RESEARCH, TESTING AND DEVELOPMENT

SUSTAINABILITY DEPARTMENT

MARAPONG AIR QUALITY MONTHLY REPORT

MAY 2024

EXECUTIVE SUMMARY

This monthly report covers the ambient air quality data as monitored at Marapong monitoring site in May 2024.

There were no exceedances of the national air quality limits recorded for all parameters monitored during the period under review.

Ambient CO and NO_2 concentrations at Marapong monitoring site show influence of emissions from low level sources in the area while ambient SO_2 concentrations show influence of emissions from tall stack emitters and other industries.

The dominant wind directions during the daytime were east and east-north-east. During the night, the most frequent directions were south-south-west, south-west and south.

DISCLAIMER

1. INTRODUCTION

At the request of Eskom Environmental Management, Research, Testing and Development Department (RT&D) commissioned an ambient air quality monitoring site at Marapong Township to assess impacts from Matimba Power Station and other pollution source emissions in the area.

The Marapong site is equipped for continuous monitoring of ambient concentrations of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), mercury (Hg), carbon monoxide (CO) and fine particulate matter (FPM) of particulate sizes <10µm and <2.5µm in diameter (PM_{10} and $PM_{2.5}$). In addition, meteorological parameters of wind velocity (WVL), wind direction (WDR) and ambient temperature (TMP) were also recorded.

Standard Specifications, Equipment/Techniques used for the measurement of SO_2, O_3 and NO_x conform to US-EPA equivalent method No EQSA-0486-060, EQOA-0880-047 and RFNA-1289-074 respectively. The monitoring site is accredited by the South African National Accreditation System (SANAS). Sampling is carried out in accordance with SANAS TR07-03 and Eskom air quality monitoring guideline, 240-93863318 and the Eskom AQM sampling document, AQM-010-02.

This report has been compiled and submitted in accordance with the Conditional Authorisation issued in respect of The Construction of the Proposed Eskom Holdings Limited: Generation Division 4800MW Medupi Coal-Fired Power Station and Associated Infrastructure near Lephalale (Ref:12/12/20/695), especially in respect of condition 3.2.1 Air Quality Management. The results presented are compared to the National Air Quality Standards, as published in DFFE discussion document, Ref: AQM&CC/24/10/07/4. In addition, this monitoring is undertaken as part of Eskom's Environmental Management Plan and to further validate the CALPUFF dispersion model that was

utilized in the original EIA but was consistently over predicting. The results of the study will be assessed for compliance against the national ambient air quality standards.

2. SITE LOCATION

The monitoring site is located in the Ditheku Primary School in Marapong at co-ordinates: -23.65407, 27.63433 and was commissioned in March 2024 (Figure 1).

Figure 1: Marapong air quality monitoring site in relation to Matimba and Medupi Power Stations and other pollution sources.

3. DATA RECOVERY

The SANAS guideline figure of 90% per parameter monitored is used as a standard for representative data capture. This describes the required completeness of data set for the reporting of averages and is based on standard arithmetic calculations. The completeness calculations for data sets exclude zero and span data and times where service and/or maintenance is being conducted on the instruments in question. The internal temperature of the monitoring hut is controlled by air conditioner and maintained at 25±5°C.

Availability is a management definition related to system reliability. The availability target is not set in terms of data quality criteria and has no associated quality objectives. A target of 100% availability has been set for performance evaluation. Availability is reported as a measure of the percentage of time that electrical power was available to the monitoring station.

Table 1: Percentage Data Recovery for May 2024

Month	NO_1	NO_2	NO_X	O_3	SGT	SO_2	TMP	WDR	WSP	WVL	$PM_{2.5}$	PM_{10}	CO	HG	HUM	Data Rec	Station Avail.
May	72.8	72.8	72.8	96.8	96.9	96.6	96.9	96.9	96.9	96.9	0	0	96.6	0	96.9	76.7	96.9

The average data recovery for the period was 76.7% and the station availability was 96.9%. Ambient $PM_{2.5}$, PM_{10} and Hg are not currently monitored due to shortage of monitoring equipment.

4. SUMMARY OF RESULTS FOR REPORTED PERIOD

Table 2 presents the National Ambient Air Quality Standards and Table 3 is a summary report presenting the highest mean concentrations and the number of exceedances above the respective national air quality standards for each measured parameter.

Table 2: National Ambient Air Quality Standards

Pollutant	Unit	Period	Limit	Number of annual exceedances allowed	Source
Carbon Monoxide	ppm	1hr	26	88	DFFE
Carbon Monoxide	ppm	8hr	8.7	11	DFFE
PM_{10}	$\mu g/m^3$	24hr	75	4	DFFE
PM_{10}	$\mu g/m^3$	1year	40	0	DFFE
$PM_{2.5}$	$\mu g/m^3$	24hr	40	4	DFFE
$PM_{2.5}$	$\mu g/m^3$	1year	20	0	DFFE
Nitrogen dioxide	ppb	1year	21	0	DFFE
Nitrogen dioxide	ppb	1hr	106	88	DFFE
Ozone	ppb	8hr	61	11.	DFFE
Sulphur dioxide	ppb	1hr	134	88	DFFE
Sulphur dioxide	ppb	10min	191	526	DFFE
Sulphur dioxide	ppb	24hr	48	4	DFFE
Sulphur dioxide	ppb	1year	19	0	DFFE

Table 3: Summary report of parameters at Marapong monitoring site for May 2024

Pollutant	Highest Hourly Mean	No of Hourly National Limit Exceedances	Highest Daily Mean	No of Daily National Limit Exceedances	No of 8hr Moving Average Limit	Highest 10min Mean	No of 10min National Limit Exceedances
FPM (PM−2.5) by Beta gauge [ug/m^3]				0			
FPM (PM−10) by Beta gauge [ug/m^3]				0			
Nitric oxide [ppb]	115.5		23.9			187.4	
Nitrogen dioxide [ppb]	56.	0	17.8			77.4	
Nitrogen oxide [ppb]	157.6		35.5			234.6	
Ozone [ppb]	63.5		34.4		0	65.2	
Sigma theta [deg]	59.4		24.9			78.3	
Sulphur dioxide [ppb]	80.1	0	24.1	0		109.6	0
Ambient temperature [deg C]	34.6		23.8			35.5	
Wind speed [m/s]	4.2		1.9			4.7	
Wind velocity [m/s]	4.		1.8			4.5	

There were no exceedances recorded for all parameters monitored during the period under review.

5. METEOROLOGICAL OBSERVATIONS

Figure 2 shows the daytime and night-time wind roses for the reporting period. The centre of the wind rose depicts the position of the air quality monitoring station. The positions of the spokes in the polar diagram represent directions from which the wind was blowing. The length of the segment indicates the percentage of the time the wind blew from that direction and the speed in the various categories are denoted by colours and width.

The dominant wind directions during the daytime were east and east-north-east. During the night, the most frequent directions were south-south-west, south-west and south.

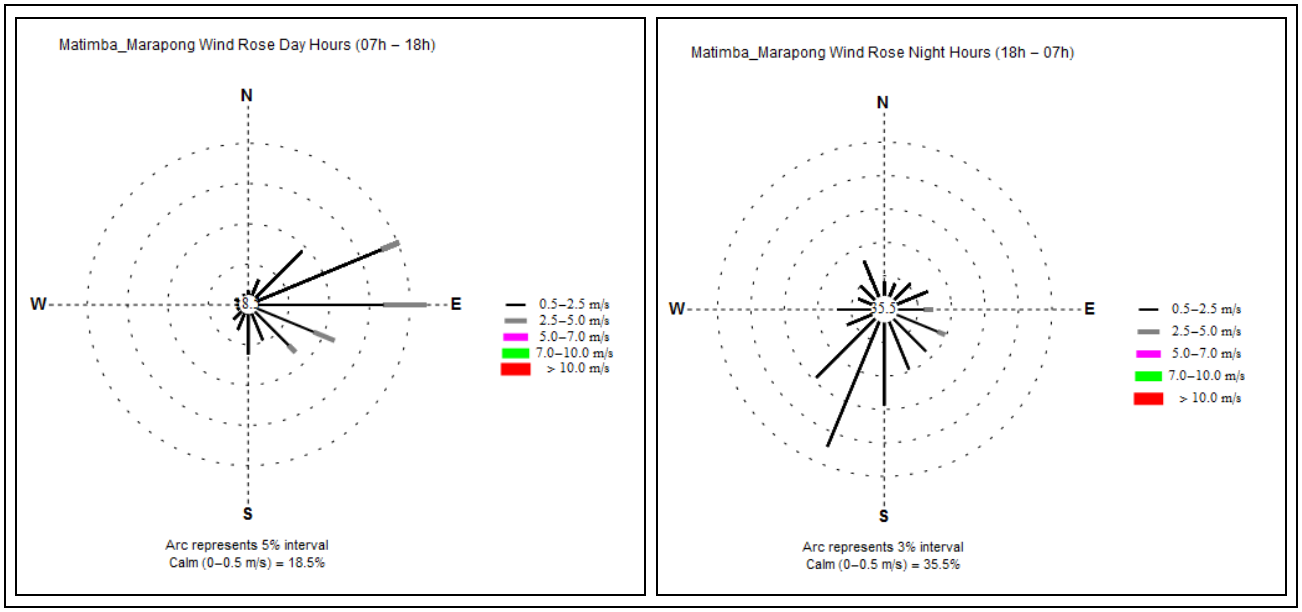

Figure 2: Wind roses at Marapong monitoring site during day and night hours

6. DISCUSSION OF POLLUTANTS

Emissions of primary pollutants such as PM_{10}, $PM_{2.5}$, SO_2 and NO_X from low level sources such as domestic combustion, motor vehicles and smouldering dumps are expected to impact at ground level more significantly during the evening and early morning hours as a result of temperature inversion. Emissions of such pollutants from tall stacks (power stations and other industries), are expected to have more significant impact at ground level during the day, due to atmospheric turbulence influences. O_3 and other oxidants are formed in polluted atmospheres as a result of a rather wide variety of photochemical reactions. A gradual increase of O_3 throughout the day is expected, peaking at mid-afternoon and then decaying once more during the night.

6.1. FINE PARTICULATE MATTER (PM_{10})

There were no data recorded for ambient PM_{10} since the analyser is faulty and was taken out for repairs.

6.2. FINE PARTICULATE MATTER ($PM_{2.5}$)

There were no data recorded for ambient $PM_{2.5}$ since the analyser is faulty and was taken out for repairs.

6.3 CARBON MONOXIDE (CO)

6.3.1. Source identification by CO diurnal variations

Figure 3 shows the CO hourly mean diurnal variation. Ambient CO levels are generally low in the morning with a minor peak recorded at 08:00 in the morning, remained low during the day and elevated from 18:00 in the afternoon until recording a maximum peak at 21:00 in the evening and drops to background levels throughout the night. These elevations could be attributed to emissions from low level sources such as domestic combustion and space heating and vehicle emissions during morning and evening commuting of workers to/from work.

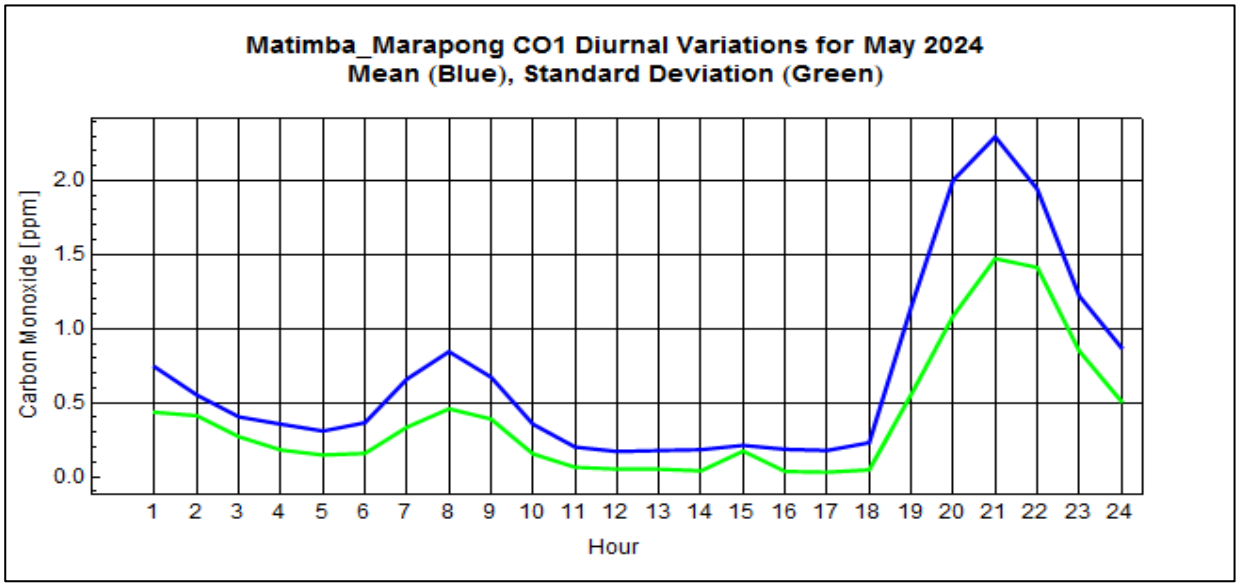

Figure 3: Diurnal variation by CO (Mean concentrations = Blue line, Standard Deviation = Green line)

The national ambient air quality hourly mean CO limit of 26 ppm was not exceeded during the period under review as shown in Figure 4 below.

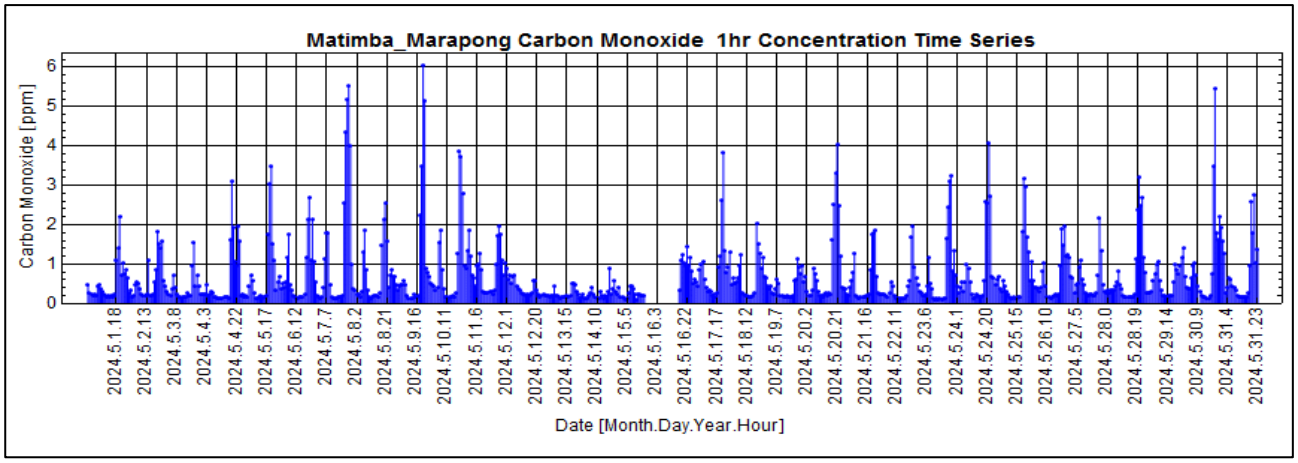

Figure 4: CO hourly Concentrations Time Series

6.3.2 CO hourly mean event roses and tables.

The daytime and night-time event roses are presented in Figure 5 to indicate the wind directions from which the highest concentrations are derived.

The most dominant hourly mean concentrations above 1.77 ppm (98th percentile value) at Marapong monitoring site during the daytime period were recorded from east-north-east, north-north-west, north-east, south-south-west and west-north-west sectors. The most dominant night-time concentrations above 4.04 ppm (98th percentile value) were recorded from north, north-east, south, south-west and west sectors. Ambient CO concentrations measured at the monitoring station could be due to emissions from different sources such as veld fires, back-up power generators, lawn mowers, leaf blowers, undiluted car exhausts without catalytic converters, combustion of fossil fuels. Other sources of CO could be from combustion of fuels such as natural gas, fuel oils from local industries and coal, wood, charcoal burning and also waste burning from Marapong Township.

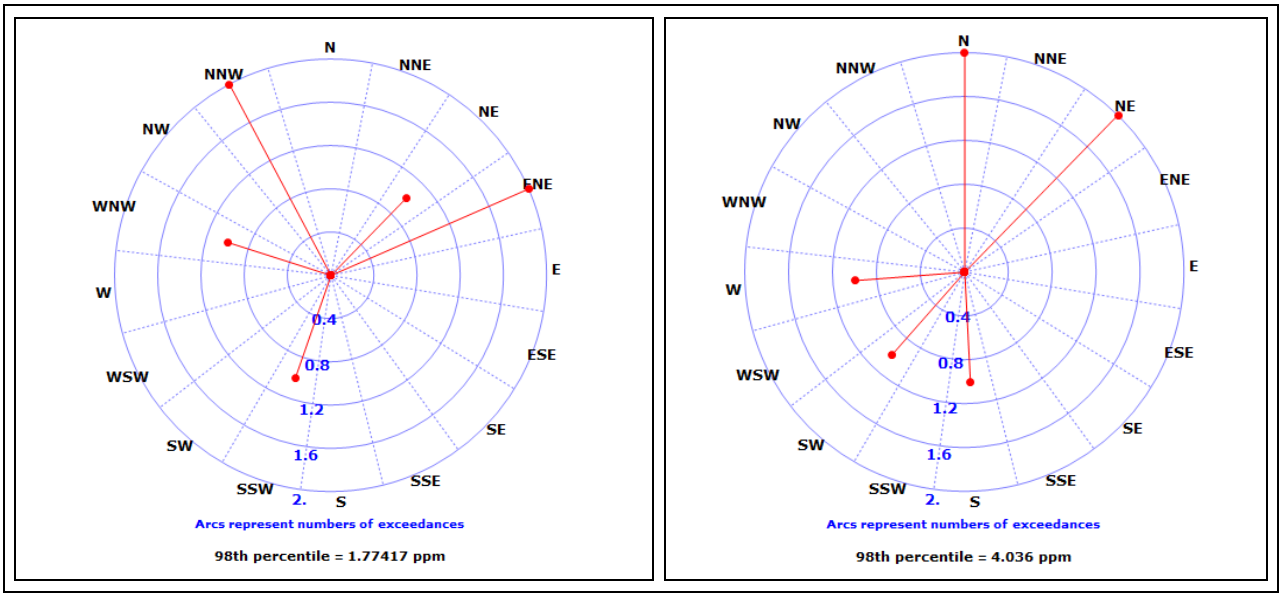

Figure 5: CO hourly mean 98th percentile event roses. Left - daytime (06:00 -18:00) and right – night-time (18:01- 05:59)

Table 4: CO daytime hourly mean 98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve.	0	0	1	2	0	0	0	0	0	1	0	0	0	1	0	2
%	0	0	14.29	28.57	0	0	0	0	0	14.29	0	0	0	14.29	0	28.57

Table 5: CO night-time hourly mean 98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve.	2	0	2	0	0	0	0	0	1	0	1	0	1	0	0	0
%	28.57	0	28.57	0	0	0	0	0	14.29	0	14.29	0	14.29	0	0	0

6.4. SULPHUR DIOXIDE (SO_2)

6.4.1 Source identification by SO_2 diurnal variations

Figure 6 shows the SO_2 hourly mean diurnal variation. The graph shows that SO_2 levels are low in the morning, start rising at 12:00 in the afternoon, peaking at 14:00 in the afternoon which indicates an influence from high stack emitters and other industries. The concentrations remained elevated throughout the afternoon and the evening, also indicating influence of emissions from low level sources in the area.

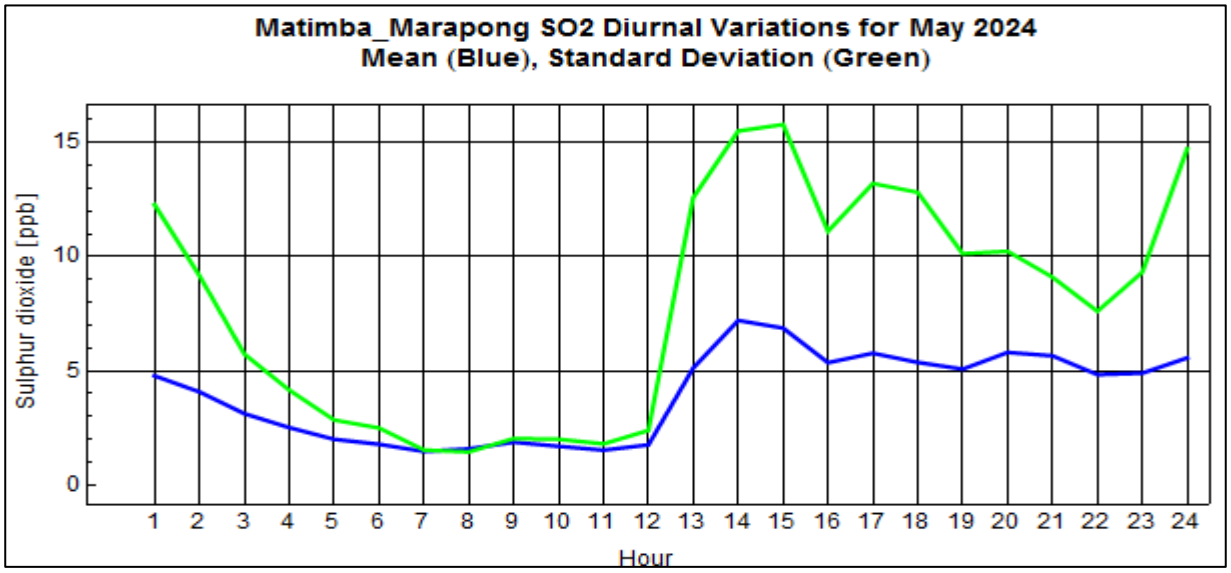

Figure 6: SO_2 diurnal variations (Mean concentrations = Blue line, Standard Deviation = Green line).

6.4.2 SO_2 hourly mean event roses and tables.

The daytime exceedance and night-time event roses are presented in Figure 7 to indicate the wind directions from which the highest concentrations are derived.

The most dominant daytime concentrations above 47.50 ppb (98th percentile value) were recorded in the north-north-east, east-north-east, south-east, south-south-east and north-east sectors. The most dominant night-time concentrations above 33.75 ppb (98th percentile value) were recorded in the west, west-north-west, north-west, north-north-west, north and west-south-west sectors.

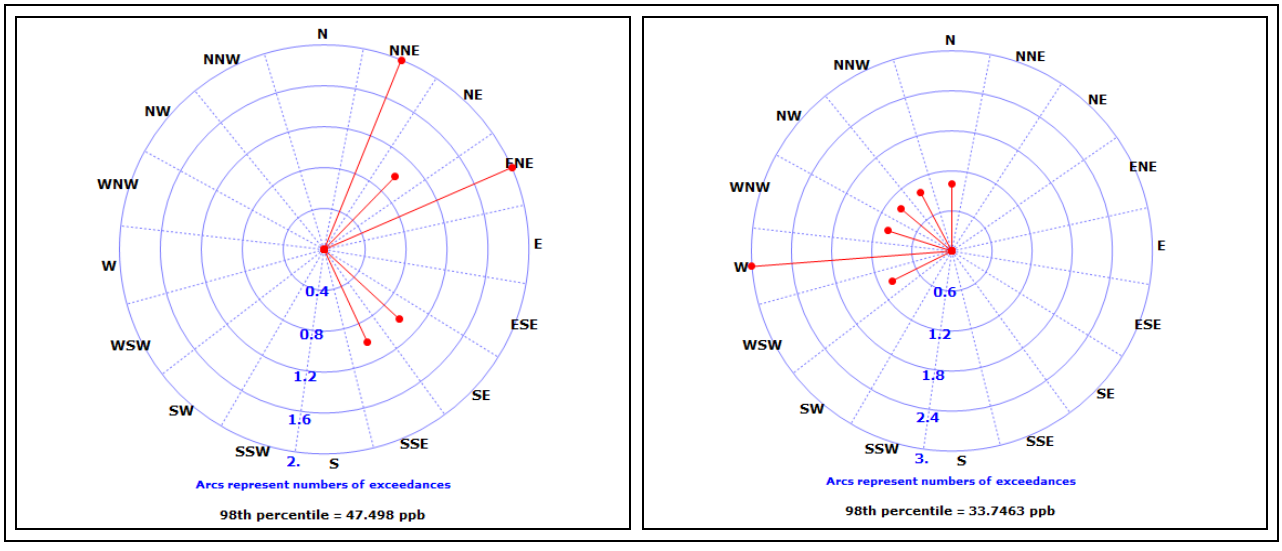

Figure 7: SO_2 daytime hourly mean exceedance and night-time hourly mean 98th percentile event roses. Left - daytime (06:00-18:00) and right – night-time (18:01-05:59)

Table 6: SO_2 daytime hourly mean 98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve.	0	2	1	2	0	0	1	1	0	0	0	0	0	0	0	0
%	0	28.57	14.29	28.57	0	0	14.29	14.29	0	0	0	0	0	0	0	0

Table 7: SO_2 night-time hourly mean 98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve.	1	0	0	0	0	0	0	0	0	0	0	1	3	1	1	1
%	12.5	0	0	0	0	0	0	0	0	0	0	12.5	37.5	12.5	12.5	12.5

6.5. NITROGEN DIOXIDE (NO_2)

6.5.1 Source identification by NO_2 diurnal variations

Figure 8 below shows the NO_2 hourly mean diurnal variation. The graph shows concentration peaks recorded at 08:00 in the morning and between 20:00 and 21:00 the evening which are indicative of contribution of emissions from low level sources on the ambient NO_2 concentrations, such as early morning and evening emissions from vehicles transporting workers from/to Marapong Township to/from Medupi, Matimba power stations, Grootegeluk coal mine and other industries in the area. The NO_2 concentrations are low throughout the afternoon as a result of absence or minimal number of vehicles and domestic burning activities in the Marapong community at those times.

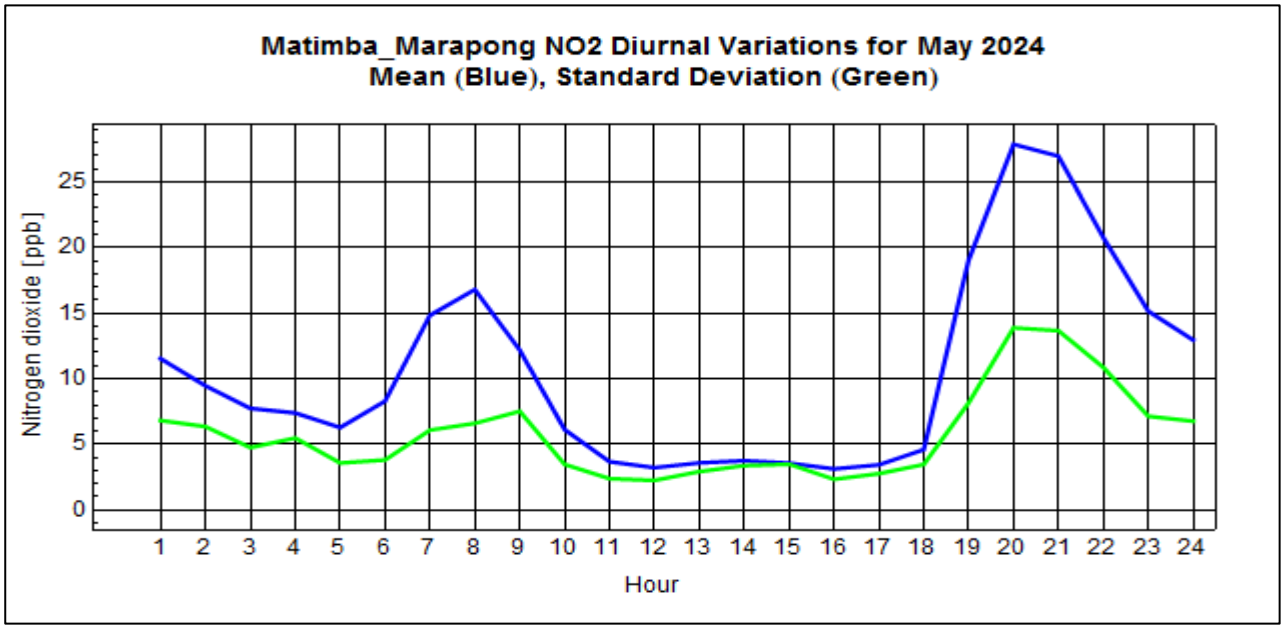

Figure 8: NO_2 diurnal variations (Mean concentrations = Blue line, Standard Deviation = Green line).

6.5.2. NO_2 hourly mean event roses and tables.

The daytime and night-time event roses are presented in Figure 9 to indicate the wind directions from which the highest concentrations are derived.

The most dominant daytime concentrations above 27.75 ppb (98th percentile value) were from north-north-west, north-east, east-north-east and west sectors. The most dominant night-time concentrations above 44.60 ppb (98th percentile value) were recorded from north, north-west and north-north-west sectors.

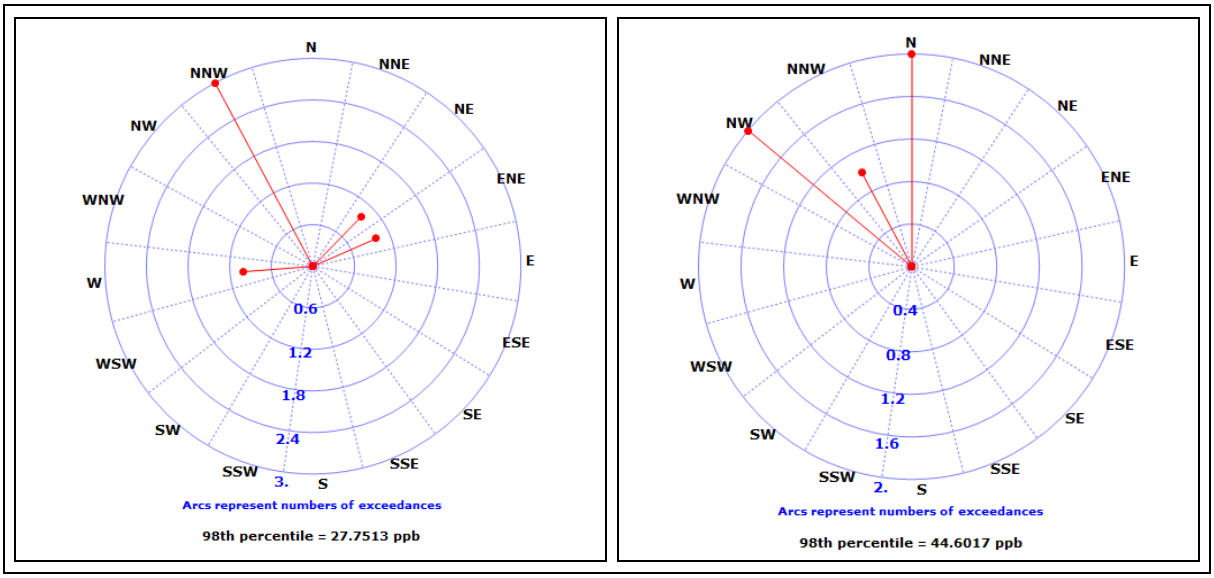

Figure 9: NO_2 hourly mean 98th percentile event roses. Left - daytime (06:00-18:00) and Right - night-time (18:01-05:59)

Table 8: NO_2 day-time hourly mean 98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve.	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	3
%	0	0	16.67	16.67	0	0	0	0	0	0	0	0	16.67	0	0	50

Table 9: NO_2 night-time hourly mean 98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
%	40	0	0	0	0	0	0	0	0	0	0	0	0	0	40	20

6.6. OZONE (O_3)

6.6.1. Source identification by O_3 diurnal variations

Figure 10 below shows the O_3 hourly mean diurnal variation. The highest O_3 concentration levels are recorded during late in the afternoon and the low concentration levels in the morning and night. The concentrations increase from 08:00 in the morning as a result of photochemical reactions until reaching maximum peak between 16:00 and 18:00 in the afternoon before dropping to background levels for the rest of the evening due to lack of sunlight which is required for the O_3 formation.

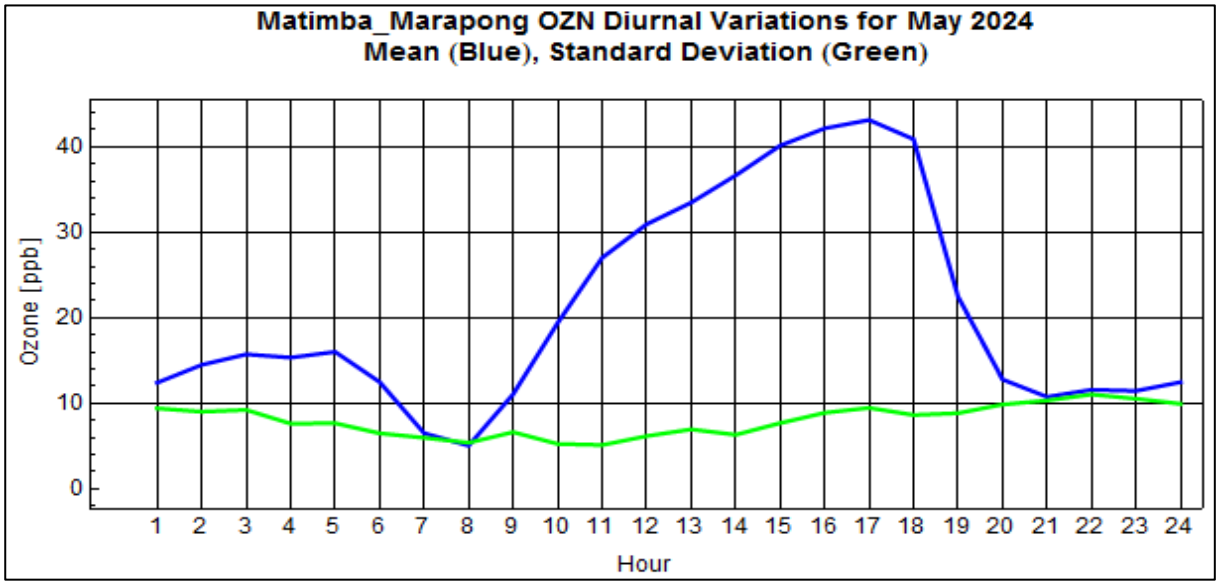

Figure 10: O_3 diurnal variations (Mean concentrations = Blue line, Standard Deviation = Green line).

6.6.2. O_3 hourly mean event roses and tables

The daytime and night-time event roses are presented in Figure 11 to indicate the wind directions from which the highest concentrations are derived. The most dominant daytime concentrations above 59.03 ppb (98th percentile value) were recorded from east-north-east, east, south-east, north-east and east-south-east sectors. The most dominant night-time concentrations above 35.19 ppb (98th percentile value) were recorded from east, east-south-east, south and east-north-east sectors.

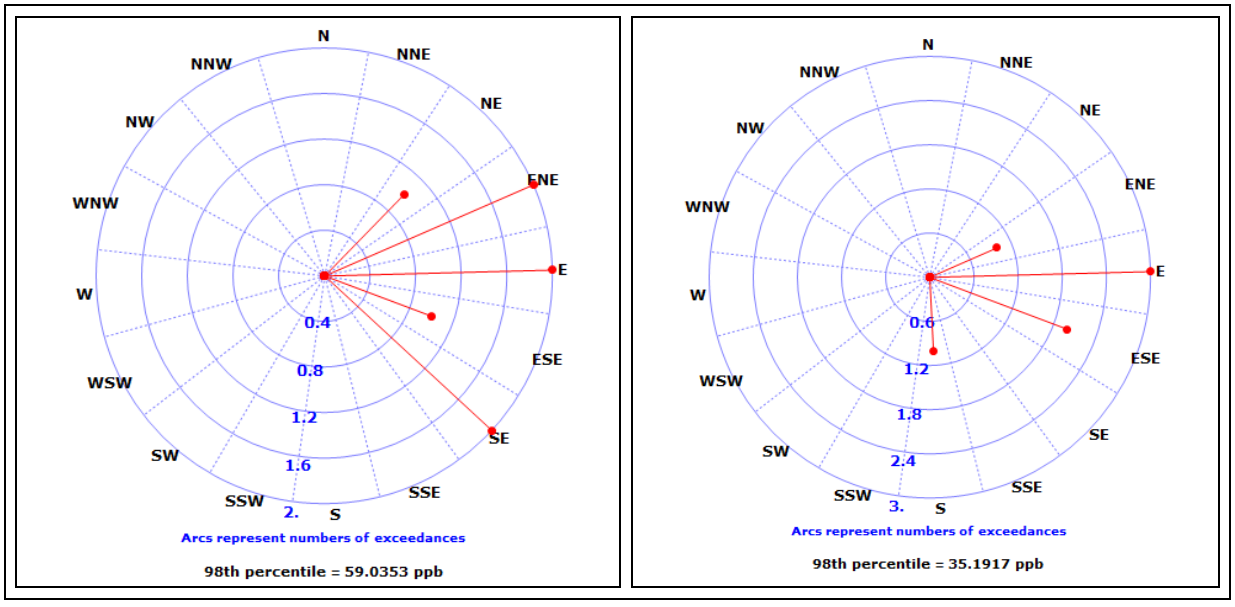

Figure 11: O_3 hourly mean 98th percentile event roses. Left - daytime (06:00-18:00) and right – night-time (18:01-05:59)

Table 10: O_3 daytime hourly mean 98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve.	0	0	1	2	2	1	2	0	0	0	0	0	0	0	0	0
%	0	0	12.5	25	25	12.5	25	0	0	0	0	0	0	0	0	0

Table 11: O_3 night-time hourly mean 98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve.	0	0	0	1	3	2	0	0	1	0	0	0	0	0	0	0
%	0	0	0	14.29	42.86	28.57	0	0	14.29	0	0	0	0	0	0	0

6.6.3. O_3 8-hourly moving average

There were no exceedances of the ozone 8-hourly moving average limit of 61 ppb recorded during the May 2024 monitoring period.

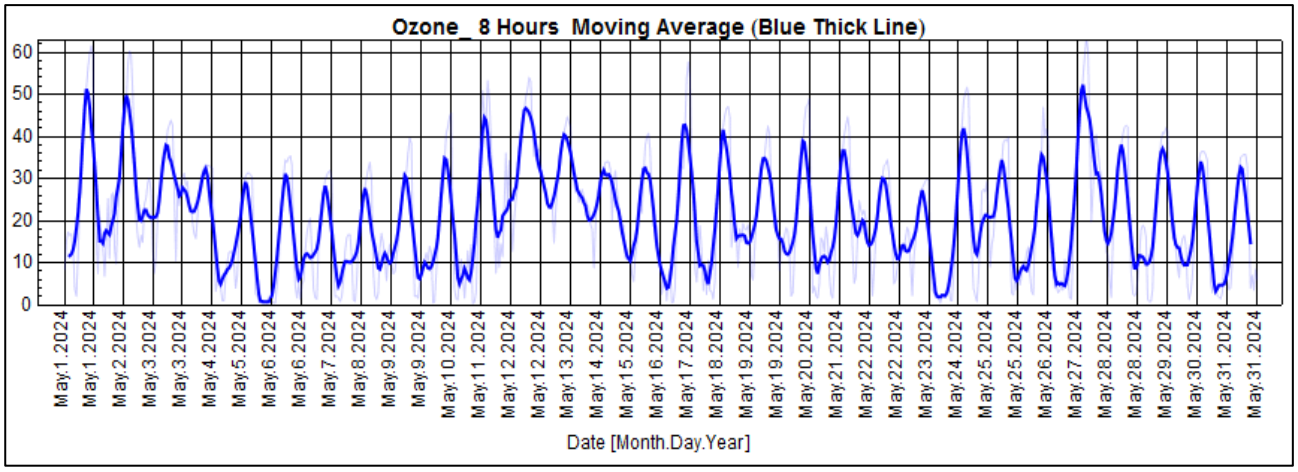

Figure 12: O_3 8-hourly moving average

6.7. MERCURY (Hg)

There were no data recorded for ambient Hg since the analyser is faulty and was taken out for repairs.

7. HISTORICAL CONCENTRATIONS

7.1. RECENT TRENDS

Time series graphs for each pollutant with respect to the National Ambient Air Quality Standards are represented from the beginning of the previous year until beginning of the current reporting period or since inception of the monitors. There are no time series graphs for the period of 2023/2024 since the monitoring site was offline for a longer period after multiple incidents of theft and vandalism. The site was switched off in October 2022 and became available for monitoring late in March 2024.

7.2. MONTHLY MEANS FOR THE CURRENT CALENDAR YEAR 2024

Table 12: Monthly Means Averages for current year 2024.

Parameter measured	Mar	Apr	May
$PM_{2.5}$ (µg/m^3)	ND	ND	ND
PM_{10} (µg/m^3)	ND	ND	ND
CO (ppm)	0.2	0.3	0.7
NO2 (ppb)	5	3.6	10.5
O_3 (ppb)	25.8	20.2	21
SO_2 (ppb)	2.7	5.6	4

ND – No Data recorded.

7.3. NUMBER OF EXCEEDANCES OF NATIONAL AIR QUALITY LIMITS

Table 13: Number of exceedances of the National Ambient Air Quality Limits

Months	SO_2 10-minute	SO_2 hourly	SO_2 daily	NO_2 hourly	PM_{10} daily	$PM_{2.5}$ daily	CO hourly	O_3 8-hourly
Mar 2024	0	0	0	0	ND	ND	ND	0
Apr 2024	2	0	1	0	ND	ND	0	0
May 2024	0	0	0	0	ND	ND	0	0
Total No. of Exceedances	**2**	**0**	**1**	**0**	**ND**	**ND**	**0**	**0**
Allowed no of exceedances	526	88	4	88	4	4	88	11

ND = No Data

8. CONCLUSIONS

Ambient CO and NO_2 concentrations at Marapong monitoring site show influence of emissions from low level sources in the area while ambient SO_2 concentrations show influence of emissions from low level sources, tall stack emitters and other industries.

Report Compiled by:
Abram Segopa

Reviewed and Authorised by: Date of Issue: 12 Jun 2024

Bontle Moiloa
Air Quality, Climate Change & Ecosystem Management CoE
Research, Testing and Development (RT&D)

9. ABBREVIATIONS

DFFE	Department of Forestry, Fisheries and the Environment
FPM	Fine particulate matter
HG	Mercury
HUM	Humidity
NO_1	Nitric oxide
NO_2	Nitrogen dioxide
NO_X	Oxides of nitrogen
OZN / O_3	Ozone
CO	Carbon monoxide
SGT	Sigma theta
TMP	Ambient temperature
WDR	Wind direction from true North
WSP	Wind speed
WVL	Wind velocity
N	North
NNE	North-north-east
NE	North-east
ENE	East-north-east
E	East
ESE	East-south-east
SE	South-east
SSE	South-south-east
S	South
SSW	South-south-west
SW	South-west
WSW	West-south-west
W	West
WNW	West-north-west
NW	North-west
NNW	North-north-west
deg	Degree
deg C	Degree Celsius
$\mu g/m^3$	Microgram per cubic meter
m/s	Meters per second
$PM_{2.5}$	Particulate matter < 2.5 microns in diameter
PM_{10}	Particulate matter < 10 microns in diameter
ppb	Parts per billion
ppm	Parts per million
MWP	Megawatt Park
RT&D	Research Testing and Development

10. DISTRIBUTION LIST

Eskom Environmental Management Attention: Thabo Khoza	Medupi Power Station
Eskom Environmental Management Attention: Matlaleng Mamabolo	Matimba Power Station
Eskom Environmental Management Attention: Mokgadi Dikgale	Medupi Power Station
Eskom Environmental Management Attention: Helry Ramahlare	Matimba Power Station
Eskom Environmental Management Attention: Sakutanya Mamabolo	Matimba Power Station
CORPORATE SPECIALIST: ENVIRONMENTAL Attention: Dave Lucas Corporate Specialist	MWP
MANAGER: ENVIRONMENTAL MANAGEMENT Attention: Bryan McCourt Manager Air Quality CoE	MWP
Project File: Abram Segopa Senior Technician	RT&D