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Kareerand Tailings Storage Facility Expansion Project
Revised Draft Environmental Impact Assessment (EIA) Report

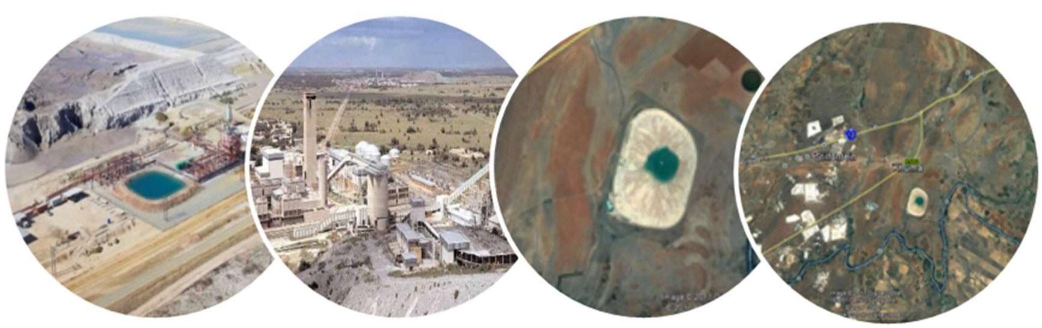
Version – Revised Draft for Public Review

January 2021

GCS Project Number: 17-0026

DMR Reference Number: NWP/EIA/176/2008

Mine Waste Solutions (Pty) Ltd



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	Name	**Signature**	**Date**
Author	Georgina Wilson		August 2020
Co-Author	Lehlogonolo Mashego		October 2020
Reviewers	Sharon Meyer / Gerda Bothma		November 2020
MWS Project Manager	Conrad Freese		December 2020
Environmental Director	Adam Gunn		January 2021

Note to the Reader:

Please be advised that this report is a Revised Draft Environmental Impact Assessment Report for the Kareerand Tailings Storage Facility.

Your attention is drawn to the revisions made within this report, for ease of reference, all revisions has been denoted as *underlined italic text* throughout the Revised Draft Environmental Impact Assessment Report.

EXECUTIVE SUMMARY

Background

Mine Waste Solutions (MWS), also known as Chemwes (Pty) Ltd (Chemwes), has been in business since 1964, and conducts its operations over a large area of land to the east of Klerksdorp, within the area of jurisdiction of the City of Matlosana and JB Marks Local Municipalities (LM), which fall within the Dr Kenneth Kaunda District Municipality (DM) in the North-West Province.

The Kareerand Tailings Storage Facility (TSF) was designed with an operating life of 14 years, taking the facility to 2025, and total design capacity of 352 million tonnes. Subsequent to commissioning of the TSF, MWS was acquired by AngloGold Ashanti and tailings production target has increased by an additional 485 million tonnes, which will require operations to continue until 2042. The additional tailings therefore require expansion of the design life of the TSF.

This project entails the expansion of the current Kareerand TSF to accommodate the increased tailings and final design capacity, along with additional pump stations and pipelines. The TSF expansion is proposed on the western edge of the current facility, and the final height of the combined facility (both expansion and current) will be 122 m. The expansion footprint will add 380 hectares (ha) to the TSF and approximately 93 additional ha will be cleared for supporting infrastructure.

This TSF expansion requires an Integrated Environmental Assessment process under the National Environmental Management Act NEMA (Act 107 of 1998, as amended) and the National Environmental Management: Waste Act NEMWA (Act 59 of 2008, as amended).

Project Motivation

The expansion of the current TSF will enable the reclamation of additional tailings dams and deposition of the tailings in an expanded facility complete with a liner and appropriate seepage mitigation measures, reducing the total seepage into the Vaal River.

The project will support concurrent rehabilitation of the current TSF and the expansion TSF, thereby reducing the risk of windborne dust and storm water management. Removing and consolidating the tailings in the KOSH area on a single mega tailings storage facility will in the long term, positively impact the surrounding environment and Vaal River.

Specialist studies have been undertaken to assess the impacts of the TSF expansion on identified aspects of biophysical and socio-economic receptors within the area. Mitigation, management, and rehabilitation designs were informed by a team of specialists and engineers.

In addition, the extended Life of Mine (LoM) of the reclamation operations will create employment for a longer period and thus bring associated socio-economic benefits to the towns and settlements in the area.

It must however be noted that MWS will require interim deposition capacity during the construction and commissioning phases of the Kareerand TSF expansion. The TSF Complex north of the N12, MWS 4 and MWS 5, has been earmarked for this purpose and the duration of the interim deposition phase would be approximately 5 years (2022 to 2027), after which these TSFs will be reclaimed, leaving the Kareerand facility as the only TSF. MWS will apply separately for the relevant authorisation(s) for the proposed interim deposition activities before commencing with the interim deposition activities. A separate environmental impact assessment process will be undertaken for the proposed interim deposition activities and all the associated environmental impacts of the proposed interim deposition will be investigated and assessed as part of the new application process.

Environmental Impact Assessment Report

This Environmental Impact Assessment Report provides a summary of the receiving environment and discusses the impacts on biophysical and socio-economic conditions within the study area. This report summarises the findings of various specialist studies undertaken and outlines avoidance, mitigation and management actions which will assist in minimising the impact of the project as far as possible.

Public Participation Process

A public announcement was published in November 2019, through advertisements, site notices and Background Information Documents. A stakeholder database has been compiled and were updated as the process unfolded and as more Interested and Affected Parties (I&APs) registered.

All comments received during the integrated application process was captured in a Comments and Responses Report (CRR). The CRR has been updated on a continuous basis and will be presented to the authorities and other I&APs together with the consultation and final reports as a full record of issues raised, including responses on how the issues were considered during the integrated application process.

The availability of the Draft Scoping Report was announced through advertisements and personal emails, notices at selected libraries and notification letters to registered I&APs. A stakeholder meeting was held during the review period of the Draft Scoping Report. A record of the deliberations at the meetings is included as part of the CRR, which was included within the Draft Environmental Impact Report.

The availability of the Draft Environmental Impact Report was also announced through advertisements and personal emails and SMS's. Due to the restrictions associated with the Covid-19 pandemic reports were not be placed at public places. Stakeholders were requested to download the report from the GCS website and / or request electronic copies of the report by prior arrangement. Copies of the report on CD and memory sticks were made available for collection at the MWS offices. Stakeholders were invited to collect copies should they had difficulty downloading the report from the GCS website. Stakeholder meetings via electronic platforms were held during the review period of the Draft Environmental Impact Report and a record of the deliberations at the meetings is included as part of the CRR, included in this Revised Draft Environmental Impact Report.

Environmental Impact Statement

It is the opinion of the EAP that although the expansion of the Kareerand TSF may cause adverse environmental impacts, provided that the proposed mitigation measures are implemented effectively and in line with the EMP, these will be outweighed by the long-term positive impacts of expanding the facility. Based on the findings of the Impact Assessment, the EAP sees no reason why Environmental Authorisation should not be granted for the proposed project to proceed.

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ABBREVIATIONS

ADDAS	Airborne Dust Dispersion Model from Area Sources
ADU	Animal Demography Unit
AERMOD	American Meteorological Society/ Environmental Protection Agency Regulatory Model
AGA	AngloGold Ashanti (Pty) Ltd
AIS	Alien Invasive Species
Al	Aluminium
AQR	Air Quality Report
AQSR	Air Quality Sensitive Receptors
ARC	Agricultural Research Council
BID	Basic Information Document
BP	Best Practice
$Bq.m^{-3}$	Becquerel (equal to one radioactive decay per second) per cubic meter, unit for radon activity concentration
$Bq.m^{2}.s^{-1}$	Becquerel (equal to one radioactive decay per second) per square meter per second, rate of radon exhalation
$Bq.kg^{-1}$	Becquerel (equal to one radioactive decay per second) per kilogram, unit indicating radioactivity
Ca	Calcium
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CBMA	Core Biodiversity Management Area
CH_4	Methane
Cl	Chlorine
CMLM	City of Matlosana Local Municipality
CoR	Certificate of Registration
CO_2	Carbon Dioxide

CO_2-e	Carbon Dioxide Equivalent
CRR	Comments and Response Register
dB (A)	A-weighted decibels (measurement of noise levels)
DAFF	Department of Forestry and Fisheries
DEA	Department of Environmental Affairs
DM	District Municipality
DMR	Department of Mineral Resources
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EC	Electrical Conductivity
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Ecological Importance and Sensitivity
EM	Electromagnetic
EMPr	Environmental Management Programme
ESA	Ecological Support Area
ESIA	Environmental and Social Impact Assessment
Fe	Iron
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
GCS	GCS Water & Environmental Consultants (Pty) Ltd
GHG	Greenhouse Gas
GIS	Geographic Information System
GLC	Ground Level Concentration

ha	Hectares
HHRIA	Human Health Risk and Impact Assessment
IA&P	Interested and Affected Parties
IPCC	International Panel on Climate Change
IDP	Integrated Development Plan
IUCN	International Union for Conservation of Nature
km	Kilometres
KOSH	Klerksdorp, Orkney, Stilfontein, Hartebeestfontein
KP	Knight Piesold
LAeq	Equivalent continuous sound pressure level
LDV	Light duty vehicle
LM	Local Municipality
LoM	Life of Mine
$\mu g/m^3$	Micrograms per cubic metre (concentration)
$\mu g/m^2$-day	Micrograms per square metre per day (rate)
$\mu Sv.year^{-1}$	Microsievert per year (dosage of radiation)
m	Metres
mg/l	Milligrams per litre
mg/m^2-day	Milligrams per square metre per day
m/s	Metres per second
m^3	Cubic metres
m^3/day	Cubic metres per day
mm	Millimetres
mamsl	Metres above mean sea level
MAP	Mean Annual Precipitation
Mg	Magnesium
mg	Milligrams

Mn	Manganese
MPRDA	Mineral and Petroleum Resources Development Act
Mt	Million tonnes
Mt/a	Million tonnes per annum
MWS	Mine Waste Solutions
N_2O	Nitrous Oxide
Na	Sodium
NAAQS	National Ambient Air Quality Standards
NAEIS	National Atmospheric Emission Inventory System
NDCR	National Dust Control Regulations
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NEM:WA	National Environmental Management: Waste Act
NDCR	National Dust Control Regulations
NGO	Non-Governmental Organisation
NHRA	National Heritage Resources Act
NNE	North North East
NNR	National Nuclear Regulator
NO_2	Nitrogen Dioxide
NO_3	Nitrate
NWA	National Water Act
NWBSP	North West Biodiversity Sector Plan
NWREAD	North West Department: Rural, Environment and Agricultural Development
PES	Present Ecological State
pH	Potential of hydrogen, measure of acidity or alkalinity
PIA	Paleontological Impact Assessment
PM	Particulate Matter

$PM_{2.5}$	Particulate Matter with a diameter less than 2.5 micrometres
PM_{10}	Particulate Matter with a diameter of 10 micrometres
PPP	Public Participation Process
PZI	Potential Zone of Influence
Ra-226	Radium isotope 226
RAP	Resettlement Action Plan
RE	Remainder (of a farm portion)
RGM	Radon gas monitor
RWD	Return Water Dam
SABAP2	South African Bird Atlas Project 2
SAHRA	South African Heritage Resource Agency
SANBI	South African National Biodiversity Institute
SANRAL	South African National Road Agency SOC Ltd
SANS	South African National Standard
SASS5	Stream Assessment Scoring System 5
SDF	Spatial Development Framework
SEIA	Socio-Economic Impact Assessment
SLUMA	Spatial Planning and Land Use Management Act
SMP	Soil Management Plan
SPD	Sulphur Paydam
StatsSA	Statistics South Africa
SSW	South South West
SWD	Storm Water Dam
TDS	Total Dissolved Salts
TOPS	Threatened or Protected Species
tpa	Tonnes Per Annum
TPS	Deposited dust

TSF	Tailings Storage Facility
TSP	Total Particulate Matter
TWQG	Target Water Quality Guidelines
SAWS	South African Weather Service
S&EIR	Scoping and Environmental Impact Reporting
US EPA	United States (of America) Environmental Protection Agency
VEGMAP	National Vegetation Map of South Africa
VR	Vaal River
WML	Waste Management Licence
WULA	Water Use Licence Application
S&EIR	Scoping and Environmental Impact Reporting

CONTENTS OF THE ENVIRONMENTAL IMPACT ASSESSMENT REPORT	RELEVANT SECTION
Details of – The EAP who prepared the report; and The expertise of the EAP, including a curriculum vitae;	Section **1.3**
The location of the development footprint of the activity on the approved site as contemplated in the accepted scoping report, including: The 21digit Surveyor General code for each cadastral land parcel; Where available, the physical address and farm name; Where the required information in terms of (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	Section **1.4**
A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is – A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or On land where the property has not been defined, the coordinates within which the activity is to be undertaken	Section **1.4**
A description of the scope of the proposed activity, including – All listed and specified activities triggered; A description of the activities to be undertaken, including associated structures and infrastructure;	Section **1.5** and Section **4.2**
A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;	Section **4**
A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted scoping report;	Section **3**
A motivation for the preferred development footprint within the approved site as contemplated in the accepted scoping report;	Section **5.1.5**
A full description of the process followed to reach the proposed development footprint within the approved site as contemplated in the accepted scoping report, including: Details of the development footprint alternatives considered; Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; The environmental attributes associated with the alternatives focusing on geographical, physical, biological, social, economic, heritage and cultural aspects; The impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts - aa. can be reversed; bb. may cause irreplaceable loss of resources; and cc. can be avoided, managed or mitigated; The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks; Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected	Section **5**

focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; The possible mitigation measures that could be applied and level of residual risk; If no alternative development footprints for the activity were investigated, the motivation for not considering such; and A concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted scoping report;	
A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity, including- A description of all environmental issues and risks that were identified during the environmental impact assessment process; and An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;	Section **10**
An assessment of each identified potentially significant impact and risk, including— Cumulative impacts; The nature, significance and consequences of the impact and risk; The extent and duration of the impact and risk; The probability of the impact and risk occurring; The degree to which the impact and risk can be reversed; The degree to which the impact and risk may cause irreplaceable loss of resources; and The degree to which the impact and risk can be mitigated;	Section **10**
Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;	Section 7
An environmental impact statement which contains— A summary of the key findings of the environmental impact assessment: A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers; and A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	Section **12**
Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;	Section **12.3**
The final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;	Section **5** & Section **10**
Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Section **12.3**
A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	Section **8**

A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	Section 0
Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	NA
An undertaking under oath or affirmation by the EAP in relation to – The correctness of the information provided in the reports; The inclusion of comments and inputs from stakeholders and interested and affected parties; The inclusion of inputs and recommendations from the specialist reports where relevant; and Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties;	Section **0**
Where applicable, details of any financial provision for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts;	NA
An indication of any deviation from the approved scoping report, including the plan of study, including— Any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and A motivation for the deviation;	NA
Any specific information that may be required by the competent authority; and	NA
Any other matters required in terms of section 24(4)(a) and (b) of the Act.	NA

1 INTRODUCTION

1.1 Project Background

Mine Waste Solutions (MWS), also known as Chemwes (Pty) Ltd (Chemwes), has been in business since 1964, and conducts its operations over a large area of land to the east of Klerksdorp, within the area of jurisdiction of the City of Matlosana and JB Marks Local Municipalities (LM), which fall within the Dr Kenneth Kaunda District Municipality (DM) in the North-West Province. The MWS Operations are located primarily to the south of the N12, east of the town of Stilfontein. The closest town is Khuma, located about 2 km northwest of the facility, and other nearby towns include Stilfontein (10 km from facility) and Klerksdorp (19 km from facility).

The operations at MWS entail the reclamation and processing of gold mine tailings that were previously deposited on tailings storage facilities (TSFs) in order to extract gold and uranium. High pressure water cannons are used to slurry the tailings on the Source TSFs, then slurry is pumped by a number of pump stations and pipelines to the MWS Processing Plant (indicated in dark green in **Figure 1-1**), and the residues from the Processing Plants are pumped to the current Kareerand TSF (indicated in yellow in Figure 1-1**)**. Once a source TSF has been completely recovered, it is cleaned-up and rehabilitated. See **Figure 1-1** for an overview of the existing infrastructure used for this process.

1.2 Project Overview

The current Kareerand TSF was designed with an operating life of 14 years, taking the facility to 2025, and total design capacity of 352 million tonnes. Subsequent to commissioning of the TSF, MWS was acquired by AngloGold Ashanti and the tailings production target has increased by an additional 485 million tonnes, which will require operations to continue until 2042. The additional tailings to be reclaimed therefore require the expansion of the design life of the current Kareerand TSF.

This project entails the expansion of the current Kareerand TSF to accommodate the increased tailings and final design capacity, along with supporting infrastructure such as additional pump stations and pipelines from old source TSFs. The Kareerand TSF expansion is proposed on the western edge of the current facility, and the final height of the combined facility (both expansion and current) will be 122 m. The expansion footprint will add 380 ha to the current Kareerand TSF and approximately 93 additional ha will be cleared for supporting infrastructure. **Figure 1-2** depicts the site layout of all additional infrastructure across the operational footprint, while **Figure 1-3** depicts the TSF expansion and its associated infrastructure.

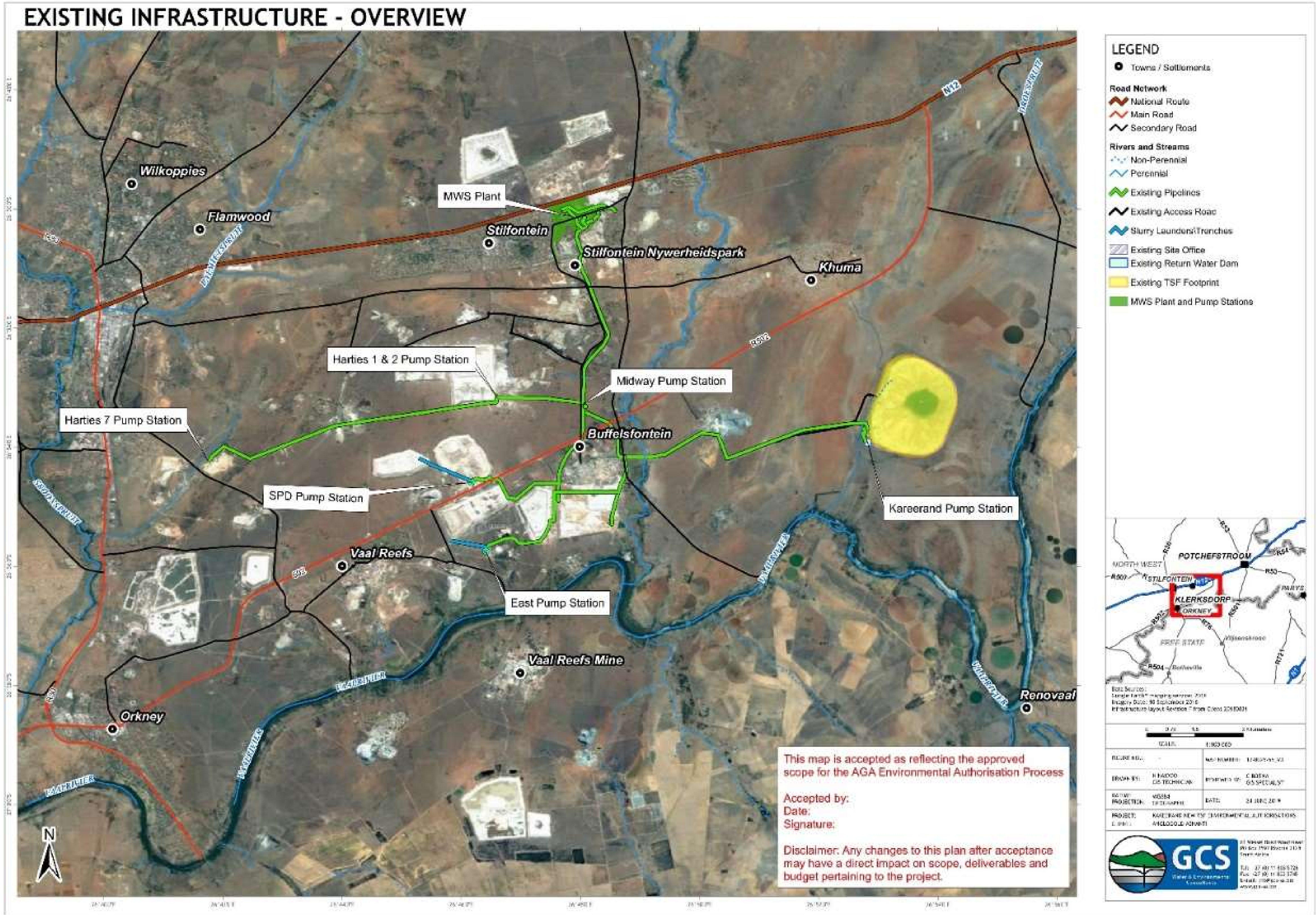

Figure 1-1: Existing Infrastructure servicing current Kareerand TSF.

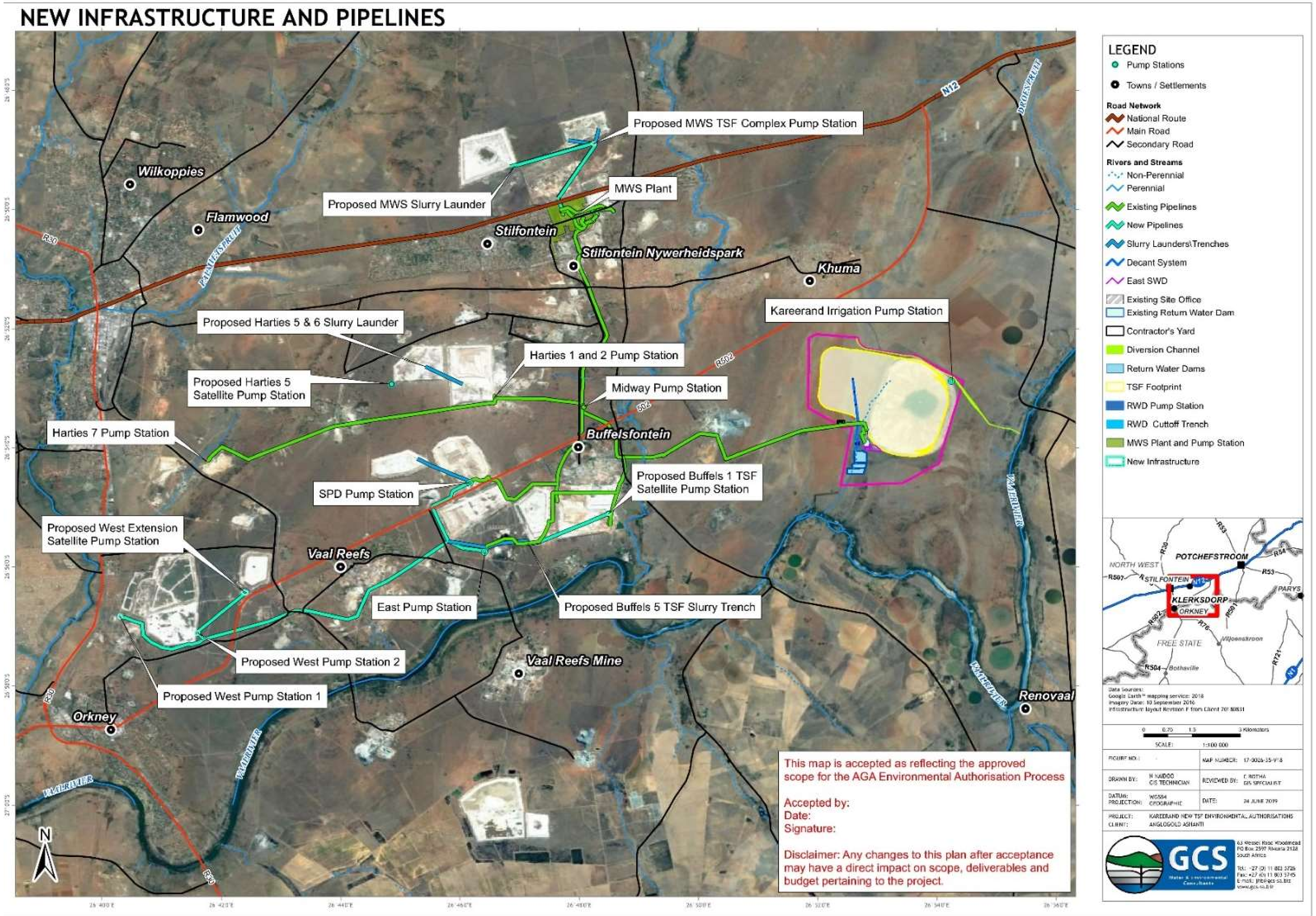

Figure 1-2: Site layout across operational footprint and TSF expansion footprint.
The new infrastructure is noted by the word "proposed", and the new pipelines are indicated in bright blue (as opposed to existing pipelines indicated in green).

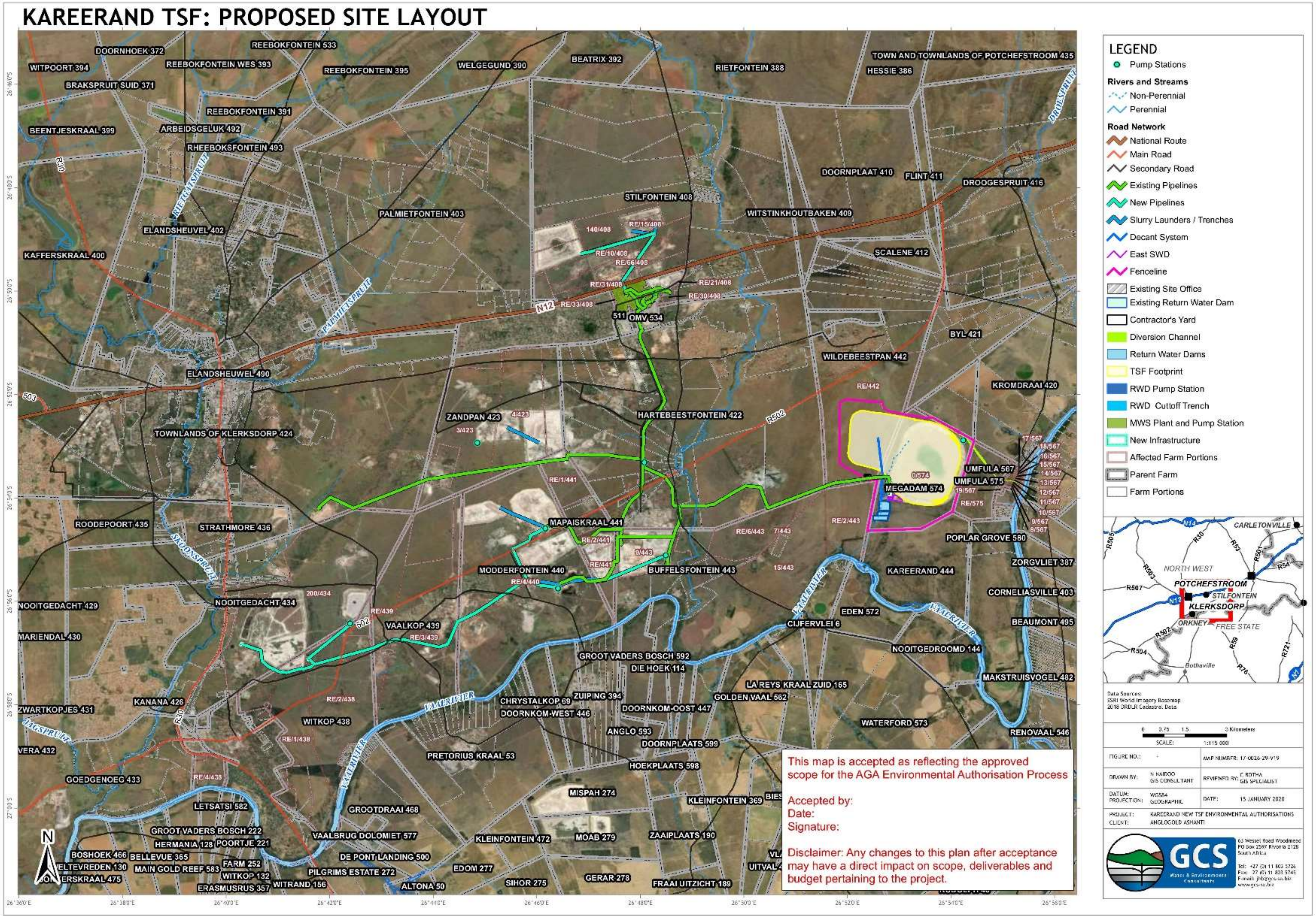

Figure 1-3: Kareerand TSF expansion site layout.

1.3 Details of the Applicant and EAP

1.3.1 Applicant

The details of the applicant are provided in **Table 1.1**.

Table 1.1: Name and address of applicant.

ITEM	COMPANY CONTACT DETAILS
Company Name:	Mine Waste Solutions (Pty) Ltd
Company Representative:	Rollet Masakona
Contact Persons:	Nicky Strydom/ John van Wyk
Telephone No.:	011 637 6691/ 018 478 6519
Facsimile No.:	NA
E-mail Address:	nicki.strydom@harmonygold.co.za jvwyk@harmonygold.co.za
Postal Address:	Mine Waste Solutions, 3 Stilfontein Road, Stilfontein, 2551

1.3.2 Environmental Assessment Practitioner

1.3.2.1 Details

GCS Water and Environment (Pty) Ltd (GCS) have been appointed as the independent Environmental Assessment Practitioners (EAP) to undertake the environmental processes required to obtain approval for the proposed listed activities, as requested by the relevant competent authorities. The contact details of the EAP are provided in **Table 1.2**.

Table 1.2: Name and address of environmental assessment practitioner.

ITEM	COMPANY CONTACT DETAILS
Company Name:	GCS Water and Environment (Pty) Ltd
Company Representative:	Sharon Meyer / Gerda Bothma
Telephone No.:	+27 (0)11 803 5726
Facsimile No.:	+27 (0)11 803 5745
E-mail Address:	info@gcs-sa.biz
Postal Address:	PO Box 2597, Rivonia, 2128

1.3.2.2 Expertise

Sharon Meyer has over 20 years of experience as a Principal Environmental Assessment Practitioner. The work experience that she has ranges from small urban development projects to large projects with multi-disciplinary team input on projects of national importance. She has worked on various projects and her focus has been on mining, industrial waste management and power generation projects. Sharon has focused on innovation in industrial waste management in the mining and electricity generation sectors. Sharon's skills and experience include project management, strategic environmental assessment, resource management and allocation, technical review, business development, impact assessment, conservation planning, sustainability reporting and auditing and environmental management and mitigation.

Recent key project experience as Project Manager and Principal Environmental Assessment Practitioner includes Medupi Power Station Flue Gas Desulphurisation Retrofit ESIA, Waste Management Licence and WULA (South Africa), Chitima Integrated Coal Power Project ESIA and RAP (Tete Province, Mozambique), Okatji Marble Mine Monitoring, Water Use Licensing and Authorisation (Namibia), Kendal Power Station Continuous Ash Disposal Facility ESIA, Waste Management Licence and WULA (South Africa), Richards Bay Combined Cycle Power Project EIA (South Africa), Koffiefontein Diamond Mine New Tailings Facility EIA (South Africa) and Kangra Water Liability Assessment and Reporting for Closure (South Africa).

Gerda has over 20 years' experience within the environmental and waste management field and strives to deliver custom environmental services to clients.

Gerda began her career in the environmental field within the government sector, managing environmental aspects and impacts as well as reviewing environmental assessments with the view of authorizing or declining authorization of the developments.

After six years within the government sector she joined a consulting engineering firm where she was ultimately responsible for the Management of the Environmental Sub-Division. Gerda has experience in project and client management, financial management and the compilation and costing of project proposals and tenders. She has been involved in several engineering projects as the Environmental Assessment Practitioner as well as the Environmental Control Officer during construction working closely with the Occupational Health and Safety Officer. Gerda has also been involved in projects where waste licensing as well as water use licensing processes formed an integral part of the services offered. Environmental auditing and compliance monitoring of waste disposal sites also forms part of her experience gained.

The EAP's Curriculum Vitae is attached as **Appendix B**.

1.4 Project Location

The proposed TSF expansion project is located in the western portion of the Witwatersrand Basin, approximately 160 km from Johannesburg in the North-West Province of South Africa. The MWS Operations are located primarily to the south of the N12, east of the town of Stilfontein. The closest town to the proposed expansion project is Khuma, located about 2 km northwest of the TSF. Other nearby towns include Stilfontein (10 km from TSF) and Klerksdorp (19 km from facility). The project is situated in the City of Matlosana and JB Marks Local Municipalities, within the Dr Kenneth Kaunda District Municipality (**Figure 1-4**).

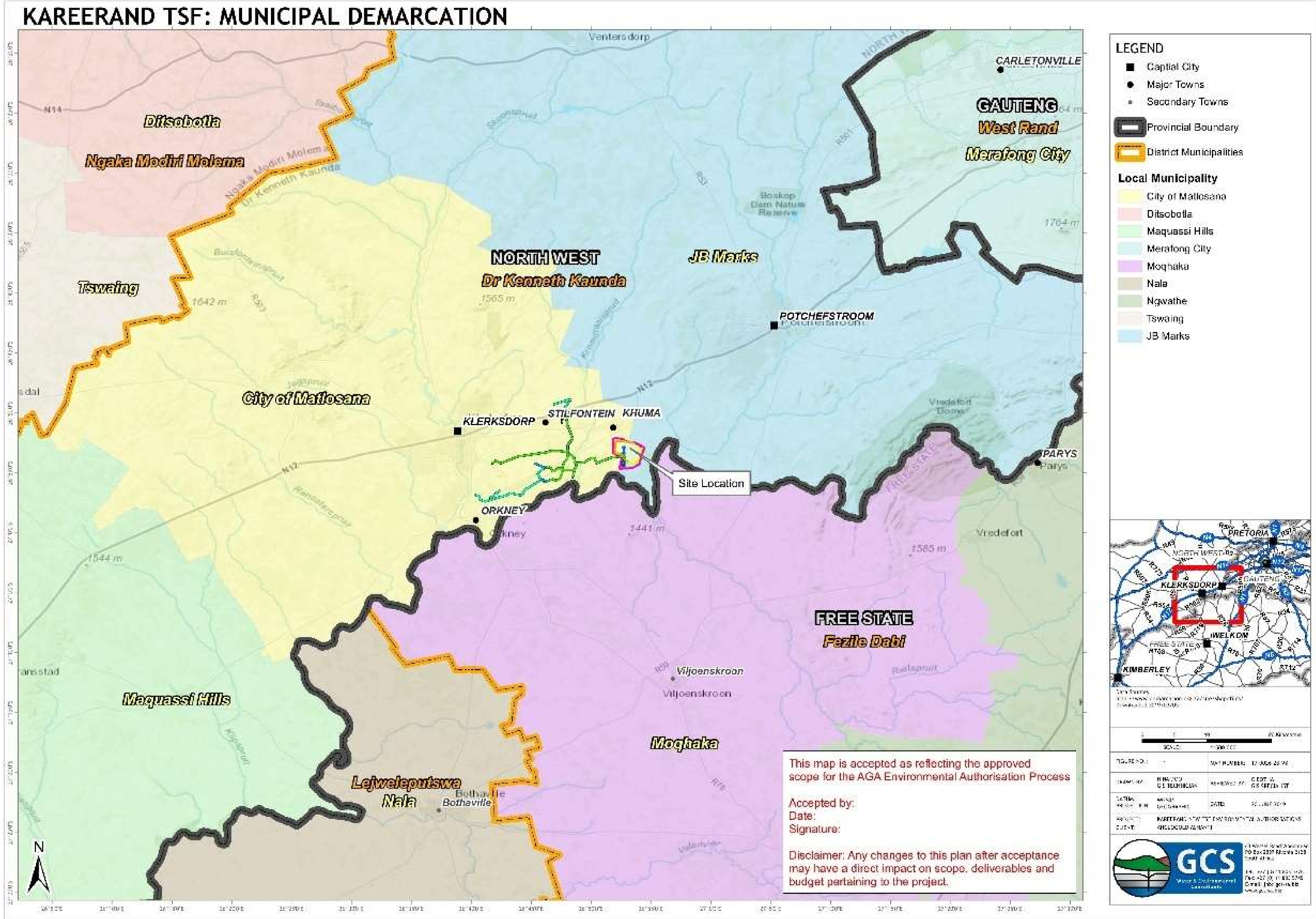

Figure 1-4: Locality map showing municipal demarcation of proposed TSF expansion.

The proposed expansion is located on various farm portions as detailed in **Table 1.3** and depicted in **Figure 1-3.**

Table 1.3: Farm portions associated with the proposed Kareerand TSF expansion project.

PARENT FARM	FARM PORTION	AREA(HA)	OWNER
STILFONTEIN 408 IP	RE/10	241.47	CHEMWES PTY LTD
	RE/15	189.26	CHEMWES PTY LTD
	RE/21	66.66	CHEMWES PTY LTD
	RE/30	78.33	CHEMWES PTY LTD
	RE/31	118.8	CHEMWES PTY LTD
	RE/33	16.83	CHEMWES PTY LTD
	RE/66	254.79	CHEMWES PTY LTD
	140	197.73	CHEMWES PTY LTD
ZANDPAN 423 IP	3	777.88	TEMOTUO REHABILITATION CO
	4	627.72	NATIONAL GOVERNMENT OF THE REPUBLIC OF SOUTH AFRICA
NOOITGEDACHT 434 IP	200	1850.7	ANGLOGOLD ASHANTI LTD
WITKOP 438 IP	RE/1	600.82	ANGLOGOLD ASHANTI LTD
	RE/2	681.4	ANGLOGOLD ASHANTI LTD
	RE/4	222.38	ANGLOGOLD ASHANTI LTD
VAALKOP 439 IP	RE	332.12	ANGLOGOLD ASHANTI LTD
	RE/3	1473.75	ANGLOGOLD ASHANTI LTD
MODDERFONTEIN 440 IP	RE/4	2572.08	ANGLOGOLD ASHANTI LTD
MAPAISKRAAL 441 IP	RE	144.91	ANGLOGOLD ASHANTI LTD
	RE/1	201.32	AFRICAN RAINBOW MINERALS LTD
	RE/2	120.82	ROCHA MARIA INES DA
WILDEBEESTPAN 442 IP	RE	1067.1	WILDEBEESTPAN (PORTION 9 & 10) COMMUNAL PROPERTY ASSOCIATION
BUFFELSFONTEIN 443 IP	RE/2	362.6	CHEMWES PTY LTD
	RE/6	362.04	CHEMWES PTY LTD
	7	2.2	CHEMWES PTY LTD
	9	326.8	CHEMWES PTY LTD
	15	601.09	CHEMWES PTY LTD
MEGADAM 574 IP	0	977.1	CHEMWES PTY LTD
UMFULA 567 IP	8	5.23	CHEMWES PTY LTD
	9	5.18	CHEMWES PTY LTD
	10	5.22	CHEMWES PTY LTD
	11	5.17	CHEMWES PTY LTD
	12	4.93	CHEMWES PTY LTD
	13	4.66	CHEMWES PTY LTD
	14	4.39	CHEMWES PTY LTD
	15	4.19	CHEMWES PTY LTD
	16	4.06	CHEMWES PTY LTD
	17	4.00	CHEMWES PTY LTD
	18	3.90	CHEMWES PTY LTD
	19	5.00	CHEMWES PTY LTD
UMFULA 575 IP	0	352.53	CHEMWES PTY LTD

1.5 Activity Description

The proposed project will make use of the existing facilities and services (including existing services related to sewage disposal, refuse removal, water and electricity supply) as well as additional supporting infrastructure. A detailed breakdown of the expansion-related infrastructure is included in **Table 1.4** below.

Table 1.4: Expansion-related infrastructure.

TSF Expansion	• TSF will be expanded by 380 ha; • The expanded footprint will be lined as per DWS requirements;
Fence	• 2.4 m high game fence with appropriate signage will be installed around the perimeter of the new TSF (length of new fence = 7 km); • This will tie into the existing fence and is the same type of fence;
Roads	• New main access road and perimeter access road; • 8 m wide gravel access road around perimeter of TSF, to the RWDs (return water dams), pump stations (western perimeter of TSF extension) and offices; • Total combined distance of new roads will be 11 km; • Access ramps provide access onto tailings dam;
Topsoil bund wall	• A bund wall will be constructed around the TSF, next to the access road; • The wall will be 6 m at highest point and 2 m at lowest point, crest width is 8 m; • The bund wall will also be used as access road on northern side of TSF;
Stormwater diversion channels	• A trench on the northern side of the TSF, 6 km in length, to divert clean storm water running from the north, towards the east in the direction of the Vaal River: o Trapezoidal in shape with side slopes of 1v:2h and base width of 9 m. o Designed to accommodate the 1:50 year storm event. o Peak flow velocity will be 125 m^3/s during 1:50 year storm events.

	• A second unlined trench next to the RWD will divert clean storm water runoff away from the RWD and solution trench and prevent it from mixing with the dirty water; • Diversion channels will assist to minimise the water quality impact from the TSF;
Delivery pipeline	• Three steel 500 mm tailings delivery pipes located at the toe of the facility (western edge); 13.5 km in total length; • Will deliver slurry to the northern, western and southern side of the TSF extension;
Solution trench	• Trench lined with 100 mm thick mesh reinforced concrete; • Around northern, western and southern side of TSF; • Will convey decant water and storm water from the side slopes, filter discharge (seepage water) from the outer drains and surface runoff from the side slopes to the RWD;
Seepage and dirty water collector sump	• Constructed on northern side of TSF; • Will collect seepage water and dirty storm water running off the TSF walls from solution trench before it is pumped back to the north-western corner;
Catchment paddocks	• Constructed around perimeter of facility at final outer wall toe location; • Constructed using material from solution trench excavations and paddock basins- will be nominally compacted; • Paddocks will be 50 m long and 20 m wide; • Designed to contain run-off from a 1:50 year storm event;
Starter wall	• The starter wall will contain tailings deposition during early development of TSF; • Constructed using clay-based material from basin or other construction areas;
Drainage system	• Under drainage system located within TSF footprint, consisting of toe, intermediate and central drains and drain outlets;

	• The existing drain outlets will connect to a collector drain system then discharge into the solution trench on the southern flank where the two facilities connect;
Decant system	• Gravity pipe decant system to ensure water does not accumulate on top of TSF; • Includes permanent double intake structure and intermediate intake structures; • Intermediate penstock intake structures positioned at different elevations along the penstock outlet pipeline: o Ensure effective decanting of supernatant water during the development phase of TSF; o Minimise delay in water returned to the reclamation sites;
Catwalk	• Timber catwalk and floating walkway structure for access from pool wall to penstock intermediate and permanent intake structures respectively;
Silt trap	• Concrete-lined silt trap with twin compartments between penstock outlet and RWD; • Should reduce volume of suspended solids flowing into RWD;
Storm water dam	• Storm water dam will be located between TSF and RWDs and will contain dirty water running off the TSF; • Capacity will be 155 000 m3 and will cover 6.6 Ha;
RWD and related infrastructure	• New RWDs with a combined capacity of 837 000 m^3 (area of 60.6 ha), south of the TSF and existing RWD complex; • RWD will have three compartments (one for operation, the other two for dirty water containment); • Will be lined with double HDPE liner system and leakage-detection material (Hi-drain); double liner will consist of a geomembrane; • RWD sunk below ground level, maximum wall height of <2 m above normal ground level;
Contractors yard	• Contractor’s yard will be located on the south western side of the TSF extent on the right of the access road travelling south; and

	• Contractor's yard will include the following infrastructure: site office, workshop, fuel storage facilities, wash bays, change houses, septic tanks.

The additional infrastructure required across the operational footprint will include new pump stations, new satellite pump stations, slurry launders and connecting slurry and process water pipelines. In the centre of operations, existing infrastructure (pump stations and main slurry and process water pipelines) will be utilised to process adjacent resources. Buffels 5 TSF will be connected to the East Complex Pump Station via a new slurry trench and Buffels 1 TSF will be pumped via a satellite pump station to the Buffels 5 TSF slurry trench feed.

Tailings from Harties 5 & 6 TSF will be directed via a slurry launder to the Harties 1 & 2 pump stations. A satellite pump station may be required at a later stage, to aid in reclamation of tailings that cannot be gravity fed. In the west, three new pump stations (West Pump Station 1, West Pump Station 2 and a satellite pump station) will be constructed. Main slurry and process water pipelines extending from the existing SPD and East Complex Pump Stations in the east to the west, will allow for the use of the SPD and East Complex Pump Stations as booster pump stations.

In the north, the MWS 4 & 5 TSF's will be reclaimed and directed to a new pump station via slurry launders. New process water and slurry piping will be installed between the MWS 4 & 5 Pump Station and the MWS plant. In total, three new main pump stations and three new satellite pump stations will be built.

The details of the supporting infrastructure for the TSF expansion are as follows:

- Pump Stations:
  - Three main pump stations: one at the MWS complex, two at the outlying western TSFs;
  - Three satellite pump stations: one at the Harties TSFs (probably at a later stage), one at the outlying western TSFs and one at the Buffels TSFs;
- Process water pipelines:
  - Extended from the existing SPD and East Complex pump stations to the western outlying TSFs;
  - Connecting MWS TSFs and MWS plant;
- Slurry pipelines:
  - Extended from the existing SPD and East Complex pump stations to the western outlying TSFs;

  - Connecting MWS TSFs and MWS plant;
- Slurry launders:
  - Connecting the Buffels TSF to the East Complex pump station;
  - Connecting Harties TSFs with the Harties 1 & 2 pump station; and
  - Connecting MWS TSFs to the proposed MWS pump station.

2 SCOPE OF WORK

This scope of work for this Environmental Impact Assessment Report is to:

- Identify the policies and legislation relevant to the activity;
- Motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location and layout;
- Identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;
- Identify and confirm the preferred site, through a detailed site selection process, which includes an identification of impacts and risks inclusive of identification of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;
- Discuss the nature, significant consequence, extent, duration and probability of the impacts occurring and the degree to which the impacts can be reversed, cause irreplaceable loss, and whether these can be avoided, managed or mitigated;
- Identify the most ideal location for the activity within the development footprint based on the levels of environmental sensitivity identified through various specialist studies in the assessment phase;
- Identify, assess and rank the impacts the activity will impose on the development footprint throughout its lifetime;
- Identify measures to avoid, manage or mitigate identified impacts; and
- Identify cumulative and residual risks that need to be managed and monitored.

2.1 Motivation

The expansion of the current Kareerand TSF will enable the reclamation of additional tailings dams and deposition of the tailings in an expanded facility complete with geofabric liner and appropriate seepage mitigation measures. This will reduce total seepage into the Vaal River from the general area.

The project will support concurrent rehabilitation of the current Kareerand TSF and the expansion, thereby reducing the risk of windborne dust and storm water management. Removing and consolidating the tailings in the KOSH area on a single tailings storage facility will in the long term, positively impact the surrounding environment and Vaal River (please refer to the Hydrogeological Assessment in Appendix D13 for further details in this regard).

Specialist studies have been undertaken to assess the impacts of the TSF expansion on identified aspects of biophysical and socio-economic receptors within the area. Mitigation, management, and rehabilitation designs have been informed by a team of specialists and engineers.

In addition, the extended Life of Mine (LoM) of the reclamation operations will create employment for a longer period and thus bring associated socio-economic benefits to the towns and settlements in the area.

It must however be noted that MWS will require interim deposition capacity during the construction and commissioning phases of the Kareerand TSF expansion. The TSF Complex north of the N12, i.e. MWS 4 and MWS 5, has been earmarked for this purpose and the duration of the interim deposition phase would be approximately 5 years (2022 to 2027), after which these TSFs will be reclaimed, leaving the Kareerand facility as the only TSF. MWS will apply separately for the relevant authorisation(s) for the proposed interim deposition activities before commencing with the interim deposition activities. A separate environmental impact assessment process will be undertaken for the proposed interim deposition activities and all the associated environmental impacts of the proposed interim deposition will be investigated and assessed as part of the new application process.

3 NEED AND DESIRABILITY

In accordance with the EIA Regulations, the need and desirability of the Kareerand TSF expansion has been considered while taking the strategic concept, broader societal needs and public interest into account. The tables below (**Table 3.1** and **Table 3.2**) provide answers to a number of guiding questions as posed in the Department of Environmental Affairs' Guideline on Need and Desirability (DEA, 2017).

The answers provided below indicate that ample consideration has been given to the need and desirability of the project.

Table 3.1: Assessment of the proposed Kareerand TSF expansion in terms of securing ecological sustainable development and use of natural resources.

HOW WILL THIS DEVELOPMENT (AND ITS SEPARATE ELEMENTS/ASPECTS) IMPACT ON THE ECOLOGICAL INTEGRITY OF THE AREA?		
No.	**Question**	**Answer**
1.1	How were the following considerations taken into account: Threatened ecosystems; Sensitive, vulnerable, highly dynamic or stressed ecosystems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure; CBAs and ESAs; Conservation targets; Ecological drivers of the ecosystem; Environmental Management Framework; Spatial Development Framework; and Global and international responsibilities relating to the environment.	The EIA process included detailed ecological and wetland studies, which took into account all ecological and environmental considerations. Due diligence was observed while undertaking the EIA to ensure that the process was in line with the MWS Environmental Management Framework, the area's SDF and relevant international guidelines.
1.2	How will this development disturb or enhance ecosystems and/or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	This development will take place in an area largely characterised by mining activities. Some wetland habitat will be lost. In order to reduce the impact of the TSF on the ecosystem, clean stormwater will be diverted around the TSF and an interception system will be installed to divert seepage away from the Vaal River. Several options were explored for this development, with the proposed position being the best strategy- the development will take place within an area already disturbed by the current TSF. Implementation of the EMPr will ensure that negative impacts are avoided, managed and mitigated as far as possible.
1.3	How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	The TSF will be lined as per the requirements of DWS and the expansion will be located on a non-dolomite foundation. Seepage from the TSF is thus expected to be minimal. Implementation of the EMPr will ensure that negative impacts are avoided, managed and mitigated as far as possible. The TSF will be authorised under the NEM:WA and managed in accordance with the standards for disposal of waste to land.

1.4	What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	The development is a storage facility for waste. The waste that will be stored is a product of the reprocessing of old mine waste, hence there are no further treatments that could be applied.
1.5	How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	This development will form the expansion of an existing facility. Furthermore, the Visual Assessment undertaken found that, due to the undulations of the landscape, the expanded facility will likely not have a large impact. The presence of cultural heritage artefacts was investigated in the Heritage Impact Assessment in order to plan the development around them- any that could not be avoided will be protected. This will also be covered by the implementation of the EMPr.
1.6	How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	This development will include the re-processing of gold resources that have already been exploited, no additional mining will take place.
1.7	How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts? Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)? (note: sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life);	Minimal additional resources will be utilised for the development of the TSF expansion- resources in use for the current TSF will just be utilised for a longer period of time.

	Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources this the proposed development alternative?); Do the proposed location, type and scale of development promote a reduced dependency on resources?	
1.8	How were a risk-averse and cautious approach applied in terms of ecological impacts? What are the limits of current knowledge? What is the level of risk associated with the limits of current knowledge? Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	The impacts on ecology were thoroughly investigated in the Ecological Impact Assessment. Gaps/limits/assumptions are discussed in **Section 8.** It is unlikely that these gaps will result in a large increase in the risk. Several options were explored for the TSF expansion and the risks thereof were investigated.
1.9	How will the ecological impacts resulting from this development impact on people's environmental right in terms following: Negative impacts: e.g. access to resources, opportunity costs, loss of amenity, air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts? Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	A comprehensive suite of specialist studies were undertaken to investigate the impacts of the expansion on the environmental rights of the community. The expansion is likely to have minimal additional impacts in terms of amenity (it is on mine- or private-owned land), air and water quality, noise, health and visual. The current TSF has already been operational for several years. The implementation of the EMPr will assist in minimising or managing any impacts as far as possible. The removal of old source TSFs and storage of all mine waste on one consolidated facility will result in positive impacts.
1.10	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	Human wellbeing in the area is linked to air quality and water quality. Should the development negatively impact either of these factors, this may result in linked socio-economic impacts. However, the development is an expansion of an existing facility so no new impacts are likely to develop. A Health Impact Study was undertaken to quantify these aspects.
1.11	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives/targets/considerations of the area?	It is likely that there will be little additional impacts on ecological integrity as the development is an expansion of existing activities.

1.12	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	The option that was identified as the best site (through the Site Selection Study) was chosen due to the presence of the existing TSF and the sub-surface geology present. The site has already been disturbed by the existing TSF, thus minimal additional impacts will occur. The development will be placed on non-dolomite foundations, thus reducing seepage risk. Furthermore, cleaning up of the old TSFs in the area will improve the overall landscape quality.
1.13	Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	Positive: • Old source TSFs (which were developed on dolomite, which has a high seepage potential) in the area will be removed. • All waste will be consolidated on one large facility, which will not be placed on dolomite and which will be subject to improved, modern management techniques. • Management of the current TSF will be improved through the installation of a groundwater interception system. Negative: • Loss of topsoil and vegetation (habitat). • Loss of grazing land. • Potential pollution of soil and water resource through improper waste and hydrocarbon management. • Minor air quality impacts from dust and particulate matter. • Minor noise impacts. • Potential movement of some heritage artefacts. • Potential erosion and sedimentation of water resource, impacting water quality. • Potential groundwater pollution through seepage (this is unlikely due to mitigation measures which will be put in place, most pollution will likely be generated by current TSF). • Permanent visibility of TSF in landscape, changing the topography.

Table 3.2: Assessment of the proposed Kareerand TSF expansion in terms of promoting justifiable economic and social development.

No.	Question	Answer
2.1	What is the socio-economic context of the area, based on, amongst other considerations, the following considerations: The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area, Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.), Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and Municipal Economic Development Strategy ("LED Strategy").	The area is characterised by high unemployment rates, with employment being driven largely by services. The development is an expansion of activities which are already underway, in a landscape dominated by mining. Thus, the development is in line with the IDP and other spatial priorities. The expansion of the facility will result in continued employment as the lifespan of the operations will be increased.
2.2	Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area? Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	The expansion of the facility will result in continued employment, as well as continued economic input from the operations, as the lifespan of the operations will be increased. This is in line with the objectives of the IDP. The SEIA noted that "despite the slow-down in mining activities, the mining sector still makes a significant contribution of 21% towards economic output" in the CMLM, which is the second-largest contributing sector. This shows that mining and related activities, such as the reprocessing that this project will allow, plays in important role in the local economy.
2.3	How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	The EIA process included a suite of detailed specialist assessments, including a Visual Assessment, Wetland Assessment, Soil Assessment, Ground- and Surface Water Assessment, Noise Assessment, Socio-Economic Impact Assessment, Heritage Assessment, Health Assessment, Air Quality Impact Assessment and Radiological Impact Assessment. These were undertaken to assist in quantifying the impact of the project on the socio-economic environment surrounding the development. Expansion of the TSF will ensure that the current employees working at MWS will have job security until 2042, thus boosting the economy of the region and helping to prevent unemployment. The heritage study was undertaken in the planning phase for the TSF expansion in order to ensure that the site layout accommodated any heritage artefacts as far as practically possible.

		The Air Quality, Radiation and Health Impact Assessments indicated that there will be negligible negative impacts on the health of nearby communities.
2.4	Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	The development will likely not require additional staff, thus the impacts will be minimal. The expansion of the Kareerand TSF result in long-term benefits through the extension of the life of mine (LOM) of MWS, providing job opportunities to future generations, as most current MWS employees will likely retire before 2042 (expected LOM with expanded TSF).
2.5	In terms of location, describe how the placement of the proposed development will: result in the creation of residential and employment opportunities in close proximity to or integrated with each other, reduce the need for transport of people and goods, result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms public transport), compliment other uses in the area, be in line with the planning for the area, for urban related development, make use of underutilised land available with the urban edge, optimise the use of existing resources and infrastructure, opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement), discourage "urban sprawl" and contribute to compaction/densification, contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs, encourage environmentally sustainable land development practices and processes, take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	As the development is an expansion of current activities, it will likely result in minimal impacts (positive or negative) to the socio-economic character of the area. However, as explained above, current employees will have a more secure future. The expansion will utilise all current resources and infrastructure in place. In terms of sense-of-place and cultural history, visual and heritage impact assessments were undertaken to quantify impacts. The heritage impact assessment informed the design and layout of the expansion. Any impacts on cultural heritage that could not be avoided will be mitigated for and appropriately managed according to the EMPr and requirements of the NHRA. The expansion will occur on mine- or private-owned land and thus will have minimal impacts on the layout of any settlements nearby. The extended LOM of will create an opportunity to promote local enterprise development in the area as well as intergenerational employment.

	the investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential), impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and in terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	
2.6	How were a risk-averse and cautious approach applied in terms of socio-economic impacts? What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)? What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge? Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	A socio-economic impact assessment, as well as a health assessment, was undertaken as part of the EIA process. Gaps noted by the specialists are discussed in **Section 8.** Mitigation measures for any socio-economic or health issues are briefly discussed under **Section 11** and noted in detail in the EMPr. Additional risk is minimal as the development forms the expansion of an existing operation. The extended LOM of will create an opportunity to promote local enterprise development in the area as well as intergenerational employment.
2.7	How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following: Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts? Positive impacts. What measures were taken to enhance positive impacts?	A health impact assessment was undertaken and found that there is unlikely to be a significant impact on human health caused by the TSF Expansion. The development and implementation of a comprehensive EMPr will assist in avoiding, mitigating and managing negative socio-economic impacts. Positive impacts were enhanced through extensive public participation and involvement of the communities impacted by the development, thereby allowing suggestions and recommendations to guide the Environmental Impact Assessment process. Issues were addressed via the Comments and Response Register. A Health Impact Study was added to the suite of specialist assessments after feedback from the public during the Scoping Phase of the project. Measures were provided in the Socio-Economic Impact Assessment which, if implemented, will assist MWS in enhancing the positive impacts provided by the project. Enhancement measures include prioritisation of recruitment from the local community, providing up-skilling opportunities to the local community

		employed by the project, use of local and small-business goods and services and development of a communication strategy for the local community.
2.8	Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socio-economic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	As the development is an expansion of current activities, there will be no additional long-term ecological impacts as a result of the socio-economic impacts. Current employees will continue to utilise natural resources at the same rate as they currently do so.
2.9	What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	The Site Selection report considered all aspects of the development, including socio-economic considerations. The proximity to human settlements and land ownership were part of the planning process.
2.10	What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	An extensive public participation process guided the development of the Environmental Impact Report and EMPr. All impacted communities were invited to provide comments and suggestions. The alternatives considered do allow for the best option to be considered, some impacts are, by nature of the development, unavoidable. These impacts will be mitigated for and managed as far as possible. All impacts were assessed by a team of highly competent specialists (see **Section 10**). A site selection process was undertaken (see **Section 5**) and the proposed site was selected as the best site for the following reasons: • Expansion to the current facility, containing the impact to a single site, which makes it easier to manage and mitigate; • Area is not underlain by dolomite; • Land is on a 99-year lease to the applicant; and • Existing infrastructure will be used by the expanded facility, reducing environmental impact associated with introducing new associated infrastructure.
2.11	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	An extensive public participation process guided the development of the Environmental Impact Report and EMPr. All impacted communities were invited to provide comments and suggestions.
2.12	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the	The EIA process and EMPr take all stages of the development's life cycle into account and impacts specific to each phase are addressed accordingly.

	development has been addressed throughout the development's life cycle?	
2.13	What measures were taken to: ensure the participation of all interested and affected parties, provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, ensure participation by vulnerable and disadvantaged persons, promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means, ensure openness and transparency, and access to information in terms of the process, ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge, and ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein was promoted?	An extensive public participation process was undertaken as part of the EIA process. All impacted communities were invited to provide comments and suggestions. Notices of the development were relayed in several different formats.
2.14	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	As previously stated, the development is purely an expansion of existing activities. Therefore, it is unlikely that any additional opportunities will arise as a result of the expansion. However, current employees will benefit from extended job security and support for their dependents.
2.15	What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	MWS will undertake all activities under the guidance of the country's the labour, employment and health/safety laws. The EMPr will further provide guidance for health and safety measures that must be implemented to ensure that employees are not subjected to adverse health conditions or dangers without the correct training, equipment and supervision.
2.16	Describe how the development will impact on job creation in terms of, amongst other aspects:	According to the Socio-Economic Impact Assessment, the duration of the construction phase is expected to be 5 years and could lead to the employment of some 270 people directly involved in construction activities (depending of the type

	the number of temporary versus permanent jobs that will be created, whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area), the distance from where labourers will have to travel, the location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	of construction activity undertaken at the time) with an estimated 120 jobs for unskilled labour, which could be fulfilled by the community. No additional permanent jobs will be created- however, current employees will benefit from extended job security. A total of 999 (MWS and contractors) people will be employed by the project permanently.
2.17	What measures were taken to ensure: that there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	The public participation process invited comment and input from all levels of governance relevant to the development- including local municipalities and relevant government department. For those government arms that had specific issues related to the development, consultation meetings were arranged to resolve those.
2.18	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	An intensive environmental impact process has been undertaken, including investigation into socio-economic and human health factors, to ensure that the environment is protected as far as possible.
2.19	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	The EMP includes implementable and realistic mitigation measures which will allow for impacts to be mitigated and managed as far as possible. The TSF will remain in place for the foreseeable future, however, rehabilitation measures will ensure that the legacy is minimised as far as possible.
2.20	What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	MWS will make financial provision based on its duty of care in accordance with accepted financial reporting and accounting standards. MWS is also committed to undertake concurrent rehabilitation of the TSF. Furthermore, the company must adhere to ISO certification requirements and EMPr conditions.
2.21	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed),	The Site Selection report considered all relevant factors when assessing the various options available for the expansion.

	resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	
2.22	Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	Cumulative impacts of the TSF expansion include: • Additional temporary jobs and income during construction, in addition to other activities providing jobs in the landscape (positive). • Improved local employment and income, reduced poverty and contribution to local economy caused by the TSF expansion in addition to other projects and activities in the landscape (positive). • Project-induced in-migration in addition to in-migration from other mining activities and projects such as solar farms in the area (negative). • Increased nuisance factors- as the TSF and other industrial activities act as sources of traffic, dust and noise pollution (negative). • Increased resource use (water and electricity) of the expanded TSF in conjunction with all other resource-users in the landscape (negative). • Impact on external costs to local communities caused by cumulative impact of expended TSF, other mining activities in the area and historic tailings facilities (negative). • Sense of place will be impacted by the long-term addition of the TSF expansion having a cumulative effect along with other activities in the area (negative). • Community safety-existing industrial activities, tailing facilities and other mining activities in the area act as additional sources of traffic, dust and noise pollution (negative). Residual impacts of the TSF expansion include: • Temporary jobs and income during construction- up-skilled labour force (positive). • Project-induced in-migration- additional pressure on provision of housing and related infrastructure and health, emergency and safety services (negative). • Local employment and income- up-skilled labour force (positive). • Sense of place- visual impact of the tailings and the residual impact on the sense of place and environmental risks possibly impacting on the sense of place (negative). • Increased nuisance factors (dust and noise) and resultant potential health risks (negative). • Environmental pollution risks (negative).

4 LEGISLATIVE REQUIREMENTS

4.1 Legislative Background

The policy and legislative context applicable to the Kareerand TSF expansion project is summarised in **Table 4.1** and penalties applicable to non-compliance to the legislation are detailed in **Table 4.2.**

Table 4.1: Legislation and guidelines applicable to the TSF expansion project.

LEGISLATION/ GUIDELINES	APPLICABILITY
The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)	The Constitution is the supreme act to which all other acts must speak to and sets out the rights for every citizen of South Africa and aims to address past social injustices. With respect to the environment, Section 24 of the constitution states that: “Everyone has the right: To an environment that is not harmful to their health or well-being; To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that: Prevent pollution and ecological degradation; Promote conservation; and Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development”.
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA)	Framework law giving effect to the constitutional environmental right. Provides the framework for regulatory tools in respect of environmental impacts. Section 24 of NEMA regulates environmental authorisations. Section 24P of NEMA sets out the requirements for financial provision for remediation of environmental damage, Section 24Q refers to the monitoring and performance assessments required for those holding an environmental authorization. Section 24S establishes that residue stockpiles and deposits should be managed according to NEM:WA. Section 28(1) states that “Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment”. *MWS will be responsible for the rehabilitation of the Kareerand Tailings Storage Facility and the expansion thereof, in accordance with the NEMA Regulations. MWS will be responsible for the Duty of Care of the affected receiving environment during the construction, operation, decommissioning and closure phases of the project.*

LEGISLATION/ GUIDELINES	APPLICABILITY
National Environmental Management: Waste Act, 2008 (Act No 59 of 2008) (NEM:WA)	Regulates inter alia the duty of care, management, transport and disposal of waste including mining waste such as residue deposits and residue stockpiles. Furthermore, this Act regulates the rehabilitation of contaminated land and waste disposal facilities including mining waste facilities. Section 16(1) of the NEM:WA provides that: "A holder of waste must, within the holder's power, take all reasonable measures to – avoid the generation of waste and where such generation cannot be avoided, to minimise the toxicity and amounts of waste that are generated; reduce, re-use, recycle and recover waste; where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner; 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; prevent any employee or any person under his or her supervision from contravening this Act; and prevent the waste from being used for an unauthorised purpose." The NEM:WA also provides for a licensing regime specific to waste management activities. Category A activities require a BA process to be undertaken, whilst Category B activities require a S&EIR process to be undertaken. *This project requires a Waste Management Licence.*
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA)	Regulates activities which may have a detrimental effect on ambient air quality including certain processes and dust generating activities such as tailings deposition. *However, an Air Emissions Licence is not required.*
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA)	Regulates the protection of biodiversity and the management of invasive species, including the use of alien and invasive species on mining sites. Section 73 speaks to duty of care with respect to listed invasive species and states that "A person authorised by permit in terms of section 71(1) to carry out a restricted activity involving a specimen of a listed invasive species must take all the required steps to prevent or minimise harm to biodiversity". *A permit will only be required should there be a direct impact to a conservation area or protected species.*
Conservation of Agricultural Resources Act 43 of 1983 (CARA)	Regulates the eradication of weeds and invader plants, including those occurring on development sites.

LEGISLATION/ GUIDELINES	APPLICABILITY
National Water Act, 1998 (Act No. 36 of 1998) (NWA)	Regulates the protection of the water resources and the use of water, including on inter alia mining areas. Furthermore, the Act contains provisions relevant to mine closure with regard to water resource protection form pollution and environmental degradation. Section 19(1) states that “An owner of land, a person in control of land or a person who occupies or uses the land on which – a) any activity or process is or was performed or undertaken; or b) any other situation exists, which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring.” *A Water Use Licence is being applied for under a separate process.* Please refer to **Appendix G** for further information in this regard.
The National Heritage Resources Act, (Act No. 25 of 1999) (NHRA)	Section 34(1) of NHRA states that “No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.” *A Heritage Licence will be required if the project disturbs any heritage structures/resources.*
Spatial Planning and Land Use Management Act, 2013 (Act No. 16 of 2013) (SPLUMA)	The aim of SPLUMA is to provide a uniform system of spatial planning and land use management throughout the country. SPLUMA places emphases on the fundamental role municipal planning and municipalities have on effective spatial planning and development. In 2012, a judgement handed down by the Constitutional Court found that mining constitutes a land use and can only be conducted lawfully if the said activity corresponds with the purpose for which land has been zoned in terms of the application Town Planning/Land Use Management Scheme (the “Scheme”). Based on the above use is primarily governed by the applicable land use or zoning scheme and land may not be used in contravention of such a scheme. Despite any issued environmental authorisation, mining and associated activities can only be executed on land with the appropriate zoning permitting such activities.
Guidelines	Handbook of Guidelines for Environmental Protection, Chamber of Mines (CEM (SA)) (Chamber of Mines of South Africa, 1979) • Volume 2/1979: The vegetation of residue deposits against water and wind erosion. • Volume 7: Statutory requirements for environmental management.
	Mine Residue – Code of Practice (SABS 10286:2010).
	Framework for the Management of Contaminated Land, DEA 2010.
	Mining and Biodiversity Guideline – Mainstreaming biodiversity into the mining sector, 2013 (DEA, DMR, CM, South African Mining and Biodiversity Forum and South African National Biodiversity Institute, 2013).

LEGISLATION/ GUIDELINES	APPLICABILITY
	Water Conservation and Water Demand Management (WC/WDM) Guideline for the Mining Sector in South Africa, June 2011 (DWA, 2011).
	Guideline Document for the implementation of Regulations on use of water for Mining and related activities aimed at the protection of Water Resources, Second Edition, May 2000.
	Best Practice Guidelines for Water Resource Protection in the South African Mining Industry (Department of Water Affairs, 2006): Series A: Best Practice (BP) Guidelines A2: Water Management for Mine Residue Deposits, July 2008; A4: Pollution Control Dams, August 2007; Series G: BP Guidelines G1: Storm Water Management, August 2006; G2: Water and Salt Balances, August 2006; G3: Water Monitoring Systems, July 2007; G4: Impact Prediction, December 2008; G5: Water Management Aspects for Mine Closure, December 2008; Series H: BP Guidelines H1: Integrated Mine Water Management, December 2008; H2: Pollution Prevention & Minimization of Impacts, July 2008; H3: Water Reuse & Reclamation, June 2006; and H4: Water Treatment, September 2007.

Table 4.2: Penalties applicable to non-compliances under the legislation tabulated above.

LEGISLATION	SECTION	FINE
NEMA	Section 49A (1) (a), (b), (c), (d), (e), (f) and (g)	Fine not exceeding R 10 million or imprisonment for a period not exceeding 10 years, or both such fine and such imprisonment.
	Section 49A (1) (i), (j) or (k)	Fine not exceeding R 5 million, or imprisonment for a period not exceeding 5 years. In the case of a second or subsequent conviction: fine not exceeding R 10 million, or to imprisonment for a period not exceeding 10 years. Or in both instances to both such fine and such imprisonment.
	Section 49A (1) (h), (l), (m), (n) (o) or (p)	Fine or imprisonment for a period not exceeding one year, or to both a fine and such imprisonment.
NWA	Section 15 and Item 31 of Schedule 4	First conviction: Fine or imprisonment for a period not exceeding 5 years, or both a fine and such imprisonment. Second or subsequent conviction: Fine or imprisonment for a period not exceeding 10 years, or both a fine and such imprisonment.
NEM:WA	Section 67 (1) (a), (g) or (h)	Fine not exceeding R 10 million or imprisonment for a period not exceeding 10 years, or both such fine and such imprisonment, in addition to other penalties that may be imposed in terms of NEMA.
	Section 67 (1) (b), (c), (d), (e), (f), (i), (j), (k) or (l), and Section 67 (2) (a),	Fine not exceeding R 5 million or imprisonment for a period not exceeding 5 years, or both such fine and such imprisonment, in addition to other penalties that may be imposed in terms of NEMA.

LEGISLATION	SECTION	FINE
	(b), (c), (d) or (e)	
	Section 67 (1) (m)	Fine or imprisonment for a period not exceeding 6 months or both a fine and such imprisonment.

4.2 Listed and specified activities

The Kareerand TSF expansion project triggers listed activities in terms of the NEMA, as contained in the amended 2014 Environmental Impact Assessment (EIA) Regulations. The identified listed activities are presented in **Table 4.3** and require that a Scoping and Environmental Impact Reporting (S&EIR) process is followed in order to obtain the necessary Environmental Authorisation (EA) in terms of the NEMA.

The Kareerand TSF expansion project also triggers listed waste management activities in terms of the NEM:WA "List of waste management activities that have, or are likely to have, a detrimental effect on the environment", and thus requires a Waste Management Licence (WML) (**Table 4.4**).

Table 4.3: NEMA Listed Activities triggered by the Kareerand TSF expansion project.

LISTING NOTICE	ACTIVITY NO	ACTIVITY DESCRIPTION	PROJECT ACTIVITY WHICH TRIGGERS THE LISTED ACTIVITY
Listing Notice 1: Government Notice R983 in Government Gazette 38282 of 4 December 2014 and amended by: GN 327 GG 40772 20170407 w.e.f. 7 April 2017 GN 706 GG 41766 20180713 w.e.f. 13 July 2018			
LN1	12	The development of- (i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse.	RWDs = 60 ha; will impact a small watercourse. East Storm Water Dam = 5.6 ha. Development of the TSF within the watercourse. Development of new pump stations
LN1	19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.	TSF expansion will be constructed on the site of a small watercourse
LN1	24	The development of a road- (i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or (ii) with a reserve wider than 13.5 metres, or where no reserve exists where the road is wider than 8 metres.	The development of 8 m wide roads to the TSF. The combined distance of the new roads will be 11 km.
LN1	28	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development: (i) will occur inside an urban area, where the total land to be developed is bigger than 5 hectares; or (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare	Industrial development which will occur on land that was used for agriculture; TSF and associated dams will be 473 ha in size, plus the footprint of the six (6) pump stations (unknown at this stage).

LISTING NOTICE	ACTIVITY NO	ACTIVITY DESCRIPTION	PROJECT ACTIVITY WHICH TRIGGERS THE LISTED ACTIVITY
LN1	31	The decommissioning of existing facilities, structures or infrastructure for- (i) any development and related operation activity or activities listed in this Notice, Listing Notice 2 of 2014 or Listing Notice 3 of 2014.	During the first ten years of the expansion operation, some of the pump stations and associated infrastructure will be decommissioned.
LN1	46	The expansion and related operation of infrastructure for the bulk transportation of sewage, effluent, process water, wastewater, return water, industrial discharge or slimes where the existing infrastructure- (i) has an internal diameter of 0,36 metres or more; or (ii) has a peak throughput of 120 litres per second or more; and (a) where the facility or infrastructure is expanded by more than 1 000 metres in length; or (b) where the throughput capacity of the facility or infrastructure will be increased by 10% or more.	Process water and slurry pipelines will range from 0.5 m to 0.6 m in diameter and pipeline network will be cumulatively expanded by approximately 30 km.
LN1	48	The expansion of- (i) infrastructure or structures where the physical footprint is expanded by 100 square metres or more.	The TSF expansion footprint will be approximately 380 Ha; expansion will occur over a small watercourse. RWD expansion.
Listing Notice 2: Government Notice R984 in Government Gazette 38282 of 4 December 2014 and amended by: GN 327 GG 40772 20170407 w.e.f. 7 April 2017 GN 706 GG 41766 20180713 w.e.f. 13 July 2018			
LN2	15	The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The total footprint that will be cleared for the proposed project is approximately 473 + footprints of six (6) pump stations (unknown at this stage)

Table 4.4: NEM:WA Listed Activities triggered by the proposed project.

CATEGORY	ACTIVITY NO	ACTIVITY DESCRIPTION	PROJECT ACTIVITY WHICH TRIGGERS WASTE MANAGEMENT ACTIVITY
B	(3)	The recovery of waste including refining, utilization, or co-processing of the waste at a facility that processes in excess of 100 tons of general waste per day or in excess of 1 ton of hazardous waste per day, excluding recovery that takes place as an integral part of an internal manufacturing process within the same premises.	Additional tailings will be processed and deposited on the new TSF.
B	(7)	The disposal of any quantity of hazardous waste to land.	The Kareerand TSF will cater to the disposal of tailings.
B	(11)	The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).	Tailings will be reclaimed from existing old TSF's

5 PROJECT ALTERNATIVES

5.1 TSF Site Selection

The project entails the expansion of the current Kareerand TSF as well as well as extension of pipelines and addition of infrastructure associated with the TSF expansion.

The scope of work covered by the site selection report (Golder, 2016) and the risk report (GCS, 2017) includes:

- Site selection and risk analysis on identified options;
- Identification and quantification of potential latent environmental risks related to post closure of each option;
- Discussion of risk management approaches; and
- Quantification of potential liabilities associated with management of the risks.

5.1.1 Site Options

5.1.1.1 Option 1

This site is located on the existing Buffelsfontein TSF footprint (shown in dark red in **Figure 5-1**). Site area is 300 ha, can accommodate 230 Mt, 70 m high at a deposition rate of 10 Mt/a. Located on dolomite. Area required for expansion incorporates the current Buffelsfontein Gold Plant which is not owned by MWS.

5.1.1.2 Option 2

This site is located directly north of the existing MWS plant, on a TSF footprint area (shown in orange in **Figure 5-1**). Consists of 4 cells: 2a, b, c, and d; of which 2b is a greenfields site and 2c is an existing TSF, still to be reclaimed. The entire footprint area can accommodate 560 Mt at 70 m high at a deposition rate of 30 Mt/a. Located on dolomite. Land mostly owned by MWS.

5.1.1.3 Option 3

This site is located north of the existing MWS plant, on a greenfields area (shown in dark yellow in **Figure 5-1).** The entire footprint area can accommodate 560 Mt at 70 m high at a deposition rate of 30 Mt/a. Located on dolomite. Land mostly owned by MWS.

5.1.1.4 Option 4

This site is a greenfields site located directly west of the current Kareerand TSF (shown in pale yellow in **Figure 5-1).** An area of 615 ha is available, which caters for 456 – 584 Mt at a deposition rate of >30 Mt/a. The land is owned by and leased from the community. Site is not located on dolomite.

5.1.1.5 Option 5

This site is a greenfields site located north of the current Kareerand TSF (shown in blue in **Figure 5-1**). An area of 560 ha is available. The land is owned by a private landowner. Site is not located on dolomite. The expected tonnages available at this site option were not calculated.

5.1.1.6 Option 6

This site is a greenfields site located directly to the south of the current Kareerand TSF (shown in purple in **Figure 5-1**). An area of 730 ha is available. The land belongs to a private landowner. Site is not located on dolomite. The TSF footprint would be located within the 500 m buffer zone of the Vaal River. The expected tonnages available at this site option were not calculated.

5.1.1.7 Option 7

This site is a greenfields site located southwest of the current Kareerand TSF (shown in pink in **Figure 5-1**). An area of >510 ha is available. The land belongs to MWS. Site is not located on dolomite. The TSF footprint would be located within the 500 m buffer zone of the Vaal River. The expected tonnages available at this site option were not calculated.

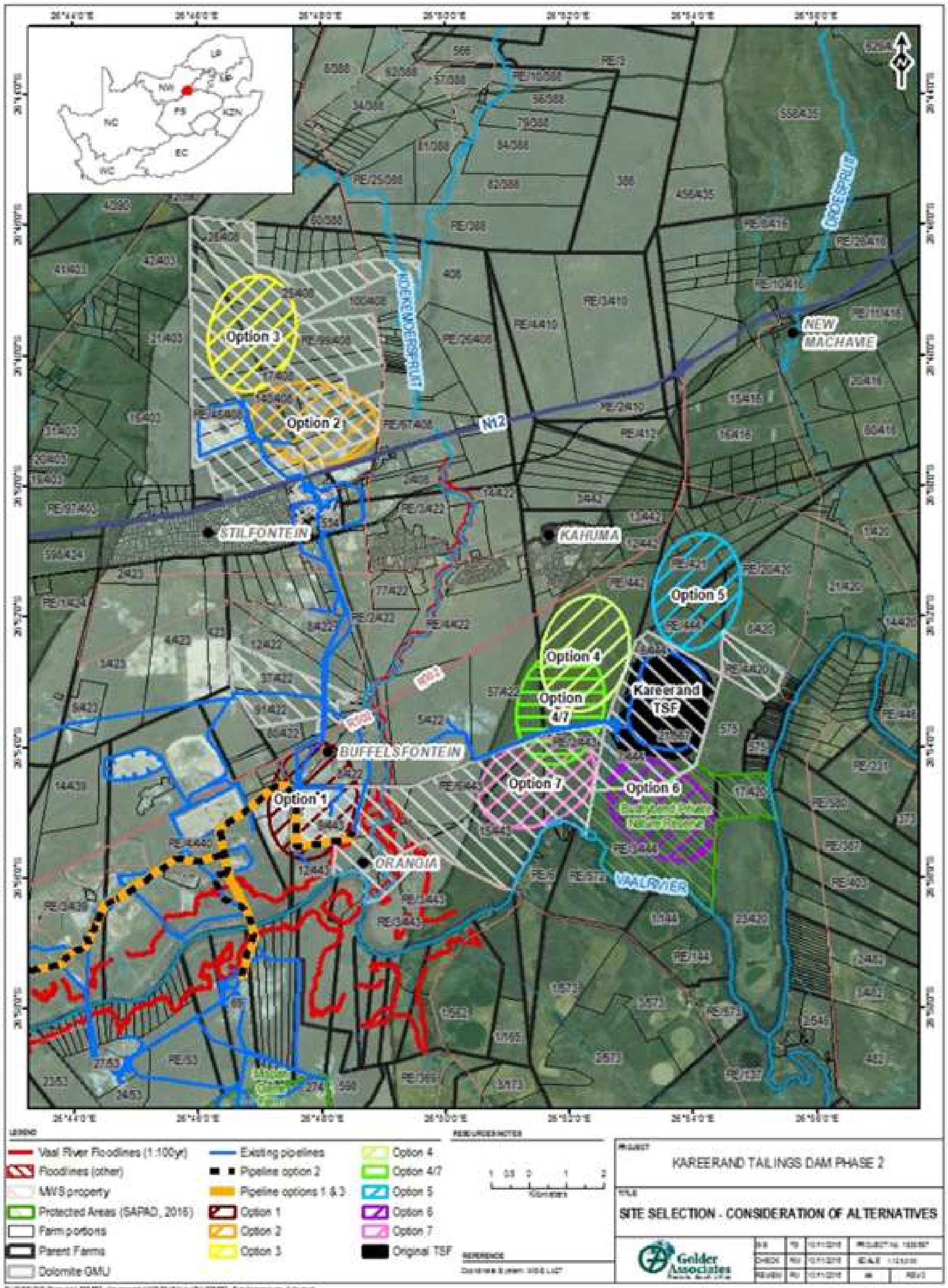

Figure 5-1: The seven alternatives investigated to identify the best site for the TSF expansion project (Golder Associates, 2016).

5.1.2 Risk Identification Process

Risk management is a continual process, performed throughout the life cycle of a system or project. It is an organised methodology for continuously identifying and measuring the unknowns; developing mitigation options; selecting, planning, and implementing appropriate risk mitigations; and tracking the implementation to ensure successful risk reduction.

Effective risk management depends on risk management planning; early identification and analysis of risks; early implementation of corrective actions; continuous monitoring and reassessment; and communication, documentation, and coordination. The risk management process model includes the following key activities, performed on a continuous basis:

- Risk Identification;
- Risk Analysis;
- Risk Mitigation Planning;
- Risk Mitigation Plan Implementation; and
- Risk Tracking.

5.1.2.1 Risk Identification

Risk identification is the activity that examines each element of the project to identify associated root causes, begin risk documentation, and set the stage for successful risk management. Risk identification begins as early as possible and continues throughout the project with regular reviews and analysis.

5.1.2.2 Risk Analysis

Risk analysis is the activity of examining each identified risk to refine the description of the risk, isolate the cause, determine the effects, and aid in setting risk mitigation priorities and strategies. It defines each risk in terms of its likelihood, its consequence, and its relationship to other risk areas or processes. Analysis begins with a detailed study of the risks that have been identified. The objective is to gather sufficient information about future risks to judge the root causes, the likelihood, and the consequence/s of the risk, should it occur. The frequently used term “risk assessment” includes the distinct activities of risk identification and risk analysis.

5.1.2.3 Risk Mitigation

Risk mitigation identification is the activity that identifies, evaluates, and selects options to set risk at acceptable levels given program constraints and objectives. Risk mitigation planning is intended to enable program success. It includes the specifics of what should be done, when it should be accomplished, who is responsible, and the funding required to implement the risk mitigation plan. The most appropriate program approach is selected from the mitigation options listed below and documented in a risk mitigation plan. One or more of these mitigation options may apply:

- Avoiding risk by eliminating the root cause and/ or the consequence;
- Controlling the cause or consequence;
- Transferring the risk; and/ or
- Assuming the level of risk and continuing on the current program plan.

5.1.3 Site Alternative Risk Matrix

Each of the seven (7) site options discussed above was subjected to the risk assessment process. The risks associated with each option are detailed below. The standardised risk categories that were used in the analysis of the risks are shown in **Table 5.1**. The risk matrices for all seven (7) options can be found in the Site Selection Report (**Appendix C**).

Table 5.1: Standardised risk categories.

Risk Category	Risk Categories
1	Ownership
2	Surface Water
3	Ground Water
4	Topography
5	Soils
6	Flora
7	Fauna
8	Air Quality
9	Noise
10	Sensitive Landscapes
11	Visual
12	Land Use and Capabilities
13	Erosion
14	Traffic
15	Social Impact
16	Safety
17	Geology
18	Heritage/Archaeology
19	Design

5.1.3.1 Option 1

Table 5.2: Risks associated with site Option 1.

Description	Risk

Underground dolomite will have an influence on the design of the tailings facility which will result in problems with stability. Failure of site and financial implication is some of the key concerns.	Extreme
Water quality and the designed barrier will allow for infiltration and interception with underground water resources. Water quality could have a short medium- and long-term effect.	Extreme
Site unable to carry the volume required for functioning. Financial and volume crises	Extreme
Infrastructure safety in mining is a key aspect of a mine's reputation. The size of the facility will increase reputational risk	Extreme
Continuous rehabilitation requires significant volumes of topsoil which might not be available at site.	Extreme
Full Environmental Impact Assessment is required which will have a major effect on the timelines required for the overall project. Timelines for the operation of the site is critical to the project	Extreme

5.1.3.2 Option 2

Table 5.3: Risks associated with Option 2.

Description	Risk
Underground dolomite will have an influence on the design of the tailings facility which will result in problems with stability. Failure of site and financial implication is some of the key concerns.	Extreme
Water quality and the designed barrier will allow for infiltration and interception with underground water resources. Water quality could have a short medium- and long-term effect.	Extreme
The proximity to people could have a negative social sentiment to communities. The social sentiment and timeframe risk is of concern	Extreme
Full Environmental Impact Assessment is required which will have a major effect on the timelines required for the overall project. Timelines for the operation of the site is critical to the project	Extreme
The height of facility will have a long-term effect on the aesthetics of the surrounding environment. Social perception and sentiment are the key concern.	Extreme
Dust generation during the operations of the facility will cause fallout of PM_{10} and $PM_{2.5}$ beyond the boundary of the facility. Health and social sentiment will be key concerns.	Extreme
Continuous rehabilitation requires significant volumes of topsoil which might not be available at site.	Extreme

5.1.3.3 Option 3

Table 5.4: Risks associated with Option 3.

Description	Risk
Underground dolomite will have an influence on the design of the tailings facility which will result in problems with stability. Failure of site and financial implication is some of the key concerns.	Extreme
Water quality and the designed barrier will allow for infiltration and interception with underground water resources. Water quality could have a short, medium- and long-term effect.	Extreme
The size of the facility will have an impact on possible Archeological finds in the region. Graves are a key concern.	Extreme
Continuous rehabilitation requires significant volumes of topsoil which might not be available at site.	Extreme
Full Environmental Impact Assessment is required which will have a major effect on the timelines required for the overall project. Timelines for the operation of the site is critical to the project	Extreme

5.1.3.4 Option 4

Table 5.5: Risks associated with Option 4.

Description	Risk
The size of the facility will have an impact on possible archeological finds in the region. Graves are a key concern.	Extreme
Alternative barrier design (Liner Designs) will cause a negative sentiment to the pollution aspect of the surrounding environment. Social sentiment and scientific facts could influence timeframe and financial risks.	Extreme
The height of facility will have a long-term effect on the aesthetics of the surrounding environment. Social perception and sentiment are the key concern.	Extreme
Full Environmental Impact Assessment is required which will have a major effect on the timelines required for the overall project. Timelines for the operation of the site is critical to the project	Extreme
Ownership surface rights of selected area would require contractual agreements to be negotiated. A timeframe risk will be a key concern.	Extreme

5.1.3.5 Option 5

Table 5.6: Risks associated with Option 5.

Description	Risk

The size of the facility will have an impact on possible Archeological finds in the region. Graves are a key concern.	Extreme
Ownership surface rights of selected area would require contractual agreements to be negotiated. A timeframe risk will be a key concern.	Extreme
Alternative barrier design (Liner Designs) will cause a negative sentiment to the pollution aspect of the surrounding environment. Social sentiment and scientific facts could influence timeframe and financial risks.	Extreme
The height of facility will have a long-term effect on the aesthetics of the surrounding environment. Social perception and sentiment are the key concern.	Extreme
Dust generation during the operations of the facility will cause fallout of PM_{10} and $PM_{2.5}$ beyond the boundary of the facility. Health and social sentiment will be key concerns.	Extreme
Full Environmental Impact Assessment is required which will have a major effect on the timelines required for the overall project. Timelines for the operation of the site is critical to the project	Extreme

5.1.3.6 Option 6

Table 5.7: Risks associated with Option 6.

Description	Risk
The size of the facility will have an impact on possible Archeological finds in the region. Graves are a key concern.	Extreme
Ownership surface rights of selected area would require contractual agreements to be negotiated. A timeframe risk will be a key concern.	Extreme
Alternative barrier design (Liner Designs) will cause a negative sentiment to the pollution aspect of the surrounding environment. Social sentiment and scientific facts could influence timeframe and financial risks.	Extreme
Full Environmental Impact Assessment is required which will have a major effect on the timelines required for the overall project. Timelines for the operation of the site is critical to the project	Extreme

5.1.3.7 Option 7

Table 5.8: Risks associated with Option 7.

Description	Risk
Impact of facility on flood lines, fountains, wetlands and buffer zones could have a detrimental effect on surrounding and district communities. Water quality and financial implications key concerns	Extreme

Water quality and the designed barrier will allow for infiltration and interception with underground water resources. Water quality could have a short medium- and long-term effect.	Extreme
The size of the facility will have an impact on possible Archeological finds in the region. Graves are a key concern.	Extreme
Alternative barrier design (Liner Designs) will cause a negative sentiment to the pollution aspect of the surrounding environment. Social sentiment and scientific facts could influence timeframe and financial risks.	Extreme
Full Environmental Impact Assessment is required which will have a major effect on the timelines required for the overall project. Timelines for the operation of the site is critical to the project	Extreme

5.1.4 Risk Summary

These impacts are specifically related to the alternative required for an option analysis for the placement of the expanded Kareerand Tailings Storage Facility.

5.1.4.1 High Extreme Risks

- Option 1
  - This site option was rejected as the site will not be able to accommodate the volume required for the project, therefore this site is fatally flawed.
- Option 2
  - This site option was rejected as the site is located in close proximity to a developed residential area, increasing the possibility of social impact and risk to human life should the facility experience structural failure.
- Option 6
  - The key extreme risk was identified in terms of ownership rights, as these will be extremely difficult to get. This risk will be very difficult to mitigate as the site is privately owned land and the owner is reluctant to negotiate.

5.1.4.2 Extreme Risks Difficult to Mitigate

- Option 3
  - Five (5) extreme risks were identified:
    - Underlying dolomite will have a major impact on the design and stability of the tailings facility;
    - The impact of the facility on underground water bodies due to the liner barrier design that will be used;

        - The size of the facility will have an impact on possible archaeology finds which will have a timeframe risk;
        - The significant topsoil requirement, and lack of availability in the area will have an influence on continuous rehabilitation; and
        - Full environmental impact assessment is required which will have a major effect on the project.

- Option 7
    - Five (5) extreme risks were identified:
        - The impact of tailings facility on flood lines, fountains, wetlands and buffer zones especially the Vaal river system could be a major disaster;
        - The impact of the facility on underground water bodies due to the liner barrier design especially the Vaal river system could be a major disaster;
        - The size of the facility will have an impact on possible archaeology finds which will have a timeframe risk;
        - An alternative barrier design may have a major effect on this property; and
        - Full environmental impact assessment is required which will have a major effect on the project.

5.1.4.3 More Manageable Extreme Risks

- Option 5
    - Three (3) extreme risks which could not be mitigated were identified:
        - Ownership of surface rights of selected area would require contractual agreements to be negotiated;
        - The size of the facility will have an impact on possible archaeology finds which will have a timeframe risk; and
        - The alternative barrier design may have a major effect on this property.
- Option 4
    - Three (3) risks were identified:
        - Ownership of surface rights of selected area would require contractual agreements to be negotiated;

- The size of the facility will have an impact on possible archaeology finds which will have a timeframe risk; and
- The alternative liner design may have major environmental and social effects on this property.

5.1.5 Site Selection

Using the matrix-based risk approach, identified risks were subjected to mitigation strategies to determine the possibility of reducing the risk rating. For certain aspects under assessment, risks were able to be mitigated, but for others- such as dolomite structures underneath the tailings storage facility- these risks had to be accepted.

In conclusion, two options (options 4 and 5) were identified as least disruptive according to the environmental, social and technical criteria used. Thereafter, Option 4 was chosen as the preferred site for the following reasons:

- Expansion to the current facility, containing the impact to a single site, which makes it easier to manage and mitigate;
- Area is not underlain by dolomite;
- Land is on a 99-year lease to the applicant; and
- Existing infrastructure will be used by the expanded facility, reducing environmental impact associated with introducing new associated infrastructure.

6 RECEIVING ENVIRONMENT

The baseline environment is described within this Chapter. The baseline environment provides a status against which to assess the proposed project activities and potential impacts.

6.1 Geology

The site is underlain by the following geological units (**Figure 6-1**), as per the regional geological map "Far West Rand, 1:250 000, South African Geological Survey, 1981":

- Vmd - Dolomite, chert and remnants of chert breccia;
- Vt - Ferruginous shale, hornfels, ferruginous quartzite;
- Vh – Andesitic lava, subordinate pyroclastic rocks, minor quartzite, shale and conglomerate;
- Vs – Ferruginous shale and quartzite;
- Vd – Quartzite and shale, ferruginous in places;
- Vdi – Diabase; and
- A – Alluvial deposits along Vaal River.

The western half of the proposed site is underlain by Andesitic Lava of the Pretoria Group of the Transvaal Sequence and the eastern part of the site by Diabase of the Hekpoort Formation. The Hekpoort Formation of the Pretoria Group is a sequence of basaltic lava turning to andesitic and tuff formations, as well as conglomerates. Andesite is an igneous, volcanic rock of intermediate composition (between basalt and felsite). It is porphyritic and consists of coarse crystals (phenocrysts) embedded in a granular or glassy matrix (groundmass). Diabase is an intrusive rock. Typically, these greenish coloured rocks occur in shaley horizons of the Transvaal Sequence at or near their contact with quartzite. The diabase sills vary in thickness from 1 – 300 m. Chemical decomposition is usually far advanced and residual soils relatively deep.

The development of the soil profile is remarkably close to that of the Hekpoort andesites. These soils are highly expansive and susceptible to heave. The geological units, as described above, dip at an angle of about 50 degrees (°) in a south eastern direction. The strike of the geological units is north east to south west. Most of the faulting (a fault is a natural fracture that cuts through the rock) in the area trends in a south-west to north-east direction and is normal, with displacement both to the north and south of between 10 – 250 m. The geological map indicates a major fault zone that runs from south-west to north-east in the western part of the investigation area, approximately 1.5 km west of the proposed TSF expansion site.

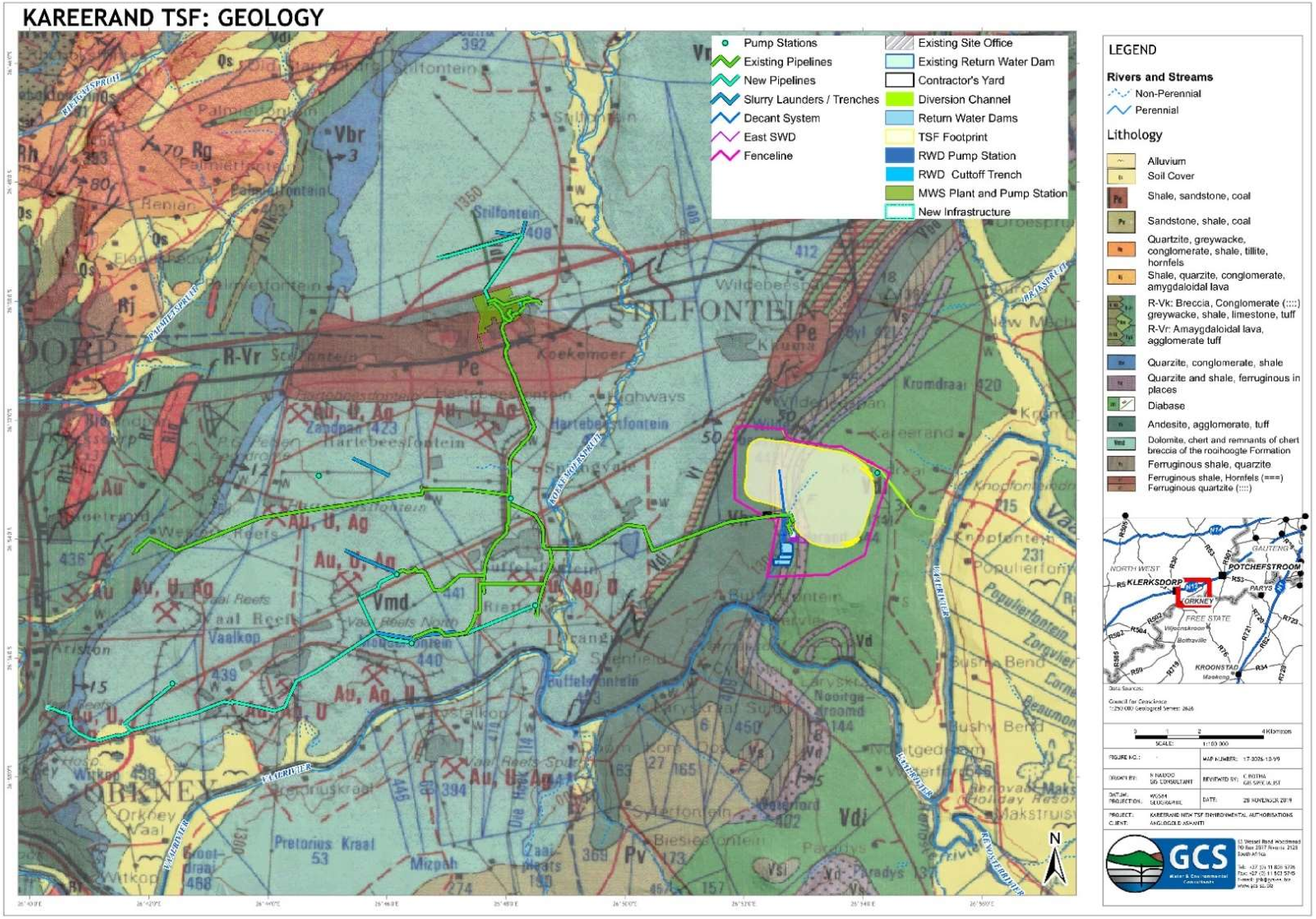

Figure 6-1: Map showing the geology underlying the proposed TSF expansion site.

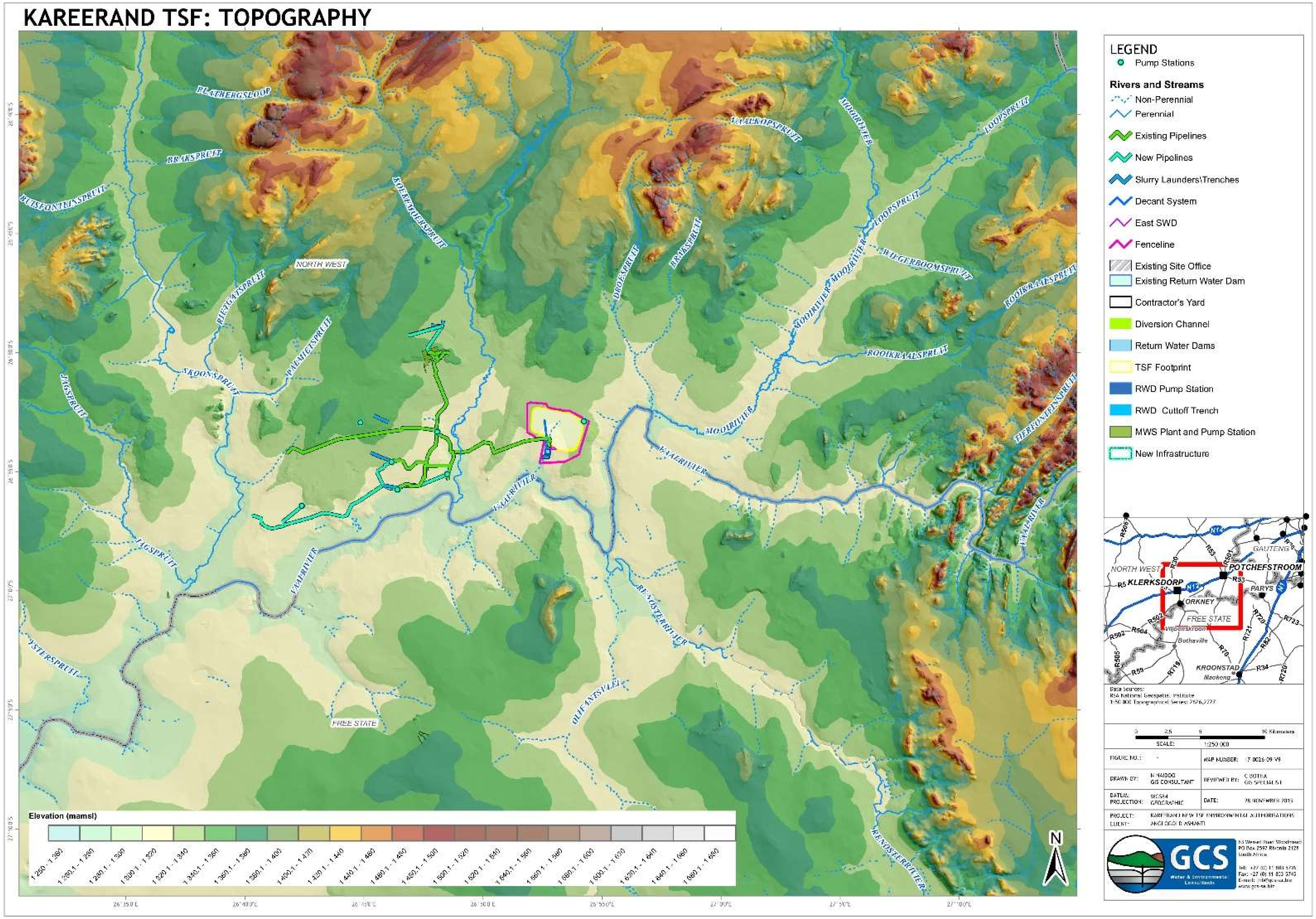

Figure 6-2: Map showing the topography of the area where the proposed TSF expansion is located.

6.2 Topography

The regional elevation ranges between 1 350 metres above mean sea level (mamsl) in the north western part of the investigation area and 1 290 mamsl in the south and east, where the Vaal River flows in a westerly direction (**Figure 6-2**).

The study area is located within the quaternary catchments (C24A, C24B, C24H & C23L). The receiving water body for the proposed site is the Vaal River. The topography of this area does not vary significantly in height and is therefore suited to Kareerand TSF expansion construction. However, increasing the TSF height will generate a definite impact to the current relatively flat scenery.

6.3 Climate

6.3.1 Precipitation

Rainfall is important to air pollution studies since it represents an effective removal mechanism of atmospheric pollutants. Monthly rainfall obtained from the measured Klerksdorp station data for 2016 is presented in **Figure 6-3**. Total annual rainfall from January 2016 to December 2016 amount to 479 mm.

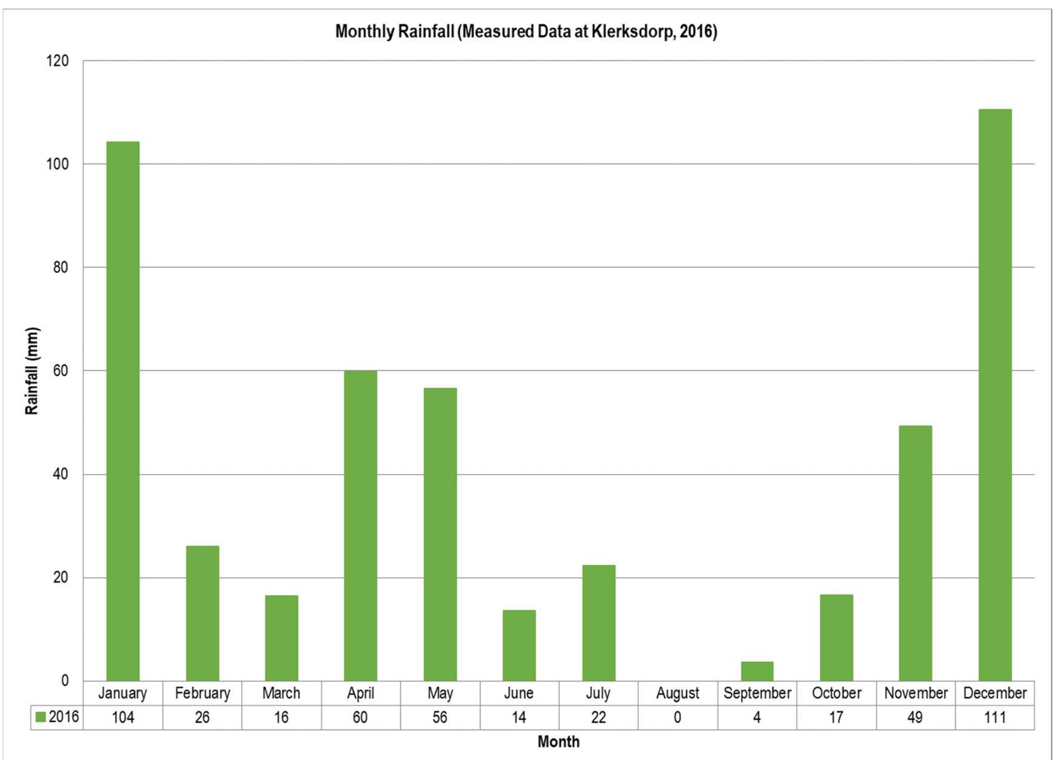

Figure 6-3: Monthly rainfall (Measured data at Klerksdorp, January 2016 to December 2016).

6.3.2 Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the emissions plume and the ambient air, the higher the plume can rise), and determining the development of the mixing and inversion layers.

Monthly mean, maximum and minimum temperatures are given in **Table 6.1**. Diurnal temperature variability is presented in **Figure 6-4**. Temperatures ranged between -6 °C and 38 °C. The highest temperatures occurred in December and the lowest in June and July. During the day, temperatures increase to reach maximum at around 14:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 06:00 i.e. just before sunrise.

Table 6.1: Monthly temperature summary (measured data, January 2018 to December 2019).

Monthly Minimum, Maximum and Average Temperatures (°C)												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Monthly Average	24	22	21	17	13	9	9	15	17	21	23	23
Hourly Maximum	37	33	34	28	28	26	27	29	34	36	37	38
Hourly Minimum	10	11	10	4	-1	-6	-6	-3	-3	3	5	10

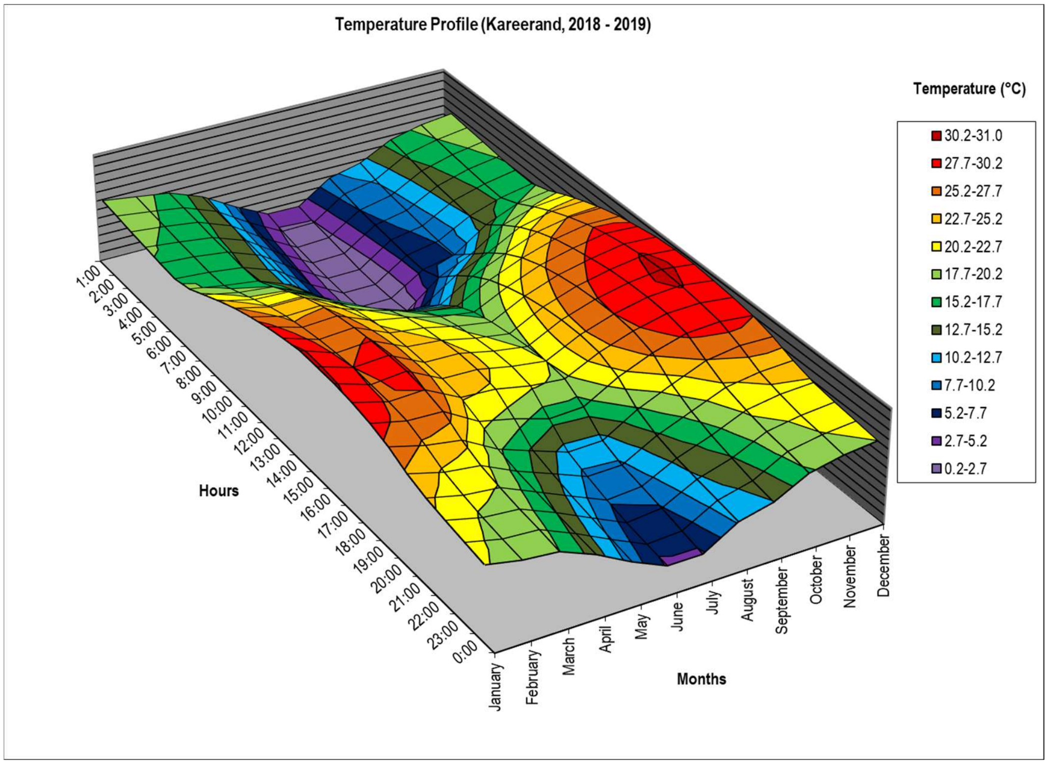

Figure 6-4: Diurnal temperature profile (measured data, January 2018 to December 2019).

6.4 Soils, Land Use and Land Capability

6.4.1 Field Crop Boundaries

The field crop boundaries data layers of both North West and Free State provinces (Department of Forestry and Fisheries- DAFF, 2019) indicated that old fields are present within the footprint of the new TSF area as well as directly north of the existing TSF. Other crop fields include rainfed crops or planted pastures north and east of the proposed development area as well as center pivot irrigation north-west, east and south-east of this area.

6.4.2 Soil Classification

The total area of land where soil classification was conducted is 3938 ha. In this area, twenty-two different soil forms were identified, including Hutton, Oakleaf, Fernwood, Sepane, Sterkspruit, Swartland, Valsrivier, Mayo, Willowbrook, Bonheim, Steendal, Milkwood, Arcadia, Katspruit, Rensburg, Shortlands, Clovelly, Glencoe, Dresden, Lichtenburg, Mispah and Glenrosa. However, a large portion of the study area will not be affected by the construction or operation of the Kareerand TSF Expansion. The areas which will be affected by the project include the entire area within the proposed boundary fence as well as the stormwater trench and a buffer zone of 50 m on either side of the trench. Within this area, seventeen soil forms are present. These soil forms are Hutton, Clovelly, Lichtenburg, Shortlands, Swartland, Valsrivier, Oakleaf, Mayo, Oakleaf, Willowbrook, Milkwood, Arcadia, Katspruit, Rensburg, Glencoe, Dresden, Mispah and Glenrosa forms. These soil forms are presented as fifteen different mapping units in **Figure 6-5** and a summary of each unit is included below:

- Vaalbos form:
  - Largest portion of proposed project area (366 ha);
  - Soil depth ranges between 0.5 and 1.0 m;
  - Red apedal soils (previously referred to as the Hutton form) with no restrictions shallower than 0.5m are generally good for crop production (Fey, 2010), permitting that the climate is suitable for crop production; and
  - Consists of orthic A horizon on a red, apedal B horizon overlying hard rock.
- Carolina form:
  - Approximately 48 ha;
  - Structural and textural characteristics similar to above, except for the colour of the B1 apedal horizon.

- Lichtenburg form:
  - Approximately 14 ha, occurring in two separate areas along the western and northern boundaries;
  - Depth on site ranges between 0.7 and 0.9 m; and
  - Consists of orthic A horizon, underlain by a red apedal B1 subsoil horizon that is limited in depth by hard plinthic material.
- Glencoe form:
  - Approximately 4 ha along the northern section;
  - Depth of soil profiles is between 0.6 and 0.9 m; and
  - Consists of orthic A horizon, underlain by a yellow-brown apedal horizon that is restricted in depth by hard plinthic material (also known as ferricrete).
- Dresden form:
  - Occurs in small, narrow section of approximately 3 ha along the south-eastern corner of the proposed fence line;
  - Shallow soil depth (less than 0.4 m);
  - Consists of orthic A horizon underlain by hard plinthite; and
  - No mottling was observed directly above the hard plinthite.
- Oakleaf form:
  - 2 ha in most easterly section of the proposed stormwater diversion trench; and
  - Consists of orthic A horizon underlain by a thick neocutanic horizon. Neocutanic horizon consists of a mixture of soil colours and has a weakly developed structure. Development of thick neocutanic horizon is likely a result of alluvial deposits from the Vaal River which have undergone an intermediate level of pedogenesis.
- Nshawu form:
  - Approximately 66 ha in the south-eastern corner of project area and around the middle of the stormwater diversion channel;
  - Soil profiles consist of an orthic A horizon that is underlain by a red structured B1 subsoil horizon; and

- Depth-limiting material underneath the red structured horizon consists of hard rock.

- Spioenberg form:
    - Approximately 66 ha along the northern boundary; and
    - Orthic A horizon underlain by pedocutanic subsoil horizon. The pedocutanic horizon is limited in depth by hard rock that occurs at soil depths of between 1.0 and 1.3 m.
- Milkwood form:
    - Approximately 4 ha present in two small pockets present south of the existing Kareerand TSF and one small pocket directly east of the north-eastern corner of the existing TSF; and
    - Represents shallow melanic topsoil (between 0.2 and 0.4 m deep) on hard rock.
- Mayo form:
    - 3 ha along the south-eastern corner of the existing Kareerand TSF; and
    - Profiles consist of melanic topsoil horizon (between 0.2 and 0.4 m deep) underlain by lithic material.
- Willowbrook form:
    - 21 ha supporting wetland functionality of landscape south of the existing Kareerand TSF;
    - Indicative of permanent wetland zone; and
    - Melanic topsoil horizon that is underlain by gley.
- Katspruit/Rensburg forms:
    - Grouped into one map unit as they occur in close proximity to each other in the permanent wetland zone directly south of the existing Kareerand TSF; and
    - Approximately 14 ha.
- Rustenburg form:
    - 76 ha of project area;
    - Vertic surface horizon underlain by hard rock;

   - Vertic horizon is dark brown to black and ranges in depth between 0.7 and 1.1 m deep on site; and
   - Vertic soil has high clay content with swelling-shrinking properties under conditions of fluctuating water content. When the vertic soil horizon dries out (especially during winter months), small cracks are visible on the soil surface.
- Mispah/Glenrosa forms:
   - Shallow soil underlain by either hard rock or lithic material;
   - 138 ha present along the northern and southern fringes of the existing TSF, as well as the south-western corner of the proposed Kareerand TSF expansion footprint;
   - Grouped together as they occur in close proximity to each other; and
   - Mispah and Glenrosa forms differ only in depth-limiting material underlying the orthic A horizon- for Mispah form, underlying material is hard rock and for Glenrosa form, it is lithic material.

6.4.3 Soil Texture

Soil texture within the proposed development area falls within one of four soil textural classes i.e. Sandy Loam, Sandy Clay Loam, Sandy Clay and Clay. The apedal horizons of the Vaalbos and Carolina soil forms have Sandy Loam texture. The soil forms with weakly to more strongly developed structures, such as Spioenberg, have Sandy Clay Loam to Sandy Clay texture. Soil forms with vertic topsoil such as the Rensburg and Rustenburg forms, have Clay texture.

6.4.4 Soil Fertility Parameters

The soil pH values range between a strongly acidic value of 4.16 (sample KR09) to a slightly acidic value of 6.05 (sample KR02). None of the samples analysed had neutral to alkaline pH values. For the purpose of crop production, pH values above 4.5 are recommended to prevent aluminium toxicities, prevent phosphate fixation and allow for optimal nutrient uptake by crop roots. However, the areas from which the samples were collected have not been used for crop production for at least ten years and the soil pH analysis results are not considered problematic for livestock production.

The calcium levels range between 382.5 mg/kg (sample KR09) and 2 885.6 mg/kg (sample KR16). The magnesium levels are the lowest in sample KR09 at 128.5 mg/kg and highest in sample KR15 at 1340.6 mg/kg. The potassium levels range between 23.5 mg/kg in sample KR08 and 211.6 mg/kg in sample KR16.

The plant-available phosphorus levels were low in all samples analysed, ranging between 2.0 mg/kg and 7.0 mg/kg. These low levels are common for undisturbed soil profiles in South Africa and higher levels are usually found in crop fields where phosphorus is supplemented with fertilizer, or in forested areas with much higher soil organic matter.

A wide range of sodium concentrations are present in soil on site, ranging from very low at 0.50 mg/kg to much higher concentrations of 350 mg/kg (as measured in sample KR02). Although sodium is not considered an essential plant nutrient and can cause soil sodicity when present in very high concentrations, a number of C4 plants use sodium for the concentration of carbon dioxide, thereby aiding in maximum biomass yield in these plants (Subbarao et al., 2003).

6.4.5 Land Capability

According to land capability raster data layer published by DAFF in 2017 and used by the Department of Environmental Affairs (DEA) Online Screening Tool, the eastern half of the proposed TSF footprint can be classified as having Moderate-High land capability. According to the data, the western half of small sections with Low land capability and larger areas with Moderate land capability, the area south of the existing TSF consists largely of Moderate land capability and the stormwater trench will run largely through land with Moderate land capability.

Following the results of the soil classification survey as well as other site assessment observations such as the terrain and climate, the entire study area can be divided into eight different land capability classes. The proposed development footprint consists of seven different land capability classes (**Figure 6-6**).

The land capability classes within the proposed development area include Moderate-High (Class 09), Moderate (Class 08), Low-Moderate (Class 07), Low (05), Low-Very Low (Class 04), Low-Very Low (Class 03) and Very low (Class 02). The area west of the existing Kareerand TSF largely consists of soil with Moderate-High land capability that could have been used for crop cultivation. This area consists largely of soil of the Vaalbos, Carolina and Lichtenburg forms. The small area with Oaklands soil profiles bordering on the Vaal River, also has Moderate-High land capability. An area south and south-east of the within the proposed development area consists of Shortland soil with Moderate land capability.

The areas consisting of moderately to strongly structured soil in the northern, eastern and southern sections of the proposed development area have Low land capability and are considered more suitable for grazing purposes. The areas where shallow rocky soil profiles are present have Low to Very Low land capability (Class 04) and livestock grazing is considered to be a more sustainable land use option in these areas. The areas where Low-Very Low (Class 03) and Very Low (Class 02) have been identified, are associated with the permanent responsive zones of the wetland areas south of the existing Kareerand TSF. These areas are not considered suitable for livestock grazing purposes as cattle grazing in these areas will result in trampling and the associated damage to the wetland vegetation.

6.4.6 Land Use

The areas within the proposed development area that were indicated as old fields (**Figure 6-7**), have not been used for crop production for at least the least ten years. This was confirmed by interrogating historical aerial imagery on Google Earth. Following the above-normal rainfall of the past summer season (2019-2020), the veld in the area identified as old crop fields is considered to be in good condition for livestock grazing and includes patches of red grass (*Themeda triandra*). The areas east and south of the existing Kareerand TSF are also used for livestock grazing.

During the last site assessment (30 May 2020), livestock grazing was observed in the area. Three groups of cattle were seen grazing the area and each group was herded by one person. The cattle groups consisted of mixed breeds and the breed mix seems to be dominated by the Brahman breed. Other livestock includes a small herd of goats and a small group of sheep.

No signs of existing land degradation, such as erosion gullies, were found within the proposed development area. However, evidence was found that dumping of household waste is taking place next to the gravel road that enters the site from the northern boundary.

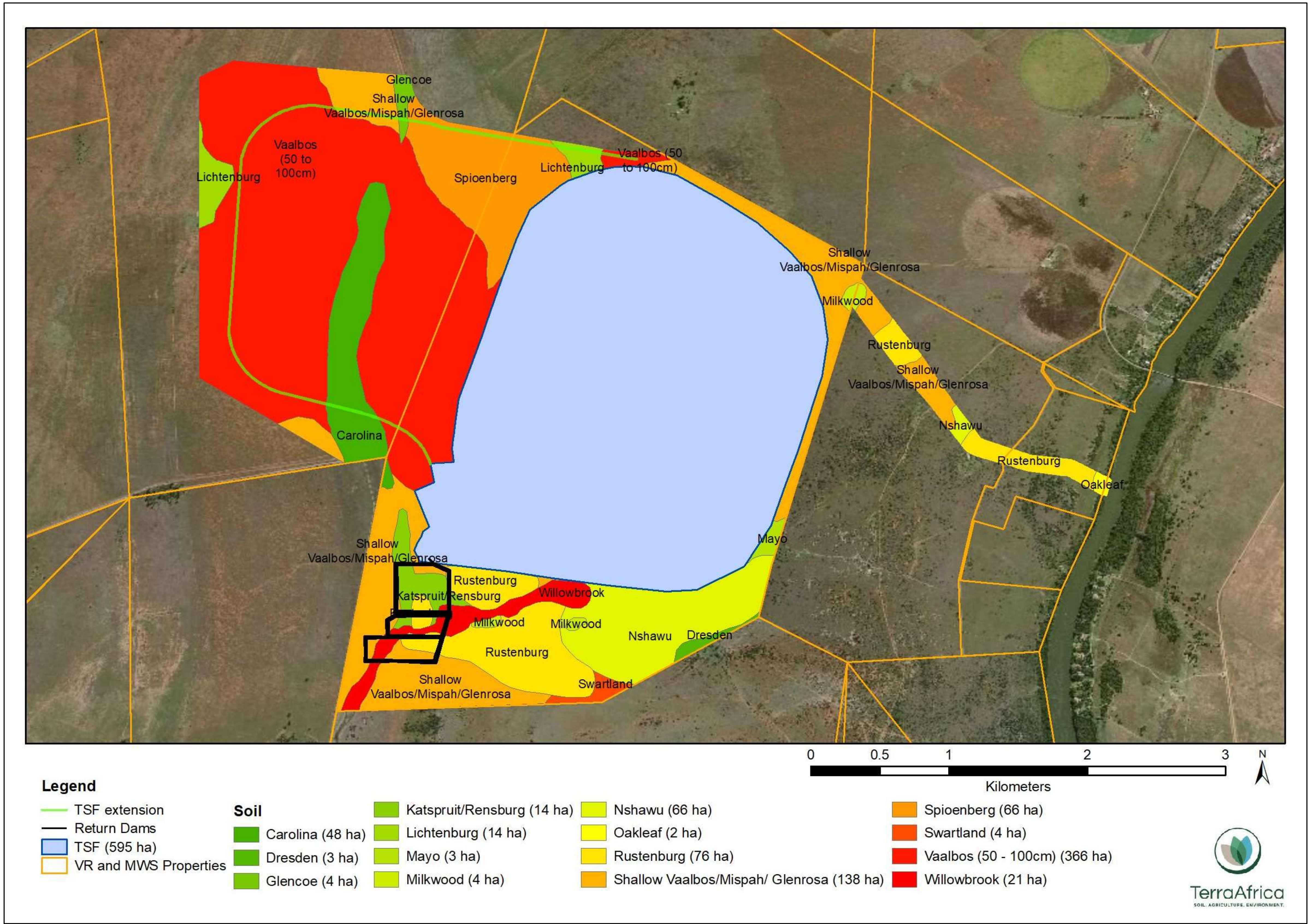

Figure 6-5: Map showing the soil forms within the project area.

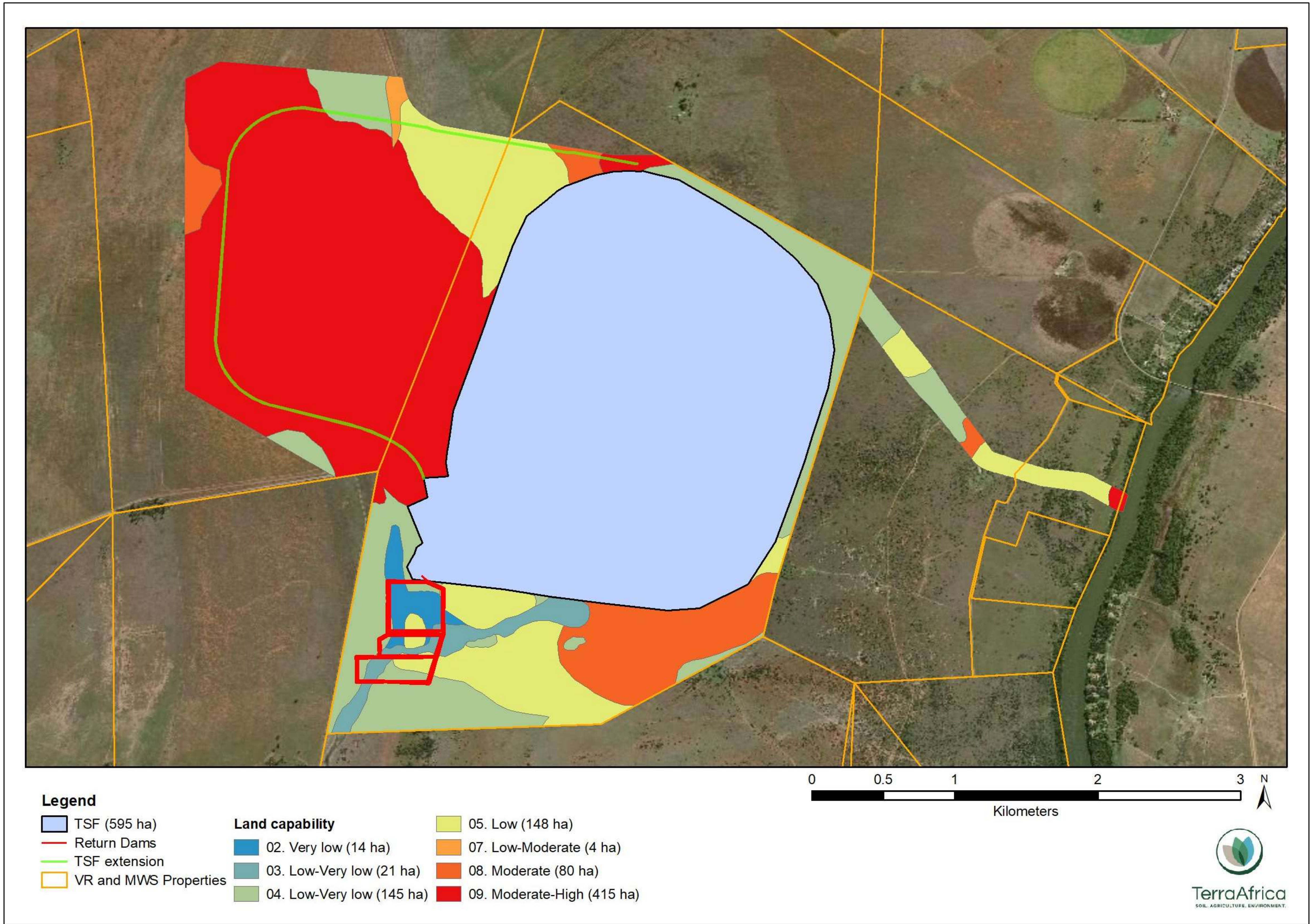

Figure 6-6: Map showing the land capability in the area where the proposed TSF expansion is located.

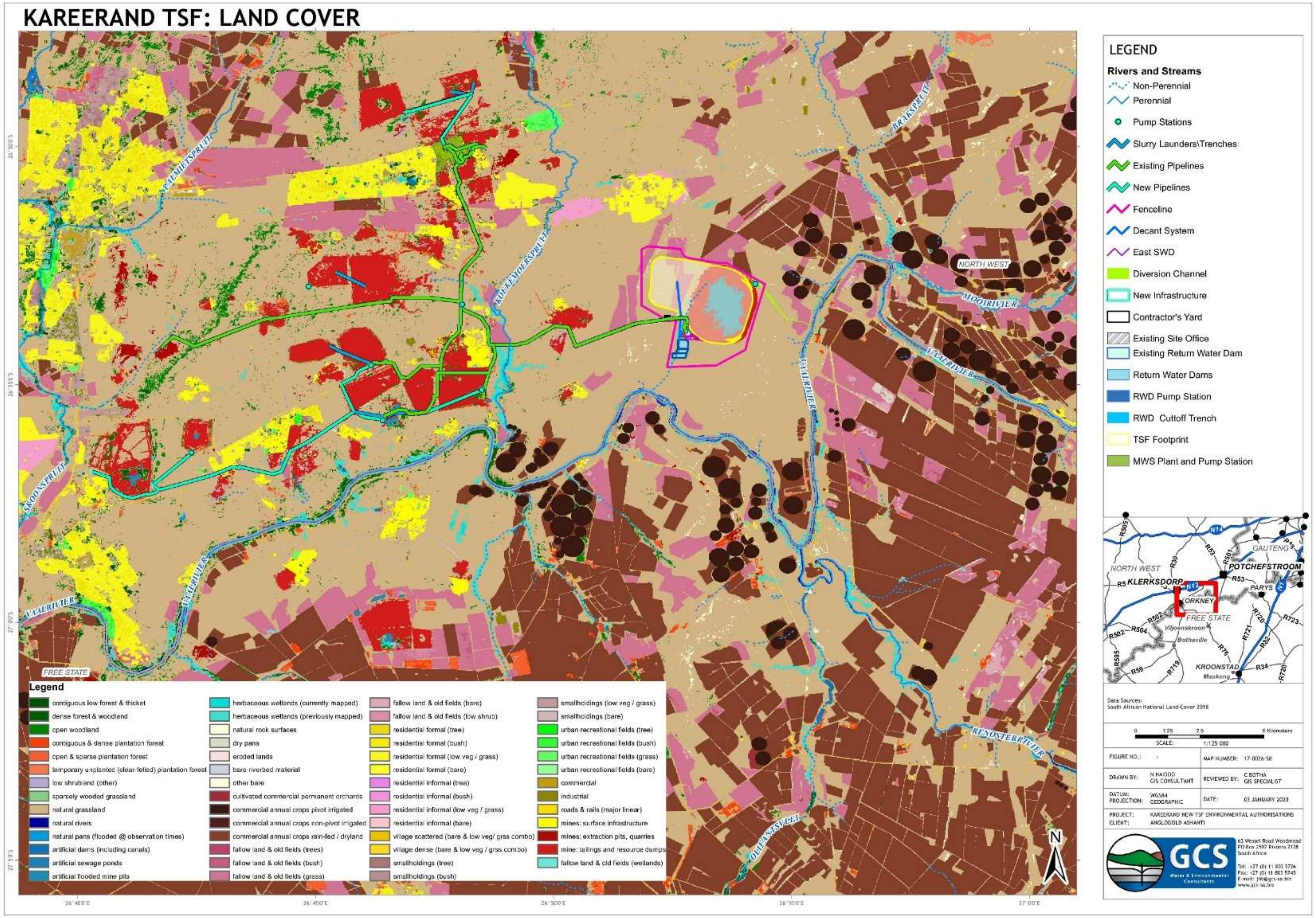

Figure 6-7: Map showing the land use of the area where the proposed TSF expansion is located.

6.5 Hydrology

The study area falls within quaternary catchments C24A, C24B, C24H and C23L (**Figure 6-8**).

The surface drainage of the area includes the Koekemoerspruit on the western boundary of the site, the Vaal River on the southern and eastern boundaries and the Droëspruit and Brakspruit on the north-eastern boundary. There is also a small, unnamed, non-perennial river that runs along the western side of the current TSF. The Vaal River is situated approximately 2 km to the south of the proposed TSF expansion. According to the natural contour elevations, surface runoff from this site will naturally flow towards the Vaal River.

6.5.1 Vaal River

Figure 6-9 indicates the geographical localities of the Vaal River water quality monitoring sites. Sites VRS63 and VRS23 represent the upstream and downstream sites for the current Kareerand TSF area. VRS03 represents the downstream site for the total area and is situated at the Orkney Bridge. The "total area" covers the area where tailings material will be mined from old TSFs. The flow of the Vaal River, as recorded at the DWS flow station at Pelgrim's Estate (C2H007), situated down-stream at Orkney, averages approximately 1600 million m^3 per annum (**Figure 6-10**). In dry years, flow can be as low as 225 million m^3 per annum.

Water quality data for the Vaal River is presented by means of sulfate time graphs for the different monitoring sites. **Figure 6-11** shows the sulfate time graph for all sites for the past four (4) years and **Figure 6-12** shows the past four (4) years of sulfate trend data for the sites up- and downstream of Kareerand TSF. The up- and downstream sulfate concentrations fluctuate with seasonal rainfall, but the results are generally similar. Elevated sulfate concentrations were measured in Oct/Nov for the period each year. These might be attributed to operational system issues experienced during storm events and seepage into the non-perennial drainage path running from the south western corner of the TSF to the Vaal River.

Between the up- and downstream sampling points of the Vaal, the Renoster River, a tributary of the Vaal River, feeds into the system from the south. The water quality of the Renoster River may therefore affect the downstream water quality of the Vaal.

6.5.2 Site Surface Water Quality

The effect of the TSF on the small non-perennial stream, flowing towards the Vaal River, is currently monitored at the locations presented in **Figure 6-13** and **Table 6.2.** The sulfate trend graph (**Figure 6-13**) indicates high sulfate concentrations in the system because of seepage and surface flows from the TSF area. The increasing trend towards 2019 is due to very low to dry conditions, which results in stagnant pools and accumulation of salts due to evaporation.

Table 6.2: Kareerand TSF surface water sample descriptions.

ID	Description	Surf X Cape LO27	Surf Y Cape LO27
KM08	Return water canal before Return Water Dam	-11772.20	-2976066.63
KM09	Vlei area at dam wall, south west of TSF complex	-12134.68	-2976504.12
KM10	Seepage on Western side of Kareerand TSF	-11638.40	-2974739.02
KM12	March area south of BH16	-11444.24	-2976662.87
KM13	Lower dam	-12172.25	-2976837.76
KM15	Stream at game park fence before Vaal River	-12997.81	-2978271.02

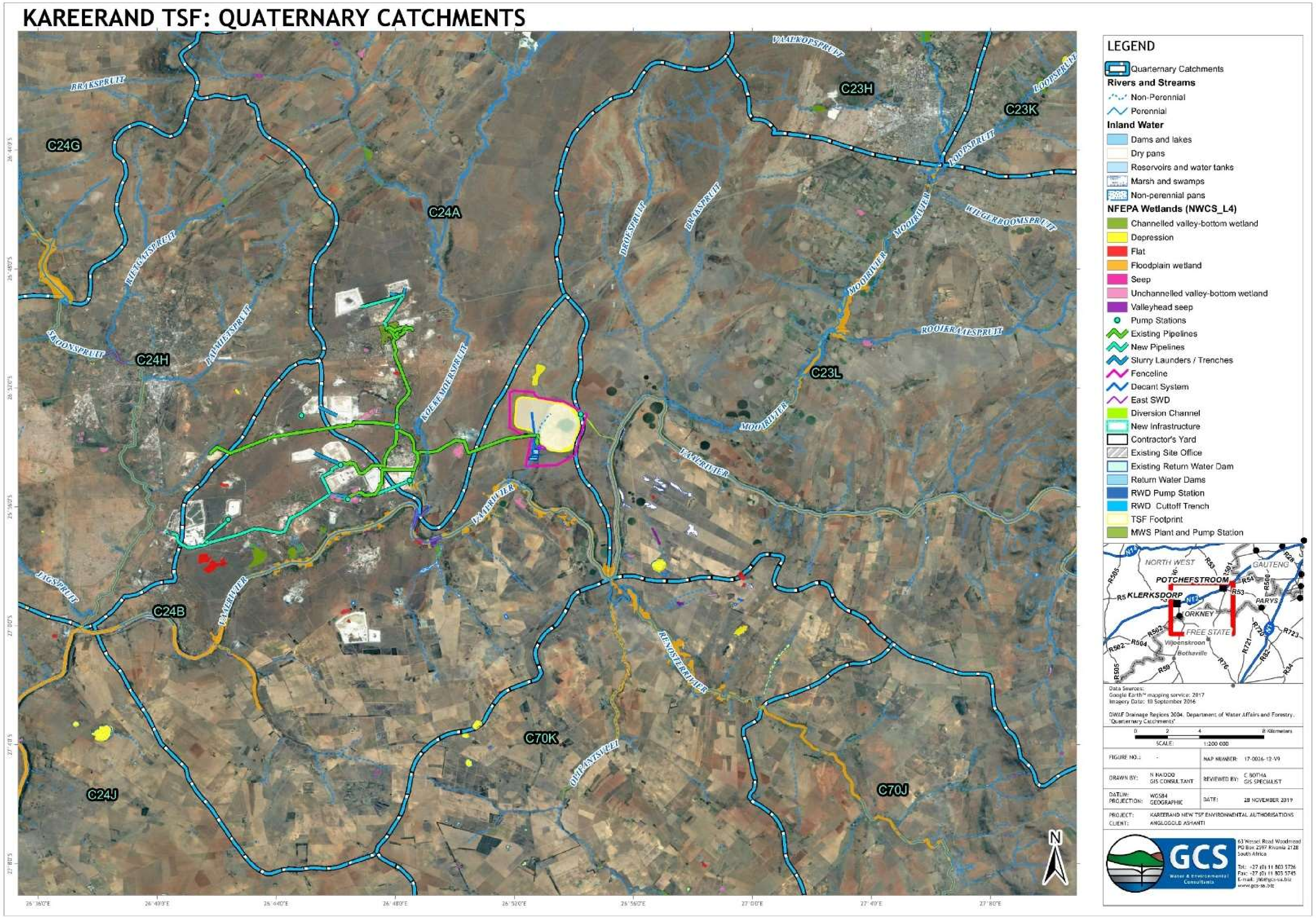

Figure 6-8: Map showing the quaternary catchment units within which the proposed TSF expansion is located.

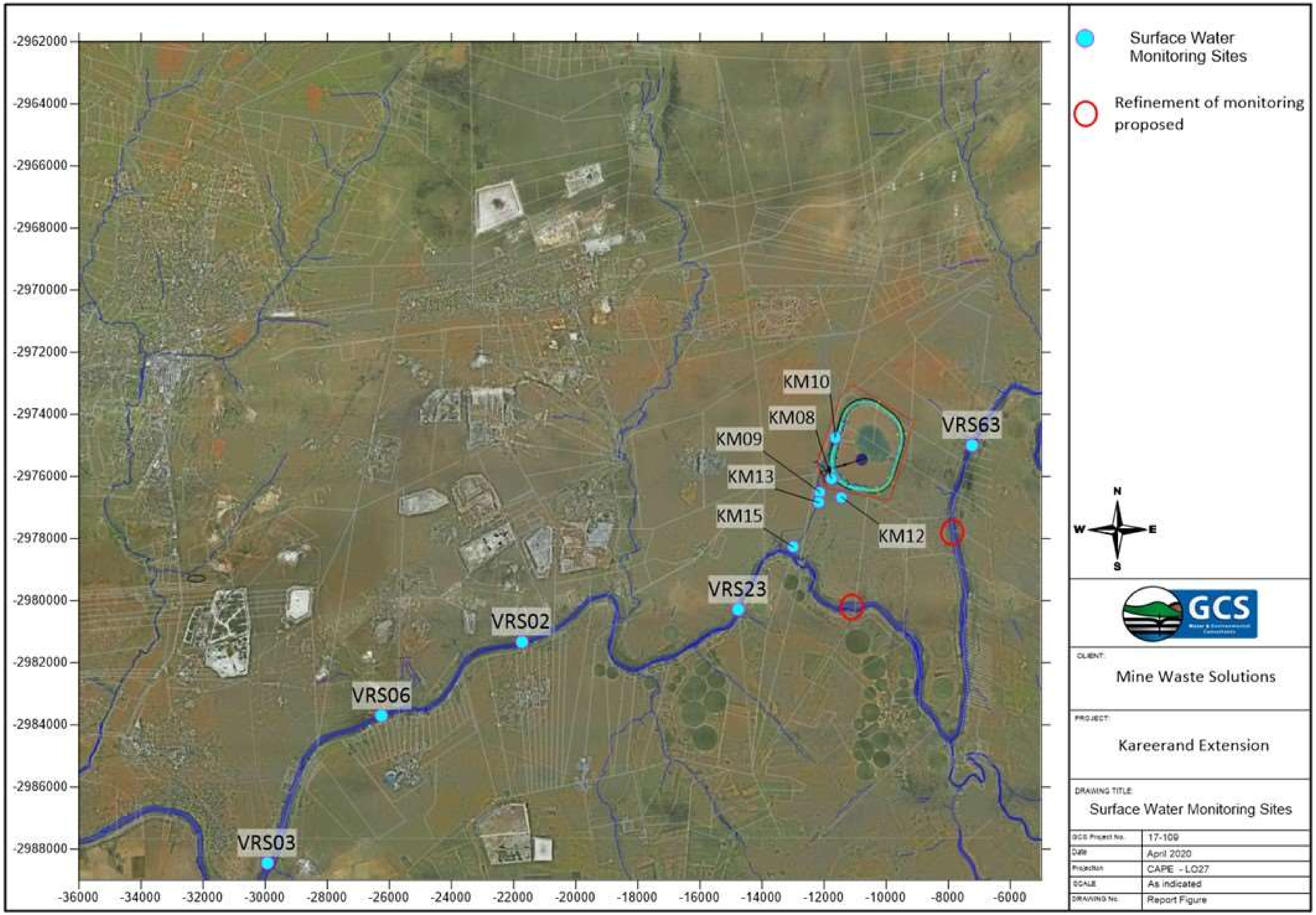

Figure 6-9: Surface water monitoring sites.

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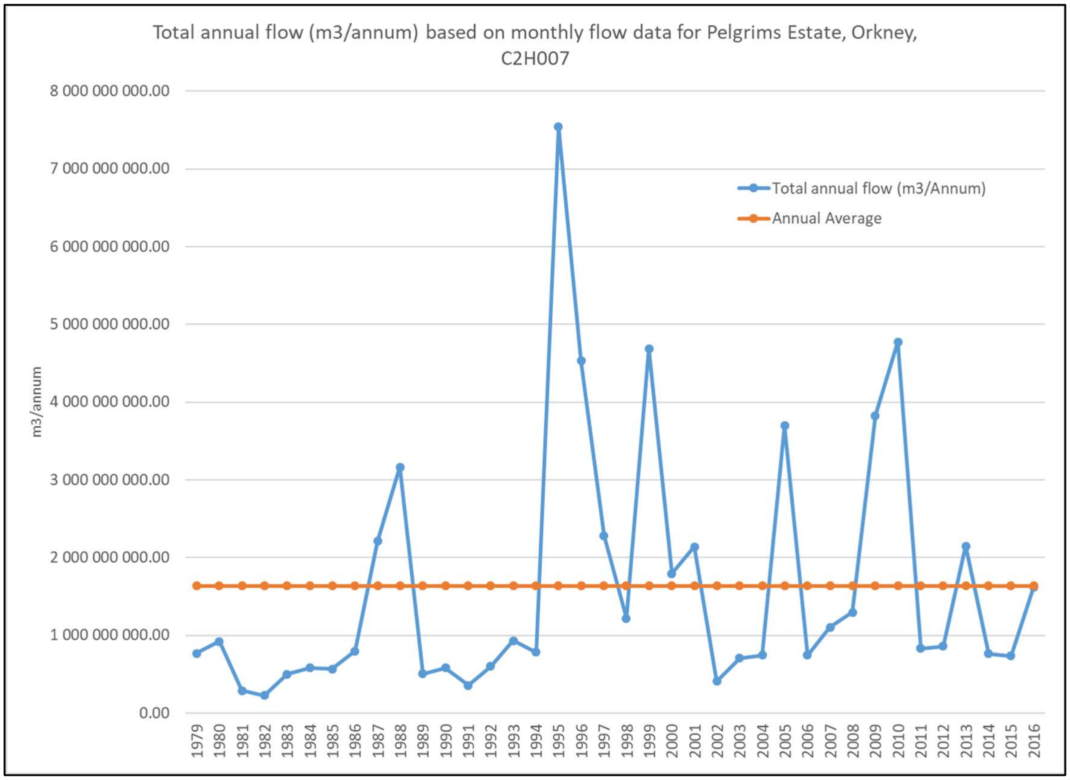

Figure 6-10: Average daily flow at flow station C2H007 in the Vaal River.

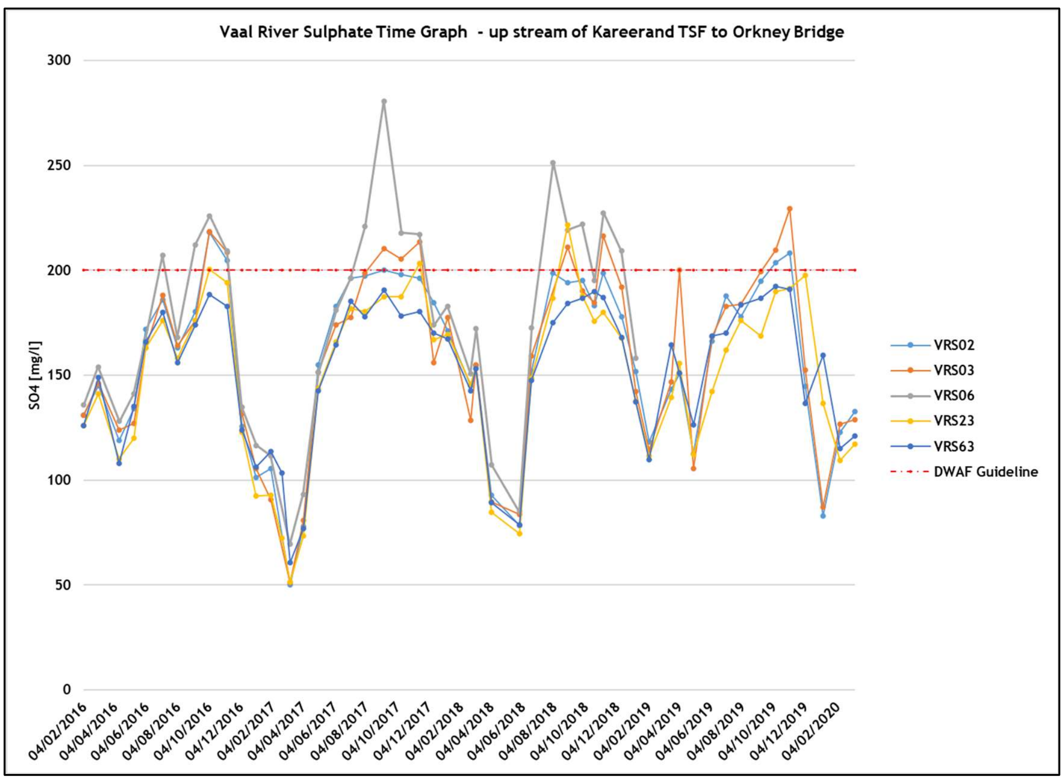

Figure 6-11: Sulfate time graph for the Vaal River monitoring sites.

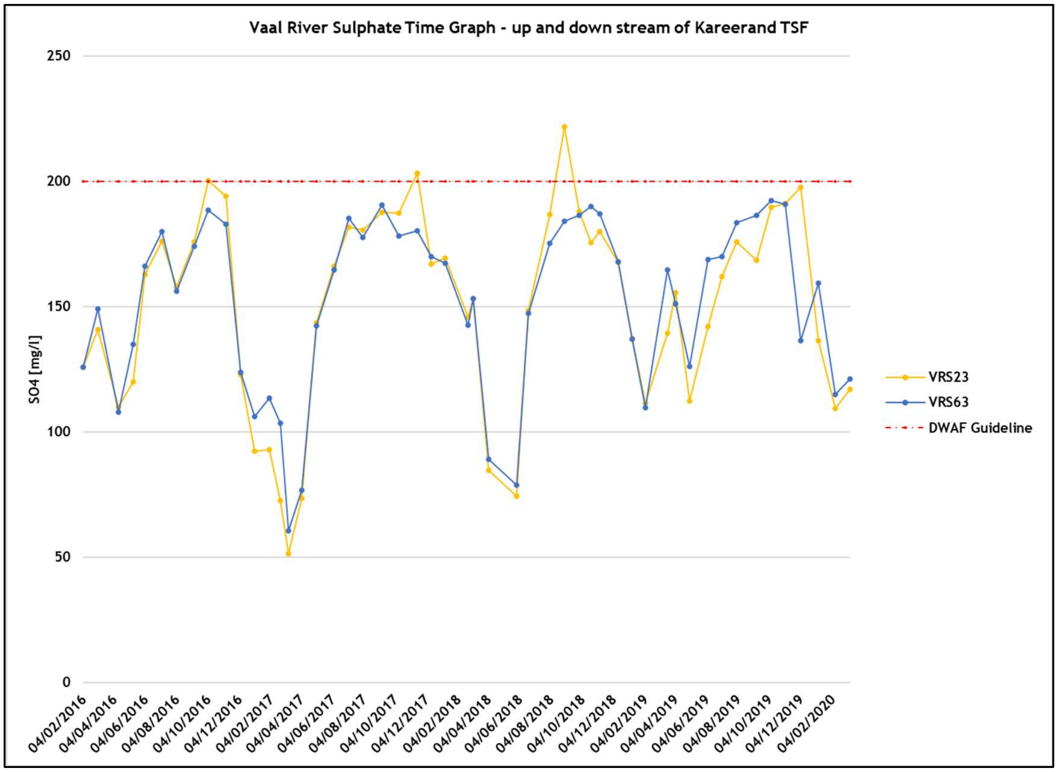

Figure 6-12: Sulfate time graph for the upstream (VRS63) and downstream sites (VRS23).

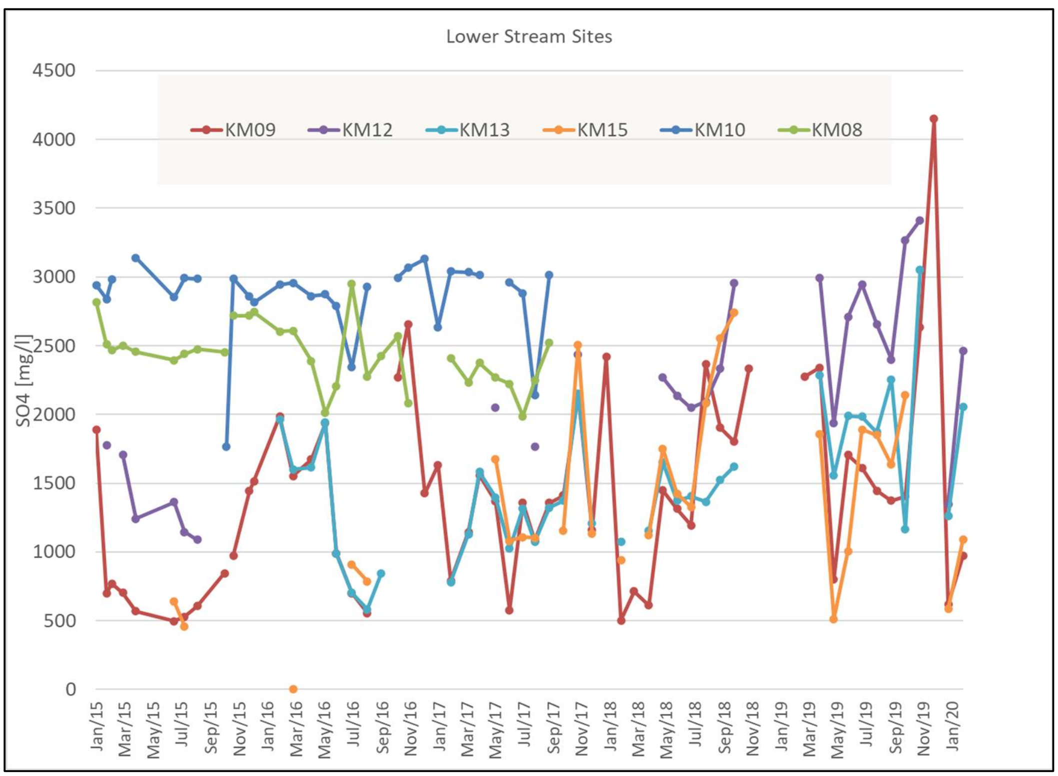

Figure 6-13: Sulfate time graph for the site-specific surface water monitoring sites.

6.6 Geohydrology

6.6.1 Aquifer Characterisation

In summary, the local geology comprises of four geological zones alternating with heterogeneous zones of inter layered rocks of both sedimentary and igneous origin.

The rock underlying the Kareerand TSF is characterized by well-developed igneous layering (diabase sill). The competent (fresh) diabase is overlain by a 0 to 25 m weathered zone, while surficial unconsolidated sediments of clayey sand range between ~0.5 to ~3 m in thickness. Unweathered diabase, shales, quartzite and andesite lava have similar hydrogeological characteristics and are characterized by a low primary porosity and permeability. The permeability of the bedrock aquifer is associated with secondary structural features (e.g. joints, fractures, fissures, dykes, faults etc.).

The basal portion of the diabase weathered zone is more permeable than the upper zone due to the presence of open fractures and highly weathered zones but also due to the presence of clay layers in the upper reaches. Deep weathering is associated with certain areas closer to the Vaal River (Viljoen Farm, Kromdraai) which enhances the groundwater potential.

The weathered / fractured aquifer that underlies the expansion site may be classified as a minor aquifer (Parsons, 1995) due to the general yields of less than 2.0 l/s. The Minor Aquifer System is defined as "fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and in supplying base flow to rivers".

The aquifer system north east of the site at the farm Kromdraai can be classified as a Major Aquifer System due to its high yields > 2l/sec and high hydraulic conductivity values.

6.6.1.1 Hydrocensus

The 2018 hydrocensus carried out as part of the existing TSF Water Use Licence study shows that 31 existing farm boreholes have been located within the surrounding area. Most of these sites are not in use; only the farms further to the north east, south east and the game farm (south west) have active boreholes. These active boreholes are mainly used for stock watering, irrigation and domestic use, as follows:

- Portion 23 of Kromdraai 420 IP of Sally Barraclough has seven (7) boreholes: four (4) production boreholes (one (1) for domestic use and three (3) for agricultural use) and three (3) not in use. Generally high sulfate concentrations have been recorded in both the initial 2008 (prior to the development of the current TSF) and 2017 follow up hydrocensus and the owner applies treatment to the domestic use water. These boreholes are situated south east of the TSF.

- Portion 8 of Kromdraai 420 IP of Nicolaas Maree has one (1) domestic use borehole and one (1) borehole for cattle watering.
- Portion 4 of Kromdraai 420 IP has one (1) production borehole situated east of the old farmhouse. The plots on Tim's Haven next to the Vaal River make use of this water for domestic purposes.
- The game farm south and south west of the TSF (Portions 2 and 14 of Buffelsfontein 443 IP), which is the property of Chemwes, has two (2) production boreholes which are used for animal watering (HC 13 on Ptn 2, HC 14 on Ptn 14).

6.6.1.2 Geophysical Survey Data

Three types of geophysical applications were introduced between 2008 and 2019, specifically magnetic surveys, electromagnetic (EM) surveys and resistivity surveys. Approximately 40 km of EM and magnetic surveys were completed in October 2017 and March 2019 around the current Kareerand TSF. Igneous rocks have the highest resistivity (lowest conductivity), sedimentary rocks have the lowest and metamorphic rocks are intermediate. The resistivity of particular rock types varies directly with age and lithology, since the porosity of the rock and salinity of the contained water are affected by both. The resistivity of rocks is strongly influenced by the presence of groundwater, which acts as an electrolyte.

The following rock types were identified using the surveys:

- Solid diabase formation (resistive, low conductivity) east of the current TSF, corresponding with the geology map for the area;
- Deeper weathered diabase zones (higher conductivity than solid diabase), in between the solid diabase formations;
- Shales (medium conductivity) to the west of the current TSF, where the expansion is planned. Shales were also observed during the field surveys to the east along the farm road and in the game camp;
- Andesites and quartzite (very low conductivity) in western portion of the planned expansion;
- Clay-rich shales (high conductivity) of the Karoo zone, in the north-western corner of the current TSF; and
- Water-logged soils and weathered diabase (fairly high conductivity) south of the current TSF. The difference in resistivity between the dry weathered diabase and the water-logged diabase is visible.

Site-specific hydrogeological conditions are presented in the recent geophysical survey and percussion drilling projects at the current Kareerand TSF. In summary, the local geology comprises geological zones alternating with heterogeneous zones of inter-layered rocks of both sedimentary and igneous origin. There is a clear differentiation between the underlying foundation conditions from east to west.

6.6.1.3 Drilling of Observation and Test Boreholes

A total number of 74 test and observation boreholes have been drilled over the past 10 years. The following basic deductions were made from drilling data:

- Boreholes were generally drilled to depths between 5 and 60 m below ground level (average of 30 m), weathering and change of lithology were considered;
- Penetration rates were measured during drilling. This supplies an indication of weathering, clay content, consistency of rock material (hard or soft) and fracturing;
- Field observed airlift yields were measured and range between 0 (dry) and 15 l/sec (majority of boreholes indicated yields between 0 and 2 l/sec). Generally, boreholes drilled within shales, andesite and dolomites (dolomites only occur much further westwards) indicated dry to low airlift yields. Shale is a sedimentary rock that has high porosity but low permeability, therefore the transmission of water will be low which will result in low storage (or low effective porosity) of water in the aquifer;
- Boreholes drilled within deep weathered diabase (10 m to 25 m) indicate medium to high airlift yields. These zones are usually known for their higher permeability and high storage characteristics. They occur south of the existing TSF and further north and north east at the Kromdraai Farm, approximately 1 km from the TSF.

6.6.1.4 Groundwater Levels

Groundwater level data was obtained from the drilled boreholes and the routine water monitoring data. The following can be derived from the available data:

- Groundwater levels were in the order of 15 to 20 m below ground level prior to deposition (GCS, 2008). The zone of unsaturation has dramatically changed over a period of 3 to 5 years after tailings deposition started and decreased from almost 15m to between 0 and 5m below and around the TSF. This is mainly as a result of seepage from the TSF. Time domain monitoring data for areas east and south of the TSF show the increase in groundwater levels. It is also evident from the graphs that groundwater levels tend to stabilise after 4 years of tailings deposition.
- The areas further to the west, where andesite and dolomite intersect, indicated much deeper groundwater levels (>30 m) which have not changed significantly over time.

6.6.1.5 Aquifer Testing and Hydraulic Parameters

Aquifer tests were completed on most of the boreholes and tests vary from constant rate pump tests to slug tests (falling and rising head tests) with recovery monitoring. The transmissivity is a measure of how much water can be transmitted horizontally through an aquifer, to a pumping well for example. The highest transmissivity was observed in the highly weathered diabase and the lowest in the dolomite. The storativity (S) is defined as the volume of water that an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head, a dimensionless unit. The size of the storage coefficient (storativity) depends on whether the aquifer is confined or unconfined. Pump test results and field observations indicate rather leaky (semi confined) to unconfined conditions (for the shallow highly weathered diabase).

6.6.1.6 Aquifer Recharge

The regional aquifer recharge is in the order of 2 to 5% of annual rainfall if the Vegter, 1995 recharge map of South Africa is considered. The chloride mass balance method was used to estimate the average diffuse groundwater recharge. The low chloride concentrations in two (2) boreholes suggest higher recharge values of >6%.

6.6.1.7 Diabase Bedrock Profile

The diabase sill was mapped by using the borehole logs and interpolation of data points. Drilling observations and data indicate minimal weathering and outcrop to the north east and east of the Kareerand TSF with thinner weathering bands and minimal fracturing. Deeper weathering (on average ~18 m) occurs to the south. The contact of the diabase sill acts as a preferred groundwater flow path in this area, the aquifer consists of zones of high permeability and significant fracturing occurs within the upper ~5 m of the sill. Deeper fracturing occurs in some boreholes, but not consistently, and groundwater yields vary significantly.

It is fair to assume that hydraulic conductivity and transmissivity decrease with depth and the main aquifer flow zone is associated with the contact between the upper weathering zone and solid diabase interface. Deep weathering was also observed at the Kromdraai farm approximately 1 km north-east of the Kareerand TSF and in 1 borehole north of the TSF (also about 1 km away). These areas can be regarded as a high yielding aquifer. In some areas the weathered diabase profile indicates limited aquifer yields with poor aquifer development, for example borehole BH51 south-east of the TSF. It is fair to assume that the phreatic surface and rise in heads at the TSF contribute significantly to borehole flow to the south which is hydraulically down-gradient.

6.6.2 Groundwater Quality

Generally, TDS and sulfate concentrations elevated above the 1996 DWAF Target Water Quality Guidelines (TWQG) were observed within the direct vicinity of the current Kareerand TSF. The results should be understood in context of the site and typical gold TSF seepage water quality indicator elements (for example pH, sulfate and iron, etc).

Routine groundwater monitoring data was obtained from the south-eastern farm boreholes, situated 5.7 and 7 km respectively from the Kareerand TSF. These two boreholes were sampled in 2008 and indicated higher sulfate concentrations when compared to ambient data collected at the same time, prior to any tailings deposition at Kareerand TSF.

The sulfate time graphs for the existing monitoring boreholes indicate that sulfate concentrations at the two eastern monitoring boreholes increased rapidly from May 2014 then decreased again from May 2015. It is fair to assume that the initial flux from the TSF caused the initial increase trend, where tailings effluent was disposed on open soil surfaces and ingress was significantly higher, until a tailings floor barrier developed.

The lab results indicate that calcium (Ca), manganese (Mn) and magnesium (Mg) were dominant in most of the groundwater samples. Mn occurred above target levels at most of the sites. Other parameters elevated above the target water quality guidelines (South African National Standards- SANS) in some of the boreholes included chlorine (Cl), nitrate (NO_3), sodium (Na), iron (Fe) and aluminium (Al). Neutral pH levels were recorded at all sites.

Piper plots are used to indicate the chemical water type of groundwater samples. According to the plots, samples can be defined as calcium sulfate waters (usually indication of gold mine waste influence), calcium bicarbonate waters, sodium chloride waters and sodium bicarbonate waters. The Piper plot for the Kareerand water sample sites emerge as calcium-sulfate water type (minority) or calcium-bicarbonate type (majority). The basic differentiator between these two water types is the concentrations of sulfate in some of the samples as a result of either natural geological influences or sites close to the Kareerand TSF impacted by tailings seepage.

A comprehensive groundwater monitoring network is in place with both quarterly and bi-annual monitoring undertaken. The monitoring programme is revised on an annual basis.

6.6.3 Current TSF Seepage

The geochemical modelling and analyses conducted between 2008 and 2016 on the Kareerand TSF material and drain water suggest that the sulfate concentration seepage is approximately 1500 mg/l. Samples obtained from the existing and redundant Daggafontein Cyclone TSF on the East Rand of Gauteng (GCS, 2009), which is similar to the TSF in question on this site, indicated a maximum sulphate concentration of 4350 mg/l, a minimum pH of 4.5, with the main metals leached from the tailings including iron and manganese.

Available data suggests that current seepage volumes from the current Kareerand TSF are approximately 6000 m^3/day. Seepage during the initial 5 years (2011 – 2015) of tailings deposition at the Kareerand TSF was at its maximum. This could be attributed to the bare soils, excavation of topsoil for construction of the perimeter wall and uncontrolled pond development during the initial stages.

A number of scavenger wells/inception boreholes have been successfully drilled and equipped to intercept seepage from the TSF and returned to the pollution control dam for reuse in the reclamation process.

6.7 Wetlands

6.7.1 Quaternary Catchments

The majority of the site is situated in Quaternary Catchment C24B with small sections in the west located in catchment C24A as well as a small area in the east located in catchment C23L. In these catchments, the precipitation rate is lower than the evaporation rate. Consequentially, watercourses in this area are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

6.7.2 Important Aquatic Ecosystems

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). CBAs are therefore areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. Ecological Support Areas (ESAs) are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The Kareerand TSF Expansion site is located within the following aquatic CBAs:

- CBA 1- Majority of the study site.
- CBA 2- Very small section in the west.

6.7.3 Presence of Wetlands

The November 2017 and February 2019 site surveys confirmed the presence of wetland habitat within the immediate area and along headwater drainage lines (see **Figure 6-14**). Recorded wetland indicators included hydromorphic features, such as gleying, low chroma matrix colours, spots of iron depletion and mottling, while hydrophyte and hygrophyte plant species were also identified.

The following natural wetlands were identified on site and classified into four different types of hydro-geomorphic (HGM) units:

- Unchanneled valley bottom wetlands (3);
- Channelled valley bottom wetlands (2);
- Seep wetlands (3); and
- Pan (depression) wetland (1).

Additional man-made wetlands were classified as artificial systems (of which two were identified). In the eastern section several smaller dams and dam-like structures were recorded during the follow up site visit. Although artificial, they do provide some biodiversity support such as habitat for several species as well as drinking water for larger animals.

A non-perennial pan is present North-East of the TSF, known as Wildebeestpan. Detailed soil and vegetation assessments in this area did not reflect conclusive wetland indicators.

6.7.4 Wetland Functionality

Each of the delineated wetlands were assessed in terms of their Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) (**Table 6.3** and **Figure 6-15**). The impacts associated with the wetlands are predominantly mining related and include sedimentation, erosion, pollution, loss of biodiversity and wetland loss. Agriculture adjacent to the wetlands also impacts on them though input of nutrients and pesticides and altered soil characteristics (for example compaction and recharge properties).

Table 6.3: The PES and EIS scores for wetlands on the Kareerand TSF Expansion site.

WETLAND	PES	EIS
New seep wetland (2019)	C - Moderately modified	High/Very High
Seep wetland 3	E – Seriously modified	Low/Marginal
Seep wetland 7	D – Largely modified	Low/Marginal
Unchanneled valley bottom wetland 1	A - Unmodified	High
Unchanneled valley bottom wetland 8	C - Moderately modified	Moderate
Unchanneled valley bottom wetland 9	C - Moderately modified	Moderate

Channelled valley bottom wetland 2	D/E (refined) – Largely/Seriously modified	Moderate
Channelled valley bottom wetland 6	C - Moderately modified	Moderate
Pan wetland 10	B – Moderately natural	High
Artificial wetland 4	NA (artificial)	Very Low
Artificial wetland 5	NA (artificial)	Very Low

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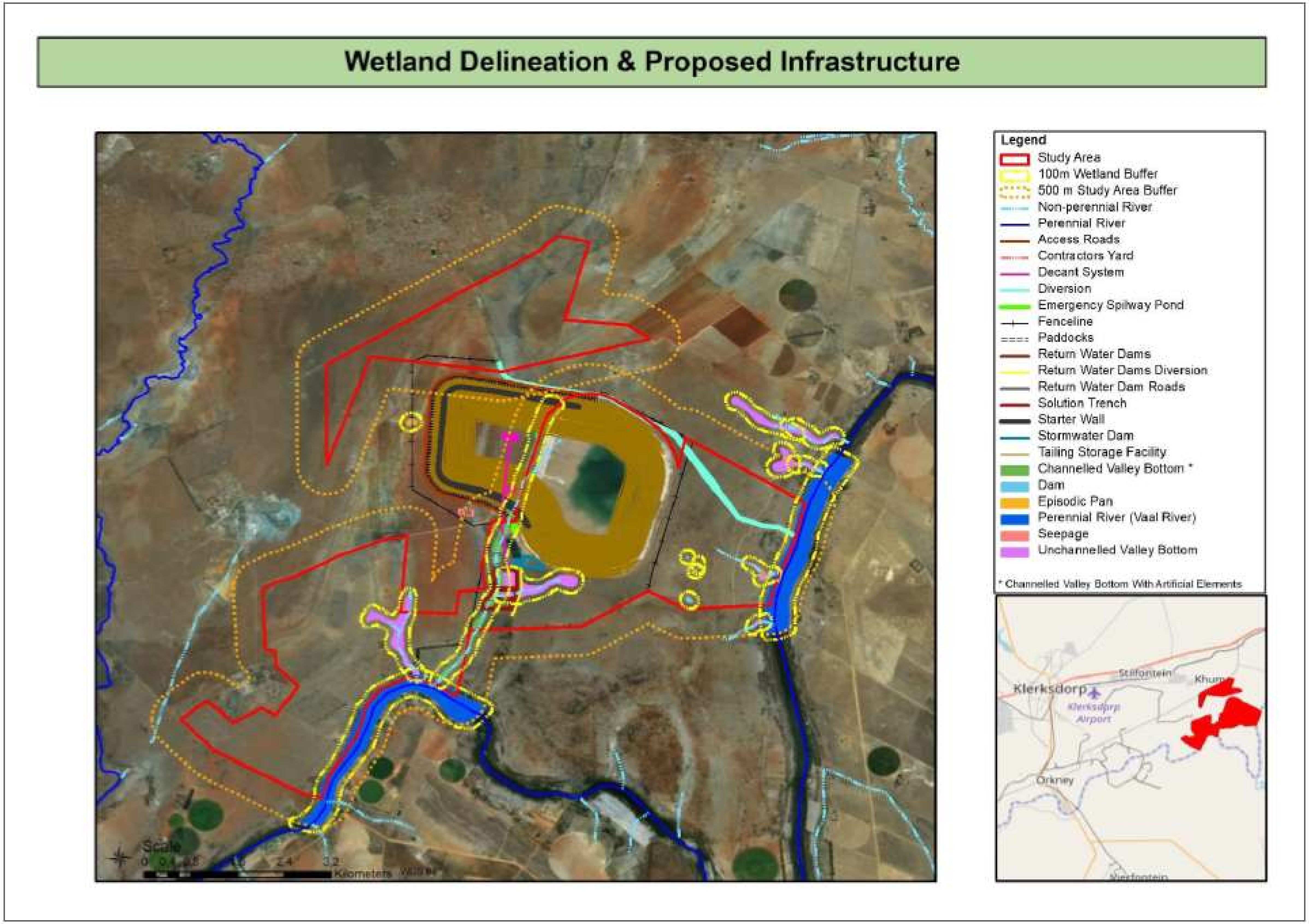

Figure 6-14: Wetlands found in the vicinity of the proposed TSF expansion site (Limosella, 2019).

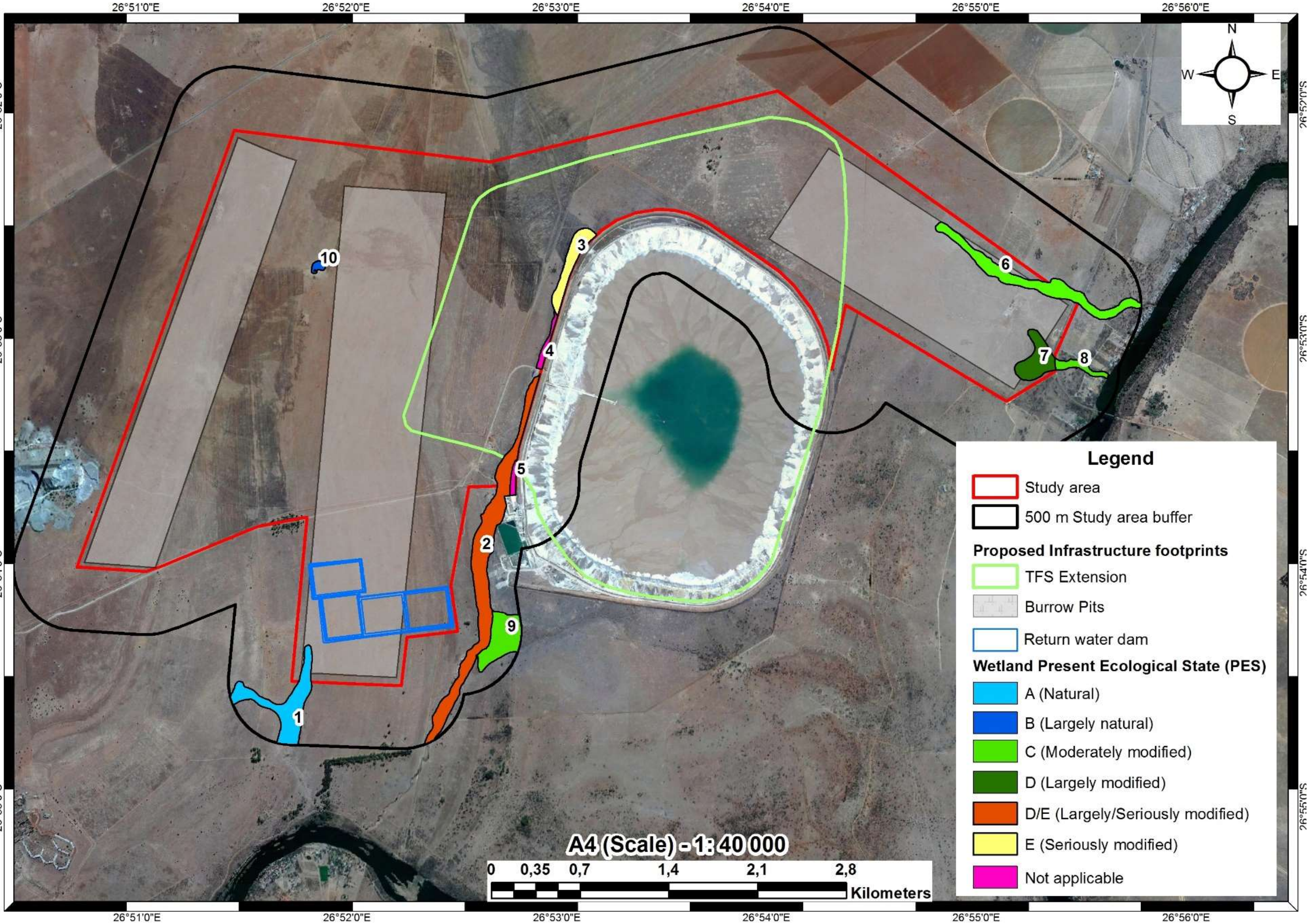

Figure 6-15: Present Ecological State (PES) of wetlands identified on site in 2017 (De Castro & Brits, 2018).

6.8 Ecology

6.8.1 Fauna

With regards to red data species of the region, eighteen (18) species are predicted to be potential inhabitants of this area. Additionally, two (2) species are expected as likely inhabitants of the site. These include:

- Honey Badger (*Mellivora capensis*)
    - Near Threatened (NT);
    - Found in most major habitats in southern Africa;
    - Feeds on wide variety of food items, but insects, other invertebrates and rodents are most important; and
    - The diversity of habitat found in the area as well as the close proximity of the Vaal River creates a higher likelihood of occurrence of the species.
- Lesser Kestrel (*Falco naumanni*)
    - Vulnerable (VU);
    - Found in open grassland, mainly on highveld, usually near towns or farms;
    - Highly gregarious and often found in large flocks, feed mainly on insects and less often small birds, lizards and rodents;
    - Does not breed in the southern African subregion, only important habitat requirements of the species in the subregion are associated with roosting and feeding; and
    - Large trees found on the banks of the Vaal River are ideal roosting sites and diversity and quality of habitat found at the site is likely to provide more food items (both invertebrates and small vertebrates) – as a result it is estimated that the species is likely to occur at the site.

6.8.2 Flora

A large portion of proposed TSF site comprises the Rand Highveld Grassland vegetation type (**Figure 6-16).** This is a highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species rich with wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. Most common grasses on the plains belong to the genera *Themeda, Eragrostis*, *Heteropogon* and *Elionurus*. High diversity of herbs, many of which belong to the Asteraceae (daisy family), is also a typical feature.

The Rand Highveld Grassland vegetation type is classified as *Endangered*; it is poorly conserved in statutory reserves and in private reserves. Almost half of this vegetation type has been transformed by cultivation, plantations, urbanisation and dam-building. Cultivation may also have had an impact on the surface area of the unit where old lands are currently classified as grasslands in land cover classifications and poor land management has led to degradation of significant portions of the remainder of this unit.

6.8.3 Biodiversity

The North West Department: Rural, Environment and Agricultural Development (NWREAD) Department of Agriculture, Conservation, Environment and Rural Development has developed the North West Biodiversity Sector Plan (NWBSP) to indicate areas of conservation concern in the province. Two important maps have been developed: one for terrestrial biodiversity and the other for freshwater/aquatic biodiversity. The NWBSP divides the terrestrial ecosystems of the North West into four main categories:

- Critical Biodiversity Areas (CBAs) – areas of high biodiversity value, needed to meet biodiversity targets. These areas should be maintained in natural or near natural state;
- Ecological Support Areas (ESAs) – these areas support CBAs, but are not essential for meeting conservation targets;
- Other Natural Areas – these areas have natural characteristics and perform a range of biological as well as ecological functions but have not been earmarked as priority areas for conservation; and
- Heavily Modified Areas – areas which have been drastically impacted and have had a significant or complete loss of natural habitat and ecological function.

According to the terrestrial NWBSP, the site crosses a terrestrial CBA2 (**Figure 6-17**) and some portions are listed as Ecological Support Areas (ESAs). The CBA2 and ESAs encompass important terrestrial features, including critical patches associated with threatened ecosystems, important habitat for fauna (including vultures), kloofs, hills and ridges, important bird areas, ecological corridors and corridor systems, and buffers for Protected Areas.

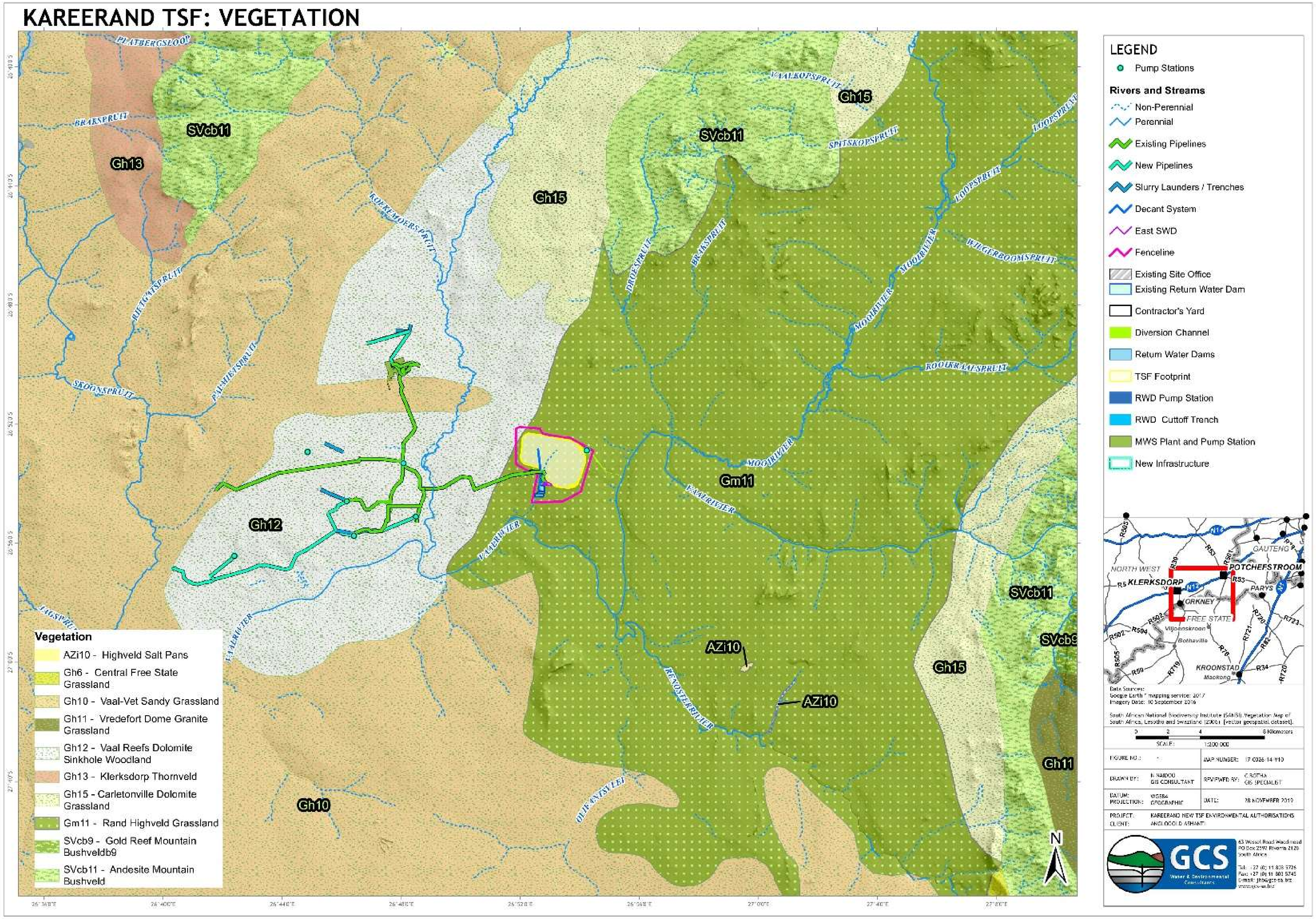

Figure 6-16: Vegetation types found surrounding the proposed TSF expansion site.

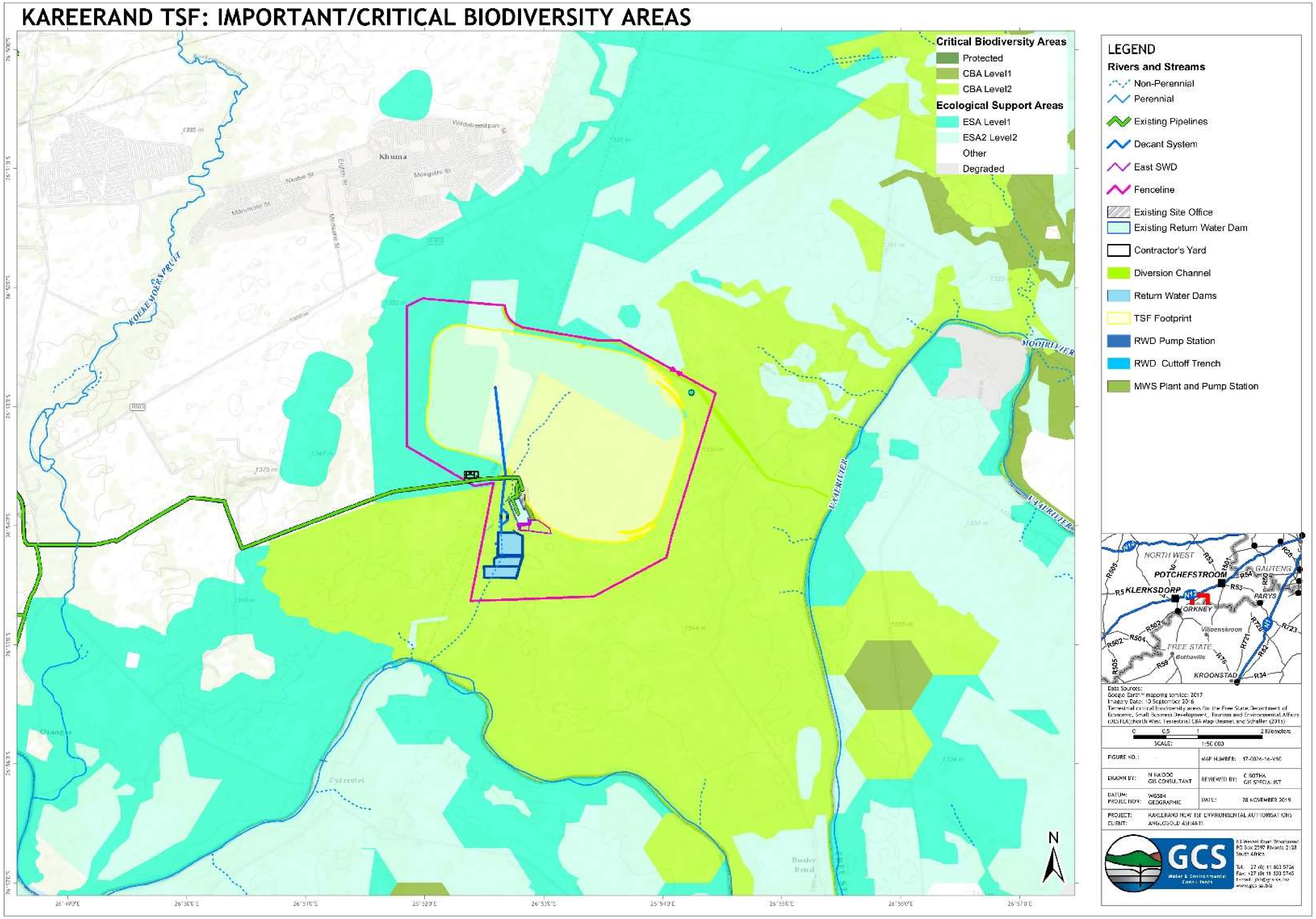

Figure 6-17: Biodiversity importance and NWBSP ecosystem classification of the proposed TSF expansion site.

6.9 Air Quality

6.9.1 Local Wind Field

The vertical dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of wind speed, in combination with surface roughness (Tiwary & Colls, 2010).

The period wind field and diurnal variability in the wind field is shown in **Figure 6-18**, while the seasonal variations are shown in **Figure 6-19**. The wind field is dominated by winds from the north-northeast. The strongest winds (>6 m/s) occurred mostly from the north-west and north-north-west. Calm conditions occurred approximately 0.4% of the time, with the average wind speed over the period of 3.06 m/s. Wind speeds increased during the day with a slight decrease in calm conditions (from 0.32% during the day to 0.48% during the night). Strong winds in excess of 6 m/s occurred most frequently during spring months. Calm conditions occurred most frequently during winter months.

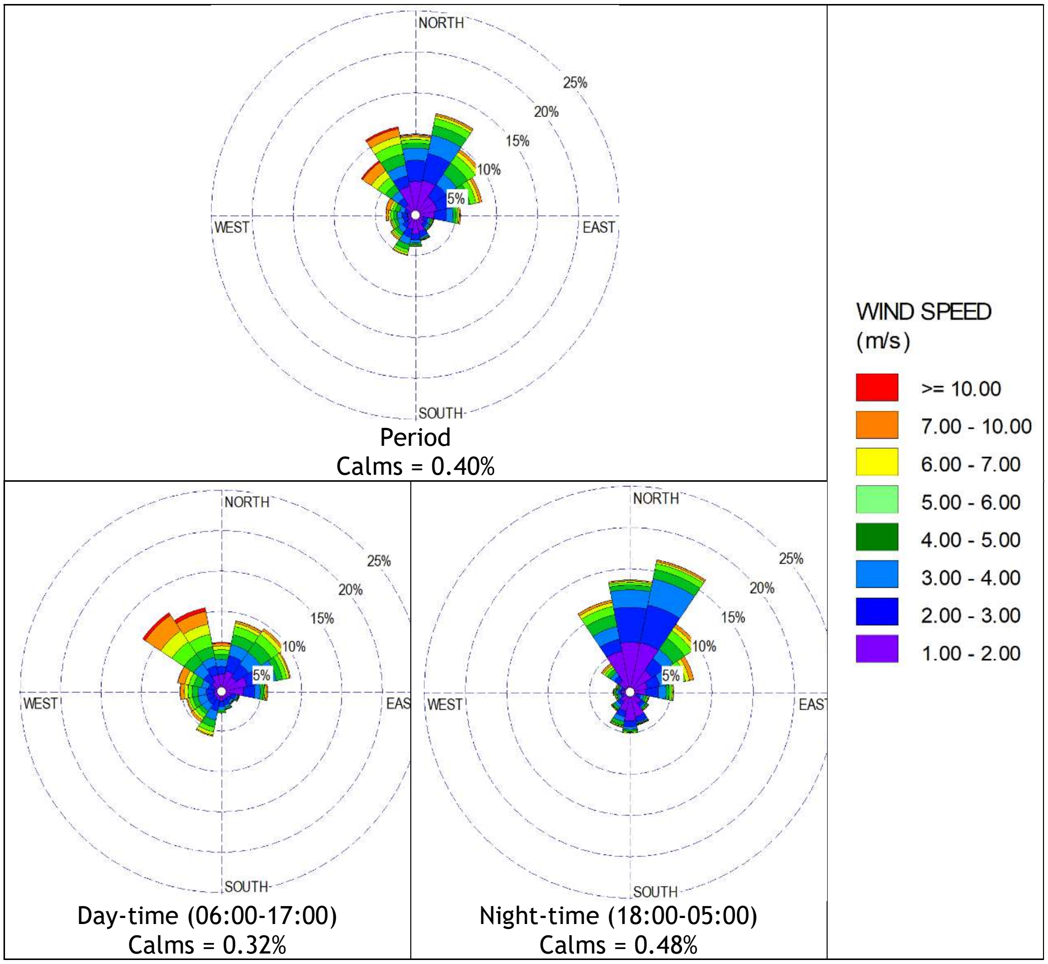

Figure 6-18: Period, day- and night-time wind roses (measured data, January 2018 to December 2019).

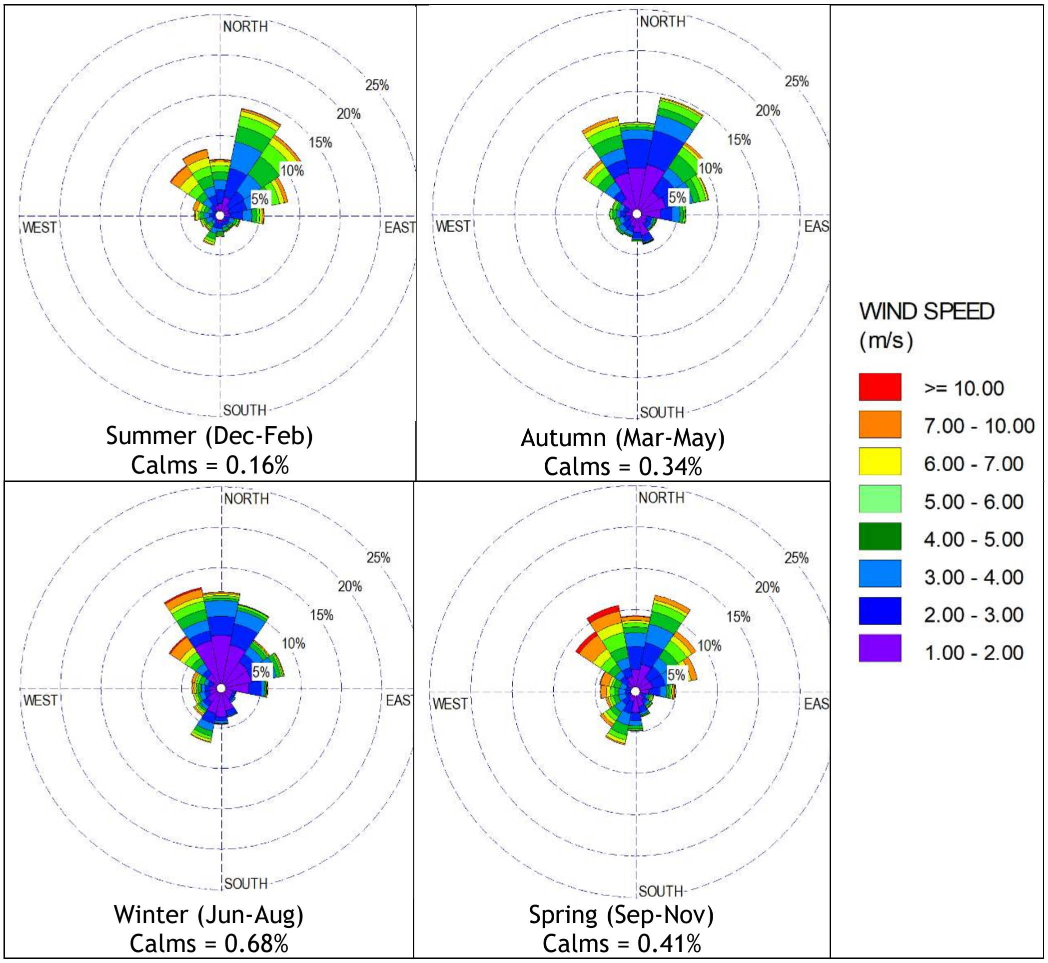

Figure 6-19: Seasonal wind roses (measured data, January 2018 to December 2019.

6.9.2 Existing Air Quality

The current air quality in the study area is mostly influenced by mining activities, farming activities, domestic fires, vehicle exhaust emissions and dust entrained by vehicles. These emission sources vary from activities that generate relatively course airborne particulates (such as farmland preparation, dust from paved and unpaved roads, and the mine sites) to fine particulate matter (PM) such as that emitted by vehicle exhausts, diesel power generators and processing operations. Other sources of PM include occasional fires in the residential areas and farm activities.

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in South Africa. When a vehicle travels on an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads are a function of vehicle traffic and the silt loading on the roads. Emissions from paved roads are significantly less than those originating from unpaved roads, however they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface.

Emissions generated by wind erosion are dependent on the frequency of disturbance of the erodible surface. Every time that a surface is disturbed e.g. by mining, agriculture and/or grazing activities, its erosion potential is restored. Airborne particulates are the most significant of these emissions and may contain airborne particulate sizes up to about 100 micron in diameter. Particles of sizes larger than about 75 micron tend to deposit out of the plume relatively nearby their source of emission. Particles less than about 20 micron, on the other hand, can be carried for considerable distances before depositing out.

A regional air quality assessment was undertaken in 2014/2015 for the AGA Vaal River and MWS operations, for the period of 2011 to 2013 using South African Weather Service Klerksdorp meteorological data (including wind speed, wind direction and temperature). PM_{10} and TSP were included in the assessment. The 2014/2015 dispersion modelling was undertaken to determine daily and annual average ground level concentrations of $PM_{2.5}$ and PM_{10} as well as daily dustfall rates. The averaging periods were selected to facilitate the comparison of simulated pollutant concentrations/dustfall with relevant NAAQS (National Ambient Air Quality Standards) and NDCR (National Dust Control Regulations), respectively.

Simulations indicate exceedances of the current daily $PM_{2.5}$ NAAQS off-site. Simulated 24-hour average $PM_{2.5}$ concentrations in a small area in the vicinity of the AGA Plant, north of Sulphur Paydam 1 and at the No. 9 Gold Plant exceed the current NAAQS. Simulated annual average $PM_{2.5}$ concentrations do not exceed the current NAAQS.

The area over which simulated daily PM_{10} concentrations exceed the NAAQS limit value of 75 $\mu g/m^3$ more than the permitted 4 days per year is largely within quadrants to the north east and south-east quadrants of the AGA Plant. The area of exceedance extends approximately 2.5 km south of the plant's southern boundary, while the Sulphur Paydam, East Complex, Southeast Complex, Buffels 5 and Vaal Reef's mine plant all exceed within 1 km of their respective boundaries. Simulated annual average PM_{10} concentrations exceed the NAAQS of 40 $\mu g/m^3$. The areas of exceedance extend approximately 1 km south of the Buffels TSF, AngloGold Ashanti plant and Vaal Reef plant's southern boundary.

The NDCR limit for residential areas (600 mg/m^2-day) is reached at the East Complex, Sulphur Paydam and Buffels TSFs, this being associated with their close proximity to one another amalgamating the particulate impact potential. This same region is the largest area where the NDCR limit for non-residentials areas (1 200 mg/m^2-day) is likely to be reached. The industrial limit is not reached at any sensitive receptor, or residential area included in the study. Other TSFs where the residential and industrial limit values are reached include the West Complex, Kopanang and Kareerand TSFs.

The significant Air Quality Sensitive Receptors (AQSRs) are those of Khuma Township, Buffels 10# Mine owned by Village Main Reef Mine, various farm and property owners, the chicken farm, the nearby supermarket/garage and Midvaal Water Company. The receptors included in the Air Quality simulations are indicated in **Figure 6-20.**

6.10 Noise

In order to assess the existing noise climate in the area surrounding the current Kareerand TSF facility, ambient noise monitoring was conducted at four on-site locations (historical monitoring locations) and at three off-site residential receptor locations surrounding the site (**Figure 6-21).** It is noted that receptors KR01, KR02, KR03 and KR04 are industrial and are located on-site. Such receptors are not sensitive in nature and have not been used to assess impacts on communities, but rather as on-site locations to assess the baseline noise climate and resultant changes in noise levels on-site as a result of the proposed extension project.

Baseline monitoring indicated current day-time noise levels at all seven monitoring locations are compliant with the SANS guideline rating levels, with the highest day-time LAeq (equivalent continuous sound pressure level) noise level recorded at KR03 (on site). The main sources of noise identified at the on-site locations were pumps, trucks, intermittent vehicles and activity of people. The R502 road is currently the main source of noise identified at both KR05 (Khuma) and KR06 (Hostel), while very quiet conditions were noted at KR07 (house south of the current Kareerand TSF site).

Due to safety concerns at night, monitoring could not be undertaken at KR05 (Khuma) and KR06 (Hostel) and as such there is no night-time data to present for these locations. Night-time noise levels at all other locations remained well below their respective guideline levels. The highest night-time LAeq noise level was recorded at KR01 (on-site). Dominant noise sources on-site included pumps and intermittent vehicles, while livestock and the R502 road were the dominant sources at the residential area south of the TSF (KR07).

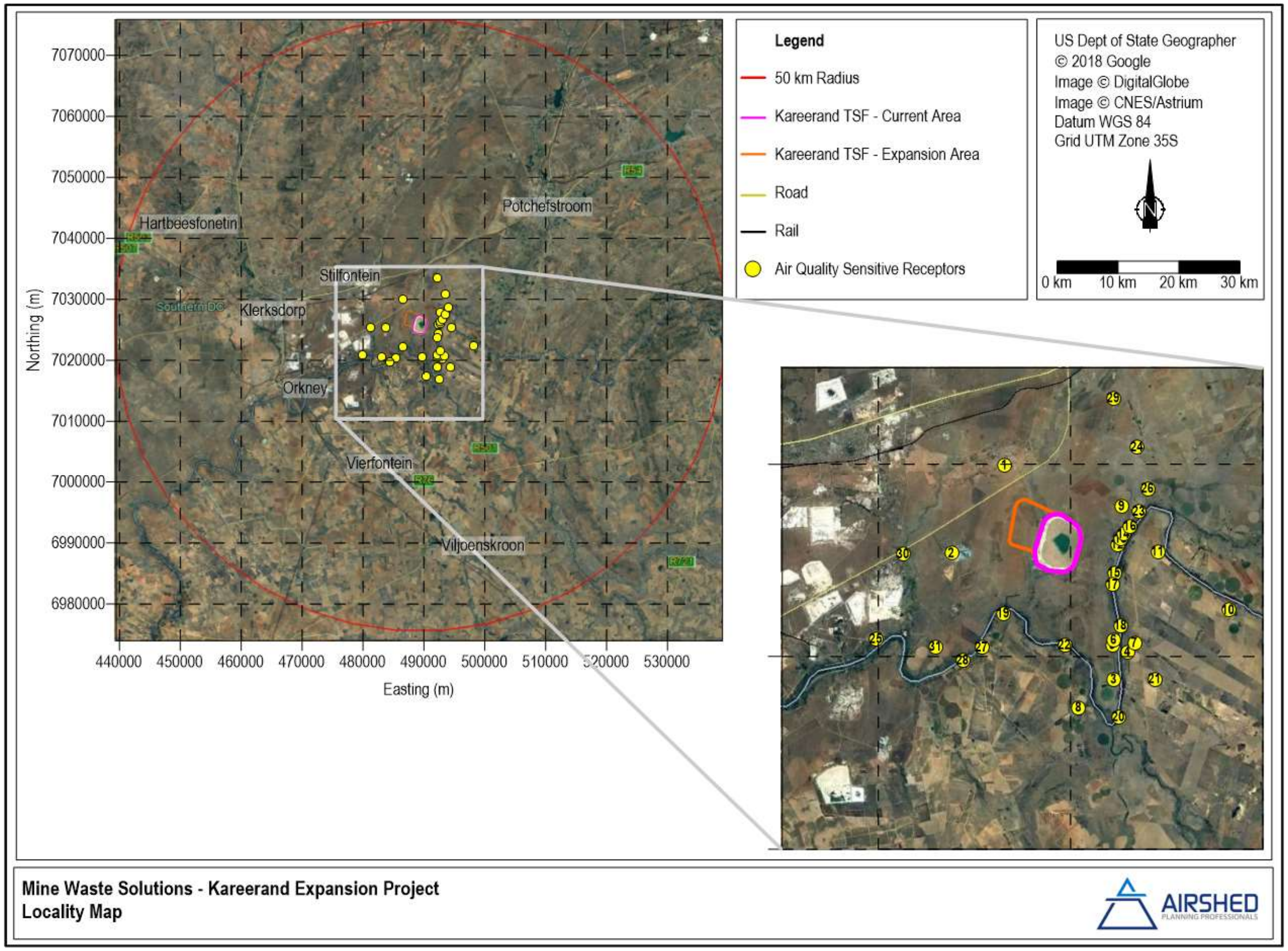

Figure 6-20: Location of Kareerand TSF and sensitive receptors included in the Air Quality simulations (Airshed, 2020).

Figure 6-21: Noise monitoring locations around the current Kareerand TSF (WSP, 2020).

6.11 Heritage sites

An archival and historical desktop study was undertaken to provide a historic framework for the project area and surrounding landscape. This was augmented by a study of available historical topographical maps and an assessment of previous archaeological and heritage studies completed for the study area and surrounding landscape.

The desktop study revealed that the study area is located in surroundings characterised by a long and significant history. Thereafter, fieldwork in the form of site walkthroughs were conducted as part of pre-feasibility resulting in the identification of 48 archaeological and heritage sites **(Figure 6-22**). These identified heritage sites are summarised in the table below **(Table 6.4**).

It is important to note that the desktop study and initial field investigation were carried out to inform the footprint and design of the proposed TSF expansion in order to **avoid and** impact these sites.

Table 6.4: Initial heritage sites identified.

SITE	DESCRIPTION	SIGNIFICANCE	CO-ORDINATES
AGA-MWS-HBF-5	Possible grave	High/Medium	S 26° 52' 56.09" E 26° 51' 23.98"
AGA-MWS-HBF-6	A rectangular stone structure (jackal proof fenced camp), brick-built reservoir	Low	S 26° 53' 08.54" E 26° 51' 19.72"
AGA-MWS-WBP-1	Rectangular cement foundation structure, possible dwelling, possibility of stillborn babies' graves	High/Medium	S 26° 52' 54.12" E 26° 51' 48.07"
AGA-MWS-WBP-2	Brick-built reservoir with a drinking trough and number of irregularly shaped structures, possibility of stillborn babies' graves	High/Medium	S 26° 52' 42.37" E 26° 51' 50.92"
AGA-MWS-WBP-3	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 52' 23.53" E 26° 51' 40.16"
AGA-MWS-WBP-4	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 52' 17.02" E 26° 51' 42.97"
AGA-MWS-WBP-5	Low density surface occurrence of Middle and Later Stone Age lithics	Medium	S 26° 52' 12.23" E 26° 51' 41.09"
AGA-MWS-WBP-6	Small cemetery	High/Medium	S 26° 52' 10.07" E 26° 51' 39.78"

SITE	DESCRIPTION	SIGNIFICANCE	CO-ORDINATES
AGA-MWS-WBP-7	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 52' 04.76" E 26° 51' 47.98"
AGA-MWS-WBP-8	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 51' 58.86" E 26° 51' 51.55"
AGA-MWS-WBP-9	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 51' 54.93" E 26° 51' 55.85"
AGA-MWS-WBP-10	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26°51'53.27" E 26°51'56.57"
AGA-MWS-WBP-11	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 51' 50.77" E 26° 51' 56.25"
AGA-MWS-WBP-12	Small cemetery	High/Medium	S 26° 51' 50.52" E 26° 51' 52.33"
AGA-MWS-WBP-13	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 51' 42.41" E 26° 52' 02.21"
AGA-MWS-WBP-14	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 51' 43.28" E 26° 52' 06.14"
AGA-MWS-WBP-15	Possible grave	High/Medium	S 26° 51' 40.55" E 26° 52' 05.56"
AGA-MWS-WBP-16	Two rectangular stone foundation structures, likely the dwellings of farmworkers, possibility of stillborn babies' graves	High/Medium	S 26° 51' 37.74" E 26° 52' 24.42"
AGA-MWS-WBP-17	Poorly preserved remains of a farmstead	Low	S 26° 51' 41.72" E 26° 52' 22.36"
AGA-MWS-WBP-18	Four formally built stone features which may be graves	High/Medium	S 26° 51' 42.50" E 26° 52' 26.09"
AGA-MWS-WBP-19	Three possible graves	High/Medium	S 26° 51' 22.44" E 26° 53' 19.29"
AGA-MWS-KRD-1	Rectangular fenced area	High/Medium	S 26° 52' 55.50" E 26° 54' 40.70"
AGA-MWS-UMF-1	Rectangular stone foundation	Low	S 26° 53' 34.07" E 26° 55' 25.62"

SITE	DESCRIPTION	SIGNIFICANCE	CO-ORDINATES
AGA-MWS-UMF-2	Low density surface occurrence of Later Stone Age and Middle Stone Age lithics	Medium	S 26° 53' 35.51" E 26° 55' 20.77"
AGA-MWS-UMF-3	Historic farmstead	Low	S 26° 53' 38.44" E 26° 54' 53.49"
AGA-MWS-UMF-4	Medium-sized cemetery containing a total of 24 graves	High/Medium	S 26° 53' 19.98" E 26° 54' 43.74"
AGA-MWS-UMF-5	Extensive area which had been used as farm worker accommodation, possibility of stillborn babies' graves	High/Medium	S 26° 53' 26.26" E 26° 54' 39.28"
AGA-MWS-MGD-1	Three rectangular stone enclosures	Low	S 26° 53' 52.3" E 26° 52' 32.9"
AGA-MWS-MGD-2	Densely overgrown stone concentrations	High/Medium	S 26° 53' 52.9" E 26° 52' 36.1"
AGA-MWS-MGD-3	Cemetery comprising four graves and two circular stone structures	High/Medium (graves), low (stone structures)	S 26° 53' 59.1" E 26° 52' 36.1"
AGA-MWS-MGD-4	Foundation remains of two stone structures, possibility of stillborn babies' graves	High/Medium	S 26° 53' 57.6" E 26° 52' 32.3"
AGA-MWS-MGD-5	Extensive historic traditional homestead with two possible graves and possibility of stillborn babies' graves	High/Medium	S 26° 54' 13.3" E 26° 52' 33.8"
AGA-MWS-MGD-6	Historic traditional homestead, one possible grave and possibility of stillborn babies' graves	High/Medium	S 26° 54' 36.62" E 26° 52' 45.12"
AGA-MWS-MGD-7	Two attached stone concentrations with appearance of graves	High/Medium	S 26° 54' 28.37" E 26° 52' 45.85"
AGA-MWS-MGD-8	Possible grave	High/Medium	S 26° 54' 07.12" E 26° 52' 34.17"
AGA-MWS-MGD-9	Possible graves	High/Medium	S 26° 54' 16.06" E 26° 53' 39.93"
AGA-MWS-BFF-7	Cemetery comprising 29 graves.	High/Medium	S 26° 55' 01.6" E 26° 51' 30.3"

SITE	DESCRIPTION	SIGNIFICANCE	CO-ORDINATES
AGA-MWS-BFF-8	Lane of eucalyptus trees that was planted to create a wind break.	Medium	S 26° 54' 48.8" E 26° 51' 54.5"
AGA-MWS-BFF-9	Historic traditional homestead, possible grave and possibility of stillborn babies' graves	High/Medium	S 26° 53' 44.1" E 26° 52' 26.8"
AGA-MWS-BFF-10	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 53' 44.48" E 26° 52' 30.14"
AGA-MWS-BFF-11	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 53' 51.2" E 26° 52' 30.1"
AGA-MWS-BFF-12	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 53' 53.3" E 26° 52' 29.8"
AGA-MWS-BFF-13	Historic traditional homestead, possibility of stillborn babies' graves	High/Medium	S 26° 53' 54.6" E 26° 52' 29.7"
AGA-MWS-BFF-14	Low density surface occurrence of primarily Middle Stone Age lithics	Medium	S 26.901044 E 26.870856
AGA-MWS-BFF-15	Low density surface occurrence of Middle Stone Age lithics	Medium	S 26.907061 E 26.869061
AGA-MWS-BFF-16	Low density surface occurrence of Middle Stone Age lithics	Medium	S 26.910178 E 26.865273
AGA-MWS-BFF-17	Low density surface occurrence of Middle Stone Age lithics	Medium	S 26.908039 E 26.860179
AGA-MWS-BFF-18	Low density surface occurrence of Later Stone Age and Middle Stone Age lithics	Medium	S 26.904346 E 26.860307

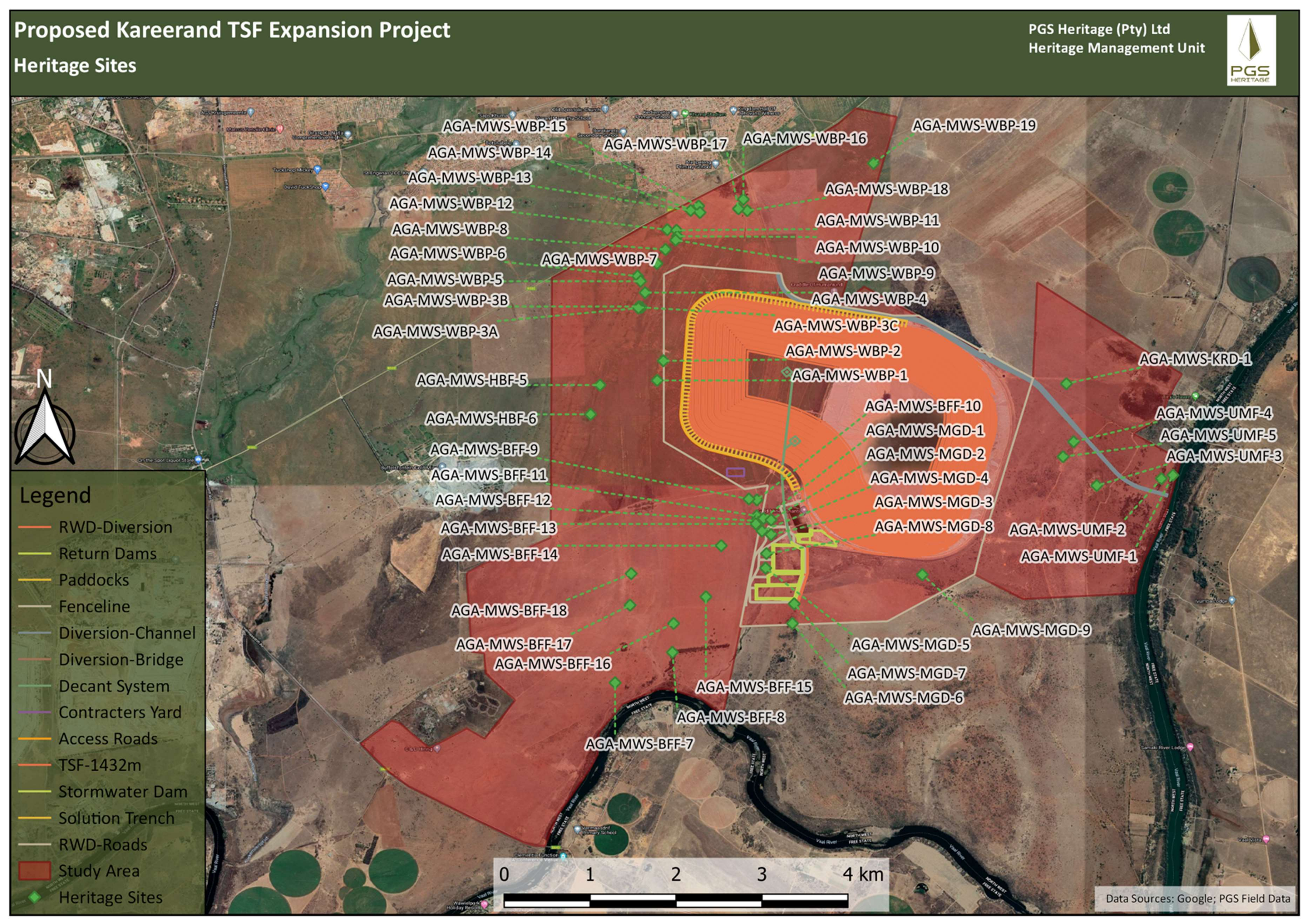

Figure 6-22: Location of heritage sites surrounding the proposed TSF expansion site (PGS Heritage, 2020).

6.12 Socio-Economic Conditions

The proposed TSF expansion project is located within Dr Kenneth Kaunda Local Municipality, midway between Potchefstroom JB Marks Local Municipality and Klerksdorp/Orkney (City of Matlosana Local Municipality - CMLM) in the North West and bordering the Free State south of the Vaal River. Khuma and Stilfontein are the settlements closets to the project area. Khuma is situated approximately 2 km to the north of the proposed site and north of the R502 for the expansion of the Kareerand TSF. Khuma township falls within Wards 33, 34, 35 and 38 of the CMLM. Stilfontein is situated to the north west of the site (approximately 10 km), with the Buffelsfontein Mine to the west. Stilfontein falls within Wards 30 and 31 of the CMLM.

Greater Stilfontein forms part of the KOSH area (Klerksdorp, Orkney, Stilfontein, Hartebeesfontein) which is known for its proliferation of gold mines and is home to some of the most prominent gold mines in the world, as well as one of the oldest meteor impact sites in the world. It is a region with a rich and diverse natural and cultural heritage, with the potential for sustained economic growth.

The predominantly spoken language in the district is Setswana. In 2016, the JB Marks LM population was at 243 527 individuals with an average of 38 people per km^2, while the CMLM had a total population of 417 282 with a density of 123 persons per km^2 (92% of whom lived in urbanised areas, which included towns and mining villages). Population and household growth in the CMLM have increased over time, with the average annual population growth between 2011 and 2016 being 1.04% and the average annual household growth between 1996 and 2016 being 3.46%. As of 2011, Khuma's population totalled 45 895 individuals and 14 154 households, which totals approximately 11% of the total municipal population.

Population figures indicate that on average, approximately one third of the population sector within all the wards is made up by youth. The gender profile is relatively balanced, with only a slightly higher percentage of women within most of the affected wards as well as the CMLM. In Ward 2 of the JB Marks LM there are significantly more males (58%) than females (42%).

Education levels within the CMLM wards are concerning, as figures indicate levels lower than the average within the district and North West Province overall. In contrast, wards within the JB Marks LM are higher than those of the North West Province. There is a larger labour force (i.e. portion of the population aged 15-64 years that offer their services on the labour market) and higher unemployment rate in the CMLM in comparison to JB Marks LM. Ward 2 of JB Marks LM, within which the project is located, shows lower unemployment rates than those experienced in the greater JB Marks LM and much lower rates than in the City of Matlosana in general or in the wards of the municipality directly adjacent to the project.

Youth unemployment rate in the province is on average much higher than the general unemployment rate- in 2011, the national youth unemployment rate was approximately 49%, whereas the North West provincial rate was 41%. Youth unemployment is especially high in the CMLM (43%) while JB Marks LM is below the provincial rate at 32%.

Informal/subsistence cattle farming was observed on the western side of the study area. Some crop irrigation and fenced off areas with game were observed to the south and east of the site. A part of the farm Buffelsfontein located to the south and west of the existing TSF is used as a game farm, owned by MWS, but leased to a third party for grazing and game farming. Various existing mining activities are also undertaken in the larger area. The area is characterised by various historical mining infrastructure. The larger study area forms part of the N12 treasure route that stretches from Emalahleni in Mpumalanga through Gauteng, and into the North West Province via Potchefstroom close to the Vredefort Dome World Heritage Site. In the Northern Cape this route later joins the N1 National Route and eventually meets the N2 National Route in George.

Services play the largest role in the economies of both CMLM and JB Marks LM. Mining is a far larger contributor to the local economy in CMLM (21%) than in JB Marks LM (2%).

6.13 Visual Assessment

6.13.1 Visual Topography

The topography of the surrounding environment includes semi-mountainous terrain, while the proposed development itself lies in a greater valley of this terrain. The elevation ranges from 1 250 to 1600 mamsl within a 10 km region of the proposed TSF expansion. **Figure 6-23** provides an illustration of the regional topography from a West to East and North to South cross-sectional view of the project area.

6.13.2 Vegetation affecting visual impact

Vegetation of the surrounding development is predominately composed of Grasslands. The majority of the infrastructure falls on the Rand Highveld Grassland with the remainder of the infrastructure, to the west, falling on the Vaal Reefs Dolomite Sinkhole Woodland. **Figure 6-24** shows the view and vegetation looking towards the south and south east from receptor sites along the R502.

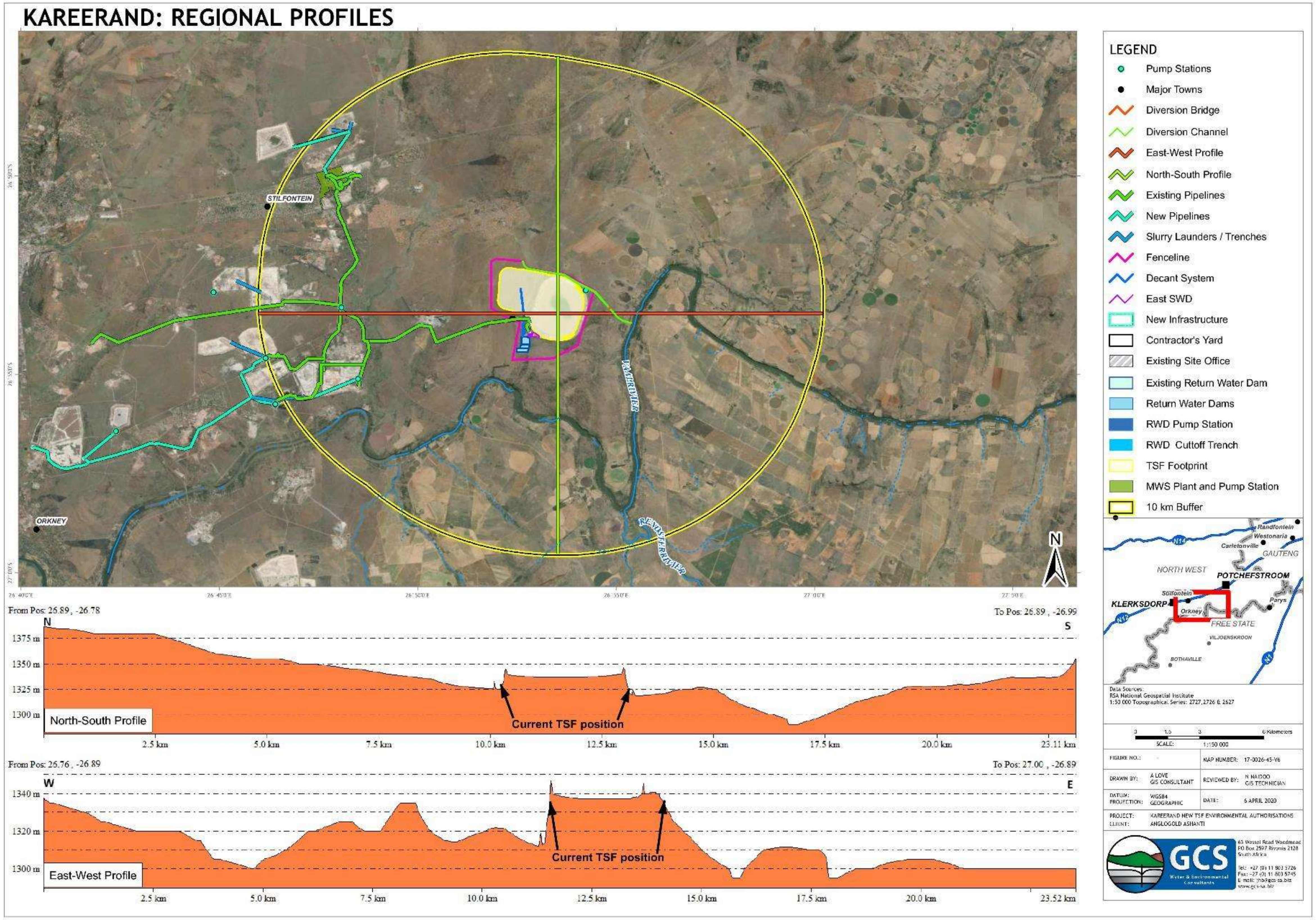

Figure 6-23: Regional cross section of the current Kareerand TSF.

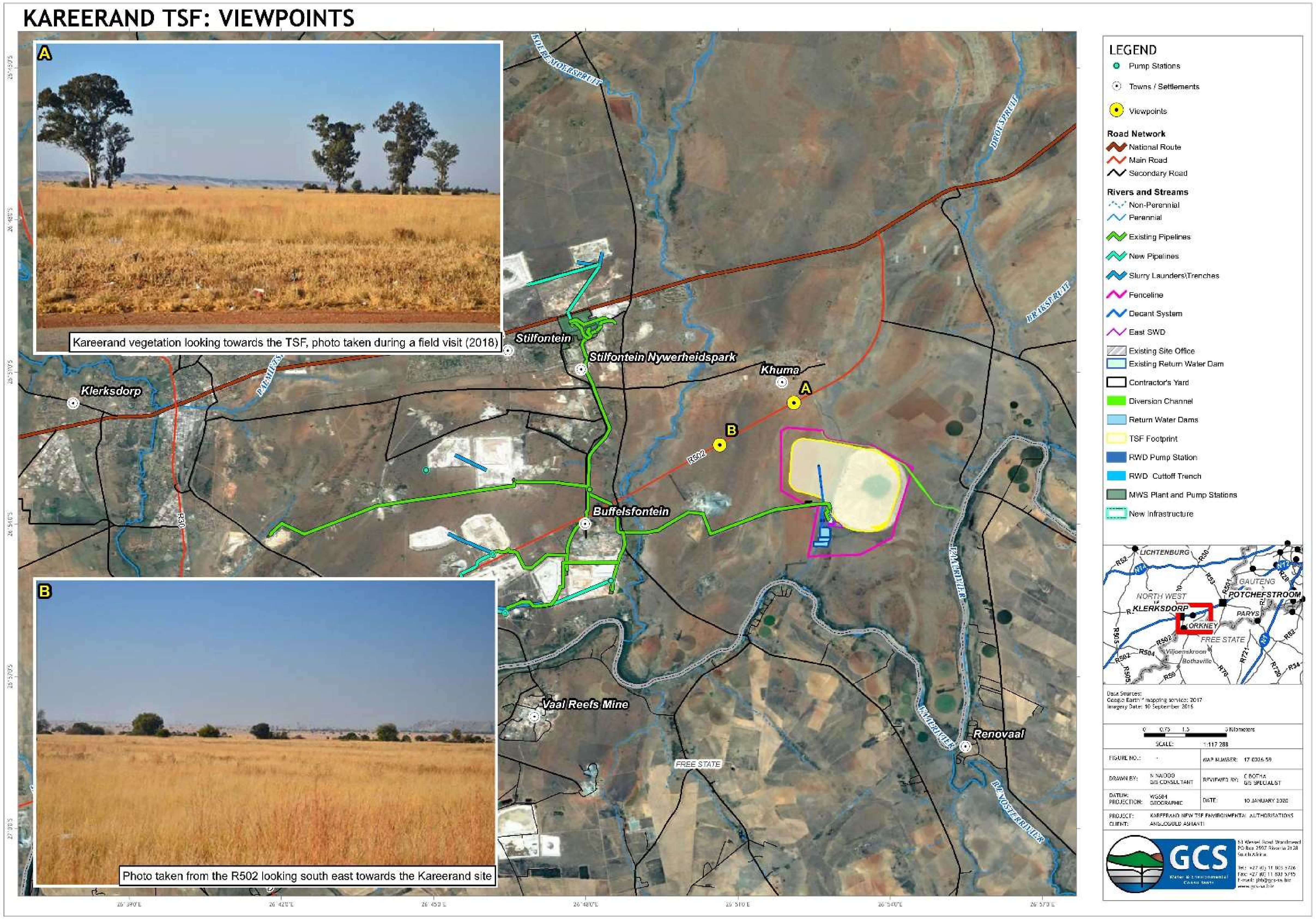

Figure 6-24: Photographs taken from the R502 to show viewpoints of the current Kareerand TSF.

6.13.3 Tourism

Figure 6-25 shows the regional protected areas, nature reserves and the identified tourist spots surrounding the proposed TSF extension. The figure indicates that the Bushybend Private Nature Reserve is located directly south of the proposed site and that several other nature reserves and game farms are located further away from the proposed site. Additional sites of interest within close proximity to the proposed extension include Kopano Brickworks, Chubby Chick Farm sites, Wawiel Park Holiday Resort and the Midvaal Water Company.

Furthermore, there are numerous nature reserves, national parks, and potential tourism points of interest that can be accessed using routes in the vicinity of the proposed development. This segment of the N12 National Route, located north of the proposed site, forms part of the “N12 Treasure Route”. The route passes through the KOSH area and runs approximately 8 km north of the proposed TSF extension. The route also links road users to the Vredefort Impact Crater (world heritage site) located east of the proposed site.

Figure 6-26 indicates the nearby mining and energy facilities surrounding the proposed TSF extension site. The figure indicates that the development of a solar plant has been approved to the east of the site. Several mines are also located within 10 km of the proposed site however, many of these mines have been mined out.

6.13.4 Sense of Place

The area surrounding the study site comprises mainly of farmland and remnants of old mine workings. The Vaal River runs directly south of the area and several towns are situated to the west and north-west of the proposed extension. The town of Khuma is located less than 5 km north of the proposed TSF extension and is the closest town in proximity to the study site. Stilfontein and Buffelsfontein are located further east and are adjacent to the remnants of the old mine workings.

Given the existence of old mine workings and the current TSF, the proposed TSF extension is expected not to significantly detract from the existing sense of place. However, the remaining areas (south and west of the proposed TSF extension) comprises mainly of farmland and the proposed TSF extension may slightly detract from the existing sense of place in this region.

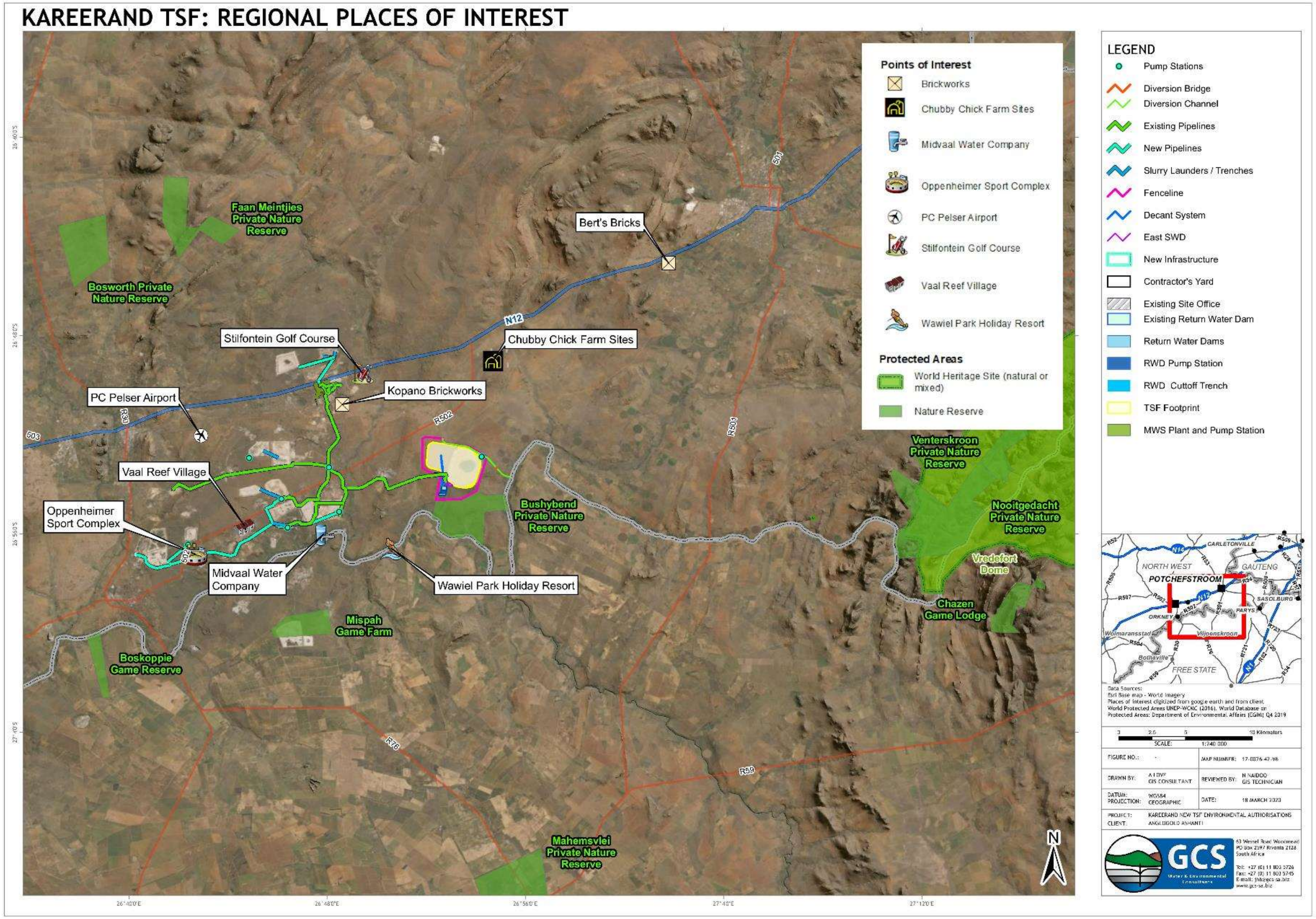

Figure 6-25: Nature reserves and places of interest.

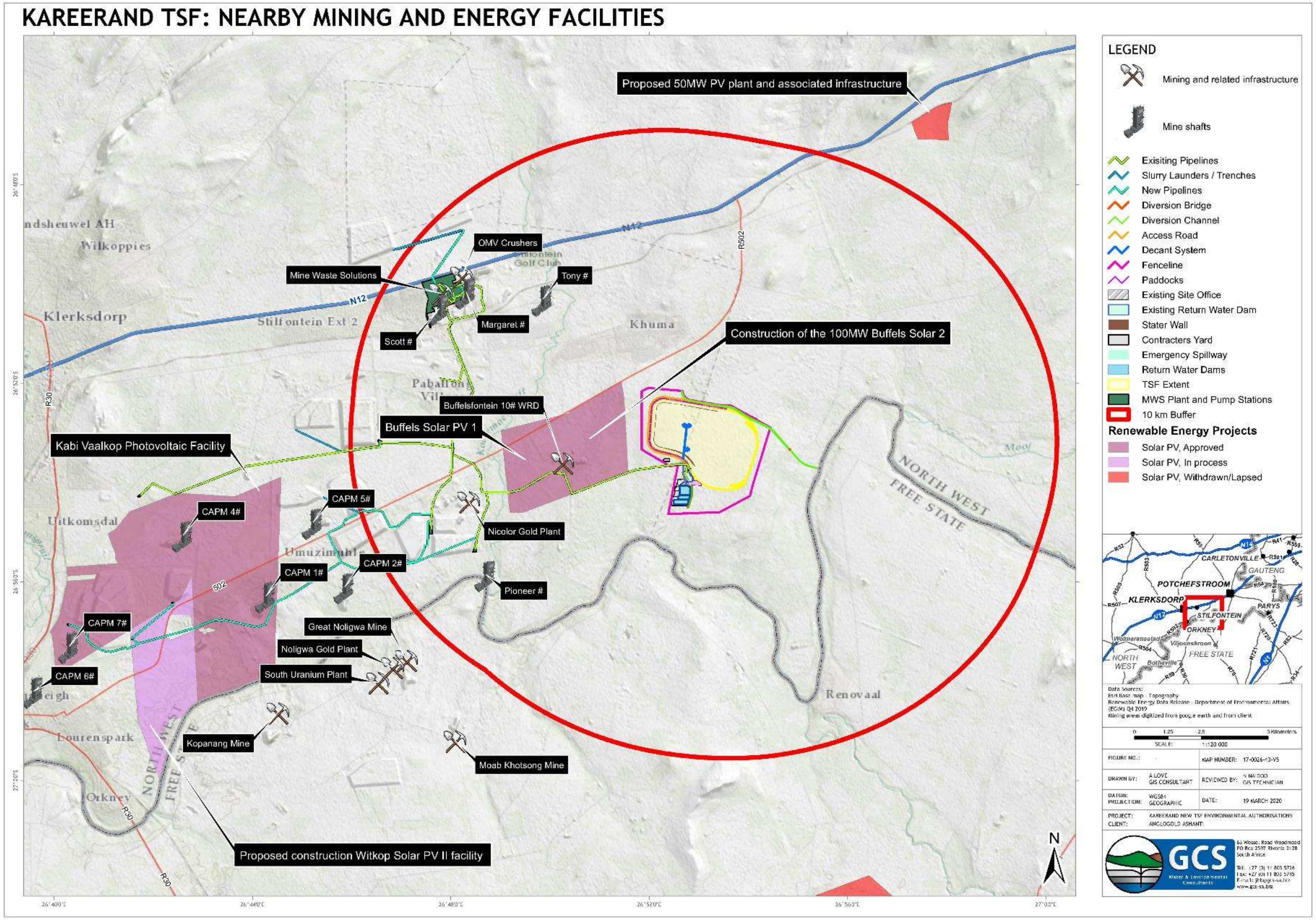

Figure 6-26: Nearby mining areas and renewable energy projects.

6.14 Health Assessment

Based on the available information for the Kareerand TSF Expansion Project, two types of sources of contamination can be identified, namely sources of atmospheric pollutants and sources of aquatic contaminants.

Information available for the atmospheric pathway indicate PMs the primary pollutant of concern. By scaling the estimated airborne PM emissions from the existing Kareerand TSF with the concentrations of elements typically associated with gold mine tailings, it was shown that under extreme conditions of exposure, concentrations of manganese and uranium may exceed health-risk based guidelines. Evaluation of the potential risks to human health must therefore consider airborne PM as well as particulate associated concentrations of manganese and uranium.

A similar evaluation of the information available for the aquatic pathways indicated that several elements are present in seepage water from a typical TSF. A geochemical evaluation of the Kareerand tailings highlight the same list of elements as likely to be mobilised as conditions in the tailings become more acidic in the future. Model predictions indicated potentially significant increases in sulfate concentrations. As an indication of the impacts most likely to occur during the operational life of a TSF, the measurements of baseline groundwater quality in boreholes near the Kareerand TSF indicates concentrations of aluminium, iron and manganese exceeding quality criteria.

7 SPECIALIST STUDIES SUMMARY

This section provides an overview of the specialist studies undertaken for the proposed Kareerand TSF Expansion project, including the following information regarding each study:

- The details of the specialist who prepared the report;
- An overview of the scope of each study; and
- An overview of each specialist's findings and the implications of those on the project.

7.1 Ecology and Wetlands

7.1.1 Specialist Details

Several specialists contributed to this section of the project, as follows:

- Iggdrasil Scientific Services (ISS): biodiversity study, "Terrestrial Biodiversity Assessment Associated with Kareerand Tailings Storage Facility Expansion Project" is attached to this report as **Appendix D1**;
- De Castro and Brits: botanical study, "Botanical Biodiversity Baseline and Impact Assessment Report for the Mine Waste Solutions Kareerand Tailings Storage Facility Extension Project" is attached as **Appendix D2**;
- Dr Andrew Deacon: zoological study, "Mine Waste Solutions – Kareerand Extension Storage Facility Extension Project, Terrestrial Fauna: Impact Assessment Report" attached as **Appendix D3**;
- Clean Stream Biological Services: aquatic fauna study, "Mine Waste Solutions – Kareerand TSF Extension Project, Aquatic Fauna Impact Assessment" attached as **Appendix D4**;
- De Castro and Brits: wetland study, "Wetland Impact Assessment Report for the Proposed Mine Waste Solutions (MWS) Kareerand Tailings Storage Facility (TSF) Extension Project" is attached as **Appendix D5**; and
- Limosella Consulting for ISS: wetland study, "Kareerand Tailings Storage Facility Expansion Project. Wetland/Riparian Delineation and Functional Assessment" is attached as **Appendix D6.**

7.1.2 Scope

7.1.2.1 Desktop study

Desktop information on the expected biodiversity of the project area, including expected vegetation communities, was obtained from relevant sources. In addition to information on expected species assemblages, the project area was assessed in terms of the following:

- NWBSP, 2015;
- Relevant SANBI GIS data regarding ecologically important and sensitive areas in terms of fauna will be incorporated where relevant.
- Whether the study area is situated within a Listed Ecosystem in terms of Section 52 of the National Environmental Management: Biodiversity Act (Act 10 of 2004) or in a vegetation that is classified as Vulnerable or Endangered;
- Whether any portion of the vegetation community in the project area is protected by legislation;
- The presence of suitable habitats for faunal or floral species of conservation concern;
- Whether any portion of the project area contributes to important ecological processes such as ecological corridors, hydrological processes and whether important topographical features such as ridges are present in the project area; and
- Whether rivers and wetlands in the project area are listed as Freshwater Ecosystem Priority Areas (FEPAs) (SANBI, 2011).

7.1.2.2 Baseline Surveys

- Vegetation communities were sampled using random stratified sampling. This method entailed the mapping of vegetation units prior to the site visit and placing at random 5 – 10 sampling plots per vegetation unit to obtain a species list. Size of sample plots fitted the type of vegetation as per methods used in the compilation of VEGMAP. Each sample plot was sampled using the Braun-Blanquet methodology (Westhoff and Van der Maarel, 1978).
- Terrestrial faunal surveys included field assessments. Direct sightings and indirect evidence (calls, scat, tracks, etc.) of fauna species were recorded. Surrounding areas were scanned as needed. Since fauna were always directly observed, the field survey also focussed on identifying habitat and micro-habitats to determine the likelihood of habitat specialists occurring on site, with focus on ecologically significant species. An assessment of likelihood of occurrence of ecologically significant species was provided, based on site survey findings.
- An assessment and mapping of any sensitive areas in terms of fauna was provided. Identification of areas of current and future potential threat to fauna species, with

focus on ecologically significant species. The development of a fauna management and monitoring plan was undertaken.

- The wetland areas were delineated in accordance with the DWAF (2005) guidelines.

7.1.2.3 Impact Assessment

Once the baseline assessment was completed, the specialists undertook the impact assessment. The significance of potential impacts on the above-mentioned attributes have been assessed using the GCS impact assessment matrix. Suitable and practically implementable mitigation measures have been identified, and the significance of potential impacts have been reassessed post mitigation.

7.1.3 Findings

7.1.3.1 Terrestrial Ecology

The project area is classified as a Critical Biodiversity Area 2, as well as Ecological Support Areas 1 and 2, based on the NWBSP.

The type and extent of the proposed activities coupled with the overall status of the sites to be affected are not expected to have extremely detrimental effects on the overall ecological character as long as mitigation measures are implemented. Due to the high faunal assemblages in the area (albeit a game farm), and the variety of habitats and micro-habitats on site, the area is largely designated as highly sensitive in terms of terrestrial fauna.

In terms of flora the largest sections of the study area are of moderate sensitivity, however three highly sensitive communities were identified. Two near threatened plant species were observed during the site visit the proposed footprint area does currently not affect the two species apart from the expected increase in dust as a result of construction activities as well as the larger surface area of the TSF during the operational phase. The management plan proposes recommendations to maintain a sample of sensitive habitats and connectivity between these habitats to retain and manage biodiversity on site. Where required, the necessary permits to relocate TOPS and provincially protected plants must be obtained prior to construction.

7.1.3.2 Aquatic Ecology

Vaal River ecosystem

According to the DWS desktop classification system, the Vaal River reaches of concern falls within a PES of B (slightly modified) to C (moderately modified) and are of moderate to ecological importance and sensitivity. The 2017 in-situ water quality monitoring results (physico-chemical habitat) did not detect any notable spatial deterioration within the Vaal River reach of concern.

The EC (electrical conductivity) levels generally remained consistent on a spatial scale throughout this reach while some temporal variation was noted (lower during the wet season when higher flows dilute salt concentration). The pH and dissolved oxygen levels were generally within guideline levels and should not be limiting to aquatic biota.

Chlorophyll-a (the primary form of the photosynthetic green pigment found in plants) results indicated that the Vaal River upstream from MWS activities is already eutrophic to hypertrophic while a general further increase was noted towards hypertrophic levels downstream of the MWS study area. This is an indication that activities upstream from MWS activities have already led to significant nutrient enrichment and that mining activities cannot be ruled out as a contributing factor to further increased levels. The nuisance factor of algal bloom activity in this reach is considered to be serious.

A total of 34 diatom species were identified from the Vaal River (2015 survey). The diatom-based water quality of the MWS Vaal River reach was classified as poor, with salinity and organic pollution levels being at unacceptable levels for the optimum functioning of aquatic biota. Nutrient levels were also very high. There were also concerns of heavy metal pollution that was picked up in the system during the analyses indicating that metal toxicity could affect the biological functioning of aquatic biota. The majority of diatom species present prefer eutrophic, organically enriched waters with high electrolyte content and is typically representative of industrially impacted waters.

Organically bound nitrogen levels were very high indicating that nutrient loading was problematic at all sites. According to available literature an estimated fifty (50) macro-invertebrate families may be expected to occur in this MWS Vaal River reach under present conditions. The presence of forty-seven (47) macro-invertebrate taxa has been confirmed in this reach from 2013 to 2017.

Overall this reach can be classified in a category B (slightly modified) to C (moderately modified) based on the aquatic macroinvertebrate composition. Temporal trends indicate notable variation over time, with all Vaal River sites indicating improvement over the latter part of the study period. Based on the latest available information and distribution maps the following eleven indigenous fish species have a high probability to occur in the MWS Vaal River reach.

During recent (2012 to 2017) surveys of selected sites within this reach, the presence of ten indigenous species was confirmed. One of the fish species present in this reach, namely the Vaal-Orange Largemouth yellowfish (*Labeobarbus kimberleyensis*) is red data listed (IUCN and TOPS), being classified as near-threatened. A further five species, namely *L. aeneus*, *L. kimberleyensis*, *L. capensis*, *L. umbratus* and *A. sclateri* are endemic to the Orange-Vaal River system. A number of exotic species are also present in the Vaal River within the study area and may impact negatively on the indigenous species. A FRAI (Fish Response Assessment

Index) score of 72% was calculated based on the latest available information, indicating that the biotic integrity (based on fish) of this reach is currently altered from its natural conditions and can be classified in a category C (moderately modified).

<u>Koekemoerspruit ecosystem</u>

According to the DWS desktop classification system, the Koekemoerspruit reach of concern falls within a PES of E (seriously modified) and are of moderate to ecological importance and sensitivity. Due to the seasonal nature of the Koekemoerspruit, many sites of often dry at the time of sampling. The physico-chemical habitat (water quality) of the Koekemoerspruit is very poor and will be greatly limiting to aquatic biodiversity of the area.

Untreated sewage was found entering this stream and it can be expected that much surface and sub-surface affected mine water will reach this stream from the many mining operations in its vicinity. High EC levels were already evident in the upper reaches with no further notable spatial increase in salinity (as measured in EC) observed during 2017.

A total of 61 diatom species were identified from the Koekemoerspruit sites (2015 survey). The diatoms encountered in the Koekemoerspruit indicated that there were concerns of high salinity loads within the system. There were valve deformities which indicated that metal toxicity was present and these might have an effect on the biological functioning of the aquatic biota in the river reach. The majority of diatom species present in the Koekemoerspruit have a preference for eutrophic, organically enriched waters with high electrolyte content and is typically representative of industrially, mining and agricultural activities.

According to literature an estimated twenty-nine (29) macro-invertebrate families may be expected to occur in the Koekemoerspruit reach under present conditions. The lower expected diversity of macroinvertebrate taxa in the Koekemoerspruit when compared to the Vaal River is especially attributed to the seasonal nature of the Koekemoerspruit. Actual sampling of the Koekemoerspruit revealed a higher diversity of invertebrates, with thirty-five (34) macro-invertebrate taxa confirmed in this reach between the period 2013 to 2017.

The ecological category of this reach (based on macroinvertebrates) ranges between a category E (seriously modified) and F (critically modified) condition. Based on the latest available information and distribution maps ten indigenous species have a high probability to occur in the Koekemoerspruit reach. The 2013-2017 monitoring surveys confirmed the presence of six indigenous species. One alien fish species, namely *Gambussia affinis* was also sampled.

A FRAI score of 18.9% was calculated indicating that the biotic integrity of this reach, based on fish, is currently in a highly deteriorated state and can be classified in a category E/F (seriously/critically modified). This is also a deterioration form the previous MWS assessment when a FRAI score of 32.7% was calculated (category E), indicating recent deterioration in the fish assemblages of this stream.

Karee tributary

The Karee tributary is highly seasonal and therefore generally not suitable for the application of biomonitoring protocols. A single site (Karee-Vaal) was sampled in the lower reached close to the Vaal River during the November 2017 survey to gain some insight into the conditions prevailing in this stream. A very high EC level of 540 mS/m was measured at site Karee-Vaal during November 2017. This is an indication that some sources of high salinity are entering this drainage line, and that it then contributes to salt loads in the Vaal River. Some probable sources of pollution that may impact this stream include Khuma township and the existing Kareerand TSF. MWS should further investigate and ensure that no spills or seepage from the Kareerand TSF is reaching this stream.

The latest (September 2017) environmental toxicity testing survey indicated that the Kareerand operations return water dam (Karee-RWD) was of a very high acute/chronic environmental toxicity hazard (Class V), with a very high safe dilution ratio of 0.1% required to negate potential impacts. It appears that this hazard was largely mitigated at the time of sampling as the downstream dams measured no acute/chronic environmental toxicity hazard (Class I) at Karee-US-Dam and slight acute/chronic environmental hazard (Class II) at Karee-DS-Dam.

High EC levels are also often measured at these sources (460 mS/m at site Karee-RWD during September 2017), indicating that there may be potential contributors to the high EC levels observed in the lower Karee tributary at site Karee-Vaal. The Karee tributary is a seasonal drainage line, and hence not suitable for the application of the SASS5 as a monitoring tool or ecological classification system. During the November 2017 survey conducted in the lower reaches of this stream as site

Karee-Vaal, 15 macroinvertebrate taxa were sampled. Most of the taxa sampled had a very low (6 taxa) and low (8 taxa) requirement for unmodified water quality, indicating that poor water quality is currently prevailing in this stream. No fish were detected at site Karee-Vaal at the time of sampling in November 2017. As this is a seasonal drainage line, the absence of fish from this site (stream) may be a natural phenomenon, as flow and hence habitats may not be suitable for the colonisation of any fish species.

The general impacts to aquatic biodiversity should also be considered and appropriately managed. It is also emphasised that the current AGA biomonitoring program should be maintained and additional sites and protocols as recommended in this report should be strongly considered for implementation.

7.1.3.3 Wetlands

Eleven wetlands were recorded on the study area earmarked for Kareerand Tailings Storage Facility Expansion Project. The wetlands on site consist of:

- 3 x unchanneled valley bottom wetlands;
- 2 x channelled valley bottom wetlands (one of which is part of the perennial Vaal River, which only enters a small section of the larger study site);
- 3 x seep wetlands;
- 1 x pan (depression wetland); and
- 2 x artificial wetlands.

In the eastern section several smaller dams and dam-like structures can be seen on aerial photography. These features are considered to be artificial and are thus not included in the function and integrity assessment during this phase of the report, although they perform some biodiversity functions such as habitat and breeding areas, as well as drinking water for larger animals.

7.2 Soils and Hydropedology

7.2.1 Specialist Details

TerraAfrica Consult cc was appointed to undertake a Soil, Land Use, Land Capability and Agricultural Potential Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D7**.

7.2.2 Scope

7.2.2.1 Literature Review and Desktop Assessment

- Review of all existing and relevant previous soil reports compiled for the study area;
- From this assessment, gaps in the baseline information available were identified and informed the site survey to ensure that these gaps were addressed; and
- In addition to this, aerial photography as well as broad soil and land capability classes as obtained from the Environmental Potential Atlas of South Africa (ENPAT) and the Agricultural Research Council (ARC) were studied.

7.2.2.2 Field Survey

- A detailed soil survey based on a 1 ha grid was undertaken, where the proposed footprint area and a 100 m buffer zone around the proposed footprint was assessed.
- In areas of great soil form variety, more sample points were evaluated in order to establish soil form boundaries.

- Observations were made regarding soil form, texture, soil profile depth, presence of soil structure and slope of the area.

7.2.2.3 Reporting

- A Soil, Land Use, Land Capability and Agricultural Potential Assessment Report was compiled that describes the desktop study as well as the site survey in line with the NEMA requirements.
- Once soil form groups were outlined, the land capability classification of the area was determined and mapped using the 2017 DAFF data and the DEA Online Screening Tool. Similarly, the agricultural potential of the study area was assessed based on these guidelines, taking other agricultural potential calculation factors into consideration. The assessment of the potential impacts of the proposed project on the soil, land use and land capability properties of the project site was then be determined using the standard GCS risk rating methodology.

7.2.3 Findings

Although some areas of the land that will be affected by the proposed Kareerand TSF expansion do have arable land capability, it has not been used for crop production within the last ten years. The properties to be affected are communal land that is leased to Chemwes for the operation of the existing waste facility. The area outside of the fence of the current TSF is used for cattle grazing by the community who owns the land.

The total gross income generated by livestock farming in the area the past year is estimated to be R699 600.00. Following the requirements of GN320, the potential gross income loss from agricultural activities in the area between 2021 and 2025 is estimated to be R4 430 760.

The potential agricultural employment which could be lost through the development of the TSF Expansion were between two (entrepreneurial project) and seven (community-based project).

The impacts on soil and agricultural agro-ecosystems are confined within the area of direct impact. Impacts on the nearby agricultural crop fields such as the pivot irrigation fields, may be caused by polluted groundwater and surface water as well as air pollution plumes. The assessment of these impacts has been addressed by the air quality and groundwater assessments.

7.3 Air Quality

7.3.1 Specialist Details

Airshed Planning Professionals was appointed to undertake an Air Quality Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D8**.

7.3.2 Scope

7.3.2.1 Baseline Assessment

A study of the receiving environment by referring to:

- Available ambient air quality data for NO_2, CO and PM (PM_{10}, $PM_{2.5}$ and TSP). The available dust fallout and PM data from the monitoring network has been used;
- Identified air quality sensitive receptors; and
- Details on the physical environment i.e. meteorology (atmospheric dispersion potential), land use and topography.

7.3.2.2 Impact Assessment

- The compilation of an emissions inventory including the identification and quantification of all emissions associated with current and proposed operations.
  - The baseline has been based on the most recent air quality impact assessment data available (likely the 2014 Air Quality Baseline Assessment conducted by Airshed).
  - The future operations will include the expansion of the Kareerand TSF and associated activities.
- Atmospheric dispersion simulations of gaseous pollutants, PM_{10}, $PM_{2.5}$ and dust fallout for the operations reflecting highest daily and annual average concentrations and total daily dust deposition due to routine and upset emissions from the TSF expansion operations. Relevant metals have been assessed. The US EPA approved AERMOD model has been used.
- Compliance and impact assessment by comparing ambient pollutant concentration levels to the relevant air quality requirements.
- The identification of air quality management and mitigation measures based on the findings of the compliance and impact assessment.

7.3.2.3 Reporting

- A specialist air quality impact assessment report.
- Assess and update if needed the ambient air quality monitoring program.

7.3.3 Findings

Baseline Assessment

- The significant AQSRs (Air Quality Sensitive Receptors) are those of Khuma Township, Buffels 10# Mine (owned by Village Main Reef Mine), various farm and property owners, the chicken farm, the nearby supermarket/garage and Midvaal Water Company (see **Figure 7-1**);
- The main sources likely to contribute to baseline PM emissions include mining operations, industrial operations, vehicle entrained dust from local roads, vehicle exhaust and windblown dust from exposed areas on existing TSFs;
- Other sources of PM include farm activities, occasional biomass burning and household fuel burning in the residential areas of Stilfontein, Klerksdorp, Khuma and Buffels 10# Mine;
- Dust fallout measurements near the Project site were available for analysis;
- The area is dominated by winds from the north-north-west and north. These wind directions are also associated with strong winds of above 6 m/s. Wind speeds exceeding 9.8 m/s, likely to result in high dust emissions, occurred for 3% of the time;
- Simulations for the VR and MWS operations were undertaken in a 2015 study:
  - PM_{10} and $PM_{2.5}$ concentrations are in compliance at the AQSRs over the short- and long-term.
  - Dustfall rates are below the National Dust Control Regulations (NDCR) limit for residential areas at the AQSRs.

Impact Assessment

- Construction phase:
  - The significance of construction related inhalation health and nuisance impacts is likely to have a “low” risk; however, using the GCS ranking methodology the impacts are “moderate” risk without and with mitigation. This is mainly due to the high likelihood in the significance ranking which increases the risk rating. The likelihood is significantly inflated since the activity assessed is governed by legislation.
- Future operational phase:
  - PM (TSP- Total Particulate Matter, PM_{10} and $PM_{2.5}$) emissions and impacts were quantified;

  - PM_{10} and $PM_{2.5}$ concentrations are within compliance off-site and at all the AQSRs over the short- and long-term;
  - Dustfall rates above the NDCR limits for residential areas at some AQSRs occurred for one month based on the meteorological data used. High winds occurred over two consecutive days where a secondary development associated with a frontal system arose. The rest of the data showed dustfall rates below the NDCR limit for residential areas at all AQSRs. Dustfall rates are below non-residential areas at all of the AQSRs. (see **Figure 7-2**);
  - The significance of operations related inhalation health and nuisance impacts is likely to be "low" risk; however, using the GCS ranking methodology the impacts are "moderate" risk without and with mitigation. This is mainly due to the high likelihood in the significance ranking which increases the risk rating. The likelihood is significantly inflated since the activity assessed is governed by legislation.
- Decommissioning and closure phases:
  - The significance of decommissioning operations related inhalation health and nuisance impacts is likely "low"; however, according to the GCS ranking methodology the risk is "moderate" without and with mitigation.
  - The significance of closure operations related inhalation health and nuisance impacts is likely "low"; however, using the GCS ranking methodology the risk is "moderate" without and with mitigation.
  - The likelihood in the significance ranking is high which increases the risk rating. The likelihood is excessive since the activity assessed is governed by legislation.

<u>Greenhouse Gas Emissions</u>

The CO_2-e (scope 1) emissions for construction is approximately 6 809 tpa and the CO_2-e (scope 1) emissions for project associated operations is approximately 4 369 tpa. Therefore, contributing less than 0.01% to the total of South Africa's GHG emissions and 0.02% of the total "manufacturing industry and construction" sector in both phases. The GHG emissions from the project are low and will not likely result in a noteworthy contribution to climate change on their own. The project and the community are likely to be negatively impacted by climate change due to increased temperatures and possible water shortages (decreased rainfall and possible increased evaporation).

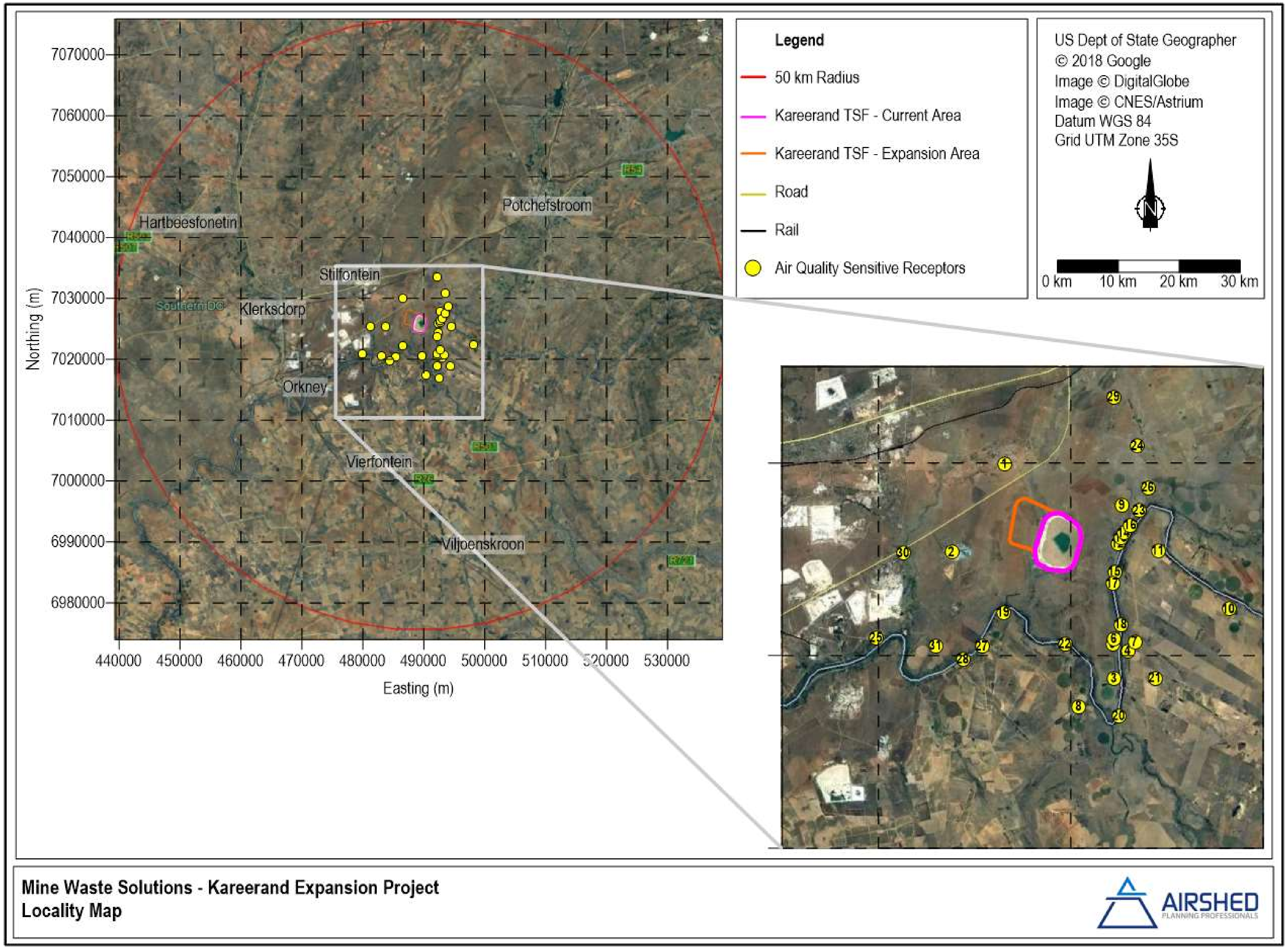

Figure 7-1: Air Quality Sensitive Receptors in the vicinity of the proposed Kareerand TSF expansion (Airshed, 2020).

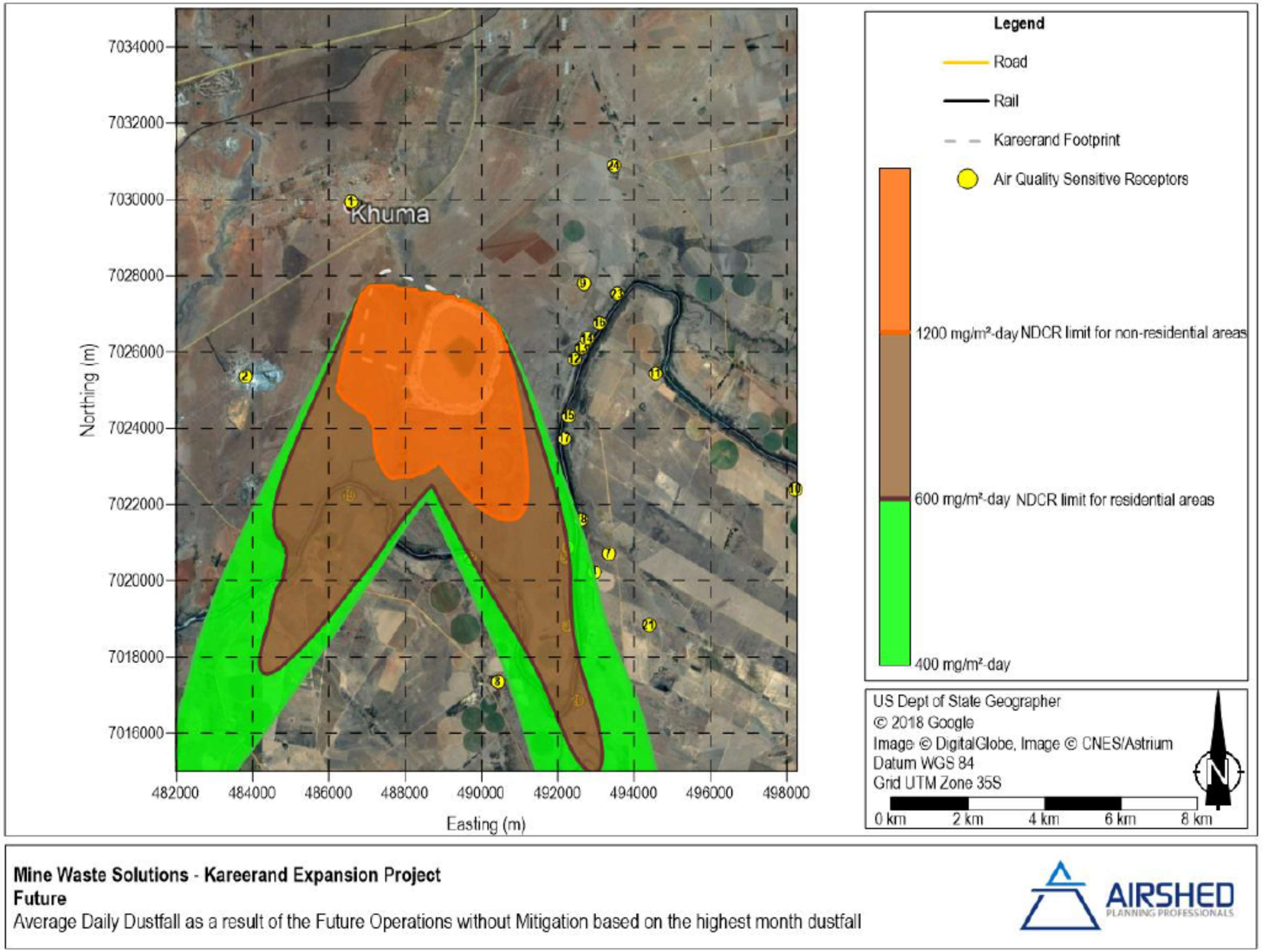

Figure 7-2: Future average daily dustfall rates during operation based on simulated highest monthly dust fallout (Airshed, 2020).

7.4 Noise

7.4.1 Specialist Details

WSP was appointed to undertake an Acoustic Impact Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D9**.

7.4.2 Scope

The scope of the study, designed to best meet the project requirements, is summarised below:

- Screening-level input into phase 1 of the assessment which will include identification of potential noise sources, sensitive receptors and relevant legislation applicable to the assessment;
- A baseline assessment of the current noise climate in the vicinity of the proposed development which includes baseline sound level monitoring within the receiving environment (receptors);
- Compilation of a comprehensive acoustic inventory to account for sources of noise associated with the proposed development;
- An acoustic modelling investigation to determine the impact of the noise associated with the proposed development;
- Submission of an Environmental Acoustic Impact Assessment Report, detailing all findings from the baseline assessment, acoustic inventory and acoustic modelling simulations; and
- Provision of recommendations on the scope of any mitigation measures that may be applied to reduce noise associated with the proposed development, if necessary.

7.4.3 Findings

Baseline monitoring indicated current day-time noise levels at all seven monitoring locations are compliant with the SANS guideline rating levels. The main sources of noise identified at the on-site locations were pumps, trucks and activity of people. The R502 road is currently the main source of noise identified at both KR05 (Khuma Town) and KR06 (Hostel), while very quiet conditions were noted at KR07 (house south of the TSF site).

Due to safety concerns at night, monitoring could not be undertaken at KR05 (Khuma Town) and KR06 (Hostel) and as such there is no night-time data to present for these locations. Noise levels at all other locations remained well below their respective guideline levels. The highest LAeq noise level was recorded at KR01 (onsite). Dominant noise sources onsite included pumps and intermittent vehicles, while livestock and the R502 road were the dominant sources at the residential area south of the TSF (KR07).

During the construction phase, noise levels at the on-site receptor locations are predicted to increase by between 5.5 and 25.4 dB(A). Such increases will result in “little” to “very strong” community response at the on-site receptor locations. It must be noted that these receptors are merely on-site locations utilised to match historical monitoring locations and do not represent sensitive receptors.

Increases in noise levels at the off-site receptor locations as a result of the construction activities will range from 6.7 to 10.0 dB(A). Such increases will result in “little” to “medium” community response when the construction activities are occurring in closest proximity to each of the receptors. These increases are above the 7 dB(A) threshold for annoyance as per the South African Noise Control Regulations. It must be noted that these results represent a worst-case scenario when construction activities are occurring at the closest TSF boundary to the receptor in question and do not represent noise levels that will occur all the time. Such a scenario is unlikely to occur in reality.

During the operational phase, the predicted day-time noise levels at one of the off-site sensitive receptor locations (Khuma Town) are predicted to increase marginally with the operation of the TSF extension (**Figure 7-3**). Noise levels at this location will increase by 0.1 dB(A) resulting in “little” community response. At night, when the reclamation activities cease, noise levels at four of the receptor locations are predicted to increase marginally with the operation of the TSF extension **(Figure 7-4**). Noise levels will increase by between 0.4 and 7.8 dB(A) resulting in “little” to “medium” community response at all locations. The highest increases are predicted at the on-site receptors, which are not residential in nature and hence are not classified as sensitive.

With the absence of monitored data at KR05 and KR06, an assessment of the increase in noise levels at these locations could not be undertaken. It must be noted that the predicted noise levels at these locations during the operation of the TSF extension are low at KR05 and non-existent at KR06 and as such, no negative impacts are envisaged at these receptor locations.

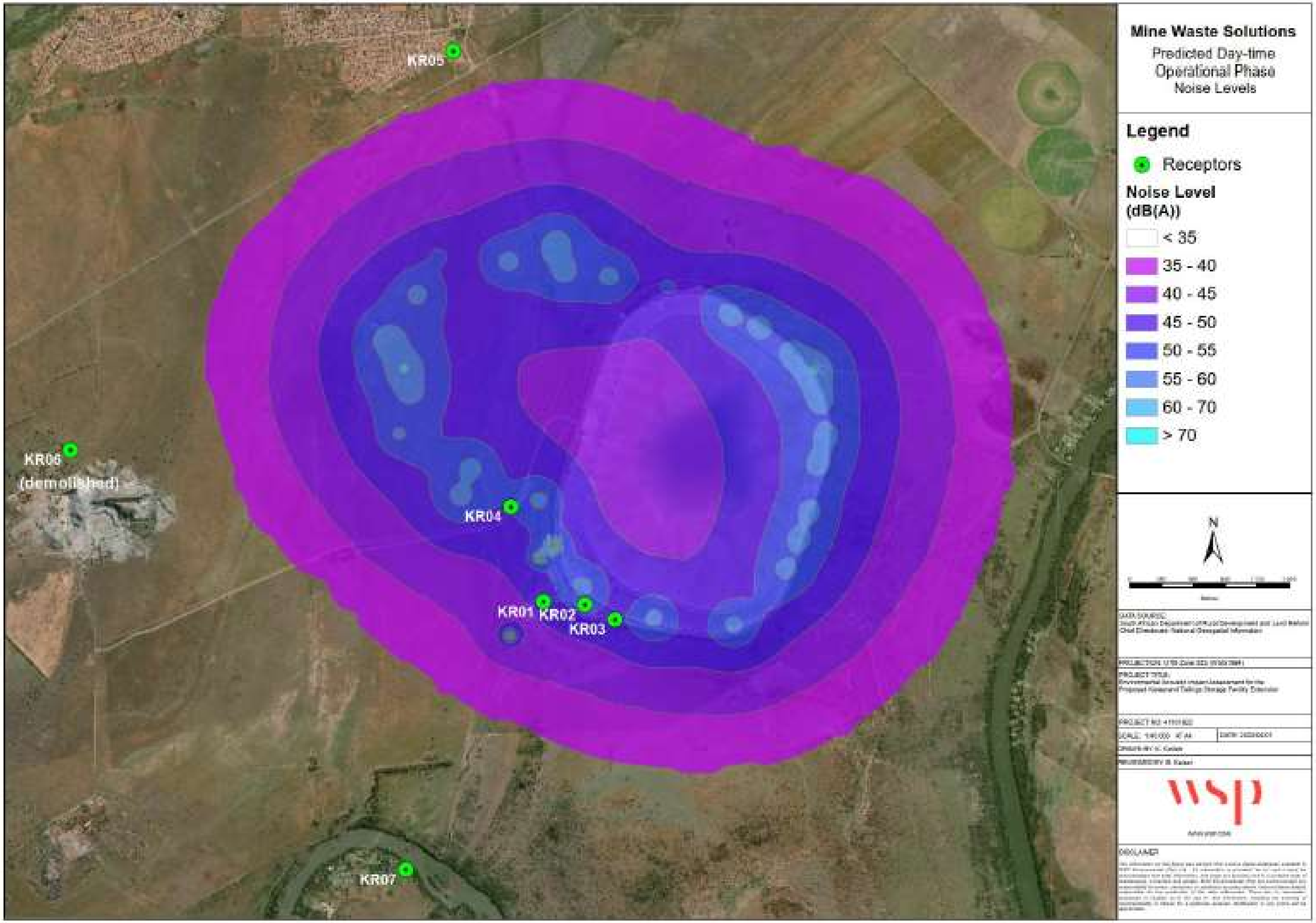

Figure 7-3: Predicted day-time noise levels during the operational phase of the Kareerand TSF extension (WSP, 2020).

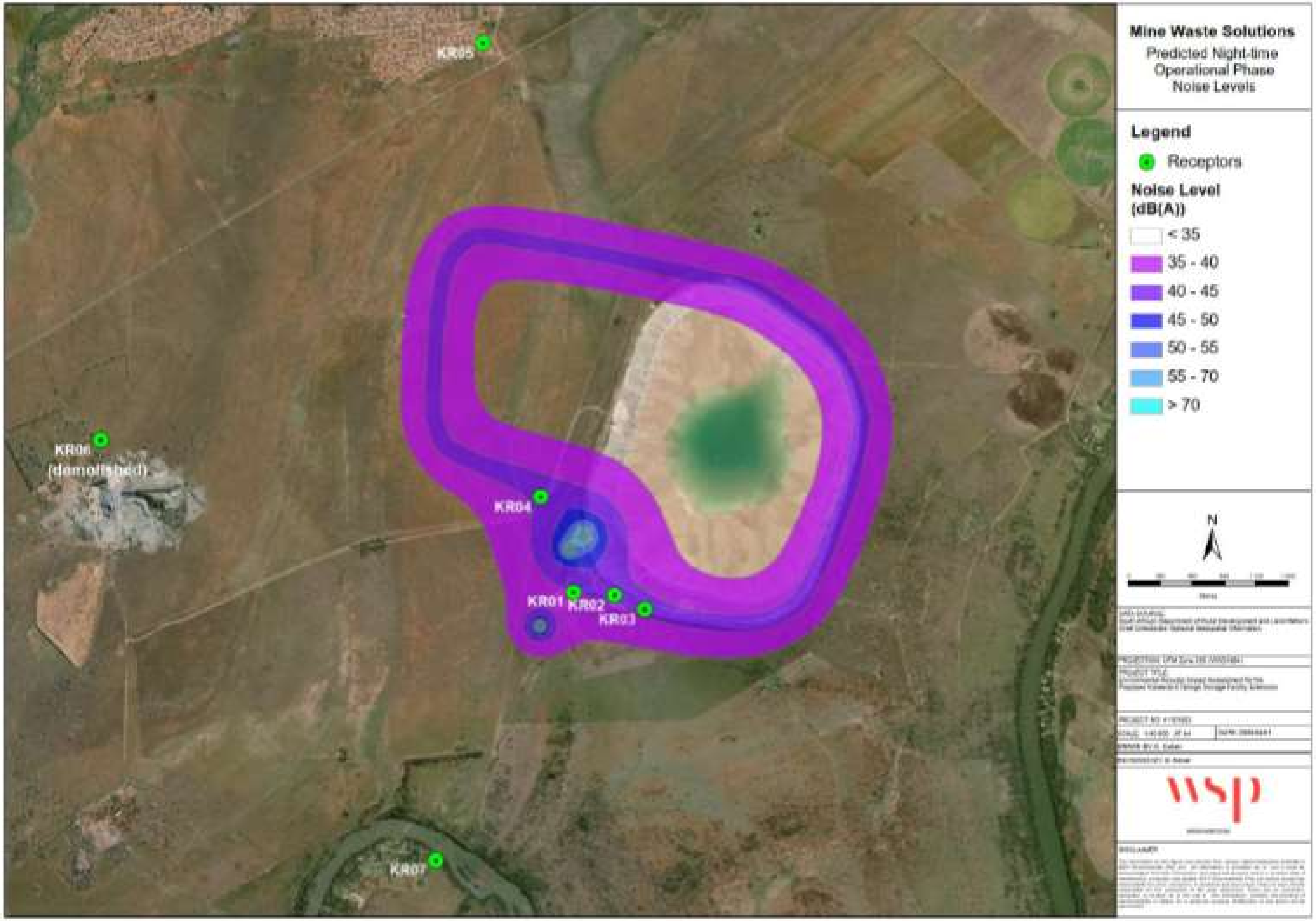

Figure 7-4: Predicted night-time noise levels during the operational phase of the Kareerand TSF extension (WSP, 2020).

7.5 Heritage

7.5.1 Specialist Details

PGS Heritage was appointed to undertake a Heritage Impact Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D10**. PGS sub-contracted the paleontological study to Banzai Environmental, and the report is attached as **Appendix D11**.

7.5.2 Scope

The scope of work comprises a background study and a Heritage Impact Assessment of the proposed impact area. The objectives for the cultural and archaeological study were:

- To obtain a good understanding of the overall archaeological and cultural heritage conditions of the area through a brief desktop study;
- To locate, identify, record, photograph and describe sites of archaeological and cultural importance;
- Should any sensitive cultural heritage sites be identified, the specialist will be required to propose a way forward to avoid and mitigate impact to these sites;
- Ensure that all requirements of the local South African Heritage Resources Agency (SAHRA) are met; and
- Report on the results of the archaeological and cultural heritage survey adhering to minimum standards as prescribed by the SAHRA and approved by the Association for Southern African Professional Archaeologist (ASAPA).

7.5.3 Findings

The desktop study revealed that the study area is located in surroundings characterised by a long and significant history. The fieldwork resulted in the identification of 48 archaeological and heritage sites, comprising of:

- Six (6) cemeteries;
- Eight (8) possible graves;
- One (1) historic black homestead containing confirmed graves;
- 20 historic black homesteads;
- Three (3) recent structures;
- Two (2) historic farmsteads;
- Seven (7) Stone Age sites; and

- One (1) old lane of trees.

Five sites are located within, or in proximity to, the proposed development footprint areas. A social consultation process is required to assess whether any local residents or the wider public is aware of the presence of graves on the site.

The proposed development area is underlain by Precambrian dolomites and associated marine sedimentary rocks that are allocated to the Malmani Subgroup as well as the Pretoria Group within the Transvaal Supergroup and Quaternary superficial deposits. The Malmani Subgroup is comprised of a variety of stromatolites, including supratidal mats, intertidal columns and large subtidal domes. This subgroup has a high palaeontological sensitivity. In the past the Quaternary superficial deposits have palaeontologically been neglected although they occasionally comprise of important fossil biotas. These fossil assemblages in the Quaternary are usually rare, occur over a wide geographic area and are low in diversity. Due to the fact that the area has already been disturbed with mining activities in the past the sensitivity is regarded as low.

While the unmitigated impact of the proposed development is expected to result in a relatively high negative impact in terms of the identified archaeological and heritage sites located here, these impacts can be suitably mitigated to acceptable levels by way of a range of mitigation measures outlined in this report. As a result, on the condition that the recommendations made in this report are adhered to, no heritage reasons can be given for the development not to continue.

7.6 Surface water

7.6.1 Specialist Details

The hydrological (surface water) assessment for the Kareerand TSF Expansion project was tasked to Knight Piésold Consulting. The report is attached as **Appendix D12**.

7.6.2 Scope

The hydrological study included the following:

- Description of the hydrological setting of the proposed TSF expansion;
- Water management and freeboard requirements;
- Water balance assessment;
- Return Water Dam sizing; and
- Stormwater and stream diversions.

7.6.3 Findings

The study area falls within quaternary catchments C24A, C24B, C24H and C23L. The Vaal River is situated approximately 2 km to the south of the proposed TSF expansion. According to the natural contour elevations, surface runoff from this site will naturally flow towards the Vaal River. There is a small non-perennial river that runs along the western side of the current TSF. The TSF and RWD require a freeboard of the 1:50 year storm plus 800 mm above the mean operating level of the pool.

A monthly water balance was modelled for different climate seasons to outline the changes and impacts of the available water resource. Various input parameters, amongst others, including the meteorological data applicable to the site, the topography of the TSF extension and RWD sites, tailings production rate, the tailings material properties and the physical dimensions applicable to the TSF and the RWD, were used for the water balance. The RWDs will be constructed downstream of the TSF and existing RWDs complex. The RWD has been designed according to current South African legislation. The required capacity of the RWDs has been determined based on the requirement to contain the 1:50-year storm event from the TSF surface area and the TSF side wall run-off.

The following potential impacts on the surrounding hydrological system were identified:

- Construction Phase:
  - Sedimentation due to soil erosion;
  - Decreased surface water quality;
  - Soil contamination; and
  - Increased runoff leading to potential erosion.
- Operational Phase:
  - Decreased surface water quality;
  - Soil contamination;
  - Increased surface runoff from side slopes;
  - Siltation of trenches/ dams; and
  - Increased runoff leading to potential erosion.
- Decommissioning Phase:
  - Decreased surface water quality;
  - Increased surface runoff from side slopes;
  - Siltation of trenches/ dams; and

- Decrease in catchment water quality.

7.7 Groundwater

7.7.1 Specialist Details

GCS Water and Environmental Consultants was appointed to undertake a Hydrogeological (groundwater) Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D13**.

7.7.2 Scope

- The main objectives of the hydrogeological assessment are:
- To collate all the available and historical hydrogeological information;
- To supply a detailed situation analysis of the current Kareerand TSF in terms of the hydrogeological environment;
- To incorporate the proposed expansion footprint;
- To assess the risk on the groundwater resources and the Vaal River; and
- To make recommendations on the management of groundwater resources and design parameters of the proposed TSF expansion.

The scope of work can be listed as follows:

- Obtain and assess all available information and identify the critical parameters that will require specific management;
- Undertake a field program to assess the foundation geology and hydrogeology;
- To understand the water quality criteria as obtained from the existing and newly drilled boreholes and surface water sites;
- Incorporation of recent field work and recommendations to fill any identified gaps;
- Application of numerical groundwater modelling;
- Final report with recommendations.

7.7.3 Findings

The seepage rates and the typical input sulfate concentration were applied in the MODFLOW groundwater model for the area. The long term predicted contamination plumes were presented in the report by means of a Scenarios. The main conclusions are:

- It can be seen from the model results that the sulfate plumes migrate mainly southwards and eastwards towards the Vaal River.
- The elevated groundwater levels around the TSF will remain.

The Vaal River and north eastern, eastern and south eastern farm boreholes are considered as the primary and most sensitive receivers for the do-nothing scenario. According to the groundwater contaminant transport model certain farm-owned boreholes may be impacted.

For the expansion project the sulfate plume will have a low impact on the Vaal River and seepage from the current TSF will pose a high to medium risk. The risk on the Vaal River will be managed by interception boreholes. Salt load and concentration increase predictions were made for the post closure phase. It is predicted that limited TDS increases will occur within the Vaal River if the full mitigation and management is followed, only 10 mg/l of TDS and approximately 200kg salt load per day. This can increase significantly if no or limited mitigation is applied.

7.8 Socio-economic

7.8.1 Specialist Details

Batho Earth Social and Environmental Consultants was appointed to undertake a Socio-Economic Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D14**.

7.8.2 Scope

The Social Impact investigation includes the following:

- Literature review, data collection and high-level stakeholder consultation;
- Scoping Report input and the determination of anticipated impacts (construction, operation, and closure phases);
- Site assessment including consultation with concerned surface owners;
- Environmental Impact Report input including a detailed impact assessment and rating of anticipated impacts (construction, operation, and closure phases); and
- A management plan applicable to anticipated social impacts.

The Economic Impact investigation includes the following:

- Identify, predict and evaluate economic aspects of the environment that may be affected by the project activities and associated infrastructure;
- Site assessment including consultation with concerned surface owners; and

- Advise on the alternatives that best avoid negative impacts or allow to manage and minimise them to acceptable levels, while optimising positive effects.

7.8.3 Findings

There are significant positive impacts associated with the proposed project, such as the continuation of employment and income generation, poverty reduction, continued tax revenue and social investment in communities and stimulation of economic growth. Another positive impact is the reclamation of old, scattered TSFs, which are currently acting as potential pollution sources. However, there are also several potential negative socio-economic impacts of the proposed project that may affect surrounding landowners and residential areas. These negative impacts may include the external costs, impact on sense of place, increased nuisance factors (dust levels, noise and traffic movement) and community safety impacts (health risks and concerns, general community safety due to illegal mining activities and increased crime, possible structural failure of the proposed TSF and possible negative impacts on environmental and water resources).

The socio-economic impacts that are rated as medium significance remain as medium even after mitigation or enhancement measures have been applied. There are various socio-economic impacts that are rated as high: the TSF remains a considerable risk due to the environmental impacts associated with such a facility, the size of the structure and the always present risk of failure. These high risks, however, can be mitigated to a medium rating. This is mainly dependent on the appropriate and successful environmental management of the TSF, as well as the strict implementation of pro-active mitigation and management measures.

The project is anticipated to facilitate the continuation of economic benefits to the local area, currently faced with high rates of unemployment and poverty. Based on the historical performance of the project in terms of environmental impacts there are, however, concerns related to the institutional capacity to monitor and manage project-related environmental externalities that could compromise the long-term growth of the local area.

7.9 Visual

7.9.1 Specialist Details

GCS Water and Environmental Consultants was appointed to undertake a Visual Impact Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D15**.

7.9.2 Scope

7.9.2.1 Gap Analysis of Spatial Data Available

Consolidating existing information and GIS data from existing information the applicant may have from previous environmental and engineering studies.

7.9.2.2 Scoping Assessment

- Identification of preliminary receptors from a desktop assessment;
- Identifying major risks during the desktop study by identifying sensitive visual receptors within the surrounding areas;
- Consolidation of existing information detailing the proposed operations; and
- Preliminary viewshed analysis to determine possible visual extent of the proposed TSF expansion and associated infrastructure.

7.9.2.3 Comprehensive Visual Impact Assessment

Extensive spatial analysis using a series of GIS techniques were used for the visual impact assessment. Additionally, data obtained from the applicant as well as documentation captured in-house were incorporated into the assessment and assisted in the initial desktop study.

A series of independent spatial analysis operations were conducted and integrated to arrive at a visual impact index. Each of these spatial analysis operations was briefly described in the following sections.

- Regional Overview and Visual Character;
- Description of the Landscape Quality;
- Description of the Sense of Place;
- Description of the Visual Resource;
- Determine Visual Absorption Capability;
- Determine Visibility and Visual Exposure; and
- Recommendation of practical Mitigation Measures.

7.9.3 Findings

The results from the viewshed analyses (**Figure 7-5**) across various infrastructure elements of the proposed TSF expansion indicate that the topography of the region acts as an effective screen for the RWDs and SWD to the potential receptors identified. The size and height of the proposed TSF expansion, with visibility coverage of 93.5% of the Potential Zone of Influence and 17.6% of the visibility being of a high visibility impact, results in the TSF having a largely un-mitigatable impact.

The sense of place of the surrounding environment should, however, be taken into consideration. The surrounding area is heavily impacted by mining and related activities, as well as the associated infrastructure and waste sites. The greater context of the project also has reference, as many old TSF's will be re-mined and rehabilitated in the process, thus reducing the visual impact of such TSFs. The majority of the visual exposure anticipated will be limited to the northern and southern regions of the potential zone of influence (within a 10 km radius).

Receptors within the models include disperse scattered mining, recreational and farming settlements, of which the majority lie within the medium visual exposure range. While mitigation measures have been suggested as per the impact table, the overall impact, from a visual perspective, largely remains in the same category as it would if it were unmitigated. This is due to the size of the TSF and the mining nature of the region. Importantly, most critical receptors, being recreational facilities, farming settlements and transportation receptors, are not highly impacted.

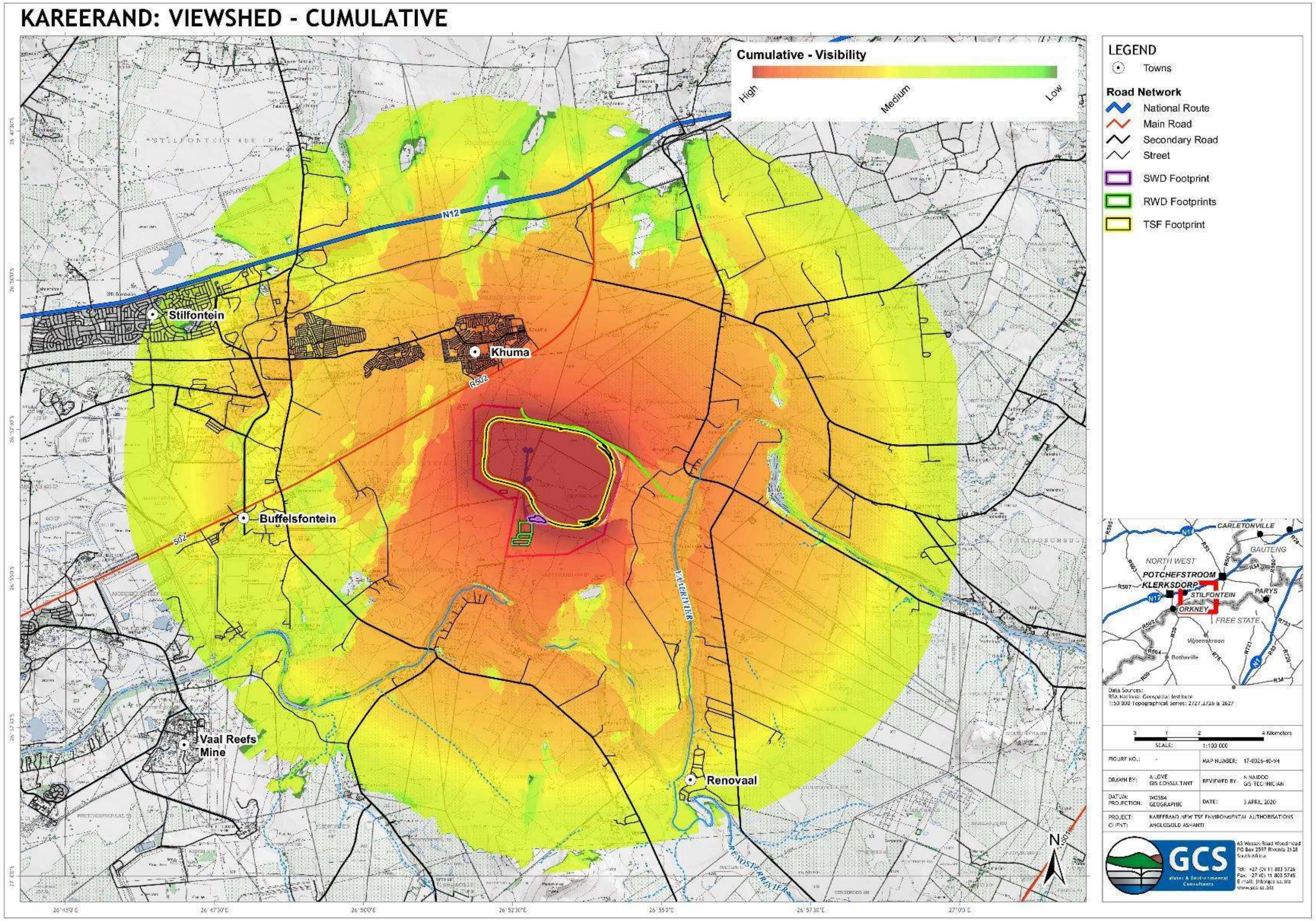

Figure 7-5: Viewshed analysis results of the proposed TSF expansion.
Highest visibility is indicated by red shading.

7.10 Health Risk Assessment

7.10.1 Specialist Details

EnviroSim Consulting (Pty) Ltd was appointed to undertake a Health Risk Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D16**.

7.10.2 Scope

EnviroSim Consulting was requested to perform an assessment of the potential impact on the health of communities living in the vicinity of the proposed Kareerand TSF Expansion, with regard to exposure to airborne pollutants as well as contaminants identified as relevant to water resources in the area. The human health risk and impact assessment (HHRIA), is aimed at specifically addressing these concerns, and is thus limited to the quantitative evaluation of potential health risks relating to the inhalation of airborne pollutants and ingestion of waterborne contaminants. In the preparation of the HHRIA, the following documents and specialist study reports were consulted:

- Feasibility Assessment Report (Knight Piésold, 2018);
- Air Quality Specialist Report for the Kareerand Tailings Storage Facility Extension (Airshed, 2020);
- AngloGold Ashanti dust monitoring project Volume II – Final Report (Annegarn, et al., 2010);
- Radiological Impact Assessment report (AquiSim, 2020); and
- Hydrogeological Impact Assessment (GCS, 2020).

Based on the understanding of the proposed activities and the environmental conditions, the atmospheric and aquatic pathways are identified as the most prominent means by which humans may come into contact with potentially hazardous contaminants from the existing Kareerand TSF and the proposed Expansion Project. The HHRIA will only consider non-radiogenic health effects associated with the potential contaminants. Health concerns relating to radioactive contaminants are addressed in the report by AquiSim Consulting (AquiSim, 2020).

The assessment endpoint of the HHRIA is limited to the evaluation of the risks posed to the health of members of the public residing in the vicinity of the proposed Expansion Project. Potential receptors will be identified from the communities closest to the proposed Expansion Project location, based on information available for these communities.

7.10.3 Findings

Based on the toxicity of the identified contaminants via different routes of exposure, manganese and uranium were considered in the evaluation of the atmospheric pathway while evaluation of the aquatic pathway considered arsenic, lead, manganese, sulphate and uranium.

Based on the estimated increase in the personal risks associated with either short- or long-term exposure to airborne particulates from the current and planned expansion of the Kareerand TSF combined, the increase in risk of all health endpoints assessed are insignificant. Although the evaluation of short-term exposure (highest 24-hour average) to concentrations of PM_{10} showed a measurable increase in the risk of both non-accidental and cardiovascular mortality, none of these estimated increases are significant. Long-term exposure to $PM_{2.5}$ was shown to lead to very low increase in personal risk of total non-accidental mortality and cardiopulmonary mortality, as compared to the baseline risk. It was reasoned that this is due to the low concentration of smaller (<2.5µm) particles assumed by the air quality specialist for the dispersion model.

Exposure to particle-associated manganese and uranium was evaluated using a set of conservative assumptions with regard to the quantities that can enter the atmosphere. The estimated airborne concentrations were evaluated assuming long-term chronic exposure, but using short term (daily) maximum airborne particulate concentrations. The resulting hazard quotients indicate that the probability of non-cancer health effects occurring from inhalation exposure to any of the contaminants is low.

The potential for health effects associated with contamination of groundwater or surface water resources from activities or sources related to the proposed Project, could not be evaluated directly due to absence of information on the concentrations of these contaminants likely to be induced in local groundwater and surface water resources. However, evaluation of source term values indicates that water resources in the area may be severely impacted. Any contribution from the proposed Project will negatively impact water quality leading to a decline in the fitness for use. Cancer risk assessment performed on the estimated concentrations of arsenic indicated cancer risks to be negligible.

Interpretation of the results leads to the conclusion that the potential for health impacts relate mainly to the residential receptors located on the Vaal River in a south easterly direction from the Kareerand TSF. However, although not significant, the increase in personal risks associated with the proposed Kareerand TSF Expansion demonstrated a potential increase over baseline risks and those relating to the current Kareerand TSF.

7.11 Radiological Public Impact Assessment

7.11.1 Specialist Details

AquaSim Consulting (Pty) Ltd was appointed to undertake a Radiological Public Impact Assessment for the Kareerand TSF Expansion project. The report is attached as **Appendix D17**.

7.11.2 Scope

The scope of the report is limited to documenting the potential radiological impact on receptors that reside near the Kareerand TSF as it pertains to exposure to naturally occurring radionuclides potentially released and dispersed into the environment from the Kareerand TSF Expansion Project.

A systematic approach was followed that included the definition of the regulatory framework and technical basis of the assessment, a system description, the systematic definition of public exposure conditions, the consequence analysis of the exposure conditions and the radiological impact assessment.

As part of the MWS Operations, the Kareerand TSF is not isolated but is associated with various operational features of the MWS Operations, some of which are known to contain or emit radioactive material to the environment and are relevant to the radiological impact assessment. Parc Scientific recently measured the radon exhalation rate from 32 samples collected at the existing Kareerand TSF (Parc Scientific, 2019). The results show an average of 0.165 $Bq.m^2.s^{-1}$ (becquerel [equal to one radioactive decay per second] per square meter per second, rate of radon exhalation), with a standard deviation of 33.5%. The 90% percentile of the cumulative frequency histogram of measured values indicated that the distribution can be represented by the average measured value.

7.11.2.1 Radiological Conditions in the Environment

AGA has been monitoring radionuclide concentrations in surface and groundwater regularly since 2003. Groundwater monitoring data indicating nuclide specific activity concentrations are available for the period 2011 to 2015. The results show that radionuclide concentrations vary greatly.

AGA also periodically measures airborne radon concentrations in the environment with passive radon gas monitors (RGMs) deployed in sets of two or three in locations around their operations. The most recent radon monitoring campaign saw RGMs deployed in pairs at 27 of the 34 dust fallout monitoring locations. The RGMs were deployed for a period of two to three months from August 2017 to November 2017.

As a further check, radon monitors were also deployed at the houses of two AngloGold Ashanti employees in Klerksdorp. These values can be referenced as background concentrations of radon, largely unaffected by the radon sources at the Kareerand TSF. Five of the sampling locations listed (Kareerand TSF, Kareerand Tailings, Kareerand Tailings North West, Kareerand Tailings South and Kareerand Tailings North) are near the Kareerand TSF.

7.11.2.2 Baseline Conditions

Some radiological baseline characterisation studies were performed for the Kareerand TSF Expansion Project, including a baseline gamma survey of the proposed site, soil sampling and full-spectrum analysis of selected locations, and an environmental radon survey using RGMs at the same selected locations.

A gamma survey was performed during July 2017 over the proposed expansion site. The maximum Uranium concentration is 74 $Bq.kg^{-1}$ (becquerel [equal to one radioactive decay per second] per kilogram, unit indicating radioactivity), while the maximum Thorium concentration is 47 $Bq.kg^{-1}$. Soil samples were collected at four locations within the proposed expansion site for full spectrum analysis. The Uranium and Thorium results are within the range of values observed in the gamma survey.

The results are typical of what could be expected for background conditions. RGMs were employed for 2 months at four locations around the Kareerand TSF and proposed expansion site. The results show that the radon concentration at these locations varies between 67 and 90 $Bq.m^{-3}$(becquerel [equal to one radioactive decay per second] per cubic meter, unit for radon activity concentration). Given its relative proximity, it is expected that the existing Kareerand TSF influences these results.

7.11.3 Findings

Only one public exposure condition was derived to be representative for the area, namely a Commercial Agricultural Exposure Condition. The atmospheric and the groundwater pathway was included as contributing pathways for the Commercial Agricultural Exposure Condition.

The following was concluded from the total effective dose assessment results:

- The contribution from the groundwater pathway is only visible in thousands of years at maximum total effective doses less than 100 $\mu Sv.year^{-1}$, which means that it cannot be considered as a contributing pathway for the Commercial Agricultural Exposure Condition during the operational phase of the expanded Kareerand TSF; and
- Conservatively it was assumed that commercial farmers are 100% dependent on the farm system to supply in their annual need for crops, fruit, vegetables and animal products as part of the Commercial Agricultural Exposure Condition. The potential total effective dose in these areas during the operational period is not expected to be higher than 100 $\mu Sv.year^{-1}$ during the operational phase the of expanded Kareerand TSF.

It can therefore be concluded, with a reasonable level of assurance, that receptors that may associate themselves with one of the exposure conditions will not be subject to a total effective dose more than the public dose constraint of 250 $\mu Sv.year^{-1}$.

These total effective dose assessment results were used to derive the radiological impact rating during the different life phases of the Kareerand TSF. The radiological impact significance rating for both the operational and post-closure phases of the expanded Kareerand TSF was "**Moderate**" across all impacts (without mitigation). The release of contaminated water containing radionuclides into the environment during the operational phase of Kareerand Project could be reduced to "**Low**" impact when mitigation/management measures are applied.

8 KNOWLEDGE GAPS AND LIMITATIONS.

The EIA Regulations require that an account of any assumptions, uncertainties and gaps in knowledge applicable to the preparation of this report is provided. The following limitations were noted pertaining to the Environmental Impact Assessment process:

- During the review of the Final Scoping Report, South Africa was subjected to a nation-wide lockdown as a result of the Covid-19 pandemic, which impacted some of the timeframes applicable to this study.

Several specialist reports were used to define the baseline environment and predict the impacts of this project. The assumptions and limitations applicable to the relevant specialist studies are outlined below.

8.1 Ecology

- The entire footprint area for the proposed TSF expansion and associated infrastructure was not surveyed in the 2019/2020 report as a recent study by De Castro & Brits (2017) and Deacon (2017) covered the middle section of the proposed activities. It is therefore important to note that both this and the De Castro & Brits (2017) report should be used when determining the sensitivity of the area, impacts, associated mitigation and management measures.
- Specialist studies are conducted to certain levels of confidence, and in all instances known and accepted methodologies have been used and confidence levels are generally high. This means that in most cases the situation described in the report is accurate at high certainty levels, but there exists a low probability that some aspects have not been identified during the studies. Such situations cannot be avoided simply due to the nature of field work.
- In situations where species sampling or sensitive site assessment is conducted (such as is completed for the fauna assessment), it must be understood that time limitation and conditions on site means that not all species can be identified / sites can be discovered during the surveys. Again, as accepted methodologies are used, this is not deemed to be a fatal flaw, but must be considered.
- In general site conditions were good for fauna surveying. Other than some areas of very dense vegetation which limited fauna surveying, the only limitations were general field work limitations discussed above.
- There are inherent errors in GPS and mapping programmes which must be considered with all mapping information presented.

- Impact assessment is a predictive tool to identify aspects of a development that need to be prevented, altered or controlled in a manner to reduce the impact to the receiving environment, or determine where remediation activities will need to be incorporated into the overall development/activity plan. This does not mean that the impact will occur at the predicted significance but provides guidance on the formulation of the management and monitoring requirements which need to be incorporated to prevent/reduce/manage the impact.
- Citizen Science projects were used for bird (SABAP2) and animal (ADU) baseline data. When utilising data from Citizen Science projects, the following must be kept in mind:
    - Public interest in sites is variable, which could have a direct effect on the number of records available and therefore the number of species recorded;
    - Populated areas or popular tourist destinations may have more participants and therefore more biodiversity data than less populated areas;
    - Misidentification of species by the public cannot be excluded but is not seen as a major problem as this is likely to be a consistent issue from year to year, and a degree of vetting does take place;
    - Animals observed in captivity may be recorded by citizens. Such animals should not be considered part of the natural biodiversity but as the data provided by citizen science sites do not make such distinctions, it cannot be separated from the biodiversity data presented in this report.
- Vegetation studies should be conducted during the growing season of all plant species that may potentially occur. This may require more than one season's survey with two visits undertaken preferably during November and February. Rainfall prior to both the November as well as February site visit was limited. This could affect the species diversity especially in the grass – herb layer. Prior to the November site visit a fire event affected large sections of the vegetation.
- Soil properties were determined in field only by observation. Soil analysis is outside the field of expertise of the specialist.
- Findings, recommendations and conclusions provided in the report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. To obtain a comprehensive understanding of the dynamics of an ecosystem in an area, ecological assessments should always consider investigations at different time scales (across seasons/years) and through replication, as ecosystems are in constant change.

8.2 Wetland

- The information provided by the client formed the basis of the planning and layouts discussed.
- All wetlands within 500 m of any developmental activities should be identified as per the DWS authorization regulations. In order to meet the timeframes and budget constraints for the project, wetlands within the study sites were delineated on a fine scale based on detailed soil and vegetation sampling. Wetlands that fall outside of the site, but that fall within 500 m of the proposed activities were delineated based on desktop analysis of vegetation gradients visible from aerial imagery.
- The detailed field study was conducted from on once-off field trip and thus would not depict any seasonal variation in the wetland plant species composition and richness.
- Description of the depth of the regional water table and geohydrological and hydropedological processes falls outside the scope of the assessment
- Floodline calculations fall outside the scope of the assessment.
- Red Data scans, fauna and flora, and aquatic assessments were not included in the study.
- Species composition described for landscape units aimed at depicting characteristic species and did not include a survey for cryptic or rare species.
- The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters.
- Wetland delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that when converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.
- The calculation of buffer zones does not take into account climate change or future changes to watercourses resulting from increasing catchment transformation.
- Although the study was conducted in the summer, it occurred during a drought in the region and consequently the wetland systems were very dry.

- Sections of the study site were recently burnt and heavily grazed. Vegetation identifications in these areas thus have a low confidence score.
- Previously inaccessible areas were visited during the February 2019 site visit.

8.3 Soils

The following assumptions were made during the calculations for agriculture-related losses:

- The construction of the new fence around the new TSF expansion will exclude any cattle farming activities from the fenced-off area. Although a smaller area of land will be permanently changed by the infrastructure, it is assumed that no cattle grazing will be allowed within the boundary fence. The area where the existing TSF infrastructure is present, is excluded from the calculations as these areas have not been used for grazing the past five years. The area considered a loss to production from the onset of the construction period is:
    - Proposed fenced-off area (1 368.8 ha) minus the area already affected (594.7 ha) = area where cattle forage will no longer be available (792.1 ha).
- At a long-term average grazing capacity of 6 hectare per Large Stock Unit (DAFF, 2018), the area of 792.1 ha, provides forage to 132 head of cattle.
- The herd is considered to have an 80% weaning rate which is considered an optimistic figure and does not take any potential losses from stock theft into consideration. This allows for the sale of around 106 weaners per annum.
- The average weight of a Brahman weaner is estimated at 220 kg and the average auction price for live weight (or "hoof weight") in 2019, was R30/kg.

The following assumptions were made during the assessment and reporting phases:

- The assessment of the anticipated impacts assumes that the proposed surface footprint of the project will stay within the confines as depicted in the layout maps in this report.
- It was assumed that the layout will consist of the components stipulated in the final project layout and description that was provided by the applicant.
- Assumptions regarding the impacts of the proposed infrastructure were made and based on the author's knowledge of the nature and extent of the planned infrastructure.

Uncertainties are centred around the cumulative impacts that the project will have on soil health and food production outside the boundaries of the proposed TSF Expansion Project.

While air quality and groundwater modelling can make rather accurate predictions on the size of the pollutant plumes associated with the project, there is currently no study available with quantitative values on the extent of soil pollution in the area around the existing Kareerand TSF.

The following knowledge gaps have been identified:

- There are no historical results on the soil pollution status of the land that was surveyed. As a result of the project being in a larger area dominated by historical gold mining activities, there may be elevated levels of possible pollutants as a result of polluted dust blowing into areas over a long period of time. Soil pollution assessment was outside of the scope of this study.
- The survey was conducted using a hand-held soil auger that could drill down to 1.5 m or refuse. This methodology causes minimal to no impact during the study but in areas where shallow soil is present, it is not possible to determine the exact depth of soil available for stockpiling and rehabilitation as the limiting horizon is not homogeneous.

8.4 Air Quality

- All project information required to calculate emissions for proposed operations was provided by MWS and GCS.
- The EIA will be completed by GCS on behalf of MWS. For this reason, the impact significance of the project was determined based on the GCS impact significance methodology. This ranking methodology inflated the risk of the air quality impacts. The use of this methodology resulted in realistic consequence but unreasonably high likelihood. The likelihood is significantly inflated since the activity assessed is governed by legislation.
- The baseline air quality is based on the modelling undertaken in 2014/2015 which accounted for 2013 VR and MWS operations. As the VR underground mining operations have ceased and MWS operations are similar, the current ambient air quality and dustfall rates may differ slightly near the shafts, plants, other TSFs and waste dumps. It is unlikely that there will be significant contribution from the other operations on sensitive receptors surrounding the Kareerand TSF.
- The impacts of the construction and operational phases were determined quantitatively through emissions calculation and but not through simulation. Decommissioning phase impacts are expected to be similar or somewhat less significant than construction phase impacts. Mitigation and management measures

recommended for the construction and operational phases are however also applicable to the decommissioning phase. No impacts are expected post-closure provided the rehabilitation of final landforms is successful.

- Meteorology:
  - It was noted in the previous VR and MWS studies that the SAWS (South African Weather Service) Klerksdorp weather station data did not appear accurate. Based on the location of Kareerand TSF in relation to this station, as well as considering the topography, land-use and landforms (other TSFs and waste dumps) in the area which can all affect the local meteorology, it was decided to use the measured meteorological data for the weather station at Kareerand TSF. The data for the period January 2018 to December 2019 were used in the dispersion modelling.
  - The National Code of Practice for Air Dispersion Modelling described in the Regulations regarding air dispersion modelling (GN 533; 11 July 2014) prescribes the use of a minimum of one year of on-site data or at least three years of appropriate off-site data for use in Level 2 and 3 assessments. It also states that the meteorological data must be for a period no older than five years to the year of assessment. The dataset period is within the timeframe recommended by the National Code of Practice for Air Dispersion Modelling being of two years (on-site) data less than five years old during the assessment period (2020).
- Greenhouse gas (GHG):
  - Scope 1 and Scope 2, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) emissions were calculated for the construction phase and operational phase;
  - Scope 1 and Scope 2 emissions were converted to CO_2 equivalent (CO_2-e) emissions for the construction phase and operational phase; and
  - Modelling was not included in the scope of work.
- Particulate matter, with reference to Total Particulate Matter (TSP), PM_{10} (PM with an aerodynamic dimeter less than 10 µm) and $PM_{2.5}$ (PM with an aerodynamic dimeter less than 2.5 µm) is the main pollutant of concern from the current and proposed expanded Kareerand TSF. The AGA PM_{10} ambient monitoring station located near the VR Offices, some 15 km from the Kareerand TSF had poor data availability (erroneous data) and could not be used. $PM_{2.5}$ is not presently sampled in the project area.

- Emissions:
  - The impact assessment was limited to airborne particulates (including TSP, PM_{10} and $PM_{2.5}$). These pollutants are regulated under NAAQS and considered key pollutants released by the operations associated with the expansion of the Kareerand TSF.
  - The quantification of sources of emission was restricted to the current Kareerand TSF operations and the expansion project. Other existing sources of emission within the area were identified. A study was completed in 2015 (using 2013 data) for the VR and MWS operations and the emissions from this study are discussed. The VR and MWS emissions inventory is being updated for the 2020 operations. Other companies' mining operations, farming activities, domestic fires, vehicle exhaust emissions and dust entrained by vehicles on public roads were not quantified as part of the Project's emissions inventory and simulations.
  - Site specific particle size, moisture and silt content data were available.
  - For the estimation of windblown dust emissions, use was made of the Airborne Dust Dispersion Model from Area Sources (ADDAS) (Burger, Held, & Snow, 1997).

8.5 Noise

In the Environmental Acoustic Impact Assessment, various assumptions were made that may impact on the results obtained. These assumptions include:

- The information provided regarding the construction and operational activities is assumed to be representative of what will occur in reality;
- In order to represent a worst-case scenario, it was assumed that one of each piece of construction equipment will be operational simultaneously at a location on the TSF extension in closest proximity to each sensitive receptor;
- The slurry and water pumps will be un-enclosed;
- The additional LDVs will operate on the perimeter of both the existing TSF area and the proposed extension area;
- In the modelling assessment, the operational equipment was placed randomly at different locations around the existing TSF and extension perimeter. Each source will not be static in nature and the exact locations of such cannot be accurately pin pointed in such an assessment; and

- Due to security concerns, night-time monitoring results could not be obtained at receptor KR05 and KR06.

8.6 Heritage

- Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites, as well as the density of vegetation cover found in some areas. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted. Such observed or located heritage features and/or objects may not be disturbed or removed in any way, until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. In the event that any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply as set out below.
- The fieldwork did not assess any part of the fenced-off area which encloses the existing Kareerand TSF. The reason for this is that this fenced-off area would have been assessed as part of the HIA undertaken for the original TSF development.
- In terms of the fieldwork undertaken on the overall study area, the farm Buffelsfontein 443 IP was not surveyed as intensively as the other properties forming part of the overall study area. The reason for this is that at the time of the fieldwork a number of breeding ostriches were observed within this property. As a result, only limited walkthroughs of this area could be undertaken.
- When conducting a Paleontological Impact Assessment (PIA), several factors can affect the accuracy of the assessment:
    - The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage.
    - Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs.
    - Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

- Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in un-documented areas.
- During desktop studies, when similar Assemblage Zones and geological formations are used, it is generally assumed that exposed fossil heritage is present within the footprint. A field-assessment is thus necessary to improve the accuracy of the desktop assessment.

8.7 Socio-Economic

- The SEIA (Socio-Economic Impact Assessment) included consultations with selected stakeholders and potentially affected parties as part of the impact assessment phase. This does not form part of the Public Participation Process (PPP) required for the overall EIA process, except where it was specified as such during the consultation sessions.
- An SEIA aims to identify possible social and economic impacts that could occur in future. These impacts are based on existing baseline information. There is thus always an uncertainty with regards to the anticipated impact actually occurring, as well as the intensity thereof. Impact predictions have been made as accurately as possible based on the information available at the time of the study.
- Sources consulted are not exhaustive and additional information can still come to the fore to influence the contents, findings, ratings and conclusions made.
- Socio-economic baseline information was mainly based on official statistics from StatsSA, as well as municipal documentation. Sub-municipal data was only available for 2011. Recent trends as well as information on a sub-municipal level were also based on quantitative and qualitative information received from local representatives with local knowledge. The lack of more recent official socio-economic data is therefore seen as a limiting factor, although it is not anticipated to influence the outcome of the report.
- Technical and other information provided by the client is assumed to be correct.
- The potential external costs associated with the project were based on information supplied by sub-specialists for the EIA of the project.
- The economic impact model was based on information supplied by the developer MWS (Pty) Ltd. It was assumed that the expansion will allow activities to continue with financial results continuing on the same level as the past few years.

- Economic multipliers, average salaries and wages and value added as a percentage of total income were based on provincial and national averages.
- An overall rating for the possible decommissioning and closure phase impacts was included although it is recommended that the socio-economic impacts be re-assessed at the time of decommissioning as the local dynamics could have changed.

8.8 Visual

- All viewsheds were based on terrain level. As such these viewsheds do not incorporate distractive views in the form of vegetation or land-use (infrastructure, buildings, etc.). An enhanced terrain model was created by GCS, incorporating the client supplied surface elevation information along with the regional National Geospatial Information derived contours.
- The accuracy and extent of the receptors mapped relates to the accuracy of the landcover dataset used in this study. GCS has however validated the receptor identification process by means of a field visit, a heads-up approach with satellite imagery and aerial photography.
- This level of assessment excludes perception surveys to establish viewer preference and thereby their sensitivity. For example, localised visual perceptions of the economically depressed communities of the population may be influenced by the short-term economic and job opportunities that will exist rather than the direct visual perception of the project.
- The major limitation of this study is the unavoidable subjectivity relating to the assessment of the visual impact. Findings will also be restricted to information on hand, as well as the quality of spatial data.

8.9 Health Risk

- Specialist study reports from other consultants formed the primary sources of information on environmental concentrations of airborne and water borne contaminants. The scope of the HHRIA was limited by the reported data and findings of specialist studies that describe the atmospheric and aquatic pathways, and the transport and dispersion of potentially hazardous contaminants within these pathways. The information and data obtained from the specialist studies was accepted to be accurate and no verification of the data was undertaken by EnviroSim.

- The HHRIA only considered non-radiogenic health effects associated with the potential contaminants. Health concerns relating to radioactive contaminants were addressed in the Radiological Impact Assessment.
- The assessment endpoint of the HHRIA was limited to the evaluation of the risks posed to the health of members of the public residing in the vicinity of the proposed Kareerand TSF Expansion Project. Potential receptors were identified from the communities closest to the proposed project location, based on information available for these communities.

8.10 Radiological

- The radiological impact assessment made extensive use of assumptions for conditions and parameter values required for the dose assessment, which is not ideal.
- The assessment is based on site-specific data as far as practically possible and justified. Where appropriate and justified, the site-specific data and information were supplemented with values from the literature. However, all the assumptions and conditions used in the assessment were documented accordingly.

9 PUBLIC PARTICIPATION PROCESS

This section of the report documents the process which was and will be followed with respect to consultation of Interested and Affected Parties (I&APs)/stakeholders and the Government Authorities.

9.1 Purpose of Public Participation

The most important objective of public participation is to provide sufficient and accessible information to potential Interested and Affected Parties ("I&APs") in an objective manner and to provide a platform for constructive participation in the application process, thereby assisting I&APs to:

- Gain an understanding of the Project, the various components and the potential impacts (positive and negative);
- Raise issues of concern and suggestions for enhanced benefits;
- Comment on reasonable alternatives;
- Verify that their issues have been recorded in the Comments and Responses Report ("CRR") and considered in investigations; and

- Contribute relevant local information and traditional knowledge to the process.

9.2 Public Consultation Process

This section provides a short summary of the various activities of the public consultation process to be undertaken in support of the application process.

9.2.1 Stakeholder database

A stakeholder database or list of I&APs was compiled and will be updated as the process unfolds and as more I&APs register. The database was compiled: a) using lists of contact details of previous applications in the area; b) using information provided by the applicant's community liaison officers; and c) including responses from I&APs.

The current I&AP database is attached as **Appendix E1** to this Report. The I&AP database is the means through which information is conveyed to stakeholders as part of the announcement of the applications and the availability of the consultation and final reports as these become available for public review. For this Project, I&APs typically include the following:

- Owners or persons in control of the land where the proposed Project activities are to be undertaken ("Project Area");
- Occupiers of the property where the activities are to be undertaken;
- Owners and occupiers of land adjacent to the Project Area;
- Provincial (North West) and local government (the City of Matlosana and JB Marks Local Municipalities which fall within the Dr Kenneth Kaunda District Municipality);
- Organs of state, other than the competent authorities, which are DMRE and DWS, such as the North West Department of Agriculture and Rural Development, Department Public Works and Roads, SANRAL, etc. having jurisdiction in respect of any aspect of the proposed activities;
- Relevant residents' associations, agricultural unions, community-based organisations, water user associations, and any catchment management authority and Non-Governmental Organisation ("NGOs");
- Media (local and regional – e.g. Klerksdorp Record);
- Environmental organisations, forums, groups and associations; and
- Private sector (businesses, industries) in the vicinity.

9.2.2 Announcement of the integrated application process

The integrated application process was announced to I&APs by means of the following:

- Advertisements (**Appendix E2** to this Report) were published as follows:
  - Klerksdorp Record (1 November 2019);
  - City Press (3 November 2019); and
  - Potchefstroom Herald (31 October 2019).
- A Background Information Document ("BID") (**Appendix E3** to this Report) was compiled and distributed as follows:
  - To all I&APs on the stakeholder database via email notifications on 1 November 2019 and as I&APs requested copies of the document in response to the advertisements published and the site notices placed; and
  - Per hand to those who were visited while the site notices were placed on 1 November 2019.
- Site notices were placed on 1 November 2019 all around the Project Area on main roads and at public places. **Appendix E4** to this Report provides a description of the locations where the site notices were placed as well as a photo of each site notice placement.
- Telephonic notification to key I&APs and landowners.
- Placement of all notices and the BIDs on the GCS website (http://www.gcs-sa.biz/documents/). The GCS website is used to make documents electronically available to stakeholders. The website address was published in the advertisement, BIDs, site notices and all other communication.
- A Registration and Comment Sheet was distributed with every BID, inviting stakeholders to register as I&APs and to provide their comments on the proposed application (see **Appendix E3**).

9.2.3 Comments and Responses Report

All comments received during the integrated application process was captured in a Comments and Responses Report (CRR). The CRR has been updated on a continuous basis and will be presented to the authorities and other I&APs together with the consultation and final reports as a full record of issues raised, including responses on how the issues were considered during the integrated application process. The following versions of the CRR will be available:

- CRR Version 1: Submitted with the Draft Scoping Report. This version of the report captured comments and issues raised from the beginning of the announcement until

8 January 2020. Comments received after this date were captured in version 2 of the CRR;

- CRR Version 2: Submitted with the Final Scoping Report. This version of the report captured comments and issues raised from the beginning of the announcement until the end of the review period of the Draft Scoping Report (24 February 2020). Comments received after this date were captured in version 3 of the CRR;
- CRR Version 3: Submitted with the Draft Environmental Impact Report/Environmental Management Plan ("EIR/EMPr"). This version of the report captures comments and issues raised from the beginning of the announcement until the end of the authority review period of the Final Scoping Report (31 July 2020). Comments received after this date will be captured in version 4 of the CRR; and
- CRR Version 4: Submitted with the Revised Draft Environmental Impact Report/Environmental Management Plan ("EIR/EMPr") (**Appendix E5**). This version of the report captures comments and issues raised from the beginning of the project announcement to the end of the public review period of the Draft EIR (14 September 2020). Comments received after the review period were also included in this version of the CRR.

9.2.4 Review of the Draft Scoping Report

The announcement of the integrated application process also introduced the availability of the Draft Scoping Report for public review and comments. Specific further activities which were conducted in terms of the public participation process during the review of the Draft Scoping Report are described in this section. The Draft Scoping Report was available for public comment for a period of 30 days from 24 January to 24 February 2020. The Report was available as follows:

PRINTED COPIES	
Klerksdorp Public Library, Voortrekker Street, Klerksdorp Central (Tel: 018 487 8373)	
Stilfontein Biblioteek- Library, Somerset Drive, Stilfontein (Tel: 018 487 8291)	
Khuma Library, Ndlondlosi Street, Khuma, (Tel: 018 487 8652)	
Potchefstroom Public Library, 25 Wolmarans Street, Potchefstroom (Tel: 018 299	
Orkney Library, Patmore Street, Orkney (Tel: 018 473 0310)	
ELECTRONIC COPIES	
Website download	http://www.gcs-sa.biz/documents/
CD copy	On request to the public participation office
Hard copies and / or CDs	To all commenting authorities

See **Appendix E6** for proof of delivery of the Draft Scoping Report to the public places listed above. The availability of the Report was announced via the publishing of advertisements (See **Section 9.2.2** and **Appendix E7**), in the BID (**Appendix E3**) and on-site notices (**Appendix E6**). E-mails with notification letters were sent to all I&APs registered on the stakeholder database, providing the direct link to an electronic version of the Draft Scoping Report and its appendices. At the stakeholder meeting, which was held on 5 February 2020, the availability of the Report and how stakeholders may access copies of the Report was communicated.

Advertisements to announce specifically the review period of the Draft Scoping Report, meetings to be held to review the report contents and to invite stakeholder comments were published as follows:

- Klerksdorp Record (23 January 2020)
- City Press (26 January 2020)
- Potchefstroom Herald (23 January 2020)
- Volksblad (23 January 2020)
- Kroonnuus (23 January 2020)

Proof of placement of the advertisements are included in **Appendix E7** to this report.

9.2.5 Stakeholder meetings: Wednesday, 5 February 2020 at 10h00, Lost Treasure, Stilfontein

Stakeholders were invited to attend two stakeholder meetings during the review period of the Draft Scoping Report. The stakeholder meeting scheduled for 10h00 on Wednesday, 5 February 2020 took place, however the meeting which was scheduled for the same evening at 18h00 was cancelled due to threats of disruption. An SMS message was sent to all stakeholders on the database on 5 February 2020 before 15h00 to inform them of the cancellation. A record of the deliberations at the meeting which took place is included as part of the CRR- **Appendix E5**. An attendance register of the meeting is included as **Appendix E8.**

The purpose of the meeting was to announce the integrated application process, to present to stakeholders a summary of the Draft Scoping Report, and to obtain their views and comments on the information available. All attendees were reminded of the process being followed and of the opportunities to comment on the Final Scoping Report as well as on the reports to be compiled as part of the integrated regulatory process. The presentations prepared for delivery at the meetings were not delivered due to the disruptions experienced during the meeting, however, the presentations are attached as **Appendix E9.**

A comprehensive list of authorities was developed during the Scoping Phase of the project. This list has been used to establish communication with the relevant authorities who are required to contribute to the environmental authorization process. All the authorities on the developed list have been invited to become involved in the process. See **Appendix E6** for proof of delivery of the DSR to the relevant authorities.

9.3 Review of the Final Scoping Report

The Final Scoping Report was submitted to the Competent Authority on 9 March 2020 and the Report was available to I&APs for their final comments from 9 March to 9 April 2020 for a 30-day period. This period was extended due to the lockdown experienced in South Africa as a result of the Covid-19 global pandemic. Feedback from the authorities was received on 31 July 2020 and all stakeholder comments until this point were considered. Stakeholders were requested to provide their comments on the final reports directly to the DMRE North-West Regional Office in a notification letter sent to them before the review of the Final Scoping Report commenced. Stakeholders were requested to copy their comments to the public participation office.

The availability of the Final Scoping Report and where copies of the Final Report can be obtained for review and comment was communicated in a notification letter to registered I&APs via email.

9.4 Public Participation During EIA Phase

The *initial* review of the DEIR/EMPr took place from 14 August 2020 to 14 September 2020. The main objectives of public participation during this phase is a) to verify that stakeholder issues have been considered by the EIA Specialist Studies and in the reports which will be compiled and b) to provide stakeholders the opportunity to comment on the findings of the EIR/EMP Report and other associated reports, including the measures that have been proposed to enhance positive impacts and reduce or avoid negative ones. The *initial* public participation activities during the EIA phase of the integrated regulatory process included:

- Email notifications and SMS messages to stakeholders to inform them of the opportunity to review the Draft EIR/EMP;
- The draft EIR/EMPr was made available for review. Due to the restrictions associated with the Covid-19 pandemic reports were not be placed at public places. Stakeholders were requested to download the report from the GCS website and / or request electronic copies of the report by prior arrangement. Copies of the report on CD and memory sticks were made available for collection at the MWS offices.

Stakeholders were invited to collect copies should they had difficulty downloading the report from the GCS website;

- Advertisements to notify stakeholders of the availability of the draft reports were published in the same newspapers used during the scoping phase. Advertisements were published as follows:
    - Klerksdorp Record (13 August 2020)
    - City Press (09 August 2020)
    - Potchefstroom Herald (13 August 2020)
    - Volksblad (12 August 2020)
    - Kroonnuus (11 August 2020)
- Stakeholder meetings via electronic platforms were held with stakeholders during the review period of the draft reports to provide them with the contents of the report for their comments and views (See **Appendix E10** for the meeting outcomes of the held public webinars and **Appendix E11** for the presentation). Meetings were held on Tuesday, 1 September at 10:00 and 14:00. The rules of engagement were communicated before the meetings were held and again at the beginning of each meeting. Stakeholders were provided the opportunity to comment and ask questions after the presentation was delivered. Stakeholders also had the opportunity to use the "conversation" facility on the electronic platform to pose questions and comments which were attended to after the presentation was delivered.

The review of the Revised DEIR/EMP will take place from 15 January to 15 February 2021. The public participation activities during this review phase of the Revised DEIR/EMPr will include:

- *Email notifications and SMS messages to stakeholders to inform them of the opportunity to review the Revised Draft EIR/EMP;*
- *The Revised DEIR/EMP will be made available for review. Due to the restrictions associated with the Covid-19 pandemic reports will not be placed at public places. Stakeholders will be requested to download the report from the GCS website and / or request electronic copies of the report by prior arrangement. Copies of the report on CD and memory sticks will be available for collection at the MWS offices;*
- *Advertisements to notify stakeholders of the availability of the revised draft report will published in the same newspapers used during the scoping phase. Advertisements were published as follows:*
    - *Klerksdorp Record (######)*

  - *City Press ((######))*
  - *Potchefstroom Herald ((######))*
  - *Volksblad ((######))*
  - *Kroonnuus ((######))*
- *Focus Group Meetings will be held with stakeholders during the review period of the revised draft report to provide them with the contents of the report for their comments and review;*
- *The final versions of the EIR/EMP report will also be made available to stakeholders once submitted to the competent authority; and*
- *The CRR will be kept updated with stakeholder comments and issued and responses will be included wit the updated versions which will be made available.*

9.5 Public Participation during Authorisation Phase

Once the Competent Authority provided information with regards to their decision in terms of the integrated application process, their decision and the detail thereof will be communicated to I&APs according to the conditions stipulated. I&APs will be made aware of their rights to appeal the decision and the proposed process to follow in such regard. The legislative and required public participation activities will end once the appeal periods have lapsed.

10 ENVIRONMENTAL IMPACT ASSESSMENT

10.1 Impact Assessment Methodology

10.1.1 Impact Calculation

The assessment of potential impacts was addressed in a standard manner to ensure that a wide range of impacts were comparable. The ranking criteria and rating scales were applied to all specialist studies for this project. The following methodology was used to rank these impacts. Clearly defined rating and rankings scales (**Table 10.1 - Table 10.7**) were used to assess the impacts associated with the proposed activities. The impacts identified by each specialist study and through public participation were combined into a single impact rating table for ease of assessment.

Table 10.1: Severity or magnitude of impact.

Insignificant/non-harmful (no loss of species / habitat)	1
Small/potentially harmful (replaceable loss with minimal effort)	2

Significant/slightly harmful (replaceable loss of species / habitat with great effort and investment)	3
Great/harmful (impact to human health or welfare / loss of species / habitat)	4
Disastrous/extremely harmful/within a regulated sensitive area (loss of human life / irreplaceable loss of Red Data species / conservation habitat)	5

Table 10.2: Spatial Scale – extent of area being impacting upon.

Area specific (at impact site)	1
Whole site (entire surface right)	2
Local (within 5km)	3
Regional/neighbouring areas (5 km to 50 km)	4
National	5

Table 10.3: Duration of activity

One day to one month (immediate – immediately reversible with minimal effort)	1
One month to one year (Short term - reversible)	2
One year to 10 years (medium term – difficult to reverse with effort)	3
Life of the activity (long term – very difficult to reverse with extensive effort)	4
Beyond life of the activity (permanent – not reversible)	5

Table 10.4: Frequency of activity - how often activity is undertaken.

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table 10.5: Frequency of incident/impact - how often activity impacts environment.

Almost never/almost impossible/>20%	1
Very seldom/highly unlikely/>40%	2
Infrequent/unlikely/seldom/>60%	3
Often/regularly/likely/possible/>80%	4
Daily/highly likely/definitely/>100%	5

Table 10.6: Legal Issues – governance of activity by legislation.

No legislation	1
Fully covered by legislation	5

Table 10.7: Detection - how quickly/easily impacts/risks of activity on environment, people and property are detected.

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Each identified impact was assessed in terms of severity, spatial scale and duration (temporal scale). Consequence was then determined as follows:

Consequence = Severity + Spatial Scale + Duration

The risk of the activity was then calculated based on frequencies of the activity and impact, whether the activity is governed by legislation and how easily it can be detected:

Likelihood = Frequency of Activity + Frequency of Impact + Legal issues + Detection

The risk of each identified impact was then based on the product of consequence and likelihood.

Risk = Consequence x Likelihood

Impacts were rated as either of high, moderate or low significance on the basis provided in **Table 10.8**.

Table 10.8: Impact significance ratings.

SIGNIFICANCE RATING	CLASS (NEGATIVE IMPACT)	CLASS (POSITIVE IMPACT)
1-30	(v L) Very Low Significance	(v L) Very Low Significance
31 – 55	(L) Low Significance	(L) Low Significance
56- 95	(L-M) Low-Moderate Significance	(L-M) Low-Moderate Significance
96- 135	(M) Moderate Significance	(M) Moderate Significance
135- 169	(H-M) High-Moderate Significance	(H-M) High-Moderate Significance
170- 300	(H) High Significance	(H) High Significance
301 – 600	(v H) Very High Significance	(v H) Very High Significance

10.2 Environmental Impact Assessment – Construction Phase

Full impact assessments can be found within the various specialist' reports. A summary of the construction phase impacts is presented in this section.

10.2.1 Ecological Impacts

10.2.1.1 Description

Impacts on terrestrial ecology during the construction phase include:

- Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3;
- Isolation between terrestrial and aquatic habitats;
- Loss of vegetation;
- Fragmentation of habitat and loss of ecological corridors;
- Increased presence of people on site;
- Exposure to fauna of dangerous areas, excavations and hazardous substances;
- Destruction of threatened or protected species (TOPS);
- Dust, noise, human activity and emissions;
- Introduction of alien invasive species (AIS) / exacerbation of existing AIS;
- Contamination of faunal habitat;
- Loss of the plant soil seed bank; and
- Contamination and complete degradation of faunal habitat without remedy.

Impacts on aquatic ecology during the construction phase include:

- Altered hydrological regimes:
    - Alteration of natural runoff patterns due to alterations of catchments through construction of dams and infrastructure (including TSF and return water dam) and canals (east and west storm water canals). The natural hydrology of the downstream rivers (Vaal River and to some extent lower Koekemoerspruit) may be influenced in terms of volume and timing of flow that reach these receiving water bodies.
- Habitat loss and deterioration
    - Increased erosion can be expected as result of the clearing of vegetation during construction. Erosion can also be aggravated by alien vegetation encroachment in disturbed areas. Increased input of sediment into the

receiving water bodies (Vaal River, Karee tributary) due to above mentioned activity may result in increased turbidity and sedimentation of bottom substrates. This is especially significant to fish and invertebrates that prefers clean rocky substrates (fish species that requires clean substrates for feeding and spawning (such as Labeobarbus aeneus, Lb. kimberleyensis, Labeo capensis that feeds and spawns in rocky areas, and various invertebrate species that have a high requirement for rocky habitats).

- Water quality deterioration
  - Accidental spills (fuels, oils, cement, etc.) during construction (of TSF, return water dams, storm water canals). Depending on the nature and type of spill, these will impact significantly on the aquatic biota of the receiving water bodies (Vaal River, Kareerand tributary). The intolerant biota will be most significantly impacted and may be eradicated due to such incidences.
  - Increase turbidity of receiving river due to removal of vegetation during construction. Predatory species (such as Largemouth yellowfish and various invertebrates will especially be impacted as they require good visibility for feeding. The secondary impact of increased turbidity is sedimentation of bottom substrates (as described above for impact 2).

10.2.1.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Site clearing / preparation	Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3. Isolation between terrestrial and aquatic habitats. Loss of vegetation.	H- M	L
Construction	Increased presence of people on site	M	L- M
	Exposure to fauna of dangerous areas, excavations and hazardous substances	M	L
	Dust, noise, human activity and emissions	L- M	L
	Introduction of AIS / exacerbation of existing AIS	H	L
Spills (chemical, tailings, dirty water)	Contamination of fauna habitat. Loss of the plant soil seed bank	M	L
Hydrocarbon spills from machinery/ storage tanks/ storage containers	Contamination of fauna habitat. Loss of the plant soil seed bank	H-M	L
Waste generation	Contamination of fauna habitat	H- M	L
Septic tank operation	Contamination of fauna habitat	M	L

10.2.2 Wetland Impacts

10.2.2.1 Description

Impacts on wetlands during the construction phase include:

- Changes in water flow regime;
- Increased high energy surface water runoff;
- Decreased vegetation germination potential;
- Sediment pollution;

- Changes in sediment deposition and high energy flows causing erosion;
- Introduction and spread of alien plants; and
- Transformation of wetland and adjacent terrestrial habitat, changes to topography and surface water runoff, pollution and alien invasive plant establishment.

10.2.2.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Soil compaction, vegetation clearing during construction	Changes in water flow regimes, increased high energy surface water runoff, decreased vegetation germination potential, sediment pollution	M	L- M
	Changes in sediment deposition and high energy flows causing erosion	M	L
Preparation of footprint: removal of vegetation and land preparation	Introduction and spread of alien plants	H	M
Preparation of the footprint of all new infrastructure	Loss and disturbance of watercourse habitat and fringe vegetation	L- M	L- M
Heavy machinery and vehicle movement: leaking of hydrocarbons and inappropriate ablutions, littering	Changes in water quality due to foreign materials and increased nutrients	M	L

10.2.3 Soil and Agricultural Impacts

10.2.3.1 Description

The areas that will be affected by the TSF expansion area as well as the RWDs, access roads and solution trench have Moderate to Moderate-High land capability. Smaller areas with Low or Low Moderate land capability are also present.

Once construction commences and soil is stripped, the current land capability of stripped areas will be lost. The largest feature of the project is the TSF expansion footprint. As the

TSF will become a permanent feature of the landscape, the area that will be affected will not be rehabilitated to the original land capability.

During the first five years of the proposed Kareerand TSF Expansion project, an agricultural gross income loss of R4 430 760.00 may occur. This income that will be lost from livestock farming in the area that will be fenced off, can provide employment either to 2 people (in the case of a commercial entrepreneurial project) or 7 people when the model of a community based project is considered.

Prior to construction, the available topsoil will be removed and stored elsewhere to be used for rehabilitation of the TSF. The soil in the affected area provides ecosystem services, such as nutrients that support vegetation growth, water management and physical support to living organisms. Once the soil is stripped and transported from its original position, it becomes a new matrix with different physical and biological properties as a result of mixing of the soil horizons and storing it in large stockpiles.

The following construction activities can result in the pollution of soil with hydrocarbons and/or solid waste:

- Petroleum hydrocarbon (present in oil and diesel) spills by machinery and vehicles during earthworks, vegetation removal and transport.
- Accidental spills from temporary chemical toilets.
- The generation of domestic waste by construction and operational workers.
- Spills from fuel storage tanks during construction.
- Polluted water from wash bays and workshops during the construction phase.
- Accidental spills of other hazardous chemicals used and stored on site.
- Pollution from concrete mixing.

10.2.3.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Topsoil stripping	Destruction of current land capability of the areas where infrastructure will be constructed	H- M	H- M
	Loss of soil ecosystem services and soil fertility in areas where topsoil are stripped	M	M
Fencing of TSF area	Loss of agricultural production and agricultural-related employment within the fenced-off area	H- M	H- M
Construction activities	Soil contamination with hydrocarbons and solid waste	M	L- M

10.2.4 Air Quality Impacts

10.2.4.1 Description

Air Quality

During the construction phase several facilities need to be upgraded including the pipelines, storm water infrastructure and TSF service roads. The following activities will take place:

- Site establishment of construction phase facilities;
- Clearing of vegetation;
- Stripping and stockpiling of soil resources and earthworks;
- Collection, storage and removal of construction related waste;
- Construction of all infrastructure required for the operational phase; and
- Operation of mechanical equipment.

Two potential direct construction phase impacts on the air quality of the area were identified:

- A1: Potential impact on human health from increased pollutant concentrations associated with construction activities;
- A2: Increased nuisance dustfall rates associated with construction activities;

A1 would likely impact on human health whereas A2 would impact on amenities.

Greenhouse Gas and Climate Change

Comparison of the results of this section with the figures obtained for the operational period indicated that the GHG emissions during construction do not constitute a material fraction of the overall emissions. During construction, there will probably be additions to the equipment fleet and will likely result in an increase in scope 1 emissions from the MWS operations; therefore, changing the national inventory's total annual CO_2-e emissions by approximately 6 809 tpa during the construction phase.

10.2.4.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
General construction activities	Impact on human health from increased pollutant concentrations*	L- M	L- M
	Increased nuisance dustfall rates**	L- M	L- M

*Unmitigated PM_{10} and $PM_{2.5}$ emissions in the project area will very seldom result in an insignificant negative impact on human health in the *medium-term* in the study area. The risk is likely LOW; however, using the GCS impact rating methodology, the environmental risk of this impact is MODERATE; without and with mitigation applied.

**Unmitigated TSP emissions in the project area will very seldom result in an insignificant negative impact on amenities in the *medium-term* in the study area. The risk is likely LOW; however, using the GCS rating methodology the environmental risk of this impact is MODERATE; without and with mitigation applied.

10.2.5 Noise Impacts

10.2.5.1 Description

Construction phase impacts of noise are limited to noise pollution on residential receptors. During the construction phase, noise levels at the on-site receptor locations are predicted to increase by between 5.5 and 25.4 dB(A). Such increases will result in "little" to "very strong" community response at the on-site receptor locations. It must be noted that these receptors are merely on-site locations utilised to match historical monitoring locations and do not represent sensitive receptors.

Increases in noise levels at the off-site receptor locations as a result of the construction activities will range from 6.7 to 10.0 dB(A). Such increases will result in "little" to "medium" community response when the construction activities are occurring in closest proximity to each of the receptors. These increases are above the 7 dB(A) threshold for annoyance as per the South African Noise Control Regulations. It must be noted that these results represent a worst-case scenario when construction activities are occurring at the closest TSF boundary to the receptor in question and do not represent noise levels that will occur all the time. Such a scenario is unlikely to occur in reality.

Should complaints arise during the construction phase, various mitigation techniques can be employed. These options include both management and technical options. Such techniques include planning construction activities in consultation with local communities; limiting the number of simultaneous activities when in close proximity to a receptor; using temporary acoustic barriers for high impact activities; selecting equipment with the lowest possible sound power levels; and ensuring equipment is well-maintained to avoid additional noise generation.

10.2.5.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
General construction activities	Nuisance noise	L	L

Significance of noise impacts does not change with mitigation due to the initial impact being so low, even without mitigation.

10.2.6 Heritage Impacts

10.2.6.1 Description

Four (4) heritage sites are located within, or in proximity to, the proposed development footprint area:

- AGA-MWS-WBP-2;
- AGA-MWS-MGD-5;
- AGA-MWS-MGD-6; and
- AGA-MWS-MGD-7.

The impacts of the proposed development are expected to occur during the Construction Phase only. With the required mitigation measures outlined for these four sites expected to be completed even before the Construction Phase commences, no further impacts are expected during the subsequent project phases (i.e. Operations, Decommissioning and Post-Closure).

The impact risk calculations show that the impact risk for the proposed development on sites AGA-MWS-WBP-2, AGA-MWS-MGD-5 and AGA-MWS-MGD-6 comprises a Moderate Impact Risk. These sites all comprise historic black homesteads where the risk for unmarked stillborn graves exist.

The following initial mitigation measure is required for the four sites:

- A social consultation process to assess whether any local residents or the wider public is aware of the presence of graves here.
- All structures and site layouts from each site must be recorded using standard survey methods and/or measured drawings. The end result would be a site layout plan.
- A mitigation report must be compiled for these sites within which all the mitigation measures and its findings will be outlined. The recorded drawings from the previous item must also be included in this mitigation report.
- The completed mitigation report must be submitted to the relevant heritage authorities.

Depending on the outcome of the social consultation process, three different outcomes would be the result, namely:

- The social consultation absolutely confirms that no graves are located here.
- The social consultation absolutely confirms that graves are located here.
- The social consultation does not yield any confident results.

The impact risk calculations show that the impact risk for the proposed development on site AGA-MWS-WGD-7 comprises a Moderate Impact Risk. This site consists of a cluster of two attached possible graves. The following mitigation measures are required for this site:

- The site must be fenced before construction commences. This fencing must be undertaken in such a way that the closest distances between the possible graves and the fence are at all times at least 2 m.
- Signposts must be erected that clearly indicate the fenced area as containing possible graves.
- The position of the possible graves must be shown on all the construction and operation maps to ensure that all individuals associated with construction and mining activities are aware of the presence of these sites.

The following mitigation measures would be required for palaeontology:

- In the unlikely event that fossil remains are discovered during any phase of construction, on the surface or exposed by excavations the Chance Find Protocol outlined in the palaeontological report must be implemented by the ECO in charge of these developments. These discoveries ought to be protected (*in situ*) and the ECO must report to SAHRA (contact details provided in the specialist report) so that correct mitigation (recording and collection) can be carry out.

- Preceding any collection of fossil material, the palaeontologist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

The following general mitigation measures are required:

- An archaeological and heritage monitoring process must be implemented for three sites containing cemeteries and possible graves located approximately 50 m from the proposed development footprint areas. Although these sites are not expected to be directly impacted upon by the proposed development, this monitoring process will ensure that no peripheral impacts take place. These four sites are AGA-MWS-MGD-2, AGA-MWS-MGD-3 and AGA-MWS-MGD-8.

10.2.6.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Erection of fence across centre of site	Damage to/ destroying of AGA-MWS-WBP-2	H- M	L
Construction of the proposed return water dams on the site	Partial destroying of AGA-MWS-MGD-5, possible impact on unmarked graves	H- M	L
Erection of fence across southern end of site	Damage to/ destroying of AGA-MWS-MGD-6, possible impact on unmarked graves	M	L
General construction	Edge-effect damage to AGA-MWS-MGD-7, possible impact on unmarked graves	M	L

10.2.7 Surface Water Impacts

10.2.7.1 Description

Construction-phase impacts to the surface water system include:

- Increased surface water runoff, resulting in increased sedimentation caused by soil erosion and a possible decrease in surface water quality;
- Soil contamination and decreased surface water quality due to insufficient hydrocarbon management (inadequate handling, storage or disposal) on site;
- Soil compaction due to vehicle movement, resulting in increased runoff and potentially leading to increased erosion;
- Reduced surface water quality, caused by incorrect stormwater management and therefore a lack of separation between clean and dirty water;
- Increased surface water runoff (possibly resulting in sedimentation caused by soil erosion) as a result of incorrect stormwater management;
- Reduced surface water quality caused by uncontrolled release of wastewater/sewage;
- Loss of topsoil due to erosion, resulting in increased sedimentation and reduced surface water quality, caused by incorrect stockpiling and/or poor rehabilitation;
- Surface water contamination resulting from improper waste management techniques;
- Increased surface water runoff from paved areas, resulting in increased sedimentation caused by soil erosion and a possible decrease in surface water quality; and
- Surface water and soil contamination caused by improper management (inadequate handling, storage and disposal) of chemicals on site.

Most construction phase impacts to water quality can be adequately addressed with proper management and implementation of mitigation measures.

10.2.7.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Site clearing / preparation	Increase surface water runoff resulting in sedimentation due to soil erosion	L	L

	Increase surface water runoff resulting in reduced surface water quality	L	L
Vehicle movement	Improper hydrocarbon management resulting in reduced surface water quality	L- M	L
	Improper hydrocarbon management resulting in soil contamination	L- M	L
	Soil compaction resulting in increased runoff leading to potential erosion	M	L- M
Storm water management	Lack of Clean Dirty water separation resulting in reduced surface water quality (mixing of clean and dirty water areas)	L- M	L
	Increase surface water runoff resulting in sedimentation due to soil erosion	L- M	L
Wastewater management (sewage)	Uncontrolled release resulting in reduced surface water quality	L- M	L- M
Topsoil stockpiling	Incorrect stockpiling and poor rehabilitation resulting in loss of topsoil due to erosion	L	L
	Incorrect stockpiling and poor rehabilitation resulting in sedimentation due to soil erosion	L	L
	Incorrect stockpiling and poor rehabilitation resulting in reduced surface water quality	L	L
Establishment of infrastructure	Waste generation (general waste) resulting in reduced surface water quality if improperly managed	L- M	L

(offices, workshops etc.)	Increase surface water runoff (roofs, paved areas) resulting in sedimentation due to soil erosion	L	L
	Increase surface water runoff (roofs, paved areas) resulting in reduced surface water quality	L	L
Hydrocarbon Management	Inadequate handling, storage & disposal resulting in reduced surface water quality	L- M	L- M
Chemical Management	Inadequate handling, storage & disposal resulting in reduced surface water quality	L- M	v. L

10.2.8 Groundwater Impacts

10.2.8.1 Description

The construction phase involves the construction of the Kareerand TSF Expansion compartment as well as the associated water management infrastructure. Deposition of the initial tailings, which may be part of the construction phase, is regarded as operational phase for discussion purposes. A Class C Barrier system will be constructed, and minimum seepage will occur to the underlying aquifer system.

- During the initial site construction, no significant groundwater impacts will occur.
- Oils and lubricants from construction vehicles might pose a short-term risk if not handled appropriately.
- Vegetation clearance, topsoil stripping and stockpiling will occur during the construction phase.
- Ancillary and temporary infrastructure will include a contractors' camp with ablution facilities, workshops and pipe/contractors' yard.

10.2.8.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Vegetation clearance, topsoil stripping and stockpiling	Decreased groundwater quality and quantity	L	L

Construction material and waste handling	Groundwater quality deterioration	L	L

10.2.9 Socio-Economic Impacts

10.2.9.1 Description

<u>Positive Impacts</u>

The duration of the construction phase is expected to be 5 years and could lead to the employment of some 270 jobs directly involved in construction activities (depending of the type of construction activity undertaken) with an estimated 120 jobs for unskilled workers, i.e. 44% of the workforce. A further 45% of workers (122) could be semi-skilled (i.e. completed matric or equivalent technical qualification). A relatively small portion of the construction workforce (11%) would be skilled (with tertiary qualifications).

The flow-on impacts (indirect and induced) could result in additional employment for some 300 workers. In the context of around 20 000 unemployed people in the wards around Kareerand TSF (13 000 located in Khuma), the impact will be relatively small. Options to consider for the enhancement of positive impacts include, but are not limited to:

- Prioritise local (Khuma) labour in the recruitment process as part of the company's own recruitment policy or as part of contractor management plan.
- Provide up-skilling opportunities for unskilled local workers during the construction phase.

<u>Negative Impacts</u>

The project is likely to result in some formal and informal population influx mainly based on rumours about possible additional work associated with the expansion project. Historic in-migration is an issue, especially in Stilfontein, the rural JB Marks ward close to the Kareerand TSF (Ward 2) and the CMLM rural wards south west of the TSF (Wards 33 and 34). Land invasions in Stilfontein and Khuma create various challenges and led to violent protests in 2019.

As indicated above, the impact of the expansion project's construction phase in terms of job creation will be small in relation to the number of the existing unemployed population. In-migration of additional people will thus result in additional pressure on the provision of infrastructure and service, especially housing and primary healthcare and emergency services, which are already an issue in the adjacent wards. Spill over effects of the anticipated formal and informal population influx can result in an increase in criminal activities in the larger study area, driven by the high unemployment numbers and social conflict and rivalry regarding available and affordable housing.

The informal population influx is difficult to mitigate and cannot just be attributed to the expansion project, as it is an existing impact in the region. It is, however, likely to increase in the short term.

Potential intrusion impacts on nearby landowners are further anticipated as a result of the influx of workers and movement of workers and machinery, especially where the S643 road is used as access road.

In order to mitigate for the influx of jobseekers, the following is recommended:

- Prioritise local (Khuma) labour in the recruitment process as part of the company's own recruitment policy or as part of contractor management plan.
- The development, publication and widespread dissemination of a recruitment policy could serve to encourage local employment and reduce the potential influx of jobseekers to the area.
- A communication strategy should be launched to ensure that unrealistic employment expectations are not created.

Additional negative impacts include nuisance impacts such as traffic movement, dust and noise. There will be permanent loss of agricultural land.

10.2.9.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
General construction	Temporary jobs and income (positive)	L- M	M
	Project-Induced In-migration	M	M
	Increase in nuisance factors	H- M	M
	Permanent loss of agricultural land	M	M

10.2.10 Visual Impacts

10.2.10.1 Description

Construction phase visual impacts will be similar to those experienced during operation, over a long period of time. Impacts include:

- Negative impact on the aesthetics of the area, caused by removal of vegetation and site preparation;
- Change in visual character of the project area, caused by movement of construction vehicles and machinery;
- Dust caused by movement of construction vehicles and machinery; and
- Change to the visual landscape caused by the construction of the TSF and its support infrastructure.

10.2.10.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Removal of vegetation for site clearing/preparation for all proposed infrastructure	Negative Impacts on aesthetics	M	L
Movement of construction vehicles and heavy machinery for site clearance	Change of Visual Character	M	L
Movement of construction vehicles and heavy machinery for site clearance	Dust creation	M	L
Architectural design of the RWD's and SWD	Landscape visual change	M	L

10.2.11 Health Impacts

During construction, airborne pollutants are expected to be generated from a variety of sources (e.g. earthworks, materials loading and off-loading, vehicle movement and vehicle exhaust emissions) associated with the construction activities. Although the contribution of these activities to the ambient concentrations of airborne pollutants is uncertain, it is expected that the duration of the activities will be limited compared to the duration of the operational phase. According to the Air Quality Specialist Report (Airshed, 2020) the potential impact on ambient air quality from the construction phase is expected to be low. Consequently, the potential of impact to health from the construction phase is expected to be low compared to that from the operational phase.

10.2.12 Radiological Impacts

Activities that will be performed during the construction phase of the project will not involve the handling, processing, or releasing radioactive material to the environment per se. This means that the potential radiological impact on members of the public through the relevant pathway during the construction phase is negligible. Thus, no radiation impacts have been assessed for the construction phase.

10.3 Environmental Impact Assessment – Operational Phase

Full impact assessments can be found within the various specialist' reports. A summary of the operational phase impacts is presented in this section.

10.3.1 Ecological Impacts

10.3.1.1 Description

Impacts on terrestrial ecology during the operational phase include:

- Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3;
- Isolation between terrestrial and aquatic habitats;
- Loss of vegetation;
- Fragmentation of habitat and loss of ecological corridors;
- Increased presence of people on site;
- Exposure to fauna of dangerous areas, excavations and hazardous substances;
- Destruction of threatened or protected species (TOPS);
- Dust, noise, human activity and emissions;
- Introduction of alien invasive species (AIS) / exacerbation of existing AIS;
- Contamination of faunal habitat;

- Loss of the plant soil seed bank; and
- Contamination and complete degradation of faunal habitat without remedy.

Impacts on aquatic ecology during the operational phase include:

- Altered hydrological regimes:
    - Alteration of natural runoff patterns due to alterations of catchments through construction of dams and infrastructure (including TSF and return water dam) and canals (east and west storm water canals). The natural hydrology of the downstream rivers (Vaal River and to some extent lower Koekemoerspruit) may be influenced in terms of volume and timing of flow that reach these receiving water bodies.
- Habitat loss and deterioration
    - Increased erosion can be expected as result of the clearing of vegetation for construction (roads, infrastructure, canals, dams, borrow pits). Erosion can also be aggravated by alien vegetation encroachment in disturbed areas. Increased input of sediment into the receiving water bodies (Vaal River, Koekemoerspruit, Karee tributary) due to above mentioned activity may result in increased turbidity and sedimentation of bottom substrates.
    - This is especially significant to fish and invertebrates that prefers clean rocky substrates (fish species that requires clean substrates for feeding and spawning (such as Labeobarbus aeneus, Lb. kimberleyensis, Labeo capensis that feeds and spawns in rocky areas, and various invertebrate species that have a high requirement for rocky habitats).
- Water quality deterioration
    - Accidental spills (fuels, oils, etc.) from transport routes used to operate and maintain TSF and associated infrastructure (TSF, return water dams, storm water canals). Depending on the nature and type of spill, these will impact significantly on the aquatic biota of the receiving water bodies (Vaal River, Koekemoerspruit, Kareerand tributary). The intolerant biota will be most significantly impacted and may be eradicated due to such incidences.
    - Increase turbidity of receiving river due to erosion of bare soils (transport routes, etc.). Predatory species (such as Largemouth yellowfish and various invertebrates will especially be impacted as they require good visibility for feeding. The secondary impact of increased turbidity is sedimentation of bottom substrates (as described above for impact 2).

- Effluents/spills originating from TSF. Based on the current information it is evident that the water sources at the existing Kareerand TSF is of poor quality and generally pose a high acute and chronic environmental toxicity risk to potential receiving water bodies (as indicated by environmental toxicity testing results: Section 3.4). Although the monitoring data suggests that the toxicity is generally negated at the most downstream return water dam, the high EC measured at site Karee-Vaal indicate that some seepage/spills may be reaching this stream/drainage line, which flows into the Vaal River. The nature of the potential impacts in terms of effluents/seeps/spills will depend on the volume and quality. It can again be expected that the intolerant biota will be the most significantly impacted by such events, although the entire population may be altered.

10.3.1.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Vegetation clearance	Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3. Isolation between terrestrial and aquatic habitats. Loss of vegetation.	H- M	L
Reclamation, disposal of waste on TSF	Increased presence of people on site	M	L- M
	Exposure to fauna of dangerous areas, excavations and hazardous substances	M	L
	Dust, noise, human activity and emissions	L- M	L
	Introduction of AIS / exacerbation of existing AIS	H	L
Spills (chemical, tailings, dirty water)	Contamination of fauna habitat. Loss of the plant soil seed bank	M	L
Hydrocarbon spills from machinery/ storage tanks/ storage containers	Contamination of fauna habitat. Loss of the plant soil seed bank	H- M	L
Waste generation	Contamination of fauna habitat	H- M	L

Septic tank operation	Contamination of fauna habitat	M	L

10.3.2 Wetland Impacts

10.3.2.1 Description

Impacts on wetlands during the operational phase include:

- Permanent changes to the catchment of waterbodies in terms of water infiltration and surface water flow rates;
- Changes in sediment and stormwater entering the system;
- Changes in water quality due to foreign materials and increased nutrients; and
- Permanent loss of wetland habitat and hydrological connectivity through loss of wetlands, pollution and invasion of alien invasive species.

10.3.2.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Plant operation - permanent location of the TSF in the catchment of the waterbodies	Permanent changes to the catchment of waterbodies in terms of water infiltration and surface water flow rates	H	H- M
Plant operation - permanent presence of pipelines and access roads	Changes in sediment and stormwater entering the system	H- M	M
Plant operation- daily movement of vehicles, changed natural ecological processes	Introduction and spread of alien plants	H- M	M
Plant operation- Presence of new infrastructure in the proximity of watercourses and waterbodies	Loss and disturbance of watercourse habitat and fringe vegetation	M	M
Plant operation - inadequate infrastructure and maintenance of vehicles	Changes in the water quality due to foreign materials and increased nutrients	L- M	L- M

10.3.3 Soils and Agricultural Impacts

10.3.3.1 Description

Pipelines are prone to wear-and-tear and mechanical errors, resulting in either leakage or instants spills of the waste slurry from the affected areas onto the soil surface. As the soil surface underneath the pipeline will not be covered with any protective material, the slurry will seep into the soil surface, carrying trace elements and other pollutants with it.

While the project layout design aims to minimise the soil pollution risk from the proposed new TSF expansion, soil pollution can still occur. Sources of soil pollution from the project include an increase in dust fallout that contain contaminant particles, failure of the TSF lining to prevent any seepage into underlying and nearby areas and failure of dirty water management systems to contain polluted water in the case of an extreme weather event resulting in floods.

During the operational phase, soil can be polluted with spills from vehicles transporting workers and equipment to and from site as well as on site. Soil can also be contaminated through the generation of domestic waste by workers.

Regular traffic of vehicles and equipment result in soil compaction. Soil compaction affects the soil porosity, thereby decreasing the water infiltration rate of soil. Compacted soil surfaces are prone to soil erosion after rainfall events as the slower infiltration rate cause higher stormwater runoff rates. The decreased ability of soil to absorb rainwater, has a negative impact on the soil biological composition and can affect the long-term ability of stored topsoil to be used for site rehabilitation.

10.3.3.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Pumping of waste slurry through pipelines to the TSF for processing	Soil pollution from leakages in the pipelines	H	M
Storage of processed mine tailings waste in the TSF	Soil pollution from spills from the TSF	H	M
General operational activities	Soil contamination with hydrocarbons and solid waste	M	L- M
	Soil compaction of topsoil bund wall and access roads	H- M	H- M

10.3.4 Air Quality Impacts

10.3.4.1 Description

<u>Air Quality</u>

Expected sources of atmospheric emissions during the operational phase include:

- Particulate emissions from vehicle entrainment along the existing unpaved access road;
- Particulate emissions from vehicles' exhaust;
- Particulate emissions from concurrent rehabilitation equipment operating on the TSF area;
- Particulate emissions from concurrent rehabilitation equipment exhaust; and
- Particulate emissions from wind-blown dust from additional TSF area.

Non-compliance of PM_{10} and $PM_{2.5}$ concentrations could result in human health impacts. The main pollutants of concern were determined to be PM (including TSP, PM_{10} and $PM_{2.5}$). Two potential direct operational phase impacts on the air quality of the area were identified:

- B1: Potential impact on human health from increased pollutant concentrations during future Kareerand TSF operations;
- B2: Increased nuisance dustfall rates associated with future Kareerand TSF operations.

Greenhouse Gas and Climate Change

The GHG emissions from the project will be relatively low and will likely not result in a noteworthy contribution to climate change on its own. With the future operations there will be additions to the equipment fleet, likely to result in an increase in scope 1 emissions from the MWS operations. This would therefore change the "manufacturing industry and construction" sector's total annual CO_2-e emissions, increasing it by approximately 4 369 tpa. The project contribution towards the 2010 total "manufacturing industries and construction" sector CO_2-e emissions is 0.01%.

The clearing of vegetation (even though the TSF will likely be re-vegetated at some stage) will result in a carbon sink loss and result in an increase towards the national GHG inventory.

Most of the South African policy is still draft or in the planning phase; however, as from the next NAEIS (National Atmospheric Emission Inventory System) reporting period MWS will have to start reporting on GHG emissions.

The most significant climate change induced impacts on the project would be as a result of:

- Temperature increase, and
- Possible reduction in rainfall.

With the increase in temperature there is the likelihood of an increase in discomfort, possibility of heat related illness (such as heat exhaustion, heat cramps, and heat stroke). Both these have the potential to negatively affect staff performance and productivity. There is also the increased change in the overheating of equipment/machinery with effects on production. Finally, there is the possibility of increased evaporation and thus the need for increased use of water for mitigation and process operations. The decrease in rainfall can result in reduced water supply.

10.3.4.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Operational activities	Impact on human health from increased pollutant concentrations*	L- M	L- M
	Increased nuisance dustfall rates**	L- M	L- M

*Unmitigated PM_{10} emissions in the project area will *seldom* result in an *insignificant negative* impact on *human health* in the *long-term* in the *study area*. The risk is likely LOW; however, using the GCS impact rating methodology, the environmental risk of this impact is MODERATE; without and with mitigation applied.

**Based on 24 months of simulated results, only one month had high dustfall in exceedance of the NDCR limit for residential areas at AQSRs which could be attributed to a meteorological event that is not a common occurrence; thus, unmitigated TSP emissions in the project area will *seldom* result in an *insignificant negative* impact on *amenitie*s in the *long-term* in the *study area*. The risk is likely LOW; however, when using the GCS methodology, the environmental risk of this impact is MODERATE; without and with mitigation applied.

10.3.5 Noise Impacts

10.3.5.1 Description

Operational phase impacts of noise are limited to noise pollution on residential receptors. During the operational phase, day-time noise levels at all four of the on-site receptor locations are predicted to increase by between 2.0 and 10.8 dB(A). Such increases will result in “little” to “strong” community response. It must be noted that such receptors are not residential in nature and hence are not classified as sensitive. Assessment of noise levels at these locations are provided for on-site management purposes and to match the historical monitoring locations. The predicted day-time noise levels at one of the off-site sensitive receptor locations (Khuma Town) are predicted to increase marginally with the operation of the TSF extension. Noise levels at this location will increase by 0.2 dB(A) resulting in “little” community response.

At night, when the reclamation activities cease, noise levels at all four on-site receptor locations are predicted to increase with the operation of the TSF extension. Noise levels will increase by between 0.5 and 10.1 dB(A) resulting in “little” to “strong” community response. It must be noted that such receptors are not residential in nature and hence are not classified as sensitive. Assessment of noise levels at these locations are provided for on-site management purposes and to match the historical monitoring locations.

With reference to the off-site residential receptors, it is noted that the predicted night-time noise levels at KR06 (Hostel) and KR07 (residential area to the south) during the operation of the TSF extension are undetectable (0.0 dB(A)) and as such, no negative impacts are envisaged at these receptors. With the absence of monitored data at KR05, an assessment of the increase in noise levels at this location could not be undertaken. Based on the generally low baseline (monitored) noise levels at all other receptors, it is envisaged that the impact at this location will also be minimal. Based on the low predicted noise levels and resultant minimal increases at all receptors, no buffers or areas to be avoided have been identified in this assessment.

With such minimal increases in noise levels during the operational phase, no mitigation recommendations for the operation of the proposed TSF extension are proposed. With rehabilitation occurring simultaneously with the operational phase, the same mitigation recommendations provided for the construction phase can be applied to the rehabilitation phase.

10.3.5.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
General construction activities	Nuisance noise	L	L

Significance of noise impacts does not change with mitigation due to the initial impact being so low, even without mitigation.

10.3.6 Heritage Impacts

10.3.6.1 Description

The impacts of the proposed development on heritage features are expected to occur during the Construction Phase only. With the required mitigation measures outlined for these four sites expected to be completed even before the Construction Phase commences, no further impacts are expected during the subsequent project phases (i.e. Operations, Decommissioning and Post-Closure). As a result, no impact assessments will be undertaken for these three subsequent project phases.

10.3.7 Surface Water Impacts

10.3.7.1 Description

Operational phase impacts to the surface water system include:

- Soil contamination and decreased surface water quality due to insufficient hydrocarbon management (inadequate handling, storage or disposal);
- Soil compaction due to vehicle movement, resulting in increased runoff and potentially leading to increased erosion;
- Reduced surface water quality caused by TSF overtopping, total TSF failure or pipeline failures;
- Reduced surface water quality, caused by inadequate separation of clean and dirty water at the RWDs and SWD;
- Reduced surface water quality, caused by incorrect stormwater management and therefore inadequate separation of clean and dirty water and/or insufficient storage capacity design;
- Reduced surface water quality, caused by spillages from water infrastructure as a result of climate change induced changes to the rainfall patterns;
- The need to source additional raw water abstraction from the catchment area due to insufficient process water availability as a result of climate change;
- Increased surface runoff from side slopes and subsequent siltation of trenches / dams, as a result of a lack of concurrent rehabilitation, in turn resulting in decreased surface water quality;
- Loss of infrastructure availability due to power failure, sabotage, inclement weather, resulting in overflow and reduced surface water quality; and
- Inadequate handling, storage & disposal of waste, hydrocarbons and chemicals, impacting negatively on surface water quality.

10.3.7.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Vehicle movement	Improper hydrocarbon management resulting in reduced surface water quality	L- M	L
	Improper hydrocarbon management resulting in soil contamination	L- M	L
	Soil compaction resulting in increased runoff leading to potential erosion	L- M	L
Tailing deposition	TSF overtopping resulting in reduced surface water quality	H	H- M
	TSF failure resulting in reduced surface water quality	H	H- M
	Pipeline failures resulting in reduced surface water quality	H	M
Water Management (RWD and SWD)	Lack of operational storage capacity / freeboard (spillage) resulting in reduced surface water quality	H- M	M
Storm water management	Inadequate clean / dirty water separation resulting in reduced surface water quality	M	L- M
	Insufficient storage capacity design resulting in reduced surface water quality	H- M	M
Climate change	Insufficient infrastructure design (spillage) resulting in reduced surface water quality	M	L- M

	Insufficient process water availability resulting in sourcing alternative water sources resulting in additional raw water abstraction from the catchment area	H- M	M
TSF Concurrent Rehabilitation	Lack of concurrent rehabilitation resulting in increased surface runoff from side slopes	L- M	L
	Lack of care and maintenance of rehabilitation, resulting in siltation of trenches / dams	L- M	L
	Lack of care and maintenance of rehabilitation, resulting in reduced surface water quality	M	L- M
Uninterrupted operation	Loss of infrastructure availability due to (power failure, sabotage, inclement weather) resulting in reduced surface water quality	M	L- M
Waste management	Inadequate handling, storage & disposal resulting in reduced surface water quality	L- M	L
Hydrocarbon Management	Inadequate handling, storage & disposal resulting in reduced surface water quality	L- M	L- M
Chemical Management	Inadequate handling, storage & disposal resulting in reduced surface water quality	L- M	v. L

10.3.8 Groundwater Impacts

10.3.8.1 Description

The life of mine for the Kareerand TSF is 2042. This allows sufficient time for chemical reactions to take place in the tailings facility to produce AMD conditions, as can be seen from the existing water monitoring data. Groundwater flow will be directed away from the TSF due to the head build-up within the TSF.

To demonstrate the risk assessment, two basic scenarios were considered:

- Class C Liner for extension with pool management but no groundwater interception, and
- Class C liner for extension with pool management and groundwater interception.

The predicted sulfate at the end of the operational life (2042) for the scenario where no groundwater interception measures were applied indicates that the sulfate plume has the potential to reach the Vaal River, both south and east of the TSF, within the operational phase of the TSF.

As mentioned in the previous section, the extension portion of the TSF will be constructed with a Class C Barrier lining system, advanced underdrain and decant system and the lined return water dams will be expanded to allow for maximum water decant from the pool on top of the TSF. Additional groundwater management measures as laid out in the Hydrogeology Report (GCS, 2020) must also be followed. The model indicates that the sulfate plume at the time of mine closure will not reach the Vaal River if the required mitigation measures are applied and no external farm boreholes will be impacted on.

Seepage from the proposed expansion contributes between 0 and 5% of the total seepage of the proposed long-term operational seepage. The majority of the seepage (95%) will be from the existing Kareerand TSF.

10.3.8.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Interception of tailings seepage from upper weathered aquifer south and east as indicated	Dewatering of the surrounding aquifers	L	L
TSF management	Impact on groundwater quality (contamination) from current TSF and expansion and potential for poor contaminant seepage into the Vaal River	H	M

10.3.9 Socio-Economic Impacts

10.3.9.1 Description

<u>Positive Impacts</u>

The expansion of Kareerand will enable the project to expand its operational lifespan from the current 2025 up to 2042, i.e. an additional 17 years. For purposes of the assessment it is assumed that the expansion will result in the continuation of the activities on the same level that was experienced the last 5 years. This will result in the following positive socio-economic impacts throughout the operational phase:

- A continuation of job and income opportunities for the surrounding communities. This impact can be enhanced by for example:
  - Prioritising local labour in the recruitment process as part of the company's own recruitment policy or contractor management plan (objective should be to reach 100% recruitment of additional/ new unskilled labour from local communities);
  - Provide skills development opportunities for workers;
  - Develop a database of goods and services that could potentially be outsourced to the local community;
  - Establish a supplier development programme as part of the Local Economic Development strategy. The programme should focus on small businesses in CMLM and JB Marks LM that could supply to the project (e.g. catering and cleaning) as well as larger businesses within the region; and
  - Following a transparent communication strategy to inform the local communities of these targets and report on progress on these targets.
- Reduce poverty in the community through employment. This impact can be enhanced by prioritising local labour in the recruitment process as part of the company's own recruitment policy or contractor management plan.
- Continued generation of public revenue.
- Continued social investment in local communities. This impact can be enhanced by for example:
  - Establishing a development fund specifically dedicated to development of local communities adjacent to the expanded Kareerand TSF; and
  - Follow a strategic approach towards establishing a socio-economic development plan for the local community.

<u>Negative Impacts</u>

The Kareerand TSF Expansion Project may result in the following negative socio-economic impacts throughout the operational phase:

- Increased economic concentration of the local economy.
- Increased resource use.
- Potential loss of income for businesses and households due to externalities.
- Loss of Sense of Place.
- Nuisance factors of traffic, dust and noise.
- Decrease in community safety in terms of safety, health and impact on environmental resources.
- Permanent loss of agricultural land.

10.3.9.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Operational activities	Local employment and income impact (positive)	M	M
	Poverty reduction through employment (positive)	M	M
	Continuation of generation of public revenues (positive)	H	H
	Economic diversity	M	M
	Increased resource use (water and energy)	H- M	H- M
	Impact on External Costs to Local Communities	H	H- M

	Sense of Place	H- M	H- M
	Nuisance factors	H- M	M
	Community safety	H- M	H- M
	Permanent loss of agricultural land	M	M

10.3.10 Visual Impacts

10.3.10.1 Description

The results from the viewshed analyses for the various infrastructure elements of the proposed TSF extension indicate that the topography of the region acts as an effective screen for the RWDs and SWD to the potential receptors identified. The size and height of the proposed TSF extension, with visibility coverage of 93.5% of the Potential Zone of Influence and 17.6% of the visibility being of a high visibility impact, results in the TSF having a largely un-mitigatable impact. However, the sense of place of the surrounding environment should be taken into consideration. The surrounding area is heavily impacted by mining and related activities, as well as the associated infrastructure and waste sites. The greater context of the project also has reference, as many old TSFs will be re-mined and rehabilitated in the process, thus reducing the visual impact of such TSFs.

The majority of the visual exposure anticipated will be limited to the northern and southern regions of the potential zone of influence (within a 10 km radius) and most receptors within the modelled results lie within the medium visual exposure range. It is important to note that the JB Marks Local Municipality and Buffelsfontein Gold Mine will experience high visual impacts from the proposed extension towards the centre of the PZI (Potential Zone of Influence). The Bushybend Private Nature Reserve will experience medium to high levels of visual exposure towards the north west portion of the reserve and motorists travelling along the R502 main road are expected to experience medium to high levels of visual exposure when travelling north of the proposed extension. If the recommended mitigation measures are adhered to, these visual impacts can be lessened.

While mitigation measures have been suggested, the overall impact, from a visual perspective, largely remains in the same category as it would if it were unmitigated. This is due to the size of the TSF and the mining nature of the region.

During the operational phase of the proposed project, night lighting will be used 24/7 for security and operational purposes. The area at the toe of the existing TSF, where there is a concentration of infrastructure and activities, is currently covered by lighting mounted on high masts and structures. All light fittings within this area are, and will remain, lower in height than the proposed TSF extension. An additional light source will come from vehicles which will be used at night to transport personnel at shift changes and for after hour emergencies. These aspects of night-time lighting are discussed in this section to create awareness for when the mine operates during low visibility times and at night.

10.3.10.2Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Expansion/Reshaping of TSF - Accumulation of residue from the processing plant	Landscape visual change	M	M
Movement of construction vehicles and heavy machinery for the TSF expansion	Change of Visual Character	M	L
Movement of construction vehicles and heavy machinery for the TSF expansion	Dust creation	M	L
Temporary stockpiling of topsoil bund for rehabilitation	Landscape visual change	M	M
24/7 Night lighting for security and operational activities	Light Pollution (Glare, spill light, sky glow)	M	L

Architectural design of the RWD's and SWD	Landscape visual change	M	M

10.3.11 Health Impacts

10.3.11.1 Description

The health risks posed to members of the public by the activities planned as part of the proposed project were evaluated using a source-pathway-receptor analysis approach. Information from specialist study reports was incorporated with toxicology data and population statistics to quantify the human health risks associated with the proposed Kareerand TSF Expansion Project.

Information presented indicates that a complete source-pathway-receptor linkage exists for the atmospheric exposure pathway. Information on the aquatic environment, both surface- and groundwater, indicated that complete source-pathway-receptor linkage for this pathway may be possible, only if proposed mitigative measures are not implemented. The aquatic pathway was therefore included in the further assessment. The potential for exposure through the atmospheric exposure pathway was evaluated for the operational life of the proposed Kareerand TSF Expansion Project.

The results from both the atmospheric dispersion modelling (Airshed, 2020) and contaminant transport modelling (GCS, 2020) indicate that the potential impact through the atmospheric and aquatic pathways are not limited to the immediate vicinity of the Kareerand TSF Expansion Project, and airborne pollutants (e.g. particulates) and water borne contaminants may extend beyond the operational boundary. However, the concentrations of both the pollutants and contaminants decrease rapidly with distance from the sources and become negligible. Nevertheless, potential receptors were identified, which may experience a small increase in the risk of health effects as a result of the proposed Extension Project.

The impacts associated with the proposed Kareerand TSF Expansion Project that are under evaluation for this study are defined as follows:

- HHRIA01- Impact to human health associated with inhalation exposure to airborne particulates ($PM_{2.5}$ and PM_{10}) emitted from the surface of the TSF.
- HHRIA02- Non-cancer (systemic) health effects in humans as a result of inhalation exposure to manganese and uranium present in PM emanating from the surface of the TSF.
- HHRIA03- Risk of systemic health effects and cancer in humans as a result of ingestion of water contaminated through seepage from the TSF.

10.3.11.2Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Dispersion of dust from TSF	Impact to human health	M	L- M
Dispersion of PM from TSF	Non-cancer (systemic) health effects in humans	L- M	L- M
Seepage of contaminated water into the drinking water system	Risk of systemic health effects and cancer in humans	M	v. L

10.3.12 Radiological Impacts

10.3.12.1Description

The radiological impact assessment for the operational phase considers the potential contribution through all three the environmental pathways. However, due to the slow-moving nature of any radionuclide contaminant plume that originates from the Kareerand TSF Project through the groundwater system, the potential radiological impact through the groundwater pathway will only occur during the post-closure. During the operational phase, the following activities may result in radiological impacts:

- Exhalation and dispersion of radon gas from the Kareerand TSF
  - Radon gas generated in the tailings material due to the presence of Ra-226 will be exhaled to the atmosphere. Inhalation of the radon gas contributes to the total effective dose.
- Emission and dispersion of PM containing radionuclides from the Kareerand TSF
  - Wind erosion at the Kareerand TSF will cause PM containing radionuclides to be emitted to the atmosphere. The airborne dust (PM_{10}) and deposited dust (TSP) contribute to the total effective dose through inhalation, ingestion and external radiation exposure routes.
- Controlled and uncontrolled releases of water containing radionuclides to the environment

- Controlled releases refer to authorised discharges of contaminated water into the environment, whereas uncontrolled releases refer to unauthorised discharges as well as runoff from contaminated areas and dirty water discharges into the environment. This may lead to an increase in the soil and/or water activity concentration.

10.3.12.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Tailings deposition (operational activities)	Exhalation and dispersion of radon gas to the atmosphere*	M	M
Dispersion of PM from TSF	Emission and dispersion of particulate matter that contains radionuclides to the atmosphere*	M	M
Seepage of contaminated water into the drinking water system	Release of contaminated water that contains radionuclides into the environment	L- M	L

* The total effective dose as a contribution from the windblown dust and radon gas released from the Kareerand TSF is below the regulatory compliance criteria, except near the TSF. This means that from a compliance perspective no additional management or mitigation measures are required.

10.4 Environmental Impact Assessment - Decommissioning and Closure Phase

Full impact assessments can be found within the various specialist' reports. A summary of the decommissioning/closure phase impacts is presented in this section.

10.4.1 Ecological Impacts

10.4.1.1 Description

Additional ecological impacts experienced in the decommissioning phase will be minimal, as the main impacts would have already been generated in the construction and operational phases. As the decommissioning of the TSFs will include complete rehabilitation and vegetation, some of the initial impacts may be lessened.

The only additional impact for the decommissioning phase would be the incorrect selection of plants used in rehabilitation, resulting in reduced habitat creation. Rehabilitation must be undertaken in line with the site-specific rehabilitation plan.

10.4.1.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Decommissioning (final rehabilitation activities)	Increased presence of people on site	M	L- M
	Dust, noise, human activity and emissions	L- M	L
	Introduction of AIS / exacerbation of existing AIS	H	L
Revegetation	Poor plant selection and habitat creation	L- M	L- M

10.4.2 Wetland Impacts

No additional wetland impacts were identified for the decommissioning phase.

10.4.3 Soil and Agricultural Impacts

10.4.3.1 Description

During the decommissioning phase, the infrastructure that will not remain permanent features of the landscape will be removed. This includes the decommissioning of the slurry pipelines. The removal of the infrastructure will result in vehicles and equipment moving around in these areas to collect the materials for transport to waste dump areas. This will result in soil compaction that causes reduced water infiltration and increases the risk of surface water runoff and soil erosion.

During the decommissioning phase, soil can be polluted with spills from vehicles that are used for the removal of infrastructure from site. The infrastructure removal will also generate solid waste that may cause soil pollution.

10.4.3.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Vehicle movement	Soil compaction of topsoil bund wall and access roads	H- M	H- M
	Soil contamination with hydrocarbons and solid waste	M	L- M
Fence removal	Agricultural production and agricultural-related employment within the fenced-off area (positive)	L- M	M

10.4.4 Air Quality Impacts

10.4.4.1 Description

It is assumed that all operations will have ceased by the decommissioning phase. It is expected that all surface infrastructure will be demolished and removed except for roads which will remain for public use. It is also expected that the TSF surface will be covered with topsoil and vegetated.

Air Quality

The potential for air quality impacts during the decommissioning phase will depend on the extent of demolition and rehabilitation efforts during decommissioning and on features which will remain. The likely activities associated with the decommissioning phase of the operations are:

- Infrastructure removal/demolition;
- Topsoil recovered from stockpiles for rehabilitation and re-vegetation of surroundings;
- Vehicle entrainment on unpaved road surfaces during rehabilitation. Once that is done, vehicle activity associated with MWS should cease; and
- Exhaust emissions from vehicles utilised during the closure phase. Once that is done, vehicle activity associated with MWS should cease.

The closure phase includes the period of aftercare and maintenance after the decommissioning phase. During this phase rehabilitated areas are checked and maintained. The activities that may be included are irregular and minimal vehicle entrainment on roads and vehicle exhaust emissions when the property is checked up on.

Two potential direct decommissioning phase impacts on the air quality of the area were identified:

- D1: Potential impact on human health from pollutant concentrations associated with closure activities;
- D2: Nuisance dustfall rates associated with closure activities;

Two potential direct closure phase impacts on the air quality of the area were identified:

- C1: Potential impact on human health from pollutant concentrations associated with decommissioning activities;
- C2: Nuisance dustfall rates associated with decommissioning activities;

C1 and D1 would likely impact on human health whereas C2 and D2 would impact on amenities.

Mitigation measures such as dust suppression will assist in reducing air quality impact, however, as the initial impact is so low, these measures will not make a significant difference on the impact.

Greenhouse Gas and Climate Change

For the decommissioning operations scope 1 and scope 2 are also applicable but available data is insufficient to determine operations GHG emissions.

10.4.4.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Decommissioning activities	Impact on human health from increased pollutant concentrations*	M	L-M
	Increased nuisance dustfall rates**	L- M	L- M
Closure activities	Impact on human health from increased pollutant concentrations*	L- M	L- M
	Increased nuisance dustfall rates**	L- M	L- M

* Unmitigated PM_{10} emissions in the project area will *seldom* result in an *insignificant negative* impact on *human health* in the *medium-term* in the *study area*. The risk is likely LOW; however, using the GCS impact rating methodology, the environmental risk of this impact is MODERATE; without and with mitigation applied.

** Unmitigated TSP emissions in the project area will *very seldom* result in an *insignificant negative* impact on *amenitie*s in the *medium-term* in the *study area*. The risk is likely LOW; however, using the GCS impact rating methodology, the environmental risk of this impact is MODERATE; without and with mitigation applied.

10.4.5 Noise Impacts

10.4.5.1 Description

Decommissioning phase impacts of noise are limited to noise pollution on residential receptors. Decommissioning will likely not result in any additional noise impacts. Since similar equipment will be utilised during the decommissioning phase, the same mitigation recommendations provided for the construction phase above are applicable to the decommissioning phase.

10.4.5.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
General decommissioning activities	Nuisance noise	L	L

Significance of noise impacts does not change with mitigation due to the initial impact being so low, even without mitigation.

10.4.6 Heritage Impacts

10.4.6.1 Description

The impacts of the proposed development on heritage features are expected to occur during the Construction Phase only. With the required mitigation measures outlined for these four sites expected to be completed even before the Construction Phase commences, no further impacts are expected during the subsequent project phases (i.e. Operations, Decommissioning and Post-Closure). As a result, no impact assessments will be undertaken for these three subsequent project phases.

10.4.7 Surface Water Impacts

10.4.7.1 Description

- Reduced surface water quality caused by lack of appropriate hydrocarbon management;
- Soil compaction due to vehicle movement, resulting in increased runoff;

- Increased surface runoff from side slopes and subsequent siltation of trenches / dams, as a result of a lack of concurrent rehabilitation, in turn resulting in decreased surface water quality;
- Reduced surface water quality, caused by incorrect stormwater management and therefore inadequate separation of clean and dirty water and/or insufficient storage capacity design;
- Decrease in catchment water yield, as a result of reduced runoff caused by stormwater management measures; and
- Reduced surface water quality, siltation of dams and trenches, and increased surface water runoff from side slopes, caused by lack of maintenance on post-closure infrastructure.

10.4.7.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Vehicle movement	Improper hydrocarbon management resulting in reduced surface water quality	L- M	L
	Soil compaction resulting in increased runoff	L- M	L
Rehabilitation	Lack of care and maintenance & monitoring resulting in increased surface runoff from side slopes	L- M	L
	Lack of care and maintenance & monitoring resulting in siltation of dams and trenches	L- M	L
	Lack of care and maintenance & monitoring resulting in reduced surface water quality	M	L
Storm water management	Inadequate clean / dirty water separation resulting in reduced surface water quality	M	L

	Insufficient storage capacity design resulting in reduced surface water quality	H- M	L- M
	Reduction of catchment yield (run-off) resulting in reduced catchment water quantity	H- M	M

10.4.8 Groundwater Impacts

10.4.8.1 Description

Decommissioning phase groundwater impacts will be similar to those experienced during the construction phase.

10.4.8.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Construction material and waste handling	Groundwater quality deterioration	L	L

10.4.9 Socio-Economic Impacts

10.4.9.1 Description

During decommissioning all redundant infrastructure are dismantled and the final rehabilitation process commence. The impacts on the socio-economic environment will include:

- Job and income losses;
- Decrease of local economic development funds from the company;
- Permanent loss of agricultural land;
- Sense of place; Nuisance factors (dust and noise) associated with decommissioning and rehabilitation activities; and
- Community safety and health.

10.4.9.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Decommissioning	Job and income losses	H- M	M
	The termination of social funds from MWS	M	M
	Permanent loss of agricultural land	M	M
	Sense of Place	M	M
	Nuisance factors	H- M	M
	Community safety	H- M	H- M

10.4.10 Visual Impacts

10.4.10.1 Description

During the decommissioning phase, it is anticipated that the visual impacts of the activity will be of medium negative significance. The decommissioning/closure phase entails the reshaping of the TSF and the removal of infrastructure where possible. This process will result in dust creation and the mitigation measures as per the construction and operational phases will apply. Additionally, any exposed areas as a result of the removal of infrastructure should be revegetated and returned as close as possible to their original state.

The final TSF structure (current and expansion) should undergo final reshaping, as should any topsoil stockpiles on site. The reshaping of these elements should be planned with the input of a landscape architect and a botanist/environmentalist. It should be ensured that the TSF is reshaped such that it simulates the natural topography of the region. It is vital that the slope/gradient of the extended TSF promotes maximum vegetation growth which is also aesthetically pleasing.

10.4.10.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Movement of construction vehicles and heavy machinery for the	Change of Visual Character	M	L

reshaping and revegetation of the TSF and for the removal of infrastructure			
Movement of construction vehicles and heavy machinery for the reshaping and revegetation of the TSF and for the removal of infrastructure	Dust creation	M	L
End of operation - Reshaping and revegetation of the TSF	Landscape visual change	M	M
End of operation - Removal of the RWD's and SWD	Landscape visual Change	M	L

10.4.11 Health Impacts

10.4.11.1 Description

The Air Quality Specialist Report (Airshed, 2020) indicates that, although dispersion modelling for dust emissions associated with decommissioning and closure phases could not be undertaken, air quality impacts from these phases are likely insignificant.

Similar to the construction phase, the decommissioning and closure phases are expected to involve various activities that will generate airborne pollutants. However the limited duration of the decommissioning activities would likely reduce the significance of the potential impacts relative to that of the operational phase. Consequently, the potential of impact to health from the decommissioning and closure phases is expected to be low compared to the operational phase.

The decommissioning and closure activities are not expected to make any directly contribution to contaminant concentration groundwater and surface water resources. Decommissioning of the Kareerand and Extension Project TSFs will likely involve cover and vegetation of the TSF surface which will limit the quantity of water infiltrating into the TSF and reduce the quantity of water seeping out of the tailings over time. As indicated in the

Hydrogeological Impact Assessment report (GCS, 2020), the quality of seepage from the tailings is expected to deteriorate post closure. However, as the mitigation measures proposed for capturing and containing the contaminated seepage are expected to prevent the contamination of off-site resources, health impacts associated with the ingestion or use of contaminated water are therefore accepted to remain negligible post closure.

10.4.12 Radiological Impacts

10.4.12.1Description

Before the actual closure of Kareerand TSF and as part of the National Nuclear Regulator (NNR) licensing (CoR) conditions and requirements, a decommissioning plan will be prepared for submission and approval by the NNR. 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 is not available at present, the following activities were identified that may result in a radiological impact to the receptors during the post-closure phase:

- Implementation of the NNR approved decommissioning plan
    - The execution of the decommissioning plan involves a site-wide plan to demolish, decontaminate and remove all the surface infrastructure that may contain or that are contaminated with radionuclides. These areas will be rehabilitated and cleaned for clearance by the NNR.
    - Implement final rehabilitation and mitigation measures at the TSF.
- Exhalation of radon gas and the emission of PM (PM_{10} and TSP) that contains radionuclides from the Kareerand TSF
    - Radon gas generated in the tailings material due to the presence of Ra-226 will be exhaled to the atmosphere. Inhalation of the radon gas contributes to the total effective dose.
    - Wind erosion at the TSF will cause particulate matter containing radionuclides to be emitted to the atmosphere. The airborne dust (PM_{10}) and deposited dust (TPS) contribute to the total effective dose through inhalation, ingestion and external radiation exposure routes.
- Leaching and migration of radionuclides from the Kareerand TSF
    - Radionuclides will leach from the TSF into the underlying aquifer, after which it 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.

The implementation of the decommissioning plan results in a positive impact in the sense that all surface infrastructure that contained or that are contaminated with radionuclides are demolished, decontaminated (to the extent possible), and removed from the site once compliance with clearance criteria has been demonstrated. A gamma radiation survey is performed at the infrastructure sites, followed by rehabilitation and clean-up for conditional or unconditional clearance from the NNR. Also, an area that becomes contaminated during or because of operational activities will be rehabilitation and clean-up for conditional or unconditional clearance.

Rehabilitation measures for the Kareerand TSF may include the establishment of vegetation to reduce dust emissions and installation of a covering later to reduce dust emissions and radon exhalation rates during the post-closure period.

10.4.12.2Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Post-closure monitoring and maintenance	Implementation of the NNR approved decommissioning plan (positive)	M	NA
	Exhalation of radon gas and the emission of PM (PM_{10} and TSP) that contain radionuclides*	M	M
	Leaching and migration of radionuclides**	M	M

* The total effective dose as a contribution from the windblown dust and radon gas released from the Kareerand TSF is below the regulatory compliance criteria, except near the TSF. This means that from a compliance perspective no additional management or mitigation measures are required.

**The total effective dose from the ingestion of groundwater as a contribution from the Kareerand TSF was hypothetically illustrated to be below the regulatory compliance criteria, which means that from a compliance perspective no additional management or mitigation measures are required. Thus, even with mitigation, the significance of the impact does not change very much.

10.5 Environmental Impact Assessment – Cumulative and Residual Impacts

Full impact assessments can be found within the various specialist' reports. A summary of the cumulative and residual impacts is presented in this section.

10.5.1 Ecological Impacts

10.5.1.1 Description

Cumulative or residual ecological impacts could result in long-term loss or degradation of habitat for biodiversity. This could subsequently result in the loss of biological corridors (important for ecosystem service provision) or important or Threatened/Protected species (TOPS) and an eventual decrease in biodiversity in the local area. Cumulative/residual impacts on the Kareerand TSF Expansion project could result from:

- Fragmentation of habitat and loss of corridors;
- Destruction of TOPS;
- Introduction of alien invasive species; and
- Contamination/degradation of habitat.

10.5.1.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Residual Impacts			
Site clearing / preparation	Fragmentation of habitat and loss of ecological corridors	M	L
All activities	Destruction of TOPS	H	L- M
	Introduction of AIS / exacerbation of existing AIS	H- M	L- M
Spills (hydrocarbon, chemical, tailings, dirty water), dumping of waste & radiation	Contamination and complete degradation of fauna habitat without remedy	H	L

Cumulative Impacts			
Spills (hydrocarbon, chemical, tailings, dirty water) & dumping of waste	Contamination and complete degradation of fauna habitat without remedy	H	L

10.5.2 Wetland Impacts

10.5.2.1 Description

Long-term and cumulative impacts on wetlands include changes to the flow regime and changes to the sediment load entering the system.

10.5.2.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Compaction of soil and the clearing of vegetation during construction of pipelines, berms and access roads	Changes in water flow regime, increased high energy surface water runoff, decreased vegetation germination potential, sediment pollution	M	L- M
Plant operation: permanent presence of pipelines and access roads	Changes in sediment and stormwater entering the system	H- M	L- M

10.5.3 Soil and Agricultural Impacts

10.5.3.1 Description

Cumulative impacts of the loss of land capability include:

- Other mining activities in the area not related to the Kareerand TSF Expansion.
- Expansion of settlement areas into areas with arable and grazing land capability when work opportunities created by the Kareerand TSF result in a population influx of migrant workers in search of employment opportunities.

Residual impacts of the loss of land capability include:

- The progressive loss of areas grazing and arable land capability that can be used for livestock grazing, game farming as well as other agricultural enterprises.

Cumulative impacts of the loss of agricultural production include:

- Other mining activities in the area not related to the Kareerand TSF Expansion.

Residual impacts of the loss of agricultural production include:

- A reduction of the volume of food produced within the district municipality.

Cumulative impacts of the loss of soil ecosystem services and soil fertility include:

- Other mining activities in the area not related to the Kareerand TSF Expansion that impact on soil ecosystem services and soil fertility.

Residual impacts of the loss of soil ecosystem services and soil fertility include:

- The progressive loss of soil ecosystem services results in the progressive degradation of soil quality and the services provided such as water and nutrient cycling.

Cumulative impacts of soil pollution include:

- Any existing soil contamination as a result of previous spills and leaks from the existing pipeline network.
- Sabotage of the pipelines by artisanal miners in search of gold-containing material that they can process.
- Other mining activities in the area not related to the Kareerand TSF Expansion.
- Any existing soil contamination present as a result of the site being part of a larger gold mining area.
- Extreme weather events such as major floods and wind storms that increase the distance and severity of contaminant transport from the TSF.

Residual impacts of soil pollution include:

- Gradual or sudden enrichment of soil with soil contaminants will result in bioaccumulation of the contaminants in vegetation and increased contamination levels of groundwater, surface water and air. This has negative human and environmental health impacts.

Cumulative impacts as a result of restoration of agricultural production include:

- Any areas that may additionally become available for livestock grazing in the larger region around the Kareerand TSF Expansion.

10.5.4 Air Quality Impacts

Land use in the region includes residences, farming, mining, industry and wilderness. The mining operations (MWS as well as other companies), farming activities, domestic fires, vehicle exhaust emissions and dust entrained by vehicles on public roads without the addition of the proposed operations will likely result in elevated ambient air pollutant concentrations and dustfall rates compared to an area where there are no anthropogenic emission sources. The simulated impacts from the VR and MWS operations are likely to be the greatest contributor to ambient air quality in close proximity to the Kareerand TSF operational areas. It is difficult to predict the location and contribution of the sources from residences, farming and wilderness to existing air quality, but it is unlikely these sources will result in NAAQS being exceeded, at least in the long-term.

The potential cumulative scenario includes the following atmospheric emissions:

- Particulate emissions from VR and MWS operations;
- Miscellaneous fugitive dust sources including vehicle entrainment on roads and wind-blown dust from open areas;
- Particulate emissions from vehicle exhaust emissions;
- Particulate emissions from household fuel burning; and
- Particulate emissions from biomass burning (e.g. wild fires).

Based on the simulated results there is not likely to be any exceedances of the NAAQS at AQSRs near Kareerand as a result of cumulative impacts of air quality.

10.5.5 Noise Impacts

10.5.5.1 Description

In order to assess the environmental acoustic impacts of the proposed expansion, both baseline (monitored) and proposed (modelled) noise levels were assessed. Comparisons of the existing and proposed noise levels at various specified sensitive receptors (noise receivers) enabled an assessment of changes in noise levels at these locations as a result of the proposed TSF expansion. Such changes essentially account for the cumulative impact of the project, taking the existing, background noise climate into consideration. These changes were then assessed against the SANS community or group responses in order to assess the anticipated impacts/responses as a result of such increases.

10.5.6 Heritage Impacts

In terms of the sites directly impacted upon by the proposed development, it is expected that latent impacts associated with the identified sites once the project has run its course, will be negligible. In general terms, this report recommends that a heritage management plan be compiled that includes all the sites listed in this report with a heritage significance of Medium and higher. Such a management plan would outline the ongoing management of these identified archaeological and heritage sites.

The evaluation of the cumulative heritage impacts is based on available heritage studies and cannot take the findings of outstanding studies on current ongoing EIA's in consideration. The only cumulative impacts on heritage resources that is foreseen on a local level, are the impacts already identified in terms of the impact assessments undertaken on an individual site basis. The site-specific mitigation measures would address the required measures to mitigate these impacts. On a regional level, and as far as is presently known, no gold mines or associated activities such as TSFs, are expected to be developed in the surroundings of the current development footprints. As a result, insignificant to low cumulative impacts are foreseen on heritage resources on a regional level. This may change should more information become available.

10.5.7 Surface Water Impacts

10.5.7.1 Description

Long-term impacts on surface water as a result of the expanded TSF are related to post-closure maintenance and could include:

- Increased surface runoff if side slopes are not properly maintained;
- Increased siltation of dams and trenches if they are not maintained; and
- Reduced surface water quality as a result of the above.

10.5.7.2 Impact Assessment

Post closure infrastructure maintenance	Lack of maintenance resulting in increased surface runoff from side slopes	L- M	L
	Lack of maintenance resulting in increased in siltation of dams and trenches	L- M	L
	Lack of maintenance resulting in reduced surface water quality	M	L

10.5.8 Groundwater Impacts

10.5.8.1 Description

The post closure phase involves the following basic mitigation and rehabilitation measures:

- Establishment of cover on final side wall and on top of the 200 m perimeter to reduce oxidation of the coarser tailings material. The cover needs to be constructed with the addition of lime to increase the buffer capacity of the oxidation zone.
- The results of the seepage modelling and cover design modelling showed that slopes with a gradient of at least 1:5 and a soil cover of at least 60 cm will have the lowest seepage rates during the closure phase of the TSF. Good vegetation cover contributes to decreased Mean Annual Precipitation (MAP) percentage percolating into the TSF and seeping into the groundwater.
- Keep return water system active to ensure the lined section can drain water as long as required.
- Expansion of the interception system and assessment of the system annually, to determine if borehole locations should be changed and/or if additional boreholes are required as the plume migrates and the phreatic surface declines (resulting in decreased seepage).
- Active groundwater interception will be required to operate for an extended time after closure. The time period will be guided by geohydrological models. Some of the wells might even need to operate beyond this time period and interception may be required closer to the river. Groundwater interception points must be aligned with plume migration as required, until environmental load is of acceptable levels (consider acceptance criteria by comparing up and down-stream river samples annually). The expected volumes for active interception will decrease over time and the predicted required minimum interception will be in the order of 6000 m^3/day or 2.2 million m^3 per annum. This will decrease to approximately 1000 to 500 m^3/day towards the end of the proposed post-closure period.
- The numerical flow models (Zyl 2019) developed for the closure phase were used to predict a time series of declining seepage volumes for a receding phreatic surface until climatic equilibrated rates are reached after the phreatic surface has receded. Initial conditions were based on the closure phase analysis.

According to KP (2018), the Kareerand Extension tailings facility is designed to be decommissioned by 2042. The beach will then be prepared and ameliorated for rehabilitation as soon as access allows. The upper slopes of the wall and top surface will be rehabilitated after closure. Side slopes will be rehabilitated concurrently with facility operation (Agreenco email communication dated 08 April 2019).

Land use surrounding the Kareerand TSF comprise of agricultural activities, with farms to the east and south east of the TSF. Impacts from the Kareerand TSF can negatively influence the farming water resources and sound monitoring must occur to track any negative impacts on any identified farm boreholes. The cumulative environmental impact from the Kareerand TSF is limited to the potential of seepage into the Vaal River within its direct vicinity and demarcated potential plume area. It is not foreseen that any other cumulative groundwater impacts will result from the Kareerand TSF extension if the proposed mitigation actions are followed, implemented and monitored.

The remining of the old TSFs will mainly result in a positive cumulative impact and the Kareerand TSF extension itself have no cumulative impacts as such.

10.5.8.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Operation and ultimate rehabilitation of TSF	Impact on groundwater quality from TSF and potential seepage of poor quality base-flow into the Vaal River	H	M

10.5.9 Socio-Economic Impacts

10.5.9.1 Description

Cumulative impacts of the TSF expansion include:

- Temporary jobs and income during construction-
  - Other mining activities in the area not related to the TFS (e.g. north of the N12).
- Project-induced in-migration-
  - Other mining activities in the area not related to the TFS (e.g. north of the N12); and
  - Proposed Buffels Solar Energy Project – if the construction phases run concurrently.
- Increased nuisance factors-
  - Existing industrial activities in the area acting as additional sources of traffic, dust and noise pollution;
  - Other mining activities in the area not related to the TFS (e.g. north of the N12); and
  - Proposed Buffels Solar Energy Project – if the construction phases run concurrently.

- Local employment and income-
    - Other mining activities in the area not related to the TFS (e.g. north of the N12).
- Poverty reduction through employment-
    - Other mining activities in the area not related to the TFS (e.g. north of the N12).
- Impact on economic diversity-
    - Other mining activities in the local area.
- Increased resource use-
    - Other mining activities in the local area.
- Impact on external costs to local communities-
    - Other mining activities in the local area; historic tailings facilities that are being reclaimed, the TSF's current and planned infrastructure (pump stations and pipelines).
- Sense of place-
    - Other mining activities in the local area; historic tailings facilities that are being reclaimed, the TSF's current and planned infrastructure (pump stations and pipelines).
- Community safety-
    - Existing industrial activities in the area acting as additional sources of traffic, dust and noise pollution;
    - Existing tailings facilities present in the larger study area; and
    - Other mining activities in the area not related to the TFS (e.g. north of the N12).

Residual impacts of the TSF expansion include:

- Temporary jobs and income during construction-
    - Up-skilled labour force (positive).
- Project-induced in-migration-
    - Additional pressure on provision of housing and related infrastructure and health, emergency and safety services.
- Local employment and income-

  - Up-skilled labour force (positive).
- Sense of place-
  - Visual impact of the tailings and the residual impact on the sense of place; and
  - Environmental risks possibly impacting on the sense of place.
- Increased nuisance factors-
  - Health risks; and
  - Environmental pollution risks.

10.5.10 Visual Impacts

10.5.10.1 Description

Residual visual impacts of the construction of a TSF may remain in the landscape for many years. The residual impact can be reduced through correct rehabilitation techniques.

10.5.10.2 Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
After closure rehabilitation	Landscape visual change	M	M
Cumulative impact of the reshaped TSF along with the surrounding existing infrastructure	Landscape visual change	M	M

10.5.11 Health Impacts

10.5.11.1 Description

The risk of impact from exposure to airborne and aquatic pathway contaminants were shown to be low, especially if proposed mitigation is applied. The contaminants further do not target the same organs and although simultaneous exposure to airborne and waterborne contaminants may result in cumulative health effects, the health effects are not synergistic.

Cumulative impacts from air pollutants originating from other sources are discussed in the Air Quality Specialist Report (Airshed, 2020). It indicates that it is difficult to predict the contribution of sources such as residences, farming, mining and wilderness to existing air quality, but that it is unlikely these sources will result in a significant increase in pollutant concentrations, at least in the long-term.

It is therefore concluded that the contribution made by the proposed Extension Project TSF to baseline concentrations of air pollutants or waterborne contaminants will most likely not lead to risks of higher significance than the operational phase.

As indicated in the Hydrogeological Impact Assessment report (GCS, 2020), the quality of seepage from the tailings is expected to deteriorate post closure. However, as the mitigation measures proposed for capturing and containing the contaminated seepage are expected to prevent the contamination of off-site resources, health impacts associated with the ingestion or use of contaminated water are therefore accepted to remain negligible post closure.

10.5.12 Radiological Impacts

10.5.12.1Description

A cumulative radiological impact to members of the public is possible, with possible contributions from the broader AGA Vaal River Operations as well as any other mining operations in the area. The scope of the assessment was limited to the Kareerand TSF Expansion project and did not make provision for a regional assessment to evaluate cumulative effects. The application of the dose constraint as regulatory compliance criteria opposed to the dose limit of 1 mSv.year^{-1} (or 1,000 µSv.year^{-1}) is to allow for the cumulative impact from more than one operation in an area. In other words, by constraining Kareerand TSF Expansion project in terms of the National Nuclear Regulator Act Regulations, GN R388 to 250 µSv.year^{-1}, provision is made for a cumulative impact while still in compliance with the public dose limit of 1,000 µSv.year^{-1}.

The radiological impact assessment compared the impact of the total effective dose for the existing Kareerand TSF footprint, with the cumulative impact of both the existing and extension TSF footprint. The existing footprint has an impact to the south and south-east, with a slight impact to the north of the existing site. No impact is registered towards the west onto the extended footprint area. The cumulative impact includes an additional component over the extended footprint area, as well as a component to the south of the extension area. The cumulative impact towards the south of the existing footprint area is slightly higher than the plume for the existing footprint.

The following activities were identified that may result in a radiological impact to the receptors during the post-closure phase:

- Exhalation of radon gas and the emission of PM (PM_{10} and TSP) that contains radionuclides from the Kareerand TSF

- Radon gas generated in the tailings material due to the presence of Ra-226 will be exhaled to the atmosphere. Inhalation of the radon gas contributes to the total effective dose.
- Wind erosion at the TSF will cause particulate matter containing radionuclides to be emitted to the atmosphere. The airborne dust (PM_{10}) and deposited dust (TPS) contribute to the total effective dose through inhalation, ingestion and external radiation exposure routes.

- Leaching and migration of radionuclides from the Kareerand TSF
  - Radionuclides will leach from the TSF into the underlying aquifer, after which it 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.

10.5.12.2Impact Assessment

ACTIVITY	IMPACT	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE AFTER MITIGATION
Post-closure monitoring and maintenance	Exhalation of radon gas and the emission of PM (PM_{10} and TSP) that contain radionuclides*	M	M
	Leaching and migration of radionuclides**	M	M

* The total effective dose as a contribution from the windblown dust and radon gas released from the Kareerand TSF is below the regulatory compliance criteria, except near the TSF. This means that from a compliance perspective no additional management or mitigation measures are required.

**The total effective dose from the ingestion of groundwater as a contribution from the Kareerand TSF was hypothetically illustrated to be below the regulatory compliance criteria, which means that from a compliance perspective no additional management or mitigation measures are required. Thus, even with mitigation, the significance of the impact does not change very much.

11 MITIGATION RECOMMENDATIONS

11.1 Ecology

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
Site clearing / preparation	Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3 Isolation between terrestrial and aquatic habitats Loss of vegetation	• Protect TOPS and ensure permits are in place where required. • Train staff on aspects of biodiversity. • No open fires. • Maintain ecological corridors. • Vegetation removal should be limited as far as possible and planned correctly. • Protect all areas susceptible to erosion. • Disturbed areas must be revegetated. • A storm-water management plan must be implemented. • Aspects of the development must be planned with biodiversity in mind. • Areas outside of the construction footprint must be designated and protected. • Implement suitable rehabilitation.

		• The biodiversity management and monitoring plan must be adhered to.
General construction activities	Increased presence of people on site	• Implement a monitoring plan for all TOPS. • No domestic animals allowed on site. • All staff to undergo environmental training. • No deliberate killing or trapping of indigenous fauna is allowed on site. • Vehicle speeds to be limited.
General construction activities	Exposure to fauna of dangerous areas, excavations and hazardous substances	• Implement a monitoring plan for all TOPS. • All staff to undergo environmental training. • No poisons against fauna are to be brought on site. • Plan activities outside the breeding season of TOPS that are likely to occur on site. • Should overhead-lines need to be erected in highly sensitive areas (once all other options have been investigated), this should be done with the site's sensitivity in mind and following appropriate precautionary measures. • All activities should proceed in a linear manner as far as possible.

		• Should any indigenous fauna be trapped within development / activity areas, activities will cease, and the necessary qualified and permitted specialists will be brought to site to trap and relocate the species. • Areas outside of the construction footprint must be designated and protected. • Implement suitable rehabilitation. • Area must be regularly monitored and rehabilitated as feasible areas become available and ecological connectivity maintained at all times.
General construction activities	Dust, noise, human activity and emissions	• Utilise quieter equipment where feasible or employ means to quieten it. • Employ dust suppression measures. • Vegetate exposed soils, where feasible. • Equipment and machinery to be serviced and maintained within operating specifications. • All staff to undergo environmental training.
Disturbance of soil/general construction activities	Introduction of AIS / exacerbation of existing AIS (fauna and flora)	• Train staff and contractors on the identification of AIS. • Clear site of AIS. • Compile and implement an alien invasive management plan (AIMP).

		• Maintain connectivity and ecological processes. • All equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. • Inspect outside areas regularly and clear all domestic and food waste from site.
Spills (chemical, tailings, dirty water)	Contamination of fauna habitat. Loss of the plant soil seed bank	• Tailings and contaminated water can only be disposed to the TSF expansion area and RWDs. • Stormwater and mine water separation, containment and treatment must be established before operation begins. • Ensure emergency response procedures for spills from the TSF and RWD are in place. • Monitor and address all issues identified immediately. • Implement emergency response procedures immediately.
Hydrocarbon spills	Contamination of fauna habitat. Loss of the plant soil seed bank	• All equipment / machinery will be serviced and maintained within operating specifications to prevent the risks of leak. Discontinue use of all faulty machinery / equipment on site until properly repaired. • Compile, implement and audit implementation of a waste management plan.

		• Hydrocarbons and hydrocarbon drums/cans/bottles, all hazardous substances and cement must be correctly stored. • All equipment / machinery to be serviced and maintained within a designated workshop area. • Any machinery or equipment parked on site must be parked on a concrete slab or have drip trays placed under them. • All hydrocarbons spills on bare ground to be cleared immediately.
Waste generation	Contamination of faunal habitat	• Compile, implement and audit implementation of a waste management plan. • Train staff and contractors on the waste management plan before allowing persons on site. • Hydrocarbons and hydrocarbon drums/cans/bottles, all hazardous substances and cement must be correctly stored. • All waste (domestic, hydrocarbon, hazardous) must be managed in line with the prescribed waste management plan. • Refuse bins with properly secured lids will be placed around site to collect waste for separation, recycling and disposal.

		• Waste (domestic, construction, hazardous) should be recycled as far as possible and sold/given to interested contractors. • Inspect and clear all litter and waste from the site and surrounds.
Septic tank operation	Contamination of faunal habitat	• Provide adequate portable toilets for the number of staff on site, provide for male and female staff and keep all facilities outside the riverine and wetland buffer zones. • Keep toilet facilities operational, clean and hygienic.
Operational Phase		
Site clearing / preparation	Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3 Isolation between terrestrial and aquatic habitats Loss of vegetation	• Protect TOPS and ensure permits are in place where required. • Train staff on aspects of biodiversity. • No open fires. • Maintain ecological corridors. • Protect all areas susceptible to erosion. • Disturbed areas must be revegetated. • A storm-water management plan must be implemented. • Areas outside of the construction footprint must be designated and protected.

		• Implement suitable rehabilitation in accordance with the biodiversity management and monitoring plan which must be adhered to.
General operational activities	Increased presence of people on site	• Implement a monitoring plan for all TOPS. • No domestic animals allowed on site. • All staff to undergo environmental training. • No deliberate killing or trapping of indigenous fauna is allowed on site. • Vehicle speeds to be limited.
General operational activities	Exposure to fauna of dangerous areas, excavations and hazardous substances	• Implement a monitoring plan for all TOPS. • All staff to undergo environmental training. • No poisons against fauna are to be brought on site. • Should overhead-lines need to be erected in highly sensitive areas (once all other options have been investigated), this should be done with the site's sensitivity in mind and following appropriate precautionary measures. • Should any indigenous fauna be trapped within development / activity areas, activities will cease, and the necessary qualified and permitted specialists will be brought to site to trap and relocate the species.

		• Areas outside of the construction footprint must be designated and protected. • Area must be regularly monitored and rehabilitated as needed and ecological connectivity maintained at all times.
General operational activities	Dust, noise, human activity and emissions	• Utilise quieter equipment where feasible or employ means to quieten it. • Employ dust suppression measures. • Vegetate exposed soils. • Equipment and machinery to be serviced and maintained within operating specifications. • All staff to undergo environmental training.
General operational activities	Introduction of AIS / exacerbation of existing AIS (fauna and flora)	• Train staff and contractors on the identification of AIS. • Clear site of AIS. • Compile and implement an alien invasive management plan (AIMP). • Maintain connectivity and ecological processes. • All equipment and vehicles should be thoroughly cleaned prior to access to the operational areas.

		• Inspect outside areas regularly and clear all domestic and food waste from site.
Spills (chemical, tailings, dirty water)	Contamination of fauna habitat. Loss of the plant soil seed bank	• Tailings and contaminated water can only be disposed to the TSF expansion area and RWDs. • Stormwater and mine water separation, containment and treatment must be established before operation begins. • Ensure emergency response procedures for spills from the TSF and RWD are in place. • Monitor and address all issues identified immediately. • Implement emergency response procedures immediately.
Hydrocarbon spills	Contamination of fauna habitat. Loss of the plant soil seed bank	• All equipment / machinery will be serviced and maintained within operating specifications to prevent the risks of leak. Discontinue use of all faulty machinery / equipment on site until properly repaired. • Compile, implement and audit implementation of a waste management plan. • Hydrocarbons and hydrocarbon drums/cans/bottles, all hazardous substances and cement must be correctly stored. • All equipment / machinery to be serviced and maintained within a designated workshop area.

		• Any machinery or equipment parked on site must be parked on a concrete slab or have drip trays placed under them. • All hydrocarbons spills on bare ground to be cleared immediately.
Waste generation	Contamination of faunal habitat	• Compile, implement and audit implementation of a waste management plan. • Train staff and contractors on the waste management plan before allowing persons on site. • Hydrocarbons and hydrocarbon drums/cans/bottles, all hazardous substances and cement must be correctly stored. • All waste (domestic, hydrocarbon, hazardous) must be managed in line with the prescribed waste management plan. • Refuse bins with properly secured lids will be placed around site to collect waste for separation, recycling and disposal. • Waste (domestic, construction, hazardous) should be recycled as far as possible and sold/given to interested contractors. • Inspect and clear all litter and waste from the site and surrounds.

Septic tank operation	Contamination of faunal habitat	• Provide adequate portable toilets for the number of staff on site, provide for male and female staff and keep all facilities outside the riverine and wetland buffer zones. • Keep toilet facilities operational, clean and hygienic.
Decommissioning Phase		
Decommissioning/ closure/ rehabilitation activities	Increased presence of people on site	• Protect TOPS and ensure permits are in place where required. • Train staff on aspects of biodiversity. • No open fires. • Maintain ecological corridors. • Protect all areas susceptible to erosion. • Disturbed areas must be revegetated. • A storm-water management plan must be implemented. • Aspects of the rehabilitation must be planned with biodiversity in mind. • Areas outside of the decommissioning footprint must be designated and protected. • Implement suitable rehabilitation. • The biodiversity management and monitoring plan must be adhered to.

Decommissioning, closure, and rehabilitation activities	Dust, noise, human activity and emissions	• Utilise quieter equipment where feasible or employ means to quieten it. • Employ dust suppression measures. • Vegetate exposed soils. • Equipment and machinery to be serviced and maintained within operating specifications. • All staff to undergo environmental training.
Disturbance of soil/ Decommissioning, closure, and rehabilitation activities	Introduction of AIS / exacerbation of existing AIS (fauna and flora)	• Train staff and contractors on the identification of AIS. • Clear site of AIS. • Continue to implement the alien invasive management plan (AIMP). • Maintain connectivity and ecological processes. • All equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. • Inspect outside areas regularly and clear all domestic and food waste from site.
Revegetation	Poor plant selection and habitat creation	• Rehabilitation and revegetation must be done in line with an approved closure and rehabilitation plan, which must include a plot plan for proposed plant species to be used in revegetation.

Cumulative and Residual Impacts		
Site clearing / preparation	Fragmentation of habitat and loss of ecological corridors – residual impacts	• Protect TOPS and ensure permits are in place where required. • Train staff on aspects of biodiversity. • No open fires. • Maintain ecological corridors. • Vegetation removal should be limited as far as possible and planned correctly. • Protect all areas susceptible to erosion. • Disturbed areas must be revegetated. • A storm-water management plan must be implemented. • Aspects of the development must be planned with biodiversity in mind. • Areas outside of the construction footprint must be designated and protected. • Implement suitable rehabilitation. • The biodiversity management and monitoring plan must be adhered to.

All activities	Any destruction of TOPS – residual impacts	• The biodiversity management and monitoring plan must be adhered to. • Protect TOPS and ensure permits are in place where required. • Train staff on aspects of biodiversity. • No open fires. • No domestic animals on site. • No deliberate killing or trapping of indigenous fauna is allowed on site. • Maintain ecological corridors. • Vegetation removal should be limited as far as possible and planned correctly. • Protect all areas susceptible to erosion. • Disturbed areas must be revegetated. • A storm-water management plan must be implemented. • Aspects of the development must be planned with biodiversity in mind. • Areas outside of the construction/operational footprint must be designated and protected. • Implement suitable rehabilitation.

		• Vehicle speeds to be limited.
All activities	Introduction of AIS / exacerbation of existing AIS (residual impacts)	• Train staff and contractors on the identification of AIS. • Clear site of AIS. • Compile and implement an alien invasive management plan (AIMP). • Maintain connectivity and ecological processes. • All equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. • Inspect outside areas regularly and clear all domestic and food waste from site.
Spills (hydrocarbon, chemical, tailings, dirty water) & dumping of waste	Contamination and complete degradation of fauna habitat without remedy (cumulative and residual impacts)	• Tailings and contaminated water can only be disposed to the TSF expansion area and RWDs. • Stormwater and mine water separation, containment and treatment must be established before operation begins. • Ensure emergency response procedures for spills from the TSF and RWD are in place. • Monitor and address all issues identified immediately. • Implement emergency response procedures immediately.

		• All equipment / machinery will be serviced and maintained within operating specifications to prevent the risks of leak. Discontinue use of all faulty machinery / equipment on site until properly repaired. • Compile, implement and audit implementation of a waste management plan. • Hydrocarbons and hydrocarbon drums/cans/bottles, all hazardous substances and cement must be correctly stored. • All equipment / machinery to be serviced and maintained within a designated workshop area. • Any machinery or equipment parked on site must be parked on a concrete slab or have drip trays placed under them. • All hydrocarbons spills on bare ground to be cleared immediately.

11.2 Wetlands

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
Compaction of soil and the clearing of vegetation during construction of pipelines, berms and access roads	Changes in water flow regime, increased high energy surface water runoff, decreased vegetation germination potential, sediment pollution	• Implement effective stormwater and sediment management. • Changed overland water flows should be accommodated. • Control of alien invasive plants should form part of the maintenance plan.
Compaction of soil and the clearing of vegetation during construction of pipelines and access roads	Changes in sediment deposition and high energy flows causing erosion	• Implement effective stormwater and sediment management. • Changed overland water flows should be accommodated. • Control of alien invasive plants should form part of the maintenance plan.
Preparation of the footprint of all new infrastructure	Introduction and spread of alien plants	• Ensure the implementation of an effective AIMP.
Operational Phase		
Permanent location of tailing facilities in the catchment of the waterbodies	Permanent changes to the catchment of waterbodies in terms of water infiltration and surface water flow rates	• Implement effective stormwater and sediment management

		• The AIMP should be implemented to prevent colonisation of waterbodies. • A wetland rehabilitation plan with plant species plan should be implemented to ensure that ecological function equal to the current habitat is returned. • Independent water quality testing should inform the management plan of corrective action required where pollution or sedimentation is recorded.
Permanent presence of pipelines and access roads	Changes in sediment and stormwater entering the system	• Changed overland water flows should be accommodated. • The AIMP should be implemented to prevent colonisation of waterbodies.
Inadequate infrastructure and maintenance of vehicles	Changes in water quality due to foreign materials and increased nutrients	• Independent water quality testing should inform the management plan of corrective action required where pollution or sedimentation is recorded

11.3 Soil

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
Construction of infrastructure	Destruction of current land capability	• Keep to project footprint. • Prevent overgrazing and soil erosion around the site.

Fencing of site	Loss of agricultural production and agricultural-related employment within the fenced-off area	• Keep to project footprint. • Investigate the introduction of alternative agricultural projects in the area.
Stripping of topsoil	Loss of soil ecosystem services and soil fertility	• Keep to project footprint. • Topsoil should be protected against wind and water erosion. • If natural revegetation does not occur, natural vegetation should be established on the topsoil stockpiles.
General construction activities	Soil contamination with hydrocarbons and solid waste	• All equipment / machinery will be serviced and maintained within operating specifications to prevent the risks of leak. Discontinue use of all faulty machinery / equipment on site until properly repaired. • Impermeable and bunded surfaces must be used for storage tanks and to park vehicles on. • Site surface water and wash water must be contained and treated before reuse or discharge from site. • Spills of fuel and lubricants must be contained using a drip tray. • Spill kits should be available on all working areas of site and should be serviced regularly.

		• Waste and hazardous substances must be appropriately managed. • Spills must be cleaned up immediately.
Operational Phase		
Pumping of waste slurry through pipelines to the Kareerand TSF complex for processing	Soil pollution	• Regular inspections and maintenance of the pipelines must be undertaken. • Contaminated soil must be assessed by a soil pollution expert. • Polluted soil must be remediated directly after detection.
Storage of processed mine tailings waste in the proposed expanded TSF	Soil pollution	• An assessment of the current soil contamination status of the area around the site must be conducted prior to the construction phase to inform a detailed soil contamination monitoring plan. • Any increase in soil contamination levels detected must be addressed as soon as possible through soil remediation. • All remediated areas must be monitored to ensure that remediation measures were effective.
General operational activities	Soil contamination with hydrocarbons and solid waste	• All equipment / machinery will be serviced and maintained within operating specifications to prevent the risks of leak. Discontinue use of all faulty machinery / equipment on site until properly repaired.

		• Impermeable and bunded surfaces must be used for storage tanks and to park vehicles on. • Site surface water and wash water must be contained and treated before reuse or discharge from site. • Spills of fuel and lubricants must be contained using a drip tray. • Spill kits should be available on all working areas of site and should be serviced regularly. • Waste and hazardous substances must be appropriately managed. • Spills must be cleaned up immediately.
Vehicular movement	Soil compaction of topsoil bund wall and access roads	• Restrict traffic and vehicle movement to access roads. • Demarcate parking areas.
Cumulative and Residual Impacts		
Construction and operation of the TSF and its supporting infrastructure	Cumulative impacts: Destruction of current land capability of the areas where infrastructure will be constructed Other mining activities in the area not related to the Kareerand TSF Expansion	• Keep to project footprint. • Prevent overgrazing and soil erosion around the site.

	Expansion of settlement areas into areas with arable and grazing land capability when work opportunities created by the Kareerand TSF result in a population influx of migrant workers in search of employment opportunities.	
	Residual impacts: Destruction of current land capability of the areas where infrastructure will be constructed The progressive loss of areas grazing and arable land capability that can be used for livestock grazing, game farming as well as other agricultural enterprises.	• Keep to project footprint. • Provide assistance in education of the local community to prevent overgrazing and soil erosion around the site.
Fencing of site	Cumulative impacts: Loss of agricultural production and agricultural-related employment within the fenced-off area Other mining activities in the area not related to the Kareerand TSF Expansion	• Keep to project footprint. • Investigate the introduction of alternative agricultural projects in the area.
	Residual impacts: Loss of agricultural production and agricultural-related employment within the fenced-off area	• Keep to project footprint. • Investigate the introduction of alternative agricultural projects in the area.

	A reduction of the volume of food produced within the district municipality	
Topsoil stripping	Cumulative impacts: Loss of soil ecosystem services and soil fertility in areas where topsoil is stripped Other mining activities in the area not related to the Kareerand TSF Expansion that impact on soil ecosystem services and soil fertility.	• Keep to project footprint. • Topsoil should be protected against wind and water erosion. • If natural revegetation does not occur, natural vegetation should be established on the topsoil stockpiles.
	Residual impacts: Loss of soil ecosystem services and soil fertility in areas where topsoil is stripped The progressive loss of soil ecosystem services results in the progressive degradation of soil quality and the services provided such as water and nutrient cycling.	• Keep to project footprint. • Topsoil should be protected against wind and water erosion. • If natural revegetation does not occur, natural vegetation should be established on the topsoil stockpiles.
Pumping of waste slurry through pipelines to the Kareerand TSF complex for processing	Cumulative impacts: Soil pollution from pumping of waste slurry through pipelines to the Kareerand TSF complex for processing Any existing soil contamination as a result of previous spills and leaks from the existing pipeline network.	• Regular inspections and maintenance of the pipelines must be undertaken. • Contaminated soil must be assessed by a soil pollution expert. • Polluted soil must be remediated directly after detection.

	Sabotage of the pipelines by artisanal miners in search of gold-containing material that they can process. Other mining activities in the area not related to the Kareerand TSF Expansion.	
	Residual impacts: Soil pollution from pumping of waste slurry through pipelines to the Kareerand TSF complex for processing Gradual or sudden enrichment of soil with soil contaminants will result in bioaccumulation of the contaminants in vegetation and increased contamination levels of groundwater, surface water and air. This has negative human and environmental health impacts.	• Regular inspections and maintenance of the pipelines must be undertaken. • Contaminated soil must be assessed by a soil pollution expert. • Polluted soil must be remediated as soon as possible after detection.
Storage of processed mine tailings waste in the proposed expanded TSF	Cumulative impacts: Soil pollution from storage of processed mine tailings waste in the proposed expanded TSF Other mining activities in the area not related to the Kareerand TSF Expansion. Any existing soil contamination present as a result of the site being part of a larger gold mining area. Extreme weather events such as major floods and wind storms that increase the distance and severity of contaminant transport from the TSF.	• An assessment of the current soil contamination status of the area around the site must be conducted prior to the construction phase to inform a detailed soil contamination monitoring plan. • Any increase in soil contamination levels detected must be addressed as soon as possible through soil remediation. • All remediated areas must be monitored to ensure that remediation measures were effective.

	Residual impacts: Soil pollution from storage of processed mine tailings waste in the proposed expanded TSF Gradual or sudden enrichment of soil with soil contaminants will result in bioaccumulation of the contaminants in vegetation and increased contamination levels of groundwater, surface water and air. This has negative human and environmental health impacts.	• An assessment of the current soil contamination status of the area around the site must be conducted prior to the construction phase to inform a detailed soil contamination monitoring plan. • Any increase in soil contamination levels detected must be addressed as soon as possible through soil remediation. • All remediated areas must be monitored to ensure that remediation measures were effective.

11.4 Air Quality

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
General construction activities	Potential impact on human health from increased pollutant concentrations	• Reduction of fugitive PM emissions through the watering of roads, stockpiles and inactive open areas and the use of screens. • Reductions of vehicle exhaust emissions through the use of better quality diesel; and inspection and maintenance programs.
General construction activities	Increased nuisance dustfall rates	• Reduction of fugitive PM emissions through the watering of roads, stockpiles and inactive open areas and the use of screens.

		• Reductions of vehicle exhaust emissions through the use of better quality diesel; and inspection and maintenance programs.
Operational Phase		
General operational activities	Potential impact on human health from increased pollutant concentrations	• Sides of TSF and dams should be vegetated and/or covered with nets or other alternate options to prevent wind-blown dust migration where feasible.
General operational activities	Increased nuisance dustfall rates	• Sides of TSF and dams should be vegetated and/or covered with nets or other alternate options to prevent wind-blown dust migration, where feasible. • Dust suppression measures should be employed on dirt roads on site.
Decommissioning Phase		
General decommissioning activities	Potential impact on human health from pollutant concentrations	• Reduction of fugitive PM emissions through the watering of roads and the use of screens. • Reduction of vehicle exhaust emissions through the use of better-quality diesel; and inspection and maintenance programs.
General decommissioning activities	Nuisance dustfall rates	• Reduction of fugitive PM emissions through the watering of roads, stockpiles and inactive open areas and the use of screens.

		• Reductions of vehicle exhaust emissions through the use of better-quality diesel; and inspection and maintenance programs.
Closure activities	Potential impact on human health from pollutant concentrations associated with closure activities	• Reductions of vehicle exhaust emissions through the use of better-quality diesel; and inspection and maintenance programs.
Closure activities	Nuisance dustfall rates associated with closure activities	• Reduction of fugitive PM emissions through the watering of roads, stockpiles and inactive open areas and the use of screens.

11.5 Noise

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
General construction activities	Disturbance to residential receptors due to construction noise	• Construction activities should be planned taking cognisance of local communities. • Limit the number of simultaneous activities to a minimum. • Use noise control devices for high impact activities, and exhaust muffling devices for combustion engines. • Select equipment with the lowest possible sound power level.

		• Ensure equipment is well-maintained to avoid additional noise generation.
Operational Phase		
Continual rehabilitation	Nuisance noise impacts (disturbance) to residential receptors due to continual rehabilitation activities	• Rehabilitation activities should be planned taking cognisance of local communities. • Limit the number of simultaneous activities to a minimum. • Use noise control devices for high impact activities, and exhaust muffling devices for combustion engines. • Select equipment with the lowest possible sound power level. • Ensure equipment is well-maintained to avoid additional noise generation.
Decommissioning Phase		
General decommissioning activities	Nuisance noise impacts on nearby communities	• Decommissioning activities should be planned taking cognisance of local communities. • Limit the number of simultaneous activities to a minimum. • Use noise control devices for high impact activities, and exhaust muffling devices for combustion engines.

		• Select equipment with the lowest possible sound power level. • Ensure equipment is well-maintained to avoid additional noise generation.

11.6 Heritage

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
General construction activities	Disturbance/damage to the sites AGA-MWS-WBP-2, AGA-MWS-MGD-5 and AGA-MWS-MGD-6	• Undertake a social consultation process. • If no graves are present, no mitigation required for graves. • If graves present, undertake a grave relocation process. • All structures and site layouts from each site must be recorded to develop a site layout plan and included in a mitigation report.
	Disturbance/damage to the site AGA-MWS-WGD-7	• The site must be fenced and signposted before construction commences. • The position of the possible graves must be shown on all maps and staff made aware of the presence of these sites.

	Disturbance/damage to palaeontological artefacts	• If a site is found during construction, the Chance Find Protocol outlined in the palaeontological report must be implemented. • Implement an archaeological and heritage monitoring process must be implemented for sites containing cemeteries and possible graves located approximately 50 m from the proposed development footprint areas.
Operational Phase		
General operational activities	Damage to archaeological/ palaeontological sites within the vicinity of operations	• The heritage site layout plan must be available on site. • The sites must be avoided by the operational team.
Decommissioning Phase		
Decommissioning, closure, and rehabilitation activities	Damage to archaeological/ palaeontological sites within the vicinity of decommissioning activities (with emphasis on the site impacted by the TSF fence)	• The heritage site layout plan must be available on site and rehabilitation team must be made aware of the heritage sites. • The sites must be avoided by the rehabilitation team. • If decommissioning activities occur within close proximity of a heritage site, it must be protected using barricading and warning signs.

11.7 Surface Water

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
Site clearing / preparation	Increased surface water runoff, resulting in soil erosion, sedimentation and possibly reduced surface water quality	• Clean and dirty water separation by means of bunded areas and upstream grader cut
Vehicle movement	Lack of hydrocarbon management, resulting in reduced surface water quality and soil contamination	• Implement hydrocarbon and traffic management plans. • Construction vehicles must be parked, refuelled and serviced in designated areas. • Drip trays to be used under all construction vehicle when parked. • Spill kits to be present on all working areas of site, regularly inspected and maintained.
Vehicle movement	Soil compaction, resulting in increased runoff and erosion	• Only identified travel routes to be utilised. • The construction method statement & traffic management plan must be implemented.
Storm water management	Lack of clean and dirty water separation, resulting in reduced surface water quality (mixing of clean and dirty water areas)	• North diversion channel must be built to divert clean water away from the TSF (designed for 1:50 year). • Clean and dirty water separation by means of bunded areas and upstream grader cuts.

		• The construction method statement & storm water management plan must be implemented, as well as the surface water monitoring programme.
Storm water management	Increase surface water runoff, resulting in sedimentation due to soil erosion	• Clean and dirty water separation by means of bunded areas and upstream grader cuts.
Wastewater management (sewage)	Uncontrolled release would reduce surface water quality	• Chemical toilets must be utilised during construction. These should be inspected and cleaned regularly. • A contractor should remove waste off site regularly. • A chemical management plan must be implemented.
Topsoil stockpiling	Incorrect stockpiling and poor rehabilitation may result in loss of topsoil, erosion, sedimentation and reduced surface water quality	• Revegetation of topsoil stockpiles. • Dedicated topsoil stockpile areas must be designated and protected from construction activity. • The construction guideline for the stockpiling of topsoil must be adhered to. • A topsoil management plan must be developed and implemented. • A clean and dirty water separation system must be constructed. • The surface water monitoring programme must be implemented.

Establishment of infrastructure (offices, workshops etc.)	Impact of waste generation (general waste) on surface water quality	• A waste management plan must be developed and implemented on site. • Site must be regularly inspected for good housekeeping. • The AGA waste management procedure must be adhered to.
Establishment of infrastructure (offices, workshops etc.)	Increase surface water runoff (roofs, paved areas) may result in sedimentation due to soil erosion and reduced surface water quality	• Construct roadside drains to manage run-off from hard surfaces. • Clean and dirty water must be separated. • The surface water monitoring programme must be implemented.
Hydrocarbon/Chemical Management	Inadequate handling, storage & disposal of hydrocarbons or chemicals may impact surface water quality	• The MWS Hazardous substance management procedure must be implemented and adhered to.
Operational Phase		
Vehicle movement	Insufficient hydrocarbon management may impact surface water quality	• MWS Hazardous substance and traffic management plans should be adhered to. • Construction vehicles must be parked, refuelled and serviced in designated vehicle areas.
Vehicle movement	Insufficient hydrocarbon management resulting in soil contamination	• Drip trays to be used under all construction vehicle when parked.

		• Spill kits need to be located in all working areas of site and must be regularly inspected and maintained. • MWS Hazardous substance and traffic management plans should be adhered to.
Vehicle movement	Soil compaction resulting in increased runoff leading to potential erosion	• Only identified travel routes to be utilized. • The traffic management plan should be adhered to.
Tailing Deposition	TSF overtopping would reduce surface water quality	• Maintain minimum pool on the TSF and ensure that it is centralised. • Maintain minimum freeboard. • Monitor pool level daily. • Implement and adhere to the AGA Code of Practice for TSFs. • Develop an Operating Manual, which should be available on site at all times.
Tailing Deposition	TSF failure would reduce surface water quality	• National and International design standards should be adhered to. • SANS 10286 should be implemented and adhered to during the operational phase of the TSF. • AGA tailings management framework should be implemented.

		• Monitoring equipment must be inspected regularly to ensure functionality. • Stability assessments must be undertaken regularly. • Implement and adhere to the AGA Code of Practice for TSFs. • Develop an Operating Manual, which should be available on site at all times.
Tailing Deposition	Pipeline failures would result in reduced surface water quality	• Secondary containment must be available in case of emergencies. • Pipelines must be regularly inspected and maintained, as per a maintenance and replacement program. • The pipeline maintenance plan and containment risk assessment guidelines must be adhered to.
Water Management (RWD and SWD)	Lack of operational storage capacity / freeboard may result in spillage, which would reduce surface water quality	• Dam level control philosophy should be adhered to, to ensure that there is always enough capacity in case of a large rainfall event. • The water balance should be updated regularly. • Applicable design criteria should be applied to the dams. • An emergency spillway must be constructed and maintained in functional condition.

		• Prescribed operating levels must be monitored and adhered to. • RWD's and trenches must be regularly inspected and desilted when necessary. • Silt traps and paddocks must be constructed and maintained in a functional condition to manage stored water. • Maximize water return to reclamation sites (water re-use and circulation). • The TSF operating manual must be adhered to.
Storm water management	Inadequate clean / dirty water separation may result in reduced surface water quality	• North diversion channel must be maintained in functional condition. • A bund wall should be constructed and maintained in a functional condition around the TSF. • Solution trench must be concrete lined. • Dirty water storage facilities (RWD) should be maintained in a functional condition with enough capacity to prevent overflow of dirty water into the environment. • Operating manual & design report must be adhered to.

Storm water management	Insufficient storage capacity design may result in reduced surface water quality	• Dams designs to 1:50 yr flood event • Operating manual & design report
Climate change	Insufficient infrastructure design (spillage) may result in reduced surface water quality	• Water balance and design report considers the impact of climate change.
Climate change	Insufficient process water availability resulting in sourcing alternative water sources, such as raw water abstraction from the catchment area	• Optimise, re-use and recycle. • Investigate water saving technologies.
TSF Concurrent Rehabilitation	Lack of concurrent rehabilitation may result in increased surface runoff from side slopes	• Rehabilitation should be undertaken concurrently and in accordance with the Kareerand Rehabilitation Plan
TSF Concurrent Rehabilitation	Lack of care and maintenance may result in siltation of trenches / dams	• Rehabilitation should be undertaken concurrently and in accordance with the Kareerand Rehabilitation Plan
TSF Concurrent Rehabilitation	Incorrect rehabilitation may reduce surface water quality	• Rehabilitation should be undertaken concurrently and in accordance with the Kareerand Rehabilitation Plan
Uninterrupted operation	Loss of infrastructure availability due to (power failure, sabotage, inclement weather) may result in reduced surface water quality	• Emergency Response plans must be developed and implemented.

Waste management	Inadequate handling, storage & disposal of waste may impact surface water quality	• The MWS waste management procedure must be implemented and adhered to.
Hydrocarbon/Chemical Management	Inadequate handling, storage & disposal of hydrocarbons or chemicals may impact surface water quality	• The MWS Hazardous substance management procedure must be implemented and adhered to.
Decommissioning Phase		
Vehicle movement	Insufficient hydrocarbon management may impact surface water quality	• Implement the MWS Hazardous substance and traffic management plans. • Decommissioning/rehabilitation vehicles must be parked, refuelled and serviced at designated vehicle area.
Vehicle movement	Increase in soil compaction may result in increased surface runoff	• Only identified travel routes identified may be utilised • Implement the traffic management plan.
Rehabilitation	Lack of care and maintenance & monitoring may result in increased surface runoff from side slopes	• The Kareerand TSF Rehabilitation Plan must be implemented. • A rehabilitation maintenance program must be developed and adhered to, post decommissioning and closure. • Continual monitoring and inspections of rehabilitated TSF must take place.

Rehabilitation	Lack of care and maintenance & monitoring may result in siltation of trenches / dams	• The Kareerand TSF Rehabilitation Plan must be implemented. • A rehabilitation maintenance program must be developed and adhered to, post decommissioning and closure. • Continual monitoring and inspections of rehabilitated TSF must take place.
Rehabilitation	Lack of care and maintenance & monitoring may impact surface water quality	• The Kareerand TSF Rehabilitation Plan must be implemented. • A rehabilitation maintenance program must be developed and adhered to, post decommissioning and closure. • Continual monitoring and inspections of rehabilitated TSF must take place. • Implement the surface water monitoring plan.
Storm water management	Inadequate clean / dirty water separation may impact surface water quality	• The Kareerand TSF Rehabilitation Plan must be implemented. • Implement the surface water monitoring plan.
Storm water management	Insufficient storage capacity (1:50; 1:100 rain event) may impact surface water quality	• The Kareerand TSF Rehabilitation Plan must be implemented. • Implement the surface water monitoring plan.

Storm water management	Reduction of catchment yield (run-off) monitoring may result in a decrease in catchment water quantity	• The Kareerand TSF must be correctly rehabilitated to allow for discharge of surface water post closure. • Water quality must be assessed before release. • The Kareerand TSF Rehabilitation Plan must be implemented.
Latent and Cumulative Impacts (Post Closure Phase)		
Post closure infrastructure maintenance	Lack of maintenance monitoring may result in increased surface runoff from side slopes, siltation of trenches / dams and may impact surface water quality	• The Kareerand TSF Rehabilitation Plan must be implemented. • Implement the surface water monitoring plan.

11.8 Groundwater

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
Vegetation clearance, topsoil stripping and stockpiling	Decreased groundwater quality and quantity	• Prepare detailed clearance and construction schedules. • Limit the vegetation clearance and topsoil stripping to the smallest area possible.
Construction material and waste handling	Groundwater quality deterioration	• Construction waste needs to be discarded at prescribed areas. • Spills must be cleaned up immediately.

		• If applicable, the appropriate authorities should be notified in the event of a significant spill. • Provide appropriate waste skips for different types of waste in a designated area. • Ensure regular removal of waste by an external accredited installer. • Provide spill kits at all working areas on site, which should be regularly inspected and maintained. • Remediated areas must be monitored.
Operational Phase		
Interception of tailings seepage from upper weathered aquifer south and east as indicated in the groundwater study (GCS, 2020)	Dewatering of the surrounding aquifers	• Electronic monitoring, monthly monitoring and where necessary upgrading of tailings seepage interception system. • Implement water quantity and quality monitoring programme, compile annual reports to assess potential impacts and implement mitigation measures if required. • Install flow meters to monitor the amount of water extracted, ensure the meters are maintained regularly. • Update numerical model every three years. • Maintain/update centralised monitoring database (for surface water and groundwater).

TSF management	Impact on groundwater quality (contamination) from current TSF and expansion and potential for poor contaminant seepage into the Vaal River	• Footprint preparation: compacting of foundation with Class C Liner during construction. • Implement tailings seepage interception system. • Appoint a qualified groundwater specialist to undertake quarterly or 6 monthly monitoring and numerical groundwater calibration as per prescribed timeframes. • Maintain/update centralised monitoring database and continuous improvement of interception system.
Latent and Cumulative Impacts (Post Closure Phase)		
Operation and ultimate rehabilitation of TSF	Impact on groundwater quality from TSF and potential seepage of poor quality base-flow into the Vaal River	• Expand and continue with groundwater interception at prescribed positions and time frames (time frames will be confirmed routinely as monitoring data is assessed). • Minimise infiltration on TSF by active phytoremediation and pond control. • Groundwater interception water evaporated on top of TSF. • Groundwater monitoring should be conducted as per the prescribed frequency. • Follow closure and rehabilitation plan. • Calibrate the numerical mass transport model at least every 3 years.

11.9 Socio-Economic

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
General construction activities	Employment opportunities through temporary job creation (positive)	• Recruit unskilled workers from local communities. • Up-skill workers during construction works.
	Nuisance factors of traffic, dust, noise	• Communicate with affected parties regarding construction activities that will affect them. • Limit dust, noise and movement of vehicles as far as possible, as per the air quality and noise management section of the EMP.
Operational Phase		
General operation activities	Employment opportunities and additional job creation (positive)	• Prioritise local recruitment and procurement if required. • Encourage upskilling of employees. • Supplier development: prioritise local supplier.
General operation activities	Jobs to low-income households, thus reducing poverty (positive)	• Local recruitment of unskilled labour if required.

General operation activities	Sustained income for social development by company (positive)	• Implement company's social policies and follow a strategic approach towards programme.
General operation activities	Reduced economic diversity due to over-reliance on mining sector	• Focus on non-core goods and services in local procurement and enterprise development programmes. • Focus on post mining resilience in social development programmes. • Commence early on with portable skills programme for unskilled workers.
General operation activities	Intensive use of water and energy	• Formulate resource use plan; support local renewable energy programmes.
General operation activities	Economic costs for community resulting from environmental degradation	• Implement specialist mitigation measures as per the EMPr. • Continue with existing MWS Community Environmental Forum, that meets quarterly and provides feedback on environmental monitoring and issues.
General operation activities	Visual, noise, environmental impacts resulting in a loss of sense of place	• Implement visual screening, dust control and water quality monitoring as per the EMP. • Ensure efficient environmental management through implementation of the EMP and assessment of implementation success (internal and external audits).

General operation activities	Nuisance factors in the form of traffic, dust, noise	• Ensure a functional communication system is in place with the affected communities. • Communicate with affected parties should an activity outside of normal operation occur, so as to warn them of increased nuisance factors. • Ensure efficient environmental management through implementation of the EMP and assessment of implementation success (internal and external audits).
General operation activities	Risk of failure, illegal miners, health risks, environmental risks impacting on community safety	• Ensure a functional communication system is in place with the affected communities. • Communicate with affected parties should an activity outside of normal operation occur, so as to warn them of increased safety risk factors. • Ensure efficient environmental management through implementation of the EMP and assessment of implementation success (internal and external audits).
Decommissioning Phase		
Decommissioning of the Kareerand operation	Employment loss through permanent job losses	• Investigate mechanisms to assist employees to find alternative jobs, focus on non-core related local supply links during the operational phase.

Decommissioning of the Kareerand operation	Loss of social funds through termination of social projects	• Follow clear communication strategy. • Investigate the funding of self-sustaining projects or hand over to other entities.
Decommissioning of the Kareerand operation	Permanent loss of land	• Continue with the lease agreement and payments for the wildebeestpan area (leased from the local community). • Commence discussions related to post-closure land-use in consultation with local community and finalise alternative land-use plan during operational phase.
Decommissioning of the Kareerand operation	Loss of visual sense of place	• Implement visual screening measures such as re-vegetation and rehabilitation.
Decommissioning of the Kareerand operation	Dust and noise nuisance factors	• Implement an agreed end-use, as well as dust suppression and pollution control measures during decommissioning activities.
Decommissioning of the Kareerand operation	Risk of failure, illegal miners, health risks, environmental risks and their impacts on community safety	• Implement an agreed end-use, as well as dust suppression and pollution control measures during decommissioning activities. • Implement re-vegetation and rehabilitation, as well as monitoring programmes.

11.10 Visual

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Construction Phase		
Removal of vegetation for site clearing/preparation for all proposed infrastructure Movement of construction vehicles and heavy machinery for site clearance	Negative Impacts on aesthetics	• Limit the construction footprint as per the EIA report. • Remove vegetation in a "natural manner", avoiding any harsh lines. • Ensure good housekeeping.
	Change of Visual Character	• Limit construction footprint. • Ensure good housekeeping.
Movement of construction vehicles and heavy machinery for site clearance	Dust creation	• Employ dust suppression measures. • Regulate the speed at which construction vehicles and heavy machinery move by implemented speed limitations (guideline: 40km/h in construction areas). • Maintain the dust monitoring programme.
Architectural design of the RWD's and SWD	Landscape visual change	• Ensure that the outer material/colour of structures is not white and will not result in any glare/reflection. Utilize colours that complement the surrounding landscape and vegetation. • Ensure good housekeeping.

Operational Phase		
Expansion/Reshaping of TSF - Accumulation of residue from the processing plant	Landscape visual change	• Utilize the topsoil bund, to an extent, as a visual screen to the TSF. • Plant indigenous trees or shrubs in a natural-looking manner, in certain areas around the perimeter fence to break structural form and provide visual screens in areas with high visual impact. • Expand and reshape the TSF as far as possible so that it simulates the natural topography.
Movement of construction vehicles and heavy machinery for the TSF expansion	Change of Visual Character	• Regulate the speed at which vehicles and heavy machinery move by implementing speed limitations (guideline: 40km/h in working areas). • Ensure good housekeeping.
Movement of construction vehicles and heavy machinery for the TSF expansion	Dust creation	• Implement dust suppression activities. • Regulate the speed at which vehicles and heavy machinery move by implementing speed limitations (guideline: 40km/h in working areas). • Maintain the dust monitoring programme.
Temporary stockpiling of topsoil bund for rehabilitation	Landscape visual change	• Reshape the stockpile as far as possible so that it simulates the natural topography of the surrounding landscape.

		• Ensure that the topsoil stockpile slope promotes revegetation.
24/7 Night lighting for security and operational activities	Light Pollution (Glare, spill light, sky glow)	• Choose suitable types of lighting that minimize glare. • Only focus light sources on where it is needed. • Direct light sources downwards. • Minimize the number of night-time lights used. • Utilize mobile lights to prevent constant lighting in one position, where possible. • Use blinds/blinkers if necessary. • Implement timers on light sources to avoid unnecessary lighting. • Vehicles should be manufactured at Original Equipment Manufacturer (OEM) Standards. • All vehicles should undergo a pre-use checklist. • Implement a lighting management plan through consultation with a qualified lighting engineer or lighting specialist.
Architectural design of the RWD's and SWD	Landscape visual change	• Maintain the condition of the structures to ensure that glare/reflection levels are always as minimal as possible.

		• Utilize colours that complement the surrounding landscape and vegetation
Decommissioning Phase		
Movement of construction vehicles and heavy machinery for the reshaping and revegetation of the TSF and for the removal of infrastructure	Change of Visual Character	• Regulate the speed at which decommissioning/ rehabilitation vehicles and heavy machinery move by implement speed limitations (guideline: 40km/h in working areas). • Ensure good housekeeping. • Minimise duration of disturbing decommissioning activities such as demolition.
Movement of construction vehicles and heavy machinery for the reshaping and revegetation of the TSF and for the removal of infrastructure	Dust creation	• Implement dust suppression measures. • Regulate the speed at which decommissioning/ rehabilitation vehicles and heavy machinery move by implement speed limitations (guideline: 40km/h in working areas). • Minimise duration of disturbing decommissioning activities such as demolition. • Maintain the dust monitoring programme until complete closure.

End of operation - Reshaping and revegetation of the TSF	Landscape visual Change	• Shape the final TSF landform as far as possible so that it emulates the natural topography. • Shape the final TSF landform with a gradient/slope that will prevent erosion and promote maximum vegetation growth. • Revegetate the TSF with indigenous vegetation that complements the surrounding natural vegetation, whilst encouraging maximum vegetation growth.
End of operation - Removal of the RWD's and SWD	Landscape visual Change	• Ensure that areas exposed by demolition of infrastructure are sufficiently rehabilitated and revegetated with suitable vegetation. • Reshape impacted areas such that they resemble the topography prior to construction. • Ensure good housekeeping.
Cumulative and Residual Impacts		
After closure rehabilitation	Landscape visual change	• Monitor rehabilitation for a year after rehabilitation activities are complete. • Ensure that alien & invasive plant species are eradicated.

11.11 Health

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Operational Phase		
Dispersion of dust from TSF	Impact to human health	• Disturbed area reduction – planned through deposition on one area at a time. • Disturbance frequency reduction – planned through continuous revegetation and rehabilitation. • Dust spillage prevention and/or removal. • Disturbed area wind exposure reduction, e.g. vegetation on side slopes, wind fences/nets at source areas.
Dispersion of particulate matter (PM) from TSF	Non-cancer (systemic) health effects in humans	• Disturbed area reduction – planned through deposition on one area at a time. • Disturbance frequency reduction – planned through continuous revegetation and rehabilitation. • Dust spillage prevention and/or removal. • Disturbed area wind exposure reduction, e.g. vegetation on side slopes, wind fences/nets at source areas.
Seepage of contaminated water into the drinking water system	Risk of systemic health effects and cancer in humans	• Seepage and runoff from the tailings must be contained as far as possible:

		◦ Class C Barrier containment system to limit seepage into the aquifer ◦ Appropriate under-drain systems ◦ Larger return water dam system serving both the Kareerand and Extension Project TSFs. ◦ Interception boreholes for active sulphate plume management • Regular groundwater and surface water quality monitoring must be established and maintained. • Any groundwater abstraction boreholes in use by members of the neighbouring communities should be closely monitored for deterioration of water quality. • Any observed increase in the concentrations of elements and ions, especially arsenic, uranium or lead, should be immediately investigated and the use of groundwater from the affected borehole must be suspended.
Decommissioning Phase		
Dispersion of dust from TSF	Impact to human health	• Implement source and ambient air quality monitoring.

Dispersion of PM from TSF	Non-cancer (systemic) health effects in humans	• Implement source and ambient air quality monitoring.
Seepage of contaminated water into the drinking water system	Risk of systemic health effects and cancer in humans	• Seepage and runoff from the tailings must be contained as far as possible. • Regular groundwater and surface water quality monitoring must be established and maintained. • Any groundwater abstraction boreholes in use by members of the neighbouring communities should be closely monitored for deterioration of water quality. • Any observed increase in the concentrations of elements and ions, especially arsenic, uranium or lead, should be immediately investigated and the use of groundwater from the affected borehole must be suspended.

11.12 Radiological

ACTIVITY	IMPACT	MITIGATION RECOMMENDATIONS
Operational Phase		
Exhalation and dispersion of radon gas from tailings material to the atmosphere	Inhalation of the radon gas contributes to the total effective dose, potentially impacting human health over the long-term	• Ensure that radiation exposure is below the regulatory compliance criteria.

		• Optimise the radiation protection by applying the ALARA principle (As Low As Reasonable Achievable, economic and social factors taken into consideration). • The most effective way to reduce the radon exhalation rate is to provide a covering layer.
Emission and dispersion of PM to the atmosphere as a result of wind erosion	The airborne dust (PM_{10}) and deposited dust contribute to the total effective dose through inhalation, ingestion and external radiation exposure routes.	• Ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint). • Optimise the radiation protection by applying the ALARA principle. • Develop and implement a dust management plan for the TSF. • Apply dust suppressant or binders on the exposed areas of the TSF. • Vegetate exposed areas of the TSF as soon as possible.
Controlled and uncontrolled releases of water containing radionuclides into the environment	Controlled or uncontrolled water releases may lead to an increase in concentration of radioactive elements in the soil and/or water	• Ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint). • Optimise radiation protection by applying the ALARA principle. • A surface water management plan should be developed to ensure that all runoff from dirty areas is directed to the existing stormwater management infrastructure and should not be allowed to flow into any of the nearby watercourses.

		• Discharge of water that can potentially contain radionuclides to the nearby watercourses should only be allowed if discharge authorisation has been granted. • The dirty water dams and dirty water channels should be lined either by concrete or High-Density Polyethylene (HDPE) to prevent contamination of groundwater through seepage. • Water quality monitoring should continue downstream and upstream of the mine site, and within all surface water circuits at the mine to detect any contamination arising from operational activities.
Decommissioning Phase		
Implementation of the decommissioning plan	The execution of the decommissioning plan involves a site-wide plan to demolish, decontaminate and remove all the surface infrastructure that may contain or that are contaminated with radionuclides. These areas will be rehabilitated and cleaned for clearance by the NNR (positive)	• Implement final rehabilitation and mitigation measures at the TSF. • A gamma radiation survey must be performed at the infrastructure sites, followed by rehabilitation and clean-up for conditional or unconditional clearance from the NNR. • Any area that becomes contaminated during or because of operational activities must be rehabilitated and clean-up for conditional or unconditional clearance. • Establish of vegetation to reduce dust emissions.

		• Install of a covering layer to reduce dust emissions and radon exhalation rates during the post-closure period.
Exhalation of radon gas and PM from the remaining TSFs to the atmosphere through wind erosion	Inhalation of the radon gas contributes to the total effective dose through inhalation, ingestion and external radiation exposure routes.	• Ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint). • Optimise the radiation protection by applying the ALARA principle. • Vegetate exposed area of the Kareerand TSF to reduce wind erosion. • Install a covering layer over the exposed area of the TSF to reduce wind erosion and radon exhalation.
Leaching and migration of radionuclides from the TSFs	Abstraction and use of the contaminated water contribute to the total effective dose through the ingestion and possible external radiation exposure routes.	• Ensure that radiation exposure is below the regulatory compliance criteria (i.e., the dose constraint). • Optimise the radiation protection by applying the ALARA principle. • Implement a passive groundwater remediation system downstream of the Kareerand TSF to capture the contaminant plume.

Please see the EMPr included as **Appendix F** for a full description of the mitigation measures.

12 ENVIRONMENTAL IMPACT STATEMENT

12.1 Key findings of impact assessment

The results of the impact assessment indicated that the most significant impacts on the receiving environment from the Kareerand TSF expansion would those listed below in **Table 12.1** to **Table 12.4**. The sensitivity of the receiving environment is depicted in **Figure 12-1**. As the project entails the expansion of a TSF footprint already present in the area, additional impacts will likely be moderate. The correct implementation of the mitigation measures outlined in the Environmental Management Plan will ensure that all impacts are managed, mitigated or avoided as far as practicably possible.

Table 12.1: Construction phase impacts.

ENVIRONMENTAL ASPECT	IMPACTS
Ecology	• Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3, isolation between terrestrial and aquatic habitats, loss of vegetation • Increased presence of people on site • Exposure to fauna of dangerous areas, excavations and hazardous substances • Dust, noise, human activity and emissions • Introduction of AIS / exacerbation of existing AIS (fauna and flora) • Contamination of faunal habitat, loss of the plant soil seed bank
Wetlands	• Changes in water flow regime, increased high energy surface water runoff, decreased vegetation germination potential, sediment pollution • Changes in sediment deposition and high energy flows causing erosion • Introduction and spread of alien plants
Soil	• Destruction of current land capability • Loss of agricultural production and agricultural-related employment within the fenced-off area • Loss of soil ecosystem services and soil fertility • Soil contamination with hydrocarbons and solid waste
Air Quality	• Potential impact on human health from increased pollutant concentrations • Increased nuisance dustfall rates

Noise	• Disturbance to residential receptors due to construction noise
Heritage	• Disturbance/damage to the sites AGA-MWS-WBP-2, AGA-MWS-MGD-5 and AGA-MWS-MGD-6 • Disturbance/damage to the site AGA-MWS-WGD-7 • Disturbance/damage to palaeontological artefacts
Surface Water	• Increased surface water runoff, resulting in sedimentation due to soil erosion • Increased surface water runoff, resulting in reduced surface water quality • Lack of hydrocarbon management, resulting in reduced surface water quality • Lack of hydrocarbon management, resulting in soil contamination • Soil compaction, resulting in increased runoff leading to potential erosion • Lack of clean and dirty water separation, resulting in reduced surface water quality (mixing of clean and dirty water areas) • Increase surface water runoff, resulting in sedimentation due to soil erosion • Uncontrolled release would reduce surface water quality • Incorrect stockpiling and poor rehabilitation may result in loss of topsoil and sedimentation due to erosion • Incorrect stockpiling and poor rehabilitation may result in reduced surface water quality • Impact of waste generation (general waste) on surface water quality • Increase surface water runoff (roofs, paved areas) may result in sedimentation due to soil erosion and reduced surface water quality • Inadequate handling, storage & disposal of hydrocarbons may impact surface water quality • Inadequate handling, storage & disposal of chemicals may impact surface water quality
Groundwater	• Decreased groundwater quality and quantity • Groundwater quality deterioration
Socio-Economic	• Employment opportunities through temporary job creation (positive)

	• Nuisance factors of traffic, dust, noise
Visual	• Negative Impacts on aesthetics • Change of Visual Character • Dust creation • Landscape visual change

Table 12.2: Operational phase impacts.

ENVIRONMENTAL ASPECT	IMPACTS
Ecology	• Destruction and fragmentation of flora and fauna habitats in CBMAs 1 and 3 • Isolation between terrestrial and aquatic habitats • Increased presence of people on site • Exposure to fauna of dangerous areas, excavations and hazardous substances • Dust, noise, human activity and emissions • Introduction of AIS / exacerbation of existing AIS (fauna and flora) • Contamination of fauna habitat. • Loss of the plant soil seed bank
Wetlands	• Permanent changes to the catchment of waterbodies in terms of water infiltration and surface water flow rates • Changes in sediment and stormwater entering the system • Changes in water quality due to foreign materials and increased nutrients
Soil	• Soil pollution/ contamination with hydrocarbons and solid waste • Soil compaction of topsoil bund wall and access roads
Air Quality	• Potential impact on human health from increased pollutant concentrations • Increased nuisance dustfall rates
Heritage	• Damage to archaeological/ palaeontological sites within the vicinity of operations

Surface Water	• Insufficient hydrocarbon management may impact surface water quality • Insufficient hydrocarbon management resulting in soil contamination • Soil compaction resulting in increased runoff leading to potential erosion • TSF overtopping would reduce surface water quality • TSF failure would reduce surface water quality • Pipeline failures would result in reduced surface water quality • Lack of operational storage capacity / freeboard may result in spillage, which would reduce surface water quality • Inadequate clean / dirty water separation may result in reduced surface water quality • Insufficient storage capacity design may result in reduced surface water quality • Insufficient infrastructure design (spillage) may result in reduced surface water quality • Insufficient process water availability resulting in sourcing alternative water sources, such as raw water abstraction from the catchment area • Lack of concurrent rehabilitation may result in increased surface runoff from side slopes • Lack of care and maintenance may result in siltation of trenches / dams • Incorrect rehabilitation may reduce surface water quality • Loss of infrastructure availability due to (power failure, sabotage, inclement weather) may result in reduced surface water quality • Inadequate handling, storage & disposal of waste may impact surface water quality • Inadequate handling, storage & disposal of hydrocarbons may impact surface water quality • Inadequate handling, storage & disposal of chemicals may impact surface water quality • Insufficient storage capacity (1:50; 1:100 rain event) may impact surface water quality

Groundwater	• Dewatering of the surrounding aquifers • Impact on groundwater quality (contamination) from current TSF and expansion and potential for poor contaminant seepage into the Vaal River
Socio-Economic	• Employment opportunities and additional job creation (positive) • Jobs to low-income households, thus reducing poverty (positive) • Sustained income for social development by company (positive) • Reduced economic diversity due to over-reliance on mining sector • Intensive use of water and energy. • Economic costs for community resulting from environmental degradation • Nuisance factors in the form of traffic, dust, noise • Risk of failure, illegal miners, health risks, environmental risks impacting on community safety
Visual	• Change of Visual Character • Dust creation • Landscape visual change • Light Pollution (Glare, spill light, sky glow)
Human Health	• Impact of dispersed dust from TSF to human health • Non-cancer (systemic) health effects in humans caused by dispersion of particulate matter from TSF • Risk of systemic health effects and cancer in humans due to seepage of contaminated water into drinking water supply
Radiaton	• Inhalation of the radon gas contributes to the total effective dose, potentially impacting human health over the long-term • The airborne dust (PM_{10}) and deposited dust contribute to the total effective dose through inhalation, ingestion and external radiation exposure routes • Controlled or uncontrolled water releases may lead to an increase in concentration of radioactive elements in the soil and/or water

Table 12.3: Decommissioning phase impacts

ENVIRONMENTAL ASPECT	IMPACTS
Ecology	• Increased presence of people on site • Dust, noise, human activity and emissions • Introduction of AIS / exacerbation of existing AIS (fauna and flora) • Poor plant selection and habitat creation
Air Quality	• Potential impact on human health from pollutant concentrations • Nuisance dustfall rates • Potential impact on human health from pollutant concentrations associated with closure activities • Nuisance dustfall rates associated with closure activities
Noise	• Nuisance noise impacts on nearby communities
Heritage	• Damage to archaeological/ palaeontological sites within the vicinity of decommissioning activities (with emphasis on the site impacted by the TSF fence)
Surface Water	• Insufficient hydrocarbon management may impact surface water quality • Increase in soil compaction may result in increased surface runoff • Lack of care and maintenance & monitoring may result in increased surface runoff from side slopes • Lack of care and maintenance & monitoring may result in siltation of trenches / dams • Lack of care and maintenance & monitoring may impact surface water quality • Inadequate clean / dirty water separation may impact surface water quality • Insufficient storage capacity (1:50; 1:100 rain event) may impact surface water quality • Reduction of catchment yield (run-off) monitoring may result in a decrease in catchment water quantity

	• Lack of maintenance monitoring may result in increased surface runoff from side slopes • Lack of maintenance monitoring may result in siltation of trenches / dams • Lack of maintenance monitoring may impact surface water quality
Groundwater	• Impact on groundwater quality from TSF and potential seepage of poor quality base-flow into the Vaal River
Socio-Economic	• Employment loss through permanent job losses • Loss of social funds through termination of social projects • Permanent loss of land • Loss of visual sense of place • Dust and noise nuisance factors • Risk of failure, illegal miners, health risks, environmental risks and their impacts on community safety
Visual	• Change of Visual Character • Dust creation • Landscape visual Change
Human Health	• Impact of dispersed dust from TSF to human health • Non-cancer (systemic) health effects in humans caused by dispersion of particulate matter from TSF • Risk of systemic health effects and cancer in humans due to seepage of contaminated water into drinking water supply
Radiation	• The execution of the decommissioning plan involves a site-wide plan to demolish, decontaminate and remove all the surface infrastructure that may contain or that are contaminated with radionuclides. These areas will be rehabilitated and cleaned for clearance by the NNR (positive) • Inhalation of the radon gas contributes to the total effective dose through inhalation, ingestion and external radiation exposure routes • Abstraction and use of the contaminated water contribute to the total effective dose through the ingestion and possible external radiation exposure routes

Table 12.4: Cumulative and residual impacts of the project.

ENVIRONMENTAL ASPECT	**IMPACTS**
Ecology	Residual impacts: • Fragmentation of habitat and loss of ecological corridors • Any destruction of threatened or protected species (TOPS) • Introduction of AIS / exacerbation of existing AIS • Contamination and complete degradation of faunal habitat without remedy Cumulative impacts: • Contamination and complete degradation of fauna habitat without remedy
Soil	Residual impacts: • Destruction of current land capability of the areas where infrastructure will be constructed • The progressive loss of areas grazing and arable land capability that can be used for livestock grazing, game farming as well as other agricultural enterprises • Loss of agricultural production and agricultural-related employment within the fenced-off area • A reduction of the volume of food produced within the district municipality • Loss of soil ecosystem services and soil fertility in areas where topsoil is stripped • The progressive loss of soil ecosystem services results in the progressive degradation of soil quality and the services provided such as water and nutrient cycling • Soil pollution from pumping of waste slurry through pipelines to the Kareerand TSF complex for disposal. • Gradual or sudden enrichment of soil with soil contaminants will result in bioaccumulation of the contaminants in vegetation and increased contamination levels of groundwater, surface water and air. This has negative human and environmental health impacts

	• Soil pollution from storage of processed mine tailings waste in the proposed expanded TSF • Gradual or sudden enrichment of soil with soil contaminants will result in bioaccumulation of the contaminants in vegetation and increased contamination levels of groundwater, surface water and air. This has negative human and environmental health impacts. Cumulative impacts: • Destruction of current land capability of the areas where infrastructure will be constructed • A cumulative impact on the area as a whole may be generation by other mining activities in the area not related to the Kareerand TSF Expansion • Expansion of settlement areas into areas with arable and grazing land capability when work opportunities created by the Kareerand TSF result in a population influx of migrant workers in search of employment opportunities • Loss of agricultural production and agricultural-related employment within the fenced-off area • Other mining activities in the area not related to the Kareerand TSF Expansion • Loss of soil ecosystem services and soil fertility in areas where topsoil is stripped. • Other mining activities in the area not related to the Kareerand TSF Expansion that impact on soil ecosystem services and soil fertility • Soil pollution from pumping of waste slurry through pipelines to the Kareerand TSF complex for disposal • Any existing soil contamination as a result of previous spills and leaks from the existing pipeline network • Sabotage of the pipelines by artisanal miners in search of gold-containing material that they can process • Soil pollution from storage of processed mine tailings waste in the proposed expanded TSF • Any existing soil contamination present as a result of the site being part of a larger gold mining area

	• Extreme weather events such as major floods and wind storms that increase the distance and severity of contaminant transport from the TSF
Visual	• Landscape visual change

12.2 Opinion regarding authorization of activity/ies

It is the opinion of the EAP that the expansion of the Kareerand Tailings Storage Facility may cause adverse environmental impacts. However, provided that the proposed mitigation measures are implemented effectively and in line with the EMP, these will be outweighed by the long-term positive impacts of expanding the facility. Based on the findings of the Impact Assessment, the EAP sees no reason why Environmental Authorisation should not be granted for the proposed project to proceed.

12.3 Proposed conditions of authorization

Following the findings of the Environmental Impact Assessment, it is suggested that the Competent Authority include the following conditions in the Environmental Authorization, should they decide to grant such:

- All feasible mitigation measures included in the Environmental Management Programme and specialist studies are implemented during the project lifecycle.
- Rehabilitation of the reprocessed TSFs is carried out according to Rehabilitation Plans that have been approved by the Competent Authority.
- Monitoring findings of potential impacts, as discussed within this EIAR and EMP, are reported on a regular and frequent basis to DMR for consideration.

12.4 Recommendations emanating from PPP

- A Health Impact Study was included after the Scoping Phase Public Participation.

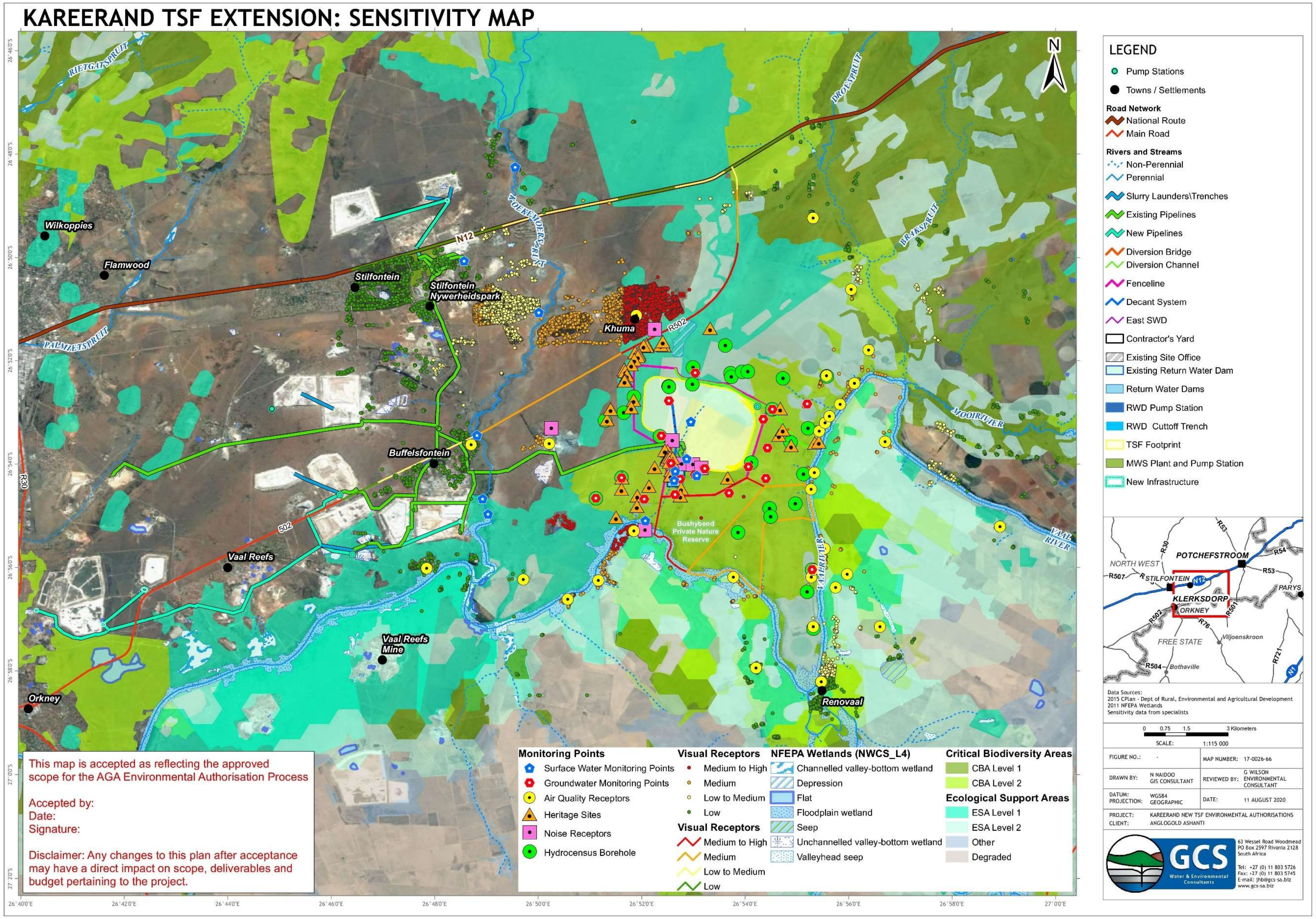

Figure 12-1: Environmental sensitivity of the receiving environment.

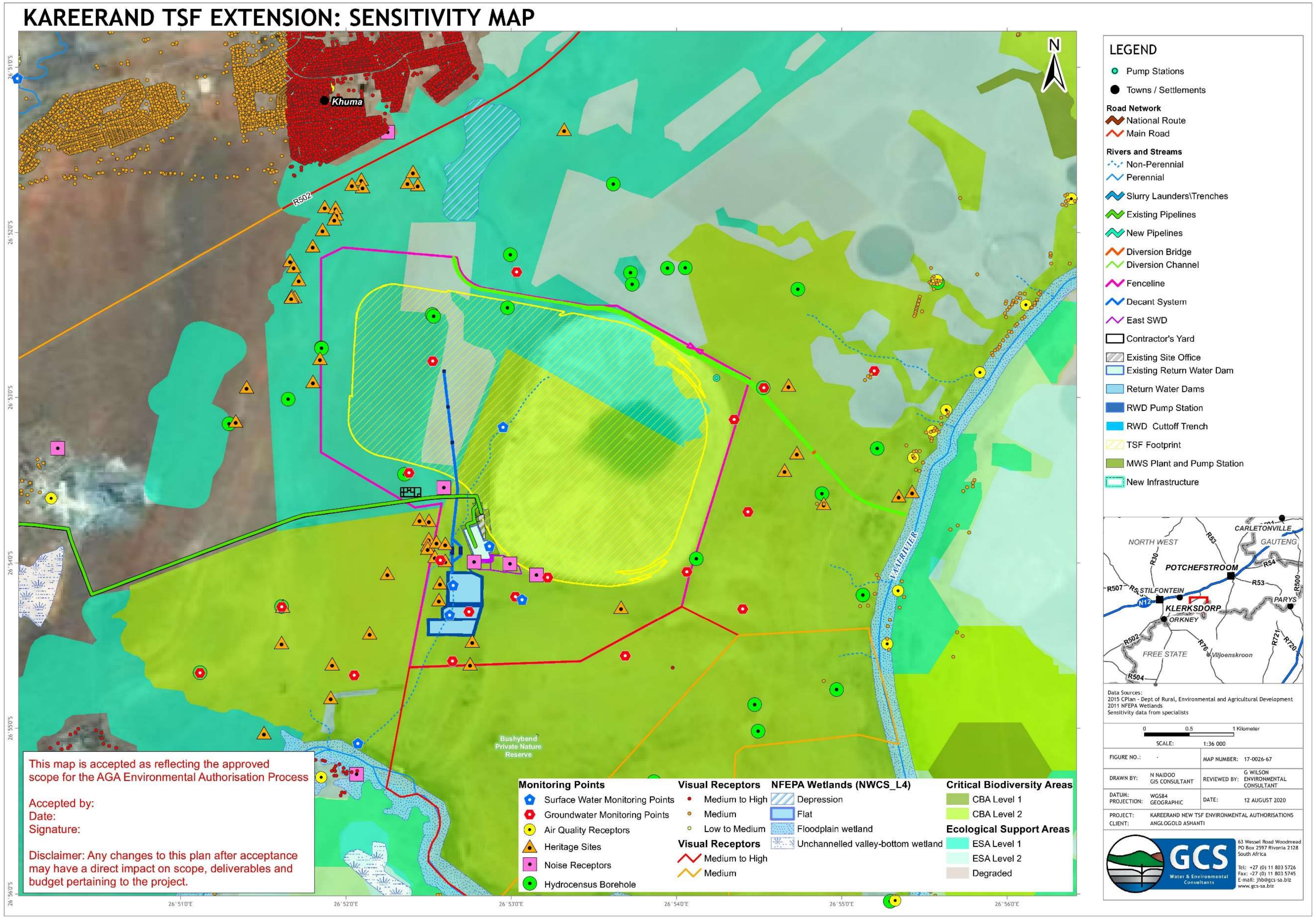

Figure 12-2: Environmental sensitivity of the receiving environment directly adjacent to the TSF expansion.

13 CONCLUSION AND RECOMMENDATIONS

Although the expansion of the Kareerand TSF will result in some impacts to the receiving environment, many of these will be negligible in comparison to the current impacts experienced as a result of the current TSF footprint. The expansion of the TSF will result in improved management of the footprint as a whole, as well as a reduction in the cumulative footprint of TSFs in the area in the long term (as a result of cleaning up and rehabilitation of the old TSF footprints). Furthermore, the extended life of operations which will result from the expansion project will have socio-economic benefits for the region.

It must however be noted that MWS will require interim deposition capacity during the construction and commissioning phases of the Kareerand TSF expansion. The TSF Complex north of the N12, MWS 4 and MWS 5, has been earmarked for this purpose and the duration of the interim deposition phase would be approximately 5 years (2022 to 2027), after which these TSFs will be reclaimed, leaving the Kareerand facility as the only TSF. MWS will apply separately for the relevant authorisation(s) for the proposed interim deposition activities before commencing with the interim deposition activities. A separate environmental impact assessment process will be undertaken for the proposed interim deposition activities and all the associated environmental impacts of the proposed interim deposition will be investigated and assessed as part of the new application process.

Should the mitigation measures recommended in the EMP and the various specialist studies be implemented on site, the impacts of the TSF expansion will be avoided, managed and mitigated sufficiently.

It is the opinion of the EAP that although the expansion of the Kareerand TSF may cause adverse environmental impacts, provided that the proposed mitigation measures are implemented effectively and in line with the EMP, these will be outweighed by the long-term positive impacts of expanding the facility. Based on the findings of the Impact Assessment, the EAP sees no reason why Environmental Authorisation should not be granted for the proposed project to proceed.

14 UNDERTAKING BY EAP

14.1 UNDERTAKING REGARDING CORRECTNESS OF INFORMATION

We, Sharon Meyer and Gerda Bothma, herewith undertake that the information provided in the foregoing report is correct, and that the comments and inputs from stakeholders and Interested and Affected Parties received since project announcement, have been correctly recorded in the report.

Signature of the EAP

Sharon Meyer Gerda Bothma

Date: August 2020 January 2021

14.2 UNDERTAKING REGARDING LEVEL OF AGREEMENT

We, Sharon Meyer and Gerda Bothma, herewith undertake that the information provided in the foregoing report is correct, and that the level of agreement with Interested and Affected Parties and stakeholders since announcement of the project, has been correctly recorded and reported herein.

Signature of the EAP

Sharon Meyer Gerda Bothma

Date: August 2020 January 2021