

**RESEARCH, TESTING AND DEVELOPMENT****SUSTAINABILITY****CAMDEN AIR QUALITY REPORT****May 2014****EXECUTIVE SUMMARY**

This monthly report covers the air quality monitoring data as monitored at Camden in May 2014.

There was one exceedance of the national ambient air quality SO<sub>2</sub> hourly limit and no exceedances of the daily FPM (PM<sub>10</sub>) and daily SO<sub>2</sub> limits. The ozone 8 hour moving average was also not exceeded. There were no exceedances of the NO<sub>2</sub> hourly limit during the period under review.

The dominant wind directions during the daytime were from west-south-west, west and south-west. During the night, the most frequent directions were from east, north-west and north-north-west. Winds from all other directions were infrequent during day and night and wind speeds remained low.

The overall percentage data recovered from the monitoring station during the reporting period was 82.2% and the overall monitoring station availability during the reporting period was 82.3%.

**DISCLAIMER**

It is certified that the data presented is, to the best of our knowledge, a true copy of the specified record and for the times and places indicated thereon, as held on file at Research, Testing and Development (RT&D). The user assumes the entire risk related to the use of this data. In no event will RT&D be liable to the user or to any third party for any direct, indirect, incidental, consequential, special or exemplary damages or profit resulting from any use or misuse of this data.

**1. INTRODUCTION**

At the request of Environmental Management, the Research, Testing and Development (RT&D) air quality monitoring team commissioned an Ambient Air Quality Monitoring site at Camden Power Station to assess possible impacts of air pollution from Camden Power Station and other pollution sources in the area (Figure 1).

The Camden station is equipped for continuous monitoring of ambient concentrations of sulphur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), ozone (O<sub>3</sub>) and fine particulate matter (FPM) of particulate size <10µm in diameter. In addition, meteorological parameters of wind velocity (WVL), wind direction (WDR), ambient temperature (TMP), humidity (HUM) and ambient pressure (PRS) are also recorded.

Standard Specifications, Equipment/Techniques used for the measurement of SO<sub>2</sub>, O<sub>3</sub> and NO<sub>x</sub> conform to US-EPA equivalent method No EQSA-0486-060, EQOA-0880-047 and RFNA-1289-074 respectively.

**2. SITE LOCATION**

The monitoring station was located close to Camden Power Station at co-ordinates: (S26° 37' 21.5") (E30° 06' 32.5") in June 2003.



Figure 1. Camden Air / Quality Monitoring Station in relation to Camden Power Station and other pollution sources

### 3. DATA RECOVERY

The SANAS guideline figure of 80% 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.

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 shows the percentage data recovered, for each pollutant monitored, during the reporting period. The overall percentage data recovered from the monitoring station during the reporting period was 82.2% and the overall monitoring station availability during the reporting period was 82.3%.

Table 1. Percentage data recovered per parameter May 2014.

Percentage data recovered per parameter per month monitored															
NO1	NO2	NOX	OZN	PRS	RFL	SGT	SO2	TMP	WDR	WSP	WVL	FPM (PM-10)	HUM	Data Recovery	Station Availability
82.	82.	82.	82.	82.3	82.3	82.3	82.	82.3	82.3	82.3	82.3	82.1	82.3	82.2	82.3

## 1. COMMENTS

In general the data losses that occurred during the monitoring period were due to routine site service, zero/span checks and power trips.

## 4. SUMMARY OF RESULTS FOR REPORTED PERIOD

Table 2 is a summary report presenting highest hourly and daily mean concentrations and the number of exceedances above the respective National Ambient Air Quality Standards limits as presented in Table 3.

Note: Where FPM is monitored, the following instrument methodologies may have been used.

TEOM (Tapered Element Oscillating Microbalance), Beta Gauge (Beta-attenuation using a C-14 source), DustTrak (Light scattering laser photometer). Where visibility is monitored, which can be converted to FPM  $<2.5 \mu\text{g}/\text{m}^3$ , an Integrating Nephelometer measuring the scattering of light is used.

The results presented may vary depending on the instrumentation methodology used.

Table 2. Summary report

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 [ $\mu\text{g}/\text{m}^3$ ]				0			
FPM (PM-10) by Beta gauge [ $\mu\text{g}/\text{m}^3$ ]	397.8		96.3	0			
Mercury [ng/ml]							
Nitric oxide [ppb]	48.		14.8				
Nitrogen dioxide [ppb]	32.2	0	16.5				
Nitrogen oxide [ppb]	80.2		31.				
Ozone [ppb]	60.5		31.9		0		
Sigma theta [deg]	80.8		37.8				
Sulphur dioxide [ppb]	154.2	1	30.9	0			0
Ambient temperature [deg C]	28.7		15.3				
Wind speed [m/s]	9.		4.3				
Wind velocity [m/s]	8.8		4.2				

Table 3. Ambient air quality standards.

<b>National Ambient Air Quality Standard</b>					
<b>Pollutant</b>	<b>Period</b>	<b>Limit</b>	<b>Exceedance frequency</b>	<b>Unit</b>	<b>Source</b>
Benzene	1year	3.2	0.	ppb	DEA
Carbon Monoxide	1hr	26.	88.	ppm	DEA
Carbon Monoxide	8hr	8.7	11.	ppm	DEA
FPM (PM-10) by Beta gauge	24hr	120.	4.	micro_g/m3	DEA
FPM (PM-10) by Beta gauge	1year	50.	0.	micro_g/m3	DEA
FPM (PM-2.5) by Beta gauge	1year	25.	0.	micro_g/m3	DEA
FPM (PM-2.5) by Beta gauge	24hr	65.	4.	micro_g/m3	DEA
Lead	1year	0.5	0.	micro_g/m3	DEA
Nitrogen dioxide	1year	21.	0.	ppb	DEA
Nitrogen dioxide	1hr	106.	88.	ppb	DEA
Ozone	8hr	61.	11.	ppb	DEA
Sulphur dioxide	1hr	134.	88.	ppb	DEA
Sulphur dioxide	10min	191.	526.	ppb	DEA
Sulphur dioxide	24hr	48.	4.	ppb	DEA
Sulphur dioxide	1year	19.	0.	ppb	DEA

#### 4.1 COMMENTS

The following exceedances of the National Ambient Air Quality Standards limits were reported during the monitoring period and indicate the day the exceedance occurred and the level of concentration, as reflected in Table 4.

Table 4. Exceedances above National Ambient Air Quality limits.

Date interval for SO2: Jun 1 2003 1h - May 26 2014 11h			
1 exceedances above DEA standard of 134. ppb			
Exceedance Date	SO2 Concentration above the DEA 1hr standard of 134. ppb	Wind Dir	Wind Vel [m/s]
2014 May 24 11h	154.2	SW	0.477

#### 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 position of the spokes in the polar diagram represents 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.

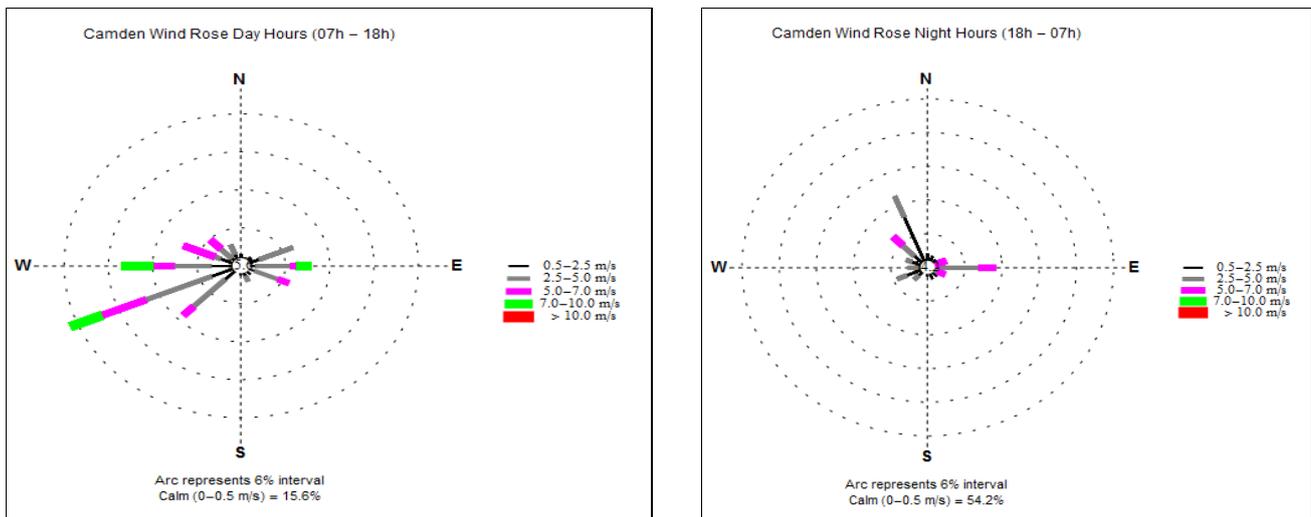


Figure 2. Wind roses.

## 5.1 COMMENTS

The dominant wind directions during the daytime were from west-south-west, west and south-west. During the night, the most frequent directions were from east, north-west and north-north-west. Winds from all other directions were infrequent during day and night and wind speeds remained low.

## 6. POLLUTANTS

Emissions of primary pollutants such as FPM, SO<sub>2</sub>, and NO<sub>x</sub> 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 (modern power stations and other industries), are expected to have more significant impact at ground level during the day, due to atmospheric turbulence influences. O<sub>3</sub> and other oxidants are formed in polluted atmospheres as a result of a rather wide variety of photochemical reactions. A gradual increase of O<sub>3</sub> throughout the day is expected, peaking at mid-afternoon and then decaying once more during the night.

## 6.1. FINE PARTICULATE MATTER (FPM-PM10)

### 6.1.1. Source identification by FPM-PM10 diurnal variations

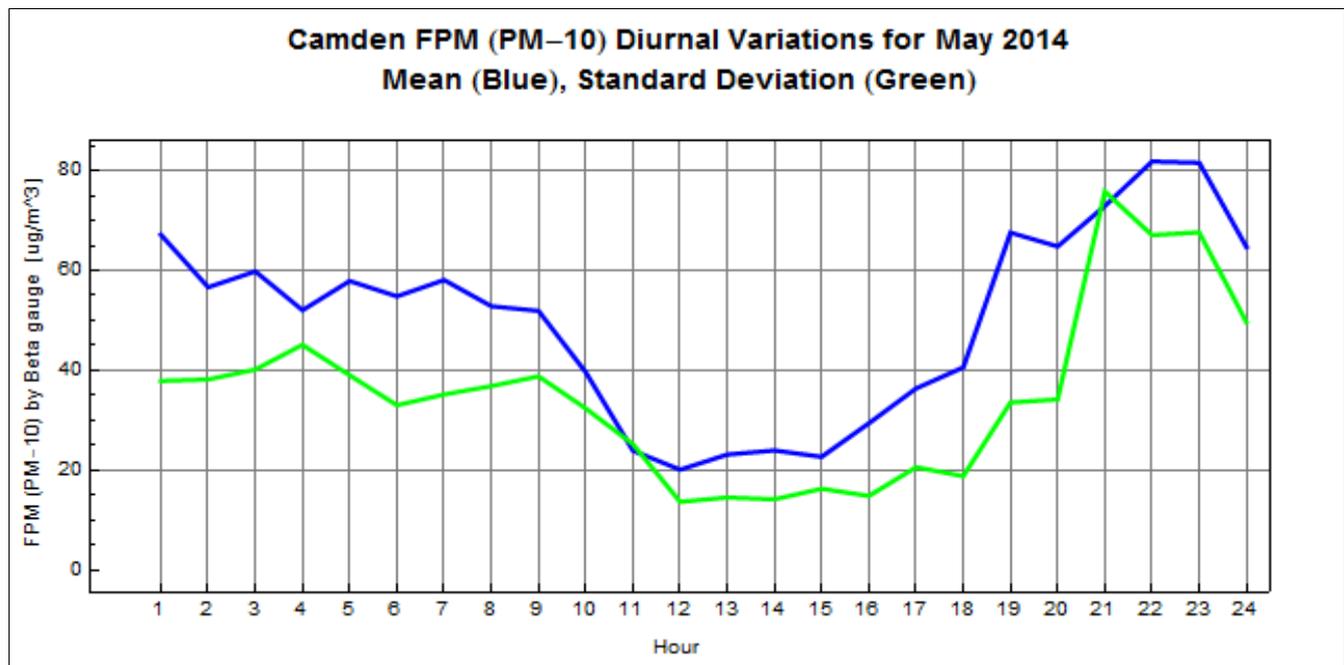


Figure 3. Diurnal variation by FPM-PM10

#### 6.1.1.1 Comments

Figure 3 shows the FPM (PM10) hourly mean diurnal variation. Impacts from low level sources are evident with slight peaks at 03:00, 05:00 and 07:00 in the morning. A slight increase in concentration levels is shown from 12:00 peaking at 14:00 followed by a sharp increase at 15:00 in the afternoon with a peak at 19:00 which is indicative of high level sources such as Camden stacks and other industries. Low level sources are shown to be impacting once more from 20:00 in the evening with peaks at 22:00 and 23:00 at night. Concentration levels drop to background from 23:00 throughout the night.

#### 6.1.2. FPM-PM10 hourly mean event roses and tables

As there are no National Ambient Air Quality hourly FPM-PM10 limits, the 98 percentile daytime and night-time event roses are presented in Figure 4 to identify the wind sectors from which the highest concentrations are derived.

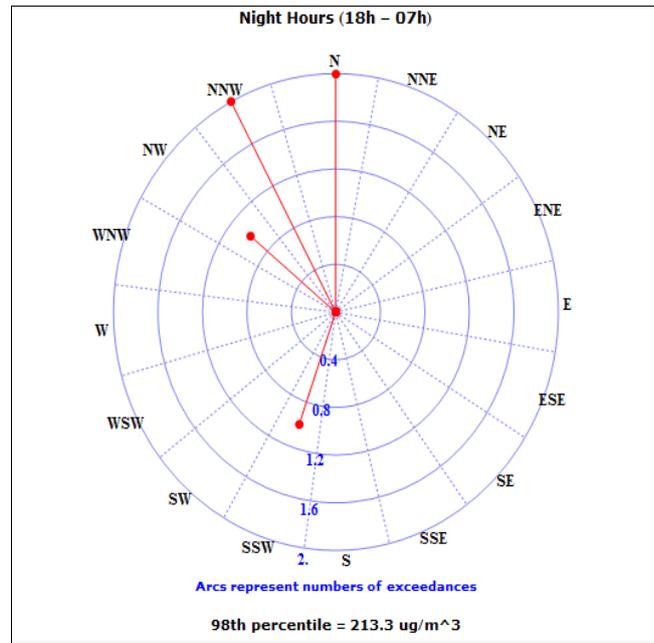
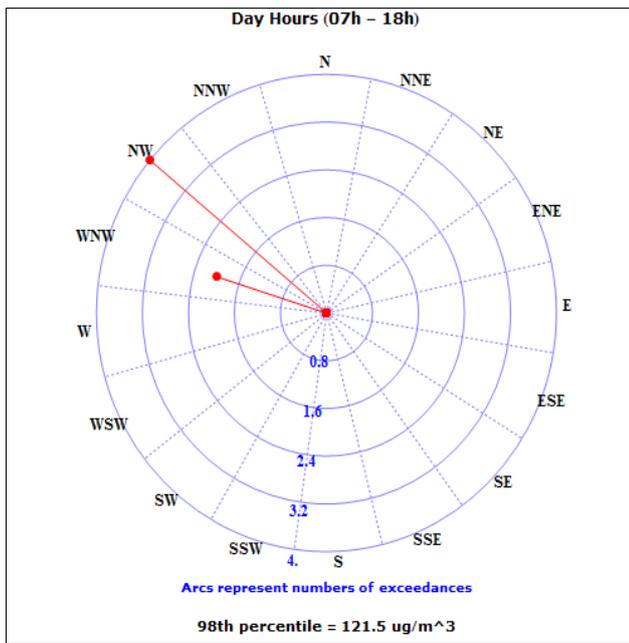


Figure 4. FPM-PM10 hourly mean 98<sup>th</sup> percentile event roses.

Table 5. FPM-PM10 daytime hourly mean 98<sup>th</sup> percentile event table.

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0
%	0	0	0	0	0	0	0	0	0	0	0	0	0	33.33	66.67	0

Table 6. FPM-PM10 night-time hourly mean 98<sup>th</sup> 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	1	0	0	0	0	1	2
%	33.3	0	0	0	0	0	0	0	0	16.6	0	0	0		16.6	33.3

There were no exceedances of the National Ambient Air Quality Standards FPM daily limit. The most dominant hourly mean concentrations above 121.5µg/m<sup>3</sup> (98<sup>th</sup> percentile value) at Camden during daytime period were recorded from west-north-west to north-west. The most dominant hourly mean concentrations above 213.3µg/m<sup>3</sup> (98<sup>th</sup> percentile) at Camden during night-time period were recorded from south-south-west and north-west to north sectors. Camden Power Station and Sasol Secunda are situated 1.9km and 91km west-north-west of the monitoring station respectively. Hendrina Power Station is situated 80km north-west of the monitoring station. Arnot Power Station is situated 80km north-north-west of the monitoring station. The ash dumps are located north-west of the monitoring station. There are mining activities to the north of the monitoring station. There is a continuous day and night movement of coal trucks to and from the power station coal stockpile. The coal stockpile is situated west-south-west of the monitoring station. The Mooiplaats open cast mine is located south-south-west of the monitoring station.

#### 6.2.1. Source identification by FPM-PM2.5 diurnal variations

There is no PM2.5 monitoring at Camden.

### 6.3. SULPHUR DIOXIDE (SO<sub>2</sub>)

#### 6.3.1. Source identification by SO<sub>2</sub> diurnal variations

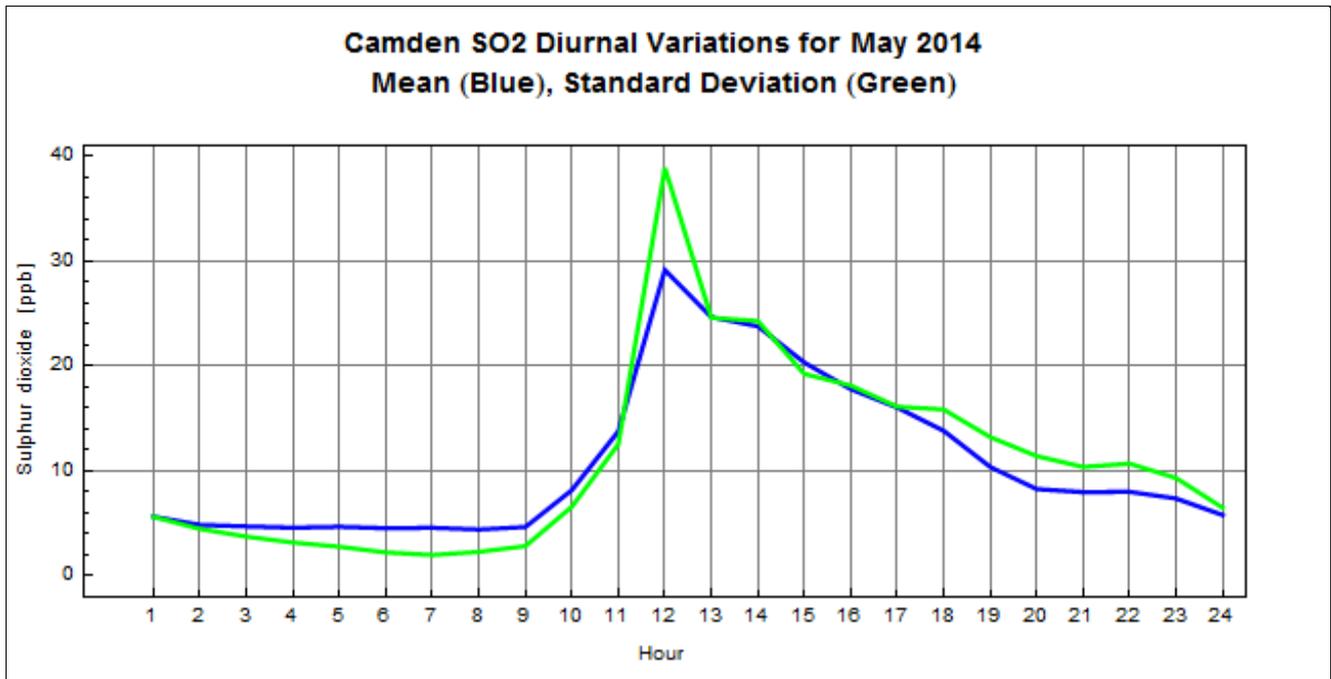


Figure 5. SO<sub>2</sub> diurnal variations

6.3.1.1. Comments

The SO<sub>2</sub> diurnal variation is presented in Figure 5. A sharp increase in concentration levels is noted from 09:00 peaking at 12:00 midday which is indicative of high level sources such as tall stacks where Camden Power Station may have directive impact. Concentration levels drop to background levels from 12:00 midday throughout the afternoon and the evening.

6.3.2. SO<sub>2</sub> hourly mean exceedance/event roses and tables

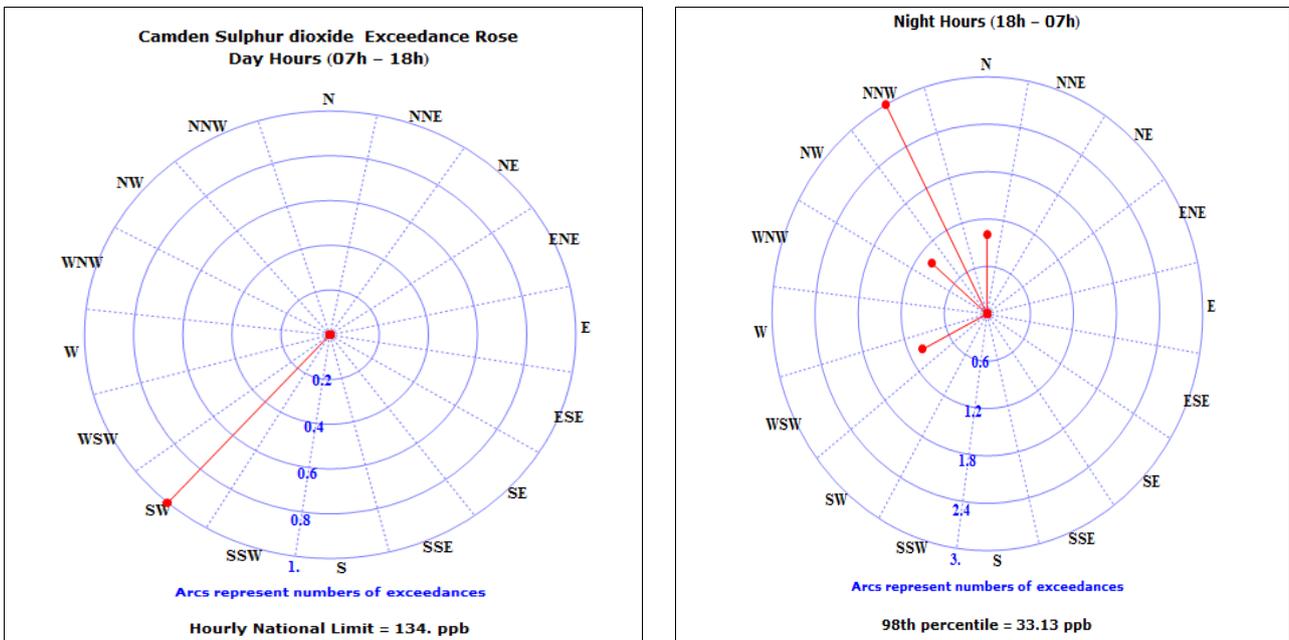


Figure 6 SO<sub>2</sub> hourly mean sector day time exceedance rose and night time 98th percentile event rose

Table 7. SO<sub>2</sub> daytime hourly mean exceedance table

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Exc	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
%	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0

Table 8. SO<sub>2</sub> 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	0	0	1	3
%	16.6	0	0	0	0	0	0	0	0	0	0	16.6	0	0	16.6	50

### 6.3.2.1. Comments

The daytime exceedance rose and night-time 98<sup>th</sup> percentile rose are presented in Figure 6 to identify the wind sectors from which the highest concentrations are derived. There was one exceedance of the national ambient air quality SO<sub>2</sub> hourly limit and no exceedances of the SO<sub>2</sub> daily limits as detailed in Table 2. The most dominant hourly mean concentrations above 134ppb at Camden during daytime were recorded from south-west sector. The most dominant night-time concentrations above 33.13ppb (98<sup>th</sup> percentile) were recorded from west-south-west and north-west to north sectors. Majuba Power Station is situated 60km south-west of the monitoring station. Tutuka Power Station is approximately 78.3km west-south-west of the monitoring station. The Mooiplaats open cast mine is located south-south-west of the monitoring station. Hendrina Power Station is situated 80km north-west of the monitoring station. Arnot Power Station is situated 80km north-north-west of the monitoring station. There are mining activities to the north of the monitoring station.

## 6.4. NITROGEN DIOXIDE (NO<sub>2</sub>)

### 6.4.1. Source identification by NO<sub>2</sub> diurnal variations

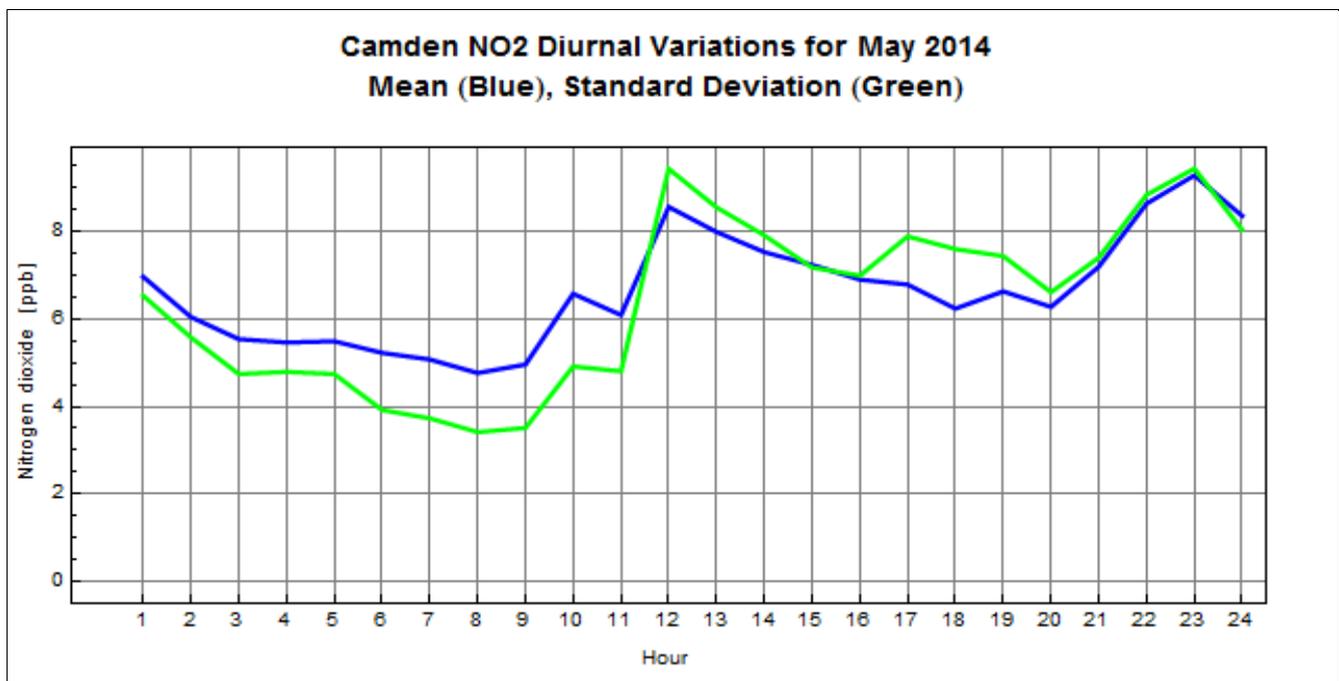


Figure 7. NO<sub>2</sub> diurnal variations

### 6.4.1.1. Comments

The NO<sub>2</sub> diurnal variation is presented in Figure 7. The levels of NO<sub>2</sub> are shown to be decreasing from 01:00 to 08:00 in the early morning followed by a slight to sharp increase in concentration levels from 08:00 with peaks at 10:00 and 12:00 which is an indication of high level sources such as tall

stacks where Camden Power Station may have directive impact. Low level sources such as vehicle emissions are shown to be impacting at 18:00 with peaks at 19:00 and 23:00. Concentration levels drop to background from 23:00 throughout the night.

#### 6.4.2. NO<sub>2</sub> hourly mean event roses and tables

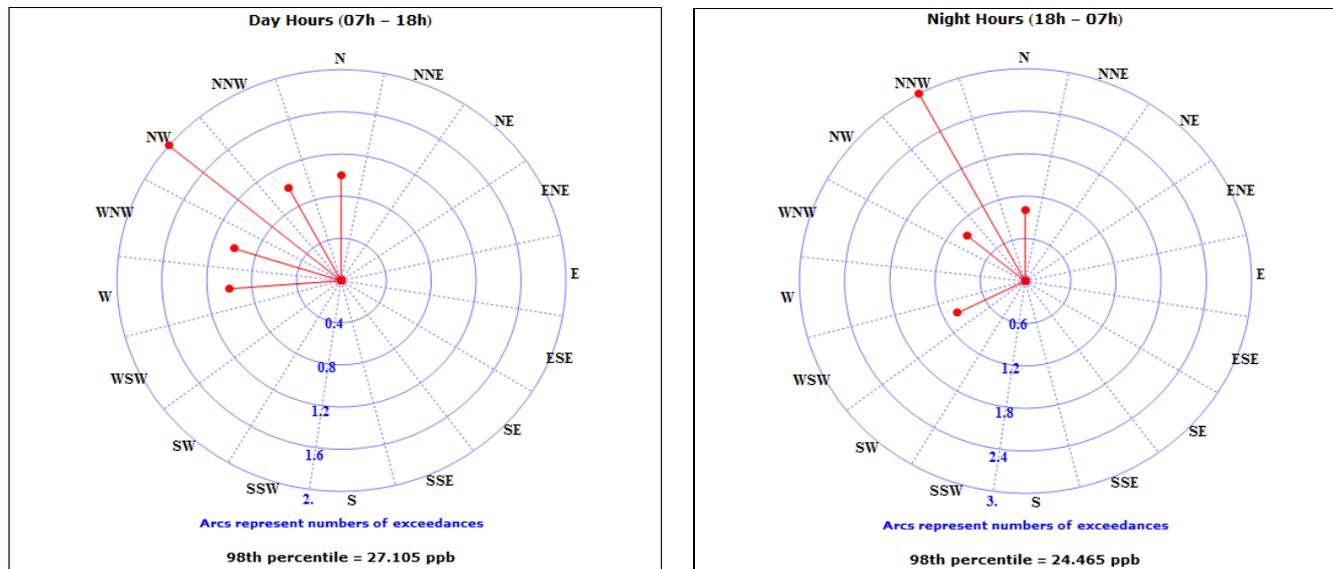


Figure 8. NO<sub>2</sub> hourly mean 98<sup>th</sup> percentile event roses.

Table 9. NO<sub>2</sub> 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	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1
%	16.6	0	0	0	0	0	0	0	0	0	0	0	16.6	16.6	33.3	16.6

Table 10. NO<sub>2</sub> 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	0	0	1	3
%	16.6	0	0	0	0	0	0	0	0	0	0	16.6	0	0	16.6	50

##### 6.4.2.1. Comments

The 98<sup>th</sup> percentile daytime and night-time event roses are presented in Figure 8 to identify the wind sectors from which the highest concentrations are derived. There were no exceedances of the National Ambient Air Quality Standards NO<sub>2</sub> hourly limits recorded during the period under review. The most dominant daytime concentrations above 27.105ppb (98<sup>th</sup> percentile value) were from the west to north sectors. The most dominant night-time concentrations above 24.465ppb (98<sup>th</sup> percentile) were from west-south-west and north-west to north sectors. Camden Power Station and Sasol Secunda are situated 1.9km and 91km west-north-west of the monitoring station respectively. There is a continuous day and night movement of coal trucks to and from the power station coal stockpile. The coal stockpile is situated west-south-west of the monitoring station. There are mining activities to the north of the monitoring station

#### 6.5. OZONE (O<sub>3</sub>)

##### 6.5.1. Source identification by O<sub>3</sub> diurnal variations

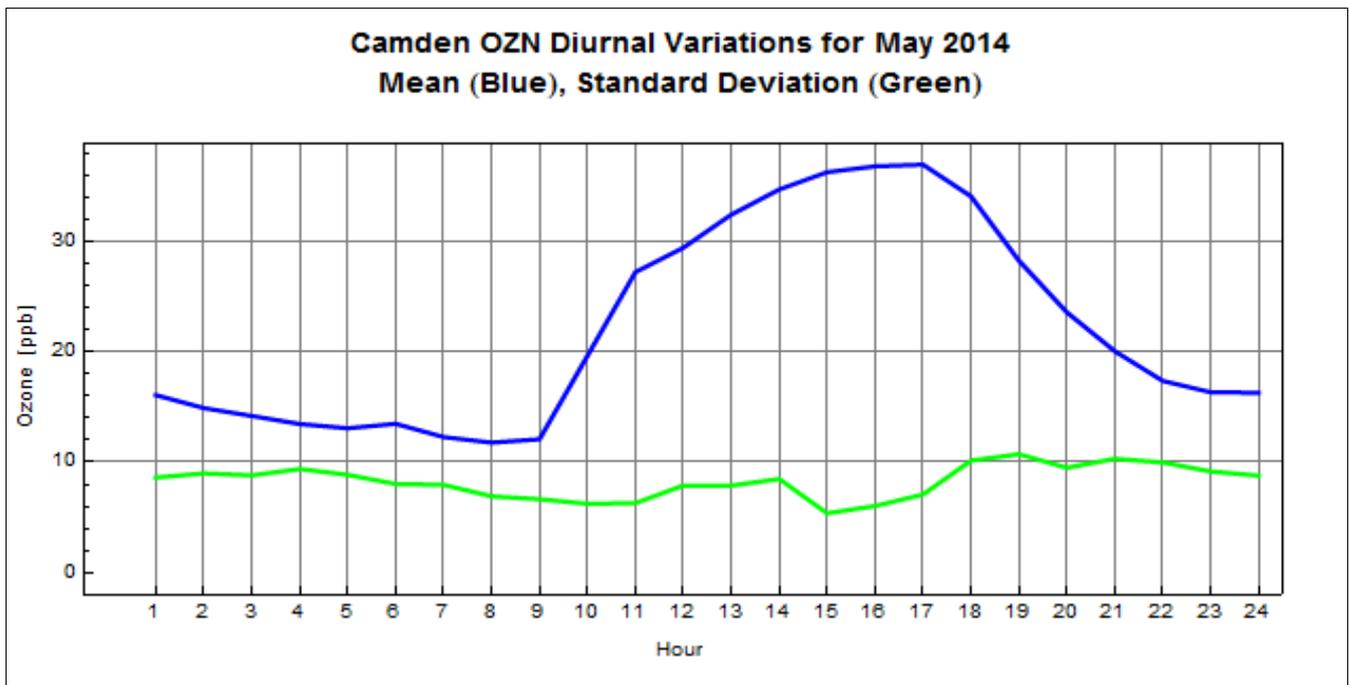


Figure 9. O<sub>3</sub> diurnal variations

6.5.1.1. Comments

Figure 9 shows the O<sub>3</sub> hourly mean diurnal variation with a slight decrease in the concentration levels occurring between 01:00 till 09:00. A sharp increase in O<sub>3</sub> concentration levels is noted from 09:00 peaking at 17:00 before decaying back to background levels throughout the night.

6.5.2 O<sub>3</sub> 8 hour Moving Average

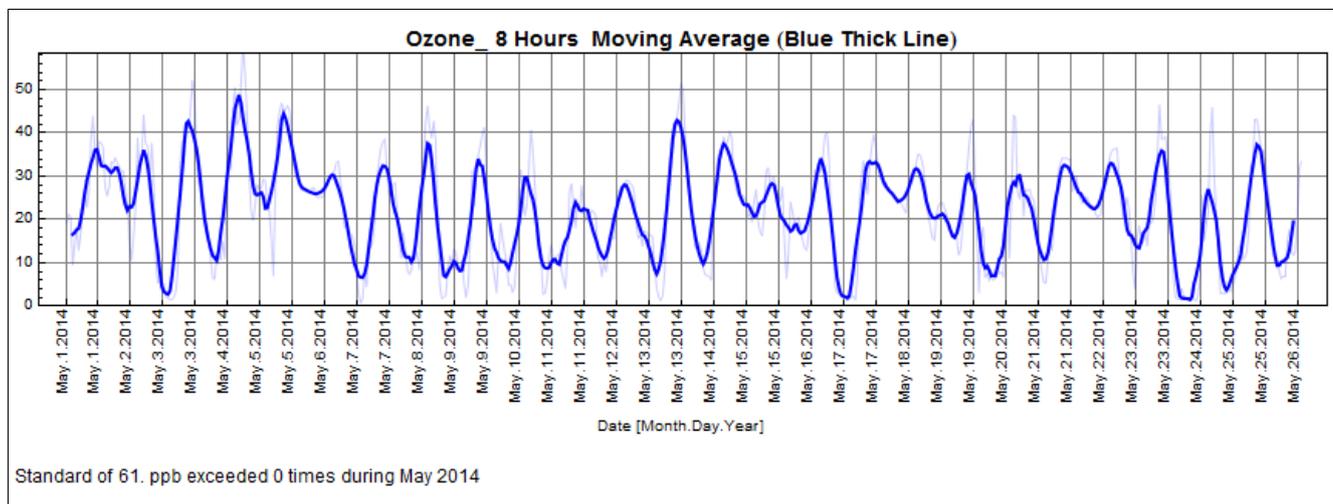


Figure 10. O<sub>3</sub> 8 hour Moving Average

6.5.2.1 Comments

The Ozone 8 hour moving average was not exceeded during the period under review.

6.5.3. O<sub>3</sub> hourly mean event roses and tables

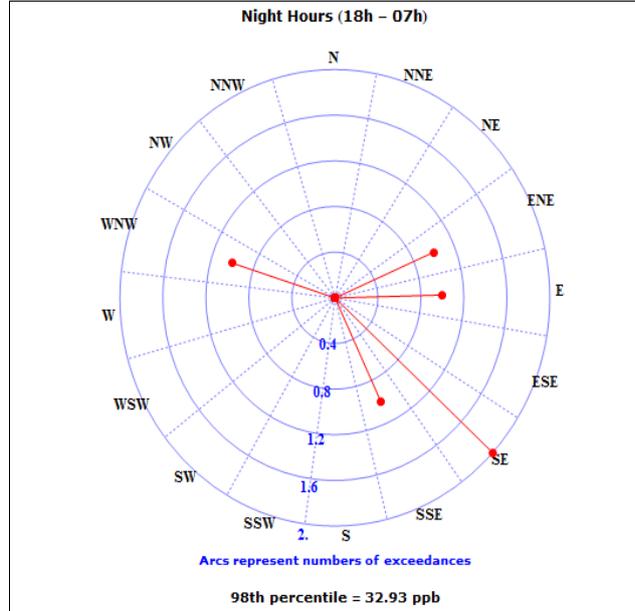
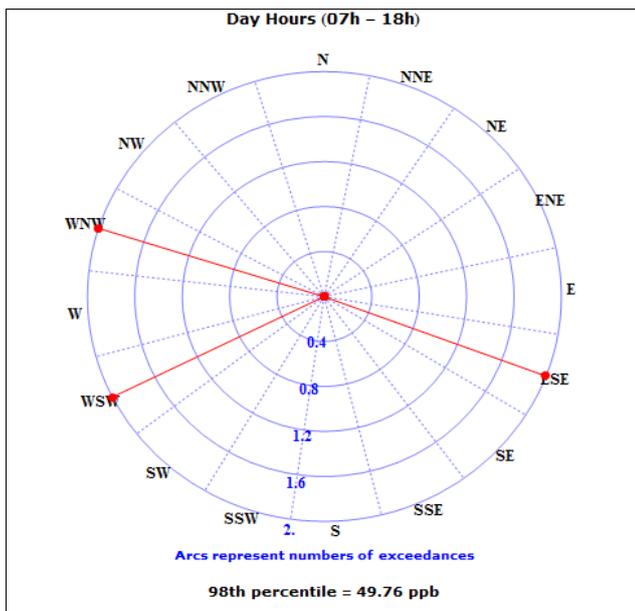


Figure 11. O<sub>3</sub> hourly mean sector 98<sup>th</sup> percentile event roses.

Table 11. O<sub>3</sub> daytime hourly mean 98<sup>th</sup> percentile event table.

Dir	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Eve	0	0	0	0	0	2	0	0	0	0	0	2	0	2	0	0
%	0	0	0	0	0	33.3	0	0	0	0	0	33.3	0	33.3	0	0

Table 12. O<sub>3</sub> night-time hourly mean 98<sup>th</sup> 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	1	0	2	1	0	0	0	0	0	1	0	0
%	0	0	0	16.6	16.6	0	33.3	16.6	0	0	0	0	0	16.6	0	0

### 6.5.3.1. Comments

The 98 percentile event roses are presented in Figure 11 to indicate the wind directions from which highest concentrations are derived. The ozone 8 hour moving average was not exceeded during the month of May. The most dominant daytime concentrations above 49.76ppb (98<sup>th</sup> percentile value) were from east-south-east, west-south-west and west-north-west sectors. The most dominant night-time concentrations above 32.93ppb (98<sup>th</sup> percentile value) were from east-north-east to east, south-east to south-south-east and west-north-west sectors.

## 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 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.

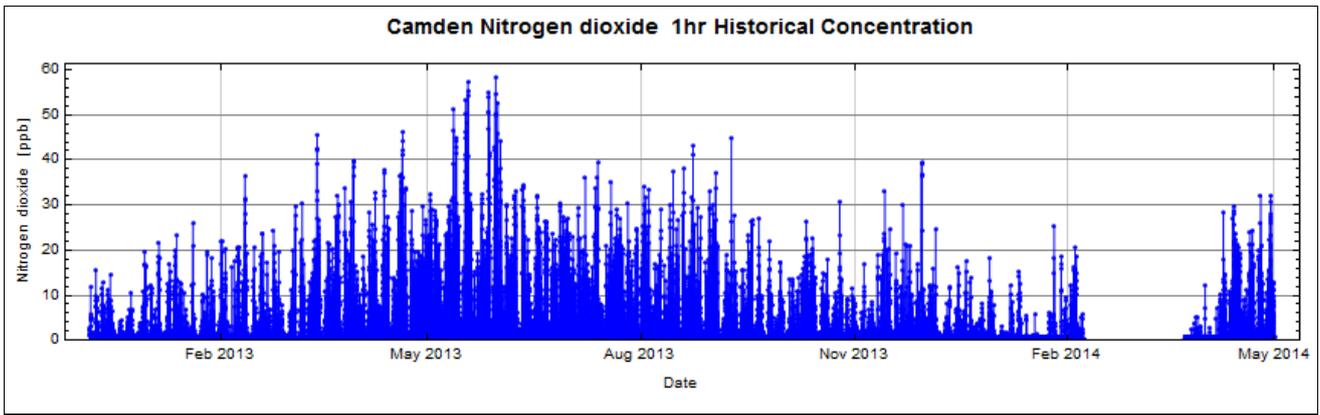


Figure12: NO<sub>2</sub> Hourly Means

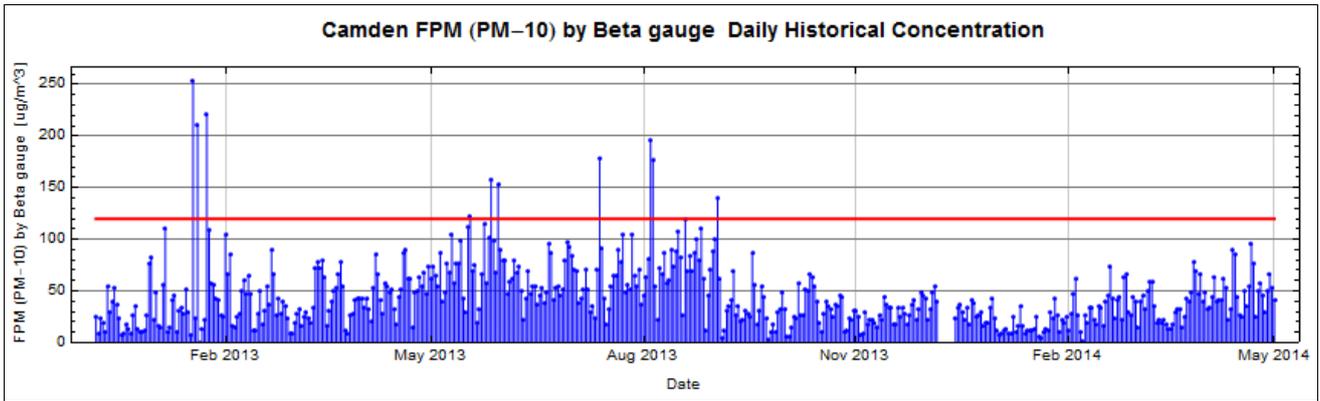


Figure 13: FPM Daily Means

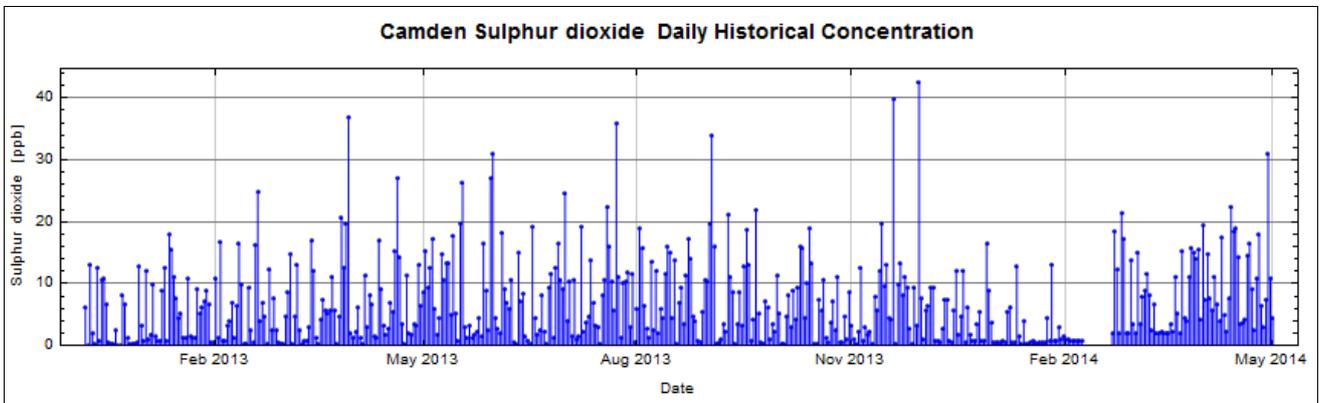


Figure 14: SO<sub>2</sub> Daily Means

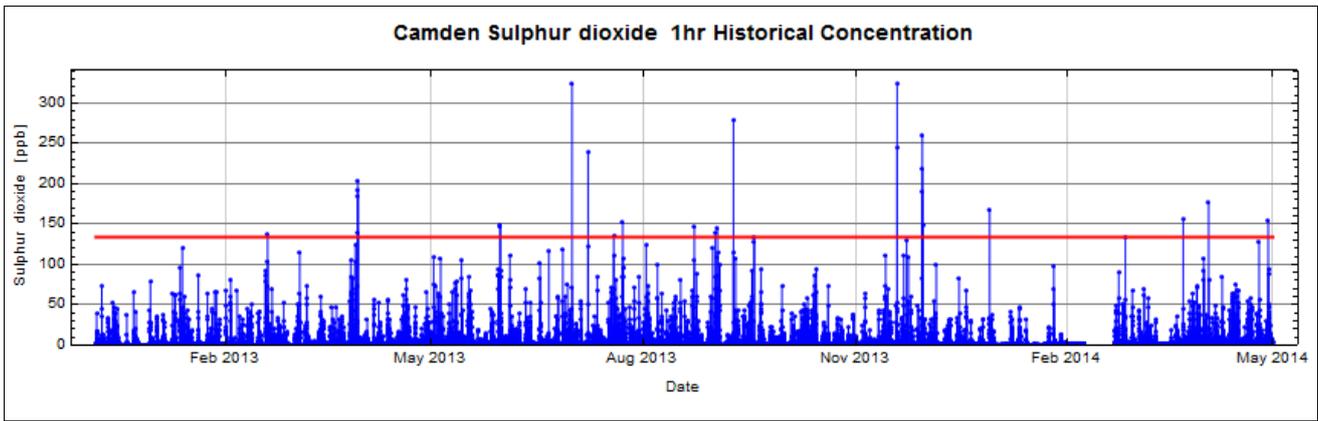


Figure 15: SO<sub>2</sub> Hourly Means

7.2. MONTHLY MEANS FOR THE CURRENT CALENDAR YEAR 2014

Table 13. Monthly Means for current calendar year 2014

Monthly Means For The Current Calendar Year					
	Jan	Feb	Mar	Apr	May
BTA	23.8	18.4	34.7	37.9	49.7
NO <sub>2</sub>	1.7	1.5	3.3	0.6	6.6
OZN	25.6	21.	22.5	20.7	22.
SO <sub>2</sub>	3.6	2.3	7.1	7.6	10.7

7.2.1. Comments

The monthly mean table shows concentrations of all the parameters monitored till May 2014.

7.3 ANNUAL MEANS AND NUMBER OF EXCEEDANCES FOR THE PRECEDING YEARS.

7.3.1. Comments

There has been only 1 exceedance of the NO<sub>2</sub> hourly mean concentration since the station was commissioned in July 2003. This happened in 2011. The SO<sub>2</sub> hourly limit was exceeded twice in 2005, once in 2006, 3 in 2007, 12 in 2008, 7 in 2009, 21 in 2010, 12 in 2011, 27 in 2012 and 22 times in 2013. The FPM daily limit had 1 exceedance in 2005, 2 in 2007, 4 in 2008, 9 in 2009, 5 in 2010, 5 in 2011, 6 in 2012 and 10 in 2013. The SO<sub>2</sub> daily limit had 1 exceedance in 2008 and 1 exceedance in 2009.

**8. CONCLUSIONS**

There was one exceedance of the national ambient air quality SO<sub>2</sub> hourly limit and no exceedances of the daily FPM (PM10) and daily SO<sub>2</sub> limits during the period under review. The ozone 8 hour moving average was also not exceeded. The above results show that stack emissions may have influence in the vicinity of Camden Power Station.

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Report compiled by: Abram Segopa  
Date: 10 June 2014

Department: RT&D

## 9. ABBREVIATIONS

DEA	Department of Environmental Affairs
FPM	Fine particulate matter
HUM	Humidity
NO1	Nitric oxide
NO2	Nitrogen dioxide
NOX	Oxides of nitrogen
OZN / O <sub>3</sub>	Ozone
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
ug/m <sup>3</sup>	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

## 10. DISTRIBUTION LIST

AIR QUALITY CENTRE OF EXCELLENCE ESKOM ENVIRONMENTAL MANAGEMENT Attention: K Langerman Senior Consultant	MWP
AIR QUALITY CENTRE OF EXCELLENCE ESKOM ENVIRONMENTAL MANAGEMENT Attention: B Monametsi Senior Advisor	MWP
OFFICER ENVIRONMENTAL MANAGEMENT Attention: Malekgoa Sejake Officer Environmental Management	CAMDEN
OFFICER ENVIRONMENTAL MANAGEMENT Attention: Fikile Sithole Officer Environmental Management	CAMDEN
ENVIRONMENTAL MANAGER Attention: Thabiso Mpongo Manager Environmental	CAMDEN
SYSTEM ENGINEER: FLUE GAS CLEANING Attention: Charlene Naicker Engineer Boiler Plant	CAMDEN
Project File: Abram Segopa Senior Technician	RT&D