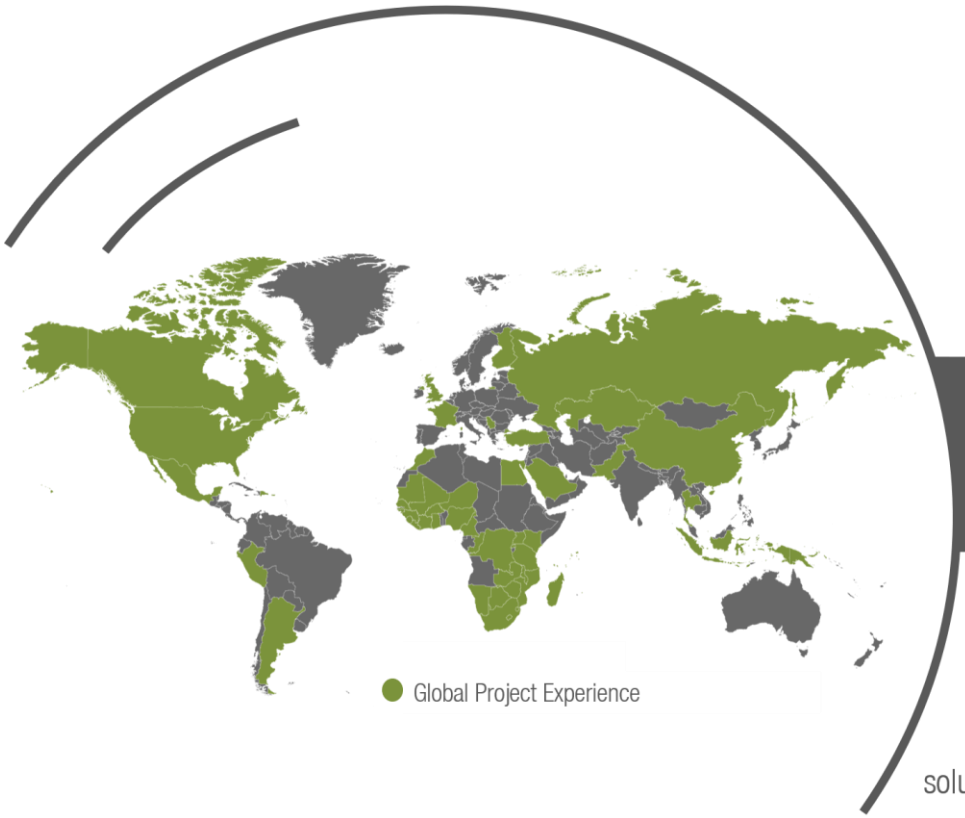

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Pan African Resources PLC (PAR) Environmental Application Process

Air Quality Specialist Study

Prepared for:
Pan African Resources PLC (PAR)

Project Number:
PAR7273

July 2022

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This document has been prepared by Digby Wells Environmental.

Report Type:	Air Quality Specialist Study
Project Name:	Pan African Resources PLC (PAR) Environmental Application Process
Project Code:	PAR7273

Name	Responsibility	Signature	Date
Matthew Ojelede (Pr.Sci.Nat.)	Report Compiler		July 2022
Stephen Burton (Pr.Sci.Nat.)	Opsco Reviewer		July 2022
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DETAILS AND DECLARATION OF THE SPECIALIST

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Brief Background of Specialist

Matthew has broad knowledge in the "*Atmospheric Sciences*" field, with more than 15 years of experience in academia and industry combined. He has garnered practical field experiences in setting up, monitoring, and decommissioning ambient air quality units and stations, encompassing real-time particulate monitor – AQ-Mesh®, Grimm Aerosol monitor®, Met-One E-Sampler®, radiello® passive/diffusive samplers for environmental monitoring, indoor and outdoor air monitoring, industrial air quality (IAQ), personal sampling and breathing zone assessment.

He is currently registered as a Professional Natural Scientist with the South African Council for Natural Scientific Professions (Reg. No. 116980/18) and is a member of the National Association for Clean Air. He has authored and co-authored research articles and conference papers in peer-reviewed journals both locally and internationally.

Full name:	Matthew Ojelede
Title/Position:	Air Quality Specialist
Qualification(s):	BSc (Hon); MSc; PhD
Experience (years):	16 Years
Registration(s):	National Association for Clean Air (NACA) International Association for Impact Assessment South Africa (IAIAsa) South African Council for Natural Scientific Professions (SACNASP)

I, Matthew Ojelede, declare that: –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
    - I declare that there are no circumstances that may compromise my objectivity in performing such work;
    - I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

July 2022

Signature of the Specialist *Date*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

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Any recommendations, statements or conclusions drawn from or based on this report must

clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

EXECUTIVE SUMMARY

Digby Wells Environmental (hereafter Digby Wells) has been appointed to undertake an Environmental Application Process and associated specialist studies for the Mogale Cluster - Mining Right (GP) 30/5/1/2/2 (206) Mining Right (MR) and, more specifically for the proposed construction of a large-scale gold tailings retreatment operation. Pan African Resources PLC (PAR) has entered into a Sale and Purchase Agreement for the acquisition of the shares in and claims against Mogale Gold (Pty) Ltd (Mogale Gold). The agreement was entered into between PAR and the liquidators of Mintails Mining SA (Pty) Ltd (in liquidation) (MMSA). MMSA is the holding company of Mogale Gold. The intended transaction is subject to a due diligence investigation which is in the process of being concluded.

The project consists of 120 million tonnes (Mt) of tailings to be reprocessed and firstly deposited into the West Wits Pit (current authorisation in place for in-pit deposition) and then undertake deposition of the footprint of 1L23-1L25 footprint (New Tailings Facility) once capacity has been reached within the West Wits Pit. There are six dumps being considered to be reprocessed, the largest of which amounts to 57.9 Mt, while the smallest contains 0.57 Mt. The primary location of processed tailings storage has been earmarked for deposition in the West Wits Pit. There are three smaller dumps that could also be included and reprocessed as part of the project namely 1L4, 1L5 and 1L6.

This Air Quality Impact Assessment (AQIA) forms part of a suite of specialist studies required for the Environmental Regulatory Process.

The baseline component shows that the meteorology of the project area was assessed with three years' worth of modelled Lakes Environmental data. The monthly temperature average varied between 10°C - 20°C. Ambient temperatures were observed to be higher during the summer months. The total monthly rainfall records show the summer months received most of the rains (>59%), followed by Spring with 24% and Autumn with 11%. While winter received the least rainfall (less than 1%). The annual total rainfall is 221 mm, while the relative humidity records ranged between 57% and 68%.

The wind rose shows the prevailing winds are from the north northeast (15.8%), north (12.9%) and northeast (12.9%) respectively. Secondary contributions are from the north northwest (8.4%). The average wind speed was at 3.6 m/s and calm conditions occurred for some 1.0% of the time. High wind speed ≥5.4 m/s occurred for about 12.7% of the time. This equates to about 46 days in a year.

The baseline data measured in the region (not site-specific) at Leratong Hospital Krugersdorp Ambient Air Quality Monitoring Station, about 4.2 km south of the project site showed that the maximum daily concentrations of PM_{10} recorded for the period - January 2020 to September 2021 was 0.03 µg/m^3 (below the standards of 75 µg/m^3). Not a single exceedance was recorded. For the gaseous pollutants, such as SO_2, data was not available. Whereas for NO_2, CO, and O_3 the ambient levels were all below the South African ambient air quality standards.

The findings presented here represent both the worst-case scenario (i.e. without mitigation measures factored into the model runs) and with mitigation (i.e. with mitigation measures factored into the model runs). These findings are summarised as follows:

- The predicted GLC of $PM_{2.5}$ over a 24-hour averaging period for the operational phase returned simulation isopleths that are lower than the 24-hour standard (40 µg/m³). The predicted GLC returned areas with exceedances of the 24-hour standard (40 µg/m³) concentrated along the haul roads and at the centre of the operation. The predicted GLC at the sensitive receptors SR 1 (Netcare K), SR2 (WestR_Sch) and SR3 (Yusuf_Sch) were all lower than the 24-daily standard. The annual GLC of $PM_{2.5}$ predicted will not exceed the standard onsite and at the selected receptors. With mitigation measures factored into the day to day operation, the predicted GLC is further minimised.
- The predicted GLC of PM_{10} over a 24-hour averaging period returned simulation isopleths that show that exceedances will occur. These areas where the 24-hour standard of 75 µg/m³ are mostly concentrated at the centre of the reclamation operation. The predicted daily GLC at the selected sensitive receptors exceeded the South African limit at SR2 (95 µg/m³) and SR3 (102 µg/m³). The predicted annual GLC of PM_{10} will not exceed the standard onsite and at the selected receptors without mitigation. The predicted annual GLC of PM_{10} will not exceed the standard onsite and at the selected receptors without mitigation. With mitigation measures factored into the day to day operation, the predicted GLC is further minimised.
- The predicted dustfall rates (without mitigation and with mitigation) show that the reclamation operation will result in areas with exceedance of the non-residential limit of 1,200 mg/m²/d. The dustfall rates confirmed that the non-residential will be exceeded onsite and at certain locations along the dirt road leading to the plant. With exceedances confined within the project area, the dustfall rates at the selected receptors will be compliant with the residential limit. Once mitigation is in place, the areas with exceedance will shrink onsite, leading to a further reduction in deposited dust.

The impacts of the operational phase of the Project were evaluated using a risk matrix that considers the nature, significance, extent, duration, and probability of such impacts occurring. Based on this rating system, impacts on the surrounding receptors from the operational phase are deemed “major negative” without mitigation. However, after mitigation, the impacts were reduced to “negligible negative”. Since anticipated emissions from the operational phase activities are likely to have major impacts on some of the receptors outside the Project boundary, with adequate mitigation and management intervention measures in place, such impacts can be minimised significantly.

Some of the mitigation measures and management intervention measures recommended are repeated and they include:

- Application of dust suppressants/binders on haul roads and exposed areas, setting maximum speed limits on haul roads and to have these limits enforced, and application of mitigation technology at the processing plant; and

- Operation of ambient air quality monitoring network to collect valuable data needed to assess the effectiveness of management mitigation measures.

Once the mine implements the recommendations outlined in this report, emissions from mining operations can be contained to lower than the regulatory limits, thus, ensuring compliance with South African ambient air quality standards.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

AEL	Air Emission Licence
AQIA	Air Quality Impact Assessment
DEA	Department of Environmental Affairs
DFFE	Department of Forest, Fisheries and the Environment
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme Report
MCLM	Mogale City Local Municipality
MRA	Mining Rights Area
Mt	million tonnes
NEM: AQA	National Environment Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NO_2	Nitrogen dioxide
O_3	Ozone
PAR	Pan African Resources
PM_{10}	particulate matter with an aerodynamic diameter less than 10 microns
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than 2.5 microns
SO_2	Sulfur dioxide
TSFs	Tailings Storage Facilities
TSP	Total Suspended Particulate
WBG	World Bank Group
WHO	World Health Organization
WRDM	West Rand District Municipality

CONTENT OF THIS REPORT IN ACCORDANCE WITH THE REGULATION GNR982 OF 2014, APPENDIX 6 (AS AMENDED)

Legal Requirement		Section in Report
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	iii iv
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	iv
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 3
cA	And indication of the quality and age of the base data used for the specialist report;	Section 6
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	Section 6
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	N/A
(g)	an identification of any areas to be avoided, including buffers;	N/A
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4

Legal Requirement		Section in Report
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
(k)	any mitigation measures for inclusion in the EMPr;	Section 10
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Section 14
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11
(n)	a reasoned opinion (Environmental Impact Statement) -	Section 14
	whether the proposed activity, activities or portions thereof should be authorised; and	Section 14
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	N/A
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 12
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 12
(q)	any other information requested by the competent authority.	N/A

1. Introduction

Digby Wells Environmental (hereafter Digby Wells) has been appointed to undertake an Environmental Application Process and associated specialist studies for the Mogale Cluster - Mining Right (GP) 30/5/1/2/2 (206) Mining Right (MR) and, more specifically for the proposed construction of a large-scale gold tailings retreatment operation. Pan African Resources PLC (PAR) has entered into a Sale and Purchase Agreement for the acquisition of the shares in and claims against Mogale Gold (Pty) Ltd (Mogale Gold). The agreement was entered into between PAR and the liquidators of Mintails Mining SA (Pty) Ltd (in liquidation) (MMSA). MMSA is the holding company of Mogale Gold. The intended transaction is subject to a due diligence investigation which is in the process of being concluded.

Mogale Gold owns the right to extract and process gold from tailings recourses by reprocessing old gold mine slimes dams and sandy mine dumps left by the extensive historic mining activities that have taken place in the area since 1888. PAR is only interested in the surface operations associated with Mining Right (MR) 206 (i.e., Tailings Storage Facilities (TSFs) for reclamation, processing and deposition), and therefore the focus of this application process.

The project consists of 120 million tonnes (Mt) of tailings to be reprocessed and firstly deposited into the West Wits Pit (current authorisation in place for in-pit deposition) and then undertake deposition of the footprint of 1L23-1L25 footprint (New Tailings Facility) once capacity has been reached within the West Wits Pit.

Alternatives are being considered for potential deposition of tailings material into the other pits, such as Monarch and Emerald Pits.

It must be noted that once the West Wits Pits reaches capacity the surface deposition will extend in a northern direction from the pit onto the surface, expanding the deposition footprint associated with West Wits Pit.

There are six dumps being considered to be reprocessed, the largest of which amounts to 57.9 Mt, while the smallest contains 0.57 Mt. The primary location of processed tailings storage has been earmarked for deposition in the West Wits Pit. There are three smaller dumps that could also be included and reprocessed as part of the project namely 1L4, 1L5 and 1L6.

The Environmental Impact Assessment (EIA) process includes a suite of specialist studies including an Air Quality Impact Assessment (AQIA) in support of the EIA process.

2. Project Description

PAR plan to undertake activities relating to reclamation associated with gold-bearing TSFs through hydraulic reclamation. Digby Wells was appointed as the Independent Environmental Consultant to undertake the EIA Application process which comprises an Air Emission Licence (AEL) and Water Use Licence (WUL) for the proposed gold-bearing TSFs.

The site is located in the West Rand, in Gauteng Province. The site comprises existing infrastructure such as sand dumps, Lancaster Dam and an open pit that will be used for the deposition of tailings materials. A process plant, overland pumping and piping inclusive of associated water management infrastructure will form part of the proposed infrastructure that will require authorisation. Once the open pit is filled, a new TSF will potentially be constructed on the footprint area of one of the reclaimed TSF sites (1L23-1L25) (Figure 2-1). The footprint of the area is 2,923.3 ha which considers MR 206 and associated infrastructure.

Ancillary infrastructure such as pipelines, powerlines and pumps will be required for the proposed reclamation activities and will be included in support of the Environmental Application Process, which will be undertaken.

2.1 Project Locality

The Mining Right Area (MRA) of the Mintails Mogale Cluster includes GI, G2 plant; Cams North Sand; South Sand; 1L23; 1L28; 1L13; 1L8; 1Ll0; West Wits Pit (WWP) and Lancaster Dam. An existing Water Use License (WUL) No. 27/2/2/C423/1/1 was issued on 22 November 2013 to Mintails Mining SA (Pty) Ltd: Mogale Gold. The mining right is located on Portions 66 and 99 of the farm Waterval 174 IQ and portions 136 and 209 of the farm Luipaardsvlei 246 IQ.

The project is within the Mogale City Local Municipality (MCLM), which is located within the West Rand District Municipality (WRDM). MCLM is the regional services authority and the area falls under the jurisdiction of the Krugersdorp Magisterial District (Table 2-1).

The site is located in the catchment of the Upper Wonderfonteinspruit, quaternary catchment C23D, which forms part of the Vaal River Water Management Area (WMA) within the Vaal Catchment Management Agency (CMA). The project is about 4 km south of Krugersdorp and northeast of Randfontein, approximately 10 km off the N14 National Road in the Gauteng Province, in an area that has been transformed by past gold mining activities.

The project locality of the site is illustrated in Figure 2-1.

Table 2-1: Summary of the PAR Project Location Details

Province	Gauteng
District Municipality	West Rand District Municipality
Local Municipality	Mogale Local Municipality
Nearest Town	Krugersdorp (4 km), Randfontein (4 km)
GPS Co-ordinates (the relative centre point of the study area)	26°07'45.54"S
	27°45'40.85"E

In the area, highly populated residential communities in all compass directions, coupled with vestiges of past mining activities and current industrial activities represent the dominant land-

use types (Google Earth® Pro V.7.3 (September 6, 2021)). These residential settlements are considered sensitive receptors.

According to the USEPA (2016), a sensitive receptor encompasses but is not limited to "*hospitals, schools, daycare facilities, elderly housing, and convalescent facilities. The aforementioned are locations where the occupants are more susceptible to airborne pollutants" if exposed*

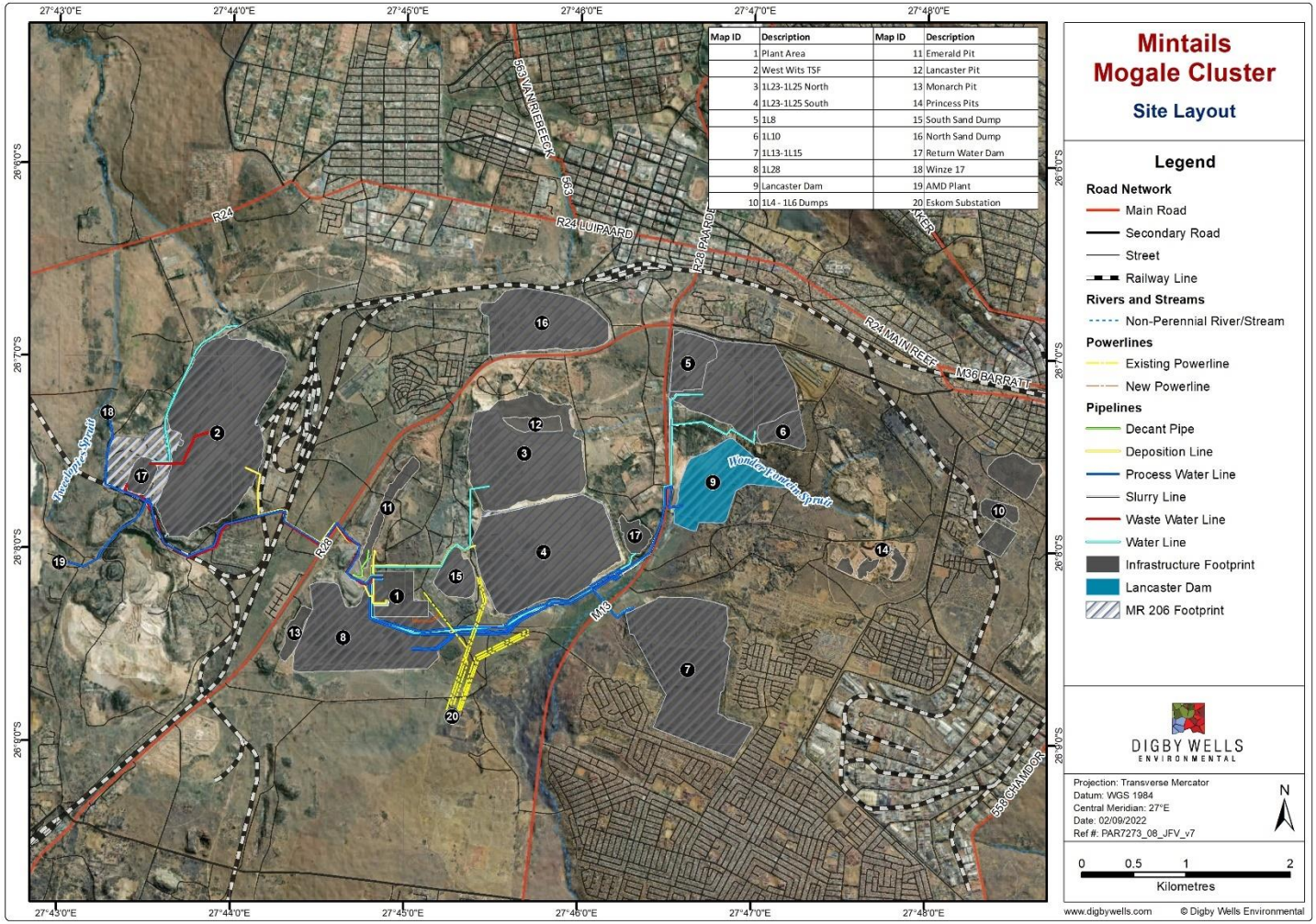


Figure 2-1:Project Locality

2.2 Proposed Infrastructure and Activities

The Project list of activities for the construction, operation, and decommissioning phases are depicted in Table 2-2 below.

Table 2-2: Project Phases and Associated Activities

Project Phase	Associated Activities
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.
	Employment and procurement for construction-related activities.
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps
	Operation of pump stations during the operational phase.
	Maintenance of pipeline routes during operational activities.
	Infilling of processed tailings material into the West Pits Pit and other potential pits.
	Surface tailings deposition within the West Wits Pit.
	Tailings deposition onto the historic footprint of 1L23-1L25.
	Production of Gold.
	Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.
	Employment and procurement for operational-related activities.
Decommissioning Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints.
	Removal, decommissioning and rehabilitation of the processing plant footprint.
	Rehabilitation of the old TSF footprints.
	Rehabilitation of the old Mintails Processing Plant footprint.
	Final rehabilitation of this facility.
	General rehabilitation of the surrounding area, including wetland rehabilitation.

3. Scope of Work

This AQIA aimed to complete an air dispersion modelling assessment to predict the future implications of the reclamation mining on the ambient air quality and exposure scenarios at nearby sensitive receptors. Based on the above-mentioned, the air quality Scope of Work (SoW) encompasses the following:

- Establishment of the site meteorology and existing background air quality;
- Assessment of the future air quality impacts of the proposed Project on ambient air quality of the area and comparison of predicted results against the standards; and
- Recommendation of management measures, including mitigation and monitoring requirements

4. Assumptions, Limitations and Exclusions

Assumptions, limitations, and exclusions pertaining to this Project are discussed in Table 4-1.

Table 4-1:Assumptions, Limitations and Exclusions

Assumption, Limitation, or Exclusion	Consequence
Available air quality data used in the background assessment was from the Ambient Air Quality Station located at Leratong Hospital Krugersdorp which is 4 km south of the project site.	May differ slightly from the site ambient air quality scenario
The uncertainty associated with dispersion models	Since mining activities were selected to demonstrate the worst-case scenario, the predicted model may have resulted in an overestimation

5. Relevant Legislation, Standards and Guidelines Applicable to Air Quality

The legislation, regulation, and guidelines considered in this air quality report are tabulated and discussed briefly in Table 5-1. The applicable standards in terms of compliance are discussed in Section 5.1 below.

Table 5-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) The prevailing legislation in the Republic of South Africa with regard to the Air Quality field is the National Environment Management: Air Quality Act, 2004 (Act No.	NEM: AQA puts in place various measures for the prevention of pollution and national norms and standards for the regulation of air quality in South Africa.

Legislation, Regulation, Guideline or By-Law	Applicability
39 of 2004) (NEM: AQA). According to the Act, the Department of Forest, Fisheries and the Environment (DFFE)[1], the provincial environmental departments and local authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement of various aspects of NEM: AQA. A fundamental aspect of the new approach to air quality regulation, as reflected in the NEM: AQA is the establishment of National Ambient Air Quality Standards (NAAQS) – "GN 1210 of 24 December 2009" and "GN 489 of 29 June 2012". These standards provide the goals for air quality management plans and also provide the benchmark by which the effectiveness of these management plans is measured. The NEM: AQA provides for the identification of priority pollutants and the setting of ambient standards with respect to these pollutants.	
National Dust Control Regulation 2013 The Minister of Water and Environmental Affairs, released on 01 November 2013 the National Dust Control Regulation, in terms of Section 53, read with Section 32 of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)(NEM: AQA) - "GN 827 of 1 November 2013". In the published National Dust Control Regulations, terms like target, action and alert thresholds were omitted. Another notable observation was the reduction of the permissible frequency of exceedance from three to two incidences within a year. The standard adopted a more stringent approach than previously and would require dedicated mitigation plans now that it is in force.	The purpose of these Regulations is to prescribe general measures for the control of dust in all areas.
Climate Change Bill, 2018 GN R 580 *To build the Republic's effective climate change response and the long term, just transition to a climate-resilient and lower carbon economy and society in the context of an environmentally sustainable development framework; and to provide for matters connected therewith.*	

5.1. Applicable South African Standard

According to the World Health Organization (WHO, 2000), guidelines provide a basis for protecting public health from adverse effects of air pollution and for eliminating or reducing to

[1] Previously the Department of Environmental Affairs (DEA)

minimum ambient levels of pollutants that are known or likely to be hazardous to human health and wellbeing. Once the guidelines are adopted as standards, they become legally enforceable. These standards prescribe the allowable ambient concentrations of pollutants which are not to be exceeded during a specified period in a defined area. If the air quality guidelines/standards are exceeded, the ambient air quality is poor and the potential for health effects is greatest.

The South African National Environmental Management Act (NEMA) "GN 617 of 27 May 2009" as amended provides a legislative framework for environmental management in South Africa. The principles in NEMA are relevant to air pollution, Section 24(4) b(i) … "*the investigation and* assessment of the potential impacts of activities that require authorisation or permission.", and Section 24(7) *(a) Investigation of the environment likely to be significantly affected by the proposed activity …; (b) investigation of the potential impact including cumulative effects,…; (c) investigation of mitigation measures to keep adverse impacts to a minimum*.

NEM: AQA is the prevailing legislation in the Republic of South Africa with regard to air quality. NEM: AQA forms one of the many pieces of legislation that falls under the ambit of the NEMA.

NEM: AQA puts in place various measures for the prevention of pollution and national norms and standards for the regulation of air quality in South Africa. It also authorizes the Minister of Environmental Affairs to enforce its provisions through the issuance of policy documents and regulations. As in section 24G of NEMA, section 22A of NEM: AQA has a provision for administrative fines for contraventions.

In line with NEM: AQA, the then Department of Environmental Affairs (DEA), now Department of Forestry, Fisheries and the Environment (DFFE) - GN R 172 of 5 March 2021 published the National Ambient Air Quality Standards for particulate matter with an aerodynamic diameter less than 10 microns (PM_{10}) - (GN R 1210 of 24 December 2009) in Table 5-2. In 2012, standards for particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$) - (GN R 486 of 29 June 2012) were promulgated (Table 5-3).

Table 5-2: National Ambient Air Quality Standards for Particulate Matter (PM_{10}) (2009)

National Ambient Air Quality Standard for Particulate Matter (PM_{10})			
Averaging Period	**Limit Value (µg/m^3)**	**Frequency of Exceedance**	**Compliance Date**
24 hours	75	4	1 January 2015
1 year	40	0	1 January 2015
The reference method for the determination of the PM_{10} fraction of suspended particulate matter shall be EN 12341.			

Table 5-3: National Ambient Air Quality Standards for Particulate Matter ($PM_{2.5}$) (2012)

National Ambient Air Quality Standards for Particulate Matter (PM2.5)

Averaging Period	Limit Value (µg/m^3)	Frequency of Exceedance	Compliance Date
24 hours	40	0	1 January 2016 – 31 December 2029
24 hours	25	0	01 January 2030
1 year	20	0	1 January 2016 – 31 December 2029
1 year	15	0	01 January 2030
The reference method for the determination of the $PM_{2.5}$ fraction of suspended particulate matter shall be EN 14907.			

The DEA (now DFFE) published National Dust Control Regulations (NDCR), the acceptable dustfall (particulate matter with an aerodynamic diameter less than 45 µm (considered as Total Suspended Particulate (TSP) as described by the World Bank Group (WBG) (WBG, 1998) limits for residential and non-residential areas (GN R 827 of 1 November 2013). The dust fallout standard is given in Table 5-4 below.

Table 5-4: Dust Fall Standards (NDCR, 2013)

Restriction Areas	Dustfall rate (mg/m^2/day, 30-days average)	Permitted Frequency of exceeding dust fall rate
Residential Area	< 600	Two within a year, not sequential months
Non-Residential Area	< 1200	Two within a year, not sequential months

6. Methodology

6.1. Baseline Assessment

The baseline assessment examines the prevailing meteorology onsite and in immediate surroundings, the baseline air quality, coupled with the potential implication(s) of the proposed Project on the ambient air quality of surrounding receptors.

6.1.1. General Description of Climate in the Project Area

Site-specific MM5 modelled meteorological data set for three years (2018-2020) obtained from Lakes Environmental Software was used to assess the prevailing weather conditions. The Pennsylvania State University / National Centre for Atmospheric Research (PSU/NCAR) mesoscale model (known as MM5) is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model, which was designed to simulate or predict mesoscale atmospheric circulation. Meteorological data for a point onsite (26.126286 S, 27.763406 E) was obtained. Data availability was 100%.

The meteorological records of temperature, relative humidity, wind speed, and direction are discussed below (Table 6-1).

6.1.1.1. Temperature

The monthly temperature (three-year average) is presented in Table 6-1 and Figure 6-1. The data indicate that the monthly temperature maximum varied between 17°C - 30°C and the minimum between 0.0°C - 12°C. Ambient temperatures were observed to be higher during the summer months.

6.1.1.2. Relative Humidity

The relative humidity records (three-year average) ranged between 57% and 68% (Table 6-1 and Figure 6-3). Ravi et al., (2006)[2], investigated the effect of near-surface air humidity on soil erodibility. Results show that the *threshold friction velocity* increases with humidity conditions (RH > 65%), as water condenses into liquid and forms bridges between the soil grains and then the liquid-bridge bonding dominates.

6.1.1.3. Rainfall

The total monthly rainfall records (three-years average) are provided in Table 6-1 and Figure 6-3. Based on the rainfall data, the summer months (December – February) received much of the rains (i.e. >59%), followed by Spring with 24% and Autumn with 11%, and Autumn with 14%. While winter (June – August), received less than 1% of rainfall.

[2] Ravi S; Zobeck TM; Over TM; Okin GS; D'Odorico P (2006) On the effect of moisture bonding forces in air-dry soils on threshold frictional velocity of wind erosion. *Sedimentology, 53, 597-609*

Table 6-1: Climate Statistics

Parameters		Three-year average												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Temp. (◦C)	Max	29	28	27	24	20	18	17	21	25	29	29	30	25
	Min	12	12	11	9	3	1	0	2	3	7	9	12	7
Mean Rel. Hum. (%)		62	66	65	67	65	67	68	66	63	59	57	63	64
Total Mon. Rain (mm)		45	42	22	8	1	0	0	2	7	12	28	53	221

(Source: Lakes Environmental)

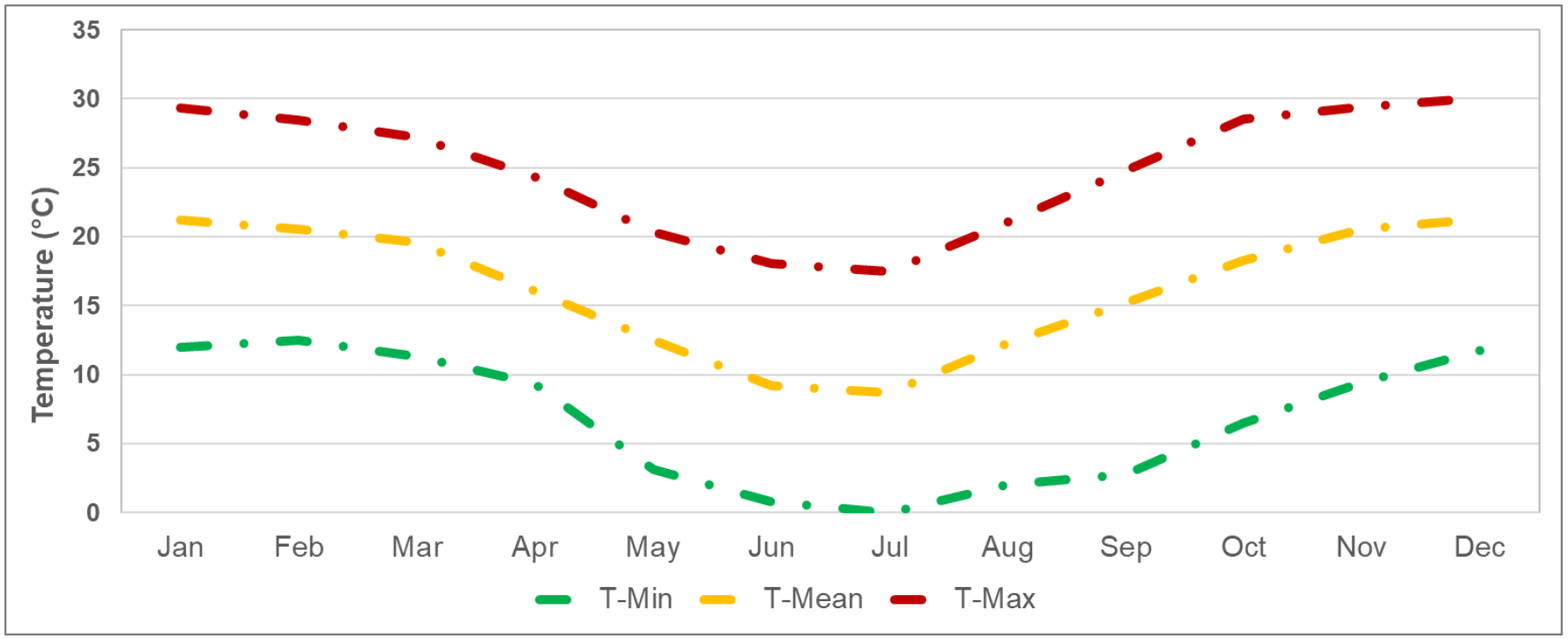


Figure 6-1: Temperature

(Source: Lakes Environnemental)

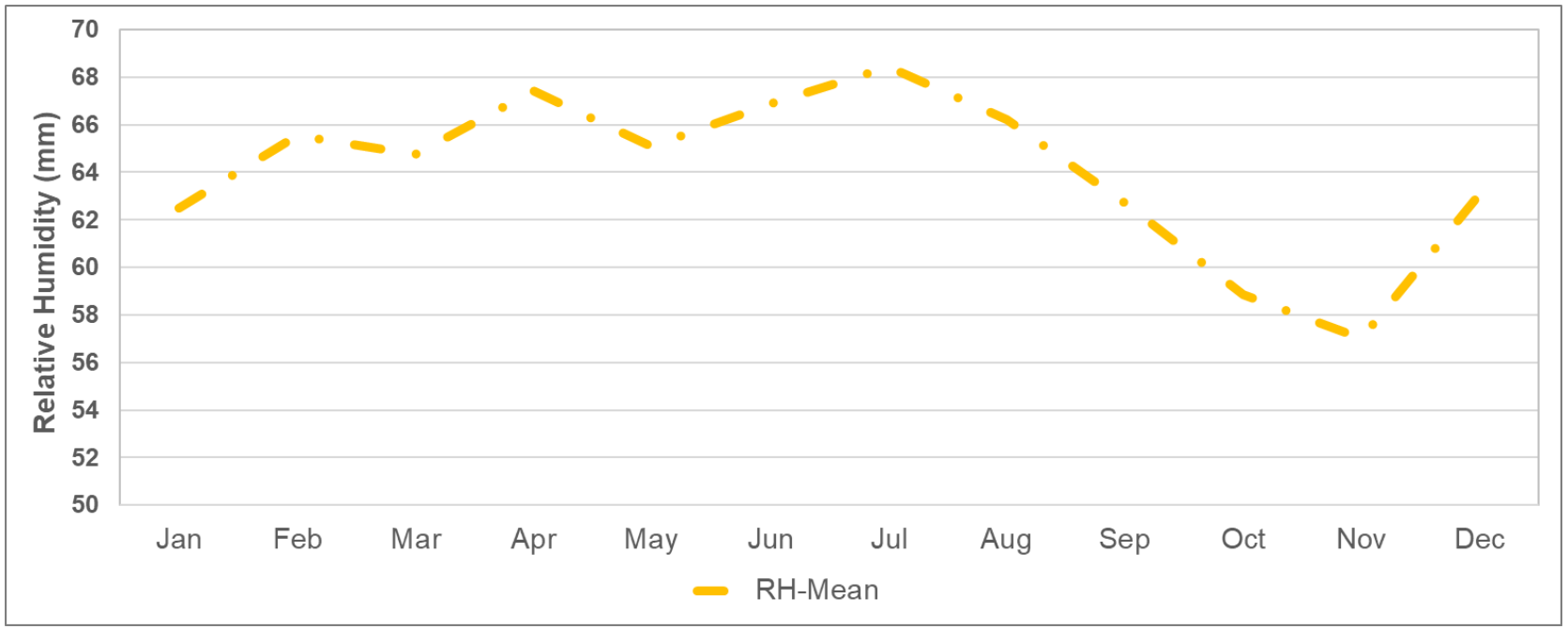


Figure 6-2: Relative Humidity

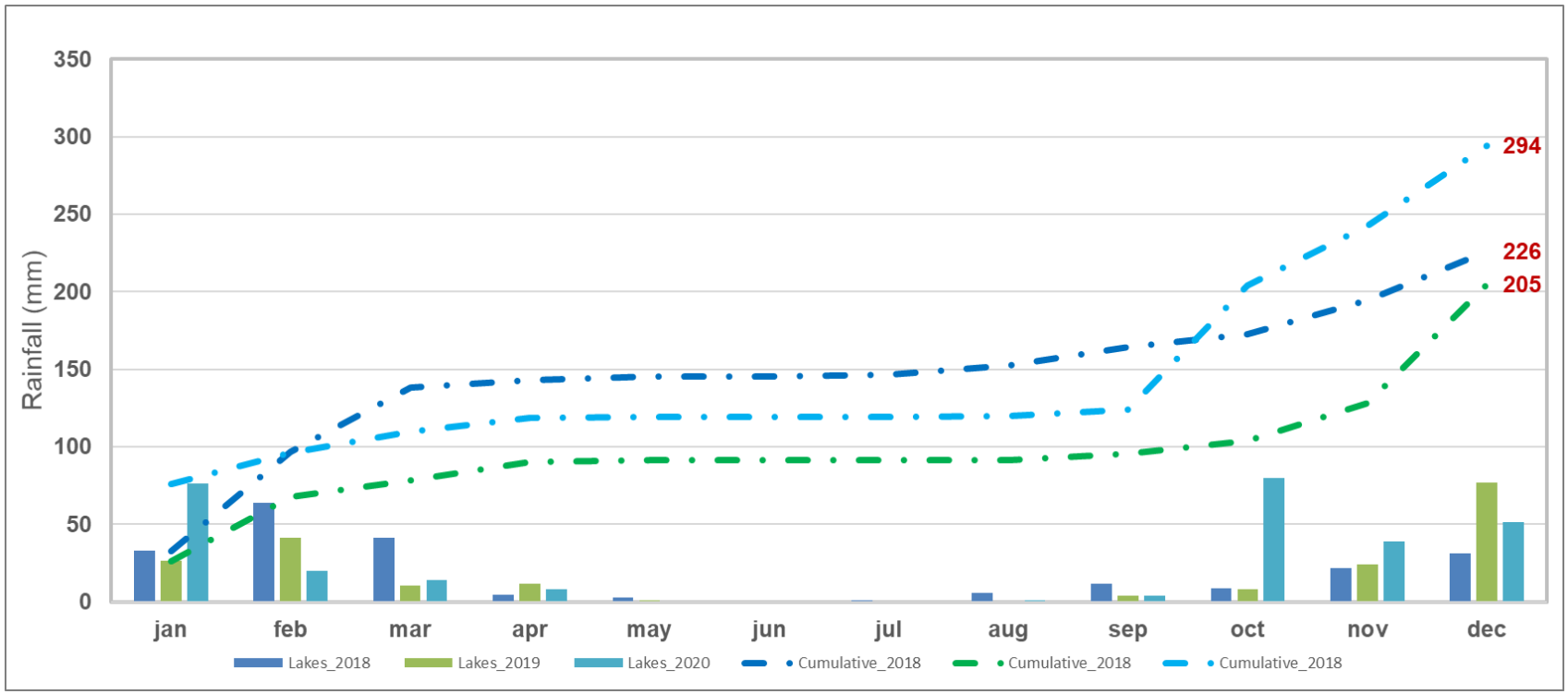


Figure 6-3: Rainfall

(Source: Lakes Environnemental)

6.1.1.4. Wind Speed

Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence. The figure given at the bottom of the legend described the frequency with which calm conditions (wind speed below 0.5 m/s) occur.

Hourly meteorological data was analysed and used to understand the prevailing wind patterns in the Project area. Data was used to assess the wind speed and wind direction regime on site. The diurnal, seasonal and periodic wind roses for the Project area are depicted in (Figure 6-5).

The prevailing winds are from the north northeast (15.8%), north (12.9%) and northeast (12.9%) respectively. Secondary contributions are from the north northwest (8.4%).

The average wind speed at the Project site is 3.6 m/s and calm conditions (<0.5 m/s) occur for some 1.0% of the time. Wind speed capable of causing wind erosion i.e. ≥5.4 m/s occurred for about 12.7% of the time (Figure 6-4). This equates to about 46 days in a year.

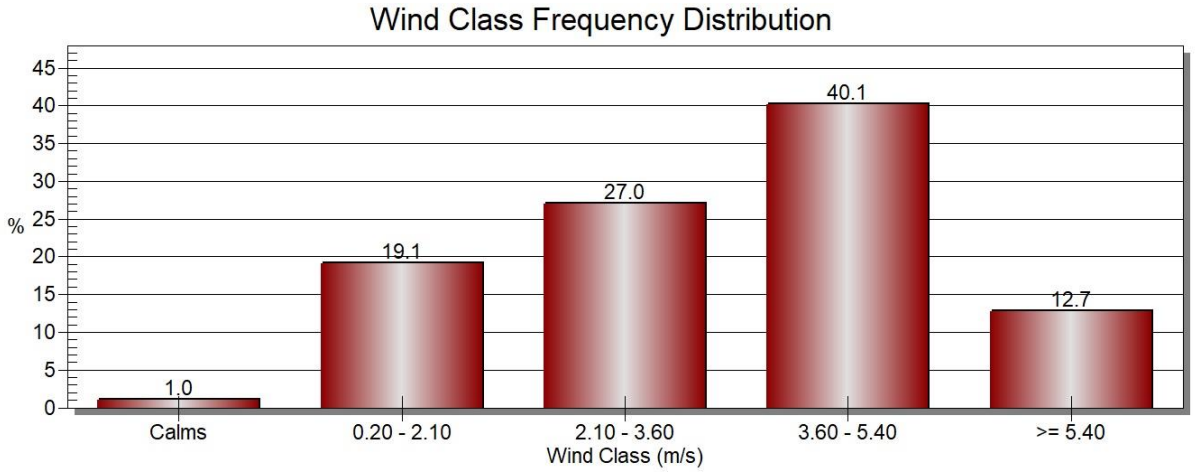


Figure 6-4: Wind Class Frequency

(Source: Lakes Environmental)

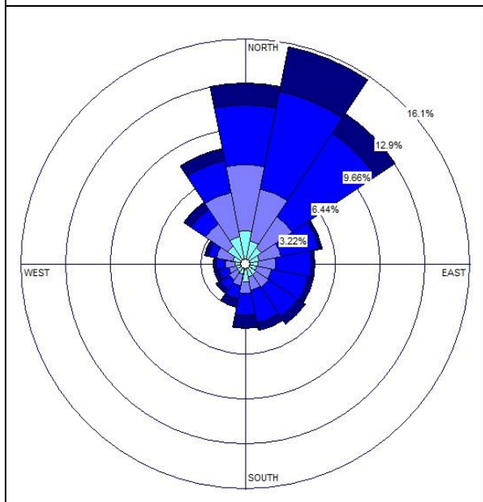
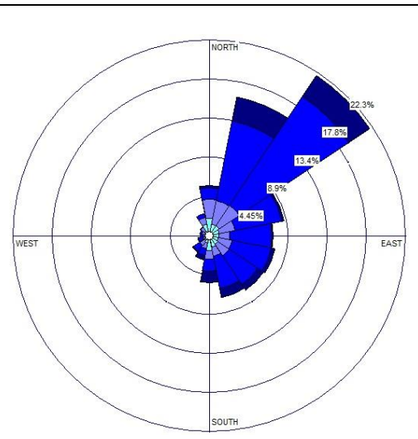
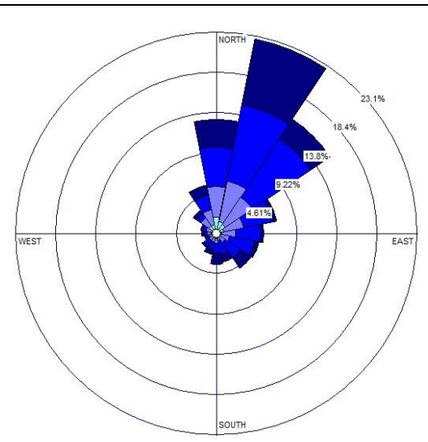
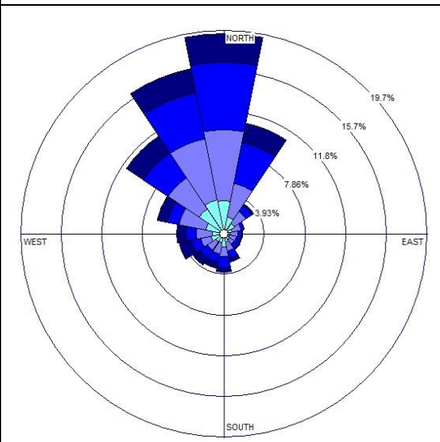
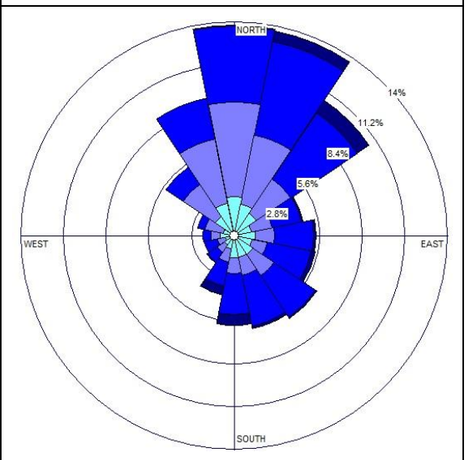
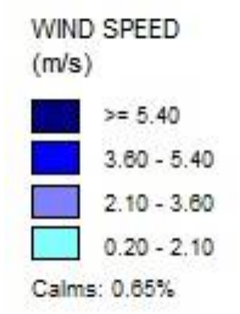
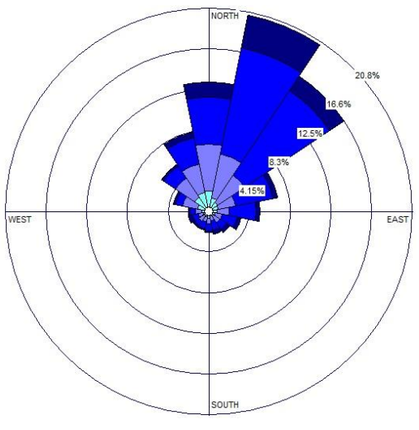
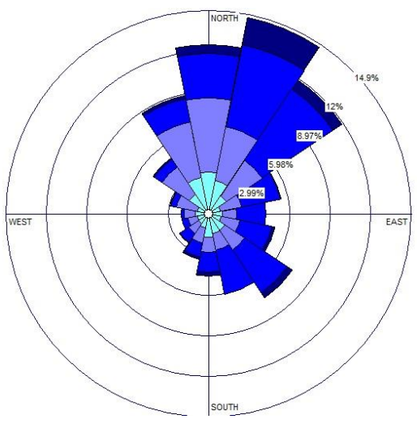
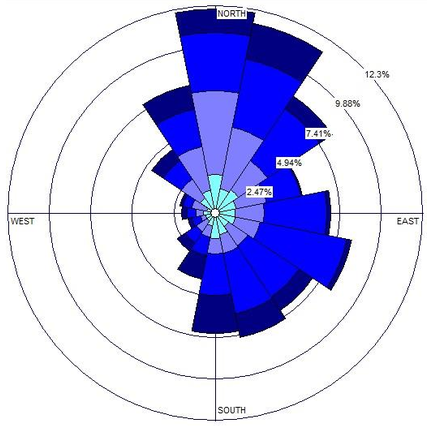
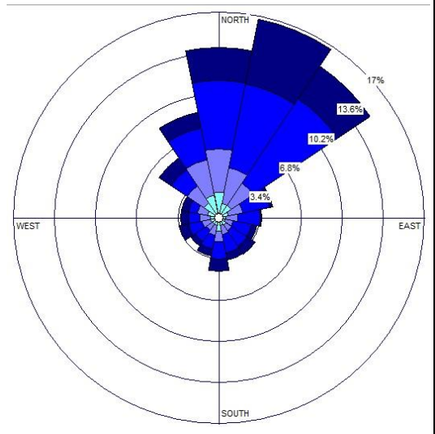
<table>
<tr><td>AERMET- Ready MM5</td><td colspan="4">Diurnal</td></tr>
<tr><td>January 2018 – December 2020</td><td>Night</td><td>Morning</td><td>Afternoon</td><td>Evening</td></tr>
<tr><td rowspan="2"> 
</td><td> 
</td><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td colspan="4">Seasonal</td></tr>
<tr><td rowspan="2"> 
</td><td>Summer</td><td>Autumn</td><td>Winter</td><td>Spring</td></tr>
<tr><td> 
</td><td> 
</td><td> 
</td><td> 
</td></tr>
</table>

Figure 6-5: Diurnal and Seasonal Wind Roses

(Source: Lakes Environmental)

6.2. Assessment of Existing Air Quality

Ambient air quality records were measured at Leratong Hospital Krugersdorp Ambient Air Quality Monitoring Station, owned and operated by the West Rand District, about 4.2 km south of the project site. The data downloaded encompasses records for particulate matter with an aerodynamic diameter of less than 10 microns (PM_{10}) and gases, such as sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and ozone (O_3). Data covering the period, January 2020 to September 2021 was assessed.

Data was only available from 27/07/2021 to 30/08/2021. The reason why prior months were lacking data is not known. The available data recorded a lot of negative values, hence, raises concern when last the station was calibrated. Figure 6-6 shows the ambient PM_{10} levels measured. The maximum daily concentrations of PM_{10} measured period was 0.03 µg/m^3 (below the standards of 75 µg/m^3). Not a single exceedance was recorded (Table 6-2). The ambient air quality results collected are summarised in Table 6-2.

Table 6-2: Summary of the Ambient Air Quality Records

Pollutant	Averaging period	SA Standard	Highest Ambient Level Measured on-site	Exceedance of the Standard
PM_{10}	24 hours	75 µg/m^3 (1)	0.03	0

(1) South African Standard, Government Notice 1210, Government Gazette 32816

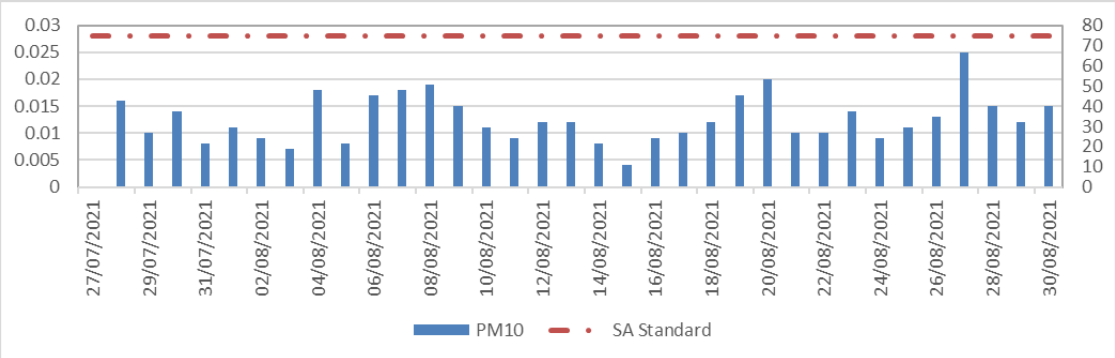


Figure 6-6: Background PM_{10} Levels (West Rand District: Ambient Air Quality Station)

6.2.1.1. Gaseous Pollutants

The gaseous pollutant data from the station, such as SO_2, NO_2, CO and O_3 are discussed below. The daily SO_2 concentrations measured had more negative than positive, with very low values. Perhaps the SO_2 sensor is faulty and requires replacement. Hence, the data were discarded.

The daily NO_2 concentrations measured at the station were generally lower than 106 ppb (Figure 6-7). The maximum daily concentration over the period was 71 ppb. During the period, no exceedance of the South African standard of 106 ppb was measured.

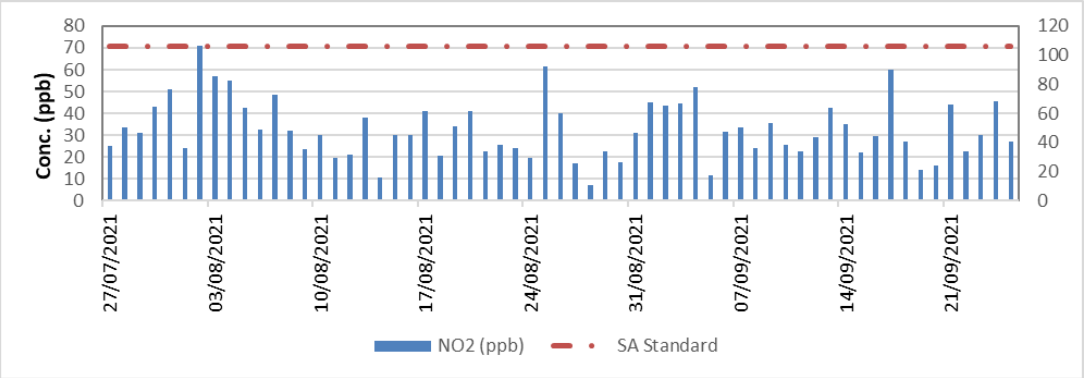


Figure 6-7: Background NO_2 Levels

The 8-hourly CO concentrations measured at the station were lower than the standard (Figure 6-8). The maximum concentration measured over the period was 2.0 ppm. No exceedance of the 8-hours South African standard of 8.7 ppm was observed.

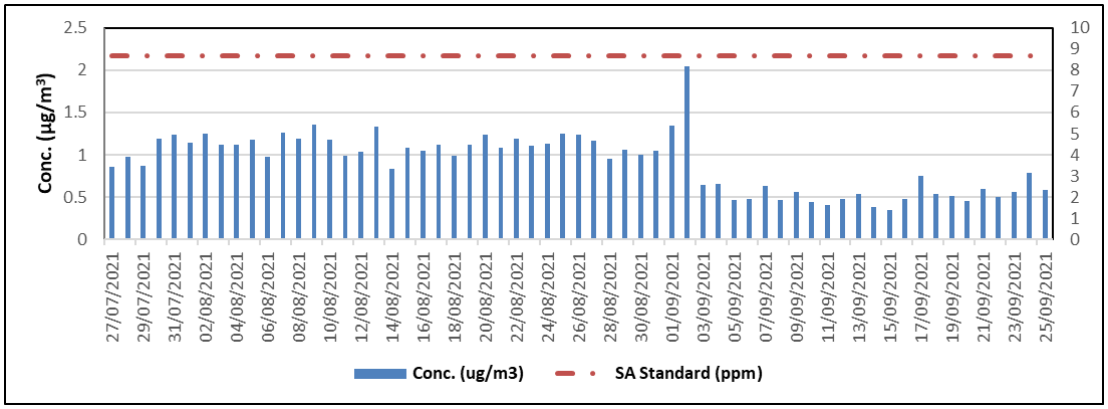


Figure 6-8: Background CO Levels

The 8-hourly O_3 concentrations measured at the station were lower than the standard (Figure 6-9). The maximum concentration measured over the period was 59 ppb. No exceedance of the 8-hours South African standard of 61 ppb was observed.

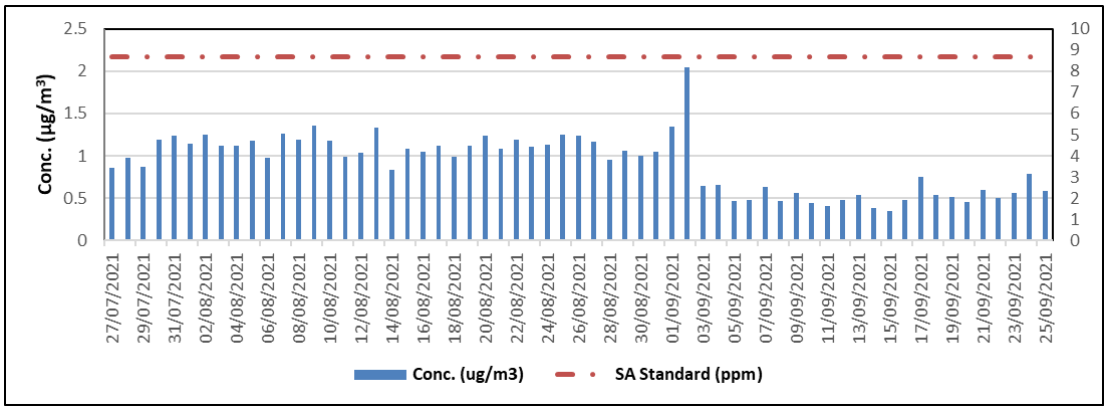


Figure 6-9: Background O_3 Levels

Table 6-3: Summary of the Ambient Air Quality Records

Pollutant	Averaging period	SA Standard	Highest Ambient Level Measured on-site	Exceedance of the Standard
NO_2	1 hour	106 ppb (1)	71	0
CO	8 hours	8.7 ppm (1)	2.0	0
O_3	8 hours	61 ppb	59	0

(1) South African Standard, Government Notice 1210, Government Gazette 32816

6.3. Air Quality Impact Assessment

The NEM: AQA regulation regarding Air Dispersion Modelling (GN R 533 of 11 July 2014) informed the assessment approach was adopted. A Level 3 assessment was used, which required detailed meteorological geophysical and source input data.

6.3.1. Impact Assessment Approach

The approach used to determine the future impacts from the operational phase of the Project and related activities is provided in Figure 6-10.

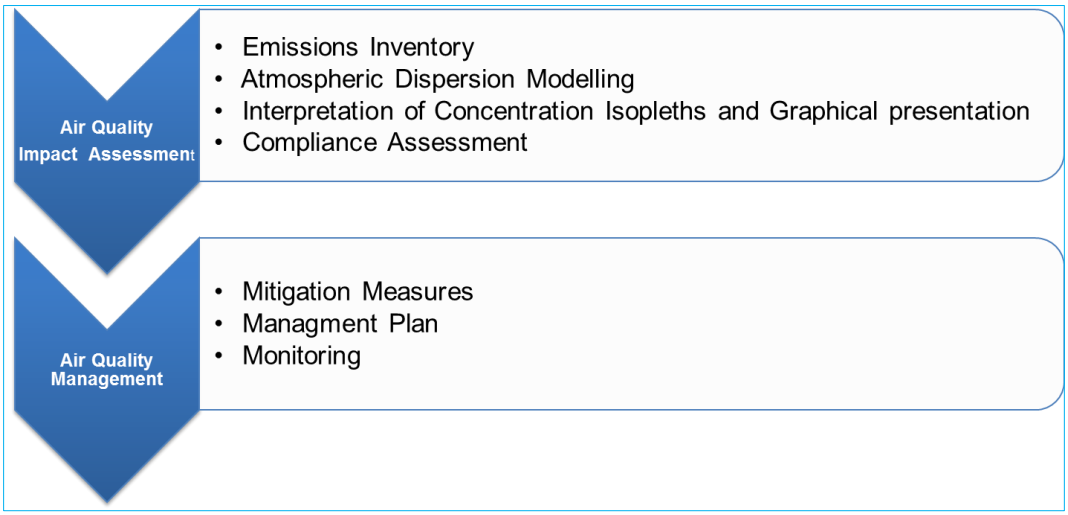


Figure 6-10: Air Quality Impact Assessment Methodology

During the impact assessment, tasks completed included the development of an emissions inventory, followed by model simulations to predict Ground Level Concentration (GLC) of criteria pollutants. The model outputs were used to assess future emissions and compliance with applicable standards. In addition, the findings informed the mitigation and management measures recommended, as well as monitoring requirements to assess the efficiency of the mitigation measures.

6.3.1.1. *Emissions Inventory*

The development of an emissions inventory forms the basis for any conceptual model. Emission rates are typically obtained using actual sampling equipment at the point of emission or are estimated from mass and energy balances or emission factors that have been established at similar operations. The latter was followed, employing emission factors published by the USEPA in its *AP-42* "Compilation of Air Pollution Emission Factors" (USEPA, 1995; 1998; 2016) and Australian National Pollutant Inventory (*NPi*) "Emission Estimation Technique (EET, 2012)" manuals were employed.

Quoting directly from the USEPA AP-42 (2016), …" *air pollutant emission factors are representative values that attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant. Such factors facilitate the estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages*".

The equations and parameters used in the calculations of the emissions anticipated from the various sources within the mine during operation are discussed in Table 6-4.

Table 6-4: Emission Factor Equations

Activity	Emission Equation	Source	Information assumed/provided
Materials handling (including conveying)	$EF_{TSP\,(kg/t)} = k_{TSP} \times 0.0016 \times \frac{\left(\frac{U_{(m/s)}}{2.2}\right)^{1.3}}{\left(\frac{M_{(\%)}}{2}\right)^{1.4}}$ Where, E = Emission factor (kg dust / t transferred) U = Mean wind speed (m/s) M = Material moisture content (%) The KTSP:0.74; KPM10:0.35 respectively. An average wind speed of 3.1 m/s was used based on the Lakes Environmental data for the period 2017 – 2019.	US-EPA AP42 Section 13.2.4	The moisture content of the materials is as follows: Ore: 4.5% Hours of operation were given as 24 hrs per day, 7 days per week.
Vehicle entrainment on unpaved surfaces	$EF_{(\frac{KG}{VKT})} = \frac{0.4536}{1.6093} * k * (\frac{s(\%)}{12}) a * (\frac{w(t)}{3}) b$ Where, E = particulate emission factor in grams per vehicle km travelled (g/VKT) k = basic emission factor for particle size range and units of interest s = road surface silt content (%) W = average weight (tonnes) of the vehicles travelling the road = 40 t side truck The particle size multiplier (k) is given as 0.15 for PM2.5 and 1.5 for PM10, and as 4.9 for TSP The empirical constant (a) is given as 0.9 for PM2.5 and PM10, and 4.9 for TSP The empirical constant (b) is given as 0.45 for PM2.5, PM10, and TSP	US-EPA AP42 Section 13.2.2	Default silt content: Mine Road: 8.6% Hours of operation were assumed as 24 hrs per day, 7 days per week. The layout of the haul roads was assumed to be 20 m wide.
Wind Erosion	$E_{TSP} = 1.9 \times \left(\frac{s}{1.5}\right) \times \left(\frac{365 - p}{235}\right) \times \left(\frac{f}{15}\right)$	USEPA, 1998	Silt content: 6.9% (Assumed)
Screening and Milling	Primar High moisture (TSP:0.01; PM10:0.004)	NPI EET Manual	

Activity	Emission Equation	Source	Information assumed/provided
	Low moisture (TSP:0.2; PM10:0.02) Secondary High moisture (TSP:0.03; PM10:0.012) Low moisture (TSP:0.6; PM10:No data)	for Mining (NPI, 2012)	
Tipping	$E_{TSP} = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \times \left(\frac{M}{2}\right)^{-1.4}$ $E_{PM10} = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}\right)^{1.3} \times \left(\frac{M}{2}\right)^{-1.4}$	US-EPA AP42 Section 13.2.4	The silt contents of materials are as follows: Topsoil: 6.9% (Assumed) U = mean wind speed in m/s: 3.2 m/s M = moisture content (4.5 %)

6.3.1.2. Air Quality Dispersion Modelling and Data Requirements

6.3.1.2.1. Meteorological Data Requirements

Dispersion models compute ambient concentrations as a function of source configurations, emission rates, and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in GLCs of pollutants arising from the emissions of various sources.

An AERMOD modelling system incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including both surface and elevated sources, and simple or complex terrain.

Three years' worth of MM5 modelled meteorological data were obtained from Lakes. This dataset consists of surface and upper air meteorological data required to run the dispersion model.

6.3.1.2.2. Modelling Domain

The AERMAP terrain pre-processor requires the user to define a modelling domain. The modelling domain is defined as the area that contains all the receptors and sources being modelled with a buffer, to accommodate any significant terrain elevations.

The influence of the terrain will vary with the source height and position and the local meteorology. Table 6-5 gives an overview of meteorological parameters and basic setup options for the AERMOD model runs.

AERMOD's three models and required model inputs are described below:

- AERMET: calculates boundary layer parameters for input to AERMOD:
    - Model inputs: wind speed; wind direction; cover; ambient temperature; albedo; surface roughness; and Bowen ratio.

- AERMAP: calculates terrain heights and receptor grids for input to AERMOD:
  - Model inputs: Digital elevation model data [x,y,z]; design of receptor grid; and
  - Model outputs for AERMOD: [x,y,z] and hill height scale for each receptor.
- AERMOD: calculates temporally-averaged air pollution concentrations at receptor locations for comparison to the relevant standard:
  - Model inputs: source parameters (from permit application); boundary layer meteorology (from AERMET); and receptor data (from AERMAP).

Table 6-5: Summary of Meteorological and AERMET Parameters

Number of grids (spacing)	100 m, 200 m
Number of grids points	121 x 121
Years of analysis	January 2018 to December 2020
Centre of analysis	Randfontein (26.126286 S; 27.763406 E)
Meteorological grid domain	20 km (east-west) x 20 km (south-north)
Station Base Elevation	1613 m
MM5-Processed Grid Cell (Grid Cell Centre)	26.126286 S; 27.763406 E
Anemometer Height	13 m
Sectors	The surrounding area land use type was cultivated
Albedo	0,33
Surface Roughness	0,27
Bowen Ratio	4,8
Terrain Option	Flat

6.3.1.3. Impact Assessment Ranking

Based on the predicted GLC of various pollutants and the spread of airborne emissions across the mining landscape, the assessment ranking methodology in Appendix A was applied in rating the impacts of the project on the surrounding air quality.

7. Findings and Discussion

7.1. Baseline Results

The meteorology of the project area was assessed with three years' worth of data. The monthly temperature average varied between 10°C - 20°C. Ambient temperatures were observed to be higher during the summer months. The total monthly rainfall records show the summer

months received much of the rains (>59%), followed by Spring with 24% and Autumn with 11%. While winter received the least rainfall (less than 1%). The annual total rainfall is 221 mm. The relative humidity records ranged between 57% and 68%.

The wind rose shows the prevailing winds are from the north northeast (15.8%), north (12.9%) and northeast (12.9%) respectively. Secondary contributions are from the north northwest (8.4%). The average wind speed was at 3.6 m/s and calm conditions occurred for some 1.0% of the time. High wind speed ≥5.4 m/s occurred for about 12.7% of the time. This equates to about 46 days in a year.

The maximum daily concentration of PM_{10} measured for the period was 0.03 µg/m^3 (below the standards of 75 µg/m^3). Not a single exceedance was recorded. For the gases, such as SO_2, data was not available. Whereas for NO_2, CO, and O_3 the ambient levels were all below the South African ambient air quality standards.

7.2. Dispersion Model Simulation Results

The model results consist of a graphical presentation of GLC (in a unit of µg/m^3) for the different pollutants, and for dust deposition rates (mg/m^2/d). The daily averages were calculated as the 4th highest value (99th percentile). Annual averages were shown as the 1st highest value (100th percentile).

Gaseous pollutants were not assessed as the reclamation activity will not be as intensive as a regular miming operation with numerous activities taking place simultaneously, hence, the anticipated impact will be negligible.

7.3. Isopleth Plots and Evaluation of Results

7.3.1. Predicted Concentration of $PM_{2.5}$

The predicted GLC of $PM_{2.5}$ over a 24-hour averaging period for the operational phase returned simulation isopleths that are shown in Figure 7-1 ($PM_{2.5}$ daily) and Figure 7-2 ($PM_{2.5}$ annual).

The model simulations show the worst-case scenario (assuming no mitigation measures were put in place). The predicted GLC returned areas with exceedances of the 24-hour standard (40 µg/m³) concentrated along the haul roads and at the centre of the operation as depicted in Figure 7-1. The predicted GLC at the sensitive receptors SR 1 (Netcare K), SR2 (WestR_Sch) and SR3 (Yusuf_Sch) were all lower than the 24-daily standard (Table 7-1). The annual GLC of $PM_{2.5}$ predicted will not exceed the standard onsite and at the selected receptors ((Table 7-1).

7.3.2. Predicted Concentration of PM_{10}

The predicted GLC of PM_{10} over a 24-hour averaging period returned simulation isopleths shown in Figure 7-3 (PM_{10} daily) and Figure 7-4 (PM_{10} annual).

The areas where the 24-hour standard of 75 µg/m³ are depicted in Figure 7-3 and are mostly at the centre of the operation. The predicted daily GLC at the selected sensitive receptors exceeded the South African limit at SR2 (95 µg/m³) and SR3 (102 µg/m³) (Table 7-1). The predicted annual GLC of PM_{10} will not exceed the standard onsite and at the selected receptors without mitigation (Figure 7-4).

7.3.3. Predicted Dustfall Rates

The predicted dustfall rates are shown in Figure 7-5 (without mitigation and with mitigation). The dustfall rates confirmed that the non-residential limit of 1,200 mg/m^2/d will be exceeded onsite and at certain locations along the dirt road leading to the plant. With exceedances confined within the project area, the dustfall rates at the selected receptors will be compliant with the residential limit. Once mitigation is in place, the areas with exceedance will shrink onsite, leading to a further reduction in deposited dust. The predicted dustfall rates at the selected receptors without and with mitigation were lower than the standard (Table 7-1).

Table 7-1: Predicted Concentrations of PM_{10}, $PM_{2.5}$ and Dust Deposition Rates at Selected Sensitive Receptors

Pollutants	Averaging Period	South Africa Air Quality Standard (µg/m³)	Predicted Ground Level Concentration (µg/m³)		
			SR1	SR2	SR3
$PM_{2.5}$ (No Mitigation)	Daily	40(1)	4	6	6
	Annual	20(1)	0.4	0.8	0.7
PM_{10} (No Mitigation)	Daily	75(1)	67	95	102
	Annual	40(1)	7	14	12
Dust Deposition Rates (mg/m²/day)					
Dust (No Mitigation)	Monthly	Residential (600(2)) Non-residential (1200(2))	49	128	336
Dust (With Mitigation)			13	30	9

1. South African National Ambient Air Quality Standards, 2009;2012
2. South African National Dust Control Regulation, 2013 (NDCR)

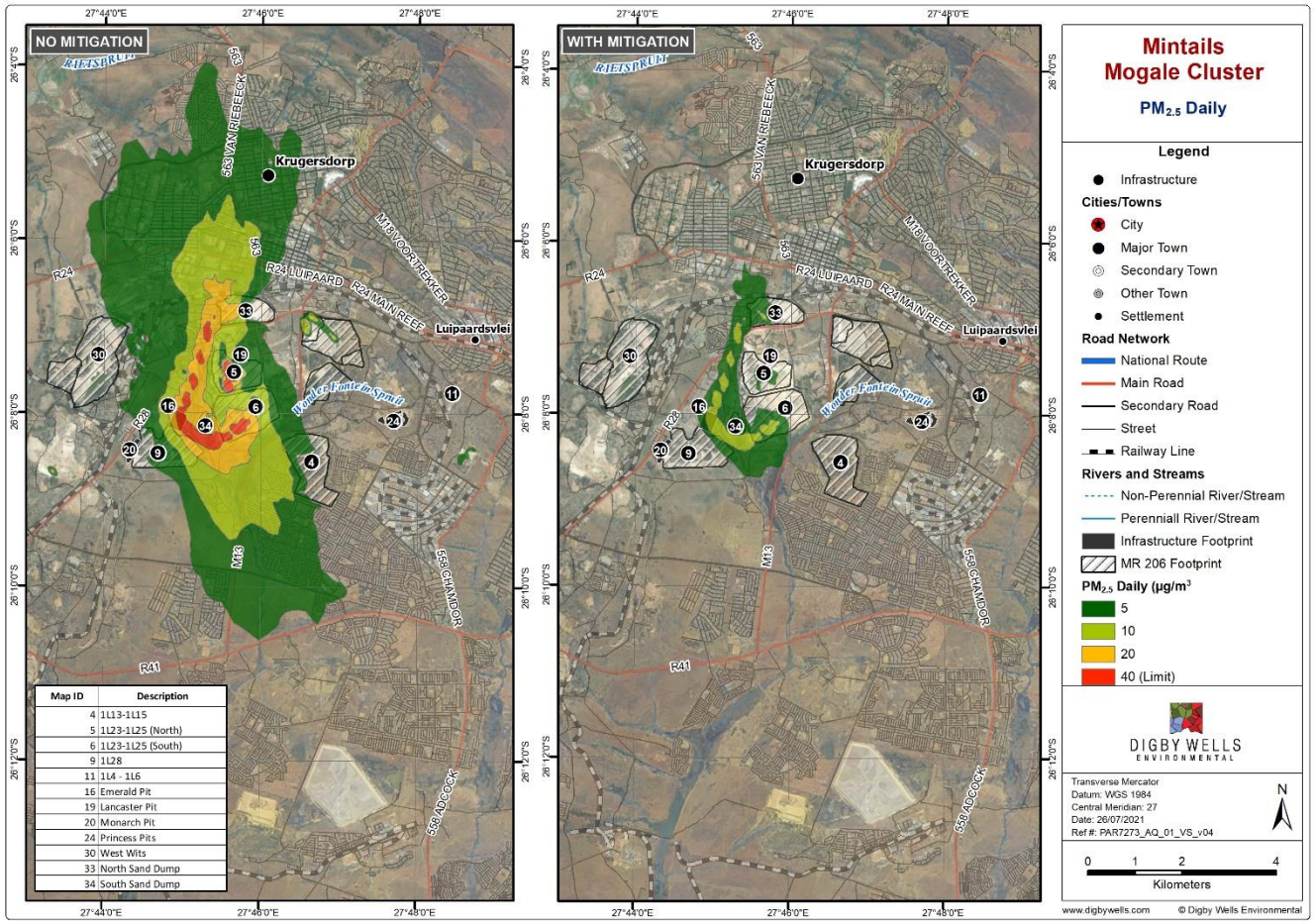


Figure 7-1: Predicted 4th highest (99th percentile) daily $PM_{2.5}$ Concentrations (µg/m³)

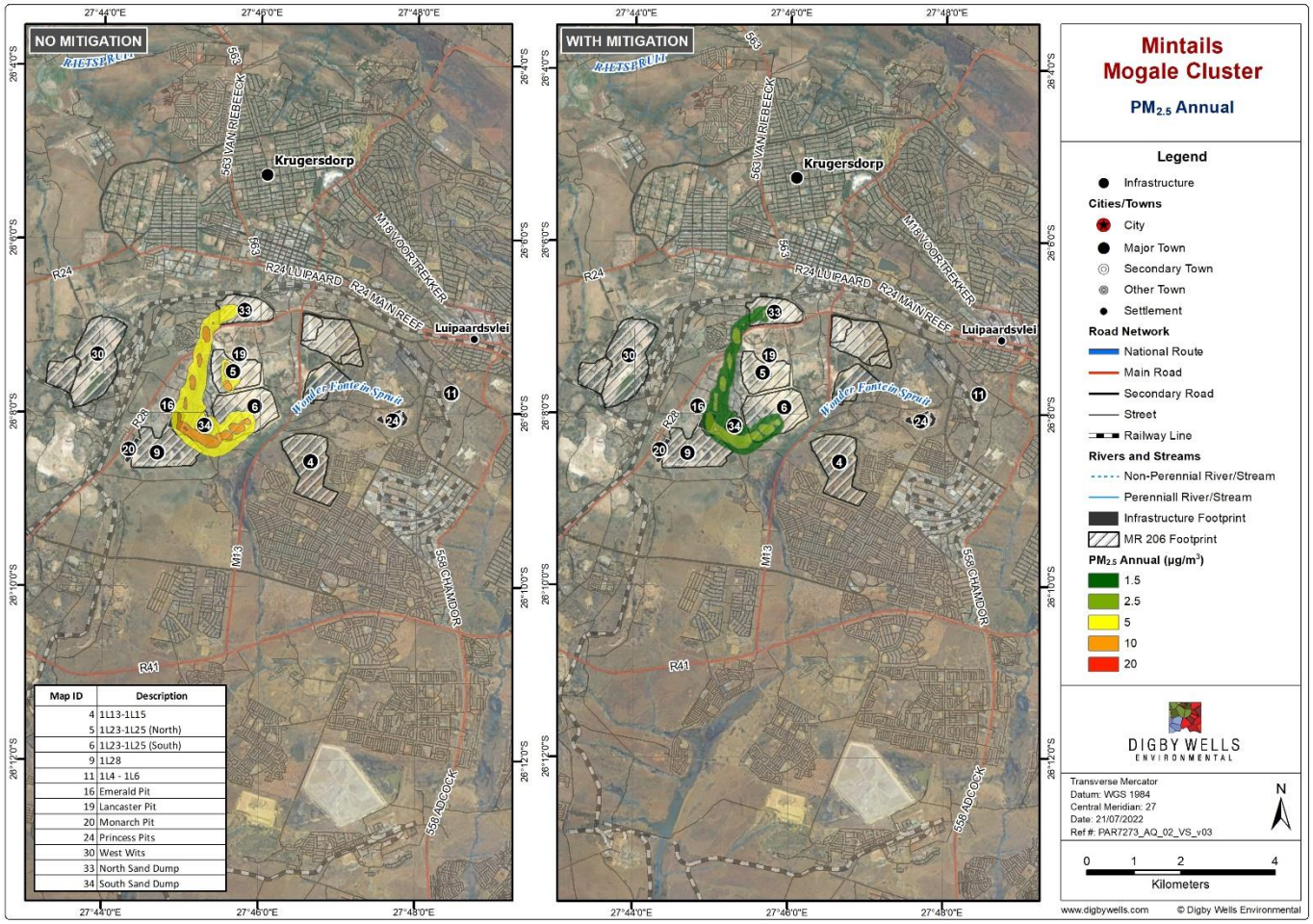


Figure 7-2: Predicted 1st highest (100th percentile) Annual PM2.5 Annual Concentrations (µg/m³)

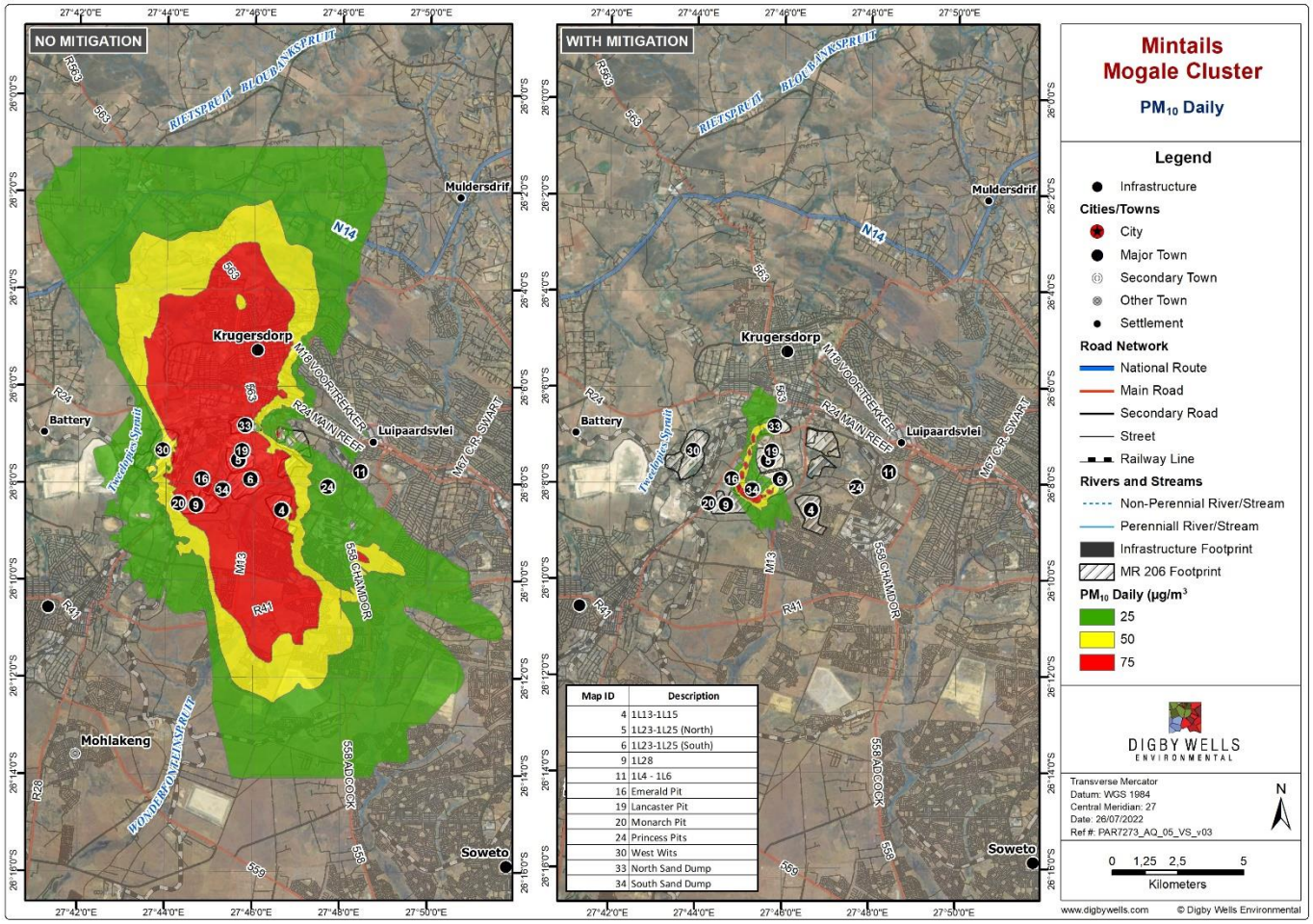


Figure 7-3: Predicted 4th highest (99th percentile) daily PM_{10} Concentrations (µg/m³)

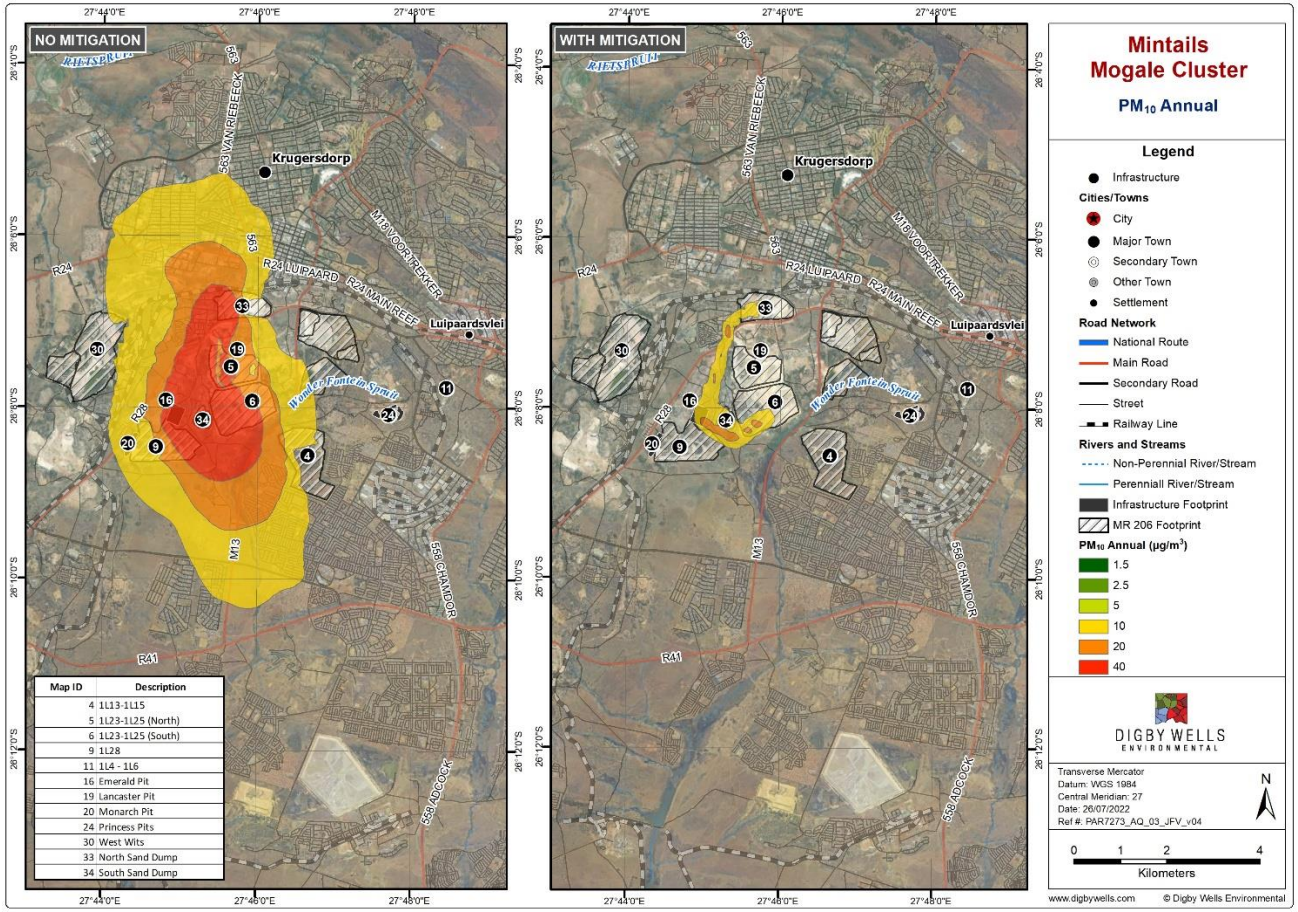


Figure 7-4: Predicted 1st highest (100th percentile) Annual PM_{10} Concentrations (µg/m³)

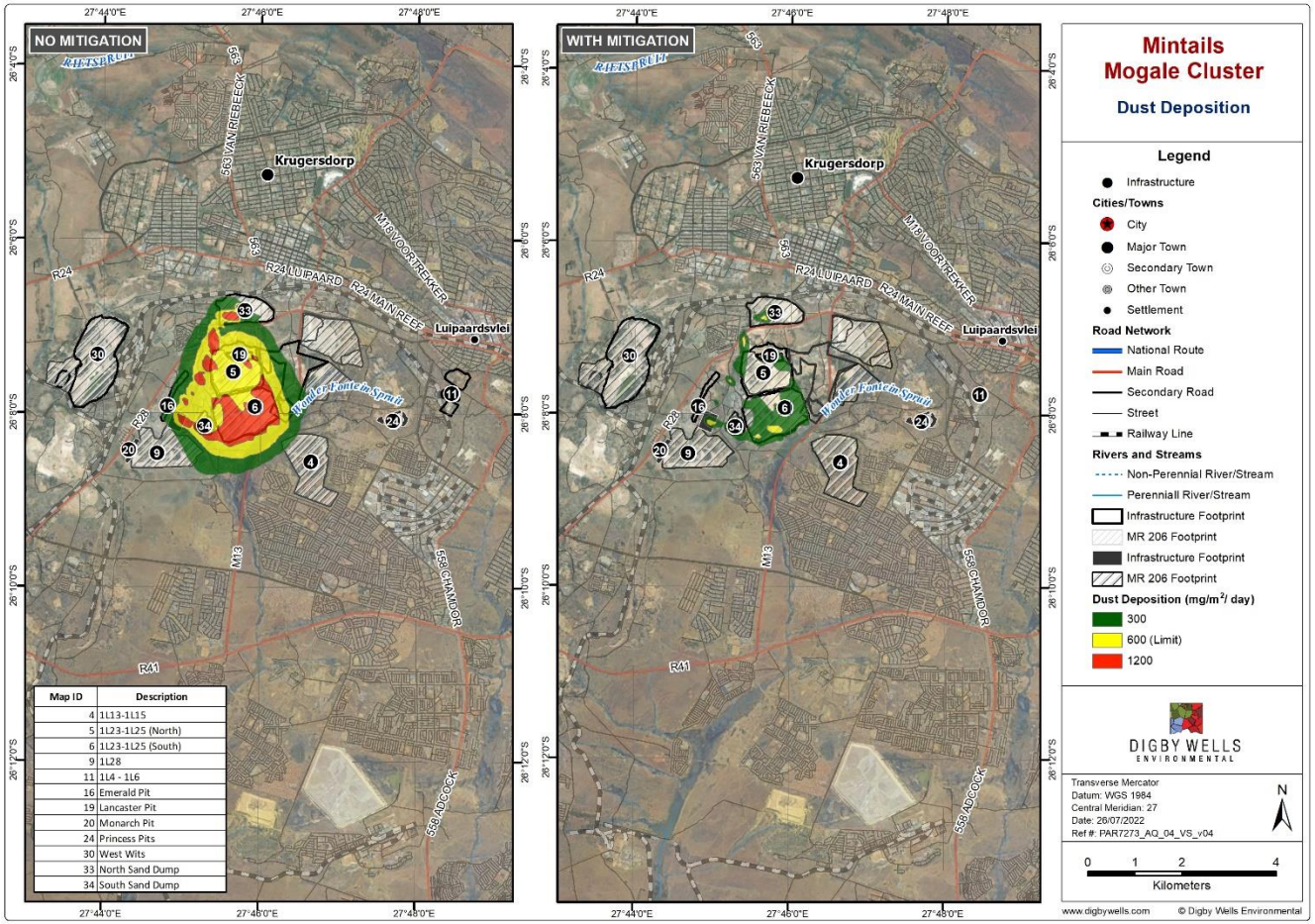


Figure 7-5: Predicted (100th percentile) Monthly Dust Deposition Rates (mg/m²/day) No Mitigation

8. Discussions

The impacts of the construction, operational and decommissioning phases on the ambient air quality of the Project area were considered. Construction and decommissioning will be short-term and conducted in phases. Hence, impacts will be minimal to negligible. The predicted GLC for the operational phase and associated project risks have been appraised in this report.

8.1. Findings

The findings presented here represent both the worst-case scenario, i.e. without mitigation measures factored into the model runs, and with mitigation (i.e. with mitigation measures factored into the model runs). These findings are summarised as follows:

- The predicted GLC of $PM_{2.5}$ over a 24-hour averaging period for the operational phase returned simulation isopleths that are lower than the 24-hour standard (40 µg/m³). The predicted GLC returned areas with exceedances of the 24-hour standard (40 µg/m³) concentrated along the haul roads and at the centre of the operation. The predicted GLC at the sensitive receptors SR 1 (Netcare K), SR2 (WestR_Sch) and SR3 (Yusuf_Sch) were all lower than the 24-daily standard. The annual GLC of $PM_{2.5}$ predicted will not exceed the standard onsite and at the selected receptors. With mitigation measures factored into the day to day operation, the predicted GLC is further minimised.
- The predicted GLC of PM_{10} over a 24-hour averaging period returned simulation isopleths that show that exceedances will occur. These areas where the 24-hour standard of 75 µg/m³ are mostly concentrated at the centre of the reclamation operation. The predicted daily GLC at the selected sensitive receptors exceeded the South African limit at SR2 (95 µg/m³) and SR3 (102 µg/m³). The predicted annual GLC of PM_{10} will not exceed the standard onsite and at the selected receptors without mitigation. The predicted annual GLC of PM_{10} will not exceed the standard onsite and at the selected receptors without mitigation. With mitigation measures factored into the day to day operation, the predicted GLC is further minimised.
- The predicted dustfall rates (without mitigation and with mitigation) show that the reclamation operation will result in areas with exceedance of the non-residential limit of 1,200 mg/m^2/d. The dustfall rates confirmed that the non-residential will be exceeded onsite and at certain locations along the dirt road leading to the plant. With exceedances confined within the project area, the dustfall rates at the selected receptors will be compliant with the residential limit. Once mitigation is in place, the areas with exceedance will shrink onsite, leading to a further reduction in deposited dust.

9. Impact Assessment Ranking

The impact assessment ranking methodology in Appendix A was applied in rating the implications of the different phases of the Project on the ambient air quality of the area.

9.1. Construction Phase

Activities during the Construction Phase that may have potential implications on the ambient air quality of the Project area and surroundings i.e. increasing pollutant levels in the atmosphere are indicated in Table 9-1.

Table 9-1: Interactions and Impacts of Activity

Interaction	Impact
Removal of vegetation/topsoil	Generation of dust, leading to poor air quality; Soiling of surfaces due to dustfall
Construction of project infrastructure, access road and haul roads, pipelines and sumps, plant and establishment of pit area in preparation for in-pit deposition, and waste rock dump	

9.1.1. Impact Description

The construction of project infrastructure will occur in phases and will be short-term in nature. Therefore, the anticipated impacts will be negligible.

Activities associated with site clearing, and construction of project infrastructure will result in the generation of fugitive dust comprising TSP, $PM_{10,}$ and $PM_{2.5}$. Also, the use of access and haul roads and wind erosion of bare soil surfaces and storage piles will result in the entrainment of dust. In addition, excavation, loading, and tipping of construction material will lead to dust generation. For gaseous emissions, i.e. tailpipe emission and volatiles from diesel storage are intermittent, short-term in nature and disperse readily to negligible levels. Hence, potential impacts and associated risks are not anticipated.

The construction phase activities will occur in phases, will be short-term and localised in nature, and will have low to negligible impacts on the ambient air quality.

9.1.1.1. Management Objectives

The management objective is to ensure that emissions on-site and at off-site locations are not in exceedance of the regulatory limits for the protection of the environment, human health, and wellbeing. Mitigation measures will be implemented to ensure that emissions remain below limit values and are in compliance with the relevant standards.

9.1.1.2. Management Actions

- Air quality monitoring at upwind and downwind locations and selected sensitive receptors; and
- Application of dust suppressants e.g. Dust-A-Side on haul roads and exposed areas to prevent dust generation and ensure compliance.

9.1.1.3. Impact Ratings

The construction phase activities will require similar mitigation measures to suppress dust generation to the atmosphere, hence in the impact rating, these activities were grouped for ranking (Table 9-2).

Table 9-2: Significance Ratings for Site Clearing and Construction of Infrastructure (Access Road, Haul Road, Storage Facility, Storage Facilities and Establishment of the Pits and Waste Rock Dump)

Activity and Interaction: Site Clearing, Construction of Infrastructure (Access Road, Haul Road, Storage Facility and Establishment of Pits and Waste Rock Dump)			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Reduction in ambient air quality			
Prior to mitigation/ management			
Duration	Medium-term (3)	Dust generation will be medium-term in the construction phase	Negligible (negative) – 28
Extent	Limited (2)	The emission of pollutants will be limited to each activity and immediate surroundings.	
Intensity	Minor (2)	Minor implications on the surrounding air quality are anticipated	
Probability	Probable (4)	Impact may probably occur	
Nature	Negative		
Mitigation/ Management actions			
• Implement localised / activity-specific surface watering to minimise emissions; • Apply dust suppressants on exposed surface areas and the haul roads, where practicable; • Limit high dust-generating activities (i.e. land clearing with bulldozers) to periods of low wind where possible (wind speed less than 5.4 m/s); • Set maximum speed limits on-site and have these limits enforced; • Minimise the footprint of disturbance as far as practicable; and • Minimise the drop heights when loading onto trucks and at tipping points.			
Post- mitigation			
Duration	Medium-term (3)	Dust generation will be medium-term in the construction phase	Negligible (negative) – 15
Extent	Very Limited (1)	After mitigation measures, It is expected that the dust generated will be limited to isolated parts of the site.	
Intensity	Minimal (1)	Generated dust will have minimal impacts on the ambient air quality after mitigation	

Activity and Interaction: Site Clearing, Construction of Infrastructure (Access Road, Haul Road, Storage Facility and Establishment of Pits and Waste Rock Dump)			
Dimension	**Rating**	**Motivation**	**Significance**
Probability	Unlikely (3)	Unlikely that impact on the ambient air quality will occur after mitigation.	
Nature	Negative		

9.2. Operational Phase

Activities that will be conducted during the Operational Phase that may have implications on the ambient air quality onsite and at surrounding locations i.e. increasing emission to the ambient atmosphere are indicated in Table 9-3.

Table 9-3: Interactions and Impacts of Activity

Interaction	Impact
Excavation and loading of sand	Generation of dust, leading to poor air quality; and Soiling of surfaces due to dustfall
Use of Access and Hauling Roads	
Operation of the plant	
Concurrent rehabilitation	

9.2.1. Impact Description

The reclamation of surface material, use and maintenance of access and haul roads and concurrent rehabilitation as mining progress will result in the emission of particulate matter.

9.2.1.1. Management Objectives

The management objective is to ensure that emissions on-site and at off-site locations are not in exceedance of the regulatory limits for the protection of the environment, human health, and wellbeing. Mitigation measures will be implemented to ensure that emissions remain below limit values and are in compliance with the relevant standards.

9.2.1.2. Management Actions

- Air quality monitoring to ensure compliance at upwind and downwind locations.
- Application of dust suppressants e.g. Dust-A-Side on haul roads and exposed areas to ensure compliance.
- Use of dust mitigation equipment at the plant emission sources.

9.2.1.3. Impact Ratings

The operational phase activities will require similar mitigation measures to contain emissions from certain sources to the atmosphere, hence the sources were grouped for the rating (Table 9-4).

Table 9-4: Significance Ratings for Excavation and Loading of Sand, Use of Access and Haul Roads, Operation of the Plant and Concurrent Rehabilitation

Activity and Interaction: Operation of the Excavation, Loading of Material, Use and Maintenance of Haul Road, Operation of the Plant and Concurrent Rehabilitation			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Dust generation and release of gaseous pollutants leading to poor air quality			
Prior to mitigation/ management			
Duration	Project life (5)	Dust and gaseous pollutants will be generated for the project's life	Major (negative) – 72
Extent	Municipal (4)	Pollutants may extend across the project site and beyond.	
Intensity	Serious (4)	Serious impact on ambient air quality	
Probability	Almost certain (6)	It is almost certain that the impact will occur.	
Nature	Negative		
Mitigation/ Management actions			
• Apply dust suppressants on access and haul roads, where practicable; • Reclamation should take place towards the upwind direction (i.e. towards the north, north-northeast and northeast), mining upwind, moving against the wind; • Limit high dust-generating activities (i.e. sand excavation) to periods of low wind where possible (wind speed less than 5.4 m/s); • Set maximum speed limits on-site and have these limits enforced; • Minimise the footprint of disturbance as far as practicable; • Minimise the drop heights when loading onto trucks and at tipping points; • Implement dust suppression equipment at the plant.			
Post- mitigation			
Duration	Project life (5)	Dust and gaseous pollutants will be generated for the project's life	Negligible (negative) – 27
Extent	Limited (2)	Airborne emissions will be limited to the site boundary and its immediate surrounding after mitigation.	
Intensity	Minor (2)	Minor impacts anticipated after mitigation	

Activity and Interaction: Operation of the Excavation, Loading of Material, Use and Maintenance of Haul Road, Operation of the Plant and Concurrent Rehabilitation			
Dimension	**Rating**	**Motivation**	**Significance**
Probability	Unlikely (3)	Unlikely that impacts will occur after mitigation.	
Nature	Negative		

9.3. Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts on the ambient air quality in the area and surroundings are indicated in Table 9-5.

Table 9-5: Interactions and Impacts of Activity

Interaction	Impact
Demolition and removal of infrastructure	Generation of dust Soiling of surfaces due to dustfall
Rehabilitation - spreading of subsoil and topsoil, profiling	
Post-closure monitoring and rehabilitation	

9.3.1. Impact Description

The dismantling of mine infrastructure and rehabilitation activities which will include the spreading of subsoil and topsoil, profiling, and re-vegetation of the area will involve the use of heavy machinery similar to those used in the construction phase. This will result in the release of fugitive emissions, such as TSP, $PM_{10,}$ and $PM_{2.5}$.

9.3.1.1. Management Objectives

The management objective is to ensure that emissions on-site and at off-site locations are not in exceedance of the regulatory limits for the protection of the environment. Mitigation measures will be implemented to ensure that emissions remain below limit values.

9.3.1.2. Management Actions

- Application of dust suppressants e.g. Dust-A-Side on haul roads and exposed areas to ensure compliance.

9.3.1.3. Impact Ratings

The decommissioning phase activities will require similar mitigation measures to those employed during the construction phase. The impact rating for this phase is discussed in Table 9-6.

Table 9-6: Significance Ratings for Demolition and Removal of Infrastructure, Rehabilitation, Post Closure Monitoring

Activity and Interaction: Demolition, Removal of Infrastructure and Rehabilitation			
Dimension	**Rating**	**Motivation**	**Significance**
Impact Description: Dust generation leads to poor air quality			
Prior to mitigation/ management			
Duration	Medium-term (3)	Dust will be generated in the medium term	Minor (negative) – 28
Extent	Limited (2)	Limited to each activity area and immediate surroundings.	
Intensity	Minor (2)	Minor effect on surrounding air quality is anticipated	
Probability	Probable (4)	Almost certain that generated dust will impact ambient air quality.	
Nature	Negative		
Mitigation/ Management actions			
• Application of dust suppressant on the haul roads and exposed areas; • Limit activity to non-windy days (wind speed less than 5.4 m/s); • Set maximum speed limits on dirt roads and have these limits enforced; • The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging or scraping must occur, especially on windy days; • The drop heights when loading onto trucks and at tipping points should be minimised; and • Rehabilitation of disturbed land to allow for vegetation growth.			
Post- mitigation			
Duration	Medium-term (3)	Dust will be generated in the medium term	Negligible (negative) – 15
Extent	Very Limited (1)	After mitigation measures are implemented, It is expected that the dust generated will be limited to isolated parts of the site.	
Intensity	Minimal (1)	Generated dust will have minimal impacts on the ambient air quality after mitigation	
Probability	Unlikely (3)	Unlikely that impacts will occur after mitigation.	
Nature	Negative		

9.4. Cumulative Impacts

The cumulative impacts could not be conducted as site-specific air quality data was not available to assess current background levels. However, the predicted GLCs show that future impacts will not be severe outside the project boundary and at nearby sensitive receptors.

9.5. Unplanned and Low-Risk Events

Table 9-7 highlights some likely unplanned events related to this Project. This was based on expert knowledge drawn from experience in the industry. Data on the type of incidents and frequency will assist in establishing the nature, risk type, geographic spread, and appropriate mitigation measures to curtail impacts in the event of an occurrence.

Table 9-7: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
Extreme wind erosion event	Adequate cover and care for storage facilities which will serve as protection during a wind storm event Exposed areas prone to erosions should be avoided or minimised at all times

10. Environmental Management Programme

Table 10-1 provides a summary of the proposed project activities, environmental aspects, and impacts on the receiving environment. Information on the mitigation measures, mitigation type, and timing of implementation of the Environmental Management Programme report (EMPr) are specified.

Table 10-1: Environmental Management Programme

Activity	Potential Impacts	Aspects Affected	Phase	Mitigation Measures	Mitigation Type	Time period for implementation
• Removal of vegetation / topsoil; • Construction of surface infrastructure.	Poor air quality due to the generation of dust	Air Quality	Construction	• Implement localised / activity-specific surface watering to minimise emissions; • Apply dust suppressants on exposed surface areas and the haul roads, where practicable; • Limit high dust-generating activities (i.e. land clearing with bulldozers) to periods of low wind where possible (wind speed less than 5.4 m/s); • Set maximum speed limits on site and have these limits enforced; • Minimise the footprint of disturbance as far as practicable; and • Minimise the drop heights when loading onto trucks and at tipping points.	• Ambient air quality monitoring • Control through the implementation of an air quality management plan	On commencement of the construction phase and for the duration of the phase
• Excavation and loading of sand; • Use of access and haul road; • Operation of the plant; • Concurrent rehabilitation	Poor air quality due to the generation of dust	Air Quality	Operation	• Implement localised / activity-specific surface watering to minimise emissions; • Apply dust suppressants on access and haul roads, where practicable; • Reclamation should take place towards the upwind direction (i.e. towards the north, north-northeast and northeast), mining upwind, moving against the wind; • Limit high dust-generating activities (i.e. sand excavation) to periods of low wind where possible (wind speed less than 5.4 m/s); • Set maximum speed limits on site and have these limits enforced; • Minimise the footprint of disturbance as far as practicable; • Minimise the drop heights when loading onto trucks and at tipping points; • Implement dust suppression equipment at the plant.	• Ambient air quality monitoring • Control through the implementation of an air quality management plan	Measurements must commence before the start of the operation phase and for the life of mine.

Activity	Potential Impacts	Aspects Affected	Phase	Mitigation Measures	Mitigation Type	Time period for implementation
• Dismantling and removal of infrastructure • Rehabilitation of the Project area • Post-closure monitoring and rehabilitation	Poor air quality due to the generation of dust	Air Quality	Decommissioning	• Application of dust suppressant on the haul roads and exposed areas; • Limit activity to non-windy days (wind speed less than 5.4 m/s); • Set maximum speed limits on dirt roads and have these limits enforced; • The area of disturbance must be kept to a minimum at all times and no unnecessary clearing, digging or scraping must occur, especially on windy days; • The drop heights when loading onto trucks and at tipping points should be minimised; and • Rehabilitation of disturbed land to allow for vegetation growth.	• Ambient air quality monitoring • Control through the implementation of an air quality management plan	On commencement of the decommissioning phase and for the duration of the phase

11. Monitoring Programme

It is recommended that an air quality monitoring network be set up and maintained for the LoM to ensure that generated emissions associated with the day to day activities during the reclamation are measured and assessed regularly to ensure compliance. The frequency of monitoring will ensure that diurnal, seasonal, annual, and inter-annual ambient air quality records are available to inform management decision-making. Table 11-1 shows the criteria pollutants that should be measured and the frequency of monitoring.

Table 11-1: Recommended Monitoring Plan

Method	Frequency	Target	Responsibility
Monitoring in accordance with: • EN14097 for $PM_{2.5}$; • EN12341 for PM_{10}; and • American Standard Test Method ASTM 1739-98 in SANS1137:2019	• Continuous PM_{10}, $PM_{2.5}$ monitoring;	Particulate pollutants from the ongoing mining operation must be kept below the South African standards: • GN R 1210 of 24 December 2009 • GN R 486 of June 2012; and • GN R 827 of 1 November 2013	A designated Environmental Officer (EO) is onsite to collect ambient air quality data and submit it to an independent consultant for interpretation and reporting.

12. Stakeholder Engagement Comments Received

Please refer to the Comments and Response Report, attached as Appendix C of the EIA Report for comments raised and responses provided.

13. Recommendations

Based on the results from this assessment, the following recommendations should apply:

Commission a dust monitoring network, with monitoring location onsite and at surrounding receptors before the commencement of the construction phase. Such monitoring can be conducted in accordance with the ASTM D1739-98 (Reapproved 2017), “Standard Test Method for Collection and Measurement of Dust fallout (Settleable Particulate Matter)”, 2019;

- Designate a qualified person to act as the EO, who will oversee the monitoring campaign and implement adequate mitigation measures in case of non-compliance;
- Ensure air quality information is incorporated into the environmental management information system and submit annual reports to the South African Atmospheric Emission Licensing & Inventory Portal (SAAELIP), as required by law;

- Establish codes of practice for good housekeeping concerning air quality management and mitigation, including regular appropriate restrictions on vehicle movements and speeds; and
- Monitor the air quality management measures and information to ensure that adopted mitigation measures are sufficient to achieve current air quality standards onsite and at nearby receptors.

14. Reasoned Opinion Whether Project Should Proceed

The model simulations have shown that areas where exceedances are likely to occur without mitigation measures in place are mostly confined within the footprint of the mine.

With appropriate mitigation measures and management measures in place, it is anticipated that emissions will be minimal and compliance with the standard can be attained. The air quality specialist will recommend that the EA Application be approved, provided the recommended mitigation measures are implemented.

15. Conclusion

The baseline assessment of the meteorology and air quality have been completed. The meteorology of the project area was assessed with three years' worth of modelled Lakes Environmental data. The monthly temperature average varied between 10°C - 20°C. Ambient temperatures were observed to be higher during the summer months. The total monthly rainfall records show the summer months received most of the rains (>59%), followed by Spring with 24% and Autumn with 11%. While winter received the least rainfall (less than 1%). The annual total rainfall is 221 mm, while the relative humidity records ranged between 57% and 68%.

The wind rose shows the prevailing winds are from the north northeast (15.8%), north (12.9%) and northeast (12.9%) respectively. Secondary contributions are from the north northwest (8.4%). The average wind speed was at 3.6 m/s and calm conditions occurred for some 1.0% of the time. High wind speed ≥5.4 m/s occurred for about 12.7% of the time. This equates to about 46 days in a year.

The baseline data measured in the region (not site-specific) at Leratong Hospital Krugersdorp Ambient Air Quality Monitoring Station, about 4.2 km south of the project site showed that the maximum daily concentrations of PM_{10} recorded for the period - January 2020 to September 2021 was 0.03 µg/m^3 (below the standards of 75 µg/m^3). Not a single exceedance was recorded. For the gaseous pollutants, such as SO_2, data was not available. Whereas for NO_2, CO, and O_3 the ambient levels were all below the South African ambient air quality standards.

The impacts of the operational phase of the Project were evaluated using a risk matrix that considers the nature, significance, extent, duration, and probability of such impacts occurring. Based on this rating system, impacts on the surrounding receptors from the operational phase are deemed "major negative" without mitigation. However, after mitigation, the impacts were reduced to "negligible negative". Since anticipated emissions from the operational phase activities are likely to have major impacts on some of the receptors outside the Project

boundary, with adequate mitigation and management intervention measures in place, such impacts can be minimised significantly.

Some of the mitigation measures and management intervention measures recommended are repeated and they include:

- Application of dust suppressants/binders on haul roads and exposed areas, setting maximum speed limits on haul roads and to have these limits enforced, and application of mitigation technology at the processing plant; and
- Operation of ambient air quality monitoring network to collect valuable data needed to assess the effectiveness of management mitigation measures.

Once the mine implements the recommendations outlined in this report, emissions from mining operations can be contained to lower than the regulatory limits, thus, ensuring compliance with South African ambient air quality standards.

16. References

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Appendix A: Impact Assessment Ranking

The potential impacts from the proposed Project have been assessed based on the severity predicted on-site and at sensitive receptor(s). This culminates in a significance rating which identifies the most important impacts that require mitigation and/or management.

Based on international guidelines and South African legislation, the following criteria were considered when examining potentially significant impacts:

- Nature of impacts (direct / indirect, positive / negative);
- Duration (short / medium / long-term, permanent (irreversible) / temporary (reversible), frequent / seldom);
- Extent (geographical area, size of affected population / habitat / species);
- Intensity (minimal, severe, replaceable / irreplaceable);
- Probability (high / medium / low probability); and
- Possibility to mitigate, avoid or offset significant adverse impacts.

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

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

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

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

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven as indicated in Table 16-1. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts. Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the Environmental Management Plan Report (EMPr).

The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 16-2, which is extracted from Table 16-1. The description of the significance ratings is discussed in Table 16-3.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 16-1: Impact Assessment Parameter Ratings

RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	Positive impacts			
7	Irreplaceable damage to highly valued items of great natural or social significance or complete breakdown of natural and / or social order.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable damage to highly valued items of natural or social significance or breakdown of natural and / or social order.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Very serious widespread natural and / or social baseline changes. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.

RATING	INTENSITY/REPLACABILITY		EXTENT	DURATION/REVERSIBILITY	PROBABILITY
	Negative impacts	Positive impacts			
4	On-going serious natural and / or social issues. Significant changes to structures / items of natural or social significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	On-going natural and / or social issues. Discernible changes to natural or social baseline.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor natural and / or social impacts which are mostly replaceable. Very little change to the baseline.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	Minimal natural and / or social impacts, low-level replaceable damage with no change to the baseline.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 16-2: Probability/Consequence Matrix

Probability	Significance																																									
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 16-3: Significance Rating Description

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