Report: Air Quality Monitoring

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Richards Bay Clean Air Association

Technical Annual Report: 2002

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RICHARDS BAY
CLEAN AIR ASSOCIATION
An Association Incorporated under Section 21

Reference: AS002.2003 v1

For and on behalf of
ECOSERV (Pty) Ltd.

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Date : 19 March 2003

Executive Summary

This report highlights the activities and monitoring results of the Richards Bay Clean Air Association (RBCAA) for the Year 2002. The meteorological conditions, sulphur dioxide (SO_2) and ozone (O_3) trends for the year are presented in the body of the report.

During 2002 there were 18 exceedances of the revised Department of Environmental Affairs and Tourism (DEAT) 10-minute average SO_2 guideline of 191 ppb and one exceedances of the daily average SO_2 guideline of 48 ppb, all recorded during June. All but two of the 10-minute average exceedances were related to Foskor emissions. Annual average SO_2 data only exceeded quality assurance (80% data capture) at two stations, viz. Arboretum and the Caravan. Power supply problems at Hillside and the relocation of Wildenweide and Veldenvlei stations to Arboretum Extension and Brackenham, respectively, meant that data capture at each locality was below quality assurance requirements for the year. Nevertheless, the overall SO_2 data capture rate was 83%. The highest statistically valid annual average of 5.7 ppb at the Caravan was 30% of the DEAT guideline of 19 ppb and there was little variation in the SO_2 annual average concentrations for those station localities that are comparable to previous years. While pollution levels were largely dependent on the station locality relative to sources and prevailing winds, there was generally an increase in pollution concentrations during winter mornings as a result of poorer dispersion conditions.

The RBCAA achieved all 2002 stated objectives, apart from achieving SO_2 data capture above 90%. The monitoring system was ISO Guide 25 accredited in March of 1999 and annual re-accreditation was conducted in September 2002, during which the systems was successfully converted to the international ISO 17025 standard.

The HAWK model operated within acceptable model parameters for stations in residential and agricultural areas and has become a useful tool in the analysis of peaks and complaints. The model was sent to Pretoria during August for detailed modelling of conditions during the "Foskor" plume downdraft on 15 July 2002, which was the subject of a provincial enquiry. The model did not operate satisfactorily on return as some of the settings had changed and was unavailable for case studies for the remainder of the year while attempts were made to resolve the problem. The number of complaints logged with the RBCAA increased from 54 last year to 136 during 2002, and was mostly from the residential areas of Veldenvlei, Arboretum and Meerensee, and from the CBD.

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Glossary

Complaint	Observation, complaint or uncertainty communicated to and recorded by the RBCAA
Data capture	Percentage measure of the valid data (not including calibration data) recorded for a period.
DEAT	Department of Agriculture and Environmental Affairs
Diurnal	Relates the average daily cycle by presenting the value for each hour of the day for a variable over the period in question. Normally, the *diurnal sulphur dioxide* trend relates the average concentration for each hour of the day for a month or year. In so doing, the author can show typical sulphur dioxide patters over the course of a day. This pattern varies with season, typical wind and geographical location.
Frequency distribution	An arrangement of statistical data that exhibits the frequency of the occurrence of the values of a variable. In the context of this report, this technique is normally applied to sulphur dioxide concentrations, where the occurrence of a certain concentration bands throughout the year is counted and reported as a percentage of total counts. In so doing the author reports, the degree of occurrence of particular concentration bands. Shifts in tendency, that might be masked by average data can be revealed in this manner.
ppb	Part per billion
RBCAA	The Richards Bay Clean Air Association, a Section 21 “Not for Gain” Company, comprising representatives from government, industry, public and environmental groups interested in protecting air quality in the Umhlatuze Municipal area and operating a monitoring network to measure conditions near Richards Bay.
SANAS	South African National Accreditation Service, a statutory body charged with assessing compliance with international quality standards
WHO	World Health Organisation

1 Introduction

This, the 6th Annual Report for the Richards Bay Clean Air Association (RBCAA), summarises the air quality and meteorological data measured in Richards Bay during 2002. The report details the annual averages, along with monthly and daily average trends of monitored pollutants in the Richards Bay area. Basic statistical analyses are discussed and a summary of relevant meteorological data for the year is presented. A list of objectives for the coming year and achievement of stated objectives for the previous year are also discussed.

The Richards Bay Clean Air Association (RBCAA) continued monitoring of sulphur dioxide (SO_2) and ozone (O_3) in the Richards Bay area during 2002. The monitoring network consists of five SO_2 monitoring stations while O_3 is measured at one of these stations (initially Veldenvlei, but latterly Brackenham). The Wildenweide and Veldenvlei stations were decommissioned during April 2002 and relocated to Arboretum Extension and Brackenham, respectively. In addition, meteorological data is measured at Bayside, Richards Bay Minerals (RBM2) and the Richards Bay Airport (RBM1).

The SO_2 concentrations reported are determined by a United States Environmental Protection Agency (USEPA) equivalent method. At the Arboretum, Wildenweide/Arboretum Extension and Hillside stations the equivalent method number is EQSA-0193-092, at the Caravan the equivalent method number is EQSA-0495-100 and at Veldenvlei/Brackenham the equivalent method number is EQSA-1086-061. The results pertain to instantaneous samples drawn from air passing the above fixed stations, and care should be taken when extrapolating these results to surrounding areas. Data is recorded as 5-minute averages. All measurements allow for a maximum precision error of 15% of the reported value. A tolerance around the zero point of plus or minus 10 ppb is allowed, but all effort is made to reduce any error to a minimum. Reported concentrations are accurate to within 1 ppb. In terms of quality assurance, data capture should be above 80% to be valid for statistical analysis.

In March 1999, after a successful audit in December 1998, the Richards Bay Clean Air Association was awarded SANAS accreditation as a set of chemical-testing laboratories. This provides the Association with a set of guidelines with which it can ensure a high quality of data captured. Accreditation is ongoing and renewed annually after a performance audit. The system was audited during September 2002 and accreditation was achieved. The World Health Organisation (WHO) guidelines for SO_2 were adopted by the National Department of Environment and Tourism (DEAT) on 21 December 2002. These guidelines are for 10-minute and 24-hour averages, thus greater emphasis is placed on the reporting of these time periods in the report.

2 Pollution Monitoring

The SO_2 and O_3 monitoring results for January to December 2002 are summarised in the following sections. The National Department of Environment and Tourism (DEAT) guidelines for SO_2, as promulgated in 1965, were repealed on 21 December 2002 and revised guidelines, equivalent to the World Health Organisation (WHO) guidelines, were passed on the same date (Government Notice No. 1387 of Government Gazette 22491, 21 December 2002). The DEAT Guidelines for ozone O_3 are also provided.

Table 1: SO_2 and O_3 guideline values

Averaging Period	DEAT SO_2 (ppb) guideline	DEAT O_3 (ppb) guideline
Instantaneous	n/a	260
10-min average	191	n/a
Hourly average	n/a	120
Daily average	48	n/a
Annual average	19	n/a

2.1 Compliance Figures

There were a total of 18 exceedances of the SO_2 10-minute average guideline (191 ppb) and one exceedance of the SO_2 daily average guideline during 2002 (Table 2), all of which were recorded during June. No exceedances of the instantaneous or hourly average O_3 guidelines were recorded during 2002. All SO_2 exceedances at the Caravan station were recorded on 24 June, those recorded at Hillside were on 5 June and at Arboretum and Arboretum Ext. both exceedances were recorded on 30 June (Appendix 5b). The daily average exceedance was recorded at the Caravan station (Appendix 5b)

Table 2: Exceedances of the DEAT SO2 10-minute average and 24-hour average guidelines during 2002, compared to previous year's exceedances.

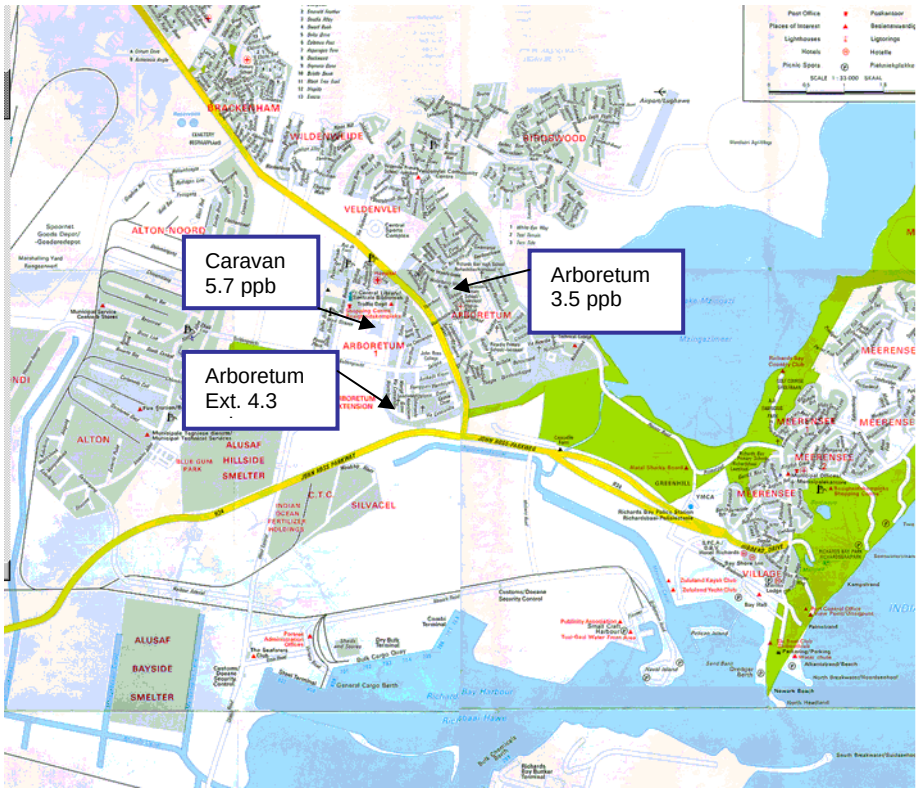
Station	24-hour average (>48 ppb)		10-minute average (>191 ppb)	
	2001	2002	2001	2002
Arboretum	0	0	0	1
Caravan	0	1	4	14
Hillside	0	0	0	2
Wildenweide	0	0	0	
Veldenvlei	0	0	0	
Arboretum Ext.	-	0	-	1
Brackenham	-	0	-	
Total	**0**	**1**	**4**	**18**

2.2 Trends and Mean Results

The trends of SO_2 in the Richards Bay region are presented in this section. Although quality assurance limits require 80% for statistical analysis, only two stations, viz. the Caravan and Wildenweide, achieved compliance during 2002. As the quality assurance requirements are quite rigorous (other organisations have been known to require only 50% data capture) and the other stations achieved data capture rates relatively close to compliance, the annual averages for the non-conforming stations are also included. Data capture rates are discussed in Chapter 6.3 and periods for which data are missing are detailed in Appendix 1.

2.2.1 Annual Mean

Figure 1: Annual mean SO_2 as measured at the monitoring stations



The annual average SO_2 concentrations for 2002 at all the stations are displayed in Figure 1. Table 3 lists the 2002 averages along with those of 1997 to 2001 for comparison. The average for Arboretum Extension, where SO_2 data capture was 67% for the year, is included for interest only. Annual averages at the remaining stations were less than 50% for the year owing to the station moves and, in the case of Hillside, lack of power supply. Of the stations for which the annual averages are displayed (Fig. 1, Table 3), the highest annual average SO_2 concentration was measured at the Caravan station. The annual average at the Caravan was similar to that measured the previous year and was 30% of the DEAT annual average guideline. The Arboretum annual average showed good agreement with the previous four years. The average at Arboretum Ext., valid for the period 13 April to 31 December 2002, was in a similar range to that at Arboretum and the Caravan. The average for

Hillside, based on 31.6% data capture was 11.4 ppb, the average for Wildenweide, based on 27% data capture, was 2.8 ppb and that for Veldenvlei, based on 16.2% data capture, was 2.9 ppb. The averages for Wildenweide and Veldenvlei, even though based on sparse data capture for the year, were similar to the averages measured during the previous year, the exception being Hillside, which was higher. The annual average ozone, measured at Veldenvlei up to 10 April 2002 and at Brackenham from 13 April 2002 onwards, was slightly lower than that measured the previous year.

Table 3: Comparison of 1997 to 2002 annual averages. DEAT guideline is 19 ppb.

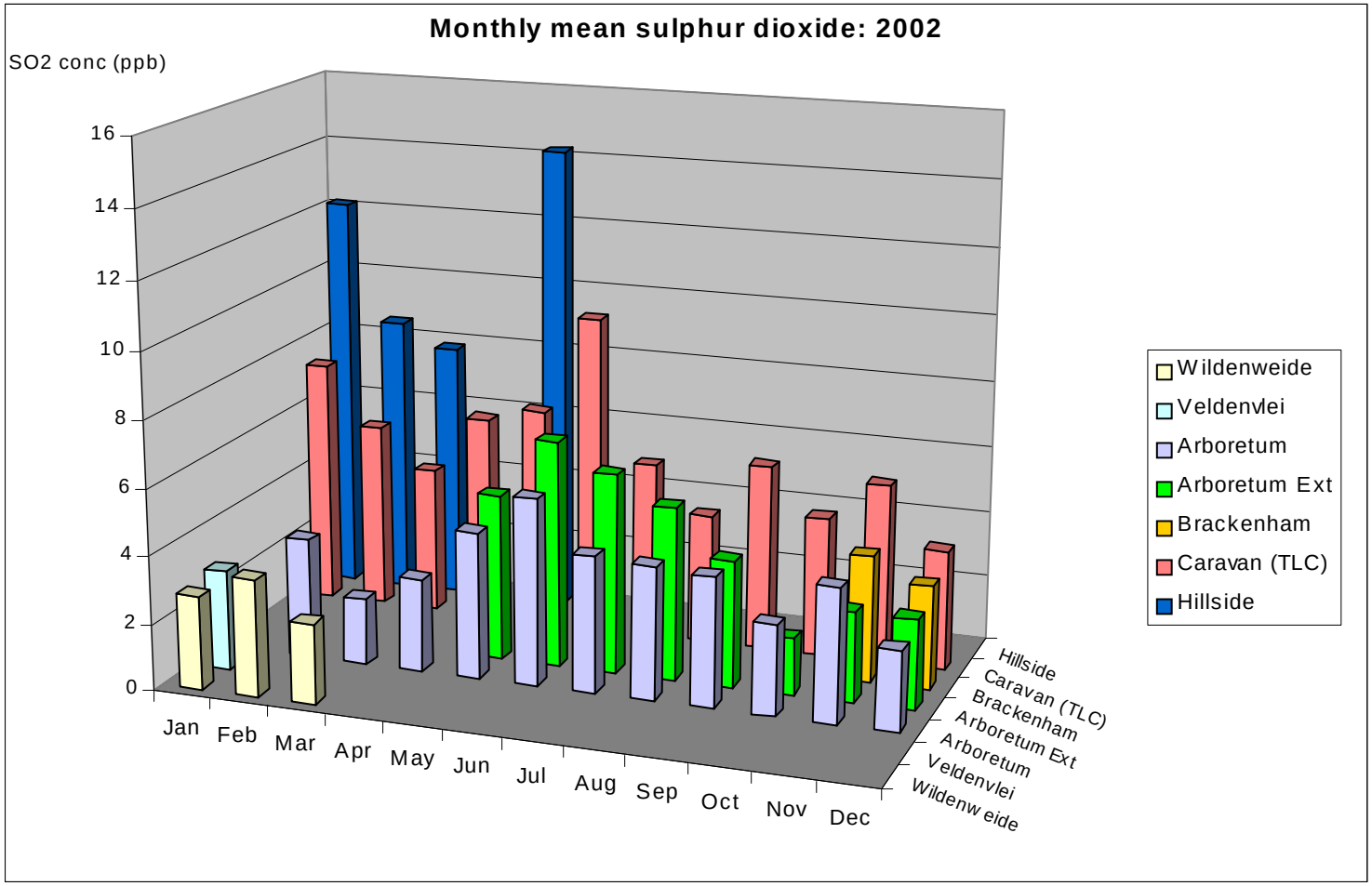
Station Name	Units	1997	1998	1999	2000	2001	2002
Arboretum SO_2	ppb	1.9	4.0	3.0	3.5	3.7	3.5
Arboretum Ext. SO_2	ppb	-	-	-	-	-	4.3
Wildenweide SO_2	ppb	2.4	2.2	3.7	2.9	2.9	-
Hillside SO_2	ppb	9.8	5.8	8.9	8.9	8.7	-
Caravan (TLC) SO_2	ppb	-	-	-	-	5.0	5.7
Veldenvlei SO_2	ppb	-	-	-	-	2.9	-
Veldenvlei/ Brackenham O_3	ppb	-	-	-	-	18.2	14.9
Esikhawini SO_2	ppb	<0.5	1.6	2.1	-	-	-
Esikhawini O_3	ppb	-	17.0	-	-	-	-
Umhlatuze SO_2	ppb	4.2	2.8	2.4	-	-	-
Hillside PM_{10}	µg/ m^3	-	30.0	39.9	-	-	-

* - Arboretum Ext. annual average for 2002 based on 67%, fails quality assurance, included for interest only

Figure 2 shows the monthly average SO_2 per station during the reporting period. The highest monthly average SO_2 was measured at the Hillside station during June. This followed the long-term trends of an increase in SO_2 at the station during winter, mainly related to poor dispersion conditions and the station's location relative to the Hillside, Bayside and Foskor plants. Maximum monthly average SO_2 at the Caravan (TLC building), Arboretum and Arboretum Ext. was similarly measured during June. While the increase at all the stations during winter is related to poor dispersion conditions, the commissioning of the new Foskor stack also played a part in contributing to the overall increased SO_2 concentrations during this time. The trends in monthly average SO_2 at the Caravan, Arboretum and Arboretum Ext. were similar, particularly for Arboretum and Arboretum Ext. for those periods where data is comparable. The stations are located in a similar area, all north-east of the major sources of Foskor and Hillside and Bayside Aluminium and east of Mondi. All three stations measure increased SO_2 during winds from the south-west sector. Data capture at Wildenweide, Veldenvlei and Brackenham was too sparse for valid trends to be noted over the annual period.

2.2.2 Monthly Mean Sulphur Dioxide

Figure 2: Monthly mean SO_2 measured at the five monitoring stations



2.2.3 Daily Means

Figure 3(a): Daily mean SO_2 measured at Arboretum

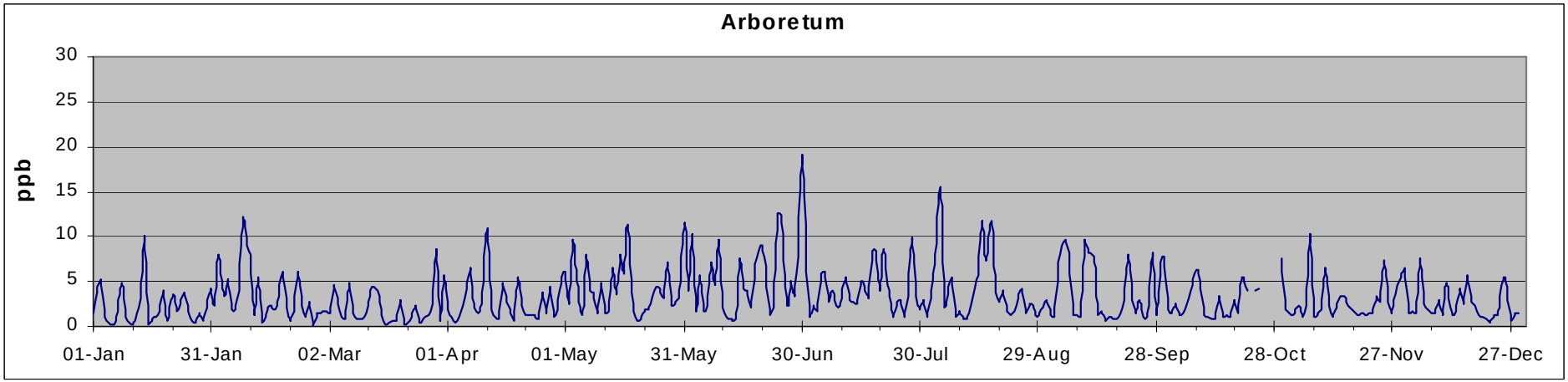


Figure 3(b): Daily mean SO_2 measured at Arboretum Extension

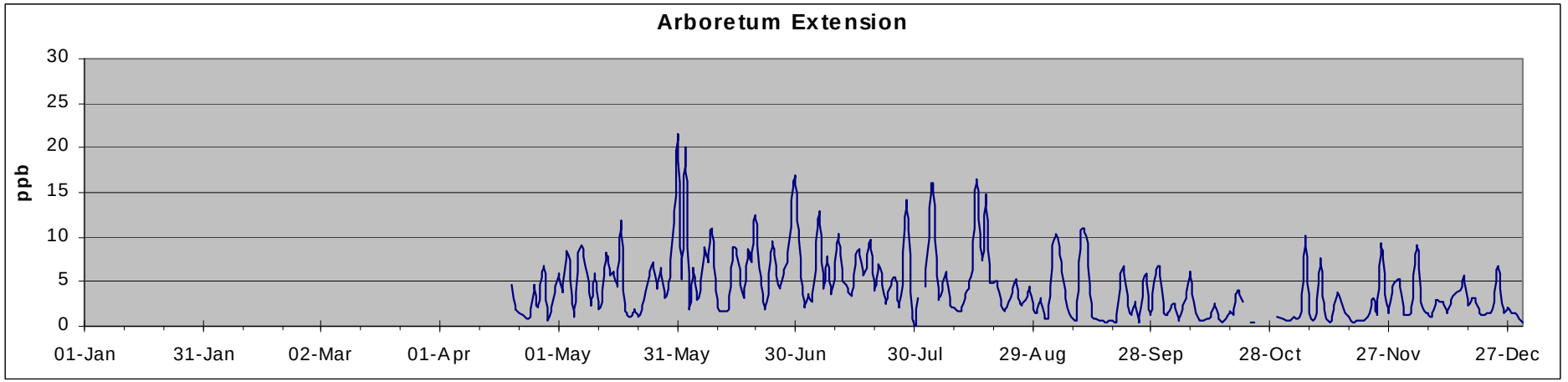


Figure 3(c): Daily mean SO_2 measured at the Caravan (TLC building)

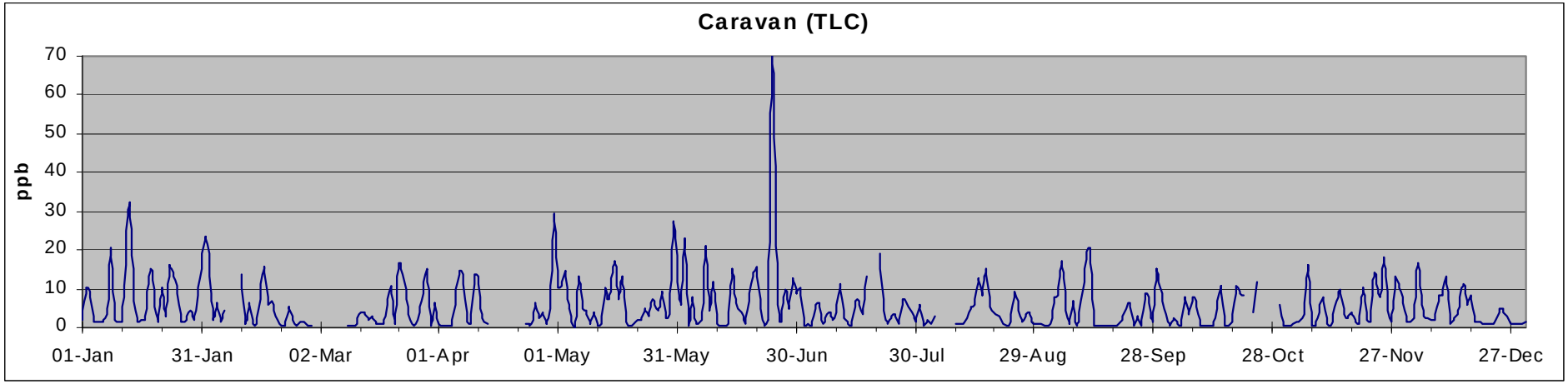


Figure 3(d): Daily mean SO_2 measured at Brackenham

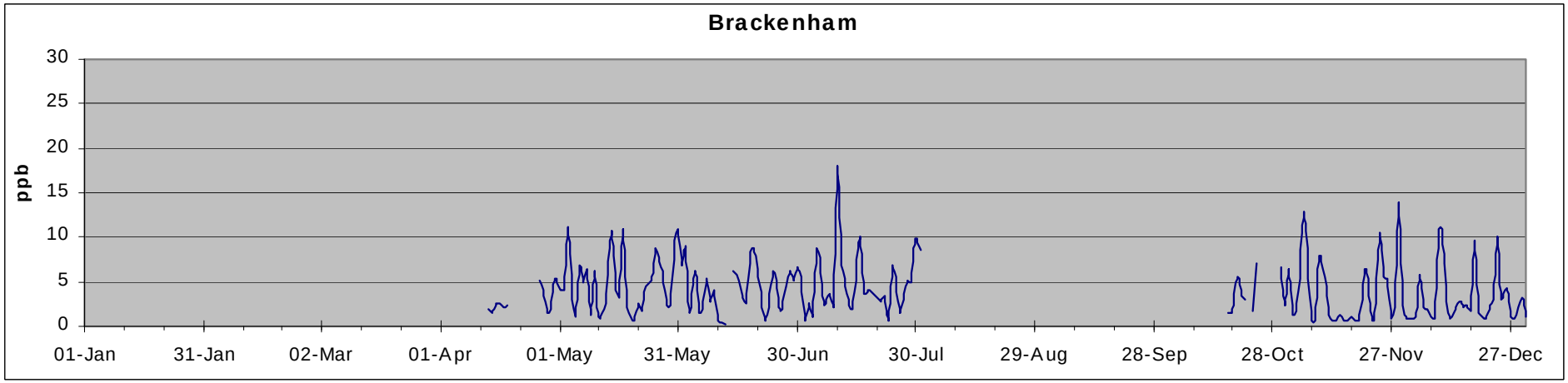


Figure 3(e): Daily mean SO_2 measured at Wildenweide

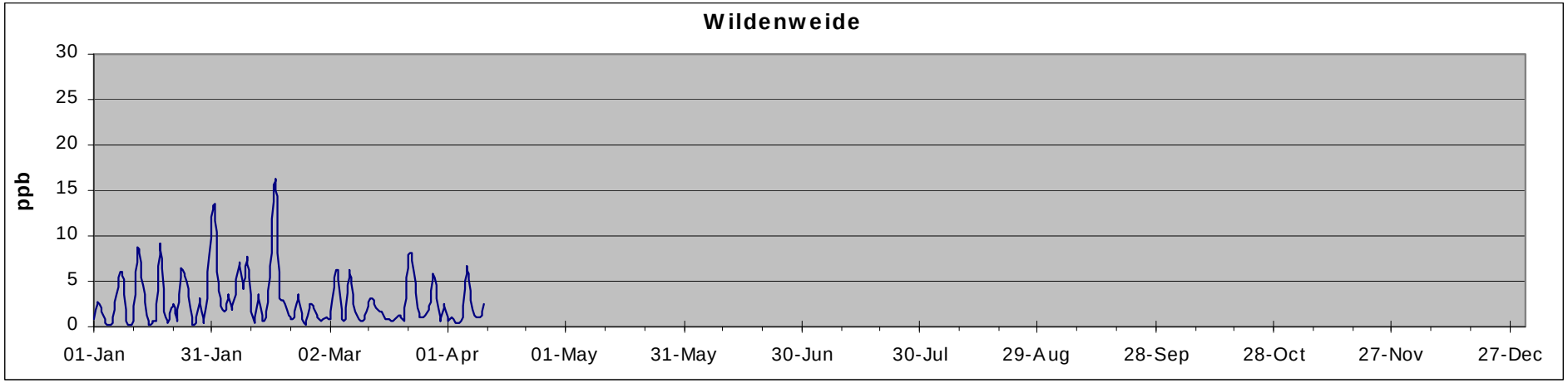


Figure 3(f): Daily mean SO_2 measured at Veldenvlei

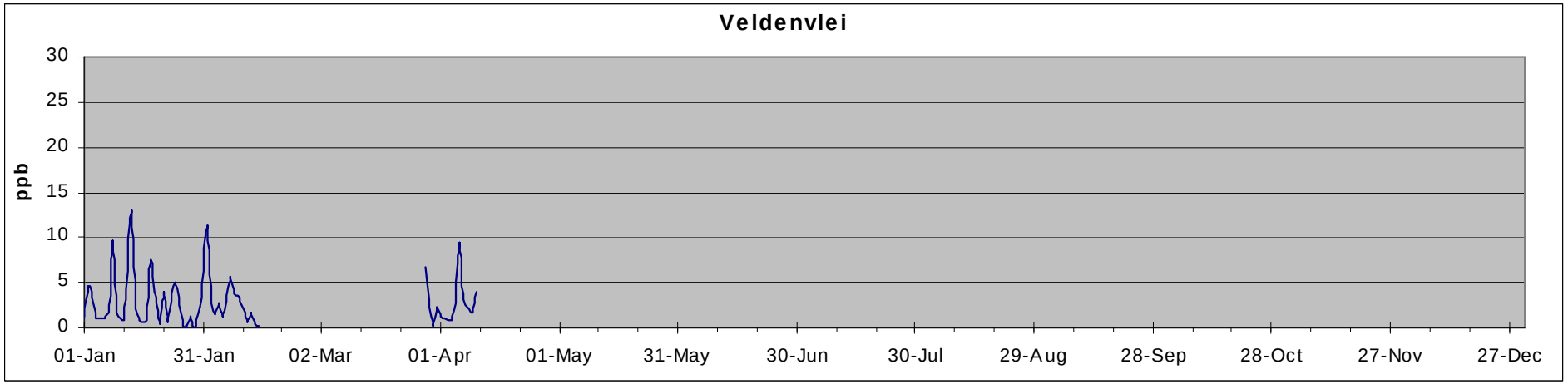


Figure 3(g): Daily mean SO_2 measured at Hillside

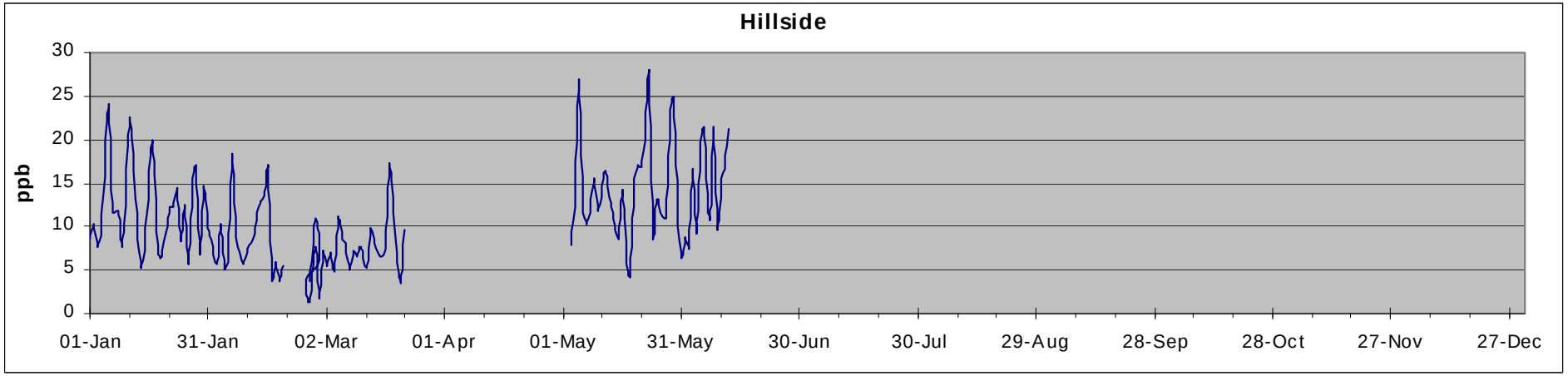
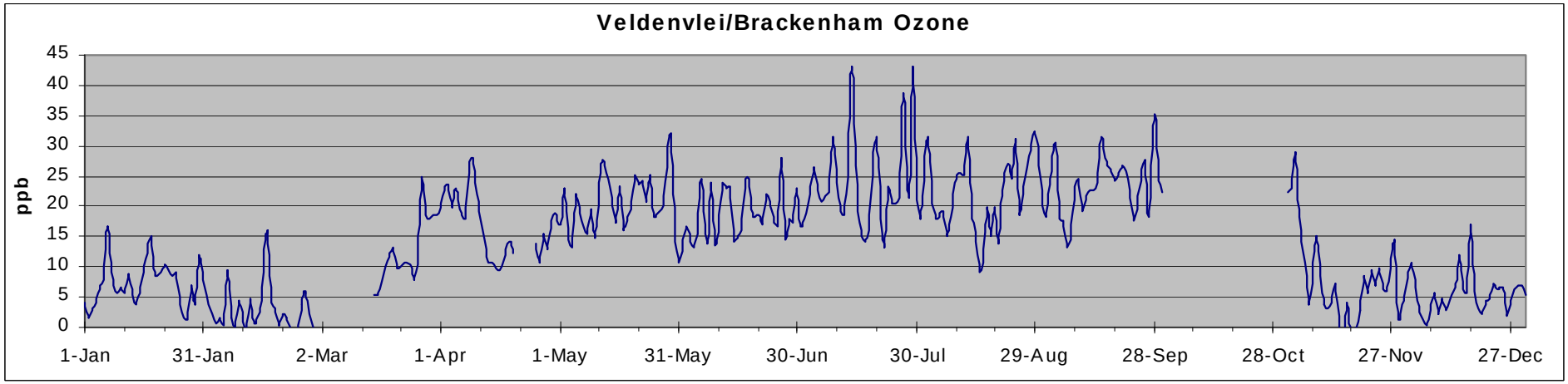


Figure 3(h): Daily mean O_3 measured at Veldenvlei and Brackenham



Arboretum

Elevated SO_2 concentrations at Arboretum (Fig. 3(a)) were generally recorded during moderate west-south-west to south-westerly winds, between 220º and 260º, with the highest daily averages recorded during July (Fig. 2). Peaks associated with this wind field generally originate from Hillside Aluminium or Foskor, although Bayside Aluminium may also contribute to a lesser extent. Elevated SO_2 was also recorded during westerly winds on occasions. In this case, the most likely source was Mondi Kraft. The maximum daily average on 30 June and elevated daily average SO_2 on 24-25 June were mainly a result of problems experienced at the Foskor plant. Winds were light to moderate WSW on the 30th and fresh south-westerly on the 24-25th, which corresponded to the direction of Foskor relative to the station. The peak on 4 August was associated with moderate WSW winds, which suggested Hillside Aluminium or Foskor as the most likely sources. The peak in daily average SO_2 at Arboretum on 8 February was measured during moderate to fresh westerly winds, thus the most likely source was Mondi, although contributions from the AECI boiler are also possible on this vector.

Arboretum Extension

Data capture commenced at the Arboretum Extension station on 13 April, after relocation of the Wildenweide station. The trend in daily average SO_2 at Arboretum (Fig. 3(b)), showed fairly good agreement with Arboretum, for data which was comparable, which is to be expected considering the station localities relative to industry. Elevated SO_2 concentrations at Arboretum Ext. tended to be associated mainly with winds from the WSW to south-west. The south-west vector corresponds mainly to Foskor and the WSW vector mainly to Hillside Aluminium, although a combination of these sources may contribute at any given time, and contributions from Bayside are also possible. Maximum daily average SO_2 at Arboretum Ext. was measured on 31 May and a prominent peak was recorded on 2 June. Winds were moderate to fresh WSW in both cases and the most likely source was one of, or a combination of, Foskor and Hillside, although contributions from Bayside were also possible. Peaks in daily average SO_2 were also evident at Arboretum on these days (Fig. 3(a)), although concentrations were lower. Similar sources were inferred for the peak on 4 August, which occurred under similar weather conditions and showed good agreement with that at Arboretum. Peaks on 15 and 17 August also showed good agreement with measurements at Arboretum, with winds moderate from the WSW. The peak on 30 June was also evident at Arboretum and was related to problems at the Foskor plant during moderate WSW winds.

Caravan (TLC building)

Daily average SO_2 measured at the Caravan site, adjacent to the Municipal building, is provided in Figure 3(c). Note the variation in Y-axis scale. There was generally good agreement in the trend in daily average SO_2 at the Caravan with Arboretum and Arboretum Extension, as well as

Wildenweide and Veldenvlei and to some extent, Brackenham, although the averages at the Caravan were usually higher than at the other stations. Most peaks in daily average SO_2 at the Caravan were associated with moderate to fresh west-south-west to south-westerly winds, which are able to transport SO_2 from Mondi, Hillside, Bayside and Foskor to the measurement station. The maximum daily average SO_2 on 30 June exceeded the daily average guideline (48 ppb) and is discussed in further detail under Chapter 3. Winds were moderate from the WSW on this day and Foskor was confirmed as the major source. The peaks on 30 May and 2 June showed good agreement with Arboretum Extension and were measured during consistent WSW winds, which suggests Hillside and/or Foskor as the main sources. The peak on 30 April was associated with sustained, fresh south-westerly winds, which again indicates the most likely sources to be Hillside and/or Foskor, with possible contributions from Bayside. The peak on 13 January was, likewise, associated with sustained south-westerly winds.

Brackenham

The daily averages for Brackenham (Fig. 3(d)) are presented for trend purposes only as adjustments were required to the data as a result of the analyser drifting out of specification during May to July. Data only became valid from 1 May onwards following the station move from Veldenvlei and data from 1 August to 17 October was unavailable owing to a slow analyser response, and thence removal of the analyser for repair (refer Appendix 1). Brackenham tended to measure higher daily averages during southerly to SSW winds, which corresponds mainly to the vectors from Hillside and Foskor. Maximum daily average SO_2 was recorded on 10 July, associated with strong southerly winds, which suggests any one or a combination of Hillside or Foskor were the most likely sources. Peaks in daily average SO_2 at Brackenham on 5 and 29 November were both associated with fresh southerly to SSW winds, which again indicates any one or a combination of Hillside or Foskor were the most likely sources, with smaller contributions from Bayside also possible.

Wildenweide

Data capture at Wildenweide (Fig. 3(e)) was discontinued after 10 April as the station was moved to Arboretum Extension. Elevated daily average SO_2 at Wildenweide was generally associated with south-westerly winds. Maximum daily average SO_2 on 16 July was measured during fresh south-westerly winds, which suggests Mondi and/or Hillside Aluminium as the most likely sources. Elevated daily average SO_2 on 31 January to 1 February showed good agreement with the Caravan and was associated with fresh south-westerly to WSW winds. The source at Wildenweide was most likely Mondi and/or Hillside Aluminium.

Veldenvlei

The trend in daily average SO_2 at Veldenvlei (Fig. 3(f)) was discontinuous owing to the analyser requiring a service followed by vandalism of the station, and then the station relocation to

Brackenham on 10 April. Elevated SO_2 at the station was generally correlated with moderate to fresh south-westerly to west-south-westerly winds, the main sources from this vector being Hillside Aluminium and Mondi, respectively, with the possibility of smaller contributions from Bayside Aluminium. The maximum daily average on 13 January (Table 6) was associated with fresh south-westerly winds, which suggests Hillside Aluminium was the main source of SO_2, possibly Mondi to a lesser extent. There was good agreement with the Caravan on this day, where the source direction also corresponded to Hillside Aluminium, and smaller peaks were also measured at Wildenweide and Arboretum. The peak on 31 January to 1 February also showed good agreement with Wildenweide and the Caravan and the main source at Veldenvlei was most likely Hillside Aluminium, although contributions from Mondi were also possible.

Hillside

Data capture at the Hillside station (Fig. 3(g)) was discontinuous owing to power supply problems to the site during February and after 13 June. Moisture entered the sample line at the end of March (Appendix 1). The station was relocated to the Scorpio substation opposite the road (West Central Arterial) during November 2002, however SO_2 data only became validated during January 2003. The SO_2 daily averages recorded at this station were generally higher than the averages recorded at the other stations. This is due to the closer proximity of the station to sources of SO_2. Elevated daily average SO_2 at Hillside was primarily associated with moderate north-north-easterly winds, which correspond to the vector from the Hillside FTC, and with light north-westerly land breezes, the main source of which is the Hillside GTC4 or Cast House. Short-term peaks are possible during wind switches through south-east, the source of which is Foskor. However owing to the short duration of winds from this direction, there is little influence in concentrations over the longer 24-hour average period.

The maximum daily average on 23 May was associated with light to moderate north-westerly winds, the source of which was Hillside Aluminium, mainly the GTC4 or Cast House. Peaks in daily average SO_2 on 5 and 28-29 May were associated with light northerly to moderate north-easterly winds, which indicate Hillside as the main source. Similar weather conditions prevailed when elevated SO_2 was measured at the station on the 6th, 8th and 12th June, which again suggests from the Hillside plant or the dam excavation site. Peaks in daily average SO_2 earlier in the year on 6, 11 and 17 January were correlated with light to moderate NNE to north-easterly winds, which corresponds to the direction from the Hillside FTC.

Veldenvlei Ozone

Daily average O_3 concentrations are provided in Figure 3(h). The analyser was moved from Veldenvlei to Brackenham on 10 April, but the data from both localities is presented together for trend analysis. O_3 data was unavailable during October as a result of the base station failure. The trend generally showed increased levels of ozone during winter and lower concentrations during

summer, a similar trend to that of the previous year. The maximum daily average O_3 on 14 July was associated with south to WSW winds, while the peak on 29 July was associated mainly with light to moderate NNE winds.

2.2.4 Diurnal Trends

Diurnal trends indicate variations with time of the day. The diurnal trend in SO_2 for each station for 2002 is shown in Figure 4(a), and the diurnal trend in O_3 is shown in Figure 4(b).

Figure 4(a): Diurnal SO_2 trends for the period January to December 2002

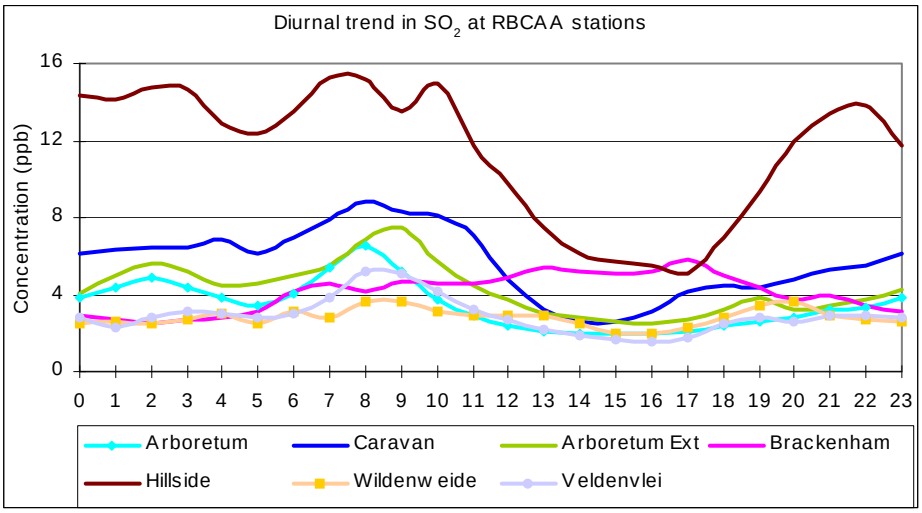
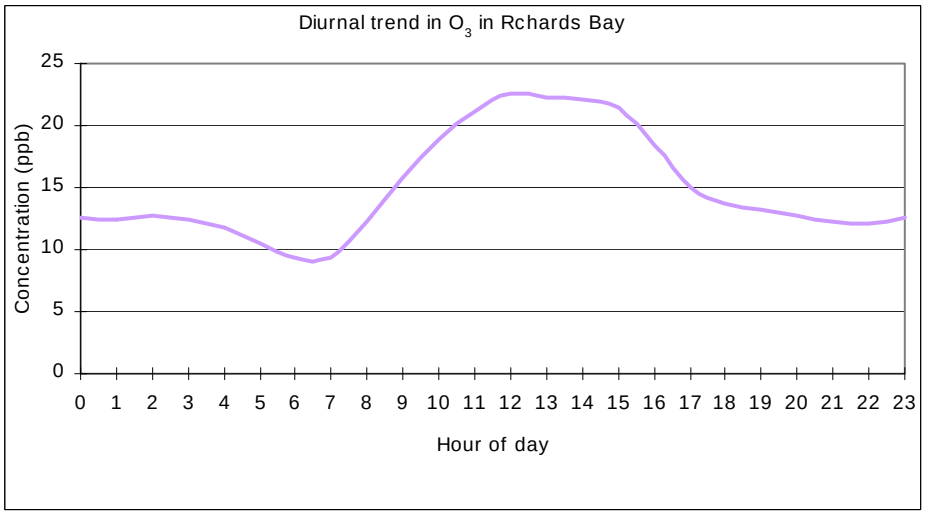


Figure 4(b): Diurnal O_3 trend for the period January to December 2002



The SO_2 diurnal trends (Fig. 4(a)) were similar to those observed in previous years, for those stations with comparable data. Consider that the trends for Hillside, Arboretum Ext., Veldenvlei, Wildenweide and Brackenham are based on data capture rates below quality assurance (80%). The Hillside station showed the strongest diurnal trend, with peak SO_2 concentrations from late evening to mid-morning, after which concentrations decreased to a minimum during late afternoon when dispersion had improved. The evening to early morning concentrations coincide mainly with the land breeze circulation (north-westerly), which transports SO_2 mainly from the Hillside GTC4 and Cast House, combined with the effects of poor dispersion conditions. The elevated mid-morning concentrations result mainly from the onset of diurnal north-easterly winds, which

transport SO_2 from the direction of the Hillside FTC. Even though high instantaneous peaks were mainly recorded during the afternoon, the winds are not prolonged enough to sustain high concentrations at the station and thus had little influence on the diurnal trend.

The diurnal trends at the Caravan (TLC building), Arboretum, Arboretum Ext., Veldenvlei and Wildenweide stations were similar, although concentrations were higher at the Caravan, followed by Arboretum Ext. and the trend was weakest at Wildenweide. SO_2 concentrations increased overnight and were generally highest during the morning, particularly between 07h00 and 09h00. The morning peak at the Caravan was of a longer duration than at the other stations. The stations generally recorded increased SO_2 during west-south-westerly to south-westerly winds. Minimum concentrations were recorded during the afternoon as dispersion conditions, particularly during summer, improved and diurnal winds veered anticlockwise from south-westerly to southerly, off the main source vectors relative to the stations. Night-time concentrations at Wildenweide and Veldenvlei were lower than the other three stations, mainly a function of nocturnal winds during inclement events turning clockwise to blow more from the WSW, off the vectors to major sources such as Hillside and Bayside Aluminium and Foskor.

The diurnal trend at Brackenham showed an increase in SO_2 during the afternoon, mainly as a result of diurnal winds during inclement weather events turning from south-west in the morning to southerly in the afternoon, which then corresponds to the vector to major sources such as Hillside Aluminium and Foskor relative to the station. Morning concentrations were sustained by south-westerly winds, which correspond to the direction from Mondi relative to the station. The diurnal trend in O_3 (Fig. 4(b)) showed a minimum shortly before sunrise and an increase during the day under the influence of ultra-violet light, a pre-requisite for photochemical reactions in the formation of ozone. Concentrations decreased again after nightfall.

2.2.5 Frequency Distribution of Results

Daily averages

A frequency analysis of environmental data is customarily performed in order to classify the air pollution for a region. It is also useful when working with large data sets. A frequency distribution of the data reveals the predominant SO_2 concentrations (as categories) over a period of time. The frequency distribution (histogram graph) and cumulative percent (line graph) of daily mean SO_2 data is given in Figures 5 (a) - (g). Note the variation in the X-axis scale and sample sizes, depending on the data capture for each station. Note also, that the Brackenham data is based on best-fit adjustments and is included for interest only. The X-axis scale indicates the upper SO_2 concentration, i.e. 2 ppb refers to the range of concentrations > 0 ppb and <= 2 ppb. A steep curve indicates a predominance of daily averages of low concentrations (i.e. air quality is very good at the station), while a gentler curve indicates a more even frequency distribution of concentrations and poorer air quality.

The mode (most frequently occurring category) was the 0-2 ppb class (denoted as 2 ppb on the graphs) at all stations apart from Hillside. The Arboretum, Wildenweide and Veldenvlei distributions were typically logarithmic, with a high proportion of low concentration daily averages and progressively lower high concentration events. The distribution at Arboretum Ext. differed in that a second peak was evident in the 4-6 ppb class. The cumulative percentage curve at the Caravan was more stepped, indicating a tendency for a number of daily averages at higher concentration classes, e.g. 6-8 ppb and 10-15 ppb. The trend at Hillside (Fig. 5 (e)) differed somewhat to the other stations in that the most frequently occurring classes were the 4-6 ppb and 8 to 10 ppb classes, not the lowest 0 to 2 ppb class, as with the other measurement stations, indicating a tendency for higher daily average SO_2, i.e. poorer air quality. The cumulative percentage distribution curve was more gentle and a "normal' distribution was evident, compared to the positively skewed distribution at the other stations.

Figure 5 (a): Frequency distribution of daily mean data at Arboretum for the period January to December 2002 (n = 361)

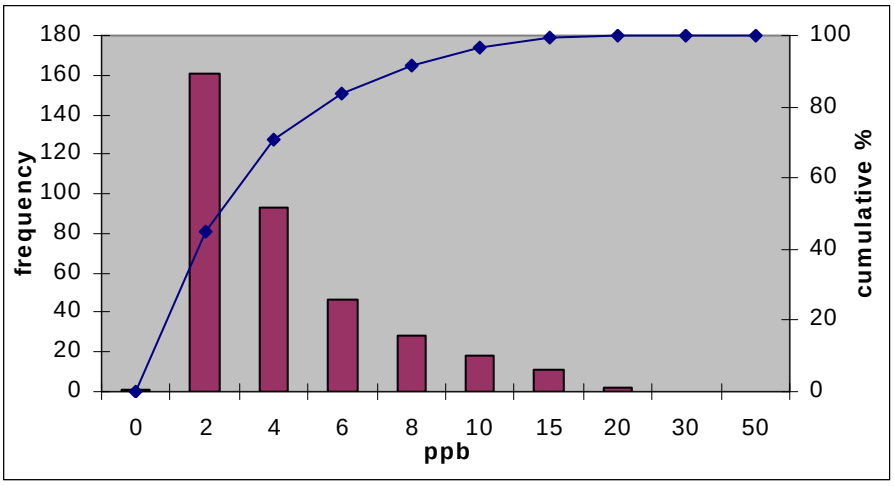


Figure 5 (b): Frequency distribution of daily mean data at Arboretum Extension for the period January to December 2002 (n = 251)

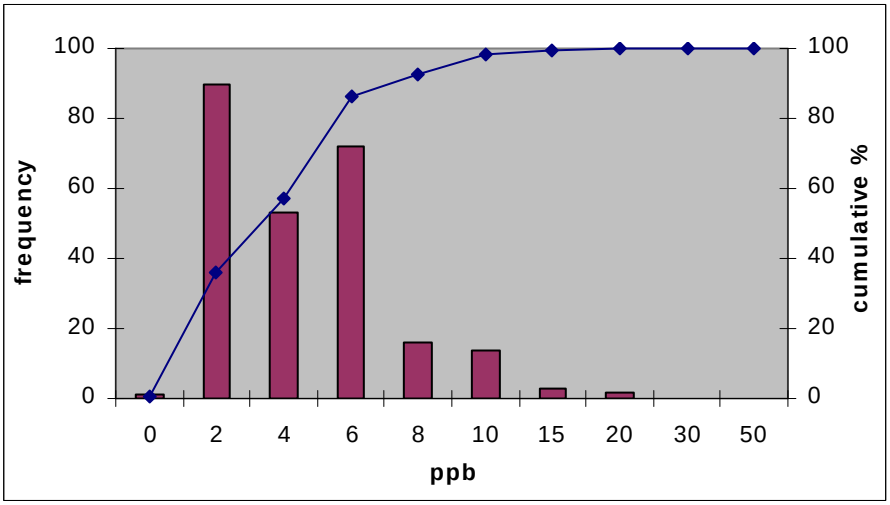


Figure 5 (c): Frequency distribution of daily mean data at the Caravan (TLC offices) for the period January to December 2002 (n = 351)

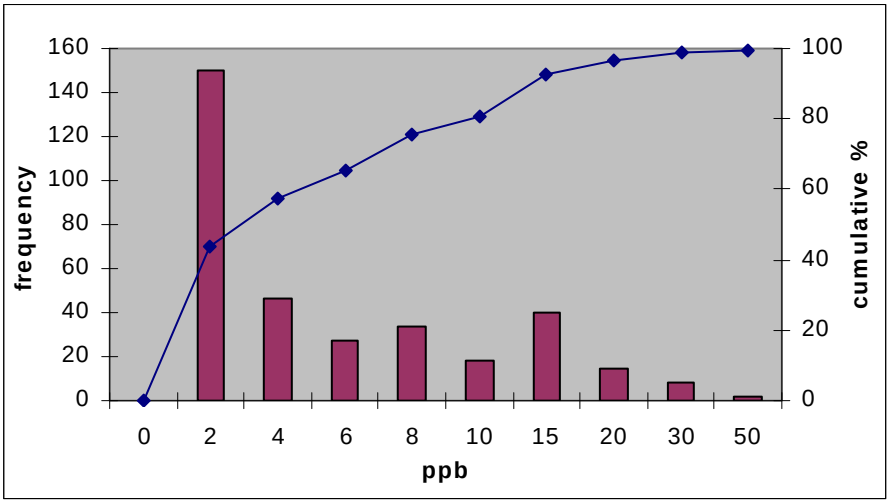


Figure 5 (d): Frequency distribution of daily mean data at Brackenham for the period January to December 2002 (n = 177)

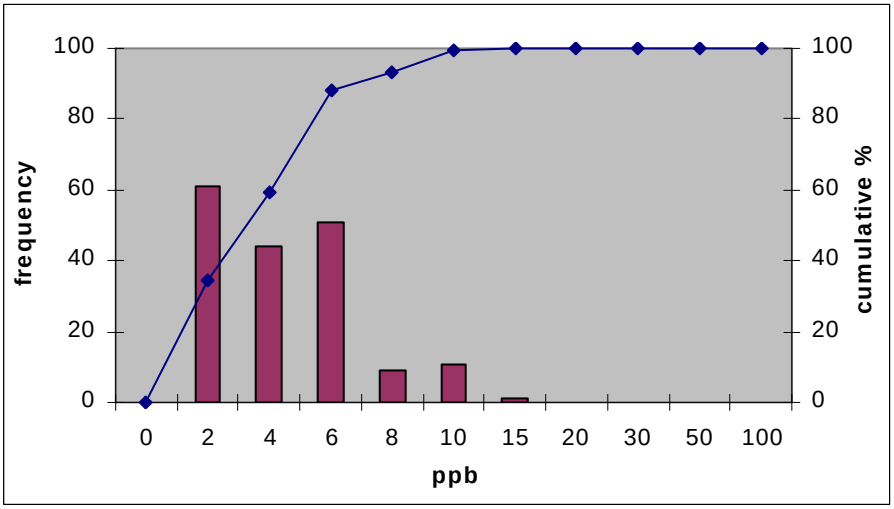


Figure 5 (e): Frequency distribution of daily mean data at Veldenvlei for the period January to December 2002 (n = 87)

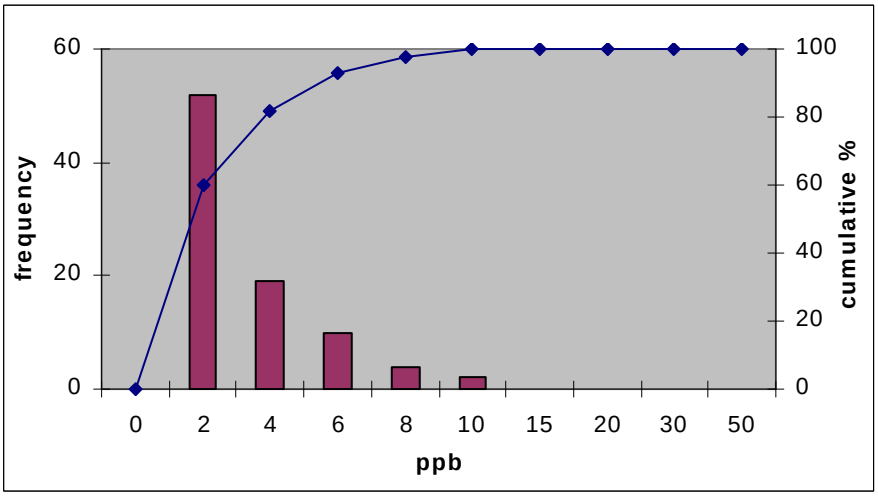


Figure 5 (f): Frequency distribution of daily mean data at Wildenweide for the period January to December 2002 (n = 100)

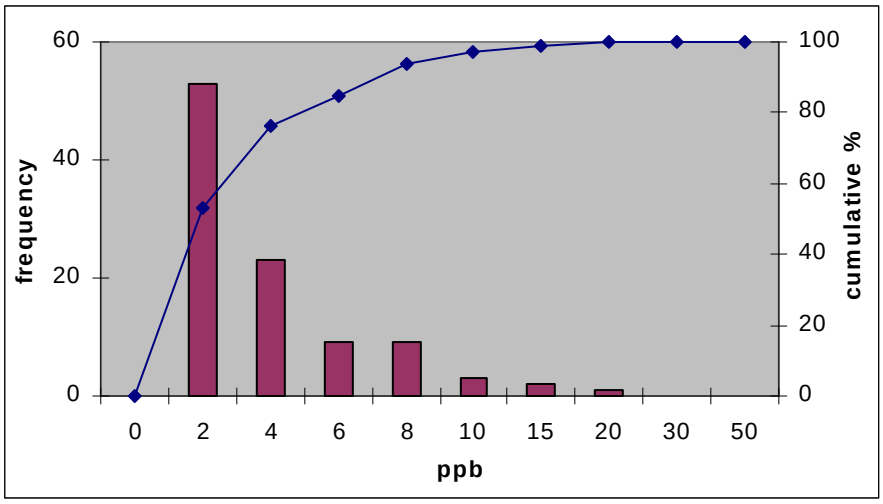
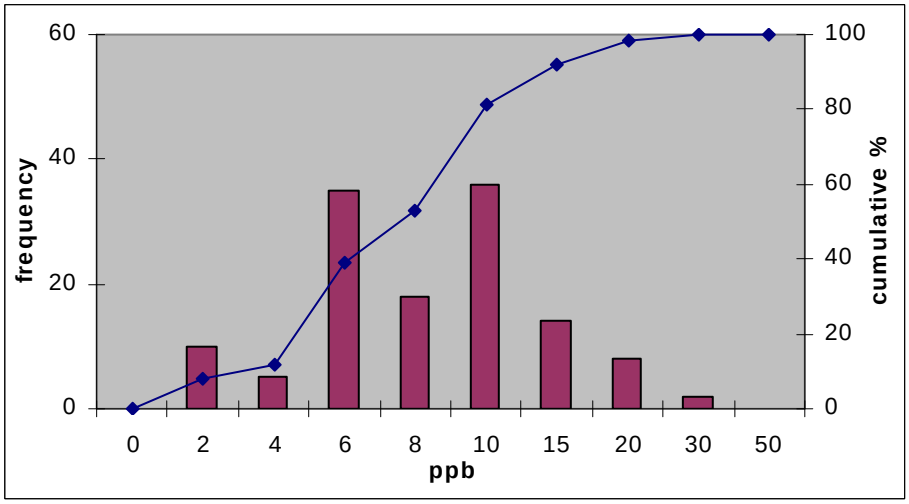


Figure 5 (g): Frequency distribution of daily mean data at Hillside for the period January to December 2002 (n = 128)



Percentiles of daily averages

Percentiles show the spread of the data by giving an indication of the concentration below which the specified percentage of the data occurs, e.g. 95% of SO_2 daily averages at the Caravan were less than 16.8 ppb, conversely, 5% of daily averages were above 16.8 ppb. 95^{th} Percentiles of the daily mean data from all the monitoring stations are shown in Table 4. Note that only the data for Arboretum and the Caravan is statistically valid, i.e. data capture was above quality assurance standards of 80%. Data for the remaining stations is presented for interest only. The percentile values were highest at Hillside, i.e. the air quality was poorest at that station.

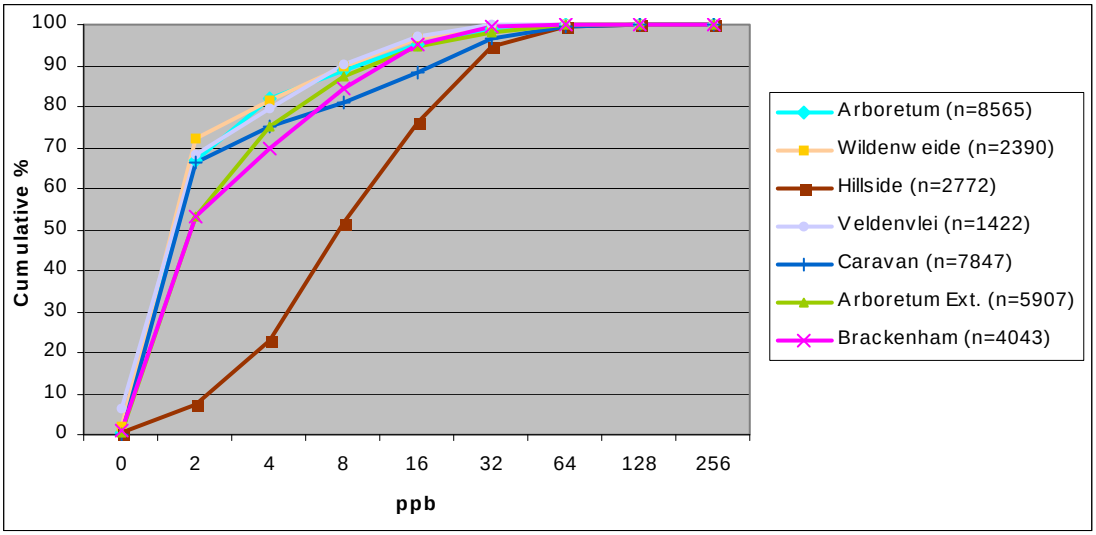
Table 4: Percentiles for the daily mean SO_2 at each station

Percentile	SO_2 (ppb)						
	Arboretum	Arboretum Ext.	Caravan	Brackenham	Veldenvlei	Wilden weide	Hillside
95th	9.7	11.4	16.8	10.6	9.4	8.2	21.5
75th	4.9	6.1	8.4	6.1	3.8	3.8	14.3
50th	2.5	3.2	3.4	3.2	2.0	1.8	10.0

Hourly averages

The cumulative percentage curve of hourly mean SO_2 data at all stations is provided in Figure 6. Note that the X-axis scale is logarithmic. The slope at Hillside was different to those of the other stations, indicating a tendency for higher hourly average SO_2 at Hillside. At the other monitoring stations, most hourly averages were of low concentration and there were fewer occurrences at the higher concentration classes. The slope for the Caravan was gentler than that for Arboretum, Wildenweide and Veldenvlei, indicating a tendency for a higher proportion of hourly averages at higher concentration ranges.

Figure 6: Cumulative percent of Hourly Mean data for the period January to December 2002



Note: Hillside, Arboretum Ext., Wildenweide, Brackenham and Veldenvlei curves are based on less than 80% data capture for the year

Percentiles of hourly averages

Percentiles of the hourly mean data from all the monitoring stations are shown in Table 5.

Table 5: Percentiles for the hourly mean SO_2 at each station

Percentile	SO_2 (ppb)						
	Arboretum	Arboretum Ext.	Caravan	Brackenham	Veldenvlei	Wilden weide	Hillside
95th	15.4	16.9	27.3	15.7	13.0	13.7	32.8
75th	2.7	4.0	4.0	5.0	2.9	2.5	15.5
50th	1.4	1.9	1.1	1.8	1.0	0.9	7.6

Note: statistics for Hillside, Arboretum Ext., Wildenweide, Brackenham and Veldenvlei are based on annual data capture rates of less than 80%.

The British Department of Environment's classification scheme suggests that, for SO_2, a 95th hourly average percentile less than 60 ppb is classified as *Very Good*, between 60 and 124 ppb is classified as *Good*, between 125 and 399 ppb is classified as *Poor* and greater than or equal to 400 ppb is classified as *Very Poor*. According to this scheme, the air quality, in terms of SO_2 measured at the stations, may be regarded as *Very Good*. The air quality was poorest at the Hillside station, where the percentiles were consistently the highest of all stations. Hourly average SO_2 was "very poor" (i.e. > 400 ppb) on two occasions at the Caravan and was "poor" (i.e. > 125 ppb) on one occasion each at the Caravan and Hillside station.

3 Maximum SO_2 Concentrations

The maximum 24-hour average, hourly average and 10-minute average SO_2 concentrations (in ppb) measured during 2002 are shown in Table 6. The maximum for the 24-hour and 10-minute averaging periods is reflected as a percentage of the DEAT guidelines. Although there is no longer an applicable DEAT hourly average SO_2 guideline, the hourly average maxima are presented for interest and in order that comparisons can be made to the UK classification scheme, which regards hourly averages of greater than 125 ppb as poor. More detailed descriptions of the maxima are available in the weekly and monthly reports. Maximum hourly and daily average O_3 measured at Veldenvlei and Brackenham is also provided.

Table 6: Highest SO_2 and O_3 concentrations (ppb) measured at each station during 2002 and percent of WHO/revised National guideline

STATION	DAILY AVERAGE		HOURLY AVERAGE		10-MIN AVERAGE	
	SO_2 (ppb)	Date	SO_2 (ppb)	Date & time	SO_2 (ppb)	Date & time
Arboretum	**19**	**30/06**	**81**	**30/06 02h00**	**697**	**30/06 03:00**
% of guideline	**40%**		**n/a**		**365%**	
Wildenweide	**16**	**16/02**	**37**	**16/02 00h00**	**63**	**31/01 11:50**
% of guideline	**34%**		**n/a**		**33%**	
Veldenvlei	**13**	**13/01**	**32**	**31/01 00h00**	**39**	**06/04 08:40**
% of guideline	**27%**		**n/a**		**21%**	
Caravan (TLC)	**71**	**24/06**	**601**	**24/06 11h00**	**837**	**24/06 11:20**
% of guideline	**148%**		**n/a**		**438%**	
Hillside	**28**	**23/05**	**148**	**05/06 10h00**	**253**	**05/06 10:20**
% of guideline	**57%**		**n/a**		**132%**	
Arboretum Ext.	**22**	**31/05**	**116**	**30/06 03h00**	**516**	**30/06 03:10**
% of guideline	**45%**		**n/a**		**270**	
Brackenham	**18**	**10/07**	**57**	**05/07 12h00**	**94**	**18/06 12:45**
% of guideline	**37%**		**n/a**		**49%**	
O_3	**43**	**14/07**	**101**	**07/01 15h00**		
% of guideline	**n/a**		**83%**			

The maximum daily average SO_2 at the Caravan exceeded the guideline and was, in fact, almost one-and-a-half times the guideline value. Maximum 10-minute and hourly average SO_2 concentrations were also recorded on this day, the maximum 10-minute average guideline being more than four times the guideline. The 10-minute average guideline was exceeded continuously between 09h40 and 11h50 (Appendix 5a). Winds were fresh from the south-west during this time and this incident was examined in some detail in the June monthly report. The investigation concluded that the most likely source of the exceedances at the Caravan was plume downdraft from Foskor.

Both Arboretum and Arboretum Ext. recorded maximum 10-minute average SO_2 during the same incident on the morning of 30 June, the maximum 10-minute averages exceeding the guideline at

both stations. The maximum daily average SO_2 for Arboretum was also recorded on this day. Winds were moderate from the WSW, which corresponded to the vector from Foskor. This incident was also addressed in the June monthly report and Foskor was confirmed as the source. The maximum 10-minute average at Hillside (which also exceeded the guideline and is described in Appendix 5a) was associated with light north-westerly winds. While the source direction corresponded to the Hillside Cast House and the GTC4, the source may have been associated with vehicles engaged in excavation works for the impoundment dam. The maximum daily average SO_2 concentration at Hillside on 23 May was mainly a result of elevated concentrations measured during the morning, associated with light north-westerly winds. The main source was most likely the Hillside GTC4. The maximum concentrations measured at Brackenham, Wildenweide and Veldenvlei were lower by comparison to those measured at Arboretum, Arboretum Ext., the Caravan and Hillside.

The maximum hourly average ozone was measured at Veldenvlei on 7 January at 15h00 and was 83% of the guideline. Winds during this time were fresh from the south-east. The maximum daily average ozone was recorded on 14 July at Brackenham, during which winds were mainly from the south to WSW.

4 Air pollution complaints

A total of 136 air pollution complaints were lodged with the RBCAA during the year 2002, two and-a-half times the number logged in 2001. The monthly breakdown is shown in Table 7 and an area breakdown is shown in Table 8. Details of the complaints are provided in each monthly report.

Table 7: Number of complaints logged with the RBCAA during the year.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	3	2	16	22	10	16	27	13	13	8	4

Table 8: Most common locality of air pollution complaints.

Location	Complaints Total for 2002
Veldenvlei	31
Meerensee	17
Arboretum	15
CBD	12
Hillside	11
Foskor area	11
Arboretum Ext.	8
Enseleni	6
Empangeni	6
Alton	4
Felixton	4
Birdswood	3
Other	8
TOTAL	**136**

Most of the complaints were from the residential areas of Veldenvlei, Meerensee and Arboretum, followed by the Central Business District (CBD). An increased number of complaints originated from the Hillside and Foskor areas, which are relatively close to each other. In all, the area totalled 22 complaints. The Hillside complaints included complaints from the Hillside expansion site. The number of complaints increased during winter, with a maximum number of complaints logged during August. The majority of complaints were odour complaints, most commonly Mondi odours, yeast odours, ammonia odours, “cat” smell and Foskor odours. A total of six complaints were logged on the morning of 6 May regarding an intense Mondi odour, the case study of which indicated Mondi as the source. A further five complaints were logged on 26 June, the complaints ranging from pesticide-like to “cat” odour and Mondi odour. Mondi was confirmed as the source.

On 15 July over 200 people were admitted to hospitals and clinics as a result of a plume which descended over the area of the Hillside expansion site and John Ross Highway. The Hillside measurement station was off-line during this time, as power was unavailable. A case study was performed and a provincial enquiry was initiated to examine the cause. The incident was related to a

start-up at the new Foskor plant. Meteorological conditions were examined in detail, and indicated a wind shift to south-east, a change in air stability and downdraft during the time of the incident.
Two of the August complaints in the Foskor area regarding breathing difficulty and itchy/burning eyes were related to emissions from the molten sulphur storage tanks at Foskor. A complaint regarding "bad stack emissions" from Foskor on 9 September was found to be the result of a trip in the A-plant. Five complaints regarding a Foskor odour, logged on the afternoon 21 October, were found to be a result of an incorrect pH of effluent used to slurry gypsum at the plant.

5 Atmospheric Data

5.1 Weather Summary

Figure 7 presents the daily average lapse rate measured at the Bayside Aluminium tower. The lapse rate is the difference between the measured temperatures at 2 m and 70m. If the lapse rate is negative, it indicates warm air above cool air, and hence stable atmospheric conditions and limited pollution dispersion potential. If the lapse rate is positive, this indicates warm air below cool air, and neutral to unstable atmospheric conditions, and dispersion is enhanced. Figure 8 indicates the average diurnal trend in lapse rate for the year. Unfortunately no data was available at the beginning of the year and from 19 July to 20 August owing to electronic instrument failure (refer Appendix 1) and during October as a result of the database crash. Nonetheless, it can be seen that the lapse rate during the summer was largely positive, i.e. atmospheric conditions are unstable and dispersion of pollution is generally favourable. The lapse rate progressively changed to become more negative with the approach of autumn and was strongly negative during much of winter, which indicates a stable atmosphere and poor dispersion conditions. A prolonged period of stability occurred from 2 to 9 July, with particularly strong inversion conditions evident on 6 and 8 July. This period was interrupted by the passage of cold front on 10 July, after which conditions stabilised again prior to the advance of another cold front on 18 July, which was accompanied by unstable weather. Springtime showed a return to a positive lapse rate and more unstable conditions.

Figure 7: Daily Average Lapse Rate at the Bayside Tower (T2m – T70m)

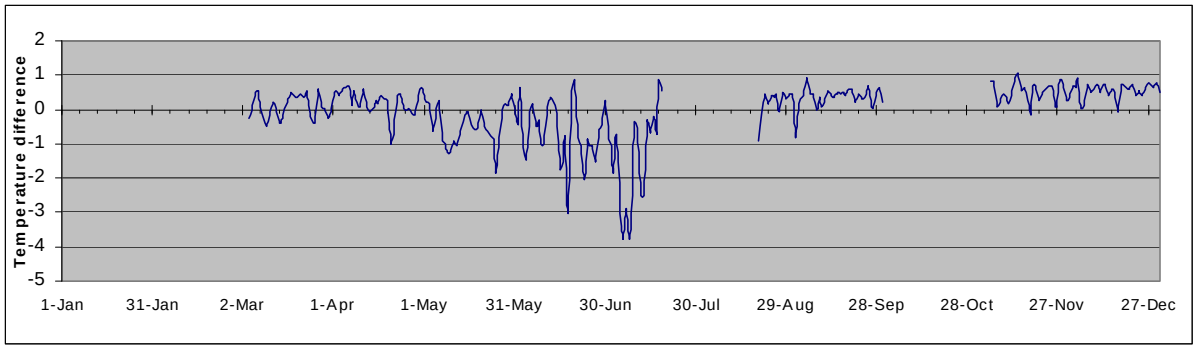
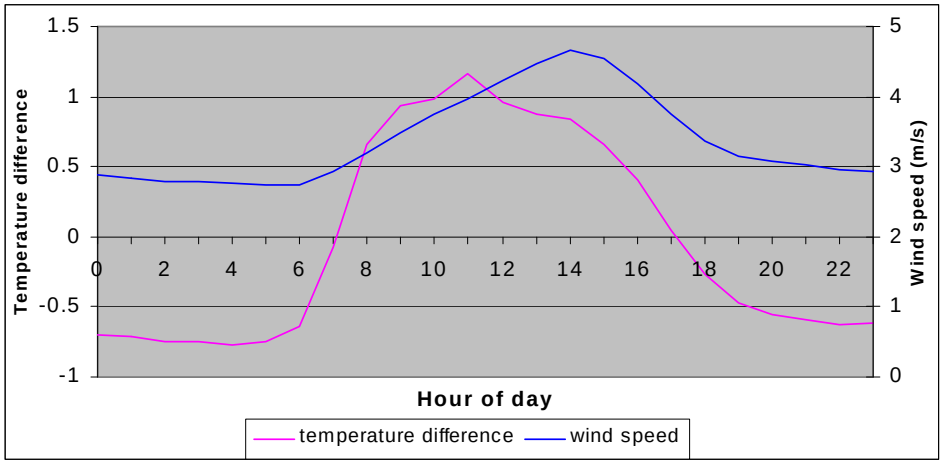


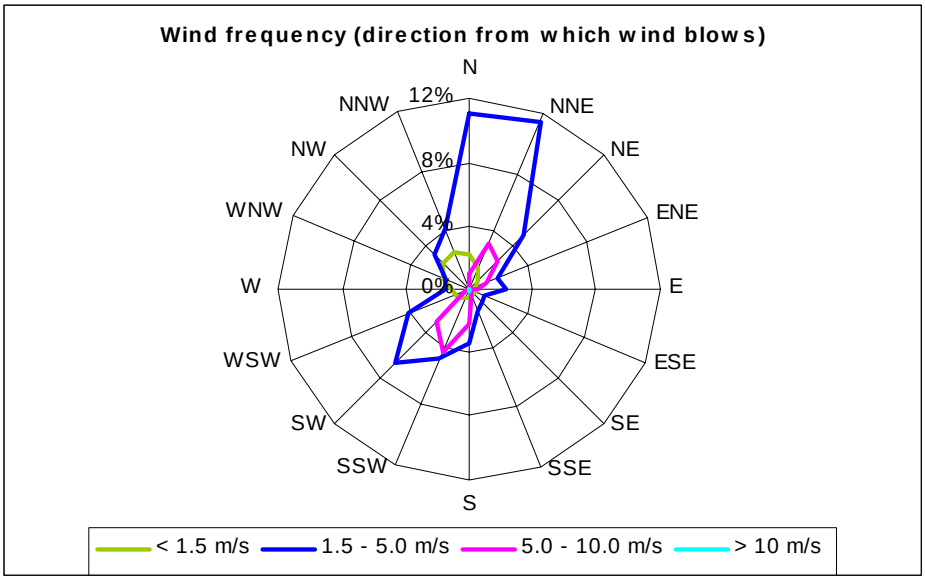
Figure 8: Average Diurnal Lapse Rate at the Bayside Tower (T2m – T70m) and wind speed at the Arboretum tower (18 m)



The diurnal lapse rate was similar to that of previous years. The lapse rate is generally negative overnight, indicating stable conditions. It generally decreases to a minimum shortly before sunrise. After the onset of diurnal heating during the day, the lapse rate becomes positive, which leads to unstable conditions. The maximum temperature difference was measured for the hour 11h00 to 12h00. The lapse rate generally decreases again towards late afternoon and becomes negative again after sunset. The diurnal trend of SO_2 is influenced by the temperature lapse rate, in that stable conditions will provide less chance of dispersion. The effect is a general increase in the SO_2 concentrations at night and early morning and a decrease in the SO_2 concentrations during the day when dispersion is enhanced (refer Fig 6). Diurnal wind speeds (Fig. 8) follow a similar trend, with wind speeds gradually increasing an hour to two hours after sunrise and peaking during the afternoon, after which speeds decrease again towards nightfall and are low overnight. The diurnal wind speeds also influence pollution levels, in that higher wind speeds generate more turbulence and result in improved mixing, while lower wind speeds are poor for pollution dispersion. The effects are also reflected in the diurnal SO_2 trends in Figure 6.

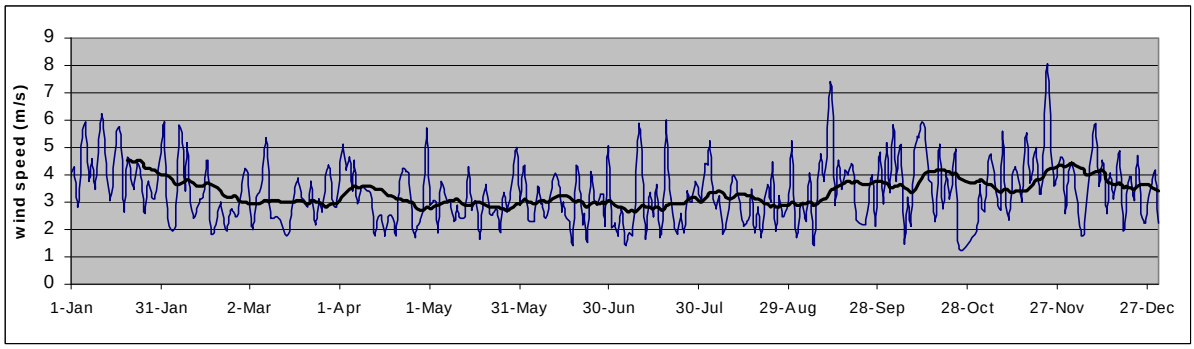
The annual wind frequency given in Figure 9 plots the frequency of speed and direction from which the winds blow. The frequency diagram was similar to that of the previous year. The highest frequency of winds were moderate (1.5 to 5.0 m/s) from the north to NNE and, to a lesser extent, from the south-west. Higher speed winds (> 5 m/s) were predominantly from the SSW, south-west and south, associated with the passage of coastal low pressure systems or cold fronts, and to a lesser extent from the NNE to north-east, associated with fine weather and high pressure east of the country. Low speed winds (< 1.5 m/s) blew mainly from the NNE to north-west. Winds from this sector were more frequent at nighttime and early morning during the colder months, in the form of a land breeze. Seabreezes or onshore flow from the NNE to north-east generally starts after the effect of daytime heating has been felt and the overnight surface inversion is raised or eliminated.

Figure 9: Wind Rose for 2002 at the Aboretum tower (18 m)



The daily average wind speed and 20-day moving average at Arboretum is shown in Figure 10. The wind speeds were on average highest during the summer, particularly January and November and gradually decreased as conditions become more stable towards autumn. Winter wind speeds were generally light, apart from fresh to strong south-westerly to SSW winds, associated with the passage of cold fronts, e.g. 10 and 19 July. Wind speeds generally increased towards spring (August to November) as a result of an increased frequency of NNE winds, but also south-westerly winds associated with the passage of coastal lows and cold fronts. Peak wind speeds were recorded from the WSW to SSW on 12 September and 24 November, associated with well-developed cold fronts.

Figure 10: Average Daily Wind Speeds



6 Quality Assurance Report

6.1 Calibration of Equipment

The ambient air monitoring stations are South African National Accreditation Service (SANAS) ISO17025- accredited laboratories. The meteorological equipment was calibrated semi-annually by Inteltronics. ESKOM TSI performed quarterly calibrations of the continuous air pollution monitors. Analyser span and zero checks are alternated with precision checks, using an external calibrator, on a weekly basis. Precision checks are performed before and after the calibrations to determine the error of each analyser before the calibration. Results of the pre-calibration checks are given in Appendix 2. Internal quality specifications allows for a maximum error of 15%.

The analysers at Arboretum and Wildenweide/Arboretum Ext. performed to specification during the reporting period. The analyser at the Caravan was reading 21.3% high according to the pre-calibration check on 12 June, however as the span check the previous week returned a response of only 5.9% high, no adjustments were made to the data.

The Brackenham analyser had drifted out of specification from 17 May and returned a response of 20.1% low and a zero response of -5 ppb during the pre-calibration checks on 13 June. The data prior to the calibration check was adjusted for trend purposes (Appendix 4). The post-calibration data was in good order until July, when a slow analyser response and negative drift was noted. The data was adjusted for trend purposes only and data for August was invalidated prior to the analyser being removed for repair. The repaired analyser was reinstalled on 17 October. The ozone analyser at Brackenham returned an 18% high response during the September pre-calibration checks. The data was left in its original form, as there was no significant step-up in the trend up to this point following the June calibration.

The Hillside analyser was removed from the station on 13 June following power supply problems and was housed temporarily at the Brackenham station. The pre-calibration results may have differed to the on-site results and the data prior to this date was left in its original form, apart from adjustments required for negative zero drift of the analyser itself and a negative database response (refer Appendix 1). The September and December calibrations were again performed while the analyser was housed at Brackenham and no data was captured at Hillside.

6.2 Quality Assurance system and ISO Accreditation

The Ecoserv quality assurance manual, detailing procedures and records for the Richards Bay Clean Air Association was drawn up and implemented in 1997 and 1998. This document formed the basis of the application to SANAS for ISO Guide 25 accreditation. Each monitoring station is regarded as a separate laboratory for accreditation purposes. The quality control scheme (in terms of quality limits and requirements) is presented in Appendix 3. The monitoring system was first accredited by SANAS during March 1999. Accreditation is now reviewed annually.

2002 saw the successful conversion of the ISO Guide 25 accreditation to the revised and upgraded ISO 17025. The conversion required Ecoserv to revise certain areas of the system. Ecoserv took the opportunity to completely renew the system and implement an electronic version that allowed for distributed teams to collaborate.
The surveillance assessment conducted in September 2002 recommended continued accreditation of the ambient air monitoring system. The assessment indicated only one major non-conformance and one minor non-conformance on the system. The non-conformances were cleared within the allocated 3 month clearance period and continued accreditation was granted on the system.

Three station moves were executed this year. As a major finding/ non-conformance during the September assessment, SANAS required a validation report for the relocation of the Wildenweide station to Arboretum Extension in accordance with station location requirements detailed in SANAS R 07-01 Supplementary requirements for the accreditation of continuous ambient air pollution monitoring stations. Clarification of the arc of exposure of the analyser at Arboretum Extension to the main source directions was required. This report was submitted to SANAS and the station move has been validated and accepted as part of the accredited system. The relocation of the Veldenvlei station to Brackenham and the Hillside station to Scorpio substation have also been successfully incorporated into the accredited ambient air monitoring system.

6.3 Data Capture rates of SO_2 Monitoring Stations

The system reliability (Table 9) provides the percentage of time that the stations, as a whole, were operational. The Wildenweide and Veldenvlei stations were moved to Arboretum Extension and Brackenham, respectively, during April and data capture for these stations is combined in the table to give an overall impression of data capture for the year from the complete suite of five RBCAA monitoring stations. Overall system reliability was 84.7%, 5.3% below the data capture goal of 90%. The lower overall reliability was mainly as a result of the power supply problems experienced at the Hillside station from 13 June onwards. As a result, the Ecoserv quality management review, recommended that this station be moved. This recommendation was accepted, if not initiated in parallel, by the RBCAA Manco. The Hillside station was relocated to the nearby Scorpio substation during November, however data capture only commenced during 2003. Overall data capture was above 90% for each of the other stations. The Arboretum station was the most reliable in terms of data capture.

SO_2 data capture for the monitoring sites for the period January to December 2002 is presented in Table 10. The overall SO_2 data capture for the five operating stations was 82.6% which was marginally above quality assurance requirements (80%) and below the data capture goal of 90%. Reasons for periods of lower data capture are presented in *Appendix 1: Missing Data*. The stations which were subject to locality moves (i.e. Wildenweide, Veldenvlei, Arboretum Ext. and Brackenham) are reflected separately so that SO_2 data capture for each locality for the year can be viewed. Only

two stations exceeded quality assurance requirements during 2002, viz. the Caravan and Arboretum. SO_2 data capture at the Arboretum was excellent, while some relatively minor interruptions occurred at the Caravan (refer Appendix 1). SO_2 data capture at the Arboretum Ext. site was good for the period in operation (13 April onwards), but over the annual period was below quality assurance. This was similarly the case for the Wildenweide station, where SO_2 data capture was good up to the time of the station move. Hillside SO_2 data capture was reduced intermittently owing mainly to moisture in the sample inlet during March to May and lack of power supply from 13 June onwards. SO_2 data capture was lowest at Veldenvlei as the analyser required servicing and the station was vandalised during March, prior to the station relocation in April. Although SO_2 data capture at Brackenham was reasonable for the time the station was in operation, the data required adjustments for the analyser drifting out of specification and for a variable data response (refer Appendix 4). The analyser was removed for servicing on 28 August and returned on 17 October. The Brackenham SO_2 data for August was invalidated owing to the slow analyser response (Appendix 1).

The data is kept in its original form wherever possible and any adjustments made, whether for analyser drift or a variable database response, are detailed in Appendix 4. Minimum intervention is preferred and any adjustments are based on the results of weekly instrument checks, the database response and baseline levels.

Table 9: System reliability at the RBCAA Monitoring Stations during 2002

Hillside	Arboretum	Wildenweide/ Arboretum Ext.	Veldenvlei/ Brackenham	Caravan (TLC)	Average
41.3	98.0	96.4	93.8	94.0	84.7

Table 10: SO2 Data Capture at the RBCAA Monitoring Stations during 2002

Month	Hillside	Arboretum	Arboretum Extension	Wildenweide	Veldenvlei	Brackenham	Caravan	Average
Jan	98.2	97.7	-	92.5	98.7	-	99.2	97.3
Feb	77.3	99.5	-	99.4	60.1	-	91.8	85.6
Mar	70	99.7	-	99.5	13.7	-	74.6	71.5
Apr	0	99.9	40	32.2	31.9	38.3	62.9	61.0
May	93.8	99.1	98.9	-	-	98.3	95.1	97.0
Jun	41.6	99.3	98.9	-	-	99.1	99.1	87.6
Jul	0	99.9	97.5	-	-	99.7	96.8	78.8
Aug	0	99.4	94.9	-	-	0	76.7	54.2
Sep	0	99.5	99.4	-	-	0	94.4	58.7
Oct	0	78	76.8	-	-	24.8	78	51.5
Nov	0	99.6	93.3	-	-	99.2	99.3	78.3
Dec	0	98.6	96.5	-	-	92.5	99.2	77.4
% of year	31.7	97.5	66.4	27.0	17.0	46.0	88.9	82.6

An Environment-SA PM_{10} analyser was reinstalled at the Caravan station at the end of September 2002 and data became available from 3 October 2002 onwards. Although the data collected during October and November appeared reasonable, data from December onwards appeared lower than expected. A portable PM10 sampler (Minivol), which measures 24-hour average PM_{10}, was operated at the same site during late December 2002 and January 2003 to verify the Environment-SA data. Results obtained from the Minivol were significantly higher than from the Environment-SA analyser and a decision was taken to exclude the PM_{10} data. The Environment-SA analyser was sent for servicing and calibration during 2003.

7. Network Report

7.1 Network Description

Outstations

The RBCAA monitoring network consists of five SO_2 monitoring stations, viz. a mobile Caravan situated near the Municipal building in the CBD; a station at Arboretum; a station at Hillside which, following power supply problems, was moved to the nearby Scorpio substation during November; a station originally located at Wildenweide and which was moved to Arboretum Extension in April; and a station originally at Veldenvlei, which was moved to Brackenham, also during April. The Veldenvlei, and later Brackenham, stations also measured ozone.

All the above monitoring stations, apart from the Caravan, also record the meteorological variables wind speed and direction and air temperature. In addition, meteorological data is measured at a 70 m tower at Bayside Aluminium, at Richards Bay Minerals (RBM2) and at the airport (RBM1). The Bayside tower measures air temperature at various levels ranging from 2 to 70 m, the information of which gives an indication of air stability. The standard deviation of wind direction in the horizontal and vertical planes (sigma-v and sigma-w), which provides an indication of turbulence, is also measured at the station. The air temperature and wind data from Bayside was unavailable until 4 March and from 19 July until 20 August owing to electronic instrumentation failure (refer Appendix 1). Meteorological measurements at the RBM2 tower include rainfall, atmospheric pressure, humidity and solar radiation, in addition to the standard measurements of air temperature and wind. The RBM1 station is mainly used for wind and temperature measurements. All data is transmitted as 5-minute averages by radio telemetry to the base station at the RBCAA offices in the Municipal building. Pollen monitoring, under the auspices of Wits University, is conducted at four sites, viz. Brackenham, Meerensee, UVS and Empangeni and analysis is conducted separately to this report.

Master Station

The master station at the Richards Bay TLC office building functioned satisfactorily during 2002.

Base Station

The base station operated satisfactorily until failure on 21 October. While data could be recovered up to the backup of end September, data for October could only be partially recovered. The problem was compounded by the laptop computer being sent in for repairs, which meant that data could not be downloaded from the station dataloggers. Fortunately most SO_2 and wind data could be recovered *via* the weekly report spreadsheets.

Hawk pollution dispersion model

The Hawk models SO_2 concentrations by accessing all available meteorological data and average industrial emissions. The model is used for case studies to investigate sources of complaints, based on the prevailing meteorological conditions and average emission rates. The Hawk computer was sent to Pretoria for detailed modelling of conditions associated with the incident on 15 July 2002. The model did not work satisfactorily on return to Richards Bay and was returned to the programmer during October for validation.

8. Summary

- Annual average SO_2 for 2002 was in the same range as previous years, for those stations which are comparable, with no significant variation.
- Air quality was poorest at the Hillside station in terms of SO_2, although data capture was incomplete for the year.
- 18 exceedances of the DEAT 10-minute average SO_2 guideline of 191 ppb and one exceedance of the 24-hour average SO_2 guideline of 48 ppb were recorded during 2002. All exceedances were recorded during June.
- A total of 136 complaints were logged with the RBCAA during the year, mostly from the residential areas of Veldenvlei, Arboretum and Meerensee and the CBD area.
- SO_2 data availability was overall 83% for the year, marginally above quality assurance (80%), but lower than the target of 90%. Overall system reliability was 85%, 5% below target. The main reason for overall data loss was power failure to the Hillside station and analyser failure at Brackenham and Veldenvlei.

9. Objectives for 2002

- Expand system to include reliable fine particulate (PM10) monitoring capability
- Expand the monitoring system to mirror the political expansion of the Umhlatuze Council area
- Improve the use of the Hawk modelling system to provide new format information for users
- Provide a commercial service for developers by using the Hawk system for planning purposes.
- Improve overall SO_2 data reliability to greater than 90% for the year.
- Maintenance of the ISO 17025 accreditation.

10. Achievement of 2002 Objectives

2002 Objectives	Objective Status
♦ Improve SO_2 data reliability to greater than 90% for the year.	♦ Overall data capture 5% below this figure, due mainly to power supply problems at Hillside and problems with the Veldenvlei/Brackenham analyser. Hillside station move to Scorpio substation should result in improved data capture rates during 2003.
♦ Maintenance of SANAS accreditation.	♦ SANAS re- accreditation audits in September 2002, system upgraded to ISO 17025.
♦ Policy regarding expansion of the system.	♦ Policy defined for monitoring and modelling. Attention shifts to the implementation of the same.
♦ Move of the Veldenvlei station to a more secure site	♦ Veldenvlei station moved to Brackenham during April 2002.

APPENDIX 1: MISSING DATA

FROM		TO		
DATE	**HR**	**DATE**	**HR**	**REASON/COMMENTS**
All stations				
22-Oct	01:20	22-Oct	23:55	Base station failure
25-Oct	03:35	30-Oct	10:00	Base station failure
Wildenweide				
10-Apr	16:00			station moved to Arboretum Extension
Hillside				
27-Jan	11:55	27-Jan	20:01	negative analyser response following power failure
20-Feb	06:00	26-Feb	11:00	power failure
23-Mar	07:00	02-May	14:00	moisture entered sample line
13-Jun	12:00	31-Dec	23:59	no power supply to station
Veldenvlei				
15-Feb	10:00	27-Mar	17:00	analyser removed for service & station vandalised
10-Apr	13:00			station moved to Brackenham
Caravan				
07-Feb	12:00	09-Feb	17:45	chamber pressure failure
27-Feb	12:00	08-Mar	15:00	sample line disconnected
12-Apr	09:00	23-Apr	10:00	failure of power supply to datalogger
19-Jul	14:00	20-Jul	12:00	UV lamp failure
04-Aug	17:00	08-Aug	18:00	broken manifold inlet
30-Aug	21:00	02-Sep	07:00	power failure
Arboretum Ext.				
19-Apr	11:50	25-Apr	14:00	manifold pump failure
20-Nov	13:14	22-Nov	10:05	datalogger maintenance
30-Dec	09:45	30-Dec	15:40	datalogger maintenance
Brackenham				
01-Aug	00:00	17-Oct	12:00	slow analyser response - removed for service on 28 Aug
27-Dec	09:00	30-Dec	12:00	analyser external pump failure
Bayside (met data)				
01-Jan	00:00	04-Mar	10:00	instrument failure
19-Jul	17:00	20-Aug	16:00	instrument failure
01-Oct	00:00	31-Oct	23:00	data lost due to database crash

APPENDIX 2: ANALYSER CALIBRATION RESULTS FOR 2002

Station	Mar '02	Jun '02	Sep '02	Dec '02
Arboretum sn 93b	- 6.5%	+ 14.1%	- 2.4%	+ 2.2%
Wildenweide/ Arboretum Ext. sn 141	+ 5.9%	+ 5.9%	+ 14.2%	- 0.09%
Caravan sn 281	- 4.1%	+ 21.3%	- 2.3%	+ 2.9%
Hillside sn 85b	- 10.4%	+ 32.4%	+ 27.2%	- 24%
Veldenvlei/ Brackenham sn 291	- 7.5%	- 20.1%	- 61.3%	- 0.09%
Veldenvlei O_3	- 2.2%	- 0.6%	+ 18%	- 1.4%

APPENDIX 3: QUALITY CONTROL CHECKS MADE TO RBCAA DATA

Data Quality Objectives

The Data Quality Assurance Objectives for the monitoring system are summarised below.

Quality Assurance Objectives						
Parameter	**Method**	**Precision (%)**	**Accuracy (%)**	**Completeness (%)**	**Level 1 span**	**Zero (ppb)**
SO2	UV Fluorescence	± 15	± 15	> 80	± 15	± 10

Tolerance Limits and Actions

The following table indicates the required corrective actions after performing a tolerance check on an analyser if the data quality objectives are exceeded. The actions are recorded on the relevant Record Sheet/s.

Tolerance Check	**<10ppb from zero**	**>10ppb from zero**	**Actions**		
			>±5%	**>±10%**	**>±15%**
Zero (with reference calibrator)	adjust if >5ppb	multipoint calibration	-	-	-
Level I Span	-	-	adjust	multipoint calibration	multipoint calibration and invalidate data
Multipoint Calibration	-	adjust zero	adjust	adjust	adjust and invalidate
Audit Span	-	-	-	multipoint	multipoint calibration and invalidate data
Precision check					Level I span. If analyser is still out of specification replace or perform a multipoint calibration. Data is to be invalidated going back to last valid precision check.
Accuracy check					Replace and repair analyser. Data is to be invalidated going back to last valid calibration.
Tolerance Check	Data quality objective		Actions if data quality objective is not achieved		
Completeness	> 80 %		Invalidate time averaged data for which completeness is not 80 %. i.e. hourly averages are to be invalidated if less than 48 minutes of data is received and daily averages are to be invalidated if less than 19.2 hours of data is available.		

APPENDIX 4: SO_2 DATA ADJUSTMENTS

FROM DATE	TO DATE	Adjustment	REASON/COMMENTS
Veldenvlei SO2			
01-Jan	31-Jan	+ 1 ppb	-ve database response
01-Feb	15-Feb	+ 1.75	-ve database response & -ve analyser drift
27-Mar	30-Apr	+ 1.5 ppb	-ve database response
Caravan (TLC)			
22-Jul	31-Aug	- 2 ppb	+ve drift of analyser
Wildenweide			
01-Jan	31-Jan	+ 1 ppb	-ve database response
01-Feb	28-Feb	+ 1.25 ppb	-ve database response & -ve analyser drift
01-Mar	14-Mar	+ 1.5 ppb	-ve database response & -ve analyser drift
14-Mar	10-Apr	+ 1 ppb	-ve database response
Hillside			
01-Jan	17-May	+ 3 ppb	-ve database response
17-May	18-May	+ 5 ppb	-ve database response & -ve analyser drift
18-May	13-Jun	+ 7 ppb	-ve database response & -ve analyser drift
Arboretum Ext.			
19-Apr	30-Apr	+ 1.75 ppb	-ve database response
01-May	31-Aug	+ 2 ppb	-ve database response
01-Sep	31-Dec	+ 1 ppb	-ve database response
Brackenham SO_2			
01-May	10-May	+ 1 ppb	1-2 May up 14%, 3-10 May up 23%
11-May	18-May	+ 1.8 ppb	11-17 May up 33%
19-May	27-May	+ 3 ppb	18-23 May up 34%
27-May	31-May	+ 3.8 ppb	24-31 May up 42%
31-May	31-May	+ 5 ppb	-ve analyser drift
01-Jun	01-Jun	+ 4 ppb	-ve analyser drift
02-Jun	13-Jun	+ 5 ppb	1-13 Jun up 20%
01-Jul	02-Jul	+ 1.4 ppb	up 18% - slow analyser response
02-Jul	11-Jul	+ 1.8 ppb	up 26% - slow analyser response
11-Jul	18-Jul	+ 2.5 ppb	up 35% - slow analyser response
18-Jul	24-Jul	+ 3 ppb	up 35% - slow analyser response
24-Jul	31-Jul	+ 4 ppb	up 43% - slow analyser response
01-Nov	24-Nov	- 0.8 ppb	+ve database response
25-Nov	31-Dec	- 0.5 ppb	+ve database response

APPENDIX 5: EXCEEDANCES OF DEAT SO_2 GUIDELINES

(a) Exceedances of the 10-minute average guideline (191 ppb)				
Station	**Date & time**	**SO2**	**wind speed**	**wind direction**
		ppb	**m/s**	**(deg from N)**
HILLSIDE	05/06/02 10:20	252.6	2.1	304
HILLSIDE	05/06/02 10:50	239.3	1.7	306
CARAVAN	24/06/02 09:40	237.3	7.5	233
CARAVAN	24/06/02 09:50	416.8	8.5	234
CARAVAN	24/06/02 10:00	255.3	8.6	235
CARAVAN	24/06/02 10:10	251.4	8.5	230
CARAVAN	24/06/02 10:20	606.5	8.5	229
CARAVAN	24/06/02 10:30	459.6	8.5	225
CARAVAN	24/06/02 10:40	495.6	9.2	223
CARAVAN	24/06/02 10:50	588.3	8.3	223
CARAVAN	24/06/02 11:00	603.8	9.2	226
CARAVAN	24/06/02 11:10	389.4	8.2	229
CARAVAN	24/06/02 11:20	836.8	7.7	230
CARAVAN	24/06/02 11:30	713.8	6.6	226
CARAVAN	24/06/02 11:40	727.0	6.9	217
CARAVAN	24/06/02 11:50	506.1	6.4	209
ARBORETUM EXT.	30/06/02 03:10	516.4	2.3	236
ARBORETUM	30/06/02 03:00	697.0	2.2	243

(b) Exceedances of the 24-hour average guideline (48 ppb)				
Station	**Day**	**SO2 (ppb)**	**Wind speed**	**Wind direction**
CARAVAN	24	71	mod-fresh	SW