RESEARCH, TESTING and DEVELOPMENT

SUSTAINABILITY DEPARTMENT

MEDUPI AIR QUALITY MONTHLY REPORT

MARCH 2024

EXECUTIVE SUMMARY

This monthly report covers the ambient air quality data as monitored at the Medupi monitoring site for the period of March 2024.

There were no exceedances of the national ambient air quality limits recorded for all the parameters monitored during March 2024.

Ambient CO concentrations were contributed to by emissions from low level sources and other industrial activities taking place around the monitoring station. Ambient SO_2 concentrations were contributed to by emissions from tall stack emitters (probably power stations).

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

The overall percentage data recovered from the monitoring station during the reporting period was 60.4% and the overall monitoring station availability was 83.9%.

DISCLAIMER

1. INTRODUCTION

At the request of Environmental Management, Research, Testing and Development (RT&D) commissioned an ambient air quality monitoring site at Kroomdraai farm to assess background conditions of ambient air quality prior to the commissioning of Medupi Power Station and the impacts thereof on the environment on the Waterberg area after the units are online. The results of the monitoring will be assessed for compliance against the national ambient air quality standards.

The Medupi site is equipped for continuous monitoring of ambient concentrations of sulphur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), fine particulate matter of sizes <10µm and <2.5 in diameter (PM_{10} and $PM_{2.5}$). In addition, meteorological parameters of wind velocity (WVL), wind direction (WDR), ambient temperature (TMP), pressure (PRS), radiation (RAD) and rainfall (RFL) are 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.

2. SITE LOCATION

The Medupi monitoring site was commissioned at Kroomdraai farm at co-ordinates: Lat.: -23.738516° and Lon: - 27.540348° in October 2014 (Figure 1).

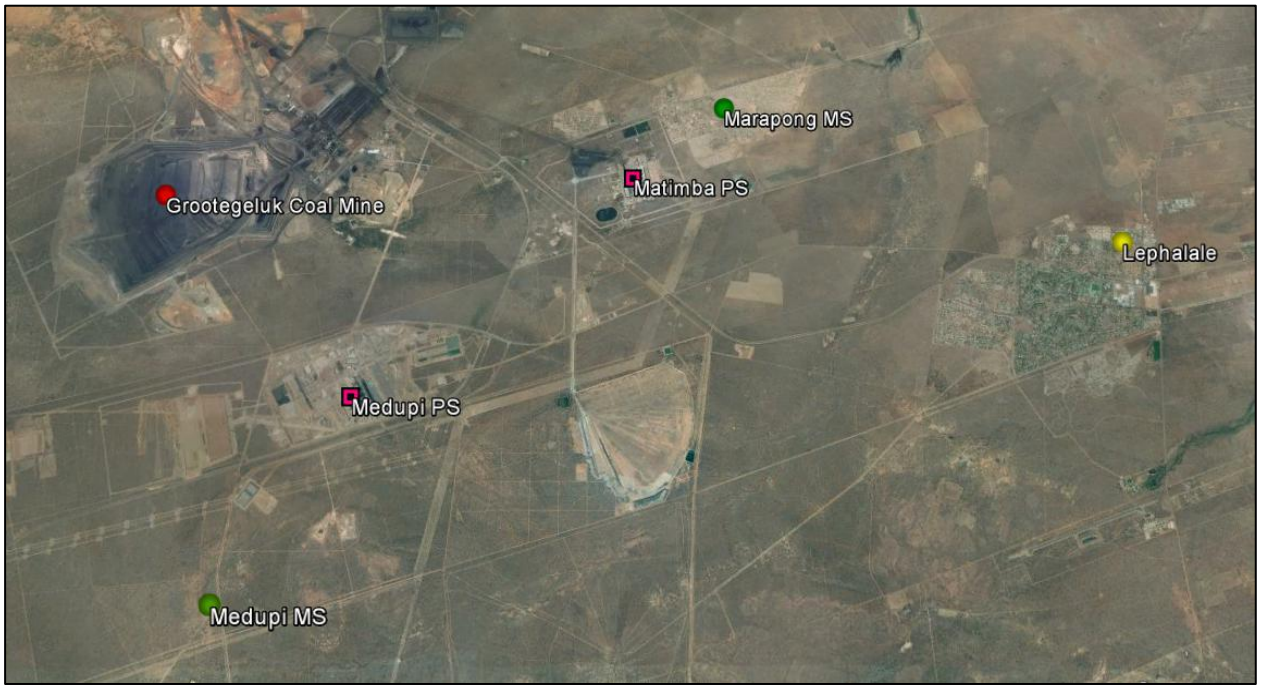


Figure 1: Medupi air quality monitoring site in relation to Matimba and Medupi power stations and other air pollution sources.

3. DATA RECOVERY

The SANAS guideline figure of 90% data recovery 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 an air conditioner and maintained at 25±5°C.

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 site. Table 1 shows the percentage data recovered, for each pollutant monitored during the reporting period.

Table 1: Percentage data recovered per parameter for March 2024.

NO	NO_2	NO_X	O_3	PRS	RAD	RFL	SO_2	TMP	WDR	WSP	WVL	$PM_{2.5}$	PM_{10}	CO	HUM	Data Rec	Station Avail
0	0	0	81.3	100	100	100	61.3	100	100	100	100	0	0	23.5	100	60.4	83.9

The overall percentage data recovered from the monitoring station during the reporting period was 60.4% and the overall monitoring station availability was 83.9%. The $PM_{2.5}$ has been removed from site since it showed errors on the data. The PM_{10} filter tape is finished, and the analyser has been switched off. The NOx analyser was affected by power outages and has been remove form site. Ambient SO_2 and CO data is low, since both the analysers were affected by power outages.

4. SUMMARY OF RESULTS FOR REPORTED PERIOD

Table 2 presents National Ambient Air Quality Standards and Table 3 is a summary report presenting highest mean concentrations and the number of exceedances above the respective national air quality standards during the month of March 2024.

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}) by Beta gauge	$\mu g/m^3$	24hr	75	4	DFFE
(PM_{10}) by Beta gauge	$\mu g/m^3$	1year	40	0	DFFE
($PM_{2.5}$) by Beta gauge	$\mu g/m^3$	24hr	40	4	DFFE
($PM_{2.5}$) by Beta gauge	$\mu g/m^3$	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 monitored at Medupi site for March 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
$PM_{2.5}$ ($\mu g/m^3$)	ND		ND	ND		ND	
PM_{10} ($\mu g/m^3$)	ND		ND	ND		ND	
Nitric oxide (ppb)	ND		ND	ND		ND	
Nitrogen dioxide (ppb)	ND		ND			ND	
Nitrogen oxide (ppb)	ND		ND			ND	
Ozone (ppb)	56.8		34.6		0	57.9	
Sulphur dioxide (ppb)	129	0	31.5	0		178.9	0
Ambient temperature (^0C)	40.5		29.8			41.5	
Wind speed (m/s)	5.3		2.7			9.4	
Wind velocity (m/s)	4.3		2.5			9.1	

ND = no data recorded

There were no exceedances of the national ambient air quality limits recorded for all the parameters monitored during March 2024.

5. METEOROLOGICAL OBSERVATIONS

Figure 2 shows the daytime and night-time wind roses for the monitoring 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 north-east, east-north-east and east. During the night, the most frequent directions were north-east, east-north-east and east. Winds from all other directions were infrequent during day and night and wind speed remained low.

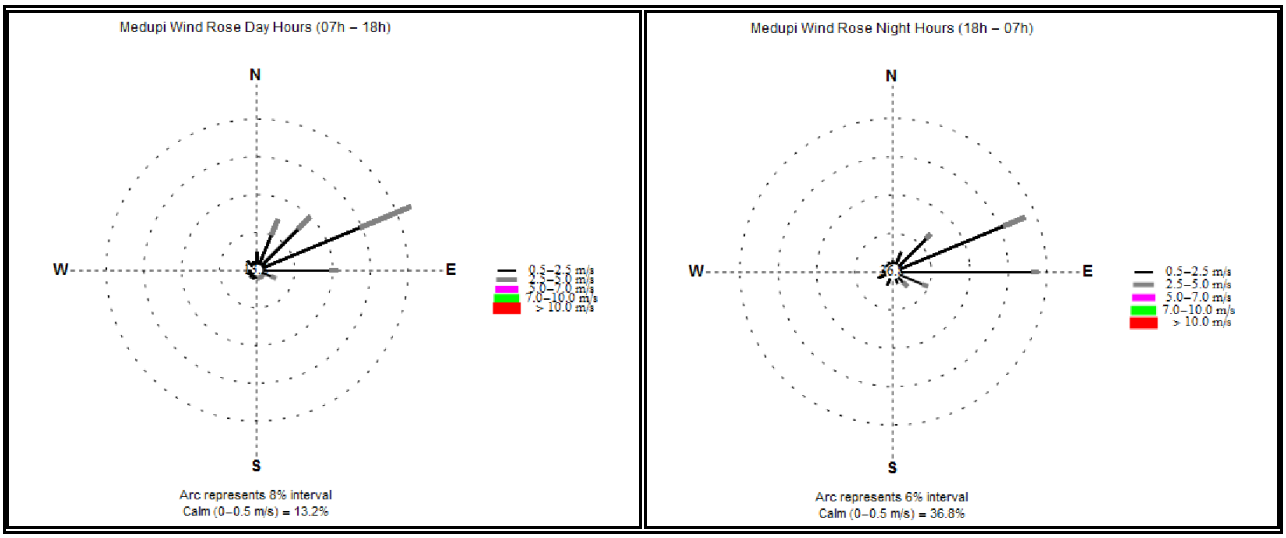


Figure 2: Wind roses during day and night times at Medupi monitoring site.

6. DISCUSSION OF POLLUTANTS

Emissions of primary pollutants such as PM_{10}, $PM_{2.5}$, SO_2, NO_X and CO from low level sources such as domestic combustion, motor vehicles around Kroomdraai farm and smouldering coal dumps at the Grootegeluk coal mine 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 instrument has been switched off because of finished filter tape.

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

There were no data recorded for ambient $PM_{2.5}$ since the data showed errors and were deleted.

6.3. SULPHUR DIOXIDE (SO_2)

6.3.1. Source identification by SO_2 diurnal variation

The SO_2 hourly mean diurnal variation is presented in Figure 3. The concentrations were low in the morning and show an increase from 08:00, with recorded peaks between 13:00 and 14:00 afternoon. The concentrations then decline throughout the day and remained low throughout the night. Ambient SO_2 concentrations were influenced by emissions from industrial activities taking place during the day and tall stack emitters (probably power stations).

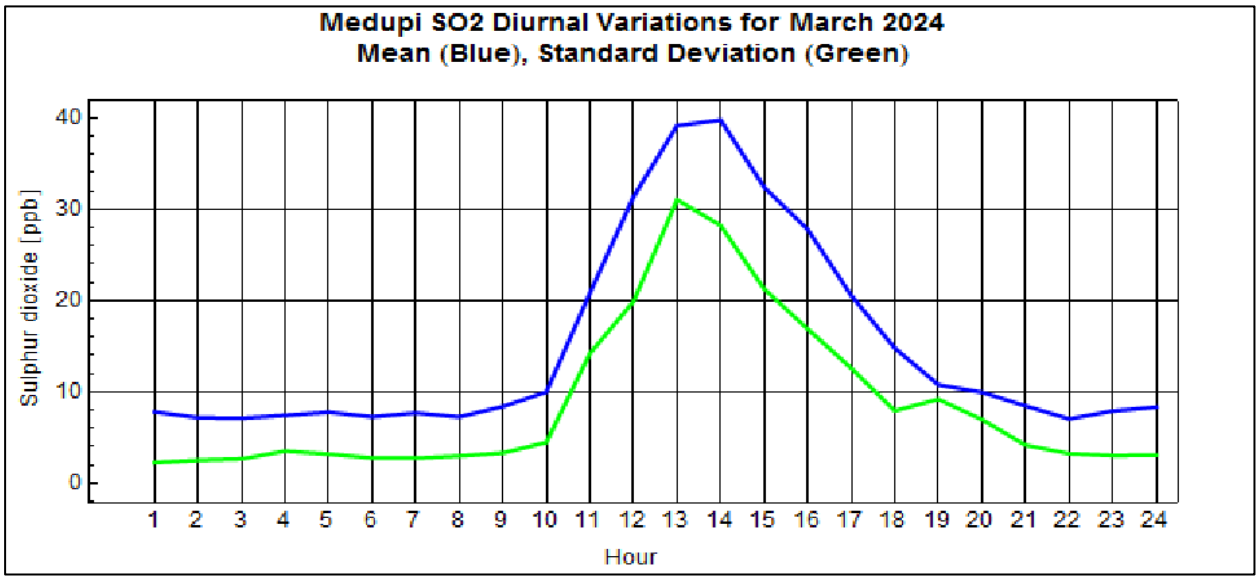


Figure 3: SO_2 diurnal variations (Mean concentrations = Blue line, Standard Deviation = Green line).

6.3.2. SO_2 hourly mean roses and tables.

The daytime exceedance and night-time 98th percentile event roses are presented in Figure 4 to identify the wind sectors from which the highest concentrations are derived. Care should be taken when interpreting the data since the percentage data recovery for SO_2 during the monitoring period was below the SANAS and DFFE reporting guidelines.

The day-time hurly mean concentration above 79.78 ppb (98th percentile value) were recorded from north-north-east and north-east sectors. Medupi Power Station is located in the north-north-east sectors and Matimba Power Station in the north-east sectors of the monitoring station.

The night-time hourly mean concentrations above 14.55 ppb (98th percentile value) were recorded from north, east-north-east, east and south-south-west sectors. The SO_2 ambient concentrations monitored at the site could be due to emissions from domestic combustion and motor vehicles around the monitoring site.

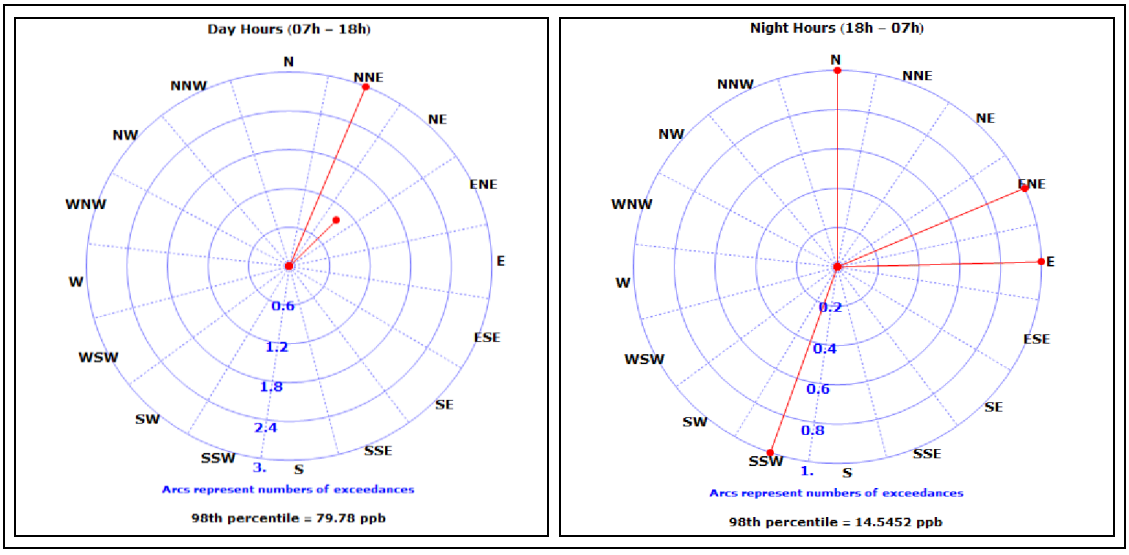


Figure 4: SO_2 hourly mean daytime and night-time 98th percentile event roses.

Table 4: SO_2 daytime hourly mean98th percentile event table

Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Exe.	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
%	0	75	25	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5: 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	1	1	0	0	0	0	1	0	0	0	0	0	0
%	25	0	0	25	25	0	0	0	0	25	0	0	0	0	0	0

6.4. NITROGEN DIOXIDE (NO_2)

There were no data recorded for ambient NO_2 since the analyser was affected by power outages and was removed for repairs.

6.5 CARBON MONOXIDE (CO)

6.5.1 Source identification by CO diurnal variations

Figure 5 shows the CO hourly mean diurnal variation. The CO concentrations were high in the morning, low in the afternoon and high in the evening. Emissions from low level sources might be contributing to the ambient CO concentrations with elevated levels recorded in the morning and in the evening.

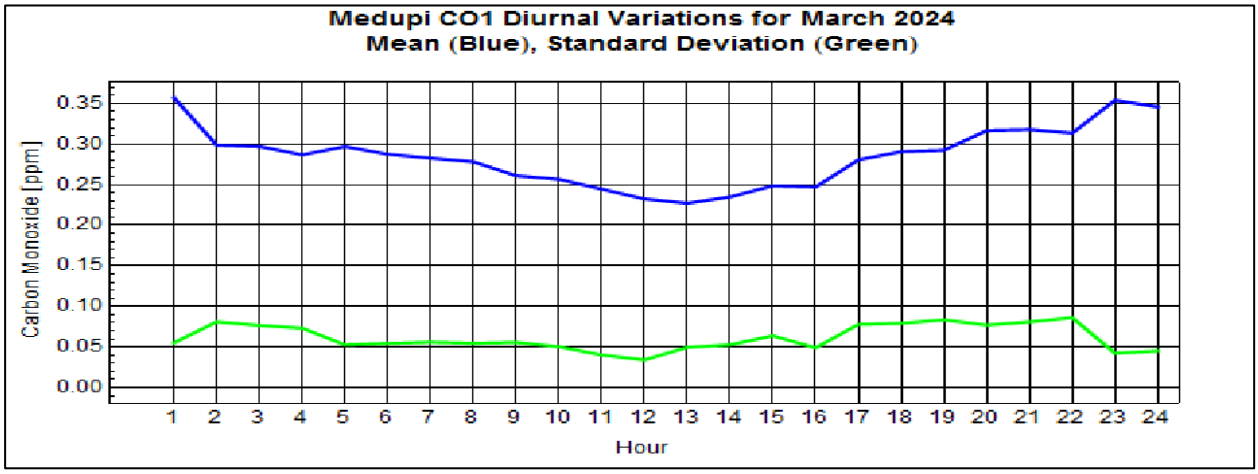


Figure 5: Diurnal variation by CO (Mean concentrations = Blue line, Standard Deviation = Green line)

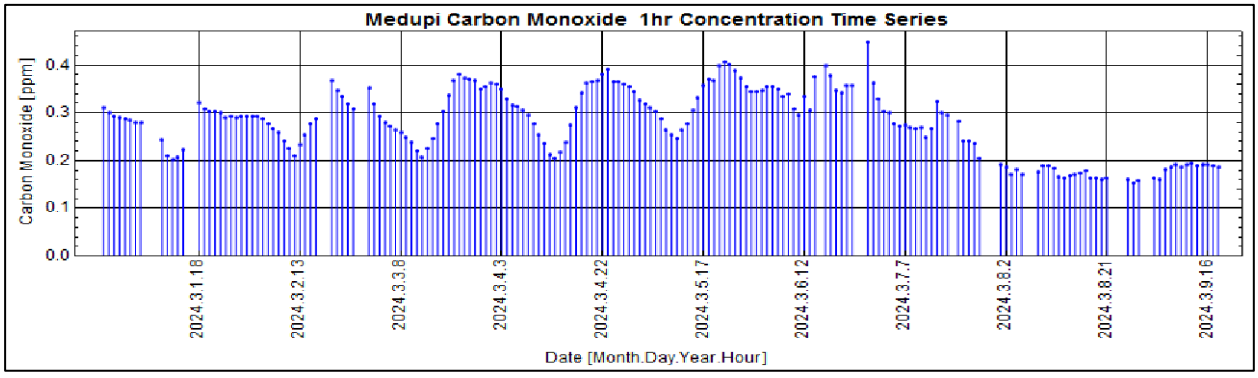


Figure 6: CO hourly Concentrations Time Series

6.5.2 CO hourly mean event roses and tables.

The daytime and night-time event roses are presented in Figure 7 to indicate the wind directions from which the highest CO concentrations are derived. It should be noted that the percentage data recovered for the ambient CO was too low (23.5%), and therefore no conclusive conclusion can be made.

The most dominant hourly mean concentrations above 0.38 ppm (98th percentile value) at Medupi monitoring site during the daytime period were recorded from north sector.

The most dominant night-time concentrations above 0.41 ppm (98th percentile value) were recorded from north-east sector.

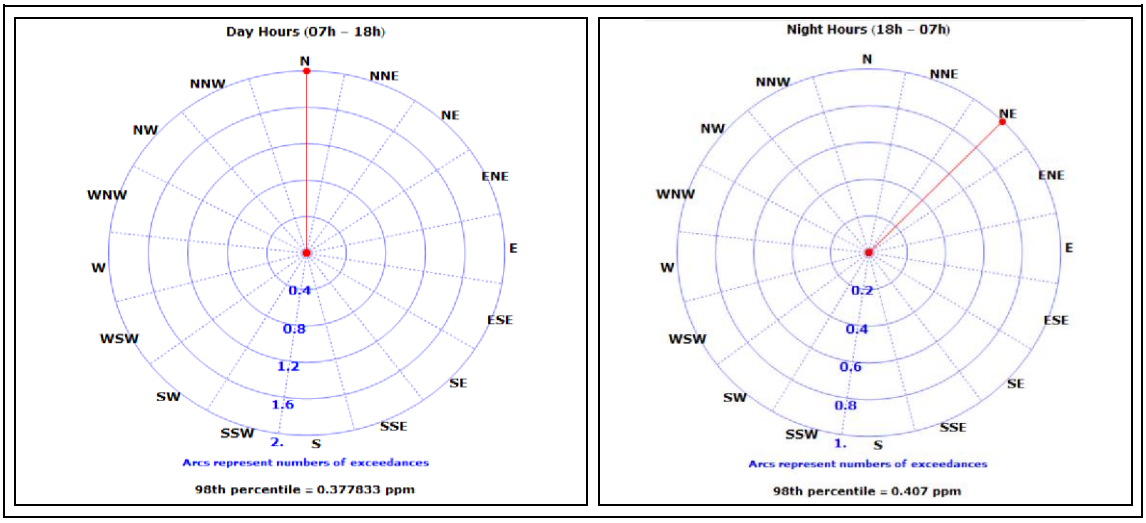


Figure 7: CO hourly mean day and night-time 98th percentile event roses.

Table 6: 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.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
%	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7: 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.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
%	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0

6.6 OZONE (O_3)

6.6.1. Source identification by O_3 diurnal variations.

Figure 8 shows the O_3 hourly mean diurnal variation. There is a gradual increase of O_3 concentrations from 08:00 in the morning and throughout the day as a result of photochemical reactions taking place during the day, peaking at 18:00 in the afternoon, before decaying rapidly due to lack of sunlight at night-time.

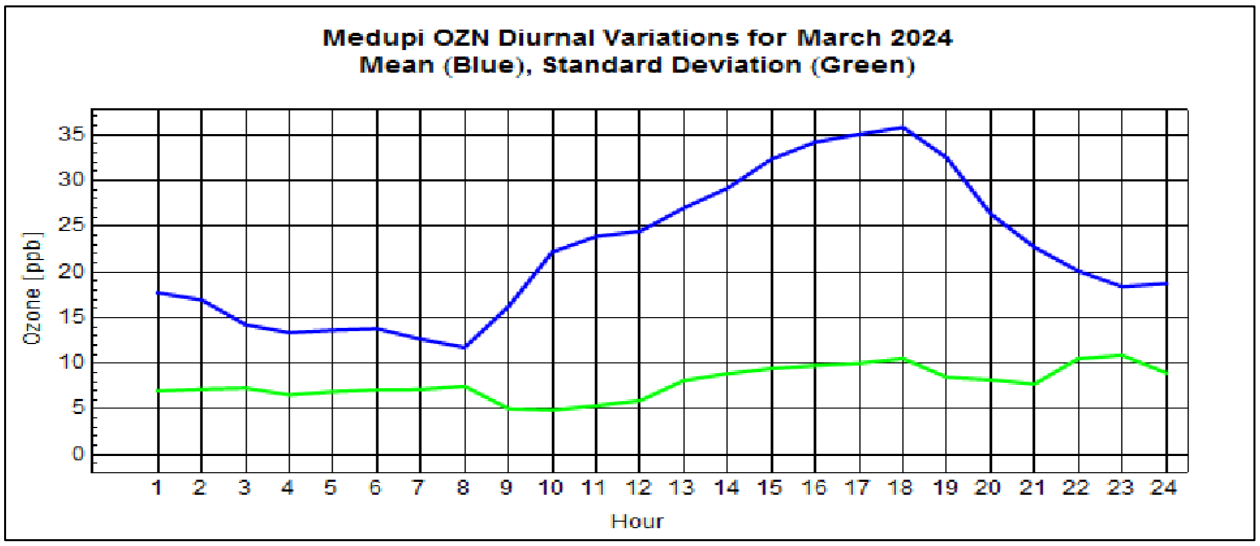


Figure 8: O_3 diurnal variations (Mean concentrations = Blue line, Standard Deviation = Green line).

6.6.2. O_3 hourly mean 98th percentile event roses and tables.

The 98th percentile 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 53.56 ppb (98th percentile value) were from the north, north-north-east, east-south-east, south-west and west-south-west sectors. The most dominant night-time concentrations above 36.46 ppb (98th percentile value) were recorded from the east-north-east, east-south-east, south-east and west-south-west sectors.

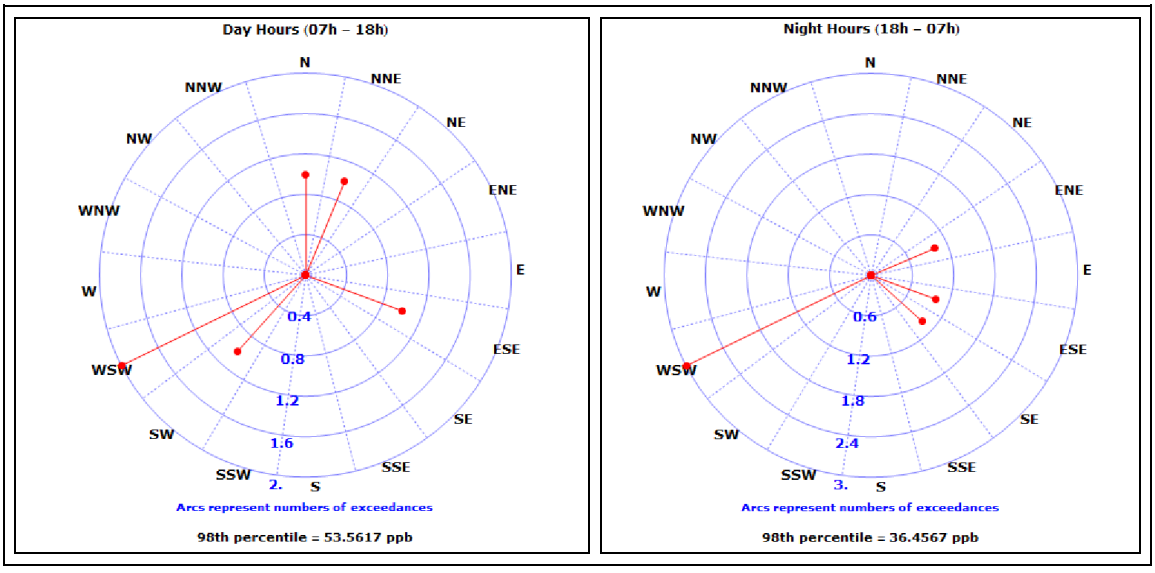


Figure 9: O_3 hourly mean sector 98th percentile event roses.

Table 8: 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.	1	1	0	0	0	1	0	0	0	0	1	2	0	0	0	0
%	16.67	16.67	0	0	0	16.67	0	0	0	0	16.67	33.33	0	0	0	0

Table 9: 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	0	1	1	0	0	0	0	3	0	0	0	0
%	0	0	0	16.67	0	16.67	16.67	0	0	0	0	50	0	0	0	0

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

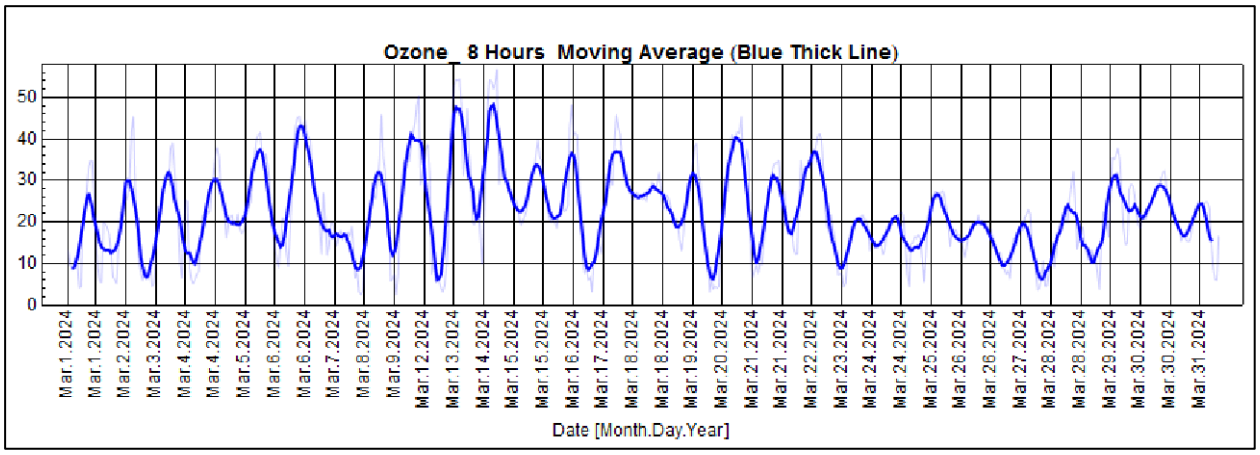


Figure 10: Ozone 8-hourly moving average concentrations for March 2024

7. HISTORICAL CONCENTRATIONS

7.1. RECENT TRENDS

Time series graphs (Figures 11 – 16) for each pollutant with respect to the National Ambient Air Quality Standard are presented from the beginning of the previous year until the end of the current reporting period or since inception of the monitors. The resultant period may vary for each analyser, depending on when it was installed.

There are no distinct seasonal trends in the ambient concentrations of all the parameters monitored at the site. Ambient NO_2 concentrations were consistently low throughout the monitoring periods and there were no exceedances recorded. Ambient SO_2 concentrations showed exceedances of the hourly and daily limits recorded frequently. Ambient PM_{10} concentrations were extremely high from September to December 2022. There are a lot of data gaps for ambient $PM_{2.5}$ due to the analyser that was in and out of the monitoring site throughout the years. Ambient ozone concentrations showed increase during the spring-summer months and low concentrations during the autumn-winter months.

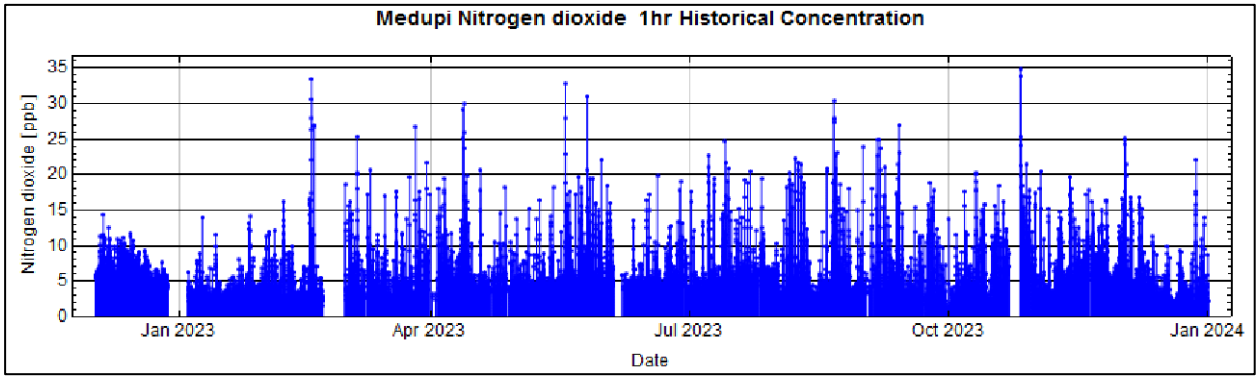


Figure 11: Historical Trends of NO_2 Hourly Mean Concentrations

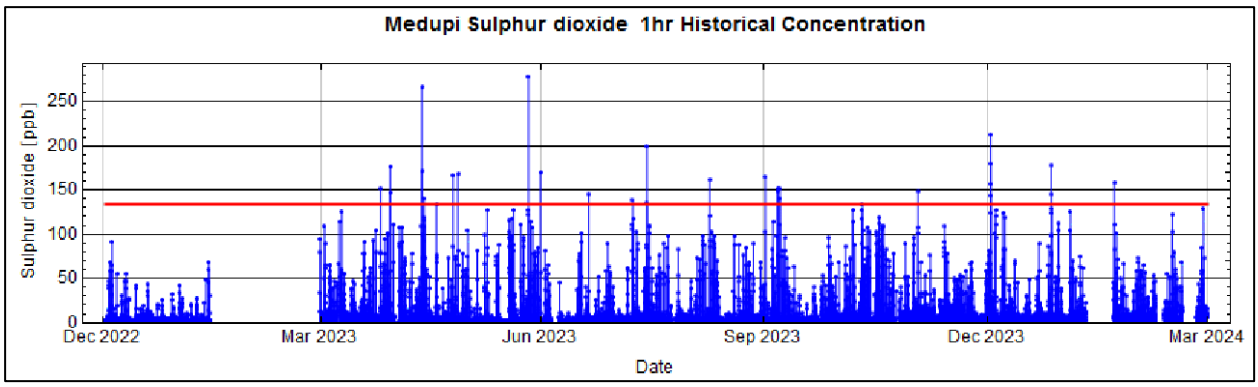


Figure 12: Historical Trends of SO_2 Hourly Mean Concentrations

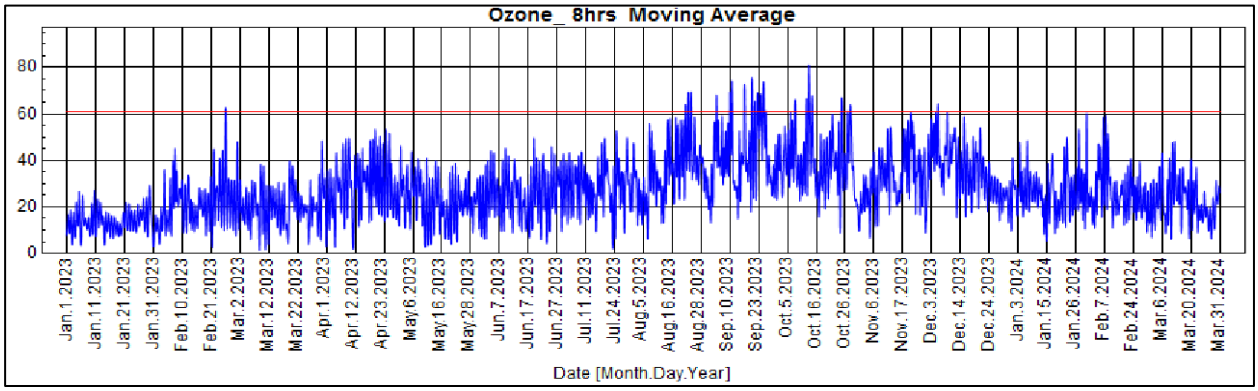


Figure 13: Historical Trends of O_3 8-hourly Moving Average Concentrations

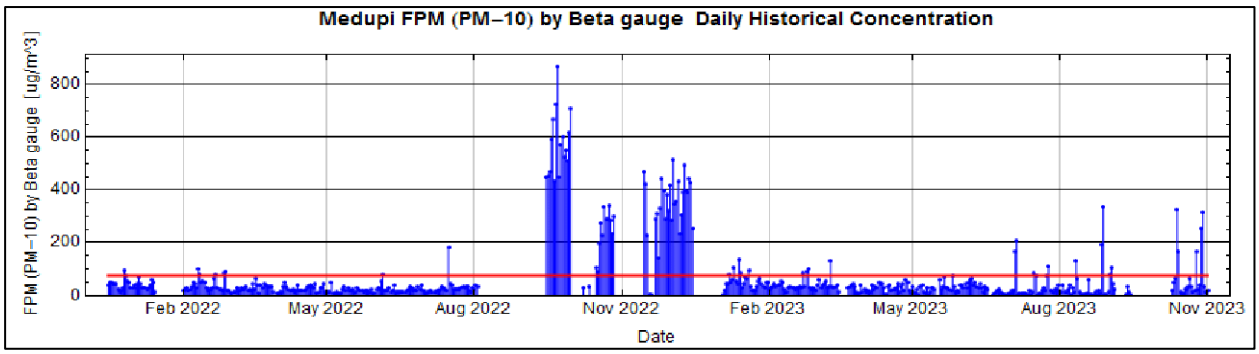


Figure 14: Historical Trends of PM_{10} Daily Mean Concentrations

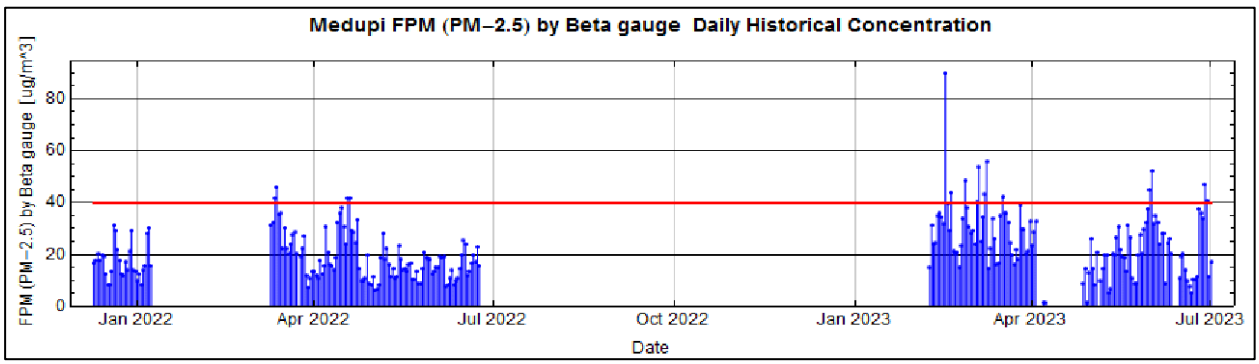


Figure 15: Historical Trends of $PM_{2.5}$ Daily Mean Concentrations

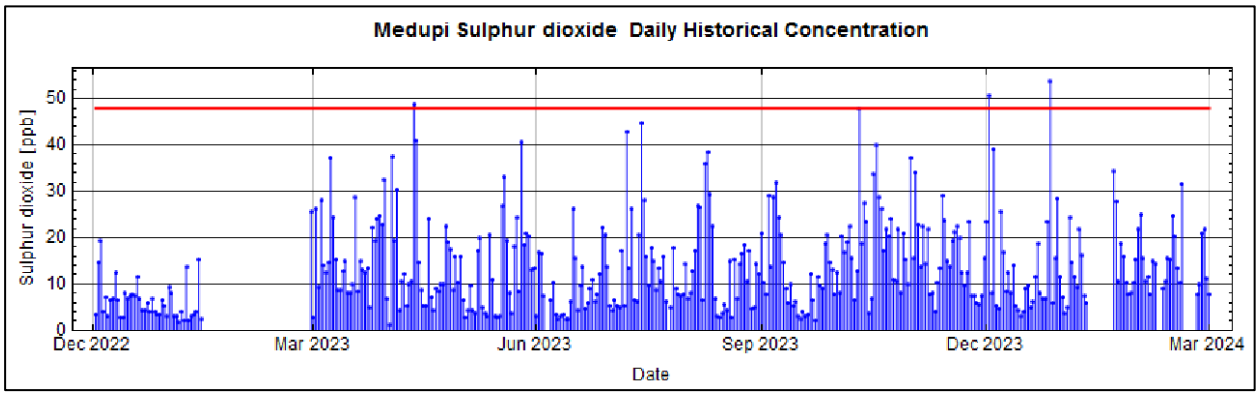


Figure 16: Historical Trends of SO_2 Daily Mean Concentrations

7.2. MONTHLY MEANS FOR THE CURRENT CALENDER YEAR 2024

Table 10: Monthly parameter means for the current calendar year (2024)

Parameter measured	Jan	Feb	Mar
$PM_{2.5}$ (µg/m³)	ND	ND	ND
PM_{10} (µg/m³)	ND	ND	ND
CO (ppm)	0.3	0.3	0.3
NO_2 (ppb)	4.9	ND	ND
O_3 (ppb)	26.3	26.5	22.4
SO_2 (ppb)	15.1	14.8	15.5

ND = no data recorded

7.3. NUMBER OF EXCEEDANCES OF NATIONAL AIR QUALITY LIMITS

Table 11: Number of exceedances of the National Ambient Air Quality Limits in 2024

	SO_2 hourly	**SO_2 daily**	**SO_2 10-minute**	**NO_2 hourly**	**PM_{10} daily**	**$PM_{2.5}$ daily**	**O_3 8-hourly**
January	6	2	11	0	ND	ND	0
February	1	0	3	ND	ND	ND	0
March	0	0	0	ND	ND	ND	0
Total	**7**	**2**	**14**	**0**	**ND**	**ND**	**0**
Allowed number of exceedances	88	4	526	0	4	4	11

ND = no data recorded

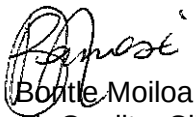
8. CONCLUSIONS

There were no exceedances of the national ambient air quality limits recorded for all the parameters monitored during March 2024.

Ambient CO concentrations were contributed to by emissions from low level sources and other industrial activities taking place around the monitoring station. Ambient SO_2 concentrations were contributed to by emissions from tall stack emitters (probably power stations).

Report Compiled by:
Johannes Kanye

Reviewed and Authorised by: Date of Issue: 18 Apr 2024



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

9. ABBREVIATIONS

DFFE	Department of Forestry, Fisheries and the Environment
°	Degree
°C	Degree Celsius
E	East
ENE	East-north-east
ESE	East-south-east
FPM	Fine particulate matter
HUM	Humidity
m/s	Meters per second
MWP	Megawatt Park
N	North
NE	North-east
NNE	North-north-east
NNW	North-north-west
NO1	Nitric oxide
NO2	Nitrogen dioxide
NOX	Oxides of nitrogen
NW	North-west
OZN / O_3	Ozone
PM_{10}	Particulate matter < 10 microns in diameter
$PM_{2.5}$	Particulate matter < 2.5 microns in diameter
ppb	Parts per billion
ppm	Parts per million
S	South
SE	South-east
SGT	Sigma theta
SSE	South-south-east
SSW	South-south-west
SW	South-west
TMP	Ambient temperature
ug/m^3	Microgram per cubic meter
W	West
WDR	Wind direction from true North
WNW	West-north-west
WSP	Wind speed
WSW	West-south-west
WVL	Wind velocity

10. DISTRIBUTION LIST

Air Quality Centre of Excellence
MWP
Bryan McCourt

Eskom Environmental Management

Medupi Power Station

Mokgadi Dikgale (Environmental Manager)
Sakutanya Mamabolo
Thabo Khoza
Ramokone Makgoka

Information Centre
RT&D Sustainability

Project File