Air Quality Impact Assessment for the Proposed Development of the Phakwe Richards Bay Gas Power 3 Combined Cycle Gas to Power Plant (PRBGP3) and associated Infrastructure on a site near Richards Bay, KwaZulu-Natal Province – Scoping Report

Project done on behalf of **Savannah Environmental (Pty) Ltd**

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REPORT DETAILS

Report Title	Air Quality Impact Assessment for the Proposed Development of the Phakwe Richards Bay Gas Power 3 Combined Cycle Gas to Power Plant (PRBGP3) and associated Infrastructure on a site near Richards Bay, KwaZulu-Natal Province – Scoping Report
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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.
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REVISION RECORD

Revision Number	Date	Reason for Revision
Draft Scoping Report	July 2020	Draft for Client Review
Revision 1	16 February 2021	Updated generating capacity, updated ambient baseline data for 11 stations
Revision 2	28 October 2021	Updated process description, capacity and proposed facility naming convention

ABBREVIATIONS

Airshed	Airshed Planning Professionals (Pty) Ltd
AQMP	Air Quality Management Plan
AQMS	Air Quality Monitoring Station
AQSR	Air Quality Sensitive Receptor
CBD	Central Business District
DEA	Department of Environmental Affairs (now DFFE)
DEAT	Department of Environmental Affairs and Tourism (Now DFFE)
DFFE	Department of Forestry Fisheries and Environment (previously DEA and DEAT)
DOE	Department of Energy
EIA	Environmental Impact Assessment
EF	Emission Factor
EMP	Environmental Management Plan
HAP	Hazardous Air Pollutant
ISO	International Organization for Standardization
LNG	Liquid Natural Gas
NAAQS	National Ambient Air Quality Standards
NEMAQA	National Environmental Management: Air Quality Act
NMES	National Minimum Emission Standards
PM	Particulate Matter
RBCAA	Richards Bay Clean Air Association
SABS	South African Bureau of Standards
SANS	South African National Standards
Savannah	Savannah Environmental (Pty) Ltd.
SAWS	South African Weather Service
US EPA	United Stated Environmental Protection Agency
WRF	Weather Research and Forecasting mesoscale model

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
$PM_{2.5}$	Particulate Matter with an aerodynamic diameter of less than 2.5 µm
PM_{10}	Particulate Matter with an aerodynamic diameter of less than 10 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)
HC	Hydrocarbons
kg	Kilograms
1 kilogram	1 000 grams
km^2	Square kilometre
m	Metres
mamsl	Metres above mean sea level (also metres above sea level – masl)
m/s	Metres per second
MW	Megawatt
µg	Microgram(s)
$µg/m^3$	Micrograms per cubic metre
µm	Micrometre
mg	Milligram(s)
mg/m^3	Milligrams per cubic metre
m^2	Square metre
m^3	Cubic metre
mm	Millimetres
N_2O	Nitrous oxide
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
O_3	Ozone
PM	Particulate matter
$PM_{2.5}$	Inhalable particulate matter (aerodynamic diameter less than 2.5 µm)
PM_{10}	Thoracic particulate matter (aerodynamic diameter less than 10 µm)
SO_2	Sulfur dioxide (1)
SO_X	Oxides of sulfur
1 ton	1 000 000 grams
TVOCs	Total volatile organic compounds
VOCs	Volatile organic compounds

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)"

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1 INTRODUCTION

Phakwe Richards Bay Gas Power 3 (Pty) Ltd (PRBGP3) intend on developing a combined cycle gas to power plant, with a generating capacity up to 2 000 MW, located on various erven within the Richards Bay Industrial Development Zone (RB IDZ) phase 1F, Richards Bay, KwaZulu-Natal. Airshed Planning Professionals (Pty) Ltd (Airshed) was appointed by Savannah Environmental (Pty) Ltd to address potential impacts on the atmospheric environment by conducting a comprehensive air quality impact assessment for the PRBGP3 Project. This report covers the Scoping study.

1.1 Background

The power plant will operate at mid-merit to baseload duty and will include the following main infrastructure:

- A number of gas turbines for the generation of electricity through the use of natural gas (liquid or gas forms), or a mixture of natural gas and hydrogen (in a proportion scaling up from 30% H_2) as fuel source, operating all turbines at mid-merit or baseload (estimated 16 to 24 hours daily operation).
- Exhaust stacks associated with each gas turbine.
- A number of Heat Recovery Steam Generator (HRSG) to generate steam by capturing the heat from the turbine exhaust.
- A number of steam turbines to generate additional electricity by means of the steam generated by the HRSG.
- The water treatment plant will demineralise incoming water from municipal, or similar supply, to the gas turbine and steam cycle requirements. The water treatment plant will produce two parts demineralised water and reject one-part brine, which will be discharged to the RB IDZ stormwater system.
- Steam turbine water system will be a closed cycle with air cooled condensers. Make-up water will be required to replace blow down.
- Air cooled condensers to condensate used steam from the steam turbine.
- Compressed air station to supply service and process air.
- Water pipelines and water tanks for storage and distributing of process water, with the potential for sourcing of alternative water outside RB IDZ or municipal supply.
- Water retention pond.
- Closed Fin-fan coolers to cool lubrication oil for the gas turbines.
- Gas generator lubrication oil system.
- Gas pipeline supply conditioning process facility.
    - Please note that the gas supply will be via a dedicated pipeline from the proposed Transnet supply pipeline network of Richards Bay (the location of this network has not yet been confirmed) or, alternatively directly from the regasification facilities in the Port of Richards Bay. The gas pipeline will be authorized separately.
- Site water facilities including potable water, storm water, and wastewater.
- Fire water (FW) storage and FW system.
- Diesel emergency generator for start-up operation.
- On-site fuel conditioning including heating system.

- All underground services, including stormwater and wastewater.
- Ancillary infrastructure including:
  - Roads (access and internal);
  - Warehousing and buildings;
  - Workshop building;
  - Fire water pump building;
  - Administration and Control Building;
  - Ablution facilities;
  - Storage facilities;
  - Guard House;
  - Fencing;
  - Maintenance and cleaning area;
  - Operational and maintenance control centre.
- Electrical facilities including:
  - Power evacuation including GCBs, GSU transformers, MV busbar, HV cabling and 1x275 kV or 400 kV GIS Power Plant substation.
  - Generators and auxiliaries;
  - Subject to a separate environmental authorisation application:
  - Eskom 275 or 400 kV GIS interface Substation
  - Underground 275 or 400 kV power cabling connecting Power Plant GIS substation and Eskom GIS Interface substation.
  - an overhead 275 kV or 400 kV power line connecting the ESKOM interface substation to the selected Eskom grid connection point.
- Service infrastructure including:
  - Stormwater channels;
  - Water pipelines;
  - Temporary work areas during the construction phase (laydown areas).

Fuel supply

- A dedicated pipeline to connect into an on-site gas receiving and conditioning station will provide the natural gas or the mixture of natural gas and Hydrogen. The pipeline will be connected to the proposed Transnet supply pipeline network of Richards Bay (the location of this network has not yet been confirmed), or it will extend directly to the regasification facilities in the in the Port of Richards Bay.
- The dedicated pipeline will be separately environmentally authorized.

The development is proposed on erven 16820, 16819,1/16674 and a subdivision of erf 17442 , and will occupy approximately 11ha, situated within Phase 1F of the RB IDZ located approximately 5 km north east of Richards Bay and 1 km north of the suburb of Alton (Figure 1-1). The project site is situated in the City of uMhlathuze which falls within jurisdiction of the King Cetshwayo District Municipality, KwaZulu-Natal Province. The site has been zoned for IDZ Industrial development as part of the planning for this IDZ area.

Please note: while the facility will be connected to a dedicated fuel pipeline, and will have grid connection infrastructure towards connecting with the Eskom substation and the national grid, these infrastructure components do not form part of this application and are subject to separate authorisation processes

1.2 Objectives

The main objectives of the air quality specialist study were to identify the potential impact of the PRBGP3 on air quality, as part of the Environmental Impact Assessment (EIA) process. In order to achieve these objectives, the scope of the air quality specialist study included the following tasks:

- A review of project information;
- A review of legal requirements pertaining to air quality and specifically referring to;
    - The National Environmental Management Air Quality Act (NEMAQA) Act No. 39 of 2004:
        - National Ambient Air Quality Standards (NAAQS)
        - National Minimum Emission Standards (NMES)
        - National Dust Control Regulations
- A desktop study of the local receiving environment including:
    - An analysis of regional climate and site specific atmospheric dispersion potential;
    - Analysis and assessment of existing (baseline) ambient air quality based on existing data collected within Richards Bay;
    - The identification of air quality sensitive receptors.
- A short report summarising the findings of a desktop study of the potential impact of the proposed facility, from an air quality perspective.

Figure 1-1: Location of the proposed PRBGP3 (up to 2 000 MW) project, Richards Bay

1.3 Legislative Framework

Prior to discussing the impact of the PRBGP3 on the atmospheric environment, the regulations governing the impact of such operations should be referenced. These include:

- Listed Activities and National Minimum Emission Standards (NMES)
- Ambient air quality standards and guidelines:
  - National Ambient Air Quality Standards (NAAQS) for criteria pollutants
- The Air Quality Management Plan (AQMP) for Richards Bay.

NMES are provided for point sources and specify the amount of the pollutant acceptable in an emission stream and are often based on proven efficiencies of air pollution control equipment.

NAAQS and inhalation health criteria are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. NAAQS and inhalation health criteria generally indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Criteria are normally given for specific averaging or exposure periods.

The primary motivation of any AQMP is to achieve and maintain compliance with ambient air quality standards through progressive realisation of air quality improvements. An AQMP for the King Cetshawyo District Municipality is still under development (https://saaqis.environment.gov.za/, accessed 2021/02/08).

This section summarises legislation pertaining to air quality for sources and pollutants relevant to the study.

1.3.1 *National Minimum Emission Standards*

The minister has, in accordance with the National Environmental Management Air Quality Act (NEMAQA) (Act No. 39 of 2004), published a list of activities which result in atmospheric emissions and which are believed to have significant detrimental effects on the environment and human health; and, social welfare. The Listed Activities and NMES were published on the 31st of March 2010 (Government Gazette, 2010) and the revised NMES on 22 November 2013 (Government Gazette, 2013). NMES applicable to the proposed PRBGP3 (up to 2 000 MW) power plant include:

- **Gas Combustion Installations**– Gas combustion used primarily for steam raising or electricity generation (more than 50 mega Watt (MW) heat input per unit). NMES subcategory 1.4 are applicable (Table 1-1) during normal operating conditions using natural gas.

Table 1-1: NMES for gas combustion installations

Subcategory 1.4: Gas Combustion Installations		
Description	Gas combustion (including gas turbines burning natural gas) used primarily for steam raising or electricity generation.	
Application	All installations with design capacity equal to or greater than 50 MW heat input per unit based on the lower calorific value of the fuel used.	
Substance or mixture of substances		**mg/Nm³ under normal conditions of 3% O_2, 273 K and 101.3 kPa**
Common Name	**Chemical Symbol**	**New plant**
Particulate matter (PM)	Not applicable	10
Sulfur dioxide	SO_2	400
Oxides of nitrogen	NO_x expressed as NO_2	50

Notes:

(a) The following special arrangement shall apply:

i. Reference conditions for gas turbines shall be 15% O_2, 273 K and 101.3 kPa; and

ii. Where co-feeding with waste materials with calorific value allowed in terms of the Waste Disposal Standards published in terms of the Waste Act, 2008 (Act No.59 of 2008) occurs, additional requirements under subcategory 1.6 shall apply.

1.3.2 *National Ambient Air Quality Standards (NAAQS)*

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}, carbon monoxide (CO), ozone (O_3), benzene (C_6H_6), and lead (Pb) were published on 13 March 2009. Standards for $PM_{2.5}$ were published on 24 June 2012. NAAQS for atmospheric pollutants associated with the project, that is CO, NO_2, PM_{10}, $PM_{2.5}$ and SO_2, are listed in Table 1-2.

Table 1-2: NAAQS for criteria pollutants considered in the study

Pollutant	Averaging Period	Limit Value (µg/m³)	Limit Value (ppb)	Frequency of Exceedance	Compliance Date
CO	1 hour	30 000	26 000	88	Currently enforceable
	8 hour	10 000	8 700	11	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
	24 hour	25	-	4	1 Jan 2030
	1 year	20	-	-	Currently enforceable
	1 year	15	-	-	1 Jan 2030
SO_2	10 minutes	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

1.3.3 *National Dust Control Regulations (NDCR)*

NDCR were published on the 1st of November 2013 (Government Gazette No. 36974 R.827). Acceptable dustfall rates according to the Regulation are summarised in Table 1-3.

Table 1-3: Acceptable dustfall rates

Restriction areas	Dustfall rate (D) in mg/m^2-day over a 30 day average	Permitted frequency of exceedance
Residential areas	D < 600	Two within a year, not sequential months.
Non-residential areas	600 < D < 1 200	Two within a year, not sequential months.

The regulation also specifies that the method to be used for measuring dustfall and the guideline for locating sampling points shall be ASTM D1739 (1970), or equivalent method approved by any internationally recognized body. Dustfall is assessed for nuisance impact and not inhalation health impact.

1.4 Study Approach and Methodology

The scoping assessment used the following approach:

1.4.1 *Project and Information Review*

A review of the Project from an air quality perspective in order to identify sources of emission and associated pollutants of concern was conducted. In the review the following documents were referenced:

- Project information supplied by Savannah Environmental (Pty) Ltd and Phakwe Richards Bay Gas Power 3;
- Emission factor documentation published by the United States Environmental Protection Agency (US EPA) for:
  - Stationary gas turbines (US EPA, 2000)
- Review of the Cumulative Air Pollution Dispersion Modelling Assessment for Richards Bay (WSP Environmental, 2016).

1.4.2 *A Study of the Affected Atmospheric Environment*

The atmospheric environment was studied by taking into account:

- the local atmospheric dispersion potential;
- the position of air quality sensitive receptors (AQSRs) in relation to the project; and
- reported ambient air quality in the study area.

An understanding of the atmospheric dispersion potential of the area is essential to an air quality impact assessment. Physical environmental parameters that influence the dispersion of pollutants in the atmosphere include terrain, land cover and meteorology.

The Richards Bay Clean Air Association (RBCAA) has the following air quality monitoring stations (AQMS): Arboretum, Brackenham, CBD, Harbour West, Felixton, eNseleni and eSikhaleni. The RBCAA also operates an automatic weather station (AWS) at the airport. The City of uMhlatuze has AQMS at Arboretum, Brackeham and eSikhaleni. Recent (2016 to 2020) data sets from the stations were provided for use in the study.

Potential AQSRs, residential areas, schools and hospitals or clinics, were identified from recent maps of the area using Google Earth™ aerial imagery.

1.4.3 *Report*

The main deliverable of the air quality specialist study is a scoping level report including a scoping level impact rating.

1.4.4 *Terms of Reference for EIA Phase – Air Quality Impact Assessment*

The Terms of Reference, as a list of tasks, for the Air Quality Study portion of the EIA phase of the project will include:

- The establishment of an emissions inventory by referring to NMES and emission factors for combustion processes and fugitive dust (construction);
- Atmospheric dispersion simulations for the incremental scenario using the CALPUFF atmospheric dispersion model;
- A human health risk and nuisance impact screening assessment based on dispersion simulation results;
- A comprehensive air quality impact assessment report in the format prescribed by the Department of Environmental Affairs (Government Gazette, 2013) in support of the Atmospheric Emission License (AEL) application.
- Impact Significance rating according to the method provided by Savannah Environmental (Pty) Ltd.

1.5 Management of Uncertainty

The following important limitations apply to the study and should be noted:

- The ambient air quality data set assessed was for the period 2016 to 2020.
- The emissions from other sources of pollution, especially the industrial sources, have been identified from the WSP report and will be used to assess the cumulative impact. Changes to the baseline are not accounted for in the scoping report.

2 PROJECT DESCRIPTION FROM AN AIR QUALITY PERSPECTIVE

2.1 Sources of Emission and Likely Pollutants

2.1.1 *Proposed PRBGP3 (up to 2 000 MW) Power Plant*

The PRBGP3 involves the installation and operation of gas turbine units for a total generating capacity of up to 2 000 MW. The power plant will include several gas- and steam turbine pairs for the generation of electricity through the use of natural gas (liquid or gas forms) or a mixture of natural gas and hydrogen (in a proportion scaling up from 30% H_2) as fuel source, operating all turbines at mid-merit to baseload duty (12 to 24 hours daily operation). No Diesel (other than for plant start-up), Heavy Fuel Oil (HFO) and Light Fuel Oil (LFO) will be used, due to their high emissions.

The amount of fuel to be consumed will depend on the degree to which the plant is used (i.e. base load or mid-merit – comparison provided in Table 3.3). The maximum fuel consumption of the power plant will be:

- at baseload duty: 116 million GJ /annum or 3 021 000 000 m^3/annum
- at mid-merit duty: 77 million GJ /annum or 2 014 000 000 m^3/annum.

LNG (or natural gas and H_2 mixture) will be received from a dedicated pipeline, from the Richards Bay harbour to the plant. LNG (or natural gas and H_2 mixture) may be purchased from Transnet or alternatively, fuel can be purchased from international suppliers.

Primary pollutants from gas turbine engines are NO_x, CO and to a lesser extent VOCs. NO_x formation is strongly dependent on the high temperatures developed in the combustor. CO, VOC, hazardous air pollutants (HAP), and PM are primarily the result of incomplete combustion. Trace to low quantities of HAP and SO_2 are emitted from gas turbines. The expected operational lifetime of the proposed gas to power plant will be 25-40 years. Under the Department of Energy's (DoE) Independent Power Producer Programme, projects are provided with a 20 - 25 year Power Purchase Agreement (PPA). There are currently no guidelines provided by the DoE as to whether these contracts will be renewed after this term in the future. If an extension to the initial contract is provided by the DoE, then the developer will undertake an assessment of the plant facilities and the latest technology available at such a point in time, and this contract period may be extended subject to the DoE requirements at the time and the findings of the assessment.

2.2 Identified Air Quality Aspects

Identified air quality aspects associated with the proposed PRBGP3 (up to 2 000 MW) power plant is listed in Table 2-1.

Table 2-1: Identified air quality aspects

Aspect or Project Phase	Expected Atmospheric Sources of Emissions and Associated Pollutants						Rationale
	Source	CO	NO_x	PM[a]	SO_2	VOC	
The construction phase of the PRBGP3 facility	Fugitive dust from civil and building work such as excavations, piling, foundations and buildings	n/a[b]	n/a	✓	n/a	n/a	The nature of emissions from construction activities is highly variable in terms of temporal and spatial distribution and is also transient. Fugitive dust emissions are, however, mostly generated by land-clearing and bulk earthworks.
	Exhaust gasses from diesel mobile construction equipment and trucks delivering materials.	✓	✓	✓	✓	✓	
The normal operation phase of the PRBGP3 facility	Exhaust gasses from the proposed turbine units	✓	✓	✓[c]	✓[c]	✓	The project is designed to operate on either natural gas or a mixture of natural gas and hydrogen in a proportion starting at 30% up to 100%. Emissions from the combustion of natural gas are notably lower than from the combustion of diesel or coal. While combustion of H_2 will release water (H_2O). The focus of the assessment is on the operation of the proposed turbine units since it triggers Subcategory 1.4 NMES. Negligible fugitive losses of VOCs are expected from storage vessels, and from pipework and fittings.
	Fuel storage	n/a	n/a	n/a	n/a	✓	
Upset conditions that may result in atmospheric impacts	Unstable combustion conditions within turbine units	✓	✓	✓[c]	✓[c]	✓	Incomplete combustion and unstable combustion temperatures may result in higher than normal PM, CO, NO_x and VOC emissions. SO_2 emissions should not be affected. Additional VOC emissions because of the fuel leaks may occur but are unlikely.
	Fuel leaks	n/a	n/a	n/a	n/a	✓	
Decommissioning phase of the Project	Fugitive dust from civil work such as rehabilitation and demolition.	n/a	n/a	✓	n/a	n/a	The nature of emissions from decommissioning activities is highly variable in terms of temporal and spatial distribution and is also transient. Detail regarding the extent of decommissioning activities and equipment movements was also not available for inclusion in the study. Fugitive dust emissions are, however, mostly generated by demolition and rehabilitation activities.
	Exhaust gasses from diesel mobile equipment and trucks removing materials.	✓	✓	✓	✓	✓	

Notes:

(a) PM includes PM_{10} and $PM_{2.5}$
(b) n/a – not applicable
(c) neg. negligible for natural gas

3 DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1 Site Description

The City of uMhlathuze falls within the King Cetshwayo District Municipality (previously known as the uThungulu District Municipality) and includes the towns of Richards Bay and Empangeni and its surrounding rural and tribal areas. The topography of the area is fairly flat comprising of hills, ridges and undulating plains. The relief ranges from sea level on the eastern side to 296 metres above mean sea level (mamsl) to the western side. The current land uses in the region include industrial and commercial processes, surface mining activities, agricultural activities (mainly sugar cane), forestry, and formal and small residential communities. The proposed location of the PRBGP3 is north of the Richards Bay Alloys facility.

The proposed project site is located less than 2 km west of the Richards Bay Central Business District (CBD) and is located within Zone 1F of the Richards Bay Industrial Development Zone (IDZ) (Figure 1-1) and is located immediately to the north of Richards Bay Alloys. The nearest large residential areas to the project site are Wild-en-Weide (1.9 km east-north-east); Richards Bay CBD (1.9 km south-east); Brackenham (2.1 km north-east); Aquadene (3.5 km north) and Arboretum (4 km east-south-east). There are several schools, hospitals and clinics located within 5 km of the proposed location (Figure 3-2 and Table 3-1). The location of the various AQMS is shown in Figure 3-1. Industrial areas (Alton and the Richards Bay CBD) are located within 5 km of the proposed project.

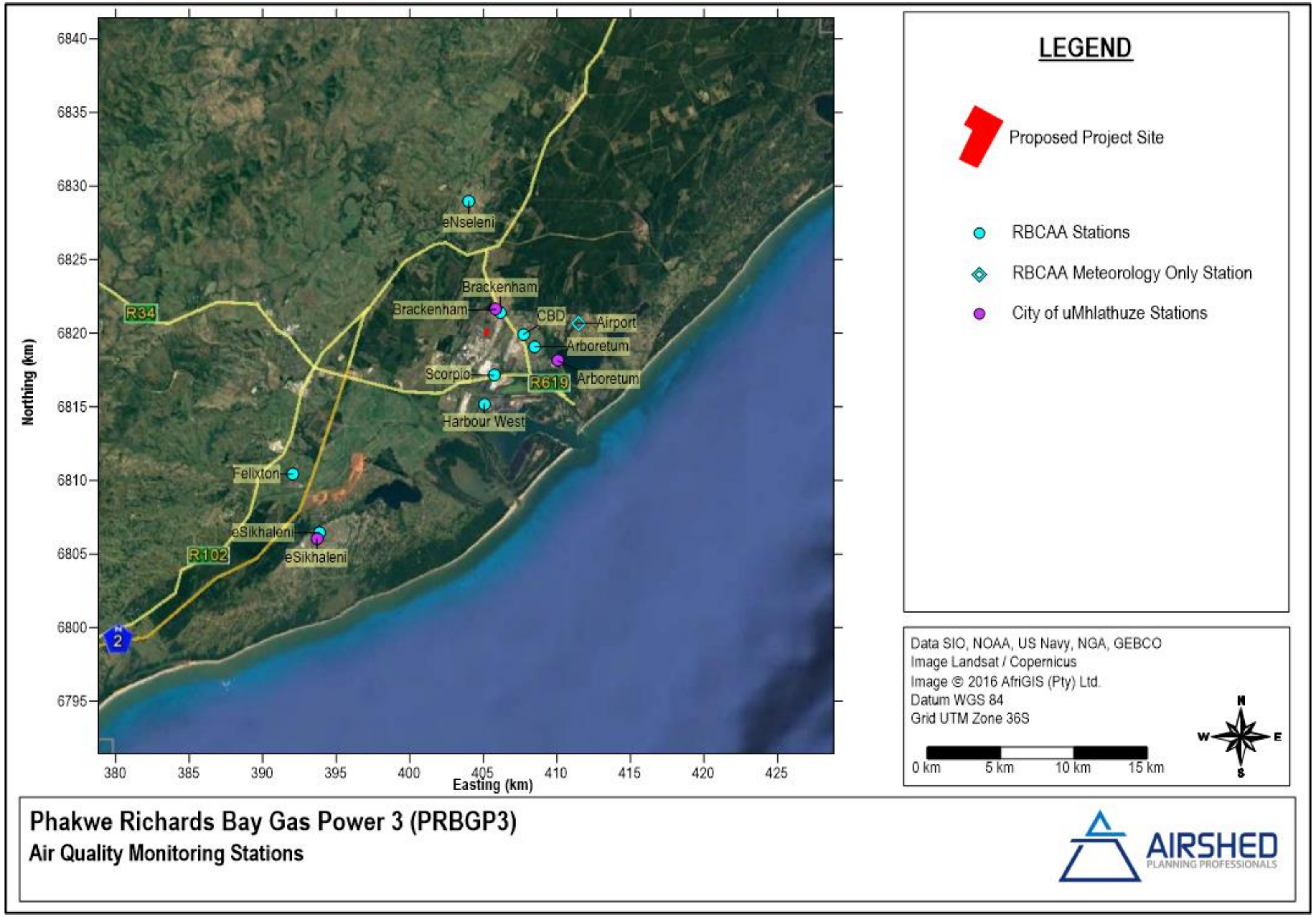


Figure 3-1: Location of the Proposed Project in relation to the AQMSs

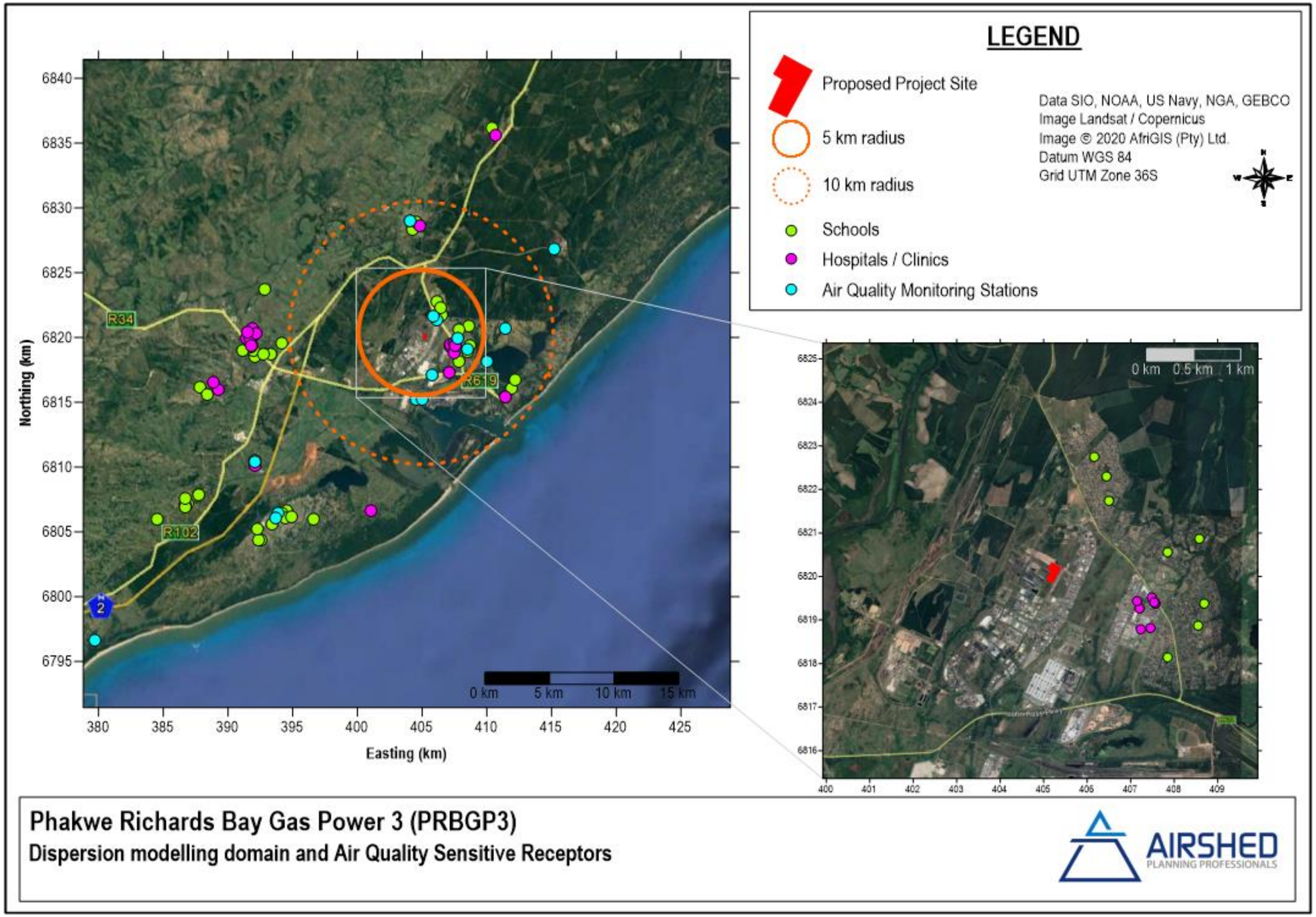


Figure 3-2: Location of the Proposed Project in relation to the AQSRs

Table 3-1: Distance to nearby air quality sensitive receptors

Air Quality Monitoring Station Name	Distance from proposed site (km)	Direction from proposed site
Brackenham (uMhlathuze)	1.5	NNE
Brackenham (RBCAA)	1.5	NE
CBD (RBCAA)	2.5	E
Scorpio (RBCAA)	3.1	S
Arboretum (RBCAA)	3.5	ESE
Bayside (RBCAA)	5.1	S
Harbour West (RBCAA)	5.0	S
Arboretum (uMhlathuze)	5.3	ESE
Airport (RBCAA)	6.3	E
eNseleni (RBCAA)	8.8	N
RBM (RBCAA)	12.0	ENE
Felixton (RBCAA)	16.4	SW
Esikhawini (RBCAA)	17.9	SW
eSikhaleni (uMhlathuze)	18.3	SW
Mtunzini (RBCAA)	34.8	SW
St Lucia (RBCAA)	55.7	NE
Receptor name / details	**Distance from proposed site (km)**	**Direction from proposed site**
Wild En Weide	1.9	ENE
Richards Bay Central	1.9	SE
Richards Bay Secondary School	2.0	NE
Better2Know Private STD Health Centre Richards Bay	2.1	ESE
Mens Clinic International - Richards Bay	2.2	ESE
Mandlazini Clinic	2.4	ESE
Brackenham Primary School	2.4	NNE
Richards Bay Medical Institute	2.4	ESE
Richards Bay Municipal Clinic	2.5	SE
The Bay Hospital	2.5	ESE
Umhlathuze Dental	2.6	ESE
Veldenvlei Primary School	2.7	E
Bay Primary School	2.7	NNE
John Ross College	3.4	SE
Richards Bay Christian School	3.4	E
Aquadene	3.5	N
Richardsbaai Hoerskool	3.6	ESE
Arboretum Primary School	3.6	ESE
Arboretum	4.0	ESE
Birdswood	5.0	E

3.2 Climate and atmospheric dispersion potential

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 horizontal dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants.

This study accessed different sets of meteorological data: simulated meteorological data for the Richards Bay airshed, and, measured meteorological data at four locations in the Richards Bay domain. For the purposes of CALPUFF dispersion modelling, Weather Research and Forecasting model (WRF) data for the period 2017 to 2019 on a 4 km horizontal resolution for a 50 km by 50 km domain was used. Four RBCAA air quality monitoring stations (AQMS) (Airport, Brackenham, CBD and Harbour West) were included for comparison to assess how representative the WRF data set is for the proposed project site. The meteorological data availability for the RBCAA stations is shown in Table 3-2.

3.2.1 *Local Wind Field*

WRF data was used to construct wind roses for the surface wind field. 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 dark red area, for example, representing winds >10 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated. For the comparison an extended data set was used for measured data (January 2016 to December 2019) to account for gaps in the data, while the simulated data set used for dispersion modelling was slightly shorter (January 2017 to December 2019).

The period, day-time and night-time wind roses for the WRF data is provided in Figure 3-3 to Figure 3-6. The data has a predominant south-south-westerly and north-easterly component over the period, and day-time. During night-time the wind is also predominantly from the south and south-south-west. The average period wind speed is 5.7 m/s. Night-time conditions reflect a decrease in wind speeds ranging mainly from 2-3 m/s in comparison to daily wind speeds of 3-4 m/s.

The seasonal variation in the wind field shows a slight northerly dominance in winter while north-northeasterlies are more dominant in summer and spring. Highest wind speeds are likely in spring.

Table 3-2: Parameters measured and data availability for the AQMS in Richards Bay (X indicates parameter not measured)

Owner	Monitoring Station	Easting (km)	Northing (km)	Year	Wind Speed	Wind Direction	Ambient Temperature	Relative Humidity	Pressure
RBCAA	Airport AWS	411.4467	6820.689	2016	17.3%	17.3%	49.6%	X	X
				2017	99.7%	79.0%	no data	X	X
				2018	98.9%	98.9%	98.9%	X	X
				2019	98.2%	98.2%	98.5%	X	X
RBCAA	Arboretum AQMS	408.497	6819.088	2016	75.6%	75.4%	75.6%	X	X
				2017	90.61%	90.61%	90.03%	X	X
				2018	94.24%	94.24%	94.25%	X	X
				2019	97.34%	97.34%	97.34%	X	X
				2020	96.51%	96.77%	96.77%	X	X
RBCAA	Brackenham AQMS	406.166	6821.399	2016	89.8%	89.8%	89.8%	X	X
				2017	82.7%	82.7%	84.8%	X	X
				2018	97.5%	97.5%	95.9%	X	X
				2019	96.4%	96.4%	96.4%	X	X
				2020	90.9%	90.9%	90.9%	X	X
RBCAA	CBD AQMS	407.714	6819.921	2016	87.3%	87.3%	87.3%	87.4%	X
				2017	73.8%	73.8%	87.1%	87.1%	X
				2018	78.7%	78.7%	98.0%	no data	X
				2019	98.6%	98.6%	98.6%	no data	X
				2020	86.7%	86.7%	86.7%	98.1%	X
RBCAA	Harbour West AQMS	405.05	6815.191	2016	49.8%	49.8%	88.8%	X	X
				2017	83.6%	83.6%	83.6%	X	X
				2018	99.5%	99.5%	99.5%	X	X
				2019	99.9%	78.2%	no data	X	X
				2020	49.7%	49.7%	99.9%	X	X
RBCAA	Felixton AQMS	392.06	6810.428	2016	X	X	no data	X	X
				2017	X	X	no data	X	X
				2018	X	X	99.3%	X	X
				2019	X	X	80.6%	X	X
				2020	X	X	92.2%	X	X
RBCAA	eNseleni AQMS	404.02	6828.96	2016	X	X	X	X	X
				2017	X	X	X	X	X
				2018	X	X	X	X	X
				2019	97.1%	97.1%	97.1%	X	X
				2020	91.3%	91.3%	91.3%	X	X
RBCAA		393.857	6806.453	2016	87.5%	87.5%	87.5%	X	X
				2017	82.0%	82.0%	82.0%	X	X

Owner	Monitoring Station	Easting (km)	Northing (km)	Year	Wind Speed	Wind Direction	Ambient Temperature	Relative Humidity	Pressure
	eSikhaleni AQMS			2018	95.5%	95.5%	95.5%	X	X
				2019	93.8%	93.8%	93.8%	X	X
				2020	85.3%	85.3%	85.3%	X	X
City of uMhlathuze	Arboretum AQMS	410.05	6818.14	2016	X	X	X	X	X
				2017	X	X	X	X	X
				2018	X	X	X	X	X
				2019	84.1%	no data	84.1%	84.1%	84.1%
				2020	83.8%	no data	83.8%	83.8%	83.8%
City of uMhlathuze	Brackenham AQMS	405.85	6821.62	2016	X	X	X	X	X
				2017	X	X	X	X	X
				2018	X	X	X	X	X
				2019	70.2%	70.2%	66.5%	70.2%	66.5%
				2020	97.8%	97.8%	97.8%	97.8%	97.8%
City of uMhlathuze	eSikhaleni AQMS	393.67	6806.05	2016	X	X	X	X	X
				2017	X	X	X	X	X
				2018	X	X	X	X	X
				2019	83.6%	83.6%	83.6%	83.6%	83.9%
				2020	94.0%	94.0%	94.0%	94.0%	94.0%

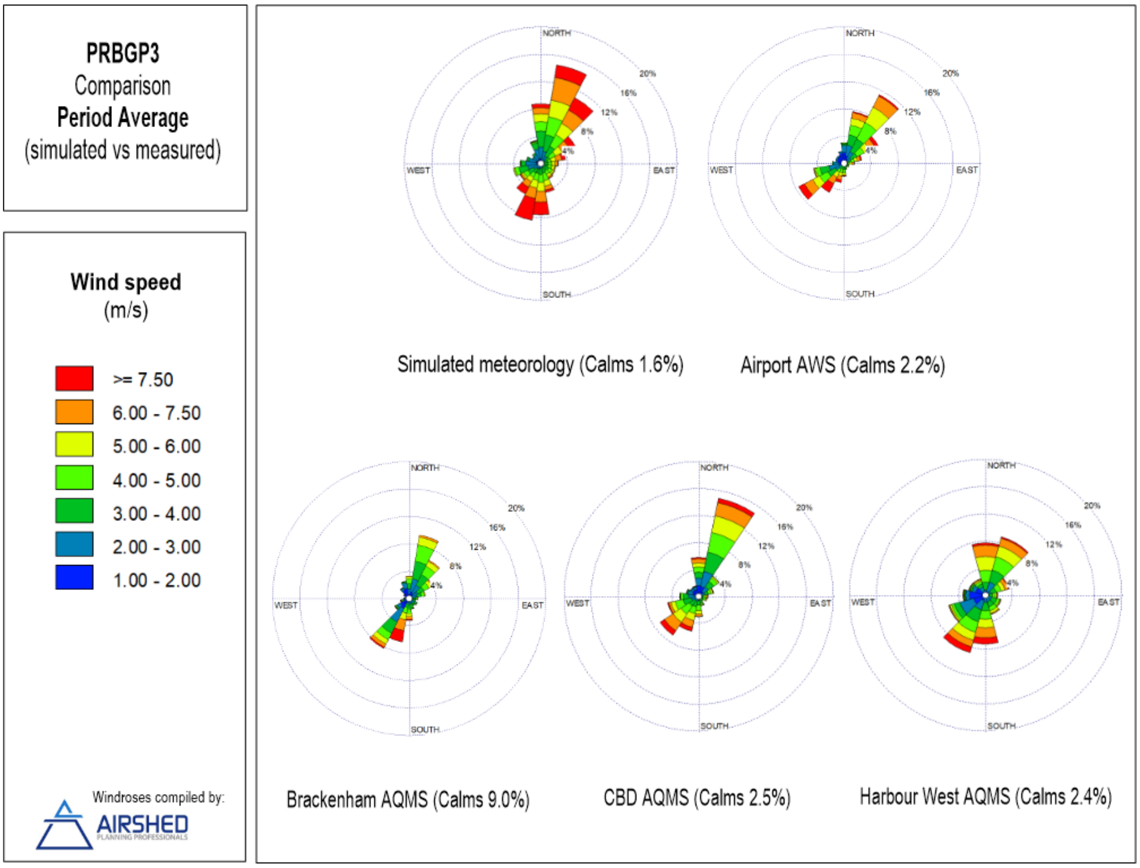


Figure 3-3: Period wind roses for the period January 2016 to December 2019

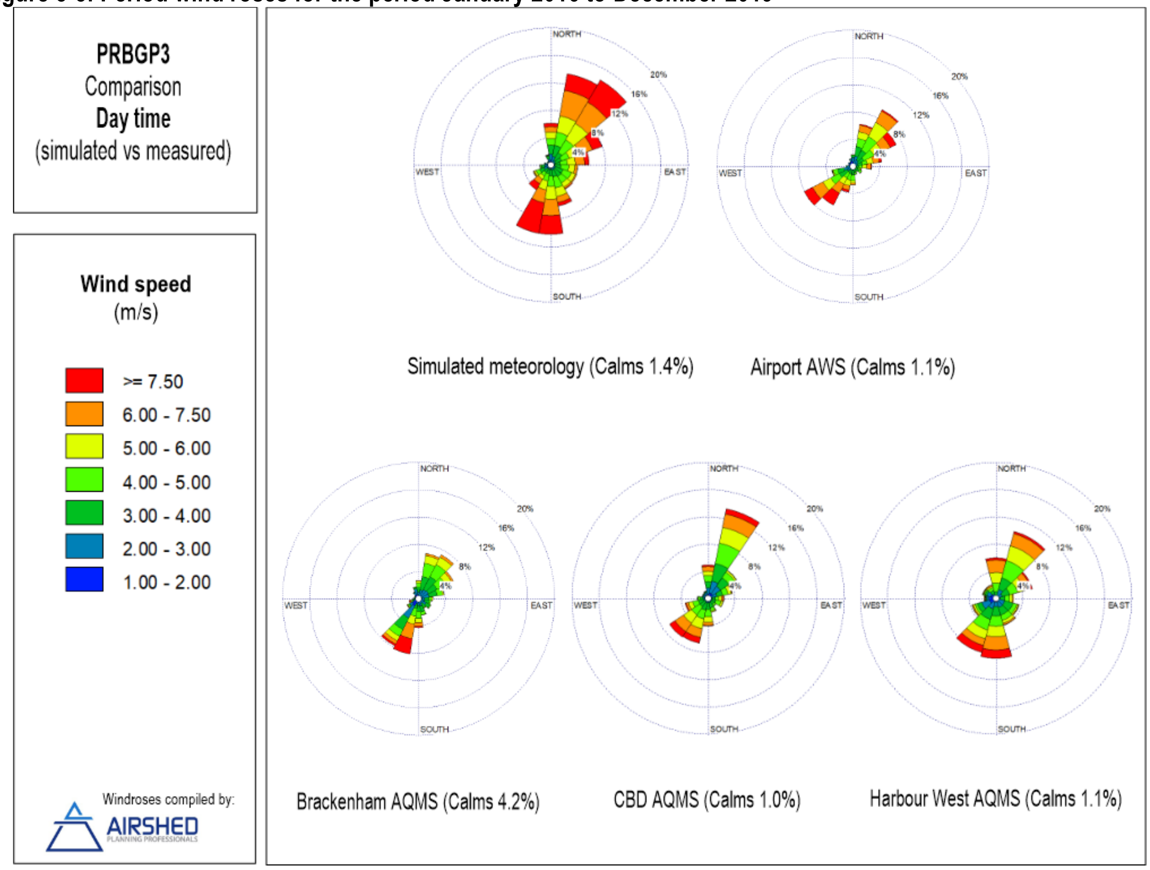


Figure 3-4: Day-time wind roses for the period January 2016 to December 2019

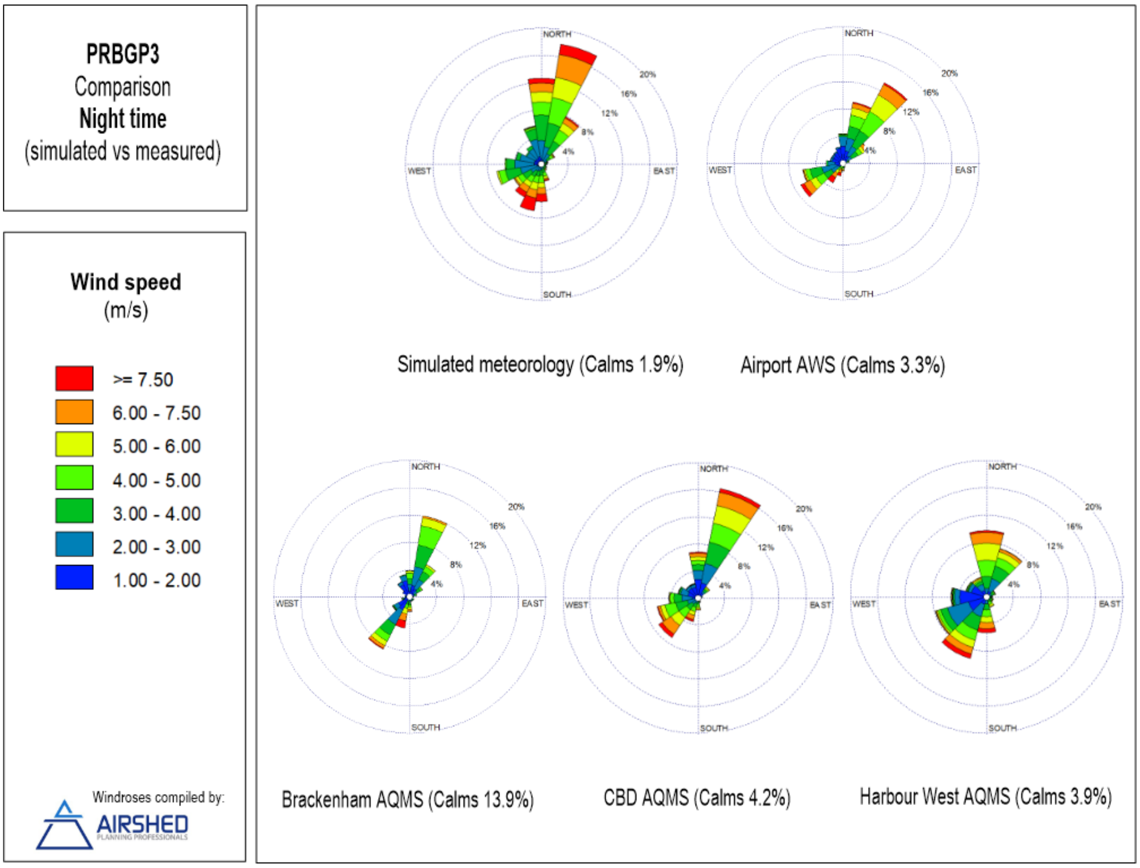


Figure 3-5: Night-time wind roses for the period January 2016 to December 2019

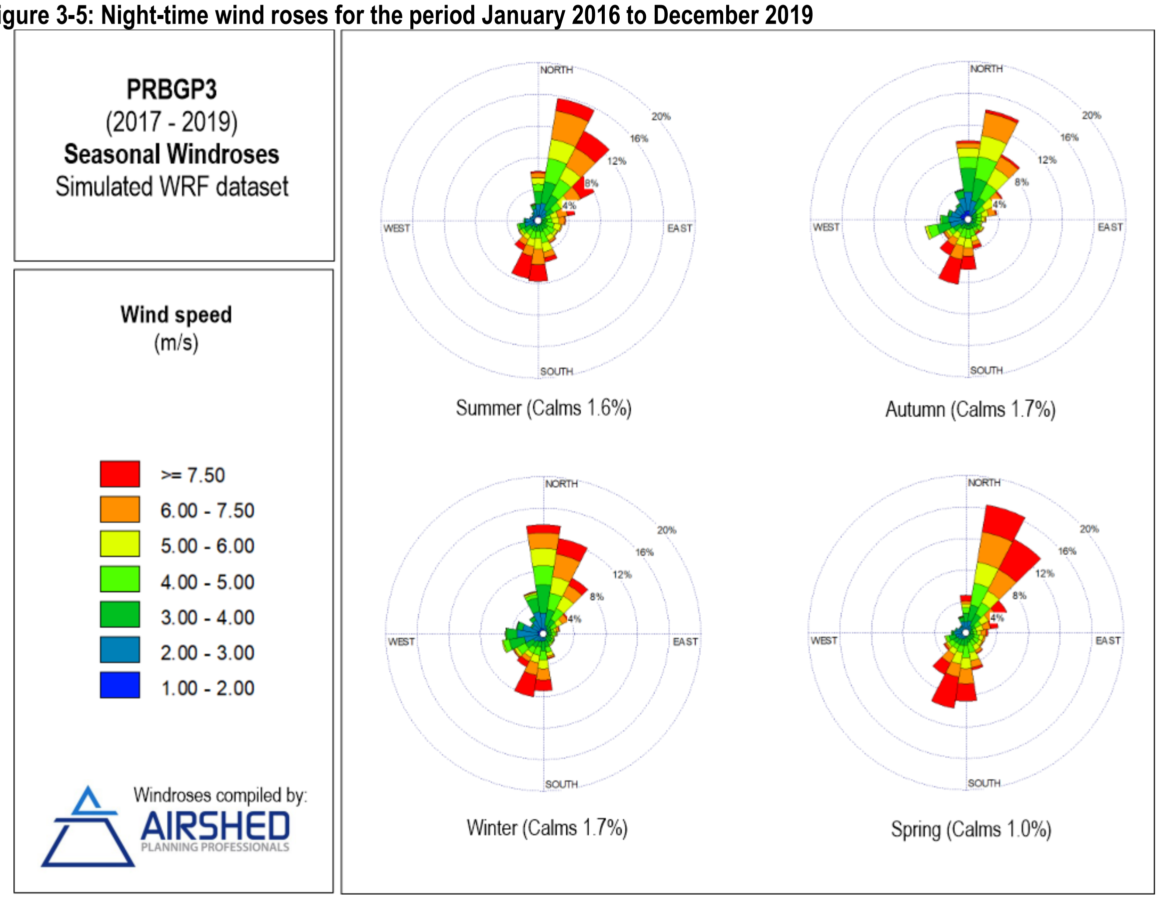
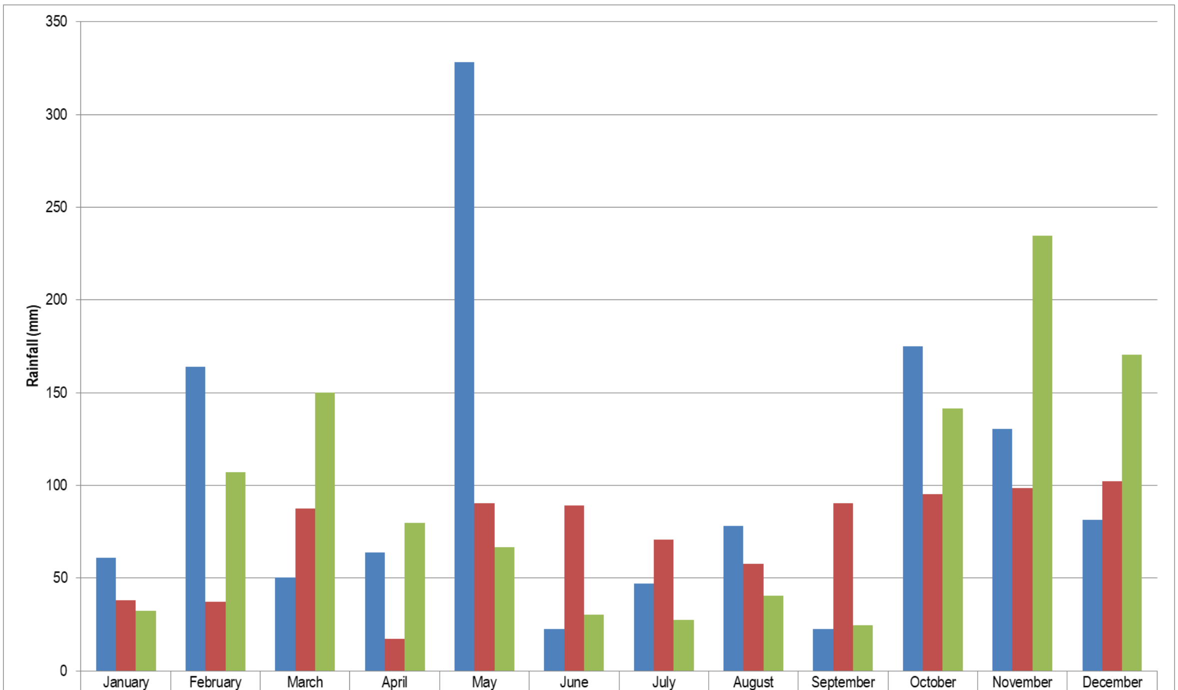


Figure 3-6: Seasonal wind roses for the period January 2017 to December 2019

3.2.2 *Precipitation*

Precipitation reduces erosion potential by increasing the moisture content of materials. This represents an effective mechanism for removal of atmospheric pollutants and is therefore considered during air pollution studies.

This WRF data rainfall pattern is observable in Figure 3-7. Rainfall peaks being between October and March, with approximately 1 070 mm of rainfall in a year. The lowest rainfall months are generally June and July.



	January	February	March	April	May	June	July	August	September	October	November	December
2017	61.1	164.1	50.4	63.9	328.1	22.7	47.1	78.3	22.8	175.2	130.6	81.6
2018	37.9	37.3	87.5	17.3	90.5	89.3	70.8	57.5	90.2	95.3	98.6	102.5
2019	32.3	107.0	150.0	79.9	66.9	30.5	27.7	40.6	24.8	141.5	234.5	170.7

Figure 3-7: Monthly rainfall based on WRF data for the period January 2017 to December 2019

3.2.3 *Temperature*

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

Monthly mean, maximum and minimum temperatures from the WRF data are given in Table 3-3. Diurnal temperature variability is presented in Figure 3-8. Temperatures ranged between 10°C and 42°C. The highest temperatures occurred in September and the lowest in July. During the day, temperatures increase to reach maximum at around 14:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 06:00 i.e. just before sunrise.

Table 3-3: Monthly average, maximum and minimum temperatures based on WRF data for the period January 2017 to December 2019 (units: °C)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Minimum	15.6	16.7	14.1	13.4	11.0	10.8	10.4	11.7	11.8	11.5	12.3	15.5	15.6
Average	24.3	25.0	24.6	23.0	21.0	19.3	19.0	19.7	21.1	21.2	22.4	23.8	24.3
Maximum	37.0	38.4	35.0	35.2	32.5	30.3	33.9	33.3	42.3	38.3	38.0	40.2	37.0

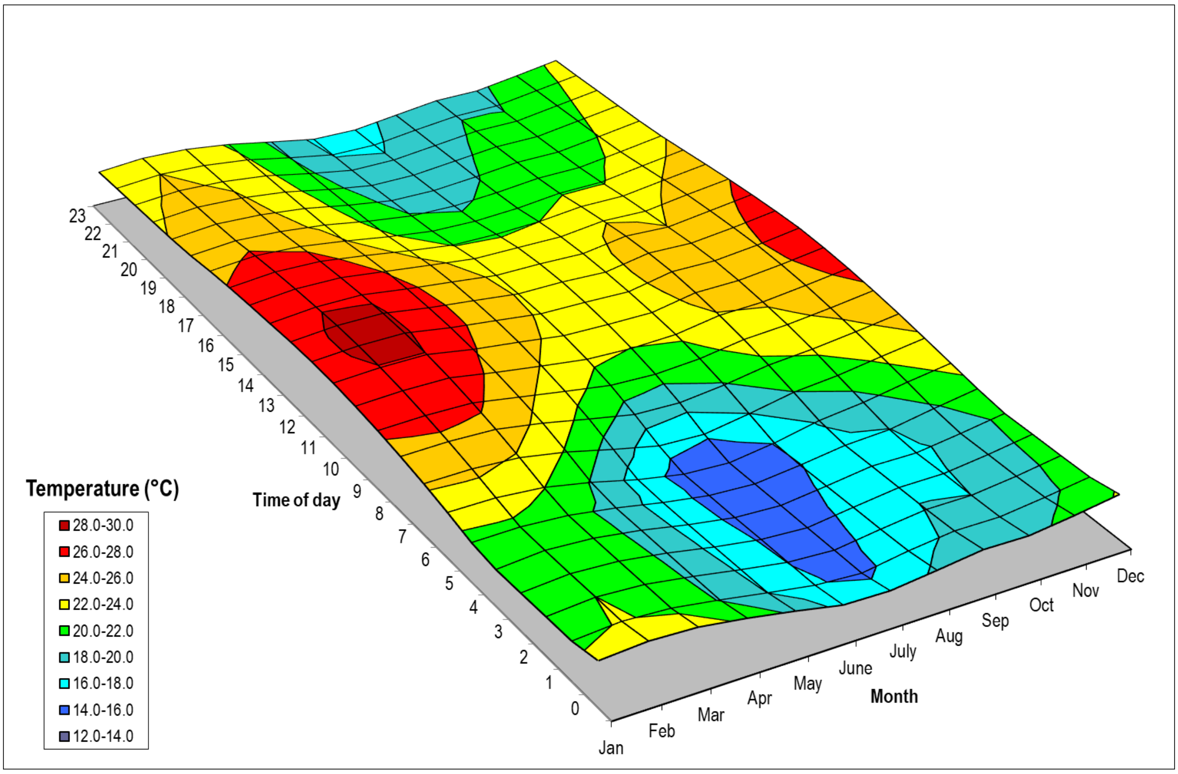


Figure 3-8: Diurnal temperature profile based on the WRF data for the period January 2017 to December 2019

3.2.4 *Mixing Depth*

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. This layer is directly affected by the earth's surface, either through the retardation of flow due to the frictional drag of the earth's surface, or as result of the heat and moisture exchanges that take place at the surface. Typically, the temperature of the atmosphere decreases with height (termed the *environmental lapse rate*), and it decreases at a rate somewhere between 4°C per kilometre and 9.8°C per kilometre (the latter known as the *dry adiabatic rate*), i.e. the atmosphere is conditionally unstable much of the time. But this can change depending on how the temperature of the atmosphere changes at different levels.

During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface. Since warmer air is less dense than cold air, it will become buoyant and rise. If warm air lies above cold air, you can see that rising motion will be inhibited (any rising parcel will be colder than the warm overlying air). This situation is referred to as a surface inversion. An inversion can also form above the mixing layer and this is termed an elevated inversion. The thickness of this mixing layer depends predominantly on the extent of solar radiation, growing gradually from sunrise to reach a maximum at about 5-6 hours after sunrise. This situation is more pronounced during the winter months due to strong night-time inversions and slower developing mixing layer.

During the night a stable layer, with limited vertical mixing, exists. Radiative flux divergence during the night usually results in the establishment of ground-based inversions and the erosion of the mixing layer. Low wind speeds are normally associated with these conditions and this result in less dilution potential. Stable conditions will cause pollutants to become trapped near ground level. Furthermore, the conditions associated with the nearby cold ocean could lead to overnight and morning fog.

Elevated inversions may occur for a variety of reasons, and on some occasions as many as five may occur in the first 1 000 m above the surface. The lowest-level elevated inversion is located at a mean height above ground of 1 550 m during winter months with a 78% frequency of occurrence. By contrast, the mean summer subsidence inversion occurs at 2 600 m with a 40% frequency.

3.2.5 *Atmospheric Stability*

The new generation air dispersion models differ from the models traditionally used in a number of aspects, the most important of which are the description of atmospheric stability as a continuum rather than discrete classes. The atmospheric boundary layer properties are therefore described by two parameters; the boundary layer depth and the Obukhov length (often referred to as the Monin-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 calculated from measured data, and described by the inverse Obukhov length and the boundary layer depth is provided in Figure 3-9. 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 fairly 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* (Tiwary & Colls, 2010). For ground level releases such as fugitive dust the highest ground level concentrations will occur during stable night-time conditions.

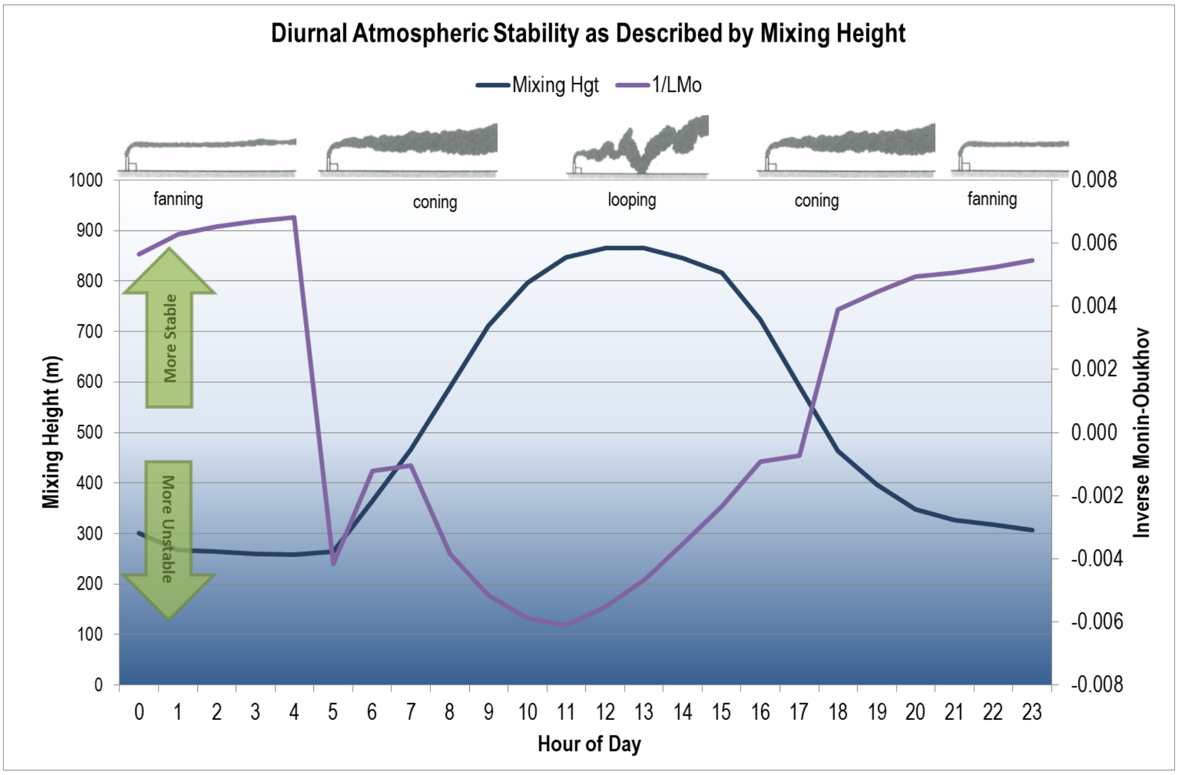


Figure 3-9: Diurnal atmospheric stability (CALMET processed WRF data, January 2017 to December 2019)

3.3 Ambient Air Quality Monitoring Data

The current air quality in the study area is mostly influenced by the industrial activities within the RB IDZ as well as farming activities, domestic fires, residential fuel burning, vehicle exhaust emissions and dust entrained by vehicles. These emission sources vary from activities that generate relatively course airborne particulates (such as farmland preparation dust from paved and unpaved roads) to fine PM such as that emitted by vehicle exhausts, power generators (at industrial operations). Other sources of PM include occasional fires in the residential areas and farming activities. Emissions from unpaved roads constitute a major source of emissions to the atmosphere in South Africa. When a vehicle travels on an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads are a function of vehicle traffic and the silt loading on the roads. Emissions from paved roads are significantly less than those originating from unpaved roads, however they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface. Emissions generated by wind erosion are dependent on the frequency of disturbance of the erodible surface. Every time that a surface is disturbed e.g. by mining, agriculture and/or grazing activities, its erosion potential is restored. Combustion gases (CO, SO_2, NO_2 and hydrocarbons) are typically released from industrial areas, power generators, vehicle exhausts, and burning activities. Although these sources are not meant to be exhaustive, it represents the main contributors.

The RBCAA has the following air quality monitoring stations (AQMS): Arboretum, Brackenham, CBD, Harbour West, Felixton, eNseleni and eSikhaleni. The RBCAA also operates an automatic weather station (AWS) at the airport. The City of uMhlatuze has AQMS at Arboretum, Brackeham and eSikhaleni. The location of the stations in given in Figure 3-1.

Diurnal and seasonal variation plots – generated using openair (Carslaw & Ropkins, 2012); and (Carslaw, 2019) - of ambient pollutant concentrations measured at the AQMS near Richards Bay show the variation of ambient concentrations over daily, weekly and annual cycles (mean with 95% confidence interval). The data have been normalised by dividing by the respective mean values to allow comparison of the shape of diurnal trends for the variables on very different measurement scales (Carslaw, 2019).

3.3.1 *RBCAA Arboretum Station*

The data availability for the RBCAA Arboretum Station is shown in Table 3-4. There was average to full data availability over the assessment period (2016 to 2020). There were no exceedances of the short-term or long-term NAAQS for SO_2. Higher concentrations of SO_2 occurring in the early mornings (Figure 3-10).

Table 3-4: Ambient concentrations and data availability for the pollutants measured at the RBCAA Arboretum Monitoring Station

RBCAA Arboretum AQMS						
Period	**Data Availability**	**Hourly** **99th Percentile**	**Daily** **99th Percentile**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2016	75%	11.4	9.5	2.1	0	0
2017	94%	29.7	19.0	3.2	0	0
2018	94%	50.0	20.7	6.7	0	0
2019	97%	21.0	17.2	9.3	0	0
2020	100%	20.9	12.6	3.0	0	0

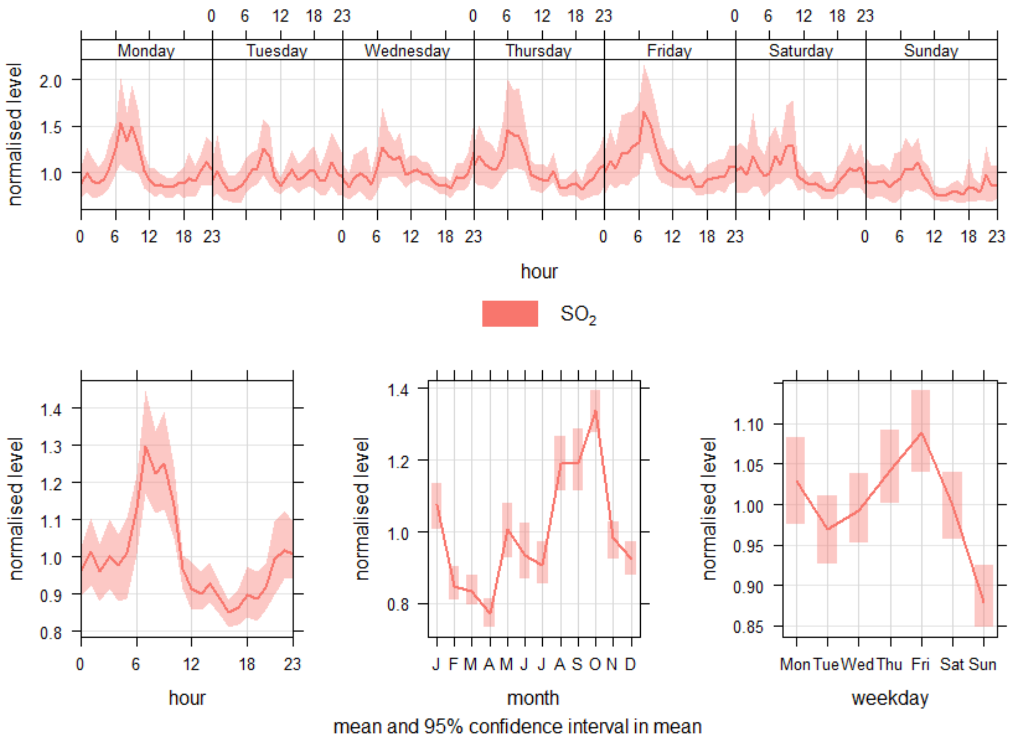


Figure 3-10: Time variation plot for the pollutants measured as RBCAA Arboretum Monitoring Station

3.3.2 *RBCAA Brackenham Station*

The ambient concentrations and data availability for the RBCAA Brackenham Station are shown in Table 3-5. The main surrounding influences on the air quality are residential activities and vehicle traffic. There were 6 exceedances of the 24-hour NAAQ limit value for PM_{10} in 2018, where four (4) are allowed per year. There were no exceedances of the 1-year NAAQS for PM_{10}. The SO_2 1-hour, 24-hour and 1-year NAAQS were not exceeded. The higher PM_{10} concentrations occurring during weekdays between 06H00 and 18H00 and especially during winter when the area has lower rainfall (Figure 3-11). The higher concentrations of SO_2 occurring during weekdays between 06H00 and 18H00 (Figure 3-11).

Table 3-5: Ambient concentrations and data availability for the pollutants measured at the RBCAA Brackenham Monitoring Station (bold text indicates exceedance of the applicable NAAQS)

RBCAA Brackenham AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2016	94%	17.5	13.1	2.8	0	0
2017	85%	11.1	9.2	2.3	0	0
2018	99%	18.3	14.1	3.4	0	0
2019	97%	7.3	12.2	1.4	0	0
2020	82%	18.27	15.87	3.50	0	0
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2016	90%		65.8	28.7		1
2017	85%		68.6	32.5		2
2018	89%		92.5	31.6		**6**
2019	96%		57.2	29.9		0
2020	90%		49.01	25.6		0

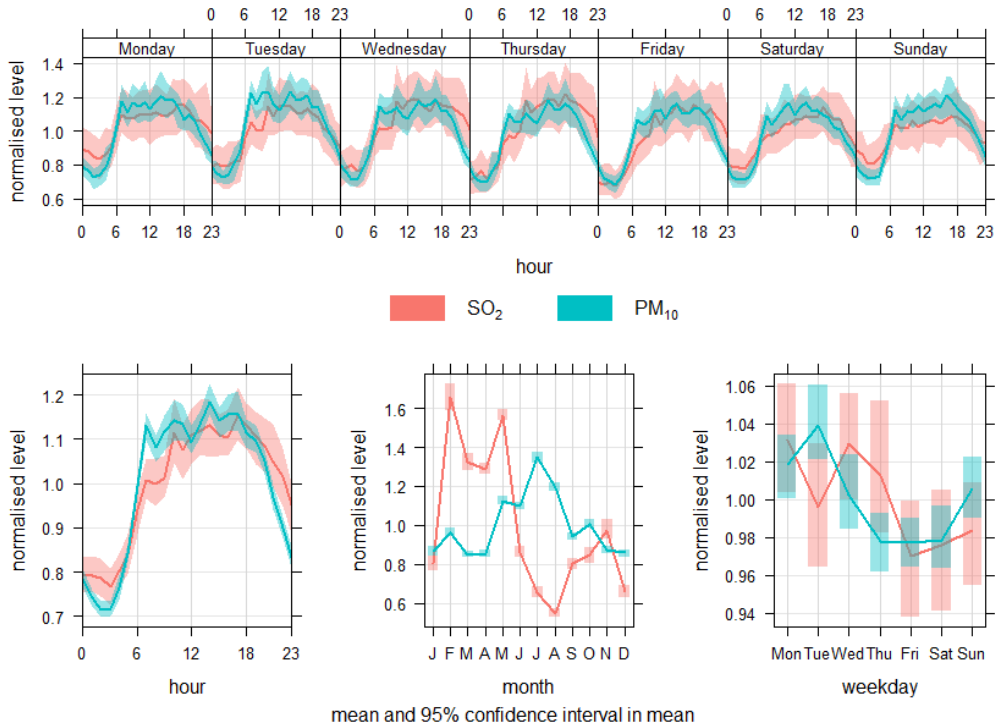


Figure 3-11: Time variation plot for the pollutants measured as RBCAA Brackenham Monitoring Station

3.3.3 *RBCAA Central Business District (CBD) Station*

The data availability for the RBCAA CBD Station is shown in Table 3-6. There was average to good availability. The SO_2 1-hour, 24-hour and 1-year NAAQS were not exceeded. There were also no exceedances of the 24-hour or 1-year NAAQS for PM_{10}. Higher concentrations of PM_{10} occur in the afternoons and during winter and the beginning of spring (Figure 3-12). Higher concentrations of SO_2 occur in the early mornings (Figure 3-12).

Table 3-6: Ambient concentrations and data availability for the pollutants measured at the RBCAA CBD Monitoring Station

RBCAA CBD AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2016	86%	28.6	37.3	2.6	1	0
2017	87%	40.7	57.9	4.2	0	0
2018	99%	97.1	46.7	10.6	0	0
2019	98%	82.5	15.6	10.7	0	0
2020	96%	29.3	15.5	5.3	0	0
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2016	85%		52.9	24.2		0
2017	87%		49.7	26.0		0

RBCAA CBD AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
2018	97%		48.9	23.6		0
2019	97%		57.1	25.4		0
2020	94%		30.9	13.1		0

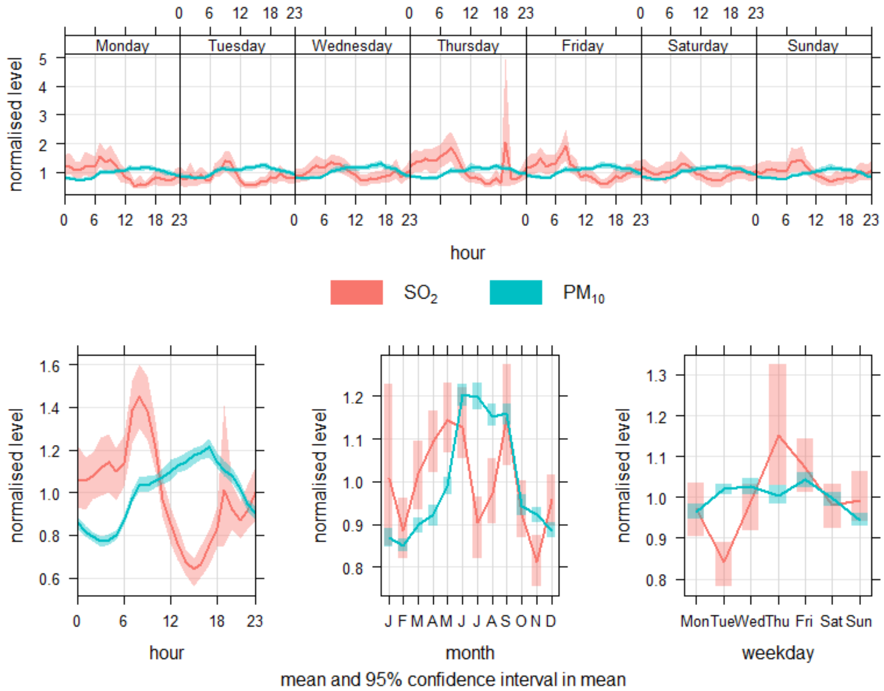


Figure 3-12: Time variation plot for the pollutants measured as RBCAA CBD Monitoring Station

3.3.4 *RBCAA eNseleni Station*

The data availability for the RBCAA eNseleni Station is shown in Table 3-7, where data availability was good for both pollutants in the first operational year, however, data availability dropped to 11% for SO_2 in 2020. The SO_2 1-hour, 24-hour and 1-year NAAQS were not exceeded. There was one daily exceedance of the 24-hour NAAQ limit value for PM_{10}, however no exceedances of the annual NAAQS have been recorded. Higher concentrations of PM_{10} and SO_2 occur in the middle of the day (Figure 3-13).

Table 3-7: Ambient concentrations and data availability for the pollutants measured at the RBCAA eNseleni Monitoring Station

RBCAA eNseleni AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2019	96%	19.1	14.4	3.4	0	0

RBCAA eNseleni AQMS						
Period	**Data Availability**	**Hourly** **99th Percentile**	**Daily** **99th Percentile**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
2020	11%	27.7	8.1	3.5	0	0
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2019	96%		58.1	29.1		1
2020	91%		49.6	24.9		0

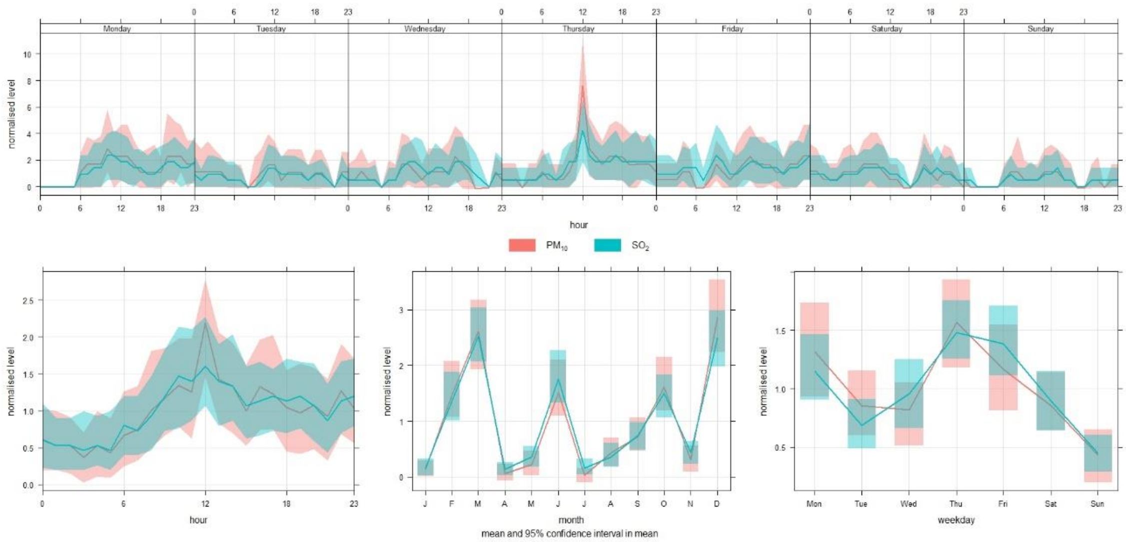


Figure 3-13: Time variation plot for the pollutants measured as RBCAA eNseleni Monitoring Station

3.3.5 *RBCAA eSikhaleni Station*

The SO_2 1-hour, 24-hour and 1-year NAAQS were not exceeded. Although exceedances of the 24-hour NAAQ limit value for PM_{10} were recorded in 2016, 2017, and 2019 they were always fewer than the allowable four (4) days per year (Table 3-8). Annual average concentrations were less than the NAAQS in all years assessed. Higher concentrations of PM_{10} and SO_2 occur in the afternoons. Higher concentrations of PM_{10} occur during winter and the beginning of spring (Figure 3-14).

Table 3-8: Ambient concentrations and data availability for the pollutants measured at the RBCAA eSikhaleni Monitoring Station

RBCAA eSikhaleni AQMS						
Period	**Data Availability**	**Hourly** **99th Percentile**	**Daily** **99th Percentile**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2016	87%	107.6	10.4	3.6	0	0
2017	82%	89.3	13.7	5.3	0	0
2018	95%	89.0	15.5	5.4	0	0
2019	94%	99.0	20.2	9.3	0	0

RBCAA eSikhaleni AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
2020	85%	97.10	19.38	4.53	0	0
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2016	87%		60.3	27.5		1
2017	82%		51.2	22.4		1
2018	95%		48.8	24.5		0
2019	94%		67.0	24.0		2
2020	85%		50.02	24.03		0

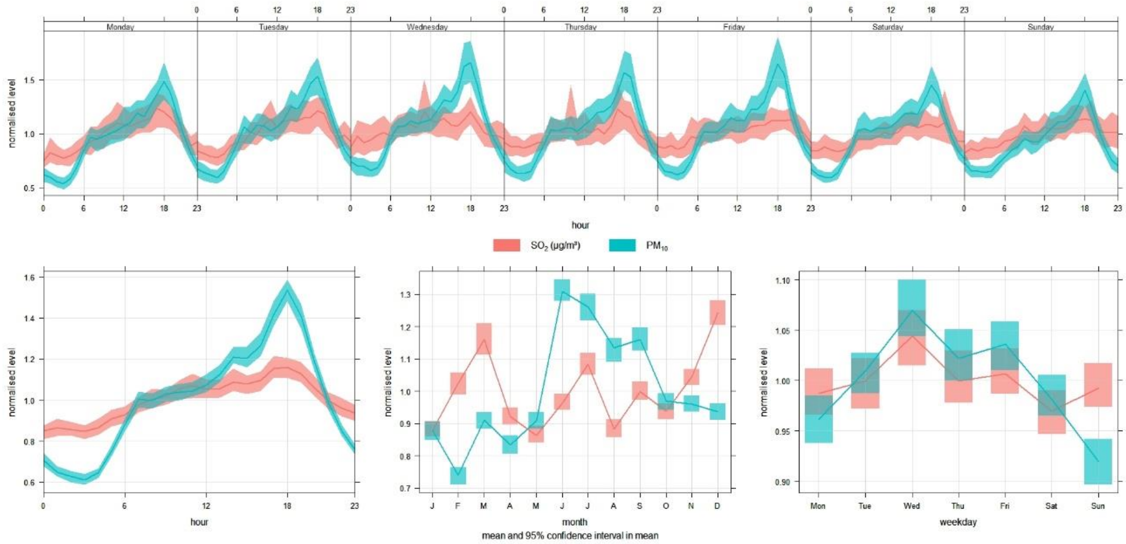


Figure 3-14: Time variation plot for the pollutants measured as RBCAA eSikhaleni Monitoring Station

3.3.6 *RBCAA Felixton Station*

There were no exceedances of the short-term or long-term NAAQS for any of the pollutants, although one exceedance of the daily PM_{10} NAAQ limit value occurred in 2018 (Table 3-9). SO_2 appears has higher concentrations occurring just after midday (Figure 3-15). The PM_{10} appears to have higher concentrations occurring in the afternoons and during winter and the beginning of spring (Figure 3-15).

Table 3-9: Ambient concentrations and data availability for the pollutants measured at the RBCAA Felixton Monitoring Station

RBCAA Felixton AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2016	85%	34.5	19.1	4.7	0	0
2017	83%	32.0	16.9	4.5	0	0
2018	98%	33.5	19.1	6.5	0	0
2019	69%	32.2	19.5	7.4	0	0
2020	96%	18.7	15.9	5.4	0	0
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2016						
2017						
2018	99%		59.6	24.7		1
2019	81%		61.1	26.2		0
2020	91%		49.4	22.7		0

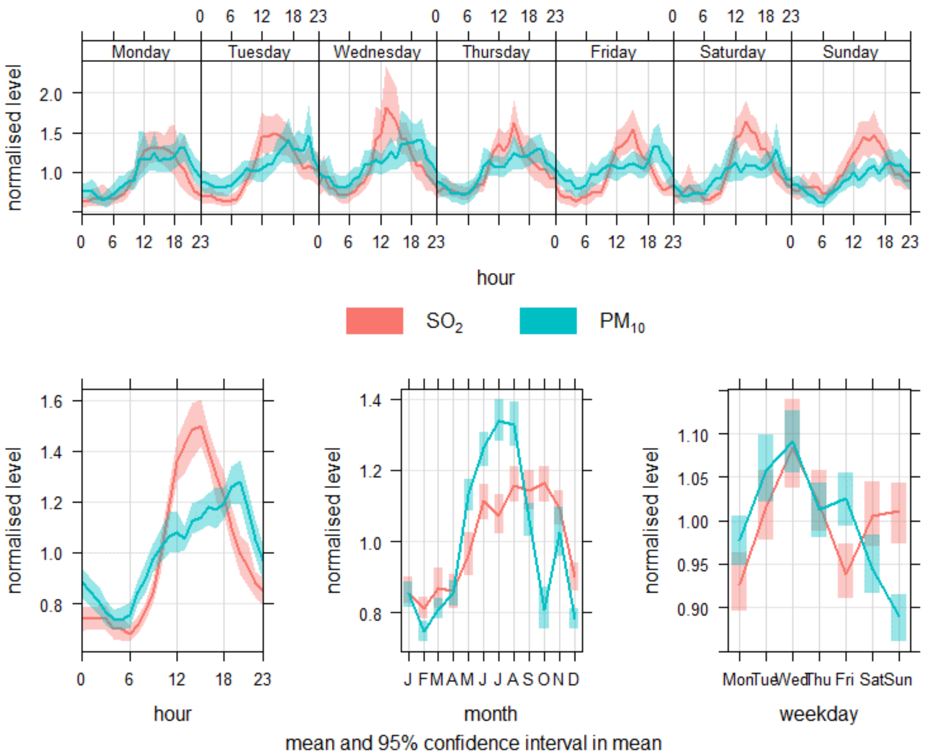


Figure 3-15: Time variation plot for the pollutants measured as RBCAA Felixton Monitoring Station

3.3.7 *RBCAA Harbour West Station*

There were exceedances of the 24-hour NAAQ limit value for SO_2 in 2018, however the number of exceedances were fewer than the allowable per year (88 hours per year allowed). Daily average SO_2 concentrations exceeded the NAAQS limit value on 5-days during 2018 – more than the allowable 4 days. There were no exceedances of the long-term NAAQS for SO_2 (Table 3-10). Higher concentrations of SO_2 occur in the mornings and during winter when the rainfall is less (Figure 3-16).

Table 3-10: Ambient concentrations and data availability for the pollutants measured at the RBCAA Harbour West Monitoring Station (bold text indicates exceedance of the applicable NAAQS)

RBCAA Harbour West AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2016	81%	119.9	71.7	19.1	1	0
2017	83%	140.8	80.8	17.7	0	0
2018	99%	246.2	102.8	23.6	22	**5**
2019	99%	137.5	78.4	17.3	0	1
2020	99%	150.0	82.6	19.9	4	0

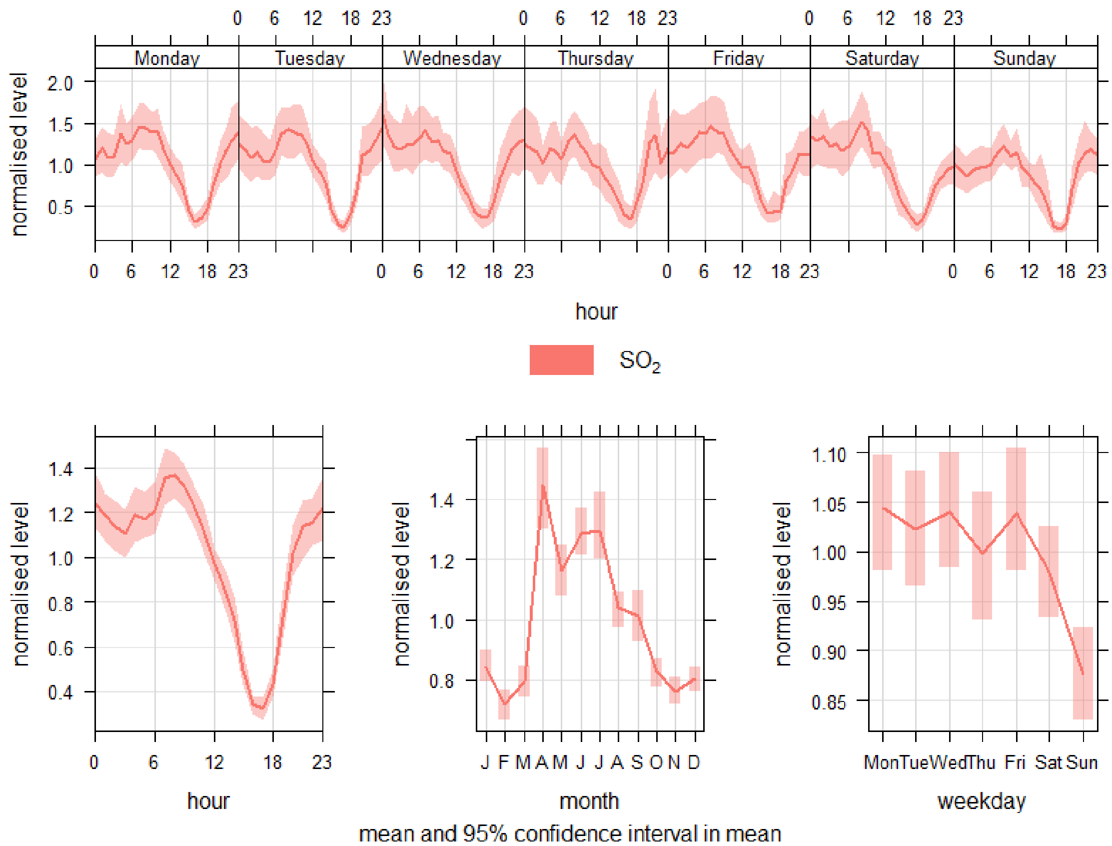


Figure 3-16: Time variation plot for the pollutants measured as RBCAA Harbour West Monitoring Station

3.3.8 *RBCAA Scorpio Station*

Exceedances of the hourly SO_2 NAAQ limit value occurred in all assessment years except 2017, however, in all cases the number of exceedances was lower than the allowable 88 hours per year. In 2020, the 24-hour NAAQS was exceeded, where 10 days exceeded the applicable limit value (Table 3-11). Annual average SO_2 concentrations were not exceeded during the 5 years of assessment. The SO_2 appears to have higher concentrations occurring between 07H00 and 10H00 and especially during winter when the area has lower rainfall (Figure 3-17).

Table 3-11: Ambient concentrations and data availability for the pollutants measured at the RBCAA Scorpio Monitoring Station

RBCAA Scorpio AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2016	84%	141.3	62.7	19.2	2	0
2017	84%	187.5	74.8	19.8	0	0
2018	98%	232.3	115.6	22.9	12	1
2019	99%	182.9	88.9	17.8	5	0
2020	96%	324.3	195.8	29.5	70	**10**

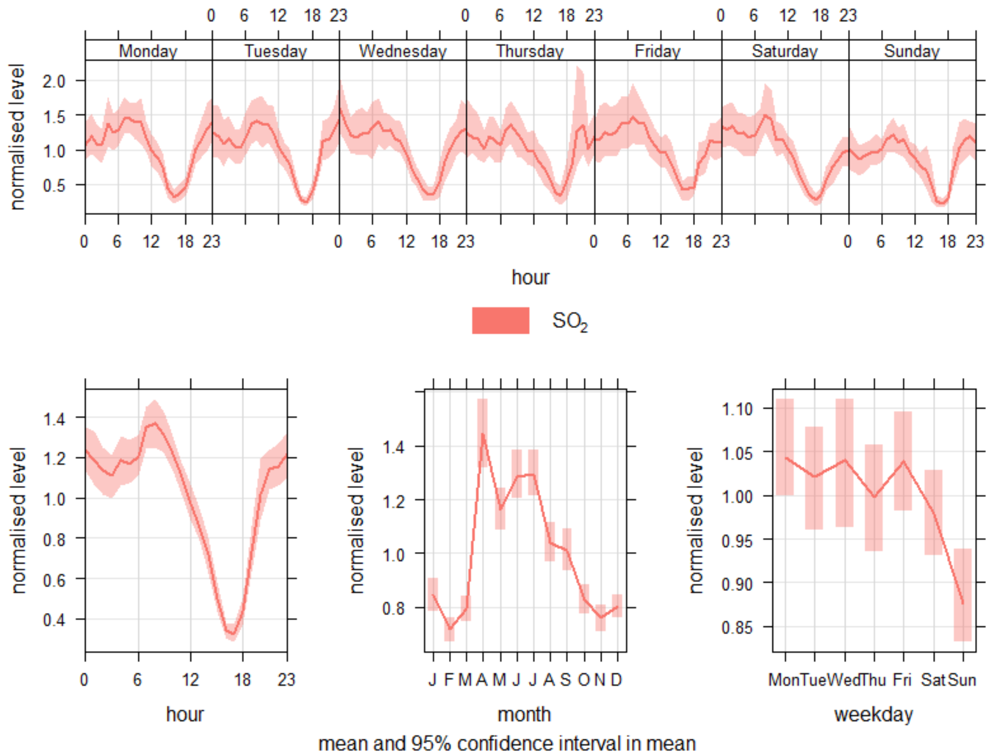


Figure 3-17: Time variation plot for the pollutants measured as RBCAA Scorpio Monitoring Station

3.3.9 *uMhlathuze Local Municipality Arboretum Station*

There were no exceedances of the short-term or long-term NAAQS for any of the pollutants (Table 3-12). Higher concentrations of NO_2 occur in the mornings around 07H00 and the evenings around 18H00 (Figure 3-18); this could be indicative of traffic as the main contributing source. Higher concentrations of SO_2 occur mid-morning and during the autumn and winter (Figure 3-18). Higher concentrations of $PM_{2.5}$ and PM_{10} occur during late night and early morning and April to July (Figure 3-19).

Table 3-12: Ambient concentrations and data availability for the pollutants measured at the uMhlathuze Local Municipality Arboretum Monitoring Station

City of uMhlathuze Arboretrum AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2019	84%	31.4	16.6	8.2	0	0
2020	98%	37.2	15.5	4.5	0	0
NO_2 (µg/m³)						
Criteria		*200 µg/m³*		*40 µg/m³*	*88 hours per year*	
2019	84%	32.0		7.5	0	
2020	97%	31.2		6.9	0	
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2019	84%		31.5	8.1		1
2020	29%		2.1	1.1		0
$PM_{2.5}$ (µg/m³)						
Criteria			*40 µg/m³*	*20 µg/m³*		*4 days per year*
2019	84%		27.5	6.7		0
2020	29%		1.9	1.0		0

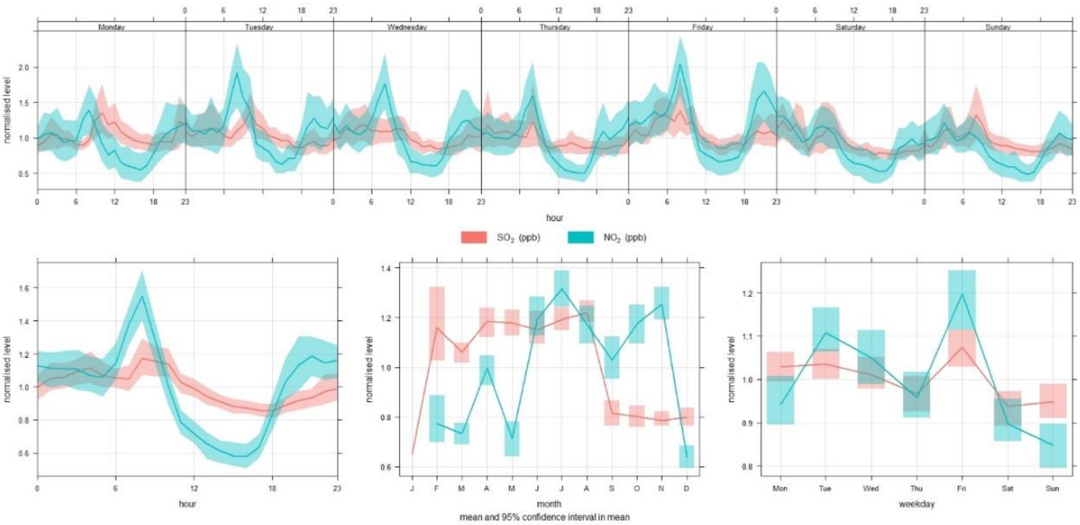


Figure 3-18: Time variation plot for the measured SO_2 and NO_2 at uMhlathuze Local Municipality Arboretum Monitoring Station

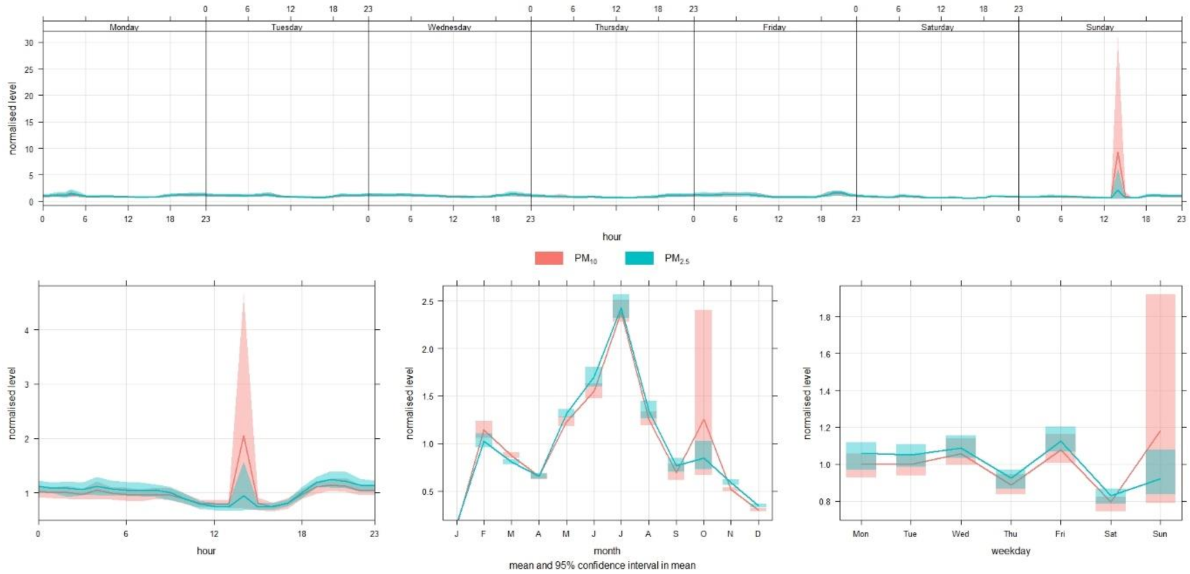


Figure 3-19: Time variation plot for the measured PM at uMhlathuze Local Municipality Arboretum Monitoring Station

3.3.10 *uMhlathuze Local Municipality Brackenham Station*

There were no exceedances of the short-term or long-term NAAQS for any of the pollutants (Table 3-13). An unusually high (for the Richards Bay network) number of hours had NO_2 concentrations above the NAAQ limit concentration in 2020 (54 hours), possibly associated with two events: between the 17th and 19th March; and between the 14th and 15th May 2020. These However, these exceedances were within the frequency of exceedance allowed by the NAAQS (88 hours per year). Higher concentrations of PM_{10} occur midday and July (Figure 3-20). Higher concentrations of NO_2 and $PM_{2.5}$ occurring in the mornings and the evenings around 18H00 (Figure 3-20); this could be indicative of traffic as the main contributing source. Higher concentrations of SO_2 occurring between 06H00 and 18H00, peaking at 15H00 and during the winter (Figure 3-20).

Table 3-13: Ambient concentrations and data availability for the pollutants measured at the uMhlathuze Local Municipality Brackenham Monitoring Station

City of uMhlathuze Brackenham AQMS						
Period	**Data Availability**	**Hourly**	**Daily**	**Annual Average**	**No of recorded hourly exceedances**	**No of recorded daily exceedances**
		99th Percentile	**99th Percentile**			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2019	80%	2.0	14.8	4.1	0	0
2020	95%	2.3	22.9	5.9	0	0
NO_2 (µg/m³)						
Criteria		*200 µg/m³*		*40 µg/m³*	*88 hours per year*	
2019	80%	25.0		9.8	0	
2020	95%	33.4		15.6	54	
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2019	83%		34.3	9.3		0
2020	46%		13.9	5.1		0
$PM_{2.5}$ (µg/m³)						

City of uMhlathuze Brackenham AQMS						
Period	Data Availability	Hourly	Daily	Annual Average	No of recorded hourly exceedances	No of recorded daily exceedances
		99th Percentile	99th Percentile			
Criteria			*40 µg/m³*	*20 µg/m³*		*4 days per year*
2019	83%		23.5	7.1		0
2020	46%		10.7	4.1		0

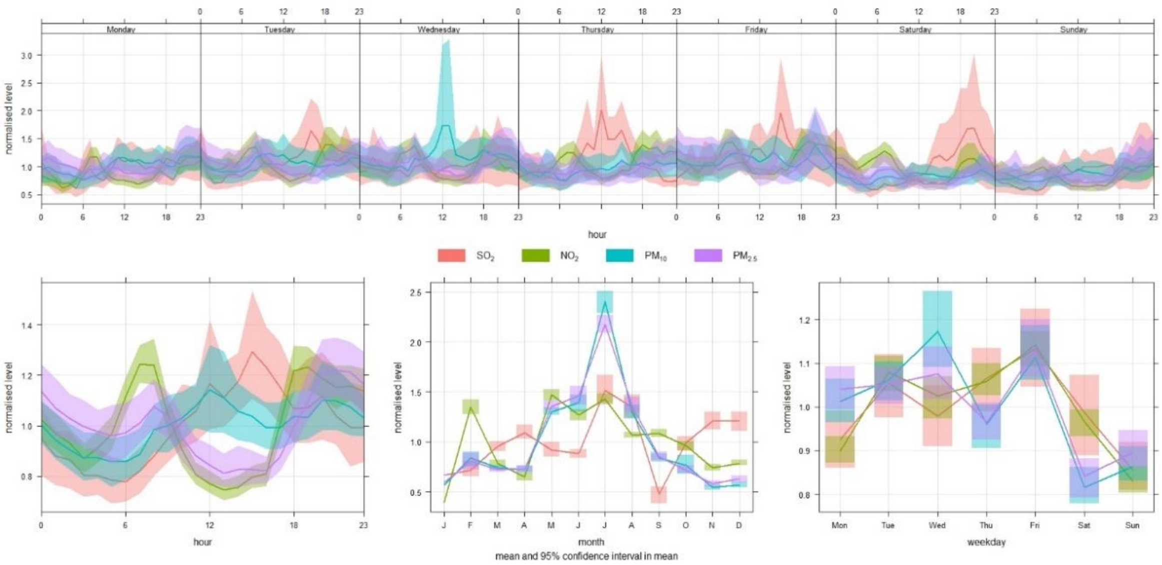


Figure 3-20: Time variation plot for the pollutants measured at uMhlathuze Local Municipality Brackenham Monitoring Station

3.3.11 *uMhlathuze Local Municipality eSikhaleni Station*

There were exceedances of the 24-hour NAAQS for both $PM_{2.5}$ and PM_{10} in 2019 and 2020. The annual NAAQS was also exceeded for $PM_{2.5}$ in 2019. There were no exceedances of the short-term or long-term NAAQS for SO_2 or NO_2 (Table 3-14). Higher concentrations of PM_{10} and $PM_{2.5}$ occur during late night and early morning and during winter months (Figure 3-21). Higher concentrations of NO_2 occurring in the mornings around 06H00 and the evenings around 18H00 (Figure 3-21); this could be indicative of traffic as the main contributing source.

Table 3-14: Ambient concentrations and data availability for the pollutants measured at the uMhlathuze Local Municipality eSikhaleni Monitoring Station (bold text indicates exceedance of the applicable NAAQS)

City of uMhlathuze eSikhaleni AQMS						
Period	Data Availability	Hourly	Daily	Annual Average	No of recorded hourly exceedances	No of recorded daily exceedances
		99th Percentile	99th Percentile			
SO_2 (µg/m³)						
Criteria		*350 µg/m³*	*125 µg/m³*	*50 µg/m³*	*88 hours per year*	*4 days per year*
2019	77%	21.0	17.8	10.0	0	0
2020	89%	16.5	14.0	4.5	0	0
NO_2 (µg/m³)						
Criteria		*200 µg/m³*		*40 µg/m³*	*88 hours per year*	
2019	82%	43.2		9.8	0	
2020	93%	40.4		8.5	0	

City of uMhlathuze eSikhaleni AQMS						
Period	Data Availability	Hourly	Daily	Annual Average	No of recorded hourly exceedances	No of recorded daily exceedances
		99th Percentile	99th Percentile			
PM_{10} (µg/m³)						
Criteria			*75 µg/m³*	*40 µg/m³*		*4 days per year*
2019	78%		117.9	30.1		**20**
2020	70%		77.5	15.6		4
$PM_{2.5}$ (µg/m³)						
Criteria			*40 µg/m³*	*20 µg/m³*		*4 days per year*
2019	68%		148.8	**27.4**		**66**
2020	70%		62.4	12.8		**16**

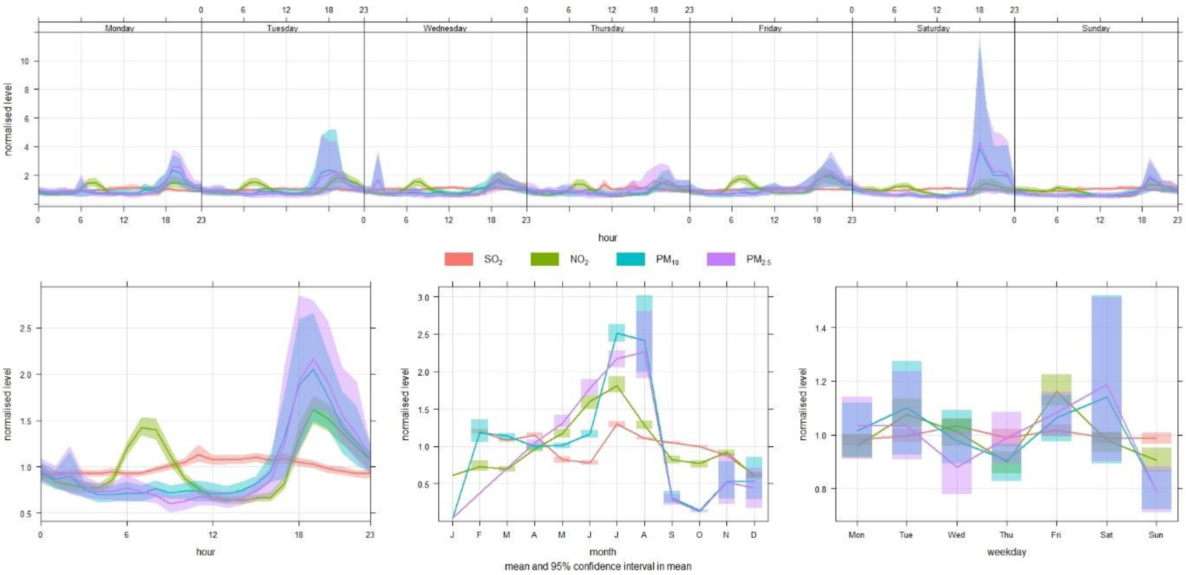


Figure 3-21: Time variation plot for the pollutants measured at uMhlathuze Local Municipality eSikhaleni Monitoring Station

3.3.12 *Summary of Ambient Air Quality*

In general, the ambient air quality in Richards Bay is in compliance with NAAQS, with the exception of Harbour West for daily SO_2, Brackenham for daily PM_{10}, and eSikhaleni for $PM_{2.5}$ and PM_{10}.

Table 3-15: NAAQS Compliance Summary for Ambient monitoring network of Richards Bay (2016-2020)

Monitoring Station	SO_2			NO_2		PM_{10}		$PM_{2.5}$	
	hour	day	annual	hour	annual	day	annual	day	annual
Arboretum (RBCAA)	√	√	√						
Brackenham (RBCAA)	√	√	√			**X 2018**	√		
CBD (RBCAA)	√	√	√			√	√		
eNseleni (RBCAA)	√	√	√			√	√		
eSikhawini (RBCAA)	√	√	√			√	√		
Felixton (RBCAA)	√	√	√			√	√		

Monitoring Station	SO_2			NO_2		PM_{10}		$PM_{2.5}$	
	hour	day	annual	hour	annual	day	annual	day	annual
Harbour West (RBCAA)	√	**X 2018 2020**	√						
Scorpio (RBCAA)	√	**X 2020**	√						
Arboretum (uMhlathuze)	√	√	√	√	√	√	√	√	√
Brackenham (uMhlathuze)	√	√	√	√	√	√	√	√	√
eSikhaleni (uMhlathuze)	√	√	√	√	√	**X 2019**	√	**X 2019 2020**	**X 2019**

3.4 Dispersion Modelling Results for Richards Bay

A recent air quality dispersion modelling study assessing the cumulative impact of operations within the Richards Bay domain was consulted with permission of the authors (WSP Environment and Energy) and the RBCAA (under request for confidentiality of its members). The report is considered by the RBCAA to be the most comprehensive assessment of normal operations of the industries in the Richards Bay airshed, although limitations of the assessment are detailed in the report. These include omission of some industrial sources (where information was not available); exclusion of vehicular traffic emissions; and intermittent sources such as sugarcane burning. Simulated annual average concentrations of PM_{10}, NO_2, and SO_2 were provided for cumulative assessment of the baseline conditions.

3.4.1 *Emissions Quantification*

Emissions were quantified from 11 industries within the Richards Bay airshed, based on information provided by the industries and the AELs. Total annual point source emissions for the pollutants of concern are summarised in Table 3-16.

Table 3-16: Baseline annual pollutant emission rates in the Richards Bay airshed

Source group	Annual emission rates (tonnes per year)		
	SO_2	NO_X	PM_{10}
Point sources	23 253	8 452	3 411
Area sources	(not reported)		

3.4.1.1 Simulated Annual Average Respirable Particulate Matter (PM_{10})

The baseline operations were simulated to result in exceedances of the currently enforceable NAAQS (40 µg/m³) across much of the port area and adjacent areas mainly due to coal stockpiling and handling operations (Figure 3-22).

3.4.1.2 Simulated Annual Average Sulfur dioxide (SO_2)

Annual average SO_2, due to normal operations of the industrial sources in Richards Bay, were simulated to comply with the NAAQS across the domain, where the highest concentrations are expected close to Richards Bay central, Alton, and Brackenham (Figure 3-23).

3.4.1.3 Simulated Annual Average Nitrogen dioxide (NO_2)

Annual average NO_2 was simulated to comply with the NAAQS across the domain for normal operation of the industries operating in Richards Bay, with maximum concentrations occurring near Alton and Richards Bay Central (Figure 3-24).

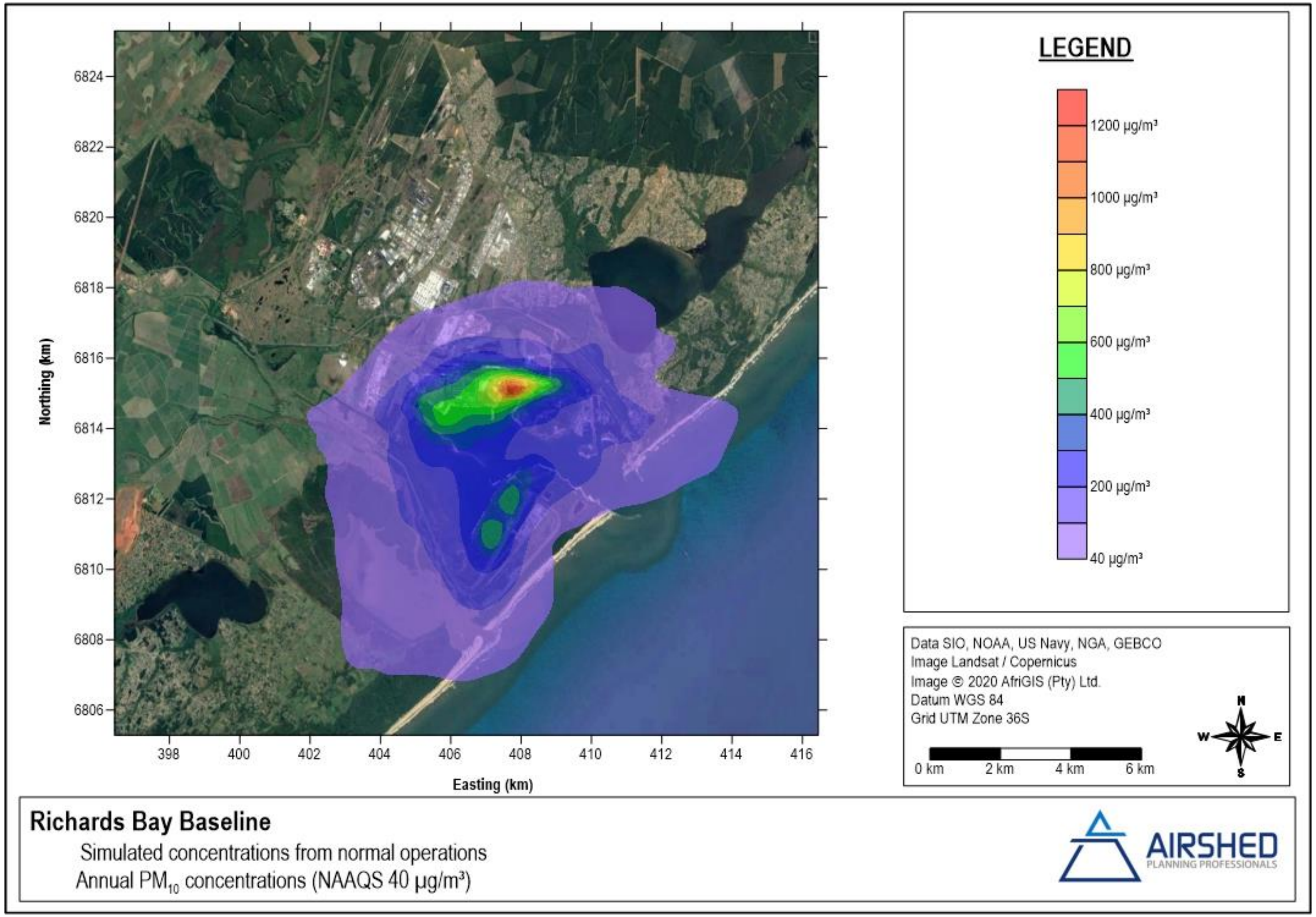


Figure 3-22: Simulated annual average PM_{10} concentrations for the Richards Bay baseline

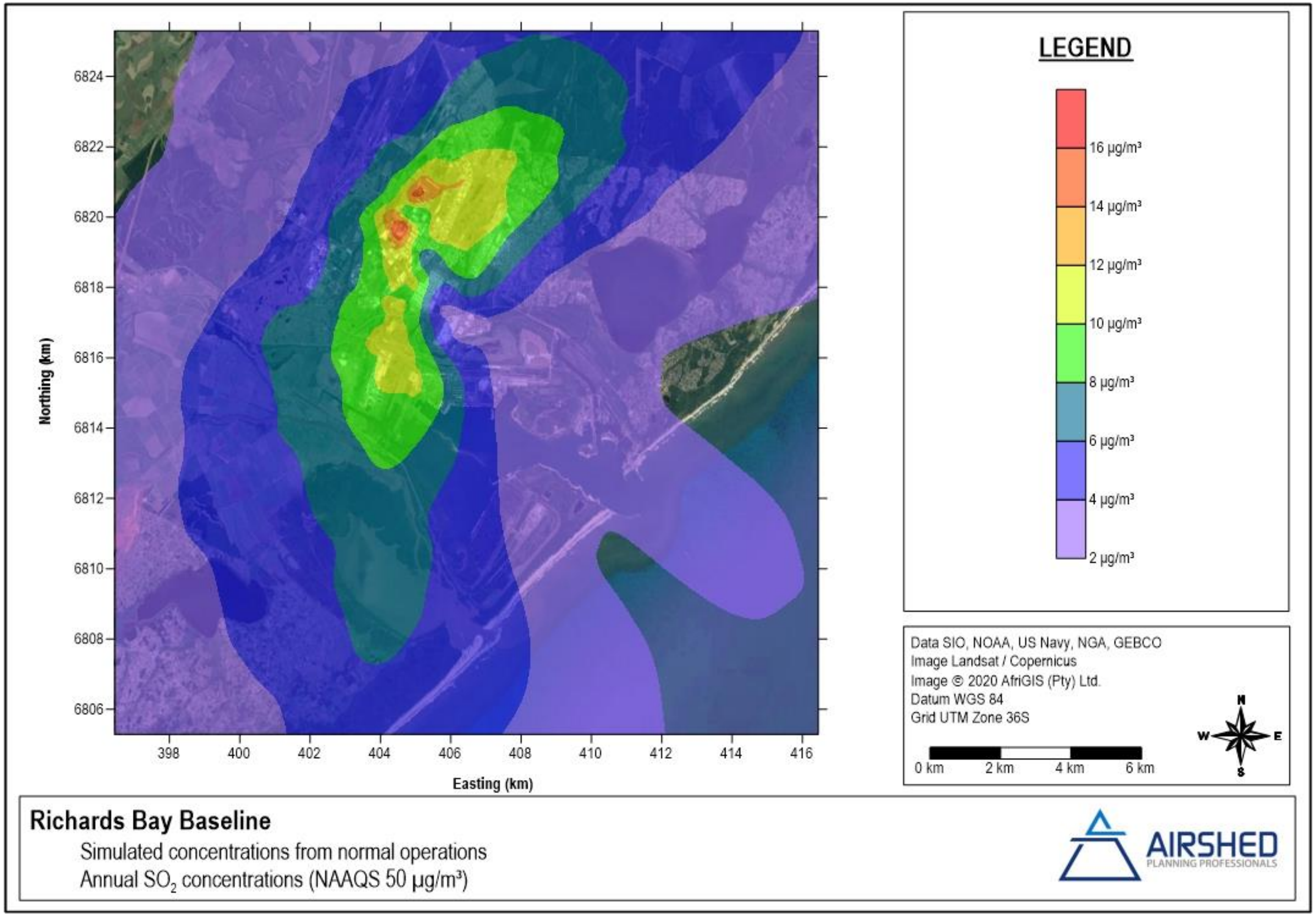


Figure 3-23: Simulated annual average SO_2 concentrations for the Richards Bay baseline

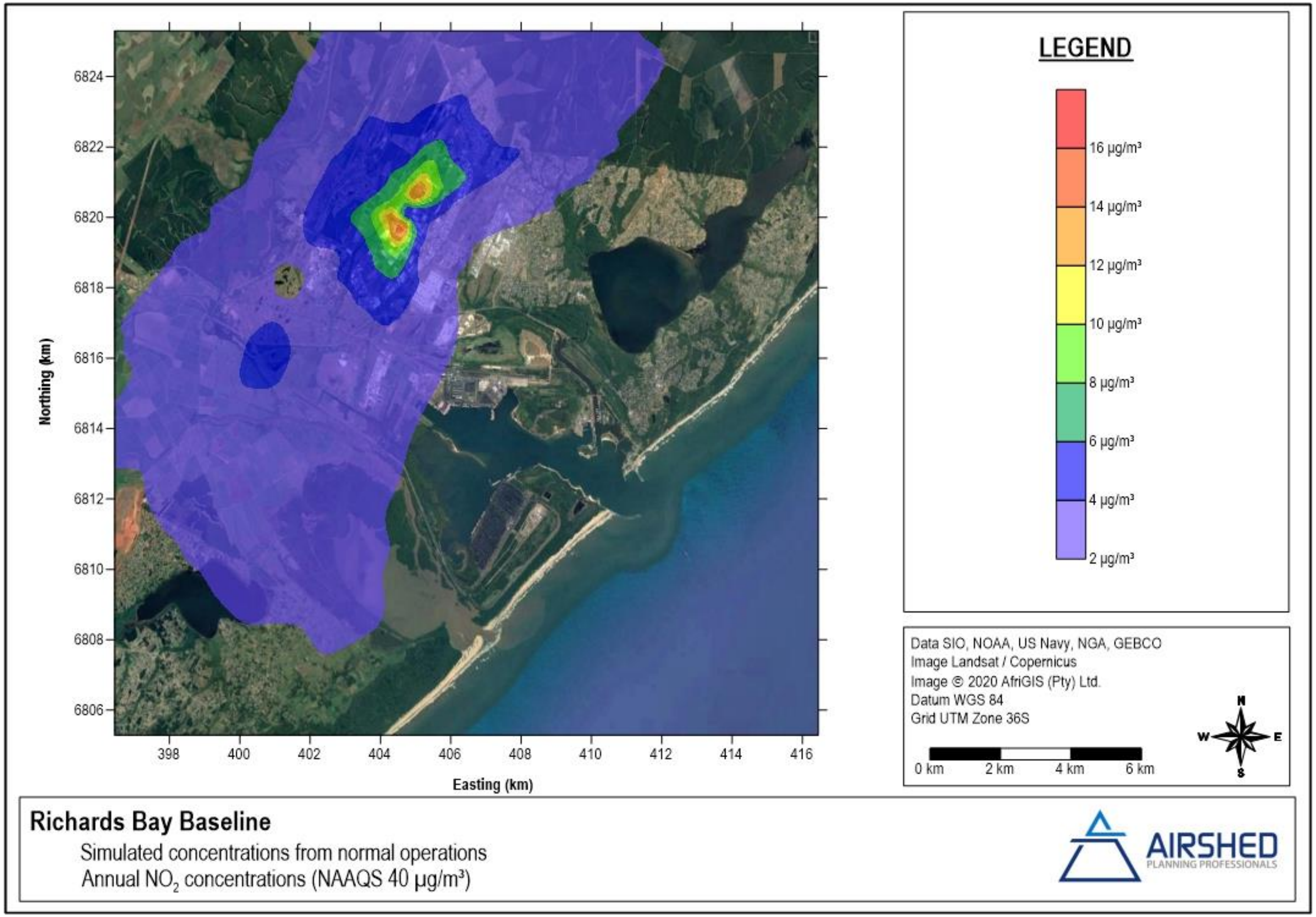


Figure 3-24: Simulated annual average NO_2 concentrations for the Richards Bay baseline

4 SCOPING PHASE IMPACT ASSESSMENT

The purpose of the Scoping Report is to identify the main issues and potential impacts of the proposed project based on a desktop assessment of existing information. The impact assessment methodology provided by Savannah Environmental (Appendix A) was used to summarise the potential impacts of the construction (**Error! Reference source not found.**) and operation phases (Table 4-2) of the proposed project.

Table 4-1: Expected Potential Impact Associated with the Construction of the PRBGP3 plant at the Scoping Phase

<table>
<tr><td colspan="4">Impact
Elevated ambient concentrations of particulate and gaseous atmospheric pollutants as a result of construction activities.</td></tr>
<tr><th>Issue</th><th>Nature of Impact</th><th>Extent of Impact</th><th>No-Go Areas</th></tr>
<tr><td>Ambient particulate concentrations and dustfall rates</td><td><u>Direct impacts:</u>
» Potentially elevated ambient particulate concentrations that may have human health impacts.
» Potentially elevated nuisance dustfall rates.
<u>Indirect impacts:</u>
» Low probability of impacts to vegetation as a result of particulate deposition</td><td>Local</td><td>None identified at this stage</td></tr>
<tr><td>Ambient gaseous pollutant concentrations</td><td><u>Direct impacts:</u>
» Potentially elevated ambient gaseous pollutant concentrations, that may have human health impacts, as a result of vehicle exhaust emissions.
<u>Indirect impacts:</u>
» Low probability of impacts to vegetation as a result of pollutant exposure</td><td>Local</td><td>None identified at this stage</td></tr>
<tr><td colspan="4">Description of expected significance of impact
The bulk earthworks and vehicle activity associated with construction of the proposed facility are likely to result in local impacts, with possible non-compliance with the NAAQS near site within the industrial area but not at sensitive receptors. The impact is likely to be short-term in nature and can be minimised through effective mitigation measures and good housekeeping practices.</td></tr>
<tr><td colspan="4">Gaps in knowledge & recommendations for further study
The duration and scale of construction activities is unknown at this stage. Construction impacts will be assessed during the EIA phase. Relevant information required includes: expected fuel use; vehicle types, activity patterns and on-site road usage; and, full extent of bulk earthworks.</td></tr>
</table>

Table 4-2: Expected Potential Impact Associated with the Operation phase of the PRBGP3 plant at the Scoping Phase

<table>
<tr><td colspan="4">Impact
Elevated ambient concentrations of gaseous atmospheric pollutants as a result of PRBGP3 operational activities (gas combustion in turbine units).</td></tr>
<tr><th>Issue</th><th>Nature of Impact</th><th>Extent of Impact</th><th>No-Go Areas</th></tr>
<tr><td>Ambient air pollutant concentrations</td><td><u>Direct impacts:</u>
» Potentially elevated ambient gaseous pollutant concentrations, that may have human health impacts, as a result of gas combustion in turbines.
» Low probability of elevated ambient particulate concentrations that may have human health impacts, due to gas combustion in turbines.
<u>Indirect impacts:</u>
» Low probability of impacts to vegetation as a result of pollutant exposure and particulate deposition.</td><td>Near site (surrounding suburbs)</td><td>None identified at this stage</td></tr>
<tr><td colspan="4">Description of expected significance of impact
The combustion of natural gas (with the possible the inclusion of hydrogen) is likely to result in local impacts, with possible non-compliance with the NAAQS near site within the industrial area and possibly within surrounding suburbs and at sensitive receptors. The pollutants of concern include: CO, NO_2, and (to a lesser extent) SO_2, PM_{10}, $PM_{2.5}$ and VOCs. The impact is likely to be long-term in nature. Effective mitigation measures are likely to reduce the extent of impact.</td></tr>
<tr><td colspan="4">Gaps in knowledge & recommendations for further study
NO_X emissions from the gas combustion during the operation phase will likely have the most substantive impact on ambient air quality. Ambient NO_X and NO_2 are not currently monitored by the RBCAA, however the City of uMhlathuze AQMSs record ambient NO_X and NO_2 and the most recent data will be used to assess cumulative impact of the proposed facility. Atmospheric dispersion modelling will be used during the EIA phase to assess the extent of the impact of the proposed facility and the cumulative impact, of the pollutants of concern, including NO_X. Existing simulated baseline studies (WSP in 2016) will support the measured baseline to assess the cumulative impacts over the Richards Bay domain. Design considerations to minimise air quality impact already under consideration include natural gas and hydrogen mix; closed cycle turbines with heat recovery (increasing the total plant efficiency). These should be expanded (if not already under consideration): turbine combustion optimisation to reduce NOx emissions; and stack height for optimal dispersion to minimise near-site impacts. These design details should be available prior to the dispersion modelling study in the EIA phase.</td></tr>
</table>

5 EIA PHASE PLAN OF STUDY

During the impact assessment phase of study as the following quantitative steps will be included

1. The establishment of an emissions inventory by referring to NMES and emission factors for combustion processes, fuel storage and fugitive dust (construction);
2. Atmospheric dispersion simulations for the construction and operational phases of the proposed facility using the US EPA CALPro suite (CALMET and CALPUFF);
3. A human health risk and nuisance impact screening assessment based on dispersion simulation results;
4. A comprehensive air quality impact assessment report in the format prescribed by the Department of Environmental Affairs (DEA) in support of the Atmospheric Emission License (AEL) application.

NAAQS and inhalation health criteria are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. NAAQS and inhalation health criteria generally indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Criteria are normally given for specific averaging or exposure periods.

The affected atmospheric environment of Richards Bay will be considered by taking into account:

- The local atmospheric dispersion potential;
- The position of Air Quality Sensitive Receptors (AQSRs) in relation to the project;
- Ambient air quality in the study area to be sourced from the South African Air Quality Information System (SAAQIS) and the RBCAA ; and
- An air quality dispersion modelling study (completed in June 2016) assessing the cumulative impact of operations within the Richards Bay domain was consulted with permission of the authors (WSP Environment and Energy) and the RBCAA (under request for confidentiality of its members).

An understanding of the atmospheric dispersion potential of the area is essential to an air quality impact assessment. Physical environmental parameters that influence the dispersion of pollutants in the atmosphere include terrain, land cover and meteorology.

The emission inventory will form the basis for the assessment of the air quality impacts from emissions on the receiving environment. As a minimum, all pollutants regulated in terms of the proposed listed activities will be included in the assessment.

Dispersion models compute ambient concentrations and fallout rates as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources. Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments and emission control requirements. It is therefore important to carefully select a dispersion model for the purpose. The specific model used for assessment will be one of those recommended in Regulations for Dispersion Modelling Guidelines (Government Gazette No. 37804 vol. 589; 11 July 2014).

Simulated ambient pollutant concentrations and fallout rates (if required) will be compared to NAAQS, health risk screening levels, and NDCRs. Compliance will be assessed, and a health risk/nuisance screening completed. The findings of the above will inform the identification of suitable management and mitigation measures, based on best practice. The main deliverables of the air quality specialist study will include an air quality impact assessment report.

6 MAIN FINDINGS AND CONCLUSIONS

The main findings from the scoping assessment are as follows:

- The airflow in the study area and project site is dominated by winds from the north-westerly and south-easterly sectors. There is little diurnal variation with the prevailing wind field from the southwest during the night and early morning, and more frequent flow from the northeast during the afternoon and evening. The seasonal wind-field reflects the same prevailing north-westerly and south-easterly winds with stronger winds in spring and summer.
- The area is highly populated with numerous settlements along the coast, to the north of Richards Bay and south along the coast to Mtunzini. The towns in the area are Richards Bay, Empangeni, Felixton and Mtunzini.
- The main pollutants of concern in the greater Richards Bay area are mainly SO_2 and PM_{10}. Measured and modelled SO_2 concentrations indicated elevated levels over the main industrial and some residential areas of Richards Bay. Measured and modelled PM_{10} concentrations also indicated elevated levels over the CBD of Richards Bay, eSikhaleni and Brackenham.
- Pollutants of concern from the proposed PRBGP3 power plant, with a generating capacity up to 2 000 MW, mainly associated with gas turbines, are NO_x, CO and to a lesser extent, SO_2, PM and VOCs.

The main issues and potential impacts of the proposed project based on a desktop assessment of existing information from an air quality perspective.

The proposed PRBGP3 power plant, with a generating capacity up to 2 000 MW, may result in elevated (and potentially non-compliance with NAAQS) daily PM_{10} concentrations during the construction phase due to background PM_{10} and the proximity to other particulate emission sources. The impacts are likely to be local.

During the operation phase, the proposed PRBGP3 power plant, with a generating capacity up to 2 000 MW, is likely to contribute NO_X, CO, and VOCs to the exiting baseline concentrations. Cumulative impacts of SO_2 and PM emissions, although small, may result in cumulative impacts with possible non-compliance to already elevated baseline concentrations. The impacts are likely to be regional.

Atmospheric dispersion modelling will be used to assess incremental and cumulative impacts on ambient pollutant concentrations during the EIA phase of assessment.

7 REFERENCES

Carslaw, D. (2019). *The openair manual - open-source tools for analysing air pollution data. Manual for version 2.6-5.* King's College London.

Carslaw, D., & Ropkins, K. (2012). openair - an R package for air quality data analysis. *Environmental Modelling and Software, 27-28*, 52 - 61.

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

Goverment Gazette. (2013, November 1). National Dust Control Regulations. *National Environmental Management: Air Quality Act (39/2004), 36974*.

Government Gazette. (2009, Dec 24). National Ambient Air Quality Standards. *National Environmental Management: Air Quality Act (39/2004), 32816*.

Government Gazette. (2010, March 31). List of activities and associated minimum emission standards. *National Environmental Management: Air Quality Act (39/2004), 33064*.

Government Gazette. (2012, June 29). National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter less than 2.5 micron metres (PM2.5). *National Environmental Management: Air Quality Act (39/2004), 35463*.

Government Gazette. (2013, November 22). List of Activities which Result in Atmospheric Emissions which have or may have a Significant Detrimental Effect on the Environment, Including Health and Social Conditions, Economic Conditions, Ecological Conditions or Cultural Heritage. *National Environmental Management: Air Quality Act (39/2004), 37054*.

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

Tiwary, A., & Colls, J. (2010). *Air pollution: measurement, monitoring and mitigation* (3rd Edition ed.). Oxon: Routledge.

US EPA. (2000). *AP42, 5th Edition, Volume 1, Chapter 3: Stationary Internal Combustion Sources, 3.1 Stationary Gas Turbines.*

WSP Environmental. (2016). *Cumulative Air Pollution Dispersion Modelling Assessment.* Bryanston: WSP Environmental.

APPENDIX G.1

RAPID HEALTH SCOPING STUDY

INFOTOX (Pty) Ltd

2001/000870/07

Retrieval and scientific interpretation of ecotoxicological information

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Project conducted on behalf of
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Scoping Report for a Rapid Appraisal Health Impact Assessment for a Gas-to-Electricity Power Generation Plant in Richards Bay

Report No 032-2020 Rev 4.0

Compiled by

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25 October 2021

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Managing Director

25 October 2021

Expertise and Declaration of Independence

This report was prepared by INFOTOX (Pty) Ltd ("INFOTOX"). Established in 1991, INFOTOX is a professional scientific company, highly focused in the discipline of Health Sciences. Both occupational and environmental human health risks, as well as risks to ecological receptors, are addressed.

Dr Willie van Niekerk, Managing Director of INFOTOX, has BSc, Hons BSc and MSc degrees from the University of Potchefstroom and a PhD from the University of South Africa. He is a Qualified Environmental Professional (Environmental Toxicologist QEP), certified by the Institute of Professional Environmental Practice (IPEP) in the USA (No 07960160), and a registered Professional Natural Scientist registered in South Africa (Pr Sci Nat, Environmental Science, No 400284/04). Dr Van Niekerk has specialised in chemical toxicology and human health risk assessments, but he has experience in many other areas in the disciplines of analytical and environmental sciences.

Dr Marlene Fourie has BSc and Hons BSc degrees from the University of Stellenbosch and MSc and PhD degrees from the University of Pretoria. Her field of specialisation is reproductive biology/toxicology. Dr Fourie also has an MSc-degree in epidemiology from the University of Pretoria. Following positions as Medical Natural Scientist at the Andrology Unit, Department of Urology, University of Pretoria and the Pretoria Academic Hospital from 1987 to 2001, she joined INFOTOX as a Medical Biological Scientist. Dr Fourie has conducted many health risk assessments and projects relating to the health status of communities. She is registered as a Professional Natural Scientist (Pr Sci Nat, Toxicological Science, No 400190/14).

This specialist report was compiled for Savannah Environmental (Pty) Ltd. We do hereby declare that we are financially and otherwise independent of Savannah Environmental (Pty) Ltd.

Signed on behalf of INFOTOX (Pty) Ltd, duly authorised in the capacity of Managing Director:

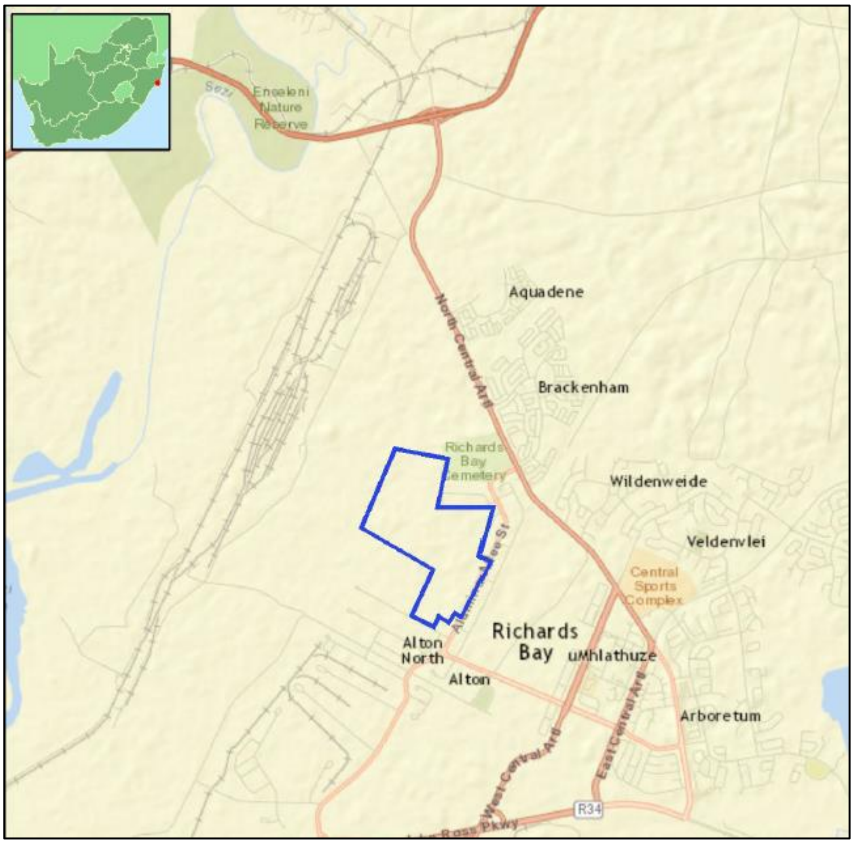
Willem Christiaan Abraham van Niekerk

25 October 2021

Table of Contents

1 Introduction

Savannah Environmental (Pty) Ltd appointed INFOTOX (Pty) Ltd to conduct a rapid appraisal health impact assessment (RAHIA) for the development of the gas-to-electricity power generation plant and related infrastructure located in Alton North, Richards Bay, within the uMhlathuze Local Municipality (LM) in the Uthungulu District Municipality (DM), KwaZulu-Natal. The current General Orientation Map, compiled by Maroga (2020) is presented in Figure 1.1.



Note to Figure: The blue outline represents the proposed project site location.

Figure 1.1: General Orientation Map of the Richards Bay Gas-to-Power project (Maroga 2020).

This document presents the scoping of the RAHIA, according to the Good Practice guidance of the International Finance Corporation (IFC), a member of the World Bank Group (IFC 2009). INFOTOX is guided, amongst other IFC guidelines, by the *Introduction to Health Impact Assessment*.

The IFC differentiates between two types of health impact assessments (HIAs), namely a comprehensive and a rapid appraisal HIA. The comprehensive HIA is recommended when the project is likely to attract or involve a significant influx of people, for example a large construction work force. Other factors in favour of a comprehensive HIA include resettlement or relocation of local inhabitants or communities, significant construction activity, or the assessment of a large project in a rural setting. The proposed gas-to-power plant in the Richards Bay area does not involve relocation of people and does not have a strong emphasis on any of these factors. Therefore, a rapid appraisal HIA is performed. However, since there are concerns about the potential health impacts of airborne contaminants dispersed to nearby communities, elements of a comprehensive health impact assessment are included, as explained in Section 2.

2 Terms of reference for the RAHIA

2.1 Elements of the assessment

According to the IFC, the RAHIA is a limited in-country assessment that does not require new data collection within the communities of concern. Data necessary to assess potential health impacts of proposed developments on potentially affected communities are extracted from existing data sources. It is evident that this requires a review determining the availability of existing data sources and a review of such sources to identify and select data relevant to the communities of concern. The IFC suggests that a limited desktop review will suffice.

With regard to the gas-to-electricity power generation plant, it is expected that potential impacts on air quality, and potential resultant impacts on the health of receptor communities, will be of primary interest. The main focus of the RAHIA is the impact of substances released or dispersed into air on the health of surrounding communities. Due to this focus, air dispersion modelling of the potential impact on air quality will be necessary. This should involve the potentially impacted geographical area, done according to the terms of reference for the Air Quality Impact Assessment, by air quality specialists appointed by Savannah Environmental.

It is understood that the dedicated pipeline providing the gas supply to the power plant will be authorised separately and will not be included in the RAHIA. Waste water generated from the plant and ancillary facilities are not included in the INFOTOX scope of work. Reject brine from the water treatment plant will be discharged to the Richards Bay Industrial Zone stormwater system and is also not included in the INFOTOX assessment.

2.2 Assessment focus areas

Integral to the RAHIA is the environmental human health risk assessment (HHRA), which will be conducted by INFOTOX. In terms of the RAHIA, the geographical study area considered as impacted include those areas and communities where the proposed developments may have an impact on the environmental quality. The assessment of the impacts via air is performed using the results of the HHRA, which is based on concentrations of hazardous substances in air, whether measured or modelled. Savannah Environmental has appointed air dispersion modelling specialists to investigate the potential impacts of the proposed power plant on air quality. INFOTOX should discuss data presentation needs with the modellers before these professionals commence modelling of the likely air pollutant concentrations in the vicinity of the gas-to-electricity power generation plant. The health consequences of impacts in air are assessed based on the results of the HHRA.

Two phases are relevant to the gas-to-electricity power generation plant, namely the construction phase and the operational phase. The HHRA for the construction phase is concerned with the effect of airborne dust generated mainly by earthmoving equipment. The air dispersion modelling specialists should model dust concentrations as the PM2.5 fraction of airborne inorganic particulate matter in the vicinity of the proposed power plant. Exposure in the residential areas is of significance, in the modelling domain determined by the air dispersion specialist on the basis of the likely emissions from the construction site and the local topographical and meteorological considerations.

The ambient air contaminants of concern in the operational phase of the plant are four criteria pollutants, namely, the PM2.5 fraction of airborne inorganic particulate matter, carbon monoxide

(CO), sulfur dioxide (SO_2) and nitrogen oxides as NO_2. The air quality scoping report (Petzer 2021) also mentions VOCs (as an unspecified group) associated with the gas turbine operations. VOCs as a group of substances are not regulated and health risk values for assessment of the group are not available. Thus, the generally accepted approach is to model and assess a surrogate chemical substance representing the group of VOCs. The surrogate that will be modelled and assessed with regard to health in this project is benzene.

It is important to note that risks of health effects due to exposure to air pollutants are commonly observed even when the prevalent air concentrations do not exceed the environmental air quality guidelines or standards. Simplistic comparisons between exposure concentrations and ambient air quality guidelines or standards are inadequate to quantify health outcomes, mainly because ambient air quality guidelines are used for management of air quality and are not intended for risk quantification. Air quality guidelines or standards also do not relate exposures to specific health endpoints, which limits the effectiveness of risk communication.

2.3 The HHRA paradigm

The original paradigm for regulatory human health risk assessment (HHRA) in the USA was developed by the USA National Research Council (NRC 1983). This model has been adopted and refined by the US Environmental Protection Agency (USEPA) and other international agencies as published under the International Programme on Chemical Safety (IPCS 1999; IPCS 2010) and is widely used for quantitative human health risk assessments. The elements of the HHRA approach are described below.

Hazard assessment

Hazard assessment is the identification of chemical contaminants suspected to pose hazards and a description of the types of toxicity that they may evoke.

Exposure-response assessment

The exposure-response assessment addresses the relationship between levels and periods of exposure and the manifestation of adverse health effects in humans, and/or how humans can be expected to respond to different concentrations of contaminants in air.

Mortality or hospitalisation rates for respiratory or cardiovascular causes are the measures of associated illness that are mostly applied in epidemiological studies of community health risks associated with exposure to criteria pollutants. The international scientific literature is not static and major regulatory agencies such as the US Environmental Protection Agency (USEPA) and the UK Committee on the Medical Effects of Air Pollutants (COMEAP) regularly review their risk models. This requires timely reviews of the literature by the health risk assessor and the status of information is checked prior to conducting health risk assessments.

The community health risk assessment involves the calculation of the potential increase in or contribution to the risk of hospital admissions or mortality due to specific causes, associated with air concentrations of specific pollutants. These calculations are based on results of epidemiological studies reported in the international scientific literature in which statistical methods were used to compare hospitalisation or mortality rates with air quality. Current statistical methods use the concept of relative risk to derive the potential increase in or contribution to effects. The potential increase or contribution associated with the pollutant contributed by a specific source, in this case, emissions from the proposed power station, is calculated using the approach of the World Health Organization (WHO), which will be discussed in the human health risk assessment report.

In the assessment of health risks, it is of critical importance to focus on health outcomes for which adequate scientific evidence has been documented. The issue of causality is fundamental in this regard, because assessments have to be based on health impacts linked to exposure with a significant degree of confidence.

Health effects in the "likely to be causal", "suggestive of a causal relationship" and "inadequate to infer a causal relationship" categories are weakly characterised and can mostly not be used in health risk assessments.

The Air Quality Impact Assessment report presenting modelled ambient air concentrations of the criteria pollutants due to the proposed construction of the facility and due to normal operations of the proposed gas turbines will serve as source of input data for the community health risk assessment. The required input data are explained in Section 2.4. The report normally identifies the locations of sensitive receptors and ambient air concentrations of pollutants across the study area. It is very important for the success of the project that INFOTOX is granted the opportunity to interact with the air dispersion modelling specialists prior to the initiation of air quality modelling.

The percentage change in personal risk of a specific health effect associated with a specific criteria pollutant emitted by the proposed power plant is calculated by INFOTOX. Please note that INFOTOX will thus not calculate the number of individuals experiencing a specific health effect, because the affected population numbers are too low. Basing interpretations on personal risk is adequate and acceptable in the assessment of health risks in small communities.

Benzene, as surrogate for VOCs, is firstly submitted to a screening Tier-1 health risk assessment. The purpose is to focus the detailed community health risk assessment on the substances of potential concern, removing substances that are "non-issues" from the study list. The Tier-1 assessment compares modelled air concentrations to conservative screening guidelines. The derivation of Tier-1 screening guidelines is essentially a "reverse" health risk assessment, starting with acceptable levels of risk. Generic exposure scenarios are assumed and a risk-based concentration of benzene that would not cause any significant health risks is derived using benzene-specific toxicity values. The premise of the Tier-1 risk assessment is that when benzene concentrations in air are below the screening guidelines, there would not be any significant health risks to individuals that may be exposed by inhalation of benzene in air. No further assessment is required in such cases.

Further data processing and more detailed benzene exposure assessment in Tier 2 is performed only if modelled air concentrations of benzene exceed the Tier-1 screening value. As the risk assessment progresses from the Tier-1 level upwards, more investigative work is conducted to replace conservative exposure assumptions, thus making the assessment more certain by adding increasing detail of exposures and risk in the higher tiers. Importantly, the risk assessment Tier does not at all affect the level of assessed level of risk, and upward progress through assessment Tiers are not to be interpreted as indicating increased levels of risk. Rather, upward progress indicates more detailed and receptor-specific exposure assessment, with associated greater certainty regarding the precise level of exposure and the likely risk to health.

Exposure assessment

In the case of emissions to air, exposure assessment includes estimates of concentrations and duration of exposure of hazardous substances in air and identification of potentially exposed individuals or communities. Exposure assessment in this study is based on the air pathway of exposure and the route of exposure is by inhalation.

Exposure scenarios are also defined in terms of the length of periods of exposure. In the case of the criteria pollutants, short-term (acute) exposure is based on the 99^{th} and 75^{th} percentiles of the modelled average 24-hour air concentrations. The 99^{th} percentiles are used to calculate the reasonable upper risk limits and the 75^{th} percentiles, if made available by the air dispersion modeller, are used to calculate a conservative central risk estimate. Chronic exposure is based on the modelled annual average concentrations of criteria pollutants and benzene. Maximum 8-hourly average benzene (or equivalent surrogate) concentrations are used to assess risks associated with short-term concentration peaks.

Risk characterisation

Risk characterisation involves the quantification of health risks and the integration of the HHRA components described above, with the purpose of determining whether specific exposures to an individual or a community might lead to adverse health effects.

Uncertainty review

This review identifies the nature and, when possible, the magnitude of the uncertainty and variability inherent in the characterisation of risks. The results of any risk assessment is inherently affected by, firstly, scientific uncertainty associated with limitations in available data and assumptions that are made in the absence of such data. Secondly, the results are subject to variability in exposure and toxicological response expected, given the diversity within the human population. These uncertainties, assumptions and limitations that form part of all risk characterisation must be discussed in the uncertainty review of the risk assessment report. The uncertainty review also demonstrates the level of confidence in the outcome of the risk assessment and indicates whether additional data might be required, or whether elements of the precautionary principle should be applied.

2.4 Input from the Air Quality Impact Assessment

The results of air dispersion modelling are estimates of the resultant air concentrations of dispersed contaminants in the vicinity of impacted communities. These estimates will be incremental; that is, it will reflect the contribution of power generating activities and fugitive gas emissions to air concentrations of contaminants, over and above the background concentrations already present in the environment. Estimates of incremental air concentrations are the input needed to estimate potential human health risks in terms of selected health effects of interest according to the airborne contaminants of interest. The results of the HHRA, together with the baseline health status of the impacted communities, are used to conduct an HIA.

The potentially hazardous air emissions that will be investigated, mentioned in Section 2.2, include four criteria pollutants, namely, PM2.5, SO_2, CO and NO_2. INFOTOX data requirements from the air quality study report are as follows:

Particular matter as PM2.5

- 75^{th} percentile of daily (24-hours average) concentrations
- percentile of daily (24-hours average) concentrations
- Annual average concentration

Sulfur dioxide (SO_2)

- 75^{th} percentile of daily (24-hours average) concentrations
- 99^{th} percentile of daily (24-hours average) concentrations

Carbon monoxide

- 75^{th} percentile of 8-hours average concentrations

- 99^{th} percentile of 8-hours average concentrations

Nitrogen dioxide (NO_2)
- 75^{th} percentile of daily (1- **or** 24-hours average) concentrations
- 99^{th} percentile of daily (1- **or** 24-hours average) concentrations

VOCs associated with construction vehicle emissions and gas turbine operations will be modelled and assessed as benzene, the likely surrogate compound to be used by the air dispersion modellers. Maximum 8-hourly average and annual average concentrations are likely to be presented in the report. The maximum 8-hourly average concentration is used to assess risks associated with acute concentration peaks and the annual average concentration to assess risks associated with chronic exposure.

The air dispersion modelling domain is determined by the expert air dispersion modeller and the HHRA is focused on the receptor communities within the air dispersion modelling domain.

2.5 Desktop review of available health literature

The baseline health status of the exposed communities is an important determining factor considered in the assessment of health impacts. The baseline health status assessment is compiled by INFOTOX, based on a desktop study of available health data for the receptor area. The intention of the desktop review of available published health literature is to provide baseline health data on the underlying burden of disease for the RAHIA and to identify specific vulnerabilities that might influence health impacts associated with the proposed operations. The following aspects are covered:

- Evaluate the underlying burden of disease, based on information gathered by INFOTOX from available open sources. Examples of open sources are World Health Organization health data and data potentially available from South African National, Provincial and Local Government Departments.

- Various burden-of-disease indicators are examined, such as:
  - Vector-related diseases
  - Soil- and waterborne diseases, if applicable
  - Sexually transmitted diseases
  - Nutrition-related diseases
  - Communicable and non-communicable diseases
  - Health impact assessments related to the project and the area, if available

Identification and consideration of sensitive groups are important activities in the RAHIA. Examples of sensitive groups are elderly individuals, infants and young children. It is also important to identify localities where sensitive groups might congregate, such as schools, old age homes, sports fields and community halls. Community-specific information, such as the adequacy of health care facilities, should also be considered in the RAHIA. Sensitive groups and their likely localities are usually identified in the Social Impact Assessment, from which INFOTOX will obtain the necessary data.

2.6 Envisioned RAHIA output

The output of the RAHIA is a contextualised rapid assessment of the potential health impact of the proposed gas-to-electricity power generation plant and related infrastructure. The significance of various identifiable impacts is assessed as suggested by the IFC (2009) based on factors such as:

- The likely perception of risks by potentially affected communities
- The nature of the impacts, whether direct, indirect or cumulative
- The timing and duration of impacts
- The extent, magnitude and frequency of impacts

The IFC (2009) also suggests that risks should be ranked in terms of severity and the probability of occurrence.

Criteria for the evaluation of impacts and impact significance ratings to be used in the impact assessment should be provided to INFOTOX. This will ensure consistent rating and assessment with impact assessments that will be compiled by other specialists. The construction and operation phases will be rated separately.

3 References

IFC. 2009. Introduction to Health Impact Assessment. Washington DC, USA: International Finance Corporation. http://www.ifc.org/wps/wcm/connect/corp_ext_content/ifc_external_corporate_site/home

IPCS. 2010. WHO Human Health Risk Assessment Toolkit: Chemical Hazards. International Programme on Chemical Safety Harmonization Project Document No. 8. Published under the joint sponsorship of the World Health Organization, the International Labour Organization and the United Nations Environment Programme, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals.

IPCS. 1999. Principles for the Assessment of Risks to Human Health from Exposure to Chemicals. Environmental Health Criteria 210. International Programme on Chemical Safety. A cooperative agreement between UNEP, ILO, FAO, WHO, UNIDO, Unitar and OECD.

Maroga KR. 2020. Screening Report for an Environmental Authorization or for a Part Two Amendment of an Environmental Authorisation as Required by the 2014 EIA Regulations – Proposed Site Environmental Sensitivity. Generated: 01/06/2020 for Richards Bay Gas 2 Power (Pty) Ltd.

NRC. 1983. Risk Assessment in the Federal Government: Managing the Process. National Research Council Committee on the Institutional Means for the Assessment of Risks to Public Health. Washington, DC: National Academy Press.

Petzer G. 2021. Air Quality Impact Assessment for the Proposed Development of the Richards Bay Gas Power 2 1 880 MW Combined Cycle Gas to Power Plant (RBGP2) and associated Infrastructure on a site near Richards Bay, KwaZulu-Natal Province – Scoping Report. Airshed Planning Professionals Report No: 19SAV22a Revision 1.