Quarterly report on the monitoring of sulphur dioxide, wind speed and wind direction at Chyandour Cliff, Penzance

January 1st – March 31st 2008

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Air Quality Unit, Cornwall College
(CAQF@cornwall.ac.uk)

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Commissioned by John Osborn, Scientific Officer, Penwith District Council, Cornwall.

1.0 Introduction

Continuous monitoring of three transport-related pollutants has been ongoing at two sites in Penzance. Sulphur dioxide (SO_2) and wind speed and direction have been continuously monitored at Chyandour Cliff, Penzance (Figure 1) since 11th April 2006; nitrogen dioxide (NO_2) and particulate matter (PM_{10}) monitoring in Albert Street are reported separately. The SO_2 monitoring programme stems from public complaints regarding emissions from Penzance train station. SO_2 is produced by diesel engines, a feature of modern locomotives and can be detrimental to health. The National Air Quality Strategy (NAQS) objective values for SO_2 concentrations are outlined in Table 1.

Table 1. NAQS objectives for SO_2.

Sulphur dioxide (SO_2)	Measured as	Concentration ($\mu g\ m^{-3}$)
	15-minute mean not to be exceeded more than 35 times a year	266
	1 hr mean not to be exceeded more than 24 times a year	350
	24 hr mean not to be exceeded more than 3 times a year	125

1.1 Chyandour Cliff

A Signal sulphur dioxides (SO_x) monitor with anemometer is situated at Chyandour Cliff above Penzance train station (Figure 1). The monitor is between residential properties and the railway line just to the east of the station. Chyandour Cliff is also a primary route into Penzance town centre and intersects the monitor and the station.

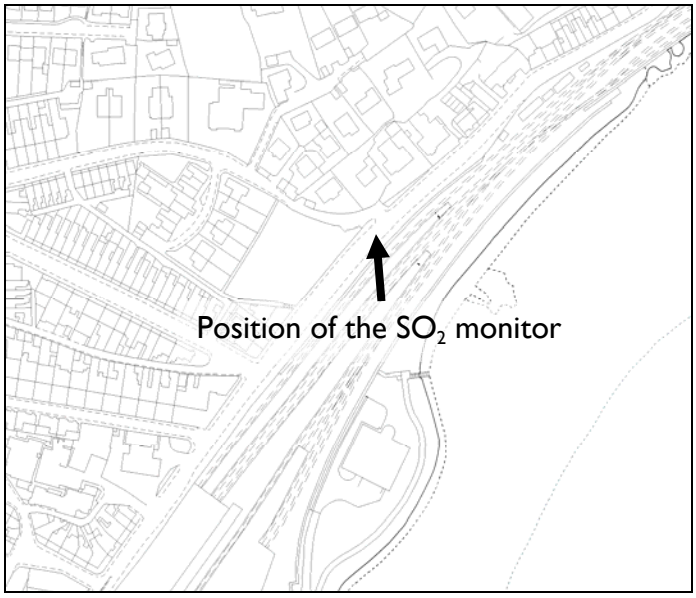


Figure 1. Position of the SO_2 monitor (Chyandour Cliff, Penzance).

1.2 Equipment

The Signal 'SO_x box' uses a chemiluminescent method to monitor ambient concentrations of SO_2. Wind speed and direction are also recorded to help identify possible SO_2 sources. The SO_2 monitor tags recorded data as 'valid' or 'invalid'; invalid data is produced when the monitor is calibrating or there is a temporary fault as is removed for analysis.

Plate 1. The sulphur dioxide monitor and anemometer at Chyandour Cliff, Penzance.

2.0 Results

2.1 Summary of 3-month monitoring period ending 31/3/2008

Table 2 provides a summary of the data recorded by the SO_2 monitor positioned on Chyandour Cliff for the period 1/1/2008 – 31/3/2008. The recorded maximum 24-hour, 1-hour and 15-minute SO_2 concentrations for the 35.5 valid days were 2.7 µg m^{-3}, 8.9 µg m^{-3} and 18.5 µg m^{-3} respectively.

Table 2. Summary of continuous monitoring for the 3-month period ending 31/3/2008.

Start date	End date	No. of days	No. of days' valid data	%Data Capture	Maximum 24-hr mean (µg m^{-3})	Maximum 1-hr mean (µg m^{-3})	Maximum 15-min mean (µg m^{-3})
01/1/2008	31/3/2008	91	35.5	39.0	2.7	8.9	18.5

2.2 Summary of 12-month monitoring period ending 31/3/2008

Table 3 provides a summary of the data recorded by the SO_2 monitor positioned on Chyandour Cliff for the period 1/4/2007 – 31/3/2008. The recorded maximum 24-hour, 1-hour and 15-minute SO_2 concentrations for the 244.0 valid days were 14.4 µg m^{-3}, 11.9 µg m^{-3} and 154.2 µg m^{-3} respectively.

Table 3. Summary of continuous monitoring for the 12-month period ending 31/3/2008.

Start date	End date	No. of days	No. of days' valid data	%Data Capture	Maximum 24-hr mean (µg m^{-3})	Maximum 1-hr mean (µg m^{-3})	Maximum 15-min mean (µg m^{-3})
01/04/2007	31/3/2008	366	207.3	56.6	6.8	54.0	154.2

2.3 Wind direction frequency

Figure 2 illustrates the frequency of wind direction recorded by the anemometer at Chyandour as a 15-minute mean for the monitoring period 1/1/2008 – 31/3/2008.

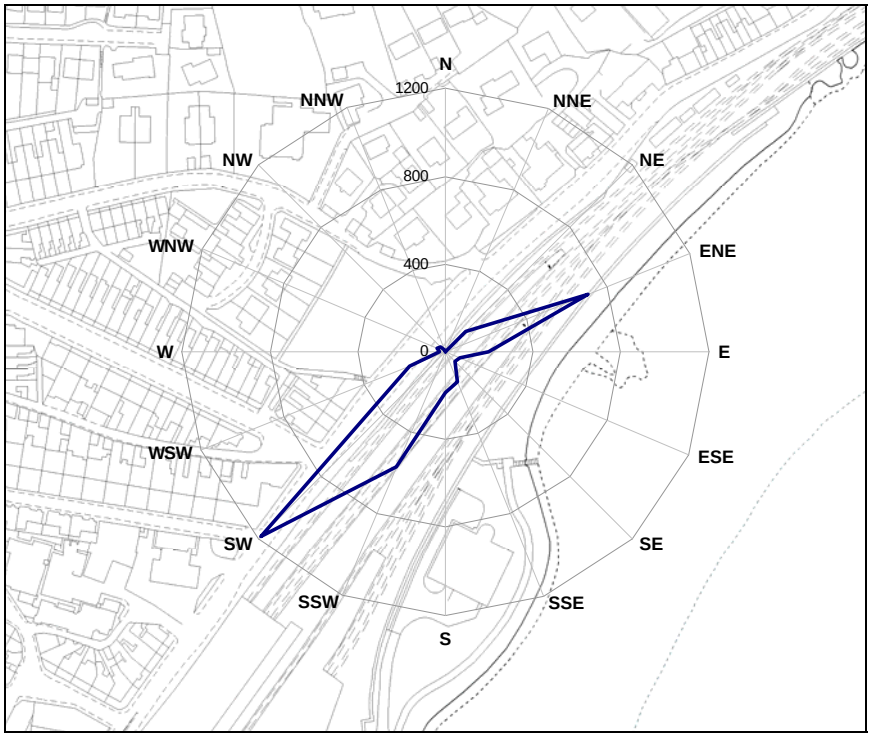


Figure 2. Wind direction frequency as a 15-minute mean.

2.4 Wind direction and SO_2 concentration

Figure 3 plots SO_2 mean concentration for the monitoring period 1/1/2008 – 31/3/2008 against wind direction.

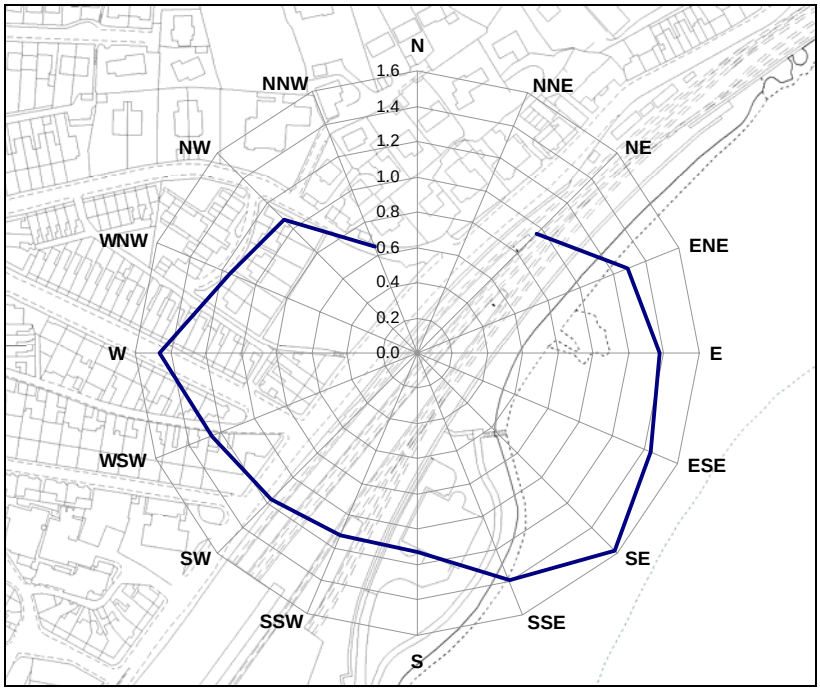


Figure 3. Wind direction and SO_2 concentration.

3.0 Discussion

3.1 Exceedances

Tables 2 and 3 indicate there was no exceedance of the NAQS 24-hour, 1-hour and 15-minute mean objectives for SO_2 recorded at Chyandour Cliff for the 3-month or 12-month monitoring periods ending 31/3/2008.

3.2 Data Capture

For the 3-month and 12-month monitoring periods ending 31/3/2008 there was a data capture rate of 39.0% and 56.6% respectively. These values fall significantly below the 90% data capture value outlined by the Government and in the first 3 months of 2008 was primarily due to the malfunction of the monitor's laptop which has now been replaced by the manufacturer.

3.3 Wind direction and SO_2 concentration

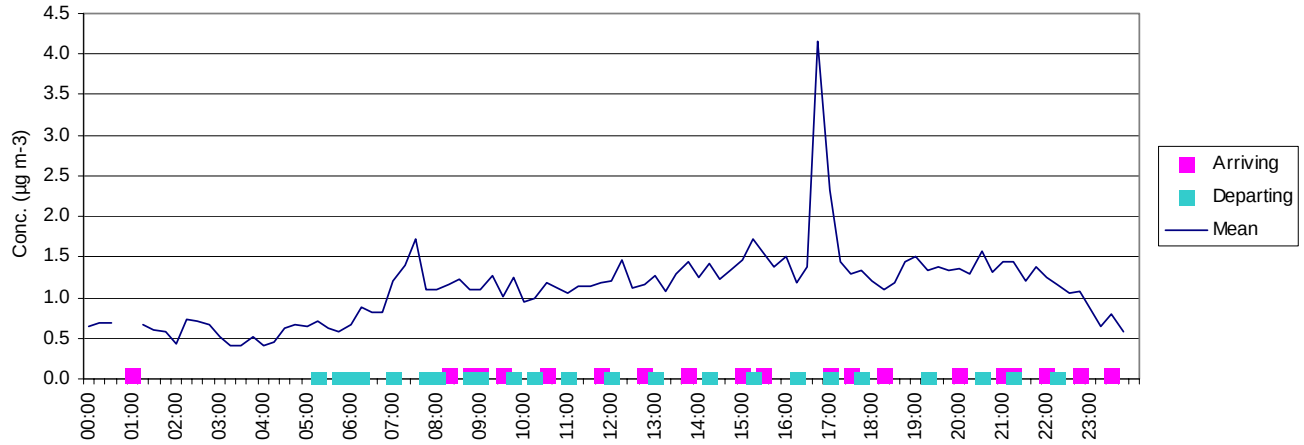
Figure 2 displays the frequency of wind direction recorded at Chyandour Cliff, the predominant wind direction from the 1/1/2008 – 31/3/2008 was from the SW vector. Figure 3 illustrates elevated SO_2 concentrations occurred when the wind was from the NE through to the SSW. SO_2 concentration with regard to wind direction (Figure 4) displays a relatively even input from all vectors (except N and NNE) with slightly elevated concentrations from the direction of the road/train station.

3.4 Diurnal SO_2 concentrations

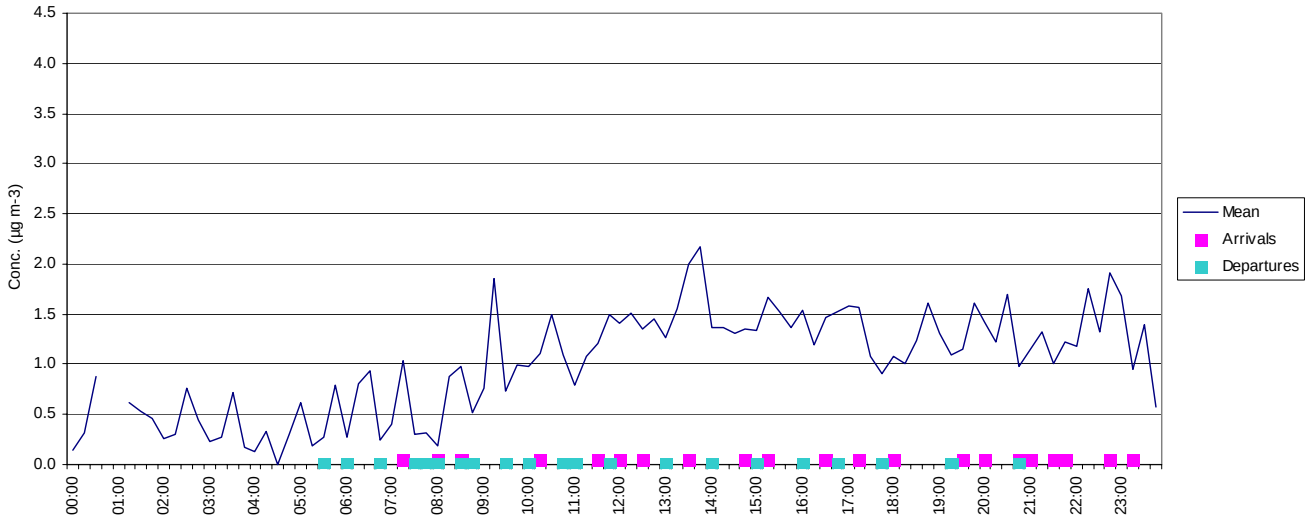
The mean SO_2 concentration recorded at Chyandour Cliff for the 3-month monitoring period ending the 31/3/2008 was 1.3 µg m^{-3}; with the highest recorded mean 24-hour, 1-hour and 15-minute concentrations of 2.7 µg m^{-3}, 8.9 µg m^{-3} and 18.5 µg m^{-3} respectively.

Figure 4a, 4b and 4c plot the diurnal mean concentrations for the period 1/1/2008 – 31/3/2008 on weekdays, Saturdays and Sundays respectively; also included are train arrival and departure times. It is suggested there is a low correlation between specific train movements in and out of Penzance and SO_2 concentration, however recorded values are so low that a determinable connection is hard to decipher. Diurnal concentrations increase slightly during daytime hours, however as this increase is minimal it is difficult to apportion this to train movements or road-vehicle activity. A relatively large peak is apparent at 16:45 on the weekday diurnal pattern; this is as a result of an accumulation of concentrations >10 µg m^{-3} at this time.

(a)



(b)



(c)

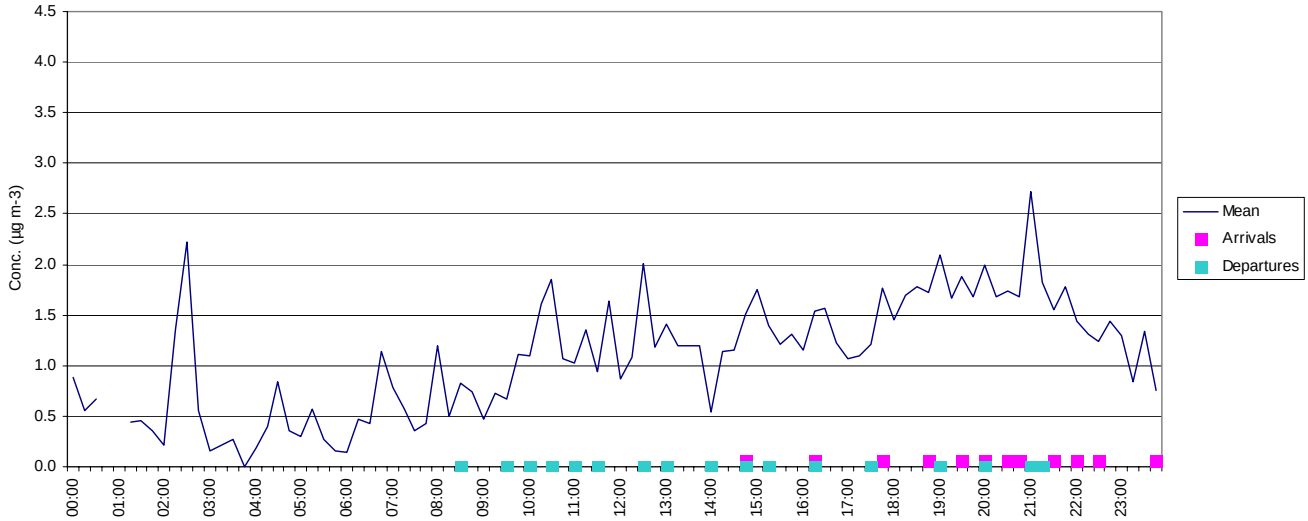


Figure 4. Diurnal SO_2 mean concentrations recorded at Chyandour Cliff for the period 1/1/2008 – 31/3/2008 on (a) weekdays, (b) Saturdays and (c) Sundays. Train arrivals are highlighted with a ■ and departures with a ■.

4.0 Conclusion

- There was no exceedance of the NAQS objectives for SO_2 for the 3-month period ending 31/3/2008 at Chyandour Cliff.
- The mean SO_2 concentration for the period 3-month and 12-month periods ending 31/3/2008 was 1.3 µg m^{-3} and 1.2 µg m^{-3} respectively.
- Wind direction was predominantly from the SW during 1/1/2008 – 31/3/2008.
- Highest 15-minute mean SO_2 concentrations occurred when the wind was from the SE, although a relatively even input is observed from all vectors.

Confidentiality

All sampling results from the monitoring sites in Penwith District will be the property of Penwith District Council, and will be subject to strict confidentiality and not disclosed any third party without prior formal permission from Penwith District Council.

Disclaimer

Cornwall College cannot accept any responsibility for the use to which the information is put nor for decisions, inferences or conclusions that are made on the basis on the information provided. No responsibility is taken for the accuracy of the sampling unless this is done under our own supervision.