWD) west of the TSFs. This will limit the potential for eroded soils or sediment to enter the environment. The proposed height increase is expected to make a limited difference in the potential (existing) erosion of soils.

Pre-mitigation and post-mitigation scoring are equivalent due to the existing operation of the TSFs and the limited impact the height extension will have on the surface water environment (compared to current).

6.3.3.2 POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT (W2)

For the most part, potential pollutants are already limited by the design of the project given the containing nature of the existing TSFs.

A stormwater management plan compliant with both TSF-specific regulations and per GN 704 requirements is expected to already be present (in operation).

Uncontrolled release of tailings or contaminated return water is possible and would be considered a residual risk (post-mitigation). A TSF failure while a highly unlikely event has the potential to cause severe pollution of the downstream environment while poor operation/management of the TSFs (and by association the RWD) could see unplanned spill from the RWD.

Pre-mitigation and post-mitigation scoring are equivalent due to the existing operation of the TSFs and the limited impact the height extension will have on the surface water environment (compared to current).

Important. It should also be noted that the potentially severe impact of a TSF failure is not adequately conveyed by the impact table since the probability is low, resulting in the impact appearing less significant than may be warranted.

6.3.3.3 DECREASE IN RUN-OFF (W3)

The existing TSFs have a containment philosophy in place as enabled by the self-containing TSF basin, toe paddocks and RWD, with overall runoff from the site decreased to near zero (before any treatment and discharge).

The proposed height increase is expected to make a negligible difference in the existing decrease in runoff (relative to an undeveloped site).

Pre-mitigation and post-mitigation scoring are equivalent due to the existing operation of the TSFs and the limited Impact the height extension will have on the surface water environment (compared to current).

6.3.3.4 FLOOD RISK (W4)

Flood risk is both an impact on the proposed TSFs height extension (flooding originating beyond the TSF) and on the environment (flooding originating from the TSFs) and includes:

- A TSF failure resulting in downstream flooding (flooding originating from the TSF);
- Flooding from the either river system to the north or south of the TSFs (flooding originating beyond the TSFs); and
- Surface water run-on towards the TSFs (flooding originating beyond the TSFs).

This risk is expected to be present during the construction, operational, decommissioning and rehab/closure phases (flooding originating beyond the TSFs) and during the operational, decommissioning and rehab/closure phases (flooding originating from the TSFs). The proposed increase in TSFs height has no influence on existing flood risk to the TSFs, however, flood risk from the TSFs may be increased due to increased TSF volume. A quantified assessment of flooding would need to consider the actual fluvial flood risk to the TSFs (from the adjacent river systems).

The consequence of flooding is potentially severe, however, flooding originating beyond the TSFs is expected to have been mitigated (to at least a degree) through the toe paddocks and associated bunding that hydraulically separates the TSFs from the adjacent environment.

TSF failure (while highly unlikely to occur), has both flooding and pollutant implications.

Pre-mitigation and post-mitigation scoring are equivalent due to the existing operation of the TSFs and the limited impact the height extension will have on the surface water environment (compared to current).

Important. It should be noted that the potentially severe impact of flood risk is not adequately conveyed by the impact table below since the probability of extreme flooding is low, resulting in the impact appearing less significant than may be warranted.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Erosion of Soils and Sedimentation of surface water features (W1)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Pollutants entering the surface water environment (W2)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Decrease in run-off (W3)	Operation, Decommissioning, Rehabilitation	Low	Low	Low

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
	and Closure and Post-closure			
Flood Risk (W4)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Potential cumulative/ confounding effects	For the erosion of soils and contamination (W1 and W2), the cumulative impact was rated as high: considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change. For decrease in run-off and flood risk (W3&W4), the cumulative impact was rated Low: considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.			

Mitigation Measures

Erosion of Soils and Sedimentation of surface water features (W1)

The below mitigation is expected to already be part of the existing TSFs management and also applies to the proposed height extension.

- Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).
- Monitor the TSFs to ensure areas of potential erosion are identified and managed appropriately.
- Rehabilitation should include topsoil replacement, re-vegetation and maintenance/aftercare for disturbed areas insofar as it should be developed for disturbed areas.
- Concurrent rehabilitation of the TSFs should ideally occur during the life of the TSFs. This would likely include cladding of TSFs side slopes and subsequent revegetation with final TSFs rehabilitation resulting in fully vegetated site.
- Additional guidance on erosion control is available in: Landcom Soils and Construction, Volume 1, 4th edition from 2004 (otherwise known as the Blue Book).

Pollutants entering the surface water environment (W2)

The below mitigation is expected to already be part of the existing TSFs management and also applies to the proposed height extension.

- Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).
- Develop the TSFs using sound engineering to limit the likelihood of a failure.
- Maintain and operate the TSFs/RWD to limit the potential for overfilling of the RWD that leads to a spill.
- Monitor the TSFs to identify any potential failures/slumps.
- Keep activity within the managed dirty water footprint where possible.
- Store hydrocarbons off-site where possible, or otherwise implement hydrocarbon storage with adequate bunding.
- Handle hydrocarbons carefully to limit spillage.

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance

- Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited.
- Use drip trays for stationary vehicles or otherwise park over areas suited to their storage (e.g. with an oil interceptor)
- Designate a single location for refuelling and maintenance where possible.
- Keep a spill kit on site to deal with any hydrocarbon leaks.
- Remove soil from the site which has been contaminated by hydrocarbon spillage.
- Undertake surface water monitoring to enable change detection related to contaminants originating from the site.

Decrease in run-off (W3)

The below mitigation is expected to already be part of the existing TSFs management and also applies to the proposed height extension.

- Limiting the time and area over which machinery operates will limit the compaction of soils on the site.
- Divert clean water run-on away from the site.

Flood Risk (W4)

The below mitigation is expected to already be part of the existing TSFs management.

- Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).
- Ensure that flood protection of the TSFs is sufficient to manage flood risk from both adjacent river systems (north and south) and
- stormwater run-on.
- Develop the TSFs using sound engineering to limit the likelihood of a failure.
- Monitor the TSFs to identify any potential failures/slumps.

Monitoring

- Potential contaminants of concern that need to be monitored are expected to have already been identified based on the historical quarterly surface water quality monitoring that has been undertaken. The understanding of the mine's processes and the associated contaminants that might be released in the event of a failure in an aspect of the TSF's (e.g. toe paddock rupture or RWD overflow) is likewise expected to be clearly understood with monitoring reflecting this.
- Quarterly monitoring reports should be produced to differentiate seasonal variations and general trends due to the mining activities, with a comparison of water samples to standards and guidelines set by the Department of Water and Sanitation (DWS) and an analysis of parameters over time so that trends can be established.
- The recommended monitoring points are also provided in the specialist report and should be included in the monitoring programme.

6.3.4 ECOSYSTEMS/ HABITATS (EH)

- *Current Impacts to Freshwater Biodiversity*

The list below refers to the present-day local impacts observed within the assessed wetland areas:

- Historical alterations to the natural hydrological regime due to the presence of access roads through wetlands;
- Alterations to hydrology and geomorphology through the development of dams within wetlands and the local catchment;
- Loss of vegetation and wetland area through infrastructure infringement;
- Impaired water quality from mining runoff;
- Impeding flow within watercourse from informal and formal road crossings;
- Proliferation of alien invasive vegetation; and
- Erosion of watercourse from altered hydrology and geomorphology.

- *Anticipated Impacts*

It should be noted that the TSF has already been established and is currently in use, and the height of the facility is now being increased. Therefore, the majority of the impact has already occurred. The project entails continuing with deposition using the cyclone method for another 2 to 3 years which is an added impact of low significance.

The construction phase for the project was not considered for the assessment as no construction would be undertaken while a decommissioning phase for the project was also not considered given the expected longevity of the infrastructure. Unlike the DWS Risk Assessment, which is activity specific, this impact assessment provides a cumulative assessment of significance per impact. As such, the pre- and post-mitigation impact ratings present within the "Low" class. The proposed activities being assessed in this impact assessment refer to TSF height extension/operation of TSF.

6.3.4.1 SILTATION OF WATER RESOURCES (EH1)

The extension of the TSF increases the risk of fine tailings material being mobilized via surface runoff, wind erosion, and stormwater discharge. If erosion control measures are inadequate, these sediments can enter nearby wetlands, altering substrate composition and smothering aquatic vegetation.

6.3.4.2 EROSION OF WATER RESOURCES (EH2)

Altered drainage patterns associated with increasing the height of the TSF can accelerate erosion along nearby watercourses.

6.3.4.3 ALTERING OF HYDROLOGICAL REGIME (EH3)

The additional height of the TSF may alter natural surface and subsurface flow paths, leading to increased runoff, reduced infiltration, and localized water table changes. This can disrupt wetland recharge and modify seasonal water availability, impacting wetland-dependent species.

6.3.4.4 PROLIFERATION OF ALIEN VEGETATION (EH4)

Disturbance from altered water flow can create favourable conditions for invasive species to establish. Poor rehabilitation practices may further encourage the spread of aggressive alien vegetation within wetland buffer zones.

6.3.4.5 IMPAIRED WATER QUALITY (EH5)

The extension of the TSF increases the potential for contaminants such as heavy metals, sulphates, and fine sediments to leach into surface and groundwater. Stormwater runoff from tailings areas, accidental spills, and seepage from storage facilities can introduce harmful substances into adjacent wetland habitats.

6.3.4.6 WETLAND DISTURBANCE AND DECREASE IN FUNCTIONALITY (EH6)

Due to all the other impacts described, the wetland will be disturbed and its functionality decreased.

6.3.4.7 PHYTOREMEDIATION FOR GROUNDWATER POLLUTION (EH7)

According to the Geohydrological Impact Assessment (van Biljon, 2025), applying Phytoremediation to counter groundwater pollution, will result in lowering the water table. Certain plant species used in phytoremediation, particularly those with high transpiration rates, can significantly draw down the water table as they uptake large volumes of water to support their growth and contaminant uptake processes. However, channelled valley-bottom wetlands are characterised by their location on valley floors, the presence of a river channel running through them, and the absence of characteristic floodplain features. Therefore, these wetlands are typically influenced by water inputs from the river channel and adjacent valley-side slopes, which contribute to their hydrological and ecological dynamics (Ollis *et al*., 2013).

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
Siltation of water resources (EH1)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Erosion of water resources (EH2)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Altering of Hydrological Regime (EH3)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Proliferation of Alien Vegetation (EH4)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Impaired Water Quality (EH5)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Wetland disturbance and decrease in functionality (EH6)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Phytoremediation for Groundwater Pollution (EH7)	Operation, Decommissioning, Rehabilitation and Closure and Post-closure	Low	Low	Low
Potential cumulative/ confounding effects	The quantitative impact of the proposed project in isolation on freshwater biodiversity is anticipated to be "Low" due to the proposed activities that will avoid wetland features and their buffers wherever possible and given that mitigation measures will be in place during the operational phase where impacts will be more likely to occur. The cumulative impact of the proposed project on freshwater biodiversity is anticipated to be "Low" given the nature of the activities and expected low magnitude of impact once the height of the TSF is established.			

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance
	Therefore, a slight and short-term deterioration to the wetland's integrity and functionality conditions are expected but will likely remain within the recommended ecological category as a result of the proposed development activities. An irreplaceable loss of freshwater biodiversity is not anticipated.			
Mitigation Measures				

Siltation of water resources (EH1)

- Update and implement the stormwater management plan.
- Implement and maintain silt traps and sediment basins at strategic stormwater discharge points.
- Establish and maintain vegetated buffer zones (using indigenous grass species) between the TSF and nearby wetlands, within 15 m from the TSF.
- Regularly inspect and clear sediment traps and drains to ensure continued functionality.
- Apply dust suppression measures (e.g., water spraying or biodegradable binders) on or vegetate exposed tailings to reduce wind-blown silt deposition where required.

Erosion of water resources (EH2)

- Install energy dissipation structures) at stormwater outflows to reduce flow velocity, where required.
- Stabilize slopes and embankments where required.
- Implement a controlled release of stormwater through designed drainage channels to prevent concentrated flows from reaching wetland areas.
- Conduct regular inspections of stormwater management infrastructure and repair erosion-prone areas immediately.
- No machinery or vehicles should be allowed to parked in any wetlands. All activities to be restricted to authorized areas only.

Altering of Hydrological Regime (EH3)

- Implement stormwater management, to be informed by the hydrological report.
- Use permeable berms or check dams in water diversion channels to slow down and evenly distribute water flow.
- Monitor groundwater levels.

Proliferation of Alien Vegetation (EH4)

- Remove alien vegetation manually or mechanically rather than using herbicides, to avoid contamination risks. This should be conducted annually.
- Implement a maintenance program to ensure that previously cleared areas do not become re-infested with alien vegetation.

Impaired Water Quality (EH5)

- Conduct routine water quality monitoring at key points downstream of the TSF to detect contamination early.
- Conduct groundwater quality monitoring.

Wetland disturbance and decrease in functionality (EH6)

Impact	Phase	Pre-mitigation Impact	Post-mitigation Impact	Final Significance

- Establish a 15 m wetland buffer zone with clear demarcation to prevent accidental encroachment. This can include signage.
- Restrict heavy vehicle access to designated and authorized roads.
- Implement a long-term wetland monitoring program to track ecological changes and implement adaptive management strategies.

Phytoremediation for Groundwater Pollution (EH7)

- Use indigenous plant species that are well-adapted to local conditions. This helps maintain the ecological balance and supports local biodiversity.
- Monitor water levels by means of the current groundwater monitoring programme to detect any significant changes in the water table. The geohydrologist is to advise on the suitability of the programme, and to recommend any changes.
- The geohydrologist is to also advise on 'allowable' changes to the groundwater levels, and to prescribe remedial actions if levels are exceeded.
- Manage the density of phytoremediation plants to prevent excessive water uptake and potential lowering of the water table. This can be achieved by spacing plants appropriately and using mixed planting strategies.

Further recommendations

- Strict adherence to the wetland buffers should be practiced, unless for activities that have been authorised;
- Update and implement a stormwater management plan for the operational phase of the development. The plan must address the movement of water on site and include measures to reduce erosion and sedimentation of the watercourses. Furthermore, the plan must ensure that only clean water is released into the environment;
- Ensure that waste generated on site during the operational phase is appropriately contained, categorised and disposed of; and
- Review and update the surface, groundwater and also aquatic biomonitoring programmes for the operation. In the event no monitoring programmes are available, these must be informed by the relevant specialists. It is recommended that an annual wetland monitoring programme be considered for the necessary authorisation, for this project.

7 STAKEHOLDER ENGAGEMENT

The Public Participation Process (PPP) is a requirement of several pieces of South African legislation and aims to ensure that all relevant Interested and Affected Parties (I&APs) are consulted, involved and their comments are considered, and a record included in the reports submitted to the Authorities. The process ensures that all stakeholders are provided this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study. The PPP for the proposed project needs to be managed sensitively and according to best practises to ensure and promote:

- Compliance with international best practice options;
- Compliance with national legislation;
- Establishment and management of relationships with key stakeholder groups; and
- Involvement and participation in the environmental study and authorisation/approval process.

As such, the purpose of the PPP and stakeholder engagement process is to:

- Introduce the proposed project;
- Explain the authorisations required;
- Explain the environmental studies already completed and yet to be undertaken (where applicable);
- Solicit and record any issues, concerns, suggestions, and objections to the project;
- Provide opportunity for input and gathering of local knowledge;
- Establish and formalise lines of communication between the I&APs and the project team;
- Identify all significant issues for the project; and
- Identify possible mitigation measures or environmental management plans to minimise and/or prevent negative environmental impacts and maximize and/or promote positive environmental impacts associated with the project.

7.1 PRE-CONSULTATION WITH THE COMPETENT AUTHORITY

A pre-application meeting with the competent authority (DWS) was requested by the EAP and was held on the 6th of June 2024. The purpose of the pre-consultation was to provide the authorities with background information of the proposed project, confirm NWA triggered listed activities, the process to be followed and details to be included in the WULA such as specialist studies.

7.2 GENERAL APPROACH TO PUBLIC PARTICIPATION

The PPP for the proposed project has been undertaken in accordance with the requirements of the MPRDA, NWA and NEMA EIA Regulations (2014), and in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&APs are afforded an opportunity to comment on the project and have their views considered and included as part of project planning.

An initial I&AP database has been compiled based on known key I&AP's, Windeed searches, and stakeholder databases provided by the mine. The I&AP database includes amongst others, landowners, communities, regulatory authorities and other special interest groups.

7.2.1 LIST OF PRE-IDENTIFIED ORGANS OF STATE/ KEY STAKEHOLDERS IDENTIFIED AND NOTIFIED

Government Authorities and other key I&APs were notified of the proposed project and include:

- Civil Aviation Authority;
- Endangered Wildlife Trust;
- Eskom Holdings SOC Limited;
- West Rand District Municipality;
- Merafong City Local Municipality;
- Gauteng Department of Agriculture& Rural Development;
- Gauteng Department of Cooperative Governance and Traditional Affairs;
- Gauteng Department of Infrastructure Development;
- Gauteng Department of Roads and Transport;
- Gauteng Growth and Development Agency;

- Gauteng Department of Mineral Resources and Energy;
- National Department of Agriculture, Forestry, Fisheries and Environment;
- National Department of Mineral Resources and Energy;
- National Department of Rural Development and Land Reform;
- National Department of Water and Sanitation;
- South African Heritage Resources Agency;
- South African National Roads Agency Limited; and
- Transnet SOC Limited.

7.2.2 INITIAL NOTIFICATION

The PPP commenced with an initial notification, call to register. The notification was given in the manner described in the sub-sections below.

7.2.2.1 REGISTERED LETTERS, FAXES AND EMAILS

Notification letters (English, Afrikaans and Setswana), faxes, and emails were distributed to all pre-identified key I&APs including government organisations, NGOs, relevant municipalities, ward councillors, landowners and other organisations that might be affected.

The notification letters included the following information to I&APs:

- List of anticipated activities to be authorised;
- Scale and extent of activities to be authorised;
- Information on the intended mining operation to enable I&APs to assess/surmise what impact the activities will have on them or on the use of their land;
- The purpose of the proposed project;
- Details of the affected properties (including details of where a locality map could be obtained);
- Details of the relevant NEMA Regulations;
- Initial registration period timeframes;
- Scoping Report commenting and Review period; and
- Contact details of the EAP.

7.2.2.2 NEWSPAPER ADVERTISEMENTS / GOVERNMENT GAZETTE

Advertisements describing the proposed project and EIA process were placed in the local newspaper with circulation in the vicinity of the study area. The initial advertisement was placed in the Carletonville Herald Newspaper (in English, Afrikaans and Setswana) in April 2025. The newspaper advert included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity and application;
- Relevant EIMS contact person for the project.

7.2.2.3 SITE NOTICE PLACEMENT

A1 Correx site notices in English, Afrikaans and Sesotho were placed at 6 locations within the local project area in April 2025. The on-site notices included the following information:

- Project name;
- Applicant name;
- Project location;
- Map of proposed project area;
- Project description;
- Legislative requirements; and
- Relevant EIMS contact person for the project.

7.2.2.4 POSTER PLACEMENT

A3 posters in English, Afrikaans and Sesotho were placed at seven local public gathering places in and surrounding Carletonville, namely the Wedela Community Hall, Spar saveMore Blyvoor, The Merafong City Local Municipality office in Carletonville, Laerskool Blyvooruitzicht, Rocklands Primary School, Wedela Public Library and The Fountain Private Hospital.

The notices and written notification afforded all pre-identified I&APs the opportunity to register for the project as well as to submit their comments of the Scoping Report and indicate the contact details of any other potential I&APs that they feel should be contacted. The contact person at EIMS, contact number, email and faxes were stated on the posters. Comments/concerns and queries were encouraged to be submitted in either of the following manners:

- Electronically (fax, email);
- Telephonically; and/or
- Written letters.

7.2.3 PUBLIC PARTICIPATION PROGRESS

I&APs will be provided with an opportunity to submit their comments during the public review period of the WULA technical report of the project for 60 days.

Comments raised will be addressed in a transparent manner and included in the final IWWMP.

7.2.3.1 PROPOSED PUBLIC REVIEW TIMEFRAMES FOR THE IWWMP

The WULA Technical Report will be made available to all I&APs for 60 days. The public will be notified regarding the availability of the report for review. Comments raised by I&APs will be used to create an issues table which will then further inform the action plan (Section 11) included in the report.

8 MATTERS REQUIRING ATTENTION/PROBLEM STATEMENT

No audits for this project have yet occurred, as such this section is not applicable. No additional matters have been identified at this stage.

9 ASSESSMENT OF LEVEL AND CONFIDENCE OF INFORMATION

This report is based on information that is currently available, further:

- The project scope and descriptions are based on project information provided by the client;
- The information presented in this report is based on the information available at the time of compilation of the report and of information gathered during site visits;

- It is assumed that all data and information supplied by the Specialist, Applicant or any of their staff or consultants is complete, valid, and true; and
- The description of the baseline environment has been obtained from registered and qualified specialists.

10 WATER AND WASTE MANAGEMENT

The following section describes water and waste aspects for the Savuka TSF, as well as the related operational processes.

10.1 WATER AND WASTE MANAGEMENT PHILOSOPHY (PROCESS WATER, STORM WATER, GROUNDWATER, WASTE)

10.1.1 SURFACE WATER

The philosophy of Harmony is to develop and implement site water management strategies to limit the negative impact on the surface water resource as far as possible. Harmony also aims to ensure compliance with the precautionary principle as indicated by the DWS. The water management measures proposed in this document aim to ensure activities are undertaken at the lowest possible impact to the environment.

10.1.2 GROUNDWATER

Harmony recognises that water is a scarce and valuable resource. Contamination of a groundwater resource impairs the beneficial use of this resource for everyone. Harmony is committed to consult with specialists on a regular basis to determine the extent of the impact on the groundwater resource and to implement recommendations if required.

10.1.3 SENSITIVE LANDSCAPES (WETLANDS AND RIVER RIPARIAN AREAS)

Harmony recognises the importance of wetlands and riparian areas and the role that they play to the environment. Harmony is committed in keeping affected and clean water systems separate. Harmony is also committed to the continual monitoring of surface water resources both upstream and down stream of the Harmony Free state Operations.

10.1.4 WASTE

Effective waste management is the responsibility of all employees and aims to reduce, re-use and recycle waste wherever possible. Key waste streams will be identified, characterised and classified and the collection, handling and disposal will be in accordance with the respective waste stream classification and legislation.

10.2 STRATEGIES (PROCESS WATER, STORM WATER, GROUNDWATER AND WASTE)

10.2.1 PROCESS WATER AND STORM WATER

No additional process and stormwater strategies are proposed for the water uses included in this application, over and above the mitigation measures proposed as part of the risk assessment conducted for this project.

10.2.2 GROUNDWATER

No additional groundwater strategies are proposed for the water uses included in this application, over and above the mitigation measures proposed as part of the risk assessment conducted for this project.

10.2.3 SENSITIVE LANDSCAPES

No additional sensitive landscape strategies are proposed for the water uses included in this application, over and above the mitigation measures proposed as part of the risk assessment conducted for this project.

10.3 PERFORMANCE OBJECTIVE GOALS

The following key objectives have been identified for the Harmony Savuka TSF as stated in Table 26.

Table 26: Performance Objectives

Theme	Objectives
Surface Water	Clean and dirty water separation.
	Containment of dirty water run-off.
	Prevent capacity constraints through regular maintenance of process water dams and through effective operation of the dams (i.e., demand and supply management).
	Protect watercourses against erosion, especially at watercourse crossings.
Groundwater	Minimise impact on groundwater quality.
	Prevent impact on groundwater availability to neighbouring users.
	To minimise the extent of disturbance of the aquifer.
Process Water	Maximise the re-use of process water.
	An up-to-date water balances.
	Manage process water dams with 0.8 m freeboard.
Sensitive landscapes	Minimise impact on sensitive areas (Wetland area) as part of future activities.
Waste	Minimise waste generation
	Re-use and recycle waste as far as possible.

10.4 PROJECT ALTERNATIVES

In terms of GNR 267 (2017) which provides guidance for water use license applications and appeals regulations, it is outlined that an IWWMP requires an alternatives analysis for the project. This was also done as part of the EIA studies for the project as required by the NEMA.

In terms of the EIA Regulations published in Government Notice (GN) R982 of 2014, as amended, feasible and reasonable alternatives must be identified and considered within the environmental assessment process. An alternative is defined as "…in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to the:

(a) property on which or location where it is proposed to undertake the activity;

(b) type of activity to be undertaken;

(c) design or layout of the activity;

(d) technology to be used in the activity;

(e) operational aspects of the activity; and

(f) Includes the option of not implementing the activity."

In terms of Section 24 of NEMA, the proponent is required to demonstrate that alternatives have been described and investigated in sufficient detail during the EIA process. It is important to highlight that alternatives must be practical, feasible, reasonable and viable to cater for an unbiased approach to the project and in turn to ensure environmental protection. In order to ensure full disclosure of alternative activities, it is important that various role players contribute to their identification and evaluation. Stakeholders have an important contribution to make during the EIA Process and each role is detailed as follows:

The role of the environmental assessment practitioner is to:

- encourage the proponent to consider all feasible alternatives;
- Identify reasonable alternatives;
- provide opportunities for stakeholder input to the identification and evaluation of alternatives;
- document the process of identification and selection of alternatives;
- provide a comprehensive consideration of the impacts of each of the alternatives; and
- document the process of evaluation of alternatives.

i. The role of the proponent is to:

- assist in the identification of alternatives, particularly where these may be of a technical nature;
- disclose all information relevant to the identification and evaluation of alternatives;
- be open to the consideration of all reasonable alternatives; and
- be prepared for possible modifications to the project proposal before settling on a preferred option.

ii. The role of the public is to:

- assist in the identification of alternatives, particularly where local knowledge is required;
- be open to the consideration of all reasonable alternatives; and
- recognise that there is rarely one favoured alternative that suits all stakeholders and that alternatives will be evaluated across a broad range of criteria, including environmental, social and economic aspects.

Table 27: Project alternatives as per NEMA EIA Regulations, 2014 as amended.

ALTERNATIVE	COMMENT
No-go Option	The 'no-go' alternative is sometimes referred to as the 'no-action' alternative (Glasson *et al.,* 1999) and at other times the 'zero-alternative'. It assumes that the activity does not go ahead, implying a continuation of the current situation or the status quo. This alternative must be discussed on all projects as it allows for an assessment of impacts should the activity not be undertaken. **This alternative is discussed in this report.**
Activity alternatives	These are sometimes referred to as project alternatives, although the term activity can be used in a broad sense to embrace policies, plans and programmes as well as projects.

ALTERNATIVE	COMMENT
	Consideration of such alternatives requires a change in the nature of the proposed activity. This would entail a process where a different project is proposed instead of the extension of Savuka 7a&b TSF. **Based on project information, there is one proposed activity and no other activity alternative. Therefore, this alternative will not be discussed in this report.**
Location / property alternatives	Location alternatives could be considered for the entire proposal or for a component of a proposal, for example the location of a processing plant within the property boundary. The latter is sometimes considered under site layout alternatives. A distinction should also be drawn between alternative locations that are geographically quite separate, and alternative locations that are in proximity. In the case of the latter, alternative locations in the same geographic area are often referred to as alternative sites. Feasibility studies for location alternatives for the proposed project were considered, however, these were found not feasible. This is discussed in this report, but were not assessed.
Process alternatives	Various terms are used for this category, including technological alternative and equipment alternative. The purpose of considering such alternatives is to include the option of achieving the same goal by using a different method or process. An industrial process could be changed, or an alternative technology could be used. These are also known as technological and equipment alternative and will be discussed as they are applicable to the Savuka 7a&b TSF. **These will be discussed in this report.**
Demand alternatives	Demand alternatives arise when a demand for a certain product or service can be met by some alternative means. This is applicable to the demand for a product or service. An example of this would be where there is a need to provide housing units. Examples of alternatives can be through managing demand through various methods or providing additional housing through either single dwelling residential units or mixed-use developments. Specific to the proposed project, **alternatives regarding the demand are not applicable and will not be discussed in this report.**
Scheduling alternatives	These are sometimes known as sequencing or phasing alternatives. In this case an activity may comprise several components, which can be scheduled in a different order or at different times and as such produce different impacts. **These are not applicable to the project and will not be discussed.**
Input alternatives	By their nature, input alternatives are most applicable to industrial applications that may use different raw materials or energy sources in their processes. Considering that the

ALTERNATIVE	COMMENT
	proposed development is a TSF which does not involve the conversion of raw materials into finished products, **feasible input alternatives are not applicable to the project and will not be discussed.**
Routing alternatives	Consideration of alternative routes generally applies to linear developments such as power lines, transport, and pipeline routes. The Savuka 7a&b TSF has existing pipelines etc. and, therefore, **no routing alternatives are applicable to this report.**
Site layout alternatives	Site layout alternatives permit consideration of different spatial configurations of an activity on a particular site. This may include particular components of a proposed development or may include the entire activity. The Savuka 7a&b's layout is existing and will not be expanded, only heightened. **Based on this, site layout alternatives will not be covered in this report.**
Scale alternatives	In some cases, activities that can be broken down into smaller units can be undertaken on different scales. For example, a housing development within an overall mixed-used development could have the option of 1 000, 2 000 or 4 000 housing units. Each of these scale alternatives may have different impacts. However, the proposed TSF cannot be broken down into smaller units. **For this reason, scale alternatives will not be discussed in this report.**
Design alternatives	This entails the consideration of different designs for aesthetic purposes or different construction materials to optimise local benefits and sustainability would constitute design alternatives. Appropriate applications of design alternatives are communication towers. In such cases, all designs are assumed to have different impacts. Generally, the design alternatives could be incorporated into the project proposal and so be part of the project description and need not be evaluated as separate alternatives. Based on project description and background information, engineering designs are still under assessment.
Operational alternatives	The Operational Alternative is where you can specify controls on the operational aspects of the project such as pressure pipes, pumps, as well as valves. In the case of the proposed TSF, **feasible operational alternatives were not identified and are not discussed in this report.**

As this application relates only to an existing TSF of which the approved height will be extended, there are limited feasible and/or reasonable alternatives that can be considered, and which are described and motivated below.

10.4.1 LOCATION ALTERNATIVES

The proposed alternative is to increase the height of existing TSFs and it is therefore anticipated to have no additional impact on the current properties.

Additional footprints on the same or surrounding property/ies that have been considered are described in the sections below. These are however, not assessed in the impact assessment, as they have been eliminated based on a desktop feasibility study. Reasons are provided below.

10.4.1.1 HEIGHT EXTENSION OF DEELKRAAL TSF

This scenario includes re-utilising the existing and dormant Deelkraal TSF (refer to Figure 38) by extending the height of the TSF. This TSF is located further away than the proposed alternative to the Savuka Plant and is not connected to the plant.

In considering the environmental permitting requirements for the height extension of these TSFs, the following aspects need to be considered:

- The facility is dormant.
- It is assumed that the facility is at its final design height.
- It is assumed that new deposition pipelines will be required.
- The pipelines from Savuka Plant may cross, or be within 500 m of wetlands or watercourse.

This option would require additional infrastructure including *inter alia*, pipelines from the TSF to the Savuka Plant to pump tailings to the TSF and these pipelines will have to cross water courses and or wetlands. This option therefore, based on the nature of the activity and its potential environmental and economic impacts have not been considered in the Basic Assessment Process.

10.4.1.2 OLD DRD TAILINGS STORAGE FACILITY

This option proposes to re-deposit on the footprint of the Old DRD TSF (refer to Figure 38). The Old DRD TSF is located approximately 6 km north-east of the proposed alternative. This option would firstly require engagements with the owner of this footprint as Harmony is not the owner of the property. In addition, this option would also require additional infrastructure including *inter alia*, TSF and starter wall, solution trenches, Return Water Dam, pipelines and access roads. This option therefore, based on the nature of the activity and its potential environmental and socio-economic impacts have not been considered in the Basic Assessment Process.

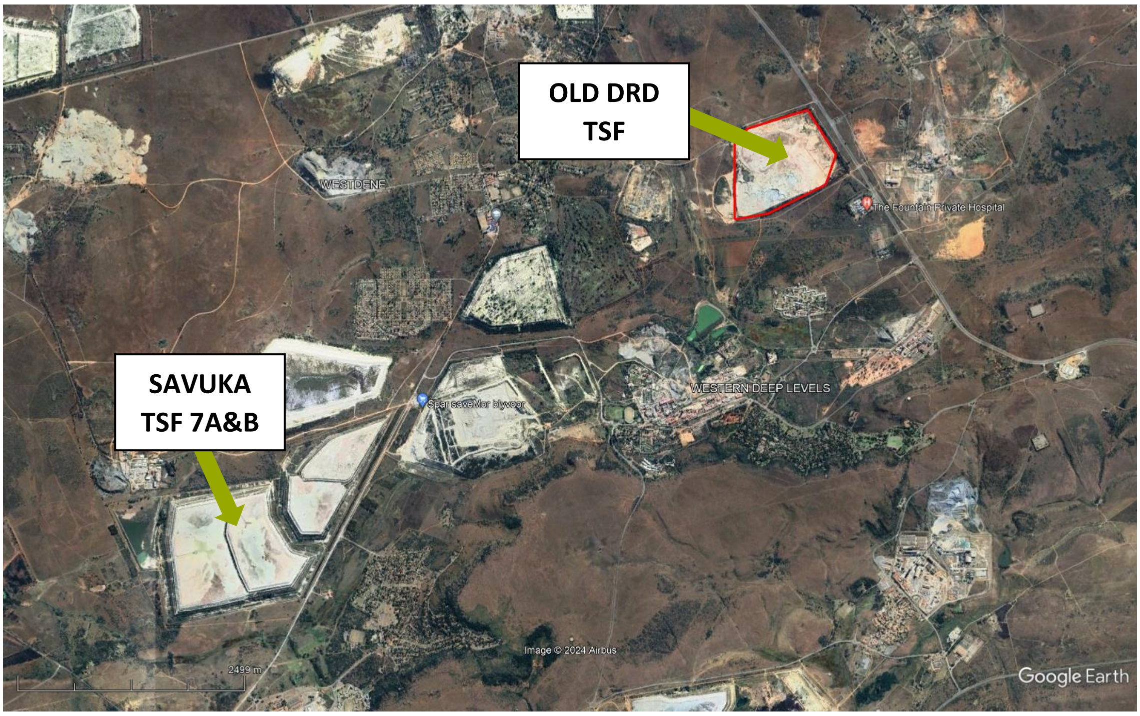


Figure 38: Location of old DRD TSFs

10.4.1.3 OLD SAVUKA TAILINGS STORAGE FACILITY

This option proposes to re-deposit on the footprint of the Old Savuka TSF (refer to Figure 39). The Old Savuka TSF is located immediately north-east of the proposed alternative and TSF 5a & 5b. This option would require additional infrastructure including *inter alia*, TSF and starter wall, solution trenches (existing and extension of existing), Return Water Dam (existing), pipelines and access roads. In addition, the mine is currently reclaiming this footprint, which means that there would not be sufficient space available to start redepositing on this footprint for some time. This option therefore, based on the nature of the activity and its potential environmental and socio-economic impacts have not been considered in the Basic Assessment Process.

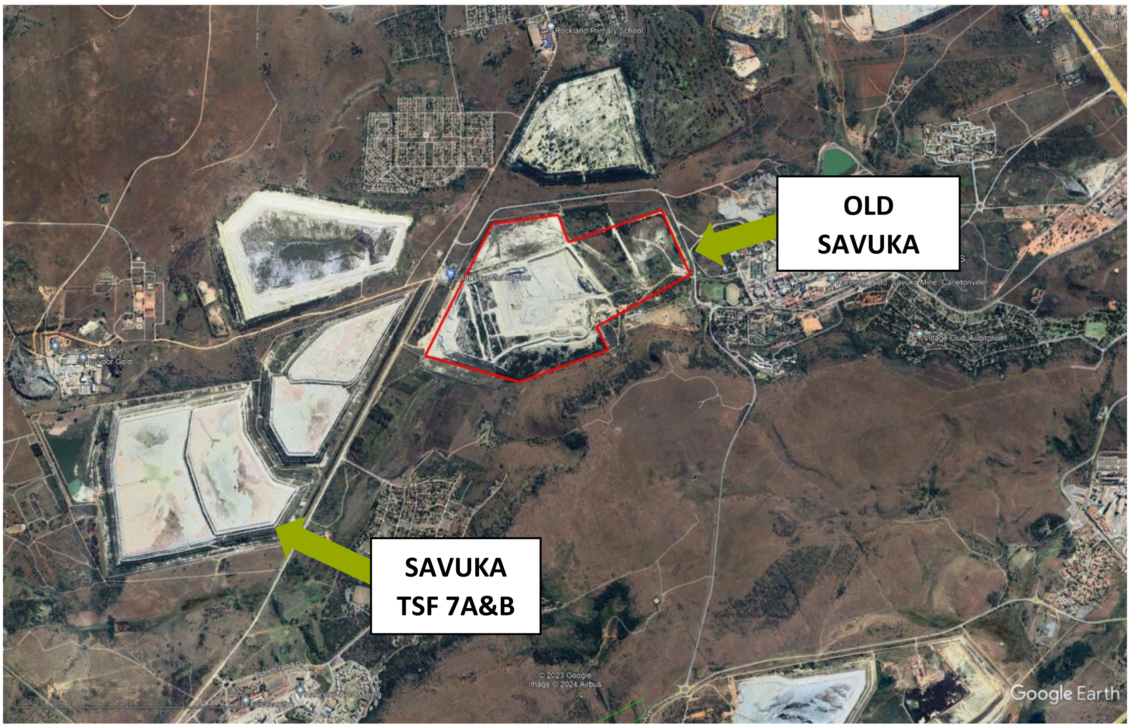


Figure 39: Location of old Savuka TSF

10.4.1.4 SAVUKA VALLEY TAILINGS STORAGE FACILITY

This option proposes to deposit within the valley between the Savuka 5b TSF and the Savuka 7a TSF (refer to Figure 40). This option would require additional infrastructure including *inter alia*, TSF and starter wall, solution trenches (use and extension of existing trenches), Return Water Dam (use of existing Return Water Dam), topsoil stockpile, subsoil stockpile, pipelines (assuming existing slurry pipeline will be used) and access roads (use of existing access roads). In addition, it will not provide sufficient space for the costs associated thereto. This option therefore, based on the nature of the activity and its potential environmental and socio-economic impacts have not been considered in the Basic Assessment Process.

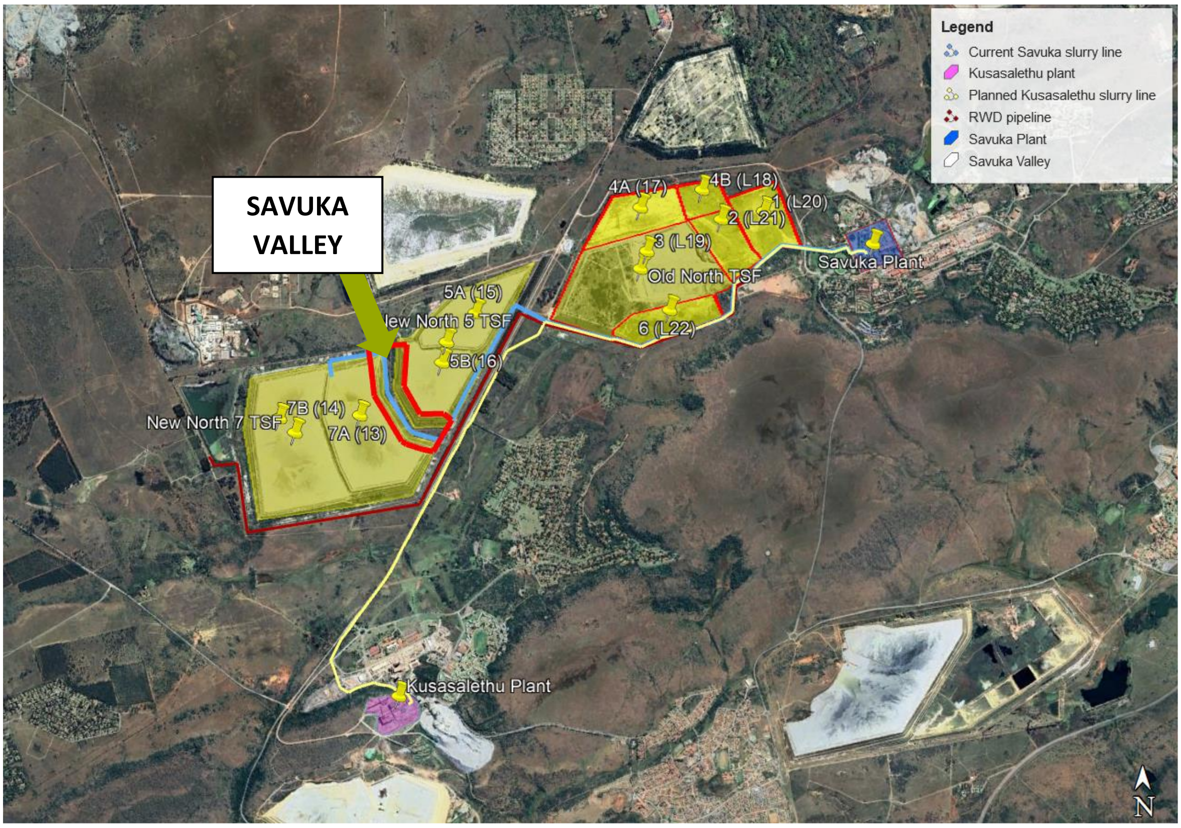


Figure 40: Location of proposed Savuka Valley TSF

10.4.1.5 HEIGHT EXTENSION OF SAVUKA 7A&7B TSFS

This scenario includes continuing to deposit tailings onto the existing and operation Savuka 7a & 7b TSFs (refer to Figure 39 and Figure 40) by extending the height of the approved height of the TSFs. These TSFs is located the closest to the Savuka Plant and is connected to the plant.

The TSFs are included in the 2014 EMPr amendment. The facility is further included in the current Water Use Licence (WUL). In considering the environmental permitting requirements for the height extension of these TSFs, the following aspects need to be considered:

- The facility is already operational and connected to the plant.
- The facility is not yet at its final design height.
- It is mentioned in the EMPr as an active facility.
- No new infrastructure is required to keep the facility operating.
- The facility is licensed in the Water Use License.

This option would not require additional infrastructure and will therefore, not have additional impacts on the surrounding environmental, except for slight increases in existing impacts e.g. in air quality, mainly due to the increased height and duration of the operation of the TSFs. This option therefore, based on the nature of the activity and its potential environmental and economic impacts have been considered in the Basic Assessment Process as the preferred alternative.

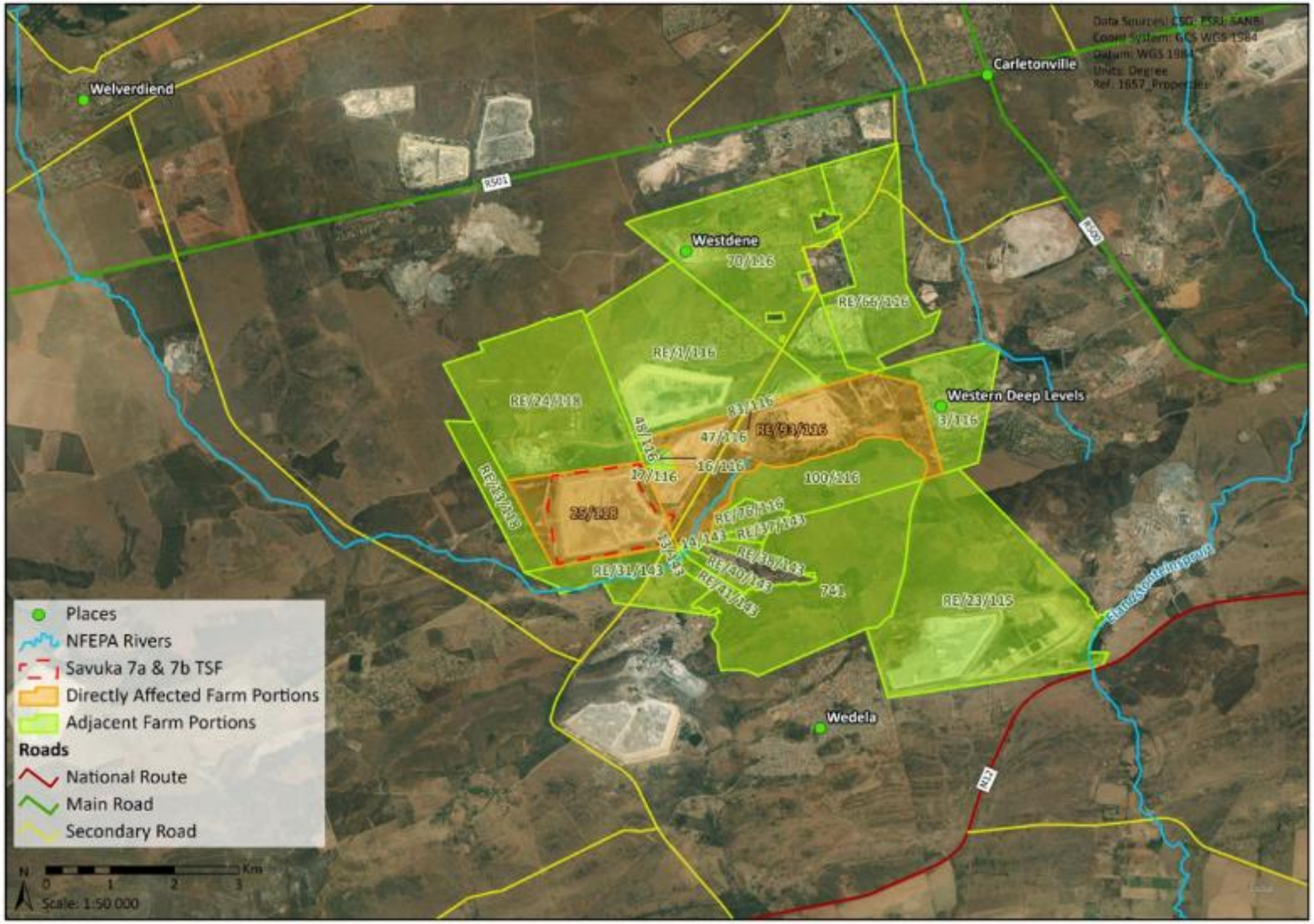


Figure 41: Affected Properties Map

10.4.2 PROCESS ALTERNATIVES

10.4.2.1 CONVENTIONAL DISPOSAL METHODS

There are various deposition techniques which are applicable to tailings storage facilities. Once the tailings slurry (dilute or paste consistency) has arrived at the tailings storage area, there are several possible ways it can be deposited. These include the spigotting method, cyclone deposition and the paddocking method.

10.4.2.2 SPIGOTTING METHOD

Spigots are multiple outlets along a delivery pipeline. They are used when it is easily possible to cause a gravitational grading split between the coarse and the tailings' fine fractions. Reticulation along the TSF embankment is achieved through spigot pipes extending from delivery stations located on the pre-constructed embankment crest (Figure 42 left). The spigot pipes are laid along the main wall, allowing deposition to occur from any point on the crest. In the course of a deposition cycle, a batch of adjacent spigots is opened, sufficient to cater for the slurry flow rate (Figure 42 right). Spigots break up the tailings delivery stream into smaller streams, thus causing a drop in stream velocity. This velocity drop lets the coarser fractions settle close to the deposition point. As the beach fills, spigots at one end of the batch are opened while the equivalent number at the other end is closed so that the deposition gradually moves along the spigot pipe and around the tailings dam.

Figure 42: Example of spigot deposition. Spigot at a pre-constructed embankment crest (left) and spigot pipes laid along the main wall (right) (Goldfields, 2023).

A variation to this method is where the spigot pipeline is located on the embankment crest, and the perimeter bund is raised to coincide with the tailings deposition cycle. The spigot lines usually have a series of nozzles located along the delivery pipeline at intervals of 2 m to 3 m. During each deposition cycle, a section of the spigot pipe is dismantled and moved to one side to allow the perimeter bund's raising, which is usually constructed of the beach tailings.

10.4.2.3 PADDOCK OR DAYWALL DEPOSITION

The daywall is so-called as it is that portion of the dam used during the day when there is supervision available and daylight to see what is going on. The conventional daywall is used to deposit uniformly graded tailings through an open-ended discharge located at one end of the paddock daywall (Figure 43 left). The principle of a paddock or daywall is to create or form small impoundments or containment berms with dried-out tailings borrowed from the previous layer deposited around the perimeter or edge of the paddock (Figure 43 right). These shallow paddocks are then filled preferentially with dilute (± 30-50 % solids) slurry. The tailings solids settle out of suspension, releasing clear water, the bulk of which can be decanted from the surface of the paddock into the basin via a drain or "vent" pipe. The resulting layer of slimes continues to dry out through some seepage, but mainly through evaporation resulting in shrinkage cracking of the surface.

Figure 43: Example of daywall deposition. An open-ended discharge at one end of the paddock daywall (left) and small impoundments with dried-out tailings (right) (Goldfields, 2023).

Since each subsequent layer deposited is formed on top of the previous layer, a paddock or daywall can essentially only be developed in an upstream manner. By definition, the upstream wall development stability depends on the strength of the earlier deposited underlying layers. Thus, it is essential to develop a daywall facility in thin layers (maximum 200 mm) to allow consolidation.

10.4.2.4 CYCLONE DEPOSITION

In **cyclone deposition** is a cyclone deposition device consisting of conical housing equipped with a feed pipe that enters the cone at its larger diameter closed end. A second pipe enters the cone and intrudes into the body of the cone. The slurry feed enters under pressure and is forced to swirl with a spiral motion towards the smaller end. In the process, centrifugal forces cause the larger particles in the slurry to move down and away from the axis, towards the narrow exit of the cone. The net effect is that the finer particles and most of the water leave the cyclone through the vortex finder and form the "overflow," while the partially dewatered larger particles leave at the opposite end as the coarser "underflow (Figure 44). The purpose of using a cyclone is to create underflow material that has good geotechnical characteristics, i.e., high permeability, fast consolidation and strength gain rate than the original tailings so that the underflow can be used to form an impoundment wall to the tailings storage facility. Effective operations of a cyclone TSF can also result in high water recoveries.

Figure 44: Example of cyclone deposition (Goldfields, 2023).

Currently cyclone deposition is the vastly preferred method of deposition for the majority of Harmony's current TSF operations due to the reasons described above. The environmental impacts associated with each deposition method are similar, however **cyclone deposition has higher water recovery rates and is also preferred from a geotechnical perspective**. **<u>Cyclone deposition is therefore recommended as the preferred method of deposition.</u>**

10.4.3 ALTERNATIVE TAILINGS DISPOSAL METHODS

Despite technological advances in mineral processing, mining companies still face challenges in how to best manage tailings materials. In addition, mining of lower grades of ore has resulted in increased water use per unit of production; at certain sites, water availability is the single greatest constraint on mine development. In some cases, alternative tailings disposal (ATD) has been viewed as a 'silver bullet' that will address all tailings management issues, especially water concerns. In addition, in some cases ATD technologies also promise a smaller footprint and reduced environmental impact and risks. Despite the perceived advantages, there are a number of factors that determine whether an ATD technology including:

- Energy supply: removing water from a slurry requires significant energy, with increased energy, expenditure comes with additional costs;
- Production rates: conventional tailings deposition remains the only proven technology at mines with high production rates;
- Project economics: a reduced footprint and less water used come at the expense of higher initial capital;
- Operational predictability: mines operating under narrow production constraints may be prohibited from employing ATD technologies because of the possibility of operational instability;
- Topography: some ATD technologies lend themselves to flat topographies and are usually not feasible (without embankment support) at sites with even moderately steep terrain; and
- Water: in many cases, the water saved by the ATD technology is only marginally better than conventional disposal methods.

Based on the above listed challenges, Conventional Disposal Methods are preferable over the Alternative Tailings Disposal methods

10.5 NO GO ALTERNATIVE

The no- go alternative would imply that the no additional tailings will be deposited on the Savuka 7a & 7b TSFs after the approved height of 60 m above ground level is reached. The option of the project not proceeding would mean that the environmental impact and social status would remain the same as current impacts assessed, that was approved in terms of the MPRDA. This implies that both negative and positive impacts would not take place. As such, negative impacts on biodiversity and water resources would not occur and also that the positive impacts such as continuation of mining at the West Wits complex, without interruption and all the benefits associated therewith for e.g. continuation of employment

10.6 MEASURES TO ACHIEVE AND SUSTAIN PERFORMANCE OBJECTIVES

Achievement of the objectives can be made certain by the following measures:

- Monitoring of water quality impacts within the catchment:
- The raw water intake (return water dam) is reduced by capturing of all contaminated water in the slimes and re-use the same water for the washing process, this includes groundwater seepage and direct rainfall into the TSF; and
- Environmental Management Plan Performance Assessment Audits to be undertaken to ensure the implementation of commitments made in the EMPr.

11 IWWMP ACTION PLAN

The IWWMP action plan for the Savuka TSF increase in height (of 7A&7B compartments), as well as the c) and i) water uses, is indicated in Table 28. This table outlines the impacts, objectives and mitigation measures that need to be implemented as well as the parties responsible for implementation of the measures.

The action plan is not however a static framework and should be updated and improved as new possible action items are identified and implemented.

Table 28: IWWMP action plan

Theme	Objectives	Management Plan	Responsibility
Groundwater	To prevent and reduce leaching and migration of radionuclides from the TSF during the post-closure phase (GW1)	• The management objective would be to first ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint), and secondly to optimise the radiation protection by applying the ALARA principle. • The total effective dose from the ingestion of groundwater as a contribution from the TSF was hypothetically illustrated to be below the regulatory compliance criteria (i.e., dose limit), which means that from a compliance perspective, no additional management or mitigation measures are required. • From the optimisation of radiation protection perspective for the post-closure period, the following management/mitigation measures can be implemented if it is assumed that the facility remains at the surface: ○ Implementation of a passive groundwater remediation system downstream of the TSF to capture the contaminant plume. ○ Note that active remediation systems, such as cut-off trenches or a pump and treat system, might also be effective in the short to medium term. However, the timescales of concern are beyond what can be considered active institutional control periods.	The Environmental Officer together with the mine manager are responsible for ensuring that the groundwater monitoring programme is adequate and in line with the WUL and that the contamination plume is mitigated according to approved mitigation measures and action plans as per the updated IWWMP and the EMPr.
Groundwater	To prevent and reduce groundwater contamination during the operational, decommissioning and rehabilitation, closure and post-closure phases.	• Phyto-remediation as preferred alternative to mitigation the contamination plume. This option will change the risk from High Negative to Low Negative during the operational phase. After closure the RWD will be decommissioned and rehabilitated whereafter the risk rating improves marginally. This option has the best rating and is the recommended long-term management option.	The Environmental Officer together with the mine manager are responsible for ensuring that the groundwater monitoring programme is adequate and in line with the WUL and that the mitigation measures as contained herein and within the approved EMPr is implemented.

Theme	Objectives	Management Plan	Responsibility
		• The existing monitoring network is comprehensive and sufficient to quantify the impact from the RWD and the TSF. The boreholes are generally close to the TSF, referred to as source boreholes. It is important to drill monitoring boreholes further from the contaminant sources to be able to quantify plume migration, as well as as close to the property boundary or receptors. These boreholes are referred to as compliance boreholes. Four additional compliance borehole pairs (one shallow and one deep) are recommended as shown in Figure 30. The aim of these boreholes is to monitor the effectiveness of the phyto-remediation. Borehole MB38, which is located inside the phyto-remediation has much better quality than the other monitoring boreholes. Further down-gradient boreholes will confirm that this is because of the phyto-remediation. It is also important to distinguish between the weathered and fractured formations. • The following is recommended in terms of monitoring: o Groundwater levels. o Groundwater quality. o Data should be stored electronically in an acceptable database. o On the completion of every sampling run a monitoring report should be written. Any changes in the groundwater levels and quality should be flagged and explained in the report. o A compliance report can be submitted to DWS once a year, if required. • A comprehensive bi-annual analysis of the dedicated monitoring boreholes. • Groundwater levels should be monitored monthly in the dedicated groundwater monitoring boreholes. • Rainfall should be monitored daily.	

Theme	Objectives	Management Plan	Responsibility

		• Samples should be submitted to a SANAS accredited laboratory. The following recommended parameters to be analysed for include:
		  ○ pH.
		  ○ Electrical Conductivity.
		  ○ Total Dissolved Solids.
		  ○ Total Alkalinity.
		• Anions and Cations (Ca, Mg, Na, K, NO3, NH_4, Cl, SO_4, F, Fe, Mn, Al, Cr).	

Surface Water	To prevent and reduce erosion of soils and sedimentation of surface water features (W1).	The below mitigation is expected to already be part of the existing TSFs management and also applies to the proposed height extension and c) and i) water uses: • Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements). • Monitor the TSFs to ensure areas of potential erosion are identified and managed appropriately. • Rehabilitation should include topsoil replacement, re-vegetation and maintenance/aftercare for disturbed areas insofar as it should be developed for disturbed areas. • Concurrent rehabilitation of the TSFs should ideally occur during the life of the TSFs. This would likely include cladding of TSFs side slopes and subsequent revegetation with final TSFs rehabilitation resulting in fully vegetated site. • Additional guidance on erosion control is available in: Landcom Soils and Construction, Volume 1, 4th edition from 2004 (otherwise known as the Blue Book).	The Environmental Officer together with the mine manager are responsible for ensuring that the surface monitoring programme, the stormwater management plan and the TSF monitoring programme is adequate and in line with the WUL and are implemented. They are also responsible to ensure that the approved rehabilitation plans and measures are implemented and to implement best practice in terms of erosion prevention practices as per the recommended guidelines.
Surface Water	To prevent and reduce pollutants entering the surface water environment (W2).	The below mitigation is expected to already be part of the existing TSFs management and also applies to the proposed height extension. • Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).	The Environmental Officer together with the mine manager are responsible for ensuring that the surface monitoring programme, the stability monitoring as well as the stormwater management plan is adequate and in line with the WUL and implemented.

Theme	Objectives	Management Plan	Responsibility
		• Develop the TSFs using sound engineering to limit the likelihood of a failure. • Maintain and operate the TSFs/RWD to limit the potential for overfilling of the RWD that leads to a spill. • Monitor the TSFs to identify any potential failures/slumps. • Keep activity within the managed dirty water footprint where possible. • Store hydrocarbons off-site where possible, or otherwise implement hydrocarbon storage with adequate bunding. • Handle hydrocarbons carefully to limit spillage. • Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited. • Use drip trays for stationary vehicles or otherwise park over areas suited to their storage (e.g. with an oil interceptor) • Designate a single location for refuelling and maintenance where possible. • Keep a spill kit on site to deal with any hydrocarbon leaks. • Remove soil from the site which has been contaminated by hydrocarbon spillage. • Undertake surface water monitoring to enable change detection related to contaminants originating from the site.	
Surface Water	To prevent the decrease in run-off water (W3).	The below mitigation is expected to already be part of the existing TSFs management and also applies to the proposed height extension. • Limiting the time and area over which machinery operates will limit the compaction of soils on the site. • Divert clean water run-on away from the site.	The Environmental Officer together with the mine manager are responsible for ensuring that the surface monitoring programme, the stability monitoring as well as the stormwater management plan is adequate and in line with the WUL and implemented.
Surface Water	To prevent or lower the Flood Risk (W4).	The below mitigation is expected to already be part of the existing TSFs management. • Ensure the existing stormwater management plan is sufficient (per GN704 and TSF-specific requirements).	The Environmental Officer together with the mine manager are responsible for ensuring that the surface monitoring programme, the stability monitoring as well as the stormwater management

Theme	Objectives	Management Plan	Responsibility
		• Ensure that flood protection of the TSFs is sufficient to manage flood risk from both adjacent river systems (north and south) and stormwater run-on. • Develop the TSFs using sound engineering to limit the likelihood of a failure. • Monitor the TSFs to identify any potential failures/slumps. *Monitoring* • Potential contaminants of concern that need to be monitored are expected to have already been identified based on the historical quarterly surface water quality monitoring that has been undertaken. The understanding of the mine's processes and the associated contaminants that might be released in the event of a failure in an aspect of the TSF's (e.g. toe paddock rupture or RWD overflow) is likewise expected to be clearly understood with monitoring reflecting this. • Quarterly monitoring reports should be produced to differentiate seasonal variations and general trends due to the mining activities, with a comparison of water samples to standards and guidelines set by the Department of Water and Sanitation (DWS) and an analysis of parameters over time so that trends can be established. • The recommended monitoring points are also provided in the specialist report and should be included in the monitoring programme	plan is adequate and in line with the WUL and implemented.
Wetland Habitat	To prevent and or reduce the siltation of water resources (EH1)	• Update and implement the stormwater management plan. • Implement and maintain silt traps and sediment basins at strategic stormwater discharge points. • Establish and maintain vegetated buffer zones (using indigenous grass species) between the TSF and nearby wetlands, within 15 m from the TSF.	The Environmental Officer together with the mine manager are responsible for ensuring that the surface and biomonitoring programmes, the stormwater management plan as well as the dust management plan is adequate and in line with the WUL and implemented.

Theme	Objectives	Management Plan	Responsibility
		• Regularly inspect and clear sediment traps and drains to ensure continued functionality. • Apply dust suppression measures (e.g., water spraying or biodegradable binders) on or vegetate exposed tailings to reduce wind-blown silt deposition where required.	
Wetland Habitat	To prevent or reduce erosion of surface water resources (EH2)	• Install energy dissipation structures at stormwater outflows to reduce flow velocity, where required. • Stabilize slopes and embankments where required. • Implement a controlled release of stormwater through designed drainage channels to prevent concentrated flows from reaching wetland areas. • Conduct regular inspections of stormwater management infrastructure and repair erosion-prone areas immediately. • No machinery or vehicles should be allowed to parked in any wetlands. All activities to be restricted to authorized areas only.	The Environmental Officer together with the mine manager are responsible for ensuring that the surface and biomonitoring programmes, the stormwater management plan as well as the dust management plan is adequate and in line with the WUL and implemented.
Wetland Habitat	To prevent or reduce the altering of the Hydrological Regime (EH3).	• Implement stormwater management, to be informed by the hydrological report. • Use permeable berms or check dams in water diversion channels to slow down and evenly distribute water flow. • Monitor groundwater levels.	The Environmental Officer together with the mine manager are responsible for ensuring that the surface and biomonitoring programmes, the stormwater management plan as well as the dust management plan is adequate and in line with the WUL and implemented.
Wetland Habitat	To prevent the proliferation of Alien Invasive Vegetation (EH4).	• Remove alien vegetation manually or mechanically rather than using herbicides, to avoid contamination risks. This should be conducted annually. • Implement a maintenance program to ensure that previously cleared areas do not become re-infested with alien vegetation.	The Environmental Officer together with the mine manager are responsible for ensuring that the surface and biomonitoring programmes, the stormwater management plan as well as the dust management plan, as well as the Alien Invasive Plants Management Plan is adequate and in line with the WUL and implemented.
Wetland Habitat	To prevent impaired water quality (EH5).	• Conduct routine water quality monitoring at key points downstream of the TSF to detect contamination early. • Conduct groundwater quality monitoring.	The Environmental Officer together with the mine manager are responsible for ensuring that the surface and grounwater, biomonitoring programmes, the stormwater management plan as

Theme	Objectives	Management Plan	Responsibility
			well as the dust management plan is adequate and in line with the WUL and implemented.
Wetland Habitat	To prevent further wetland disturbance and decrease in functionality (EH6).	• Establish a 15 m wetland buffer zone with clear demarcation to prevent accidental encroachment. This can include signage. • Restrict heavy vehicle access to designated and authorized roads. • Implement a long-term wetland monitoring program to track ecological changes and implement adaptive management strategies.	The Environmental Officer together with the mine manager are responsible for ensuring that the buffers are upheld, groundwater and surface water and biomonitoring programmes, the stormwater management plan as well as the dust management plan is adequate and in line with the WUL and implemented.
Wetland Habitat	To prevent the impact of lowering of the water table due to Phytoremediation for Groundwater Pollution (EH7) on the wellbeing and functioning of the wetlands.	• Use indigenous plant species that are well-adapted to local conditions. This helps maintain the ecological balance and supports local biodiversity. • Monitor water levels by means of the current groundwater monitoring programme to detect any significant changes in the water table. The geohydrologist is to advise on the suitability of the programme, and to recommend any changes. • The geohydrologist is to also advise on 'allowable' changes to the groundwater levels, and to prescribe remedial actions if levels are exceeded. • Manage the density of phytoremediation plants to prevent excessive water uptake and potential lowering of the water table. This can be achieved by spacing plants appropriately and using mixed planting strategies.	Environmental Officer together with the mine manager are responsible for ensuring that the surface and biomonitoring programmes, the stormwater management plan as well as the dust management plan, as well as the Alien Invasive Plants Management Plan is adequate and in line with the WUL and implemented. They are also responsible to appoint a geohydrologist and ecologist/wetland specialist, to implement mitigation measures/ oversee mitigation measures to ensure correct implementation, where required.
Wetland Habitat	To ensure the general wellbeing and functioning of the wetlands.	• Strict adherence to the wetland buffers should be practiced, unless for activities that have been authorised; • Update and implement a stormwater management plan for the operational phase of the development. The plan must address the movement of water on site and include measures to reduce erosion and sedimentation of the watercourses. Furthermore, the plan must ensure that only clean water is released into the environment;	The Environmental Officer together with the mine manager are responsible for ensuring that the surface and biomonitoring programmes, the stormwater management plan as well as the dust management plan, as well as the Alien Invasive Plants Management Plan is adequate and in line with the WUL and implemented. They are also responsible to appoint a geohydrologist and ecologist/wetland specialist, to implement

Theme	Objectives	Management Plan	Responsibility
		• Ensure that waste generated on site during the operational phase is appropriately contained, categorised and disposed of; and • Review and update the surface, groundwater and also aquatic biomonitoring programmes for the operation. In the event no monitoring programmes are available, these must be informed by the relevant specialists. It is recommended that an annual wetland monitoring programme be considered for the necessary authorisation, for this project.	mitigation measures/ oversee mitigation measures to ensure correct implementation, where required.

12 CONTROL AND MONITORING

This section will discuss measures to be implemented for the monitoring and control where necessary to ensure that the project does not prove detrimental to the baseline hydrological environment.

12.1 MONITORING OF CHANGE IN BASELINE INFORMATION

Harmony has implemented a surface and groundwater monitoring programme across all of their West Wits operations as described in Section 5.4. The geohydrolgist has made recommendations to adjust the groundwater monitoring network, refer to the Action Plan (Section 11) as well as the recommendations in Section 5.4.2. The annual reports are to be submitted to the authorities at the stipulated time interval in the IWUL. Harmony currently has a monthly groundwater monitoring programme in which monitoring is conducted and a data record is kept. The detailed environmental monitoring schedule are described in the WUL and the monitoring reports. The recommendations is detailed in this report, the social and environmental aspects that act as environmental indicators and are most common have been considered.

12.2 AUDIT AND REPORT ON PERFORMANCE MEASURES

The mine is committed to continual improvement and prevention of pollution. The applicant undertakes annual internal and external EMPr compliance audits. Harmony will further undertake internal and external audits on compliance with the conditions of the WUL, once issued, and in line with the frequency required by the WUL (i.e., on an annual basis).

12.3 AUDIT AND REPORT ON RELEVANCE OF IWWMP ACTION PLAN

The WUL will require that the efficacy of the measures proposed as part of the action plan be reviewed and updated where required. As such, the IWWMP action plan will be reviewed and updated in line with the frequency required by the WUL (i.e., on an annual basis).

13 CONCLUSION

This section provides the concluding statements relating to the regulatory status of the activity, the motivation of the activity in terms of Section 27 of the NWA (Appendix 7) and the proposed WULA.

13.1 REGULATORY STATUS OF ACTIVITY

The Savuka TSF height extension is a listed activities in terms of environmental management legislation, and at the moment concurrent Environmental Authorisation and WUL application processes are underway. As part of the EA process, an application for an EA as well as a waste management licence application is being conducted by EIMS.

13.2 KEY COMMITMENTS

Harmony is committed to implementing and reviewing the IWWMP action plan included in this document based on any new information where required.

REFERENCES

Department of Water Affairs and Forestry, 1996: South African Water Quality Guidelines. 2nd Edition. Volume1: Domestic Use.

Department of Water Affairs and Forestry, 2000: Guideline for the implementation of Regulations on use of water for mining and related activities aimed at the protection of water resources: Operational Guideline No. M6.1. 2nd edition.

Department of Water Affairs and Forestry, 2000: Water Use Authorisation Process (Individual Applications). Edition 1: Final draft for implementation and use, Revision 3.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline G1: Storm Water Management. Final August 2006.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline G2: Water and Salt Balances.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline G3. Water Monitoring Systems.

Department of Water Affairs and Forestry, 2006. Best Practice Guideline H3: Water.

Department of Water Affairs and Forestry, 2007. Best Practice Guideline H2: Pollution Prevention and Minimisation of Impacts.

Department of Water Affairs and Forestry, 2007. Best Practice Guideline H4: Water Treatment.

Department of Water Affairs and Forestry, 2007. Best Practice Guideline A3: Water Management in Hydrometallurgical Plants. Final July 2007

Department of Water Affairs and Forestry, 2008. Best Practice Guideline H1: Integrated Mine Water Management.

Department: Water Affairs and Forestry, 2007. Best Practice Guideline A2: Water Management for Mine Residue Deposits Final July 2008.

Department: Water Affairs and Forestry, 2007. Best Practice Guideline A4: Pollution control dams.

Mine Health and Safety Act, 1996 (Act 29 of 1996).

Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002). Mineral and Petroleum Resources Development Regulations. Government Notice R.527.

Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002).

Minerals Act, 1991 (Act 50 of 1991).

National Environmental Management Act, 1998 (Act 107 of 1998).

National Water Act, 1998 (Act 36 of 1998).

Regulation GN 704, 4 June 1999: Regulations on use of water for mining and related activities aimed at the protection of water resources, dated June 1999, under the National Water Act, 1998, (Act 36 of 1998).