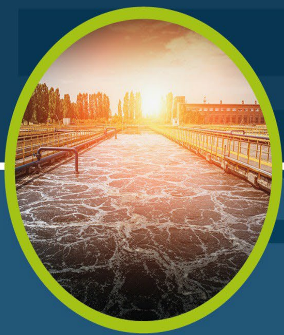
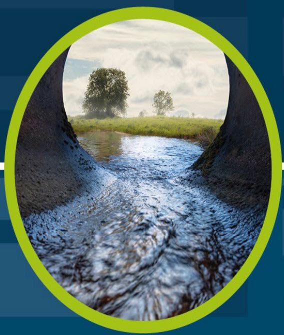
Application Reference : Gaut 002/24-25/E0003

PROPOSED DEVELOPMENT OF A NEW MALTING PLANT IN SEDIBENG DISTRICT MUNICIPALITY

APPENDIX G – SPECIALIST REPORTS

Royal HaskoningDHV
Enhancing Society Together

Appendix G1:
Air Quality

Royal HaskoningDHV
Enhancing Society Together

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE
Air Quality Impact Assessment: New Malting Facility, Sedibeng, Gauteng Province

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with '*the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)*', where applicable.

1. SPECIALIST INFORMATION

Title of Specialist Assessment	Air Quality Impact Assessment: New Malting Facility, Sedibeng, Gauteng Province
Specialist Company Name	Airshed Planning Professionals Pty (Ltd)
Specialist Name	Marilize Steyn
Specialist Identity Number	[redacted]
Specialist Qualifications:	MEng, MSc
Professional affiliation/registration:	
Physical address:	[redacted]
Postal address:	[redacted]
Postal address	[redacted]
Telephone	[redacted]
Cell phone	[redacted]
E-mail	[redacted]

2. DECLARATION BY THE SPECIALIST

I, Marilize Steyn declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- 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 NEMA Act.

[redacted]

Signature of the Specialist

Airshed Planning Professionals Pty (Ltd)

Name of Company:

19 Jul 2024

Date

BAHAL SINGH GILL • PUBLIC NOTARY • ADE [redacted] STRALIA

BAHAL SINGH GILL
SOLICITOR & PUBLIC NOTARY
SUITE 8/70, WALKERVILLE TERRACE
WALKERVILLE
SOUTH AUSTRALIA 5081
M: +61 (0)423 405 381
DATED: 19th JULY 2024

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _ Marilize Steyn_________, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

[redacted]

Signature of the Specialist

Airshed Planning Professionals Pty (Ltd)

Name of Company

19/07/2024

Date

[redacted]sioner of Oaths

19th July 2024.

Date

BAHAL SINGH GILL • PUBLIC NOTARY • ADELAIDE [redacted]

BAHAL SINGH GILL
SOLICITOR & PUBLIC NOTARY
SUITE 8/70, WALKERVILLE TERRACE
WALKERVILLE
SOUTH AUSTRALIA 5081
M: +61 (0)423 405 381
DATED: 19th July 2024

AIRSHED
PLANNING PROFESSIONALS

AIR QUALITY IMPACT ASSESSMENT REPORT:
New Malting Facility
Sedibeng, Gauteng Province

Project done on behalf of **Royal Haskoning DHV (Pty) Ltd**

Project Compiled by:
M Steyn

Project Manager
T Bird

Report No: 23RHD03 Revision 3 | **Date:** 3 October 2024

Address: 62 Constantia Avenue, Mnandi AH, Centurion
Postal: PostNet Suite #18 Private Bag x59, Halfway House, 1685
Tel: +27 (0)11 805 1940

Report Details

Project Name	Air Quality Impact Assessment Report: New Malting Plant, Sedibeng DM
Client	Royal Haskoning DHV (Pty) Ltd
Report Number	23RHD03
Report Version	Revision 3
Date	October 2024
Prepared by	Marilize Steyn, MEng (Env Eng) (University of Pretoria)
Reviewed by	Terri Bird, Pr.Sci.Nat, PhD (Wits)
Notice	Airshed Planning Professionals (Pty) Ltd is a consulting company located in Midrand, South Africa, specialising in all aspects of air quality, ranging from nearby neighbourhood concerns to regional air pollution impacts as well as noise impact assessments. The company originated in 1990 as Environmental Management Services, which amalgamated with its sister company, Matrix Environmental Consultants, in 2003.
Declaration	Airshed is an independent consulting firm with no interest in the project other than to fulfil the contract between the client and the consultant for delivery of specialised services as stipulated in the terms of reference.
Copyright Warning	Unless otherwise noted, the copyright in all text and other matter (including the manner of presentation) is the exclusive property of Airshed Planning Professionals (Pty) Ltd. It is a criminal offence to reproduce and/or use, without written consent, any matter, technical procedure and/or technique contained in this document.

Revision Record

Revision Number	Date	Reason for Revision
Draft	12 July 2024	Draft for client review
Rev 1	30 July 2024	Incorporating client comments
Rev 2	23 September 2024	Clarifications added to section 4.1.1
Rev 3	3 October 2024	Cumulative impact table added. Recommendation for pre- and post-commissioning passive ambient monitoring to establish contribution to cumulative impact. Recommendation added for the development of an air quality management plan (section 5.7.3)

Executive Summary

Malteries Soufflet operates more than 41 malting plants worldwide and is currently the biggest maltster in the world. Through its operations, the Group has developed extensive knowledge in the malt processing to achieve high quality malt and to optimize energy consumption. The proposed project involves the establishment of a Malting Plant located in the Sedibeng District Municipality of Gauteng, South Africa.

The Facility is to be established at Graceview Industrial Park in Sedibeng which is located in the southern part of Gauteng. The site has been zoned as an industrial development area. Graceview Industrial Park is selected as the best location for the following reasons:

- Strategically located next to potential customers
- Availability of ample land for industrial zone development
- Located in close proximity to the national highway network
- Ease of access to raw materials, and
- Availability of variety of types of labour and creation of employment opportunities.

Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed by Royal Haskoning DHV (Pty) Ltd to conduct an air quality impact assessment for the project. The main objective of the air quality study is to determine air quality related impacts as a result of the proposed Sedibeng Malting Plant.

The meteorological data set used in the dispersion modelling was measured data for 2021 to 2023 from the Kliprivier monitoring station. The wind field at the site is dominated by winds from the north-east and north-west, with winds infrequently from the south and south-east. Calm conditions occurred 3.8% of the period, more frequently during the night (3.9%). During the day, winds at higher wind speeds occurred more frequently from the north-east. Night-time airflow was dominated by north-westerly winds. The terrain within the study domain contains gentle terrain features – especially to the northwest and west - that may influence the dispersion of pollutants and therefore topography was included in the model.

The proposed facility is located in the Vaal Triangle Airshed Priority Area (VTAPA) where the main background sources include: household fuel combustion; industrial sources; vehicle tailpipe emissions; biomass burning (for example, veld fires); and, various miscellaneous fugitive dust sources. The Kliprivier air quality monitoring station (AQMS) is located approximately 1.8 km north-east of the proposed facility and measured pollutant concentrations between 2021 and 2023 indicated that SO_2, NO_2, and CO comply with NAAQS over all applicable averaging periods. Daily PM_{10} and $PM_{2.5}$ concentrations measured at the Kliprivier AQMS were in non-compliance with the applicable NAAQS between 2021 and 2023.

Boilers with a design capacity equal to 10 MW but lower than 50 MW net heat input per unit (based on the lower calorific value of the fuel used) were declared as controlled emitters (Notice number 831, 1 November 2013) in terms of section 23 of National Environmental Management Air Quality Act (NEMAQA). It is recommended that the requirement to register as a controlled emitter in terms of section 23 be reviewed once equipment selection has been finalised for the backup boilers, as well as, the CHP.

The main findings from the air quality impact assessment are:

- Ambient air quality data from the Kliprivier AQMS shows compliance with short-term SO_2, NO_2 and CO standards, although short-term peak concentrations can occur. Daily PM_{10} and $PM_{2.5}$ concentrations as well as 8-hour rolling average O_3 concentrations were in non-compliance with the NAAQS.

- Emissions quantification and dispersion modelling show that the New Malting Plant does not result in a substantive concentrations of criteria air pollutants (SO_2, NO_2, CO, VOCs, PM_{10}, and $PM_{2.5}$).
- Increased odour impacts are possible at receptors located towards the south and south-west of the facility, but the quantum of the impacts are likely to be overestimated by this assessment.

Recommendations for ambient and source monitoring have been made to ensure that PM and NOx emissions from the facility are controlled and remain within the specifications provided by the equipment suppliers. It is further recommended that periodic inspections be conducted to identify dust and odour sources and implement corrective actions where necessary. It is further recommended that complaints registers be kept for both odour and PM and any corrective action taken be detailed in the register. It is recommended that, if an on-site WWTP is commissioned, an on-site wastewater treatment plant (WWTP) be designed using best practice principles to reduce the impact of odours on surrounding communities. It is recommended that a comprehensive air quality management plan (AQMP) be developed. The AQMP should contain detailed plans for the implementation of all the recommendations contained in section 5.7 of this report, provide for stakeholder engagement and detailed plans for the management of complaints. The AQMP should include provisions for regular reviews of mitigation measures. It is recommended that the AQMP be submitted to the regulator for review and approval prior to the commissioning of the facility.

It is the opinion of the specialist that the project, with effective mitigation measures implemented and corrective action taken when necessary, has a low impact on ambient air quality beyond the property boundary. Regular maintenance of control equipment and continued monitoring of sources (including all baghouses and kilns) is recommended along with periodic ambient monitoring.

Table of Contents

List of Tables

List of Figures

Abbreviations

AEL	Atmospheric Emissions Licence
AERMOD	A dispersion modelling suite
Airshed	Airshed Planning Professionals (Pty) Ltd
AMS	American Meteorological Society
AQIA	Air Quality Impact Assessment
AQMS	Air quality monitoring station
AQMP	Air quality management plan
AQSRs	Air Quality Sensitive Receptor(s)
AST	Anemometer starting threshold
ASTM	American Society Testing and Materials (now ASTM International)
CLRTAP	Convention on Long Range Trans-boundary Air Pollution
DEA	Department of Environmental Affairs (now DFFE)
DFFE	Department of Forestry, Fisheries, and Environment (previously DEA)
EIA	Environmental Impact Assessment
NAAQ Limit	National Ambient Air Quality Limit concentration
NAAQS	National Ambient Air Quality Standards (as a combination of the NAAQ Limit and the allowable frequency of exceedance)
NDCR	National Dust Control Regulations
NEMA	National Environmental Management Act
NEMAQA	National Environmental Management Air Quality Act
NPI	Australian National Pollution Inventory (published by the Australian Department of the Environment)
SAAQIS	South African Air Quality Information System
SAWS	South African Weather Services
VTAPA	Vaal Triangle Airshed Priority Area
UNECE	United Nations Economic Commission for Europe
US EPA	United States Environmental Protection Agency
WWTP	Wastewater treatment plant

Glossary

Air pollution[(a)]	The presence of substances in the atmosphere, particularly those that do not occur naturally
Dispersion[(a)]	The spreading of atmospheric constituents, such as air pollutants
Dust[(a)]	Solid materials suspended in the atmosphere in the form of small irregular particles, many of which are microscopic in size
Frequency of exceedance	Permissible margin of tolerance of the Limit Concentration
Instability[(a)]	A property of the steady state of a system such that certain disturbances or perturbations introduced into the steady state will increase in magnitude, the maximum perturbation amplitude always remaining larger than the initial amplitude
Limit Concentration	Maximum allowable concentration of a pollutant applicable for an applicable averaging period
Mechanical mixing[(a)]	Any mixing process that utilizes the kinetic energy of relative fluid motion
Oxides of nitrogen (NO_x)	The sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2) expressed as nitrogen dioxide (NO_2)
Particulate matter (PM)	Total particulate matter, that is solid matter contained in the gas stream in the solid state as well as insoluble and soluble solid matter contained in entrained droplets in the gas stream
PM_{10}	Particulate Matter with an aerodynamic diameter of less than 10 µm
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter of less than 2.5 µm
Stability[(a)]	The characteristic of a system if sufficiently small disturbances have only small effects, either decreasing in amplitude or oscillating periodically; it is asymptotically stable if the effect of small disturbances vanishes for long time periods
Standard	A combination of the Limit Concentration and the allowable frequency of exceedance

Notes:

(a) Definition from American Meteorological Society's glossary of meteorology (AMS, 2014)

Symbols and Units

°C	Degree Celsius
CO	Carbon monoxide
g	Gram(s)
g/s	Grams per second
ha	Hectare
kg	Kilograms
1 kilogram	1 000 grams
km	Kilometre
l/s/t	Litres per second per tonne
m	Metres
mamsl	Metres above mean sea level
m/s	Metres per second
µg	Microgram(s)
$\mu g/m^3$	Micrograms per cubic metre
µm	Micrometre
mg/m^3	Milligram per cubic meter
m^2	Square metre
m^3	Cubic metre
m^3/hr	Cubic metre per hour
$mg/m^2.day$	Milligram per square metre per day
m^3/hr	Cubic metre per hour
mm	Millimetres
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
O_3	Ozone
O&M	Operations and Maintenance
PM	Particulate Matter
PM_{10}	Thoracic particulate matter (aerodynamic diameter less than 10 µm)
$PM_{2.5}$	Inhalable particulate matter (aerodynamic diameter less than 2.5 µm)
SO_2	Sulfur dioxide (1)
t/a	Tonnes per annum
TSP	Total Suspended Particulates
VOC	Volatile Organic Compounds
1 tonne	1 000 000 grams

Notes:

(1) The spelling of "sulfur" has been standardised to the American spelling throughout the report. The International Union of Pure and Applied Chemistry, the international professional organisation of chemists that operates under the umbrella of UNESCO, published, in 1990, a list of standard names for all chemical elements. It was decided that element 16 should be spelled "sulfur". This compromise was to ensure that in future searchable data bases would not be complicated by spelling variants. (IUPAC. Compendium of Chemical Terminology, 2nd ed. (the "Gold Book"). Compiled by A. D. McNaught and A. Wilkinson. Blackwell Scientific Publications, Oxford (1997). XML on-line corrected version: http://goldbook.iupac.org (2006) created by M. Nic, J. Jirat, B. Kosata; updates compiled by A. Jenkins. ISBN 0-9678550-9-8.doi: 10.1351/goldbook)"

NEMA Regulation (2017), Appendix 6

NEMA Regulations - Appendix 6	Relevant section in report
Details of the specialist who prepared the report.	Report Details (page i)
The expertise of that person to compile a specialist report including curriculum vitae.	Appendix A: Impact Assessment Methodology Appendix B: Authors Curriculum Vitae (page 43)
A declaration that the person is independent in a form as may be specified by the competent authority.	Report Details (page i)
An indication of the scope of, and the purpose for which, the report was prepared.	Background and Context (page 1) Purpose and Scope (page 1)
An indication of quality and age of base data used.	Section 5.4
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	Sections 5.1; 5.2; 5.3, 5.5 and, 6
The date and season of the site investigation and the relevance of the season to the outcome of the assessment.	No site investigation was conducted. Description of the current land use in the region, simulations undertaken for the current operations and meteorological data included used in the study are considered representative of all seasons.
A description of the methodology adopted in preparing the report or carrying out the specialised process.	Section 5.1.1: Study Methodology (page 15)
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.	Section 1
An identification of any areas to be avoided, including buffers.	Section 5.1.2.4
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.	Section 1.3
A description of any assumptions made and any uncertainties or gaps in knowledge.	Sections 4 and 5.4
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment.	Section 5.1: Analysis of Emissions' Impact on Human Health (page 15) Section 5.2: Analysis of Emissions' Impact on the Environment (page 35) Section 5.3 Analysis of Emissions' Impact on Odour (page 36) Section 5.6: Impact Assessment (page 40)
Any mitigation measures for inclusion in the EMPr.	Section 5.7
Any conditions for inclusion in the environmental authorisation	Section 5.7
Any monitoring requirements for inclusion in the EMPr or environmental authorisation.	Section 5.7
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised.	Section 5.7: Recommendations
If the opinion is that the proposed activity 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.	Section 5.7: Recommendations
A description of any consultation process that was undertaken during the course of carrying out the study.	Not applicable.
A summary and copies if any comments that were received during any consultation process.	Comments received will be dealt with by the EAP through the S&EIA process and will be recorded in the associated reports.
Any other information requested by the competent authority.	None

1. INTRODUCTION

1.1 Background and Context

Malteries Soufflet operates more than 41 malting plants worldwide and is currently the biggest maltster in the world. Through its operations, the Group has developed extensive knowledge in the malt processing to achieve high quality malt and to optimize energy consumption. The proposed project involves the establishment of a Malting Plant located in the Sedibeng District Municipality of Gauteng, South Africa.

The Facility is to be established at Graceview Industrial Park in Sedibeng which is located in the southern part of Gauteng. The site has been zoned as an industrial development area. Graceview Industrial Park is selected as the best location because of the following reasons:

- Strategically located next to potential customers;
- Availability of ample land for industrial zone development;
- Located in close proximity to the national highway network;
- Ease of access to raw materials; and,
- Availability of variety of types of labour and creation of employment opportunities.

Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed by Royal Haskoning DHV (Pty) Ltd to conduct an air quality impact assessment for the project. The main objective of the air quality study is to determine air quality related impacts as a result of the proposed Sedibeng Malting Plant.

1.2 Purpose and Scope

The main purpose of the project is to develop an air quality impact assessment report for the proposed Sedibeng Maltings Plant, which included the following tasks are included in the scope of work:

1. Review of ambient air quality monitoring information (if available).
2. Review of guidelines and standards against which air emissions, ambient air quality and inhalation health impacts are assessed and/or screened.
3. Study of physical environmental parameters that influence the dispersion of pollutants in the atmosphere, including terrain, land use and meteorology.
4. Identification and quantification of *routine* air quality emissions from the facility.
5. Atmospheric dispersion modelling to determine ground level pollutant concentrations.
6. A health risk and environmental screening study based on predicted ground level pollutant concentrations in comparison with selected air quality criteria.
7. A comprehensive report.

1.3 Location and Extent of the Plant

The proposed Malting Plant is located within the Graceview Industrial Park in Sedibeng, located in the southern part of Gauteng. The site has been zoned as an industrial development area. The proposed facility layout is provided in Figure 1-1. The closest residential areas are Sky City located towards the north-east of the facility and several dwellings located to the south, south-east and south-western areas of the facility. In accordance with the Regulations Regarding Air Dispersion Modelling (DEA, 2014), hospitals, clinics, and schools were identified as air quality sensitive receptors (AQSRs) (Figure 1-2 and Table 1-1) and were included in the dispersion model setup as discrete receptors. Additional receptors were included to represent residential buildings located in close proximity to the facility.

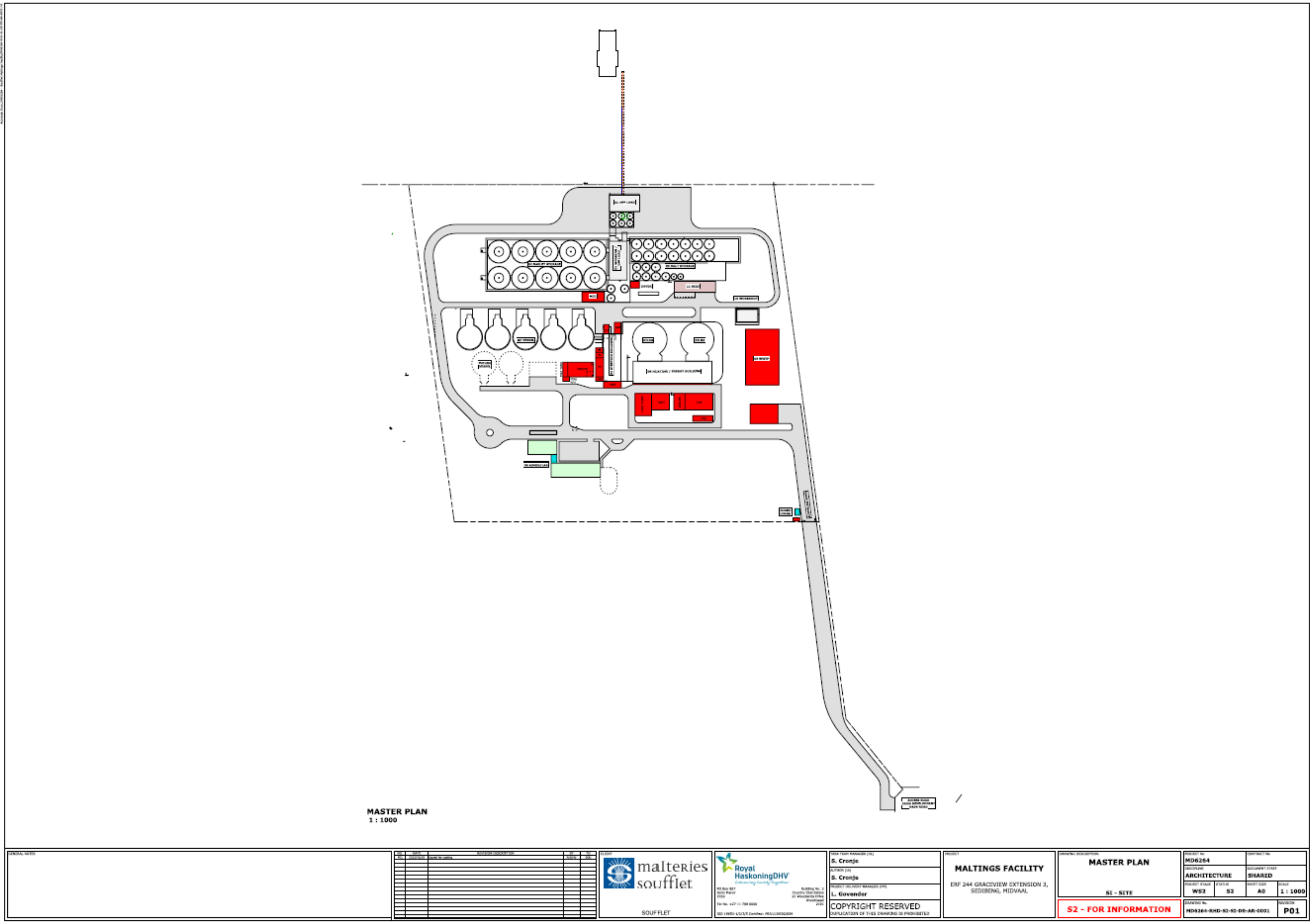


Figure 1-1: Site Layout for the proposed New Malting Plant

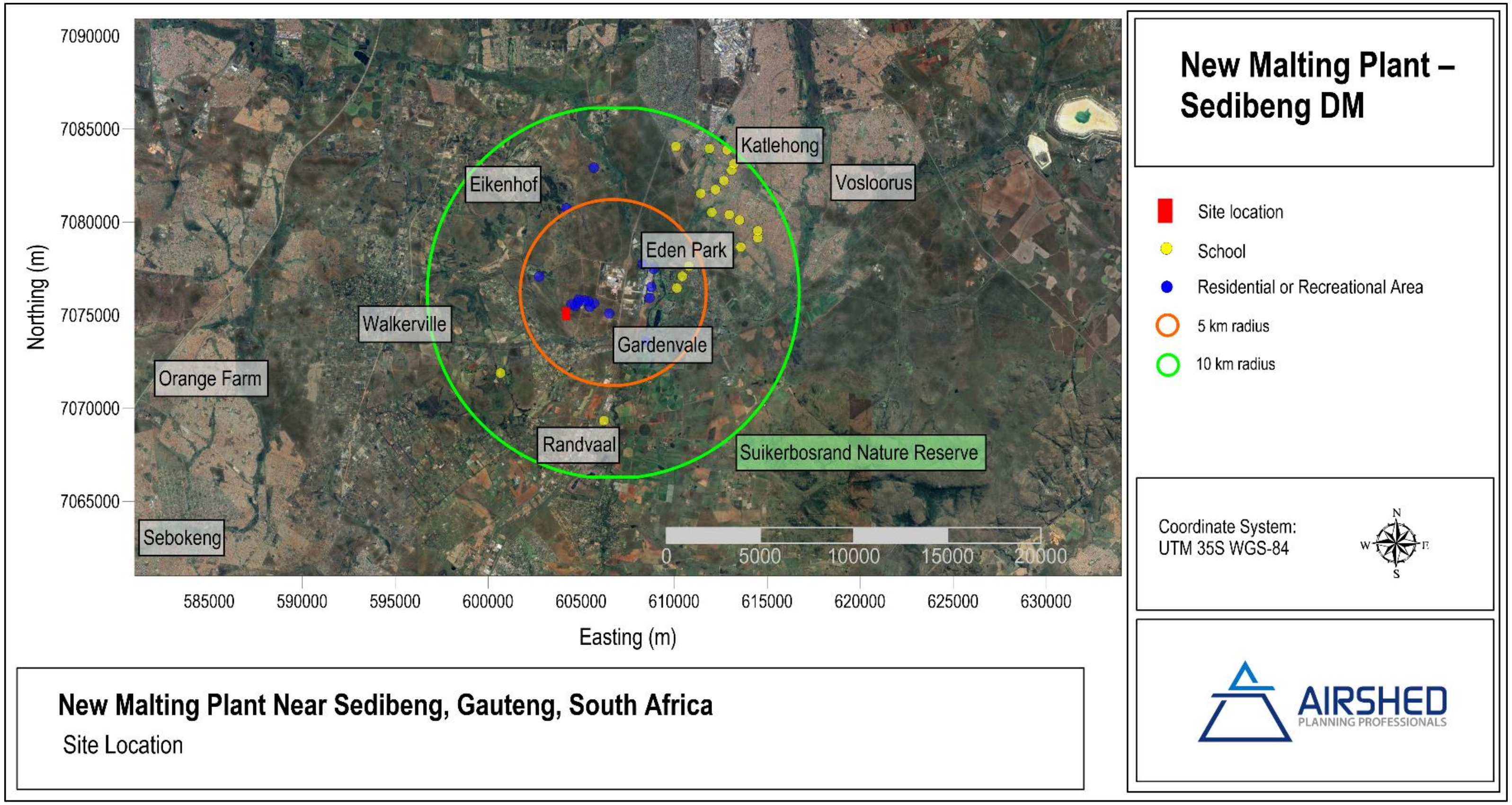


Figure 1-2: Location of the map of the facility in relation to its surroundings

Table 1-1: List of AQSRs within 10 km of the site and Residential or Recreational Facilities in close proximity to the facility

Receptor name	Distance from site (km)	Latitude	Longitude
Hanlie's Daycare	3.8	28.1045895	-26.4278193
Sibonile School for the Blind	4.3	28.1073626	-26.4221827
Royal School Sky City	8.8	28.1109395	-26.4171452
Greenfields Secondary School	6.8	28.1229003	-26.3910016
Pheasant Folly Primary School	7.2	28.1386914	-26.4076844
Palmridge Ext 6 Secondary School	8.2	28.1478844	-26.403224
Realeboha Primary School	8.4	28.1478078	-26.3996857
Edenridge Secondary School	7.8	28.1379466	-26.3946357
Greenfields Primary School	7.5	28.1324826	-26.3920434
Eden Ridge Primary School	7.1	28.1170372	-26.3819067
Stoneridge Primary School	7.8	28.1247553	-26.3798868
Edenpark Secondary School	8.4	28.1293403	-26.3755099
Royal Schools Alberton	8.5	28.1033081	-26.3591366
Tiietsong Secondary School	9.7	28.1309519	-26.3606605
Mohlodi Primary School	9.1	28.1334428	-26.370443
Nqubela Primary School	9.5	28.1346234	-26.367349
Encochoyini Primary School	9.2	28.1214247	-26.3600923
Randvaal Primary School	7.1	28.0657477	-26.4924793
Bosco Youth Centre	7.5	28.009789	-26.4698084
Residential or Recreational Facility	1.1	28.0679878	-26.4404792
Residential or Recreational Facility	1.5	28.059863	-26.435584
Residential or Recreational Facility	1.4	28.0575523	-26.4373051
Residential or Recreational Facility	1.6	28.0567992	-26.4346664
Residential or Recreational Facility	1.9	28.0545358	-26.4342667
Residential or Recreational Facility	2.0	28.0515557	-26.4337766
Residential or Recreational Facility	2.1	28.0511093	-26.4353388
Residential or Recreational Facility	2.3	28.0497749	-26.4370031
Residential or Recreational Facility	4.0	28.047833	-26.4362068
Residential or Recreational Facility	4.9	28.0301595	-26.4228616
Residential or Recreational Facility	6.5	28.0445744	-26.3895632
Residential or Recreational Facility	2.2	28.0591708	-26.3698088
Residential or Recreational Facility	2.5	28.0861205	-26.4165226
Residential or Recreational Facility	2.1	28.0920463	-26.4185181
Residential or Recreational Facility	2.0	28.0907057	-26.4274958
Residential or Recreational Facility	3.3	28.0898212	-26.4327979
Residential or Recreational Facility	3.5	28.0882147	-26.4540143

2 NATURE OF THE PROCESS

2.1 Process Description

The developers plan to establish a malt production plant with an annual capacity of 100 000 tonnes (per year) in Phase 1 and 135 000 tonnes (per year) in Phase 2 for the local market. The malting production process combines four separate stages:

- Barley Intake and Storage;
- Steeping: Initiation of growth through forced grain hydration;
- Germination: Controlled growth of barley to facilitate endosperm modification; and,
- Kilning: The termination of grain growth to fix extract potential and malt specifications through grain dehydration.

Following harvest barley must be sufficiently dried to prevent germination and reduce the risk of microbial infections occurring prior to use. If dried incorrectly the quality of the grain will deteriorate in store. Barley harvested from the field will vary in moisture content from around 13% in a dry year to 20% in a wet year. Whatever the moisture at intake, barley must be dried down to about 13% for safe storage. Above 13% moisture, the grain is susceptible to insect attack. After drying, barley is cooled and stored until it is ready for use. During storage the grain respires, even though at a low rate, and must be kept fresh by aeration. All (medium to long term) barley silos are fitted with low volume fans for this purpose. The barley is cleaned using vibrating screens and sieves, in combination with air jets and magnets. These act to remove any non-barley material that is not of equal size or weight.

The process of malting is the forced growth of the barley grain to achieve the required endosperm modification. By allowing the grain to germinate under controlled conditions, the ability of the grain to produce hydrolytic enzymes can be manipulated. Hydrolytic enzymes released during germination are required to partially degrade (or modify) the starchy endosperm during malting and later to release fermentable extract during mashing. The steeping process for Soufflet Malting project will be carried out using eight cylindrical stainless-steel tanks. The processes that take place during steeping are as follows:

- Moisture content of the grain is increased to 40% - 45%;
- Increased respiration rate;
- Initiation of enzymatic activity that will continue during the germination phase;
- Washing dust off and leaching of substances from outer layers of grains;
- Production of waste steep liquors with high biological oxygen demand (BOD);
- "Chitting" - the appearance of the coleorhiza, surrounding the first rootlet.

After steeping, the activated and chitted barley at about 42% moisture is transferred into the germination vessel and levelled. The germination process consists of five days of actively managing the aerobic respiration process that was activated during steeping. Oxygen and moisture must be provided to the barley, and the carbon dioxide (CO_2) and heat generated must be dissipated by aeration. Apart from helping to maintain bed hydration, circulating air replenishes the supply of oxygen for the grain and purges out any CO_2 that could stifle respiration. By maintaining air circulation, cooling of the grain bed is also accomplished.

Following the completion of germination, the green malt is transferred to the kiln for finishing. The proposed project plans to install two circular kilns with a capacity of 250 tonnes each , with both being installed during Phase 1. The kilning section of the malting plant, contained in two floors (one per each kilning stage) located side by side and a so called “energy building” for kiln fans, heating system, heat recovery, air ducts and flaps. In order to reduce heat consumption, a glass tube heat exchanger allows recovering heat from air going out of the kiln to air coming in. Drying occurs in two different stages. Initially, moisture is removed from the grain from approximately 44% to 12%. With an upward flow of air, this process takes approximately 12 to 24 hours to pass through the bed for a double-deck kiln, depending upon the airflow. This phase of drying is rapid and is referred to as the "free-drying" or "withering" stage. The second phase of drying where the malt is dried from 12% to 4% occurs in a much slower process, commonly referred to as the "curing" stage.

Energy to power the proposed prosed will be provided through a combined heat and power genset (CHP) with a capacity of 8 MW of heating energy, 4 MW of cooling energy and 3 MW of electrical power through the CHP Plant, heat pumps and heat exchangers. Approximately 94 GWh (338.4 TJ) of liquified natural gas (LNG) will be used in the CHP annually, in Phase 2 of the project. Two 8 MW back-up boilers (using LNG) are planned for when the CHP is unavailable due to maintenance and breakdowns. The cooling system will use ammonia as a refrigerant in a closed loop system with a total storage capacity of 2 000 m^3. Significant emissions from the refrigeration system would potentially only be through a loss of containment event. Minor emissions may occur due to fugitive losses (not estimated).

The malting process consumes large amounts of water on a daily basis. The expected water usage for the current mandate based on the process mass energy balance spreadsheet is projected at 1 000 m^3/day at peak load. The arrangement of the water storage tanks is described below:

- One (1) freshwater tank of 1 000 m^3 available water storage volume. This volume includes 10% spare capacity for malt production usage demand for 24 hours.
- One (1) process water tank of 1 000 m^3 available water storage volume. This volume including the option to be 50% recycled water.

It is uncertain at this stage of project design, if liquid effluent from the process is likely to be discharged to an off-site wastewater treatment plant (WWTP) or treated at an on-site WWTP. In total (including domestic sewage from the Administration building) approximately 575 m^3 per day (in Phase 1[1]) will be generated. Effluent will be temporarily stored in a concrete tank below the steeping building that will have a capacity of 1 000 m^3.

2.2 Unit Processes

The unit processes associated with the New Malting Plant are listed in Table 2-1. All processes are batch-type processes operating as required by sales demand to meet client specifications.

Table 2-1: The unit processes

Unit Process	Function of Unit Process	Batch or Continuous Process
Baley intake and storage	Barley is delivered to the facility and screened to remove any non-barley material. The barley is dried to less than 13% moisture. Dried barley is stored in silos (eight silos for phase 1 and a total of 10 for phase 2) with a storage capacity of 4 200 tonnes each.	Batch (intake) Continuous (storage)
Steeping	Barley is immersed in water at a given temperature in order to increase the moisture content and to initiate germination. During steeping, hydration rejuvenates the barley grain and respiration recommences. The steeping process will be carried out using eight cylindrical stainless-steel tanks with a capacity up to 68 tonnes each.	Batch
Germination	The barley is transferred to the germination vessels (five vessels in phase 1 and a total of seven for phase 2) where the germinating barley in a 1.4 m thick bed on a perforated floor. Each box is equipped with a turning machine and a loading and unloading screw, a 180 000 m^3/h fan capacity for keeping temperature in the barley bed within suitable	Batch

[1] Linear estimate for Phase 2 based on malt production is ~780 m^3

Unit Process	Function of Unit Process	Batch or Continuous Process
	limits and air conditioning system (cooling and humidification). The germination process consists of five days of actively managing the aerobic respiration process that was activated at steep.	
Kilning	Following the completion of germination, the green malt is transferred to the kiln for finishing in two circular kilns (capacity 250 tonnes each), with both being installed during phase 1. The kilning section of the malting plant, contained in two floors (one per kilning stage) located side by side and a so called “energy building” for kiln fans, heating system, heat recovery, air ducts and flaps. In the energy building, they are four fans (two per floor operating in parallel) with a capacity of about 450 000 m^3/h each, together with hot water exchangers.	Batch
Malt Storage	The malt storage capacity will consist of 12 malt cylindro-conical malt cells in Phase 1, with an additional six cells having a capacity of 700 tonnes each. There will be another eight buffer cells (1 batch capacity) and some bins for malt expedition and by-products storage.	Continuous

3 TECHNICAL INFORMATION

Raw material consumption rates (for all materials more than 0.1 tonnes per annum) for the New Malting Plant are tabulated in Table 3-1, while production rates are tabulated in Table 3-2. The proposed project also generates by-products from the production process including straw, husk, thin grains and broken grain which cannot be used in the process but are not considered waste. The quantity of these by-products estimated between 3 500 and 6 000 tonnes per year in Phase 1 and 10 000 tonnes per year for Phase 2. The facility is likely to generate wastewater. It is anticipated that wastewater will be generated from the industrial processing and sanitation facilities. The quantity of wastewater that will be discharged during phase 1 and phase 2 stages of the project is estimated to be 200 000 m^3/year and 260 000 m^3/year respectively.

3.1 Raw Material Used and Production Rates

Table 3-1: Raw materials consumption rates

Plant Area	Material Type	Quantity Phase 1	Quantity Phase 2
Barley Intake and Storage	Raw Barley	125 000 tonnes/annum	170 000 tonnes/annum
Water	Process Water	250 000 m^3	323 000 m^3

3.2 Production Rates

Table 3-2: Production rates

Product	Maximum Production Capacity (Quantity)	Design Production Capacity (Quantity)	Actual Production Capacity (Quantity)	Units (Quantity/Period)	Monthly production[(a)] [tonnes]
Malt	135 000	135 000	n/a	tonnes/annum	11 250
By-product	10 000	10 000	n/a	tonnes/annum	833

4 ATMOSPHERIC EMISSIONS

4.1.1 Point and Fugitive Sources

Point source emissions from the operation of the New Malting facility includes three gas powered combined heat and power (CHP) units, two standby boilers and a barley dryer. It was assumed that off gas from the CHP unit will be used as an indirect heat source for the Dryer. The boilers are planned to be used only when required and will not be operated continuously. Similarly, the Dryer will only be utilised when raw barley requires drying.

To obtain a worst-case impact scenario it was assumed that the CHP operates at full capacity, one boiler is operating at full capacity and off gas with the same emissions as the CHP off gas, is utilised in the Dryer. Since it was not known how much off gas would be diverted, it was assumed that the CHP runs at full capacity and the dryer utilises CHP off gas in excess of what would normally be produced by the CHP to heat the air through the dryer from 25 °C to 33 °C. Under normal operation it is expected that the CHP runs continuously and that back-up boilers and the dryer are not utilised.

Fugitive sources include: barley storage and handling, emissions from the kiln, and the paved access road along which vehicle entrainment of particulates and vehicle exhaust emissions are to occur. Pollutants of concern from the fugitive sources include: oxides of nitrogen (NO_X); carbon monoxide (CO); volatile organic compounds (VOCs); and particulate matter in the coarse (total suspended particulates – TSP) and fine (PM_{10} and $PM_{2.5}$) fractions.

Particulate matter from the barley intake, cleaning and storage was assumed to be contained in a closed system and passed through a filter prior to release to the atmosphere. An emission limit of 10 mg/m^3 was utilised to calculate PM emissions and it was assumed that PM was continuously emitted at the limit value, thereby providing a conservative estimate of the PM emissions which may overestimate actual PM emissions. The air flow through the silos (aeration rate) was assumed to be 3 litres per second per tonne (l/s/t) (GRDC, 2004) and all silos were assumed to be 80% full.

The Sasol Gas marketing specification of 15 mg sulphur/Nm^3 was utilised to quantify SO_2 emissions from the CHP. The SO_2 emissions are very low due to the low sulphur content of the gas and was not modelled as the ambient impact can be considered negligible.

The cooling system will use ammonia as a refrigerant in a closed loop system with a total storage capacity of 2 000 m³. Significant emissions from the refrigeration system would potentially only be through a loss of containment event. Minor emissions may occur due to fugitive losses (not estimated).

Odourous compounds are most likely to be released from the on-site WWTP (if developed) and could potentially arise during the malting process. The emissions from the malting plant utilised for the odour assessment were based on a study by PAEHolmes (2009). The study utilised measured data from an operation malting facility to assess the potential emissions from a proposed facility. The emission rates utilised for the PAEHolmes (2009) study were scaled for malt production throughput and used as a basis for this study. The majority of the odour emissions were measured from kilning operations (>92%). Significant odour emissions are not expected from the germination and steeping processes. The kiln emissions were assumed to be released to atmosphere from the heat and energy building. The emission rates utilised were based on the measured emissions from an older existing facility and may be an overestimation of the emissions from a new facility with newer technology. The odour assessment should therefore be utilised to assess whether odour effects could potentially occur and which areas could potentially be affected by such occurrences.

Odour emissions could result from on-site storage and treatment of wastewater. There is some uncertainty if the wastewater will be discharged for off-site treatment or if an on-site WWTP will be commissioned. Because of this uncertainty, any design detail of the WWTP and the composition of the wastewater was not available at the time of the assessment. Therefore, off-site treatment was assumed, and potential odour impacts from this facility was not quantified. It is assumed that if a new on-site WWTP was commissioned it would be designed using best practice measures to minimize odour impacts.

Table 4-1: Emission equations used to quantify emissions from the project

Activity	Emission Equation	Source	Information assumed/provided
Vehicle entrainment on paved surfaces	$E = k(sL)^{a}(W)^{b}$ 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 sL = road surface silt content (%) W = average weight (tonnes) of the vehicles travelling the road = 15.6 t The particle size multiplier (k) is given as 0.15 for $PM_{2.5}$ and 0.62 for PM_{10}, and as 3.23 for TSP The empirical constant (a) is given as 0.9 for $PM_{2.5}$ and PM_{10}, and 4.9 for TSP The empirical constant (b) is given as 0.45 for $PM_{2.5}$, PM_{10} and TSP	US-EPA AP42 Section 13.2.1	In the absence of site-specific silt data, the mean silt content for corn wet milling (Table 13.2.1-3) of 1.1% was used. The capacity of the trucks to be used was given as 10 t. The layout of the roads was provided. Emissions were based on 14 trucks per day delivering raw barley.
CHP, Boiler and Dryer	$E_{PM} = 0.0036\ \text{kg/GJ}$	NPI Gas Combustion (Table 21)	CHP operating at full capacity (94 GWh). One boiler operational, based on feed rate of a John Thompson Enviropac boiler. NOx emissions based on 500 mg/Nm³ emission limit.
Kiln	$E_{PM} = 0.085\ \frac{\text{kg}}{\text{t barley}}$	NPI Malt Manufacturing (Table 3)	Based on feed rate provided in section 3.1. Flow rate based on fan capacity (4 fans with a capacity of 450 000 m³/h operating at an average of 60% capacity).
Barley intake and storage	n/a	n/a	PM emissions based on 10 mg/m³ emission limit from a fabric filter. Aeration rate of 3 l/s/t Silos at 80% capacity
Malt Manufacturing – VOC emissions	$E_{VOC} = 0.6\ \frac{\text{kg}}{\text{t barley}}$	NPI Malt Manufacturing (Table 4)	Potential VOC emissions for calculated using the NPI emission factor for the purposes of providing a total emission value included in Table 4-3. The emission factor was derived from a single study and the NPI Manual notes that it is likely an overestimation and indicative of a worst-case scenario. The VOC emissions calculated using the NPI emission factor were therefore not utilised as an input to

Activity	Emission Equation	Source	Information assumed/provided
			the dispersion model as it was assumed that odour measurement values from a similar facility (See PAEHolmes (2009)) would better represent potential emissions from the facility. VOC emissions are unlikely to be in the benzene-toluene-xylene (BTEX) family (see from PAEHolmes (2009)).
Malt Manufacturing - Odour emissions	n/a	PAEHolmes (2009)	Measured odour emissions were scaled for production throughput and utilised for dispersion modelling purposes.
Vehicle emissions	$E_{Pollutant} = \text{p g/km}$	NPI Aggregated Emissions from Motor Vehicles	Vehicle distances travelled based on 7 000 trucks delivering raw barley to and from the facility travelling 250 km each way per annum and 5 500 trucks dispatching the by-product travelling 50 km each way. Maximum travel distances were used for all trips to provide the maximum estimated emissions. P dependent on pollutant type:

PM_{10}	$PM_{2.5}$	NOx	CO	SO_2	VOC
0.584	0.584	6.69	4.42	0.272	1.01

Table 4-2: Parameters for sources of atmospheric pollutant emissions at the facility

Point Source code	Source name	Northing (m)	Easting (m)	Height of Release Above Ground (m)	PM Emissions (g/s)	NOx Emissions (g/s)	Odour (OUm^3/s)	Effective Diameter at Stack Exit (m)	Actual Gas Exit Temperature (°C)	Actual Gas Exit Velocity (m/s)
CHP	CHP unit	606782	7076149	220	0.04	1.69		0.7	120	12.6
BOIL	Boiler	606754	7076157	22	0.01	1.08		0.75	120	9.9
DRY	Barley Drier	606767	7076275.2	22	0.03	1.18		0.75	96	7.7
KILN	Kiln	606781	7076193	17	0.46		1 246 396	15	40	1.7
INTAKE 1-4[(a)]	Barley intake and storage	606750	7076318	43	0.25			1.1	25	26.5
ROAD 1-10	Access Road	n/a	n/a		2.13e-6[(b)]			n/a	n/a	n/a

Notes:
(a) Assume 4 release sources at building closest to silos
(b) Units in $g/s/m^2$

From lipids	Hexanal, *trans*-2-hexenal, *trans,trans*-2, 4-hexadienal, heptanal, *trans*-2-octenal, *trans*-2-nonenal, *trans*-2-*cis*-6-nonadienal, *trans,trans*-2, 4-nonadienal, 1-hepten-3-ol, 1-hexanol, *trans*-2-hexen-1-ol, 1-octanol, 1-nonanol, *trans,trans*-2, 4-decadienol, hexanoic acid, octanoic acid
Aldehydes from Strecker degradations	Acetaldehyde, propionaldehyde, isobutyraldehyde, isovaleraldehyde, methional, benzaldehyde, 2-phenylacetaldehyde
Compounds with oxygen heterocyclic ring structures	Furfural, furfuryl alcohol, 2-pentylfuran, 2-acetylfurfural, 5-methylfurfural, 3-phenylfuran, maltol, isomaltol, furan-2-carboxylic acid
Sulphur-containing molecules	Hydrogen sulphide, methyl mercaptan, ethyl mercaptan, carbon disulphide, dimethyl sulphide, diethyl sulphide, dimethyl disulphide, furfuryl mercaptan
Heterocyclic sulphur-containing molecules	Thiazole, 4-methylthiazole, 2-acetylthiazole, various thiazolines, thiophenes
Other substances	Ethanol, vanillin, *p*-hydroxybenzaldehyde, acetic acid and other volatile acids
Amines	Ammonia, methylamine, dimethylamine, ethylamine, *s*-butylamine, isobutylamine, *n*-butylamine, *p*-hydrobenzylamine, isoamylamine
Heterocyclic nitrogen-containing molecules	Pyrrolidine, 2-formylpyrrole, 2-acetylpyrrole, 2-methylpyrazine, dimethylpyrazine, ethylpyrazine, 3,6-dimethyl-2-ethylpyrazine, indole, pyridine, methylpyridine, 2-acetylpyridine, 5-methyl-6,7-dihydro-5*H*-cyclopentapyrazine
Phenolic substances	4-Hydroxybenzaldehyde, 4-vinylguaiacol, 4-vinylphenol, vanillin
Other groups of substances	Other alcohols, aldehydes, esters, alkanes, alkenes, aromatic hydrocarbons, lower fatty acids, lactones
Diketopiperazines	Cyclized dipeptides, e.g. *cyclo*-L-phenylalanine-L-proline, *cyclo*-L-proline-L-proline

Figure 4-1: Examples of volatile substances with flavour and aroma characteristics that have been found in dark malts and roasted barley (from PAEHolmes, 2009 and original sources cited therein)

4.1.2 Emission Source Summary

Emissions associated with the normal operation of the New Malt facility were estimated as described in Section 4. Annual total emissions are summarised in Table 4-3. The barley intake, storage and drying were quantified to be the largest contributing source of particulate matter (PM), while the CHP stack emissions were the largest sources of NOx. Gaseous emissions are mostly contributed by vehicle exhaust emissions.

Table 4-3: Annual pollutant emission rates (by source group) for normal operations

Source Group	Estimated Annual Average Emission Rates (tonnes/annum)				
	SO_2	NOx	CO	VOC	PM_{10}
Barley intake, storage and drying					31.8
Malting Process				102[(a)]	
Dryer		37.3			0.9
CHP	0.12	53.3			1.2
Boiler		34.2			0.2
Kiln					14.5
Road					0.3
Vehicle Emissions[(b)]	1.1	27.1	17.9	4.1	2.4
Total	**1.2**	**152**	**18**	**106**	**51**

Notes: (a) VOC emission were quantified, but not modelled as they are indicative of a worst-case scenario and likely an overestimation. To account for potential odour effects, measured odour values from a similar facility were utilised as set out in Table 4-1.
(b) Vehicle emissions were quantified, but not modelled as they largely occur off-site.

5 Impact of Enterprise on the Receiving Environment

5.1 Analysis of Emissions' Impact on Human Health

5.1.1 Study Methodology

The study methodology may conveniently be divided into a "preparatory phase" and an "execution phase".

The preparatory phase included the following basic steps prior to performing the actual dispersion modelling and analyses:

1. Understand scope of work
2. Review of legal requirements (e.g. dispersion modelling guideline) (see Section 5.1.2)
3. Decide on dispersion model (see Section 5.1.1.1)

The Regulations Regarding Air Dispersion Modelling (Gazette No 37804 published 11 July 2014) was referenced for the dispersion model selection (Government Gazette, 2014).

Three levels of assessment are defined in the Regulations Regarding Air Dispersion Modelling:

- Level 1: where worst case air quality impacts are assessed using simpler screening models
- Level 2: for assessment of air quality impacts as part of license application or amendment processes, where impacts are the greatest within a few kilometres downwind (less than 50 km)
- Level 3: requires more sophisticated dispersion models (and corresponding input data, resources and model operator expertise) in situations:
  - where a detailed understanding of air quality impacts, in time and space, is required;
  - where it is important to account for causality effects, calms, non-linear plume trajectories, spatial variations in turbulent mixing, multiple source types, and chemical transformations;
  - when conducting permitting and/or environmental assessment process for large industrial developments that have considerable social, economic and environmental consequences;
  - when evaluating air quality management approaches involving multi-source, multi-sector contributions from permitted and non-permitted sources in an airshed; or,
  - when assessing contaminants resulting from non-linear processes (e.g. deposition, ground-level ozone (O_3), particulate formation, visibility).

The assessment of the impact as a result of emissions from the New Malting facility was considered to fall within the scope of a Level 2 assessment (to be used for air quality impact assessments in standard / generic licence or amendment processes where impacts are the greatest within a few kilometres downwind (less than 50km)).

The execution phase (i.e. dispersion modelling and analyses) firstly involves gathering specific information in relation to the emission source(s) and site(s) to be assessed, and secondly the actual simulation of the emission sources. The information gathering included:

- Source information: Emission rate, exit temperature, volume flow, exit velocity and release height;
- Site information: Site building layout, terrain information, land-sea interface and land use data;
- Meteorological data: Wind speed, wind direction, temperature, cloud cover and mixing height; and,
- Receptor information: Locations using discrete receptors and/or gridded receptors.

When supplied with the above information, the dispersion model uses this specific input data to run various algorithms to estimate the dispersion of pollutants between the source and receptor. The model output is in the form of a simulated timeaveraged concentration at the receptor. These simulated concentrations are added to suitable background concentrations and compared with the relevant ambient air quality standard or guideline.

5.1.1.1 Dispersion Model Selection

As per the National Code of Practice for Air Dispersion Modelling, the regulator AERMOD atmospheric dispersion modelling suite for the simulation of ambient air pollutant concentrations and dustfall rates. AERMOD is a gaussian plume model, which is best used for near-field applications where the steady-state meteorology assumption is most likely to apply. AERMOD is a model developed with the support of the AMS/EPA Regulatory Model Improvement Committee (AERMIC), whose objective has been to include state-of the-art science in regulatory models (Hanna, Egan, Purdum, & Wagler, 1999). AERMOD is a dispersion modelling system with three components, namely: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD terrain pre-processor), and AERMET (AERMOD meteorological pre-processor).

AERMOD is an advanced new-generation model designed to simulate pollution concentrations from continuous point, flare, area, line, and volume sources. AERMOD offers advanced algorithms for plume rise and buoyancy, and the computation of vertical profiles of wind, turbulence and temperature. However, retains the single straight-line trajectory limitation. AERMET is a meteorological pre-processor for AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters. AERMAP is a terrain pre-processor designed to simplify and standardise the input of terrain data for AERMOD. Input data includes receptor terrain elevation data. The terrain data may be in the form of digital terrain data. The output includes, for each receptor, location and height scale, which are elevations used for the computation of air flow around hills. A disadvantage of the model is that spatial varying wind fields, due to topography or other factors cannot be included. Input data types required for the AERMOD model include: source data, meteorological data (pre-processed by the AERMET model), terrain data and information on the nature of the receptor grid.

Version 9 of the AERMOD and its pre-processors were used in the study (Table 5-1).

Table 5-1: Summary description of AERMOD model suite with versions used in the investigation

Module	Interface Version	Executable	Description
AERMOD	Breeze v9.0.0.17	(US) EPA 19191	Gaussian plume dispersion model.
AERMET	US EPA's Mesoscale Model Interface Program	(US) EPA 22112	Meteorological pre-processor for creating AERMOD compatible formats.
AERMAP	Breeze v9.0.0.17	(US) EPA 18081	Terrain preprocessor for creating AERMOD compatible formats

5.1.1.2 Receptor Grid

The dispersion of pollutants expected to arise from the proposed operations was simulated for an area covering 17 km (east-west) by 17 km (north-south). The area was divided into a grid matrix with a resolution of 100 m (Table 5-2). A nested grid with a resolution of 50 m, 1 km (east-west) by 1 km (north-south) was used over the facility. All AQSRs identified (Table 5-2) were included in the model as discrete receptors; none of which are located within the 2 km simulation domain. AERMOD calculates ground-level concentrations and dustfall rates at each grid intercept point and at discreate receptors.

Table 5-2: Simulation domain

Parameter	Simulation domain
Domain Grid	
South-western corner of simulation domain	600 214.7 m (Easting); 7 068 719 m (Northing)
Domain size	17 km x 17 km
Projection	Grid: UTM Zone 35S, Datum: WGS-84
Grid resolution	100 m across simulation domain
Nested Grid	
South-western corner of simulation domain	606 250.3 m (Easting); 7 075 811 m (Northing)
Domain size	1 km x 1 km
Projection	Grid: UTM Zone 35S, Datum: WGS-84
Grid resolution	50 m

5.1.1.3 Sources Simulated

All routine emissions from the proposed facility were included in the dispersion model (as per section 4). All processes were assumed to run continuously to provide a worst case scenario. For the NOx emission sources, both normal operations and a theoretical worst case scenario were run. To obtain a worst case impact scenario it was assumed that the CHP operates at full capacity, one boiler is operating at full capacity and boiler off gas with the same emissions as the CHP off gas, is utilised in the dryer. Since it was not known how much off gas would be diverted, it was assumed that the CHP runs at full capacity and the dryer utilises CHP off gas in excess of what would normally be produced by the CHP to heat the air through the dryer from 25°C to 33°C. Under normal operation it is expected that the CHP runs continuously and that back-up boilers and the dryer are not utilised.

5.1.2 Legal Requirements

5.1.2.1 Listed Activities and Controlled Emitters

The Minister, in terms of Section 21 of the NEMAQA, published a list of activities which result in atmospheric emissions and which are believed to have significant detrimental effects on the environment, human health and social welfare. All scheduled processes as previously stipulated under the Atmospheric Pollution Prevention Act (act 45 of 1965) were included as listed activities, with additional activities being included in the list. The Listed Activities and Minimum National Emission Standards were first published on the 31st of March 2010 (Government Gazette No. 33064), with a revision of the schedule on the 22nd of November 2013 (Government Gazette No. 37054), and subsequent amendments. The proposed project includes processes fall under Category 1: Combustion Installations (where the trigger is 50 MW heat input). Based on the net heat input capacity of the CHP and boiler units, the process does not trigger the need for an atmospheric emissions licence.

Section 23 of NEMAQA provides that the Minister or MEC may declare any appliance or device a controlled emitter if the activity results in atmospheric emissions that present a threat to health or the environment and must set emission limits for such activities. Small boilers (any boiler with a design capacity equal to 10 MW but lower than 50 MW net heat input per unit, based on the lower calorific value of the fuel used) were declared as controlled emitters (Notice number 831, 1 November 2013) in terms of section 23 of NEMAQA. In section 23, 'Boiler' is defined as "*a combustion appliance designed to heat water*". The notice provides for emission standards per fuel type. Based on the per unit net heat input capacity of the boilers (~9 MW), the backup boilers are not considered to be controlled emitters. Based on the and the definition of boiler in the legislation along with the understanding of the CHP model, gas combustion rates contemplated at design stage, with a net heat input of 10.7 MW, will require registration as a Controlled Emitter and will have annual emissions measurement and reporting requirements. It is recommended that the requirement to register as a controlled emitter in terms of section 23 be reviewed once equipment selection has been finalised for the backup boilers, as well as the CHP.

5.1.2.2 Municipal By-laws

The facility falls within the Midvaal Local Municipality which forms part of the Sedibeng District Municipality. Municipalities may enact by-laws that govern air quality matters and provide for the registration of certain sources and emitters and impose additional emissions limits, amongst other provisions. The Midvaal Local Municipality and the Sedibeng District Municipality did not have air quality by-laws in place at the time of the assessment and no additional registration or compliance measures are required of the new malting facility.

5.1.2.3 National Ambient Air Quality Standards

Criteria pollutants are considered those pollutants most commonly found in the atmosphere, that have proven detrimental health effects when inhaled and are regulated by ambient air quality criteria. South African NAAQS for SO_2, NO_2, PM_{10}, CO, ozone (O_3), benzene (C_6H_6), and lead (Pb) were published on 13th March 2009. Standards for $PM_{2.5}$ were published on 24th June 2012. The standards applicable to the project are listed in Table 5-3.

Table 5-3: National Ambient Air Quality Standards for criteria pollutants

Pollutant	Averaging Period	Limit Value (µg/m³)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
SO_2	10-minute	500	191	526	Currently enforceable
	1-hour	350	134	88	Currently enforceable
	24-hour	125	48	4	Currently enforceable
	1-year	50	19	-	Currently enforceable
NO_2	1-hour	200	106	88	Currently enforceable
	1-year	40	21	-	Currently enforceable
PM_{10}	24-hour	75	-	4	Currently enforceable
	1-year	40	-	-	Currently enforceable
$PM_{2.5}$	24-hour	40	-	4	Currently enforceable
		25	-	4	1 Jan 2030
	1-year	20	-	-	Currently enforceable
		15	-	-	1 Jan 2030
CO	1-hour	30 000	26 000	88	Currently enforceable
Benzene	1-year	5	1.6	-	Currently enforceable

5.1.2.4 Vaal Triangle Airshed Priority Area

The Vaal Triangle Airshed Priority Area (VTAPA) is considered an area of compromised air quality. The spatial extent of the priority area includes: Regions D and G of the City of Johannesburg; the Emfuleni Local Municipality; the Midvaal Local Municipality; and the Metsimaholo Local Municipality. Although the major industrial sources are located in the central and southern portions of the VTAPA, the northern sections (Regions D and G of the City of Johannesburg) are dominated by residential sources and gold mining tailings storage facilities.

The Vaal Triangle is a highly industrialised area housing numerous industries, a coal fired power station, and various smaller industrial and commercial activities in addition to a few collieries and quarries giving rise to noxious and offensive gasses. The Vaal Triangle is also home to a number of large informal settlements mainly using coal and wood as fuel source. This in return impacts directly on the health and well-being of the people residing there. Other sources of concern contributing to the pollution mixture within the area include vehicle tailpipe emissions, biomass burning, water treatment works and landfill areas, agricultural activities and various other fugitive sources.

An Air Quality Management Plan (AQMP), providing detailed intervention strategies, was first developed for the Vaal Triangle Priority area between 2007 and 2009, with the final plan published 29 May 2009 (Government Gazette No. 32254). The second generation AQMP for the VTAPA (DFFE, 2020) conducted a background assessment to evaluate the current state of air quality in the VTAPA as well as the drivers of air quality in the area. The study found that while there is variability in the wind fields across the VTAPA, winds were predominantly from the north-easterly and north-westerly directions. Measured ambient air quality indicated that there was non-compliance with the PM_{10} and $PM_{2.5}$ NAAQS for most of the years assessed at the majority of monitoring stations. The long-term trends in SO_2 concentrations indicate show compliance with the NAAQS for most of the time in most areas. Annual average NO_2 concentrations were non-compliant with the NAAQS at Diepkloof (all the years except 2011), Kliprivier (2009 and 2010), Sebokeng (2015) and Sharpeville (2015). Hourly NO_2 concentrations were also noncompliant with NAAQS at Sebokeng in 2015 (DFFE, 2020).

Dispersion modelling was conducted using the CAMx model and the results indicated widespread exceedances of O_3 and PM over the majority of the VTAPA (DFFE, 2020). The study further noted that PM_{10} impacts could be attributed to industries within the VTAPA, but that outside sources played a large role in O_3 formation within the VTAPA.

The interventions proposed for the second generation AQMP for the VTAPA (DFFE, 2020) were developed by means of a Stakeholder Consultation Workshop for eight sectors, with a main goal for each sector :

1. Industries and power generation / compliance monitoring and enforcement
    - Goal: All Listed Activities will be compliant with the minimum emission standards, and fugitive emissions would have reduced such as to ensure compliance with NAAQS.
2. Mining operations
    - Goal: By 2025, fence line monitoring to confirm compliance with NAAQS, specifically PM_{10} and $PM_{2.5}$, and NDCR.
3. Ash dumps and tailings storage facilities
    - Goal: By 2025, 80% reduction in windblown dust emissions ensuring compliance with NAAQS within the vicinity of all ash dumps and tailings storage facilities.
4. Domestic fuel burning
    - Goal: By 2025, emissions from domestic fuel burning would have decreased by 50%, and with a further 25% reduction by 2030, which would ensure compliance with NAAQS.
5. Domestic waste burning
    - Goal: No informal waste burning by 2030.
6. Biomass burning
    - Goal: Reduced uncontrolled veld fires through veld management measures and quick response times.
7. Education and awareness
    - Goal: Increased awareness on air quality challenges within the VTAPA.
8. Vehicle emissions
    - Goal: By 2025, reduce emissions from vehicles to ensure compliance with NAAQS near roads.

Within Sector 1 (Industries and Power Generation /Compliance Monitoring and Enforcement), the reduction of emissions from dust-generating activities is listed as one of the objectives, which includes the development of a legal framework to manage emissions from small/unlicensed facilities, such as the New Malting Plant in Sedibeng. More details for interventions for each sector can be found in the draft second generation AQMP (DFFE, 2020). Operating in the Priority Area requires stringent compliance with NEMAQA; including, but not limited to, a facility-specific air quality management plan (AQMP) using best practice on-site control of fugitive emissions.

5.1.2.5 Buffer Zones

A buffer zone refers to an area of land required to filter out the deleterious effects of the pollution source that is buffered (based on current understanding of the pollution type and mode of dispersal). The Gauteng Department of Agriculture and Rural Development (GDARD) Pollution Buffer Zones Guideline (initially developed in 2002 and reviewed in 2017) (GDARD, 2017) was developed to ensure that pollution buffer areas are created between the pollution sources and the nearest human settlements. Buffer zones are defined for three categories of industries along with landfill sites/waste disposal facilities; mine dumps; mine slimes dams and ash dumps; sewage treatment works; and nuclear complexes.

The three industry categories and the respective the generic buffer zones are defined as follows:

- Category 1 represents a group of industries with pollution risks that can have potentially serious health effects on a large scale.
  - Examples include heavy industries like steel mills, petrochemical plants, power stations, hazardous waste treatment facilities.
  - Buffer zone distance between 750 and 1 500 m.
- Category 2 represents a group of industries with pollution risks that may cause minor health effects or with activities that result in nuisance rather than actual health impacts.
  - Examples include container depots, panel beater workshops, and tanneries.
  - Buffer zone distance between 250 and 500 m.
- Category 3 represents a group of industries that pose little or no health impacts and that may result in a nuisance on a localised scale.
  - Examples include general warehousing and distribution operations, information technology and research laboratories.
  - Buffer zone distance between 50 and 100 m.

The generic and expanded buffers provide a guideline for safe distances for the location of sensitive land uses adjacent to pollution sources. However, specialist studies may still influence the need for and actual distance for buffer zones to account for specific environmental and social impacts and risks. These buffer zones are merely guidelines and not legally enforceable. Based on the industrial category definitions, the malt plant would be classed as a Category 2 industry.

5.1.3 Atmospheric Dispersion Potential

Physical and meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The analysis of hourly average meteorological data is necessary to facilitate a comprehensive understanding of the dispersion potential of the site. The primary meteorological parameters for air pollutant dispersion include wind speed, wind direction and ambient temperature. Other meteorological parameters that influence the air concentration levels include rainfall (washout) and a measure of atmospheric stability. Atmospheric stability is not normally measured but rather derived from other parameters such as the vertical height temperature difference or the standard deviation of wind direction. The depth of the atmosphere in which the pollutants can mix is similarly derived from other meteorological parameters by means of mathematical parameterizations. The meteorological data used for the assessment was obtained from the Kliprivier Air Quality Monitoring Station (AQMS) located 1.8 km north-east of the facility for the three-year period 2021 to 2023. Data availability for

2023 was below 80% for all parameters, with improved availability for 2021 and 2022 as further discussed in section 5.1.4. The parameters of interest are discussed below.

5.1.3.1 Topography

The study area is characterised by terrain elevations in the range 1 375 and 1 916 mamsl as shown in Figure 5-1. The terrain includes terrain features that might influence the dispersion of pollutants and terrain effects were included in the dispersion model setup.

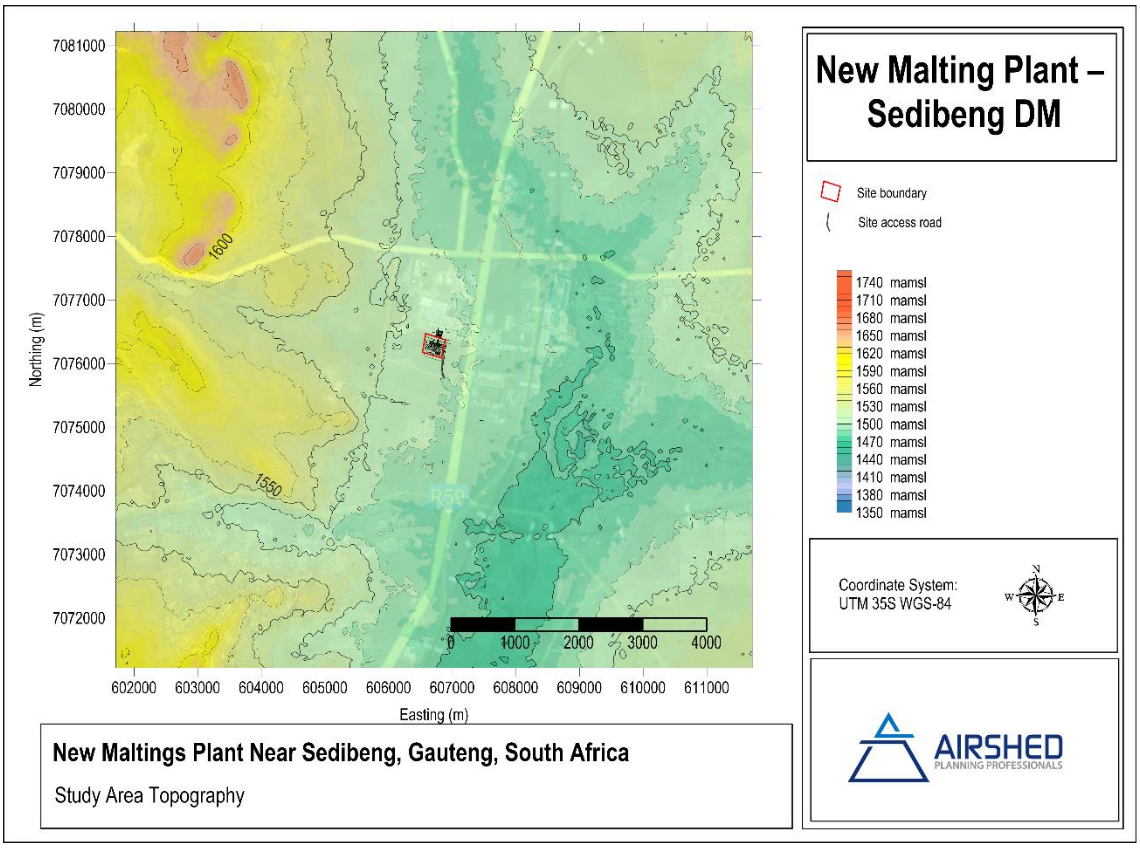


Figure 5-1: Topography of the study area

5.1.3.2 Surface Wind Field

The wind field for the study area is described with the use of wind roses. Wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 2 and 3 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. Calm conditions are periods when the wind speed was below 1 m/s. These low values can be due to “meteorological” calm conditions when there is no air movement; or, when there may be wind, but it is below the anemometer starting threshold (AST). The period, day-time and night-time wind roses are shown in Figure 5-2 for the site, and seasonal wind roses are shown in Figure 5-3.

The wind field at the site is dominated by winds from the north-east and north-west, with winds infrequently from the south and south-east. Calm conditions occurred 3.8% of the period, more frequently during the night (3.9%). During the day, winds at higher wind speeds occurred more frequently from the north-east. Night-time airflow had was also dominated by north-westerly winds.

Calm conditions were most frequently recorded in autumn and winter and most infrequently in spring and summer (Figure 5-3). Although the seasonal wind directions were similar to the period average, slight variations were observed especially in wind speed. The spring and winter wind fields showed more frequent and higher wind speeds from the north-west while summer winds shows frequent north-easterly winds with relatively lower wind speeds. Winds in the higher wind speed categories are most common in spring, with the fewest calm conditions. South westerly winds were most frequent in winter and autumn.

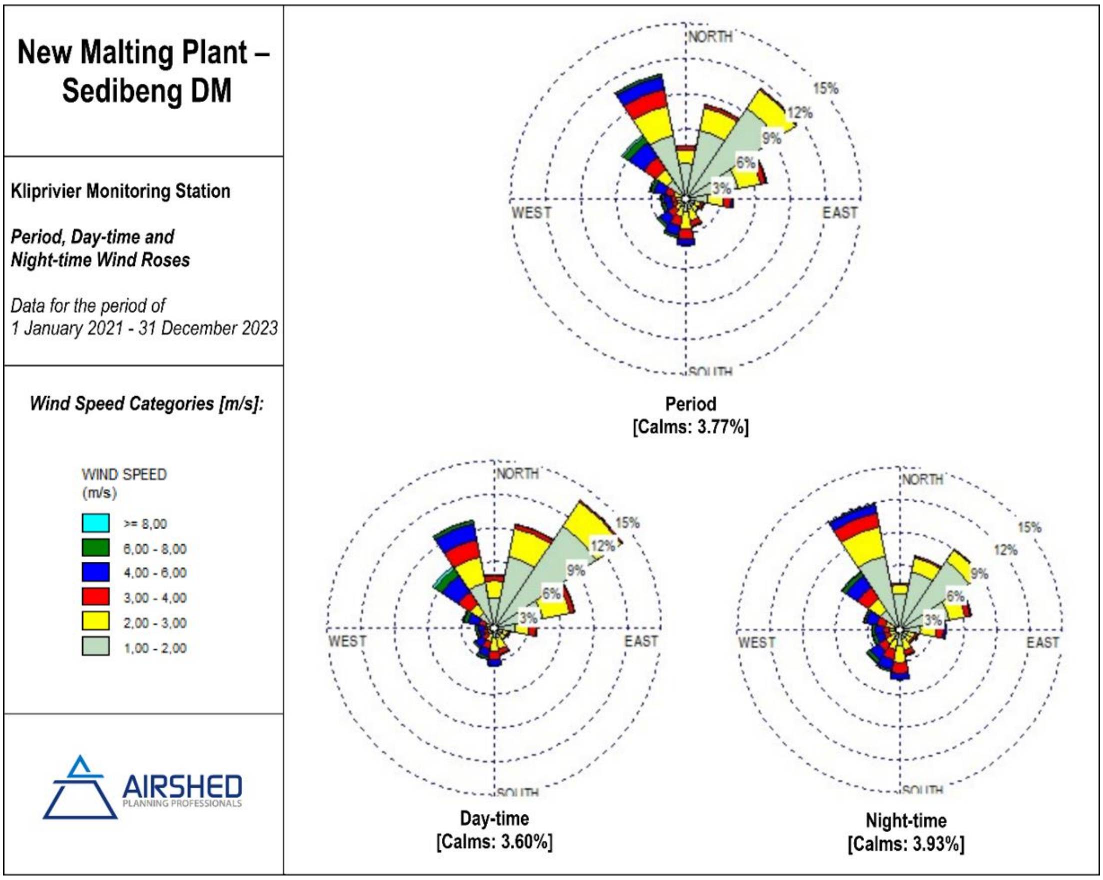


Figure 5-2: Period average, daytime and night-time wind roses (Kliprivier AQMS; 2021 to 2023)

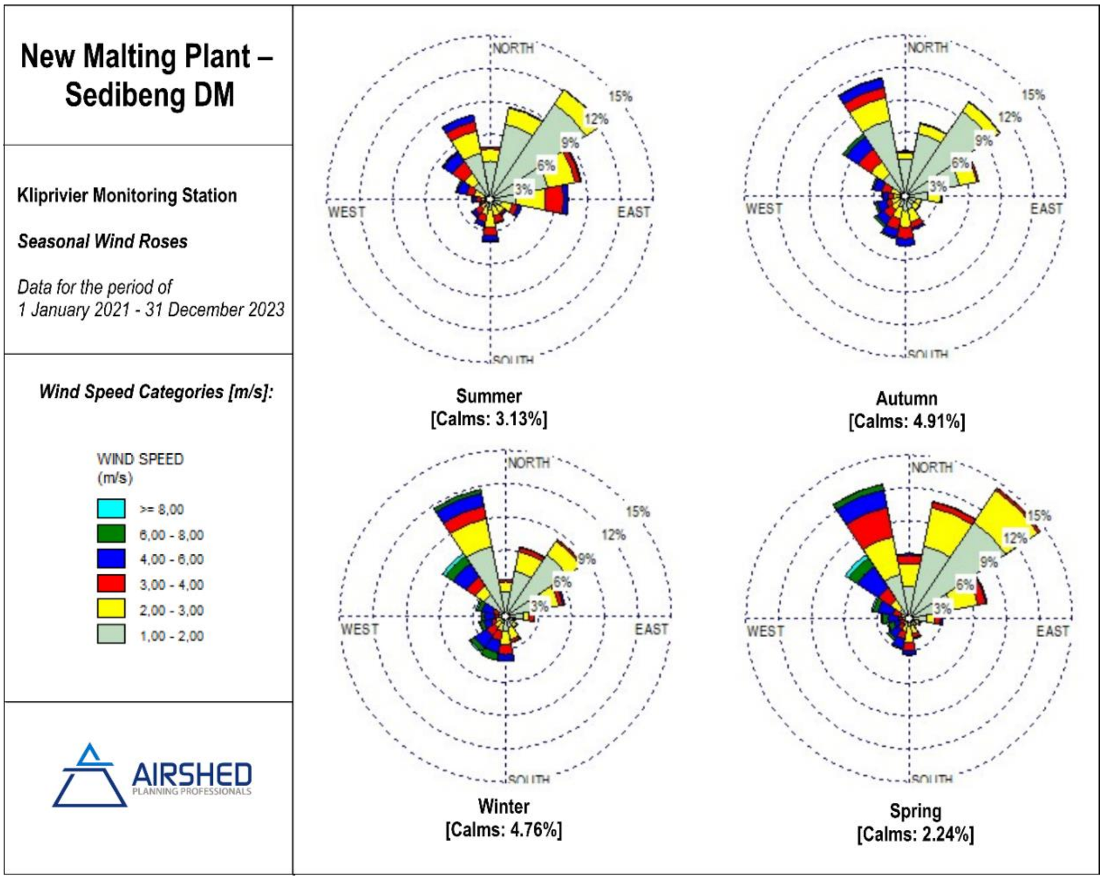
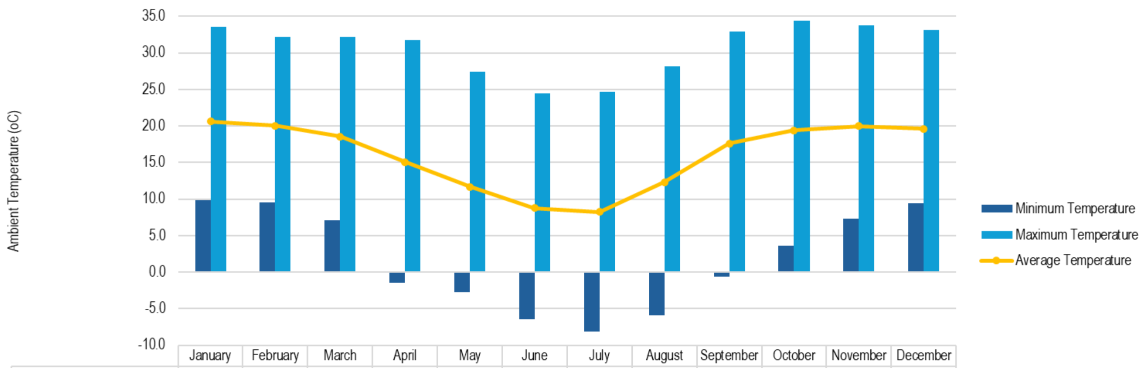


Figure 5-3: Seasonal wind roses (Kliprivier AQMS; 2021 to 2023)

5.1.3.3 Temperature

Air temperature is an important factor, both for determining the effect of plume buoyancy and determining the development of the mixing and inversion layers. The monthly temperature trends are presented in Figure 5-4. The average monthly temperature at each hour of the day is resented in Figure 5-5. The warmest temperatures experienced from October to February, while the coolest temperature occur in June, July and August.



	January	February	March	April	May	June	July	August	September	October	November	December
Minimum Temperature	9.8	9.5	7.1	-1.5	-2.7	-6.5	-8.1	-5.9	-0.6	3.6	7.3	9.5
Maximum Temperature	33.6	32.2	32.2	31.8	27.4	24.5	24.7	28.2	32.9	34.4	33.7	33.1
Average Temperature	20.6	20.0	18.6	15.1	11.7	8.7	8.2	12.3	17.6	19.4	20.0	19.6

Figure 5-4: Monthly temperature summary (Kliprivier AQMS 2021 - 2023)

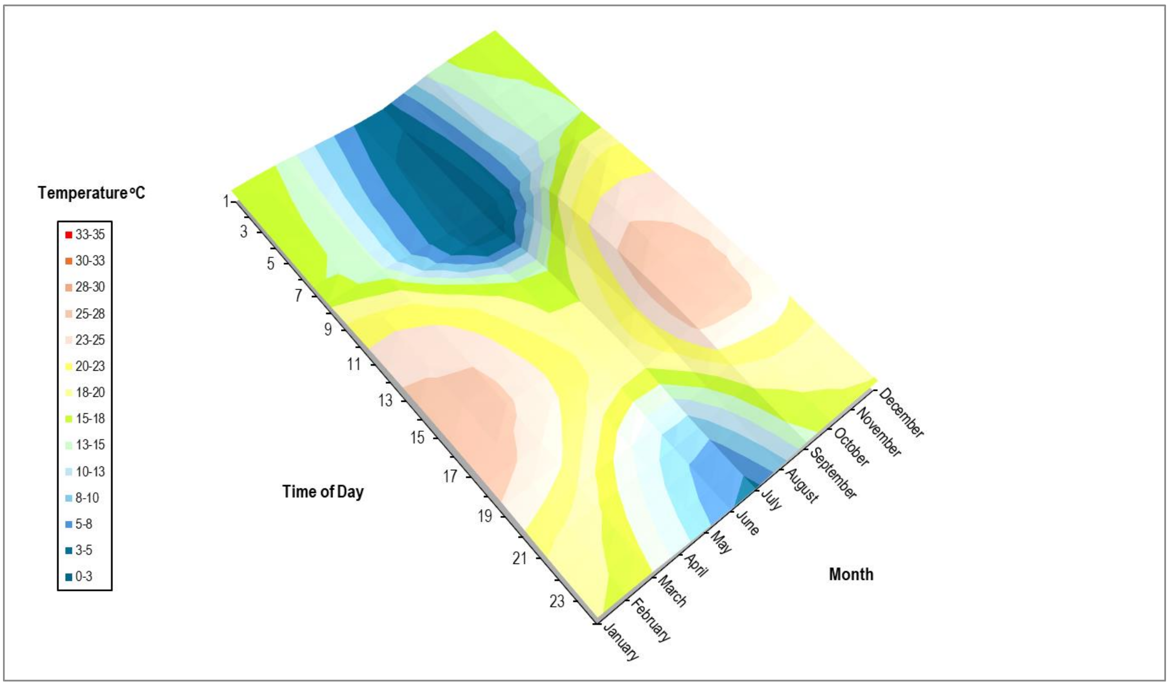


Figure 5-5: Monthly average temperature profile (Kliprivier AQMS 2018 to 2020)

5.1.3.4 Atmospheric Stability

The new-generation air dispersion models describe atmospheric stability as a continuum rather than discrete classes used in older models. The atmospheric boundary layer properties are therefore described by two parameters; the boundary layer depth and the Obukhov length. The Obukhov length (L_{Mo}) provides a measure of the importance of buoyancy generated by the heating of the ground and mechanical mixing generated by the frictional effect of the earth's surface. Physically, it can be thought of as representing the depth of the boundary layer within which mechanical mixing is the dominant form of turbulence generation (CERC, 2004). The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. During daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface. Night-times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds and lower dilution potential.

Diurnal variation in atmospheric stability as described by the inverse Obukhov length and the boundary layer depth is provided in Figure 5-6. The highest concentrations for ground level, or near-ground level releases from non-wind dependent sources would occur during weak wind speeds and stable (night-time) atmospheric conditions. For elevated releases, unstable conditions can result in very high concentrations of poorly diluted emissions close to the stack. This is called *looping* and occurs mostly during daytime hours. Neutral conditions disperse the plume equally in both the vertical and horizontal planes and the plume shape is referred to as *coning*. Stable conditions prevent the plume from mixing vertically, although it can still spread horizontally and is called *fanning*. For ground level releases, the highest ground level concentrations will occur during stable night-time conditions.

Together with topography, atmospheric stability accounts for occurrence of low-level inversion layers where pollutants may not disperse effectively. The upper air profile, generated by the AERMET pre-processor, accounts for periods when inversion layers develop in the upper air.

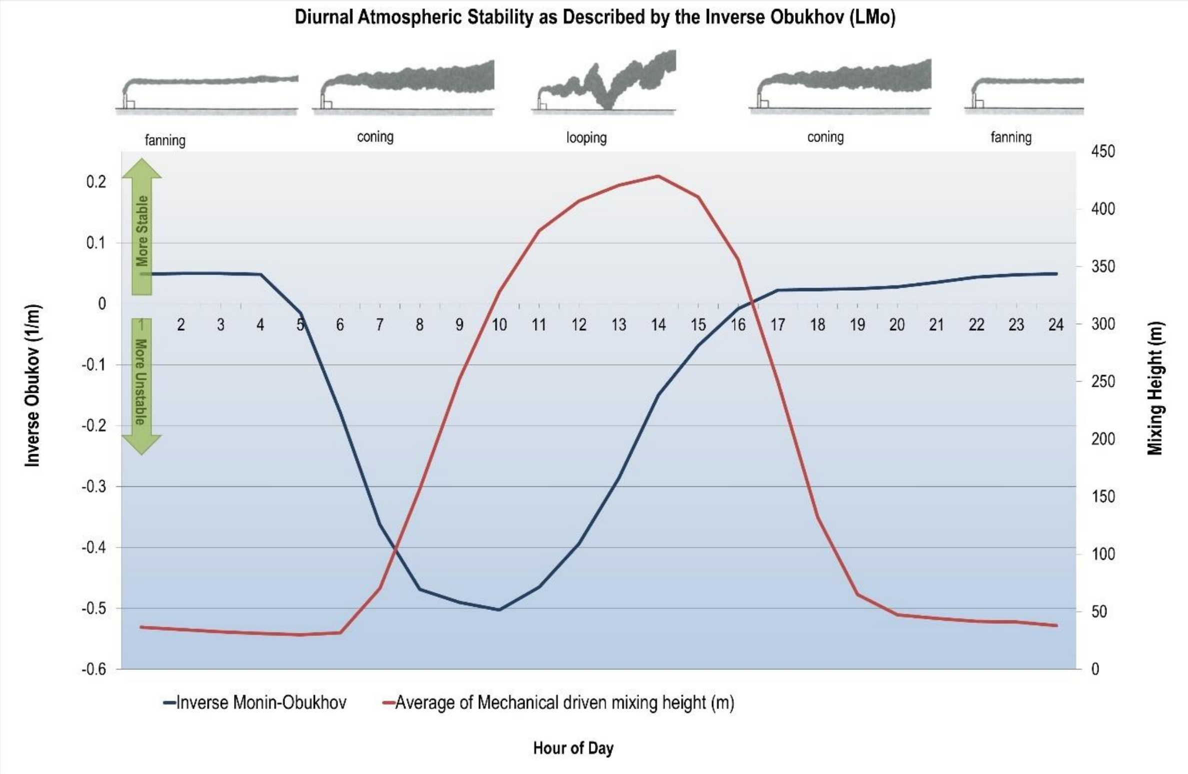


Figure 5-6: Diurnal atmospheric stability (AERMET-View processed simulated data; 2021 to 2023)

5.1.4 Existing Sources of Emissions and Ambient Air Quality Monitoring Data

A comprehensive emissions inventory for the study area was outside of the scope of the current study. Instead, source types present in the area and the pollutants associated with such source types are noted with the aim of identifying pollutants which may be of importance in terms of cumulative impact potentials. The facility is planned to be located within an industrial complex. Other sources, within 5 km, include:

- industrial sources, including: the Heineken Sedibeng Brewery and smaller manufacturing industries;
- vehicle tailpipe emissions (in order of proximity, not traffic volumes: R59, R550, M61; as well as vehicle activities in surrounding residential areas);
- household fuel combustion (particularly coal and wood) and small boilers at education facilities used for heating purposes;
- biomass burning (veld fires);
- various miscellaneous fugitive dust sources (i.e. vehicle-entrainment of dust along paved and unpaved roads, agricultural activities, and wind erosion from unvegetated areas, etc.).

Measured air quality data set from the VTAPA ambient monitoring network (managed by the South Africa Weather Service – SAWS), were accessed[2] for use in this assessment. The Kliprivier AQMS dataset for the period 2021 - 2023 was accessed, based on proximity to the proposed facility (1.8 km south-west of the AQMS).

Data availability for the period (2021 - 2023) varied between 64% and 96%, depending on the pollutant (Table 5-4). The following is noted from the dataset:

[2] Accessed via the South African Air Quality Information System (https://saaqis.environment.gov.za/)

- Data availability from the station was poor to in 2023, with data availability below 77% for all pollutants. Data availability for 2021 and 2022 was generally higher for all pollutants.
- The pollutant suite at the station includes: SO_2, NO_2, CO, PM_{10} and $PM_{2.5}$, benzene and O_3.
- SO_2 concentrations: although hourly exceedances were recorded, there were fewer than the allowable number of exceedances in all years assessed.
- NO_2 concentrations: a single exceedance of the hourly limit concentration was recorded in the three years assessed.
- Daily average PM_{10} concentrations were non-compliant with the allowable frequency of exceedance across the three years assessed. The annual average concentration in exceeded the standard (40 µg/m³) for all three years assessed.
- Daily average $PM_{2.5}$ concentrations exceeded the allowable frequency of exceedance in all three years of assessment. The annual average concentrations in all three years exceeded the current standard (25 µg/m³).
- Ozone 8-hour rolling average concentrations exceeded the standard for all three years assessed.

Time series plots are presented for hourly (Figure 5-7) and daily (Figure 5-8) average concentrations of the pollutants discussed above.

Table 5-4: Summary of the ambient measurements at SAWS Kliprivier AQMS for the period 2021 – 2023

Kliprivier AQMS						
Period	Data Availability	Hourly	Daily	Annual Average	No of recorded hourly exceedances	No of recorded daily exceedances
		99th Percentile	99th Percentile			
SO_2 (ppb)						
Criteria		*134 ppb*	*48 ppb*	*19 ppb*	*88 hours per year*	*4 days per year*
2021	96%	30.5	17.2	5.24	3	0
2022	91%	28.6	17.9	5.17	0	0
2023	**77%**	28.4	17.8	5.14	0	0
NO_x (ppb)						
Criteria		*106 ppb*		*21 ppb*	*88 hours per year*	
2021	94%	51.1		15.87	1	
2022	84%	47.6		15.23	0	
2023	**74%**	57.5		18.56	0	
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2021	91%		139.9	57.45		94
2022	93%		113.9	50.89		65
2023	**75%**		126.8	48.88		38
$PM_{2.5}$ (µg/m³)						
Criteria			*40 µg/m³*	*20 µg/m³*		*4 days per year*
2021	85%		62.9	27.68		52
2022	88%		68.9	28.89		67
2023	**67%**		90.3	32.04		48
Benzene (ppb)						
Criteria				*1.6 ppb*		
2021	**72%**			1.28		
2022	81%			0.77		
2023	**64%**			0.47		
O_3 (ppb)						
Criteria		*61 ppb(a)*			*88 hours per year*	
2021		61.4			82	
2022		65.3			116	
2023		67.6			107	
Note: (a) 8 hour rolling average concentration used in assessment						

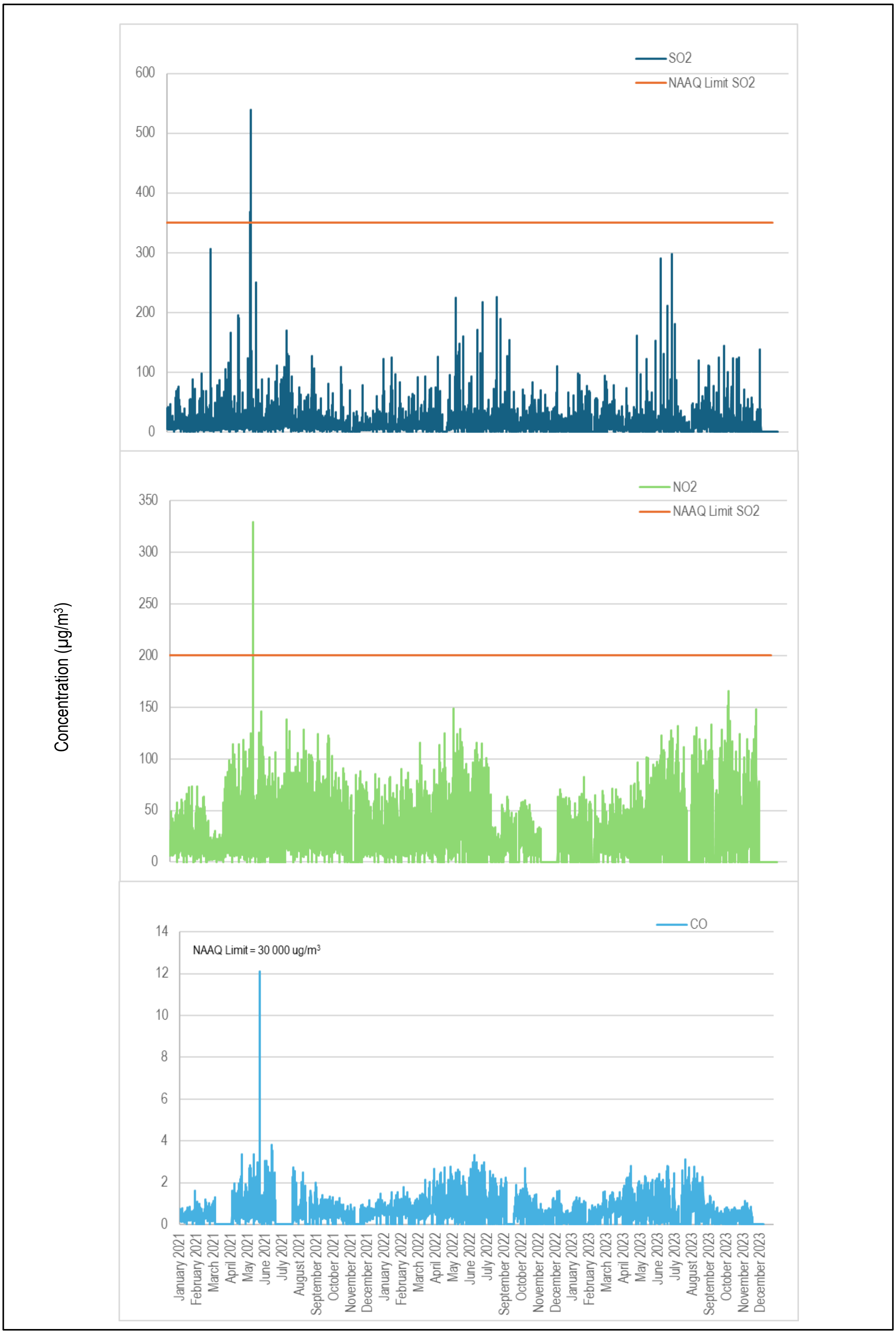


Figure 5-7: Time series of hourly SO_2, NO_2 and CO concentrations measured at the Kliprivier AQMS (2021 - 2023)

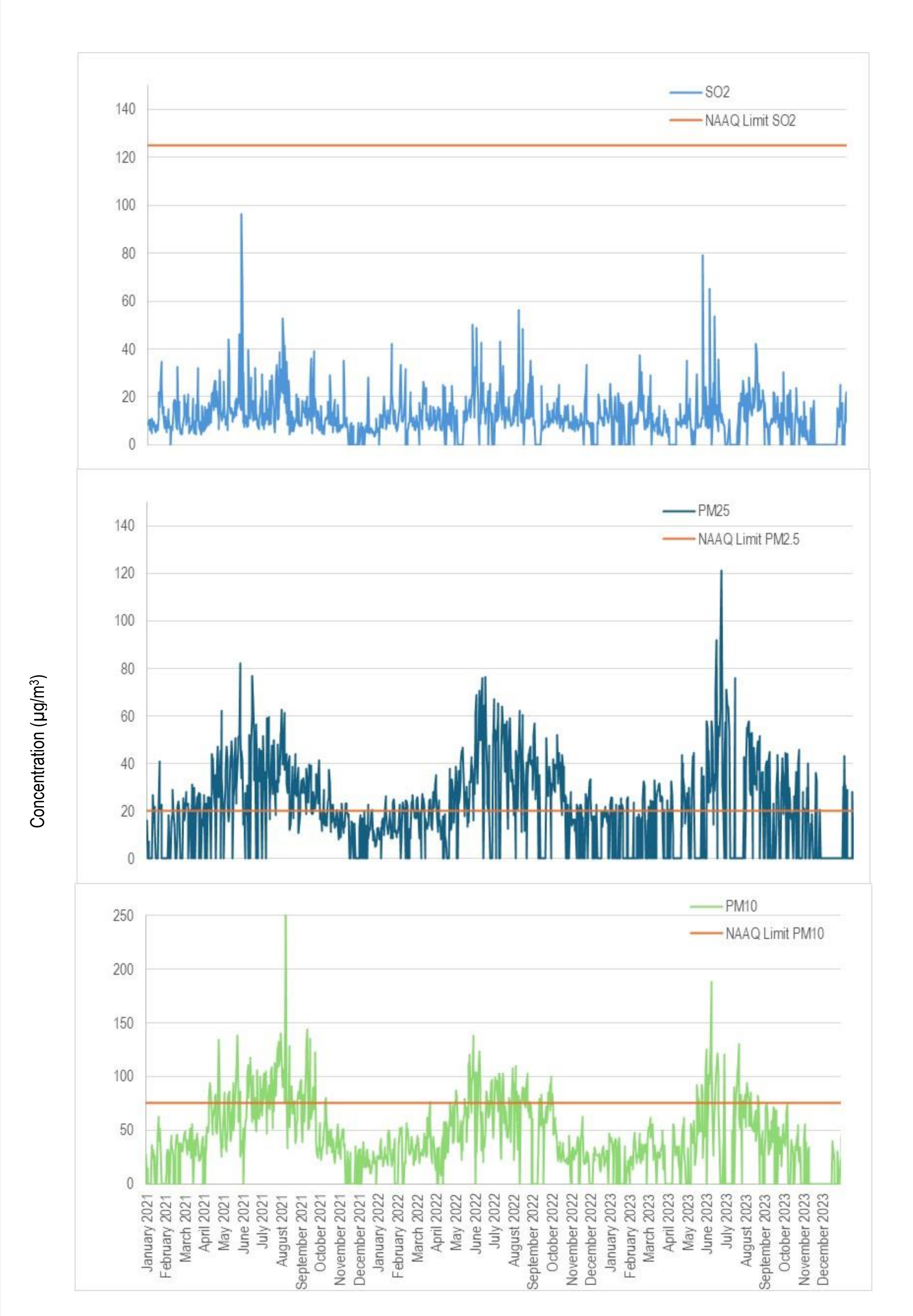


Figure 5-8: Time series of daily SO_2, PM_{10} and $PM_{2.5}$ concentrations measured at the Kliprivier AQMS (2021 - 2023)

5.1.5 Dispersion Modelling Results – Normal Operations

5.1.5.1 Simulated NO_2 Concentrations

Hourly and annual average NO_2 concentrations were obtained from simulated NO_X concentrations assuming all NOx is transformed to NO_2. Normal operation of the New Malting Plant does not result in exceedances of the ambient NO_2 NAAQS on an hourly basis (Figure 5-9), or an annual average basis (Figure 5-11). Under worst case conditions, the hourly NOx ambient footprint increases, but does not exceed the hourly NOx NAAQS (Figure 5-10). The impact of terrain features on the modelled concentrations can be seen towards to the south-west of the facility with elevated NOx concentrations due to terrain effects.

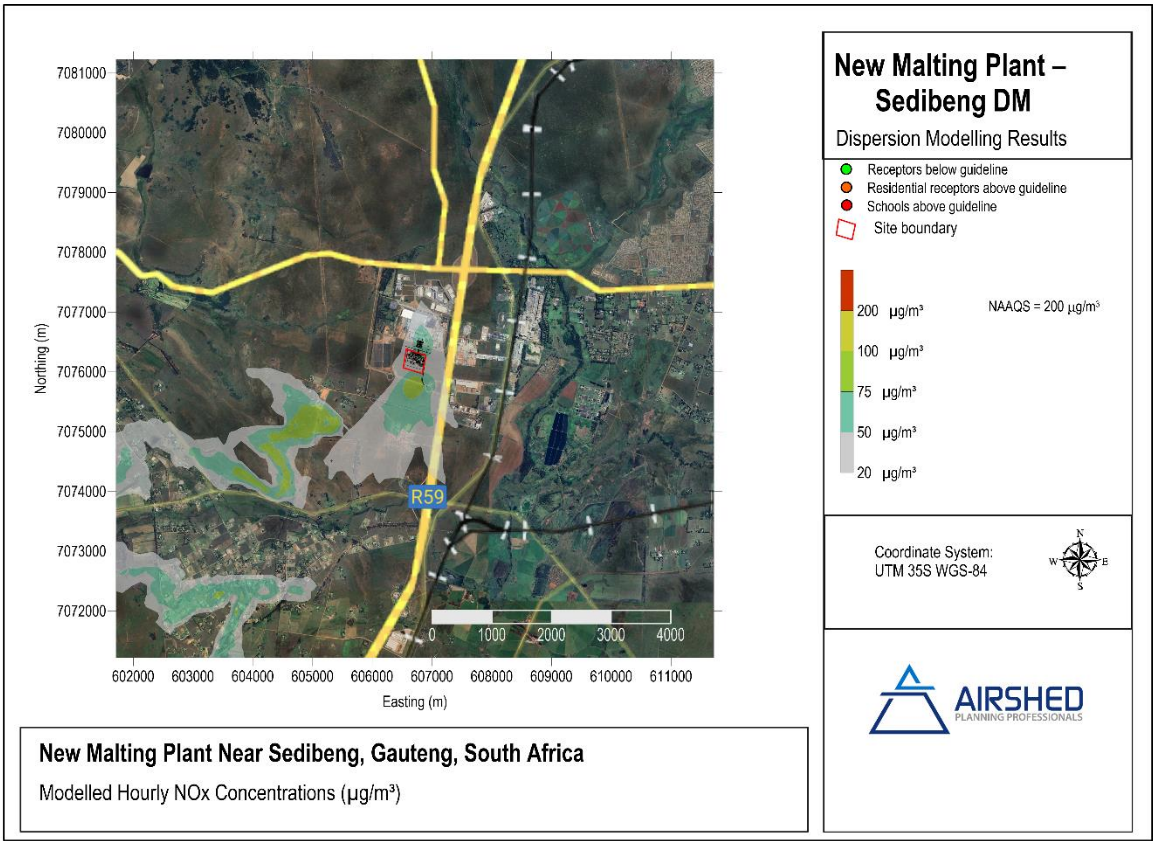


Figure 5-9: Simulated hourly average (99th percentile) ambient NO_2 concentrations for the New Malting Plant normal operations

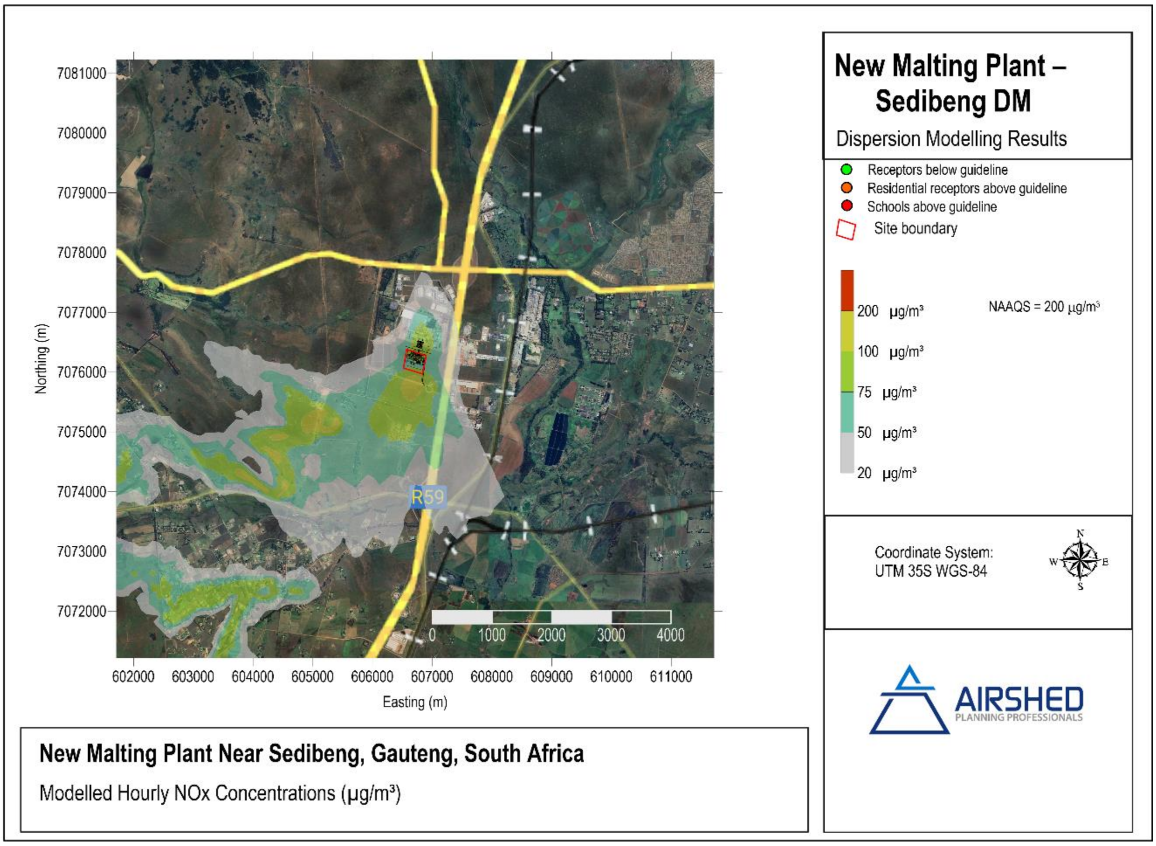


Figure 5-10: Simulated hourly average (99th percentile) ambient NO_2 concentrations for the New Malting Plant worst case conditions

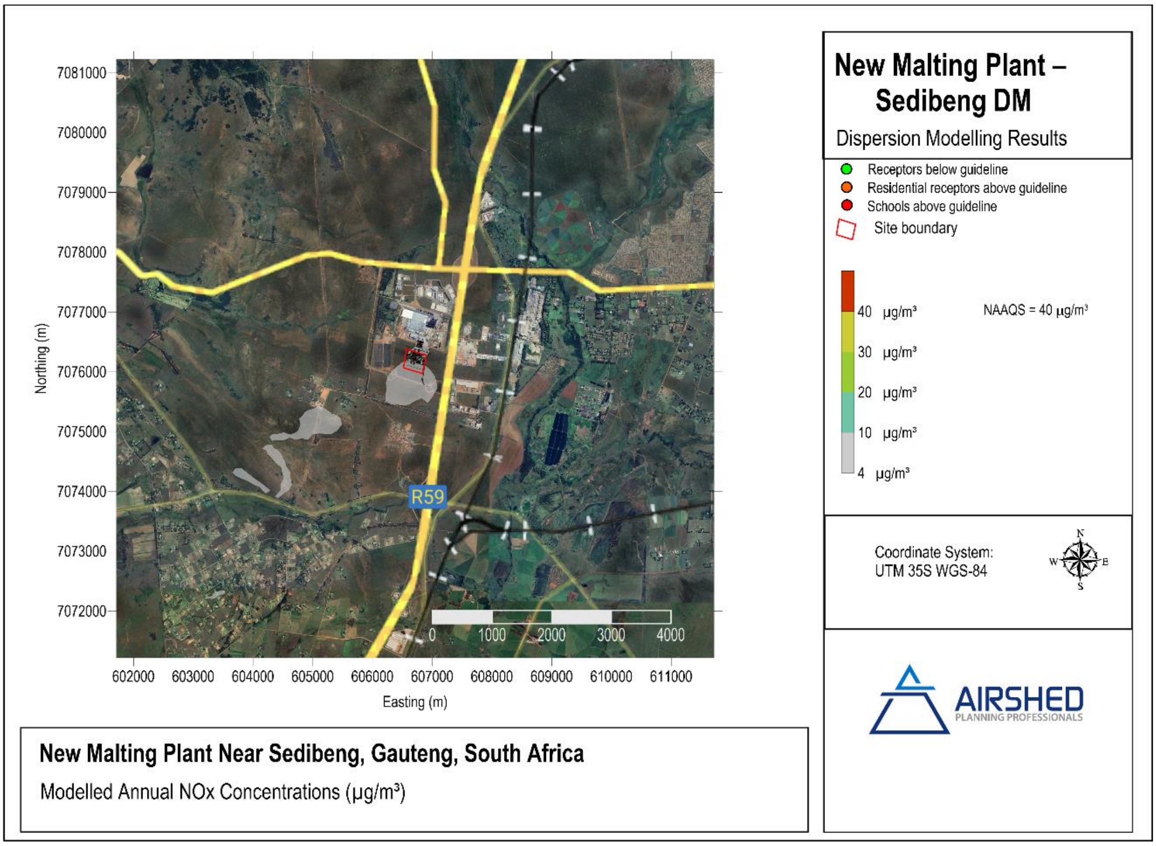


Figure 5-11: Simulated annual average ambient NO_2 concentrations for the New Malting Plant normal operations

5.1.5.2 Simulated PM Concentrations

No exceedances of the PM_{10} daily (Figure 5-12) or annual (Figure 5-13) NAAQS were simulated across the domain, however, elevated concentrations could occur due to emissions from barley receiving, storage and drying. The off-site impacts are predicted to be less than 25% of the NAAQS. It should be noted that the emissions were based on continuous emissions at a ceiling level of 10 mg/m^3, which is likely to overestimate the PM impacts from the facility.

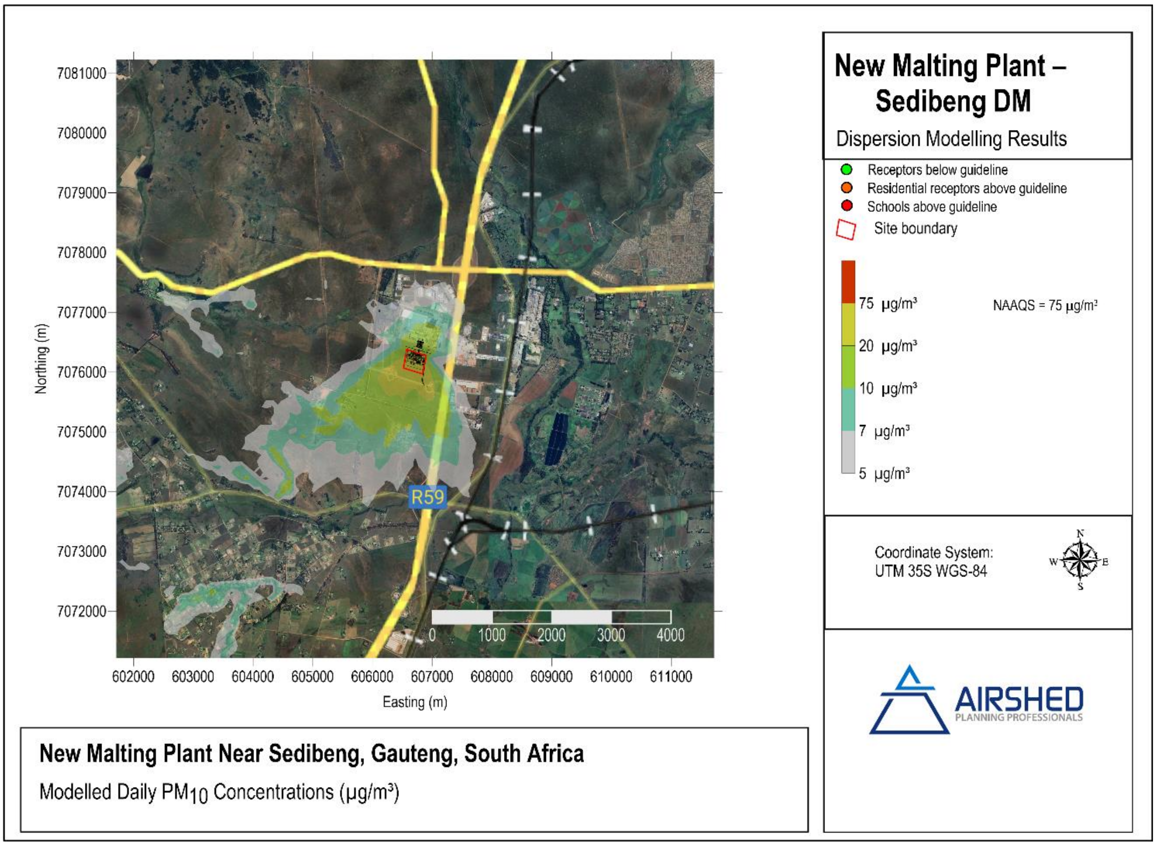


Figure 5-12: Simulated daily average ambient PM_{10} concentrations for the New Malting Plant normal operations

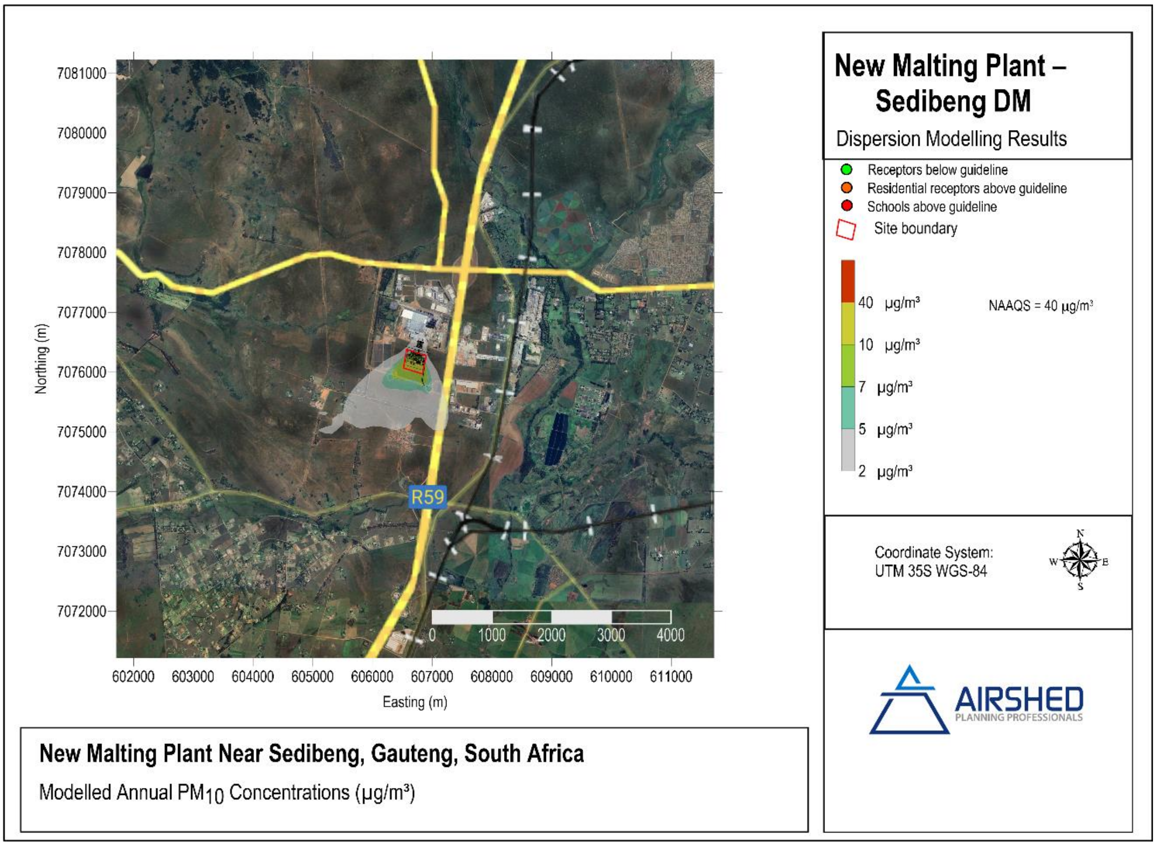


Figure 5-13: Simulated annual average ambient PM_{10} concentrations for the New Malting Plant normal operations

The largest source of PM modelled was from grain storage and handling and it was assumed that all PM was PM_{10} that was emitted at 10 mg/m³. It is uncertain what fraction of the total PM falls within the $PM_{2.5}$ fraction, particularly after filtering has occurred. Particle size distribution analyses done on soybean, corn and wheat dust indicated that less than 3% of total PM was $PM_{2.5}$ (Parnell *et al.*, .1986). It must be noted that the samples in the Parnell *et al.* (1986) study, were taken from the ducts prior to passing through a filter or cyclone. An analysis of the size distribution and the rate of wheat dust generated during grain elevator showed that approximately 5% of the dust sampled before the cycle was $PM_{2.5}$ (Boac, *et al.,* 2009). It is expected that barley handling would show a similar trend with less than 5% of the total PM reporting to the $PM_{2.5}$ fraction and that $PM_{2.5}$ impacts of the proposed malting plant are, therefore, not likely to be significant.

5.1.5.3 Estimated Cumulative Impact

The cumulative impact of the proposed facility and the existing baseline was estimated using short-term and annual averaging period for the pollutants of concern for the Kliprivier AQMS. Cumulative impacts at the site boundary and at the Kliprivier AQMS are estimated by summing the appropriate simulated incremental concentration (from Section 5.15) and the corresponding measured value from the Kliprivier AQMS (Table 5-5). The cumulative concentrations for short-term averaging periods (hourly for NO_2, and daily for PM_{10} and $PM_{2.5}$) show potential exceedances if the boundary maximums are added to the measured values at the Kliprivier stations. However, the likelihood of this occurrence is considered low and potentially overestimating based on the predominant wind direction. Annual average cumulative concentrations at the site boundary are only estimated to exceed NAAQS for PM_{10} and $PM_{2.5}$ but based solely on the existing baseline and not as a result of the proposed malt plant. For short-term and annual averages the estimated cumulative concentrations at the Kliprivier AQMS may exceed NAAQS for PM_{10} and $PM_{2.5}$ but not as a result of the minor contributions due to the proposed malt plant.

Table 5-5: Estimated cumulative impact of the existing baseline pollutant concentrations and the incremental increase due to the malt plant

Pollutant	NAAQS	Kliprivier AQMS Maximum Measured(a)	Simulated incremental(b) (at site boundary)	Cumulative (at site boundary)(c)	Simulated incremental(d) (at Kliprivier AQMS)	Cumulative (at Kliprivier AQMS)(e)
Short term averaging period						
NO_2	200	57	153	**210**(f)	2	59
PM_{10}	75	**140**	15	**155**(f)	2	**142**
$PM_{2.5}$ (g)	25(h)	**90**	0.8	**90.8**(f)	0.1	**90.1**
Annual average						
NO_2	40	10	9.5	19.5	0.2	10.2
PM_{10}	40	**58**	3.6	**62**	0.1	**58**
$PM_{2.5}$ (g)	15(h)	**32**	0.18	**32**	0.006	**32**

Notes:
(a) Maximum value from the three years summarised in Table 5-4
(b) From dispersion modelling reported in Section 5.1.5 at the site boundary
(c) Kliprivier AQMS maximum measured (a) plus simulated incremental at site boundary (b)
(d) From dispersion modelling reported in Section 5.1.5 at the Kliprivier AQMS
(e) Kliprivier AQMS maximum measured (a) plus simulated incremental at the Kliprivier AQMS (d)
(f) A likely overestimation of impact at the plant boundary due to wind direction and distance from the monitoring station
(g) All $PM_{2.5}$ due to the malt plant is assumed to be 5% of the PM_{10} (as discussed in Section 5.1.5.2)
(h) NAAQS for $PM_{2.5}$ that will be applicable from 1 January 2030

5.2 Analysis of Emissions' Impact on the Environment

In the absence of a prescribed methodology (in the Regulations Prescribing the Format of the Atmospheric Impact Report, Government Gazette No. 36904, Notice Number 747 of 2013; 11 October 2013), the impact of emissions from the facility on the environment was assessed using the pollutant critical levels that may affect vegetative productivity, and nuisance dustfall. The same dispersion modelling approach was used as in the assessment of impact of the facility on human health (described in Section 5.1.1).

5.2.1 Critical Levels for Vegetation

The impact of emissions associated with the facility on the surrounding vegetation was assessed by comparing the simulated annual NO_2 concentrations for each of the emission scenarios against the critical levels for vegetation as defined by the United Nations Economic Commission for Europe (UNECE) Convention on Long Range Trans-boundary Air Pollution limits (CLRTAP, 2015) (Table 5-6). The simulated annual concentrations of NOx are unlikely to affect vegetation via various measures of productivity and reproductive success (see Figure 5-11 where maximum annual concentrations were less than 4 µg/m³ off-site). As the facility utilises gas as a fuel source, it is unlikely that the facility will have a significant impact on ambient SO_2 concentrations.

Table 5-6: Critical levels for SO_2 and NO_2 by vegetation type (CLRTAP, 2015)

Pollutant	Vegetation type	Critical Level (µg/m³)	Time Period[(a)]	Maximum simulated concentration
SO_2	Cyanobacterial lichens	10	Annual average	not simulated
	Forest ecosystems (including understorey vegetation)	20	Annual average and Half-year mean (winter)	
	(Semi-)natural vegetation	20	Annual average and Half-year mean (winter)	
	Agricultural crops	30	Annual average and Half-year mean (winter)	
NO_2	All	30	Annual average and Half-year mean (winter)	10 µg/m³ (on-site)[(b)]
		75	Daily average	not simulated

Notes:
(a) For the purposes of mapping of critical levels and exceedances CLRTAP recommend using only the annual average, due to increased reliability of mapped and simulated data for the longer period. It is also noted that long-term effects of NO_X are more significant than short-term effects (CLRTAP, 2015).
(b) Maximum simulated in the domain as a result of worst case operation

5.2.2 Dust Impact Assessment

5.2.2.1 National Dust Control Regulations

The National Dust Control Regulations (NDCR) was gazetted on 1st November 2013 (No. 36974). The purpose of the regulations is to prescribe general measures for the control of dust in all areas including residential and light commercial areas. The standard for acceptable dustfall rate is set out in Table 5-7. The method to be used for measuring dustfall rate and the guideline for locating sampling points shall be ASTM D1739: 1970, or equivalent method approved by any internationally recognized body. The measurement of dustfall and the submission of a dust mitigation plant is only applicable to those installation identified, and notified by written notice, by the local air quality officer.

Table 5-7: Acceptable dustfall rates

Restriction Area	Dustfall Rate (mg/m².day, 30-day average)	Permitted Frequency of Exceeding Dustfall Rate
Residential area	D<600	Two in a year, not sequential months
Non-residential area	600<D<1200	Two in a year, not sequential months

A revised Draft National Dust Control Regulations were published on 25th March 2018 (Government Gazette No. 41650) which references the same acceptable dustfall rates but refers to the latest version of the ASTM D1739 method to be used for sampling.

5.2.2.2 Simulated Dustfall Rate

Simulated dustfall rates were well below NDCR rates, as shown in Figure 5-14, in which off-site dustfall rates were simulated to be below the acceptable dustfall rate for residential areas, again under the conservative assumption that all PM emissions would result in nuisance dustfall and emissions from grain handling, storage and drying would be continuous at 10 mg/m³.

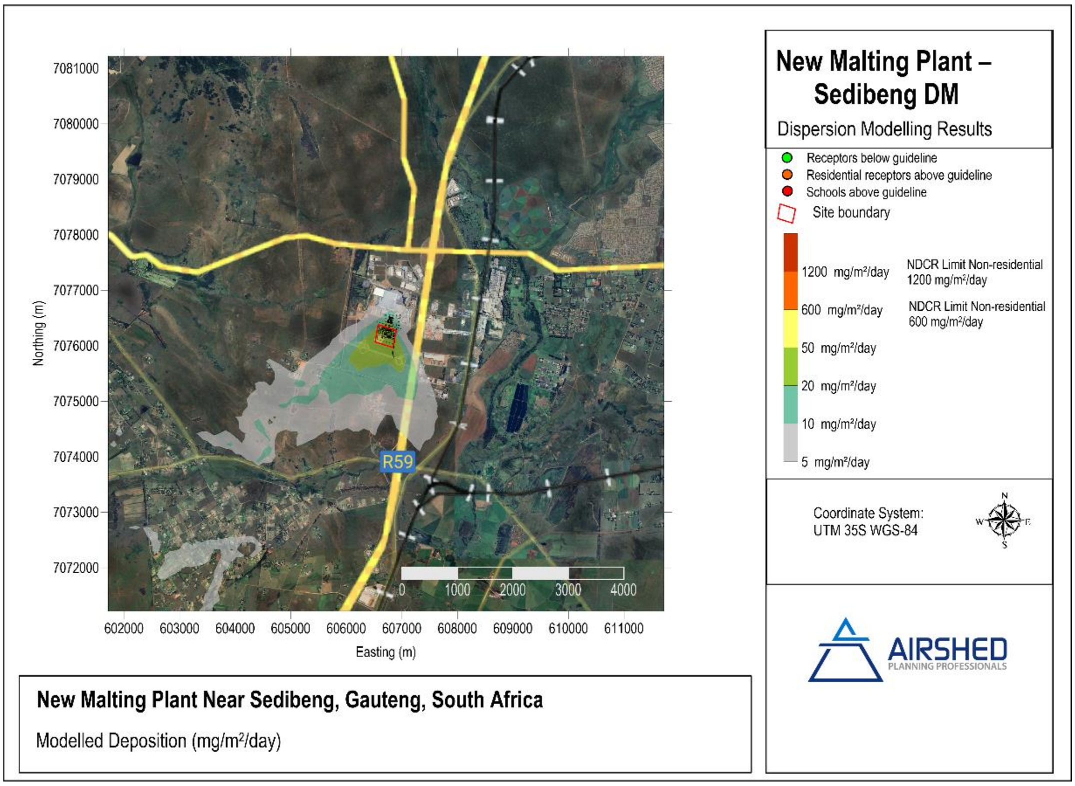


Figure 5-14: Simulated daily nuisance dustfall rates for the New Malting Plant normal operations

5.3 Analysis of Emissions' Impact on Odour

The odour threshold is defined as a theoretical minimum concentration that produces an olfactory response. This threshold defines one odour unit (OU). At levels below 1 OU theoretically, no odour impact is expected, and literature values suggest that odour levels that can be perceived as a nuisance can range between 2 OU and 10 OU depending on various factors such as the odour quality, odour intensity, the frequency, timing and duration of the odour and population sensitivity, amongst others (NSW 2006). Odour assessment criteria can be defined using a statistical approach which depends on the size of the population. As the size of the population increases, so too does the statistical number of sensitive individuals. Odour assessment criteria have been defined by NSW (2006) using this approach and is set out in Table 5-8. For schools, an OU threshold of 2 OU was used and for single residences close to the facility a threshold of 7 OU was used.

Table 5-8: NSW EPA odour performance criteria defined based on population density (NSW 2006)

Population of Affected Community	Odour performance criteria (OU)
Urban area (≥2000)	2.0
~ 500	3.0
~ 125	4.0
~ 30	5.0
~ 10	6.0
Single residences (≤2)	7.0

For the purposes of this assessment, the US EPA's AERMOD dispersion model was selected to simulate odorous air emissions from the New Malting Plant. However, AERMOD, as with many other regulatory models, outputs hourly average concentrations which in reality can mask peak short-term odour episodes. The two approaches that could be followed to assess odour impacts may include:

- Calculate hourly average concentrations and assess the nuisance using percentiles, typically 98th, or 99th, and apply criteria that assumes an acceptance concentration level for a 1-hour average; or,
- Extrapolate short-term odour concentrations from the 1-hour average values and apply corresponding short-term odour threshold criteria. In this instance, to estimate the effects of plume meandering and concentration fluctuations perceived by the human nose over short exposure periods, this may be achieved by multiply 1-hour average dispersion model predictions by a correction factor, such as followed in the "peak-to-mean" approach.

The simulated odour impact for the study used the 99th percentile hourly value. In order to determine the peak ground level concentrations, the peak to mean ratios set out in NSW EPA (2022) was utilised as set out in Table 5-9. For this assessment a peak to mean ration of 2.3 was utilised to calculate one second peak values.

Table 5-9: Peak-to-Mean ratios as used in NSW (NSW EPA 2022)

Source type	Pasquill–Gifford stability class	Near-field P/M60(a)(b)	Far-field P/M60(a)c)
Area	A B C D	2.5	2.3
	E F	2.3	1.9
Line	A–F	6	6
Surface wake-free point	A B C	12	4
	D E F	25	7
Tall wake-free point	A B C	17	3
	D E F	35	6
Wake-affected point	A–F	2.3	2.3
Volume	A–F	2.3	2.3

Notes:
(a) Ratio of peak 1-second average concentrations to 1-hour average concentrations
(b) "Near-field" is defined as less than ten times the largest source dimension
(c) "Near-field" is defined as greater than ten times the largest source dimension

Odour impacts were estimated due to emissions from the kilns during normal operations of the New Malting Plant. Simulated 99th percentile hourly odour impacts modelled in odour units (OU) as shown in Figure 5-15. Odour impacts were found to be elevated towards the south and south-west of the facility. The peak values calculated for each receptor are presented as colour coded dots in Figure 5-15 and classified as being below the guideline (represented by a green dot), or above the guideline (represented by an orange dot for residences and a red dot for schools). Households towards the south of the facility could potentially experience odour nuisance impacts, particularly households located at the receptor numbered 1 towards the south of the facility Potential odour impacts from an on-site WWTP are likely to impact similar receptors.

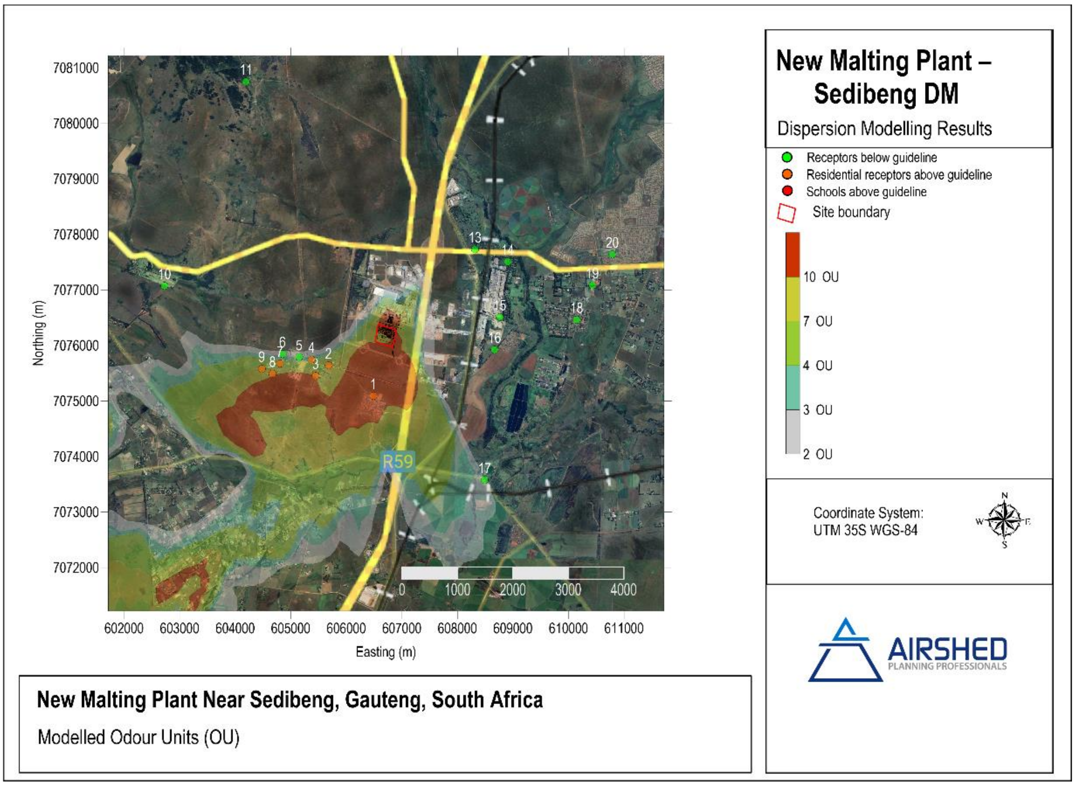


Figure 5-15: Simulated hourly (99th percentile) odour impacts for the New Malting Plant normal operations and peak value exceedances at the receptors included in the model

5.4 Management of uncertainty, assumptions, limitations and exclusions

There will always be some degree of uncertainty in any geophysical model, but it is desirable to structure the model in such a way to minimize the total error. A model represents the most likely outcome of an ensemble of experimental results. The total uncertainty can be thought of as the sum of three components: the uncertainty due to errors in the model physics; the uncertainty due to data errors; and the uncertainty due to stochastic processes (turbulence) in the atmosphere. Nevertheless, dispersion modelling is generally accepted as a necessary and valuable tool in air quality management.

The main assumptions, exclusions and limitations are summarised below:

- Meteorological and Ambient Data:
  - Measured meteorological data for the period January 2021 to December 2023 was used for the assessment. The data availability varied from year to year, with lower data availability in 2023. Due to the proximity of the measuring station to the proposed facility, the data was considered the most representative data available for the assessment.
- Emissions:
  - The quantification of sources of emission was restricted to the Project activities only. Although other background sources were identified, such as emissions from roads, domestic fuel burning, these could not be quantified and did not form part of the scope of work. Baseline air quality was discussed based on measured concentrations and cumulative effects considered in the impact significance rating.

- Emissions were based on the process description and facility layout plan as provided. Where specific information regarding exit points of emissions was not provided, the likely emission points were based on the three-dimensional layout provided.
- No site-specific particle size fraction data for the PM emission sources were available. Based on the literature reviewed, it was assumed that all PM emissions were PM_{10} emissions and that $PM_{2.5}$ emissions contribute less than 5% of the PM_{10} emissions.
- It was assumed that PM_{10} emissions occurred continuously and that the PM emissions from barley intake, cleaning and drying were continuous at the limit provided (10 mg/m^3 from the filter). This assumption is likely to overestimate the PM emissions from the facility.
- The SO_2 emissions from the CHP are very low due to the low sulphur content of the gas (15 mg sulphur/Nm^3) and was not modelled as the ambient impact can be considered negligible.
- During the time of the study, the operational hours of the boilers and the dryer were not available. Two scenarios were therefore modelled to obtain best and worst-case impacts. In the best-case scenario, only the CHP was operational. In the worst-case scenario the CHP, dryer and on boiler were all simultaneously and continuously operational.
- Ammonia will be utilised and stored on-site. Ammonia emissions will only be expected due to a loss of containment and not normal operation and these emissions were therefore not quantified as part of the assessment.
- Odour emissions were estimated using measurements conducted at a similar facility, which is likely to overestimate the emissions from the new malting plant. The odour emissions from an on-site WWTP were not quantified in this assessment.

- Impact Assessment:
  - Gaseous emissions from vehicle exhaust from barley delivery and by-product transport were quantified, but not modelled since impacts from these sources occur mostly off-site.
  - It was conservatively assumed that 100% of NOx convert to NO_2.

5.5 Main Findings

The main findings from the air quality impact assessment are:

- Ambient air quality data from the Kliprivier AQMS shows compliance with short-term SO_2, NO_2 and CO standards, although short-term peak concentrations can occur. Daily PM_{10} and $PM_{2.5}$ concentrations as well as 8-hour rolling average O_3 concentrations were in non-compliance with the NAAQS.
- Emissions quantification and dispersion modelling show that the New Malting Plant does not result in a substantive concentrations of criteria air pollutants (SO_2, NO_2, CO, VOCs, PM_{10}, and $PM_{2.5}$).
- Increased odour impacts from kilning and an on-site WWTP are possible at receptors located towards the south and south-west of the facility, but the quantum of the impacts is likely to be overestimated by this assessment.
- The assessment of impact of the malt plant on ambient air quality (section 5.2*)* showed minimal off-site impact other than the potential of nuisance odour impacts. On this basis the applicable buffer zone between 100 and 250 m is recommended. The current plant layout indicates that there is at least 300 m between the malt plant and the industrial complex access road or the R59, along with the distance to the closest residence (1.1 km), it is the specialist's opinion that an additional buffer zone is not required. Since the purpose of a buffer zone is to restrict more sensitive categories from being developed next to existing facilities, if any additional development occurs within the Graceview Industrial Park around the malt plant, the buffer zone of between 100 m and 250 m should be considered based on the type of industry to be developed (as defined in GDARD, 2017).

5.6 Impact Assessment

The impact assessment methodology was provided by the client and is set out in Appendix A. The impact assessment requires an impact rating before and after mitigation. For this study it was assumed that the control equipment such as filters were part of the design of the facility and not additional mitigation. The impacts were evaluated under conservative operation assumptions, which are likely to overestimate the air quality impacts of the facility. The ratings therefore apply to a conservative scenario which includes mitigation and therefore no additional mitigation is considered necessary.

The impact significance ratings for the project impacts are provided in Table 5-10 for the project impacts and Table 5-10 for cumulative impacts which consider the baseline air quality of the area. The impact with the highest significance is the potential impacts associated with increased odour from the facility. The significance ratings of the cumulative impact of the project are provided in Table 5-11. Due to the ambient $PM_{2.5}$ and PM_{10} exceedances currently experienced in the area, the cumulative impact of increased PM emissions is rated higher when cumulative impacts are considered.

Table 5-10: Impact Significance Ratings for the potential air quality impacts from the New Malting Plant

Impact	Description	Probability	Duration	Scale	Magnitude	Impact Significance
NOx – Short term	Increase in hourly ambient NO_2 concentrations	3	2	2	2	18 - Low
NOx – Long term	Increase in annual ambient NO_2 concentrations	3	2	2	2	18 - Low
PM – Short term	Increase in hourly ambient PM concentrations	3	2	2	2	18 - Low
PM – Long term	Increase in annual ambient PM concentrations	3	2	2	2	18 - Low
Odour Impacts	Odour impacts at nearby receptors	3	2	2	4	24 - Low
Dustfall Impacts	Nuisance dust impacts at nearby receptors	2	2	1	2	10 - Low

Table 5-11: Impact Significance Ratings for the potential air quality impacts from the New Malting Plant - Cumulative

Impact	Description	Probability	Duration	Scale	Magnitude	Impact Significance
NOx – Short term	Increase in hourly ambient NO_2 concentrations	3	2	2	2	18 - Low
NOx – Long term	Increase in annual ambient NO_2 concentrations	3	2	2	2	18 - Low
PM – Short term	Increase in daily ambient PM concentrations	4	2	2	6	40 - Moderate
PM – Long term	Increase in annual ambient PM concentrations	3	2	2	2	18 - Low
Odour Impacts	Odour impacts at nearby receptors	3	2	2	4	24 - Low
Dustfall Impacts	Nuisance dust impacts at nearby receptors	2	2	1	2	10 - Low

5.7 Recommendations

5.7.1 Ambient Monitoring

Environmental indicators are used in air quality monitoring to simplify environmental assessments. Indicators are defined as a single measure of a condition of an environmental element that represents the status or quality of that element, and a threshold is the value of an indicator or index. For example, ambient PM_{10} concentrations monitored within a specific area will be the indicator, with the NAAQS being the threshold.

It is recommended that an annual short-term (14-day) monitoring using passive diffusive sampling techniques for NO_2, VOCs, and PM_{10} should be undertaken at three locations on the site boundary to ensure that compliance with NAAQS is maintained at the site boundary. This should be undertaken prior to commissioning – to establish a site baseline - and after commissioning to show the cumulative impact of the facility.

It is recommended that an odour complaints register be kept, and all complaints received noted, investigated and corrective action taken, where appropriate. Any corrective action taken should be noted in the register. It is recommended that, if an on-site WWTP is commissioned, it be designed using best practice principles to reduce the impact of odours on surrounding communities.

It is recommended that the facility monitor and maintain records of the frequency and the methods used to control fugitive dust emissions and maintain records of all fugitive dust complaints received and the corrective action taken in response to the complaint.

It is further recommended that facility-wide inspections of all sources of fugitive emission sources be conducted and if any of the sources of dust or odours are not being reasonably controlled, corrective action be taken.

5.7.2 Source Monitoring

It is recommended that maintenance of the baghouses be performed if visible emissions exceed 0% opacity. In addition, the pressure drop across the baghouses is required to be maintained within manufacturer and the operation and maintenance manual specifications. It is recommended that performance tests on the baghouse(s) to ensure that the emission limit of 10 mg/m^3 is not exceeded. $PM_{2.5}$ as well as PM_{10} should be measured to provide more accurate data for future assessments. It is recommended that as minimum the following emission sources be monitored periodically for PM emissions:

- all baghouse sources; and,
- kilns.

It is further recommended that performance testing be conducted to ensure that the following equipment achieve the performance standard set by the manufacturer for NOx emissions:

- CHP units; and,
- boilers.

5.7.3 Air Quality Management Plan

It is recommended that a comprehensive air quality management plan (AQMP) be developed that incorporates the recommendation contained in section 5.7.1 and 5.7.2. The AQMP should contain detailed plans for the implementation of all the recommendations contained in section 5.7 of this report, provide for stakeholder engagement and detailed plans for the management of complaints. The AQMP should include provisions for regular reviews of mitigation measures. It is recommended that the AQMP be submitted to the regulator for review and approval prior to the commissioning of the facility.

It is the opinion of the specialist that the project, with effective mitigation measures implemented and corrective action taken when necessary, has a low impact on ambient air quality beyond the property boundary. Regular maintenance of control equipment and continued monitoring of sources (including all baghouses and kilns) is recommended along with periodic ambient monitoring.

REFERENCES

Boac JM, Maghirang RG, Casada ME, Wilson JD and Jung YS (2009) "Size distribution and rate of dust generated during grain elevator handling", *Applied Engineering in Agriculture*, vol 25, no 4, pp 533-541.

CERC. (2004). *ADMS Urban Training. Version 2. Unit A.*

DEA. (2014). *Regulations regarding Air Dispersion Modelling.* Department of Environmental Affairs, Government Gazette No. 37804, 11 July 2014.

DFFE. (2020, June 12). Draft Second Generation Air Quality Management Plan For Vaal Triangle. *Government Gazette G43418 GN655: Draft Second Generation Air Quality Management Plan For Vaal Triangle*. Pretoria: Department of Forestry, Fisheries and Environment. Retrieved 04 28, 2021, from https://saaqis.environment.gov.za/Pagesfiles/Draft%20Second%20Generation%20Air%20Quality%20Management%20Plan%20For%20Vaal%20Triangle%20%5BG%2043418%20-%20GN%20655%5D.pdf

GDARD. (2017). *Gauteng Pollution Buffer Zones Guidelines.* Johannesburg: Gauteng Department of Agriculture and Rural Development.

Government Gazette. (2013, November 22). Listed activities and associated minimum emissions standards. *National Environmental Management: Air Quality Act (39/2004), 37054*.

Government Gazette. (2013, October 11). Regulations Prescribing Format of Atmospheric Impact Report. *National Environmental Management: Air Quality Act (39/2004), 36904*.

Government Gazette. (2014, July 11). Regulations Regarding Air Dispersion Modelling. *National Environmental Management: Air Quality Act (39/2004), 37804*.

Government Gazette. (2018, October 31). Amendments to the Listed Activities. *National Environmental Management: Air Quality Act (39/2004), 42013*.

Hanna, S. R., Egan, B. A., Purdum, J., & Wagler, J. (1999). *Evaluation of ISC3, AERMOD, and ADMS Dispersion Models with Observations from Five Field Sites.*

NPI. (1998). *Emissions Estimation Technique Manual for Bricks, Ceramics, and Clay Product Manufacturing.* Canberra: ustralian Government Department of Sustainability, Environment, Water, Population and Communities.

NPI. (2008). *Emissions Estimation Technique Manual for Combustion Engines. Version 3.* Canberra: Australian Government Department of Sustainability, Environment, Water, Population and Communities.

US EPA. (1995). *AP 42, 5th Edition, Volume 1, Chapter 11: Mineral Products Industry, 11.5 Refractory Manufacturing.* Retrieved from http://www.epa.gov/ttn/chief/ap42

US EPA. (2011). *AP 42, 5th Edition, Volume 1, Chapter13: Miscellaneous Sources, 13.2.1 Introduction to Fugitive Dust Sources, Paved Roads.* Retrieved from http://www.epa.gov/ttn/chief/ap42

van Niekerk, F. (2016a). *Isokinetic Stack Emission Survey Report for Calderys Refractory Solutions: New Plant Dust Extraction System.* Pretoria: OH&AP Consulting Services.

van Niekerk, F. (2016b). *Calderys Refractory Solutions: Hazardous Chemical Substance Exposure Survey Report.* Pretoria: OH&AP Consulting Services.

van Niekerk, F. (2021). *Calderys Material Drying Process: Gas emission test (March 2021).* Pretoria: OH&AP Consulting Services.

Zhu, L., Liu, J., Cong, L., Ma, W., Ma, W., & Zhang, Z. (2016). Spatiotemporal Characteristics of Particulate Matter and Dry Deposition Flux in the Cuihu Wetland of Beijing. *PLOS ONE, 11*(7), e0158616. doi:doi:10.1371/journal.pone.0158616

APPENDIX A: IMPACT ASSESSMENT METHODOLOGY

Impact Assessment Methodology

The potential environmental impacts associated with the project will be evaluated according to its nature, extent, duration, intensity, probability and significance of the impacts, whereby:
Nature: A brief written statement of the environmental aspect being impacted upon by a particular action or activity;
Extent: The area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact. For example, high at a local scale, but low at a regional scale;
Duration: Indicates what the lifetime of the impact will be;
Intensity: Describes whether an impact is destructive or benign;
Probability: Describes the likelihood of an impact actually occurring; and
Cumulative: In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Occurrence		**Severity**	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:
Criteria for the ranking of impacts

Probability	Duration
5 - Definite/ don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8 - 15 years)
2 - Low probability	2 - Short-term (0 - 7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 – None	0 - None
Scale	Magnitude
5 - International	10 - Very high/ don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 – None	0 - None

Once these factors have been ranked for each impact, the significance of the two aspects, occurrence and severity, must be assessed using the following formula:

SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). The impact significance is then rated as follows:

Impact significance:

SP >75	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 75	Indicates moderate Environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions

Impacts must be assessed and rated before and after mitigation.

APPENDIX B: AUTHORS CURRICULUM VITAE

CURRICULUM VITAE

Name	Theresa (Terri) Leigh Bird
Nationality	South African
Employer	Airshed Planning Professionals (Pty) Ltd
Position	Senior Consultant
Profession	Air Quality Specialist Consultant
Years with Firm	12 years

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- National Association for Clean Air (NACA), 2012 to present
- South African Council for Natural Science Professions (Pr.Sci.Nat.), 2016 to present

EXPERIENCE

Projects contributing to Environmental Impact Assessments

Project type	Experience
Mining (including coal, platinum, tin, gold, and rare earth minerals)	▪ At least five proposed open-cast coal mining projects, mostly in South Africa and Botswana ▪ Air quality assessment for the expansion of an underground platinum mine to include a concentrator facility and tailings facility. ▪ Assessment of underground mining of cassiterite (the mineral ore mined for tin) in the Democratic Republic of Congo. The project included the assessment of emissions along a long-distance haul road from the mine to Mombasa for export. ▪ Assessment of open-cast and underground mining of gold-rich ore, including gold plant activities, in order to design an air quality monitoring network. ▪ Three rare earth mineral mining projects included dispersion model runs to assist the radiation specialist assessment of impact of radioactive compounds. ▪ The impact of mine tailings facilities on a proposed mixed use (residential and commercial) development, especially consideration to particulate matter and potential hazardous compounds on the residents of the development.
Power Stations	▪ A project assessing the impact of Namibian coal-fired power station on urban air quality, in the context of many small industrial sources. ▪ The assessment of retrofitting improved particulate emission controls on an existing coal-fired power station on the Mpumalanga Highveld. ▪ The assessment of impact of a floating power plant, fuelled by various potential liquid fuels, docked in a port servicing an industrial development zone.

Projects contributing to Environmental Impact Assessments

Project type	Experience
	▪ Professional opinion on the impact of solar power facilities (one concentrated solar power (CSP) and one photovoltaic (PV)) on ambient air quality. ▪ The assessment of three coal-fired power stations in Botswana, including two projects where the assessment assessed the combined impact of an open-cast coal mine and the associated coal-fired power station. ▪ Assessment of gas- and liquid fuel-to-power facilities using a mix of fuel options and abatement technologies.
Ash disposal facilities for coal-fired power stations	▪ Conducted the assessment of impact of ash disposal facilities coal-fired power stations requiring additional disposal area. Assessment included the estimation of increased life-time cancer risk as a result of exposure to carcinogenic metals in the wind-blown dust from the disposal facilities.
Tyre pyrolysis plant	▪ Assisted on an assessment of a plant that will use waste tyres as raw material to produce machine and vehicle oils.
Mineral alloy plant	▪ Project for a plant that uses multiple listed activities to recovery metals, via thermal processes, to produce ferroalloys that are pressed into briquettes for dispatch to clients.
Domestic waste landfill	▪ Assessing the health and odour impacts of a domestic waste landfill to support residential development plans for the area.
Hazardous waste landfill	▪ Assessing the health and odour impacts of a hazardous waste landfill to support the reduction of the required buffer zone.
Thermal oxidation of industrial waste	▪ The project quantified the impact of an industrial thermal oxidation plant for waste disposal and considered upgrading of new technology to meet more stringent emission standards.
Marine Repair Facility	▪ The project quantified the impact on air quality of a marine vessel repair facility in the context of a busy port which includes an iron-ore transfer yard.
Industrial complexes	▪ Air quality impact of a large industrial special economic zone development (project assistant) ▪ Impact of road traffic on air quality associated with the development of an automated supplier park.

Air Quality Management Plans (AQMP) and Policy Developments

Project type	Experience
Priority Area Level AQMP	▪ Involvement included: - baseline assessment of climatic conditions and ambient air quality across the Province; - collation of questionnaires from point-source emission; - point-source emissions inventory database management ▪ Contributor to management plan write-up. ▪ The management intervention strategies proposed in the AQMP were a collaborative effort of the technical project team, which included the client, stakeholders, and consultants.
Provincial Level AQMP	▪ Involvement included: - baseline assessment of climatic conditions and ambient air quality across the Province; - collation of questionnaires from point-source emission;

Page **2** of **8**

Air Quality Management Plans (AQMP) and Policy Developments

Project type	Experience
	- point-source emissions inventory database management ▪ Assisted with quantification of vehicle emissions and with dispersion modelling of baseline emissions. ▪ Main contributor to management plan write-up. ▪ The management intervention strategies proposed in the AQMP were a collaborative effort of the technical project team, which included the client and consultants.
Metropolitan city level AQMP	▪ Contributed to the emission inventory of industrial sources ▪ Collaborative project with the Council for Scientific Research (CSIR)
New Policy Development	▪ Involved in a project to assess the impact of fuel burning appliances towards a controlled fuels policy in a metropolitan municipality.
Platinum smelter complex	▪ Fugitive dust emissions from ground-level sources and materials handling were a concern for a platinum smelter complex. The project scope included the identification of all sources; the quantification and ranking of emissions; and proposed management strategies. A risk assessment model was used to assess where the variability of emission sources would constitute a risk if improperly managed.
Diamond mine	▪ The project scope for a Botswana-based diamond mine approaching end-of-life required the assessment of current and future impacts of operations on the ambient air quality; including the development of an air quality management plan and the proposal of an ambient air quality monitoring network, based on the findings of the impact assessment.

Atmospheric Impact Reports (AIR)

Project type	Experience
Coal-to-liquid fuel refineries	▪ Postponement application included four sites with multiple point-sources and modelling iterations for all sources emitting at four different levels for multiple pollutants. ▪ A collaborative project where responsibilities included: model simulations, post-processing and extractions; management of model extractions and management of file transfer for peer review process; graphic summaries results; mapping of results; and, graphic presentation of measured ambient air quality. My contributions to the written report included: report template sections (as per Government Gazette No. 36904: 747); summary of meteorological data used in the assessment; measured ambient air quality; results analysis, interpretation and write-up; and, a literature review of potential impacts of the operations on the environment. ▪ The assessment of impact of petroleum storage tanks storing products of the tar process on the ambient air quality, especially with respect to total volatile organic compounds (TVOCS).
Crude oil refinery	▪ Postponement application included emissions from multiple point-sources, and fugitive emissions from storage tanks; modelling iterations for all sources emitting at two different levels for sulfur dioxide [from point sources] and total volatile organic compounds (TVOCS) [from tanks]. ▪ A collaborative project where I focused on the point-sources, including the model simulations; post-processing and extractions; graphic results summaries; and,

Atmospheric Impact Reports (AIR)

Project type	Experience
	graphic presentation of measured ambient air quality. Contributions to the written report included: report template sections; summary of meteorological data used in the assessment; measured ambient air quality; results analysis, interpretation and write-up.
Fertilizer production	▪ Assessment report (prepared as AIR) included emissions from multiple point-sources; modelling iterations for all sources emitting at two different levels for particulate matter and ammonia emissions. ▪ A collaborative project where my responsibilities included: model simulation setup, post-processing and extractions; graphic summaries results; mapping of results; and, graphic presentation of measured ambient air quality. My contributions to the written report included: report template sections (as per Government Gazette No. 36904: 747); summary of meteorological data used in the assessment; measured ambient air quality; results analysis, interpretation and write-up.
Platinum smelter	▪ Postponement application included emissions from the smelter furnace and converter; modelling iterations for the sources emitting at two different levels where the pollutant of concern was sulfur dioxide.
Veterinary waste incinerator	▪ New Atmospheric Emissions License (AEL) application for a State Veterinary incinerator. The assessment included calculating emission rates from the incinerator; dispersion modelling; preparation of an AIR (as per Government Gazette No. 36904: 747); and completing the technical sections of the AEL application.
Galvanizing plant	▪ The project assessed the impact of a steel galvanising plant on air quality in a developing industrial development zone. Pollutants of concern included hydrochloric acid (HCl).
Secondary Aluminium Smelter	▪ A project involving the assessment of a secondary aluminium smelter in an already developed urban industrial area
Refractory product facility	▪ A project for a facility producing monolithic refractories and dried 'ready-shape' refractory castables made specially for industrial equipment and refractory installations.
Waste to energy facility	▪ A project to assess the impact of a general waste to energy project, using pyrolysis, located in a tourism, recreational, commercial and residential area of the Western Cape province.
Impact screening at receptors	▪ Assessment of air quality impact at sensitive receptors based on measurements at monitoring stations where not collocated.
NEMA Section 30	▪ Assessment of air quality impact due to industrial 'upset' events including simulating the off-site impacts for short-term high-emission events.

Ambient air quality monitoring projects

Project type	Comments regarding project details and involvement
Ferrochrome smelter complex	▪ Compiled reports for the dustfall monitoring campaign for a period of 12 months. Results were compared with the relevant legislation and recommendations made for source management as required.
Platinum smelter complex	▪ Project scope required monthly reports of the ambient sulfur dioxide concentrations downwind of a platinum smelter complex, for a 12-month

	reporting period. Report preparation included: data cleaning and filtering; data analysis, presentation; and report write-up.
Dustfall monitoring	▪ Collate, summarise and report on dustfall rates, and metal content, after laboratory analysis. Projects include: baseline monitoring prior to active coal mining; landfill dustfall monitoring; baseline dustfall monitoring for a residential development.
Ambient air quality monitoring	▪ Using radiello™ passive samplers to assess ambient pollutant concentrations. Projects include: volatile organic compounds around industrial waste water dams; pre-development levels near a medical waste incinerator; pre-development levels near a coal-fired power station; levels near a hazardous landfill; monitoring near an operational natural gas compression plant.
Asbestos monitoring	▪ Air and soil sampling and reporting for asbestos fibres
Petroleum product storage tanks	▪ Calculation of annual (volatile organic compound) emissions from petroleum storage tanks for the purposes of emissions reporting via the National Atmospheric Emission Inventory System.

Emissions Reporting and Offset Projects

Prepared emissions inventories for online submission via the Atmospheric Emission Inventory System (NAEIS)

Project types

- Coal Mine
- Liquid fuel to power plant
- Dispersion modelling of air quality offset projects
- Manufacturer of alloys and associated products
- Petroleum product tank farm

Greenhouse Gas Emissions Foot-printing and Climate Change Impact Statements

Project type	Comments regarding project details and involvement
Coal Mine	▪ Quantified the direct and indirect (due to imported electricity) emissions for a coal mine on the Highveld. ▪ Assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.
Gas-to-power plant	▪ Quantified the direct and indirect (due to imported electricity) emissions for a risk mitigation gas-to-power plant on South Africa's north-east coast. Avoided emissions from coal-fired power plants were also considered. ▪ Assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures; risk of intense storms, including tropical cyclones; sea level rise and coastal stability.
Liquid fuel to power plants	▪ Quantified the direct and indirect (due to imported electricity) emissions for a risk mitigation liquid fuel-to-power plant, used to support solar PV arrays, in South Africa's Northern Cape Province. ▪ Assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures, water scarcity, risk of intense storms.
Calcination plant	▪ Quantified the direct and indirect (due to imported electricity) emissions from a calcination facility on the Highveld. ▪ Assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures; water scarcity and risk of intense storms.
Liquid fuel refinery	▪ Quantified the direct and indirect (due to imported electricity) emissions for liquid fuel refinery.

	▪ Assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures; water scarcity; sea level rise; and storm water surges.
General Waste Landfill	▪ Quantified the direct and indirect (due to imported electricity and vehicle fuel use) emissions for a general waste landfill. ▪ Assessed the climate risks and vulnerabilities of the project and surrounding communities due to increasing ambient temperatures and water scarcity.

SOFTWARE PROFICIENCY

- Atmospheric Dispersion Models: AERMOD, CALPUFF, ADMS (United Kingdom), CALINE, GRAL.
- Emissions models: COPERT and GASSIM
- Graphical Processing: Surfer, ArcGIS
- The R Project for Statistical Computing, especially with the package "openair"

EDUCATION

University of the Witwatersrand

Ph.D. (School of Animal, Plant and Environmental Sciences) (2006 - 2011)	Thesis title: **Some impacts of sulfur and nitrogen deposition on the soils and surface waters of the Highveld grasslands, South Africa.**
M.Sc. (School of Animal, Plant and Environmental Sciences) (1999 – 2001).	Dissertation title: **Some effects of prescribed understory burning on tree growth and nutrient cycling, in *Pinus patula* plantations.**
B.Sc. (Hons) (Botany) (1998)	Project title: **The rate of nitrogen mineralization in plantation soils, in the presence of *Eucalyptus grandis* wood chips.** *Courses*: Wetland ecology, Ecophysiology and Environmental studies.
B.Sc. (1995 – 1997)	Botany III, Geography III, Zoology II.

COURSES COMPLETED AND CONFERENCES ATTENDED

- Paper presented at the International Union of Air Pollution Prevention and Environmental Protection Associations World Clean Air Congress, 2013 in Cape Town, South Africa,29 September - 4th October 2013
  - *Paper entitled*: Nitrogen cycling in grasslands and commercial forestry plantations: the influence of land-use change
  - *Co-authors*: T.L. Bird, M.C. Scholes, Y. Scorgie, G. Kornelius, N.-M. Snyman, J. Blight, and S. Lorentz
- Paper prepared for the National Association for Clean Air (NACA) annual conference, 2012 in Rustenburg, South Africa, 1-2 November 2012, Rustenburg. Annual Conference Proceedings ISBN 978-0-620-53886-2, Electronic Proceedings ISBN 978-0-620-53885-5
  - *Paper entitled*: Developing an Air Quality Management Plan: Lessons from Limpopo
  - *Co-authors*: T. Bird, H. Liebenberg-Enslin*, R. von Gruenewaldt, D. Modisamongwe, P. Thivhafuni, and, T. Mphahlele

- National Association for Clean Air (NACA) annual conference, 2017 in Johannesburg, South Africa, 4-6 October 2017, Rustenburg. Annual Conference Proceedings ISBN 978-0-620-77240-2, Electronic Proceedings ISBN 978-0-620-53885-5
    - *Poster entitled*: Air Pollution in sub-tropical urban and suburban areas: Do trends indicate vegetation as a pollution source?
    - *Co-authors*: T. Bird, G. Petzer, N. von Reiche

COURSES PRESENTED

Training organisation	Details of involvement
National Association for Clean Air (NACA)	▪ Presenting the module regarding the Development of Air Quality Management Plans ▪ Module forms part of a 5-day course presented annually ▪ Atmospheric dispersion modelling training with AERMOD and CALPUFF
Centre for Environmental Management (CEM), University of the North-West (Potchefstroom)	▪ Presented two modules: 1. Development of Air Quality Management Plans 2. Air Pollution Meteorology ▪ Modules forms part of a 2-day course presented annually, or at special request

COUNTRIES OF WORK EXPERIENCE

South Africa, Botswana, Mozambique, Democratic Republic of Congo, Namibia, Tanzania

LANGUAGES

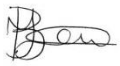
Language	Proficiency
English	Full professional proficiency
Afrikaans	Good understanding; fair spoken and written

REFERENCES

Name	Position	Contact Number
Dr. Hanlie Liebenberg Enslin	Managing Director at Airshed Planning Professionals	+27 (83) 416 1955 hanlie@airshed.co.za
Dr Lucian Burger	Director at Airshed Planning Professionals	+27 (82) 491 0385 lucian@airshed.co.za
Dr. Gerrit Kornelius	Associate of Airshed Planning Professionals	+27 (82) 925 9569 gerrit@airshed.co.za

CERTIFICATION

I, the undersigned, certify that to the best of my knowledge and belief, these data correctly describe me, my qualifications and my experience.



20 June 2024