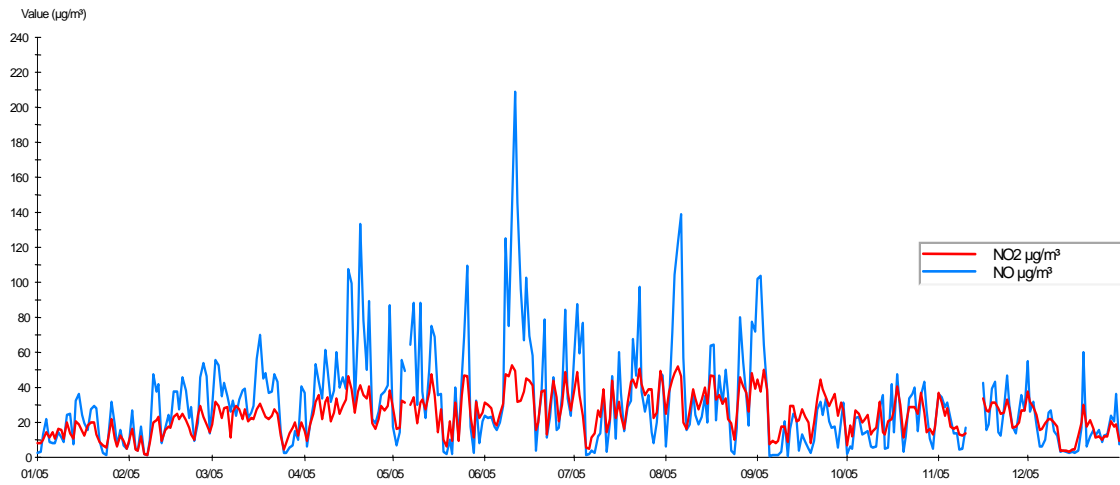
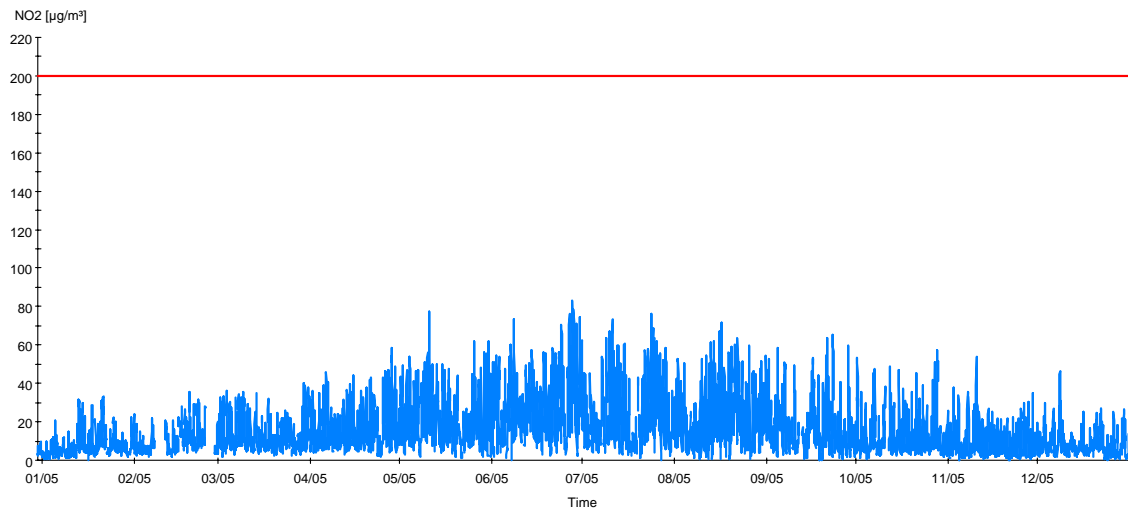


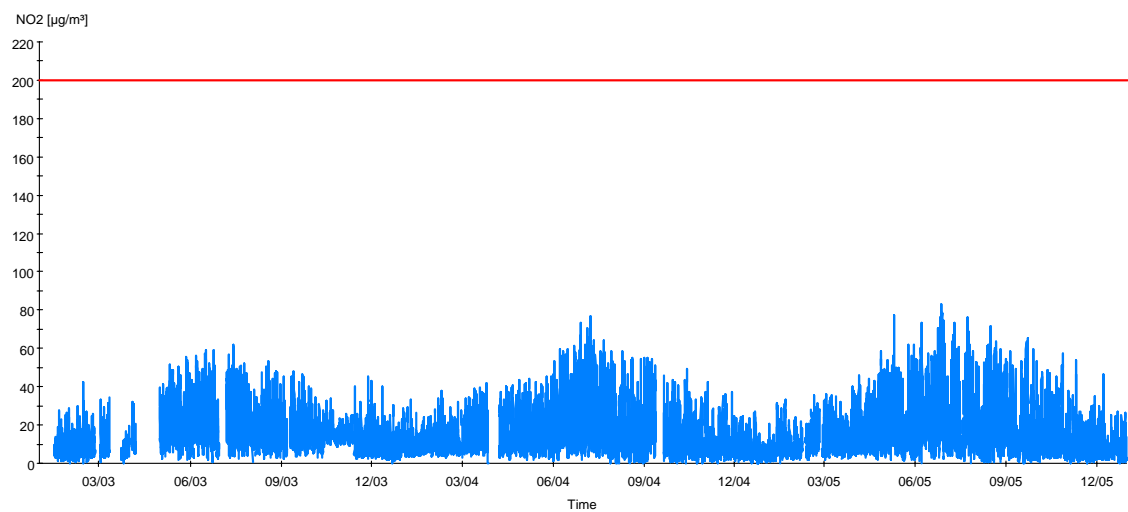
**Figure 21: MfE Gavin Street NO<sub>2</sub> and NO 24-hour fixed average January – December 2005**



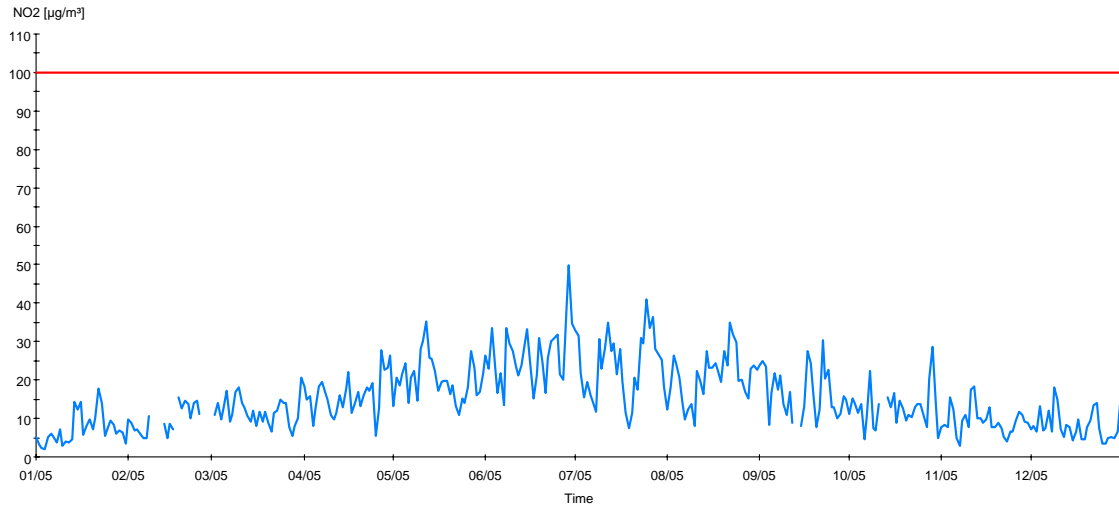
**Figure 22: MfE Burnside NO<sub>2</sub> 1-hour fixed average January – December 2005**



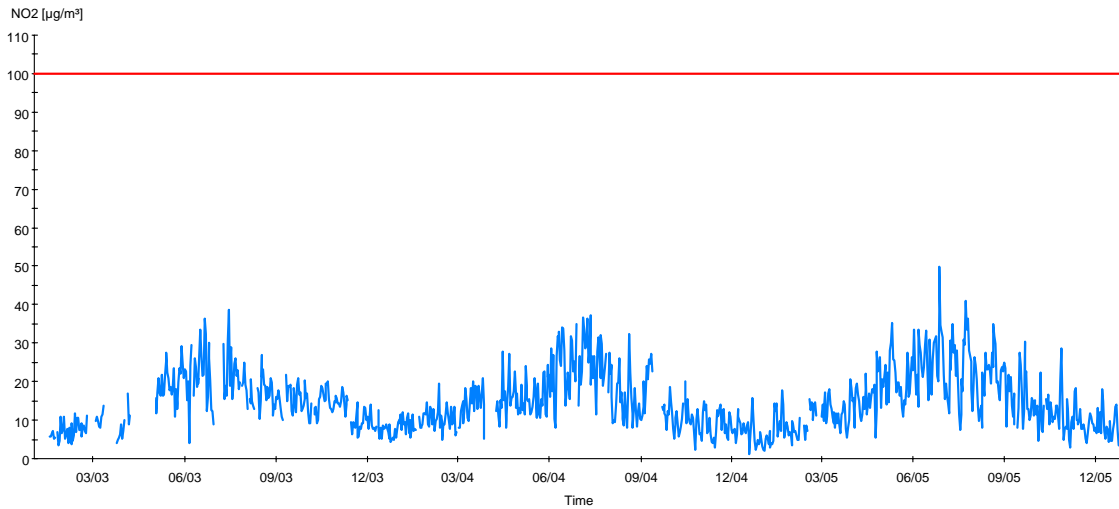
**Figure 23: MfE Burnside NO<sub>2</sub> 1-hour fixed average 1 January 2003 – 31 December 2005**



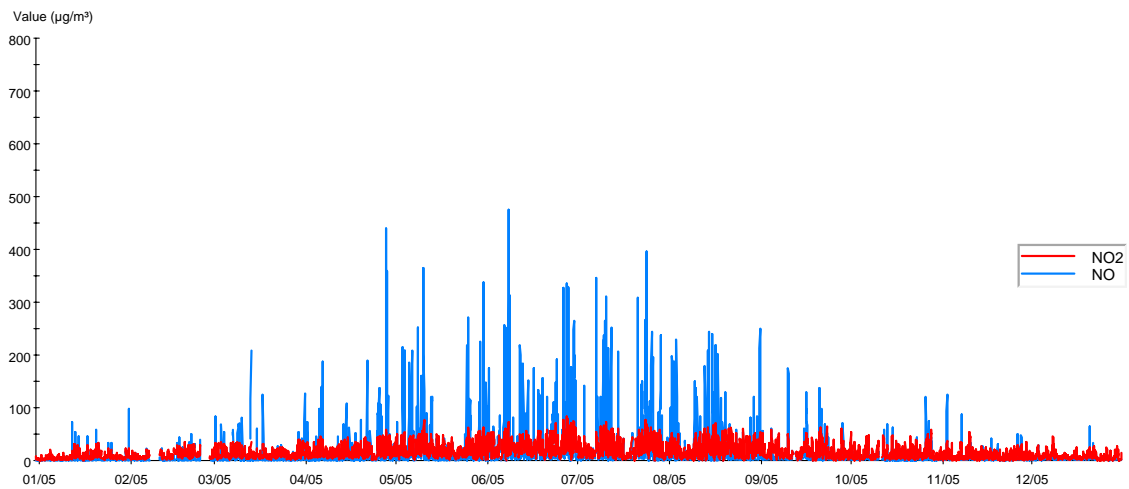
**Figure 24: MfE Burnside NO<sub>2</sub> 24-hour fixed average January – December 2005**



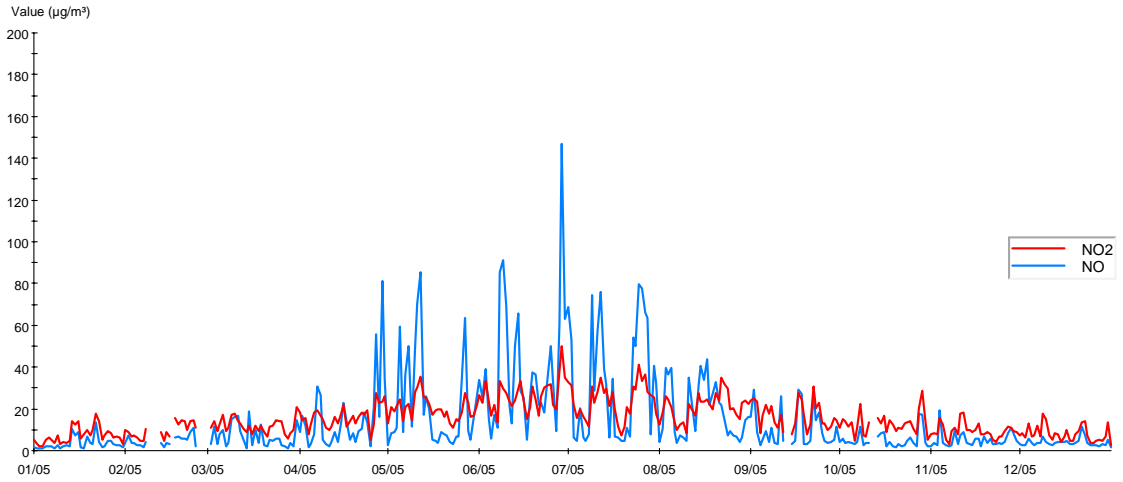
**Figure 25: MfE Burnside NO<sub>2</sub> 24-hour fixed average 1 January 2003 – 31 December 2005**



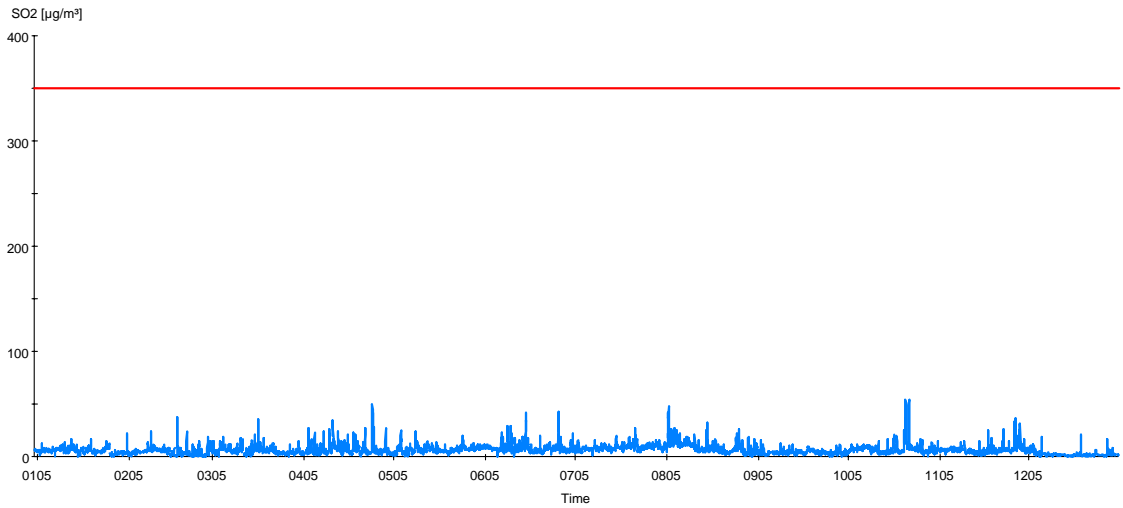
**Figure 26: MfE Burnside NO<sub>2</sub> and NO 1-hour fixed average January – December 2005**



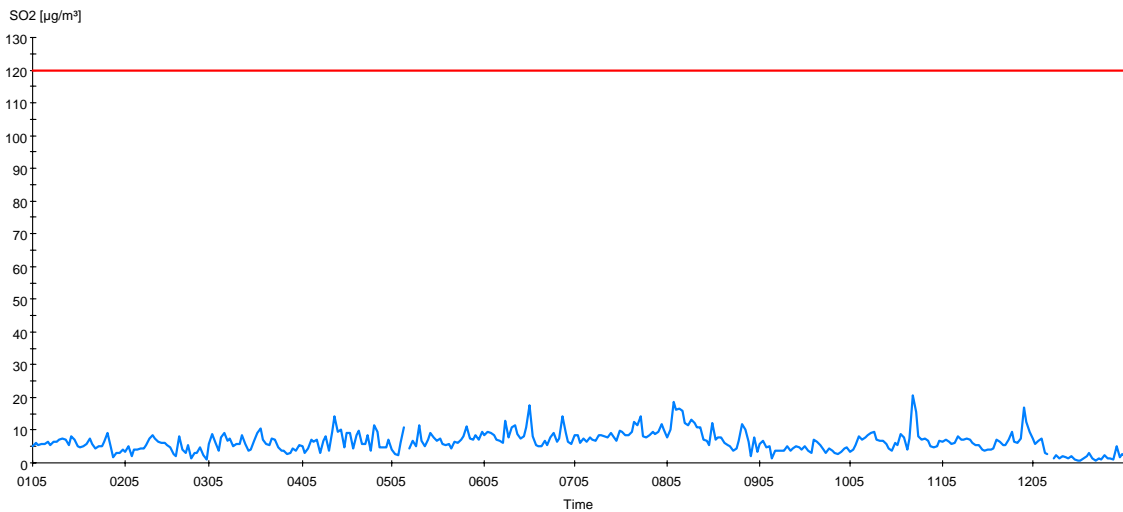
**Figure 27: MfE Burnside NO<sub>2</sub> and NO 24-hour fixed average January – December 2005**



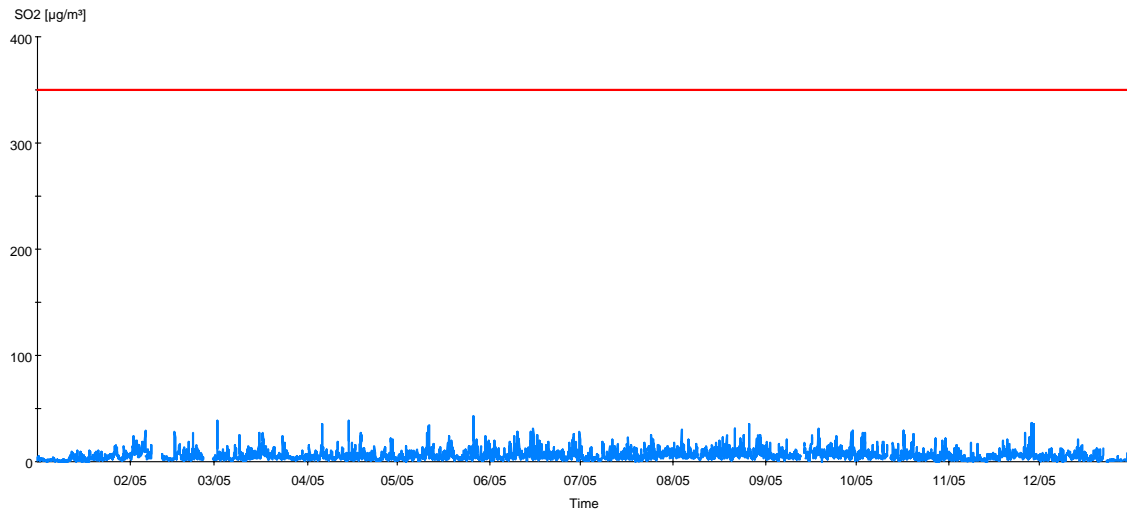
**Figure 28: MfE Gavin Street SO<sub>2</sub> 1-hour fixed average January – December 2005**



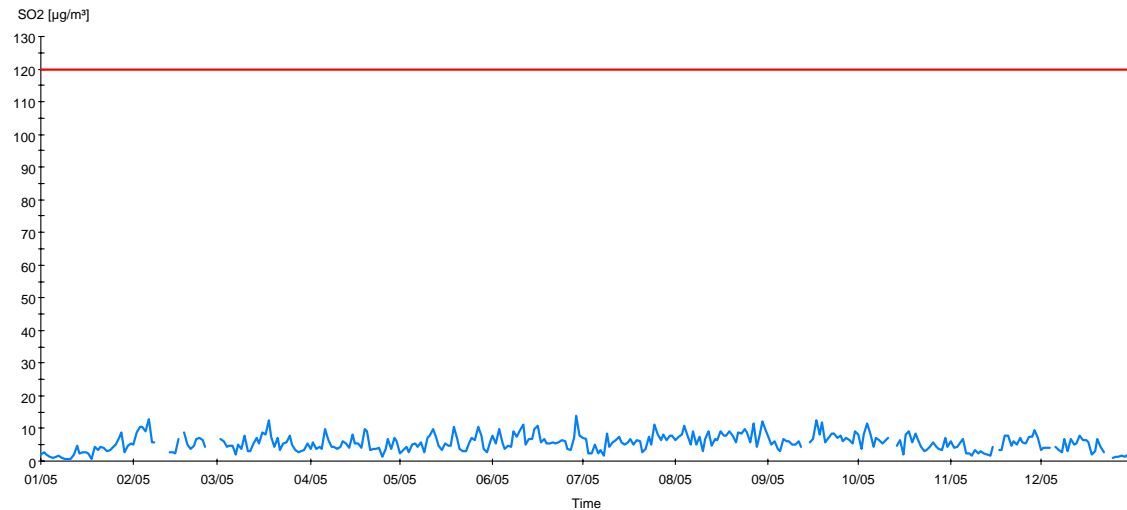
**Figure 29: MfE Gavin Street SO<sub>2</sub> 24-hour fixed average January – December 2005**



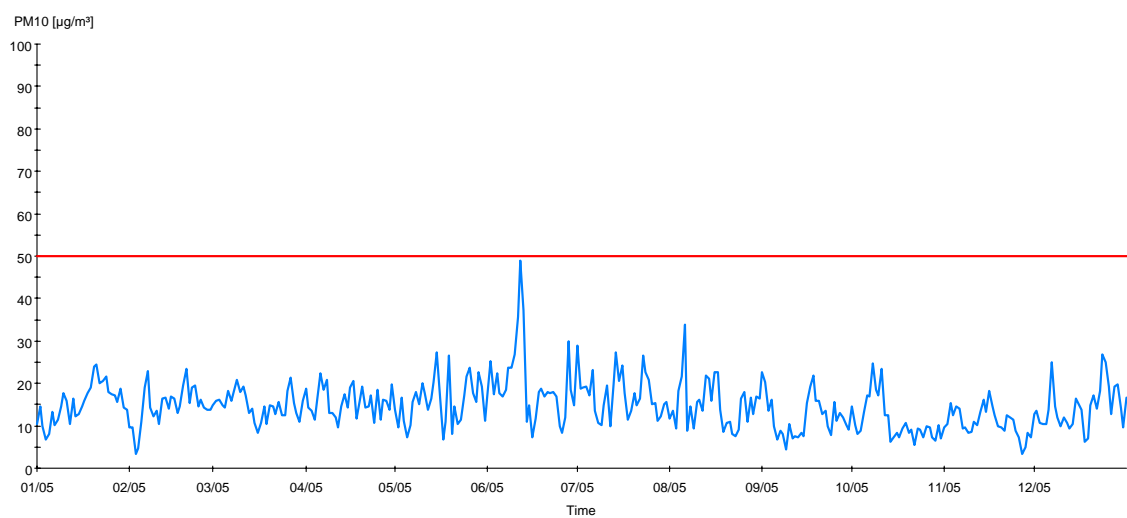
**Figure 30: MfE Burnside SO<sub>2</sub> 1-hour fixed average January – December 2005**



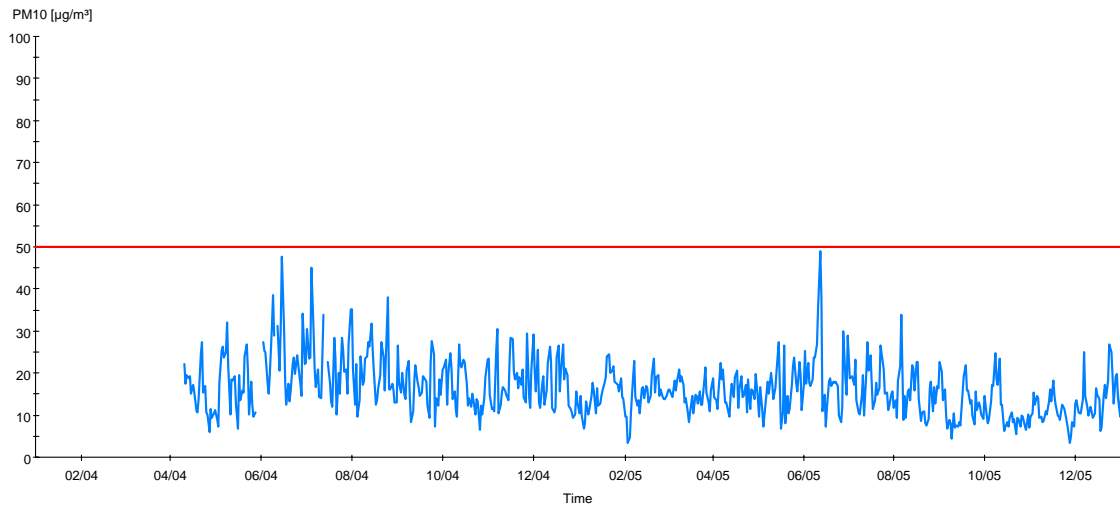
**Figure 31: MfE Burnside SO<sub>2</sub> 24-hour fixed average January – December 2005**



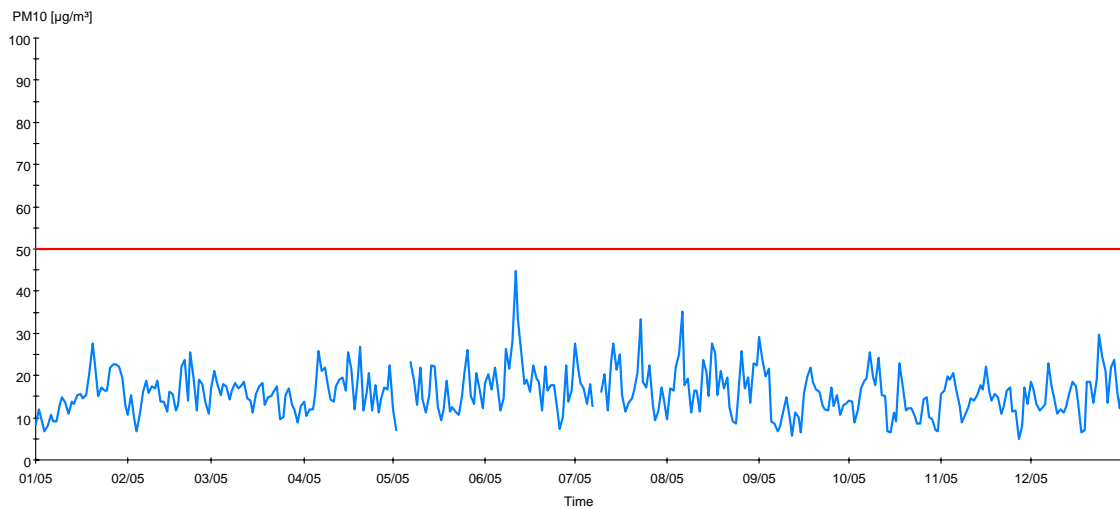
**Figure 32: MfE Kowhai PM<sub>10</sub> 24-hour fixed average January – December 2005**



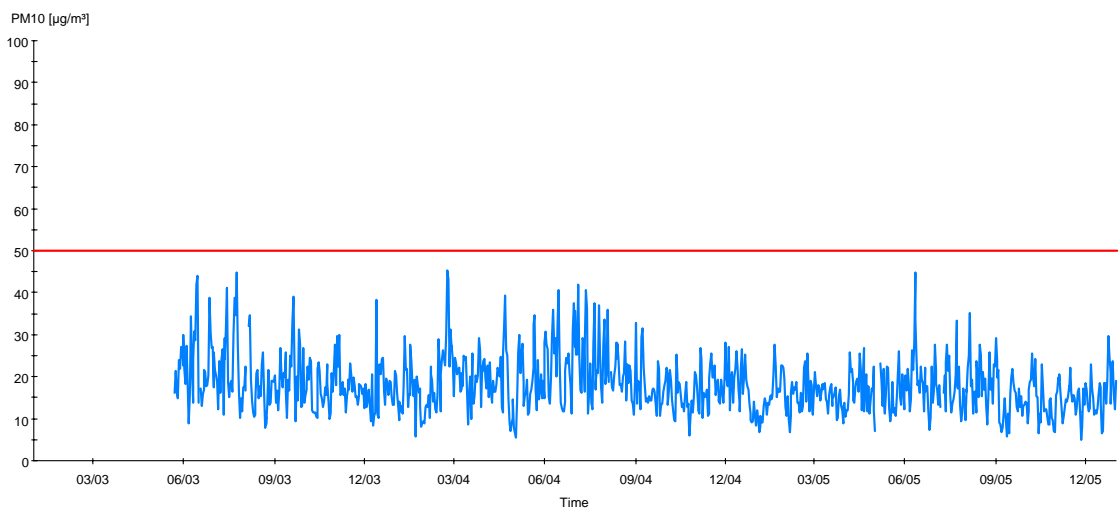
**Figure 33: MfE Kowhai PM<sub>10</sub> 24-hour fixed average 1 January 2004 – 31 December 2005**



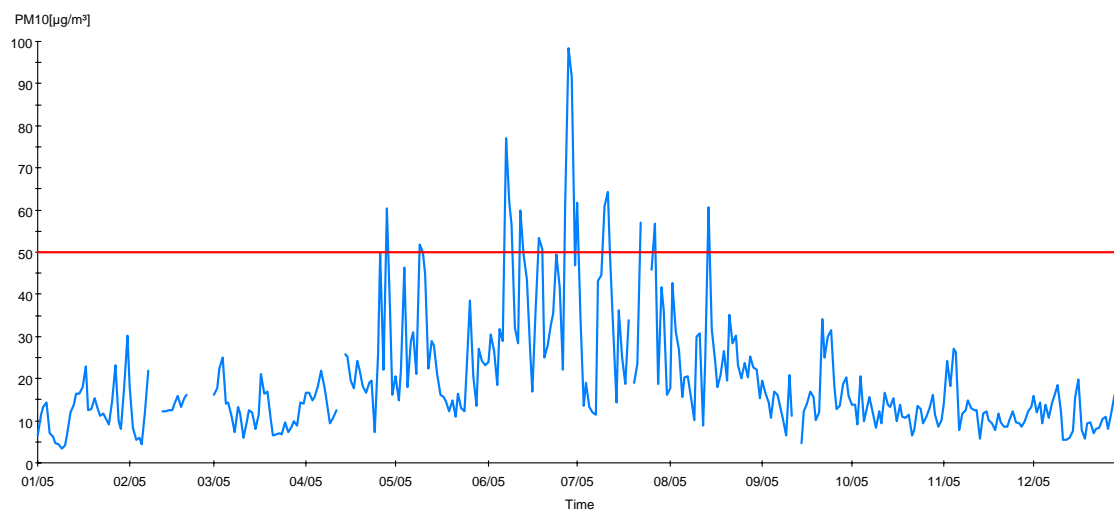
**Figure 34: MfE Gavin Street PM<sub>10</sub> 24-hour fixed average January – December 2005**



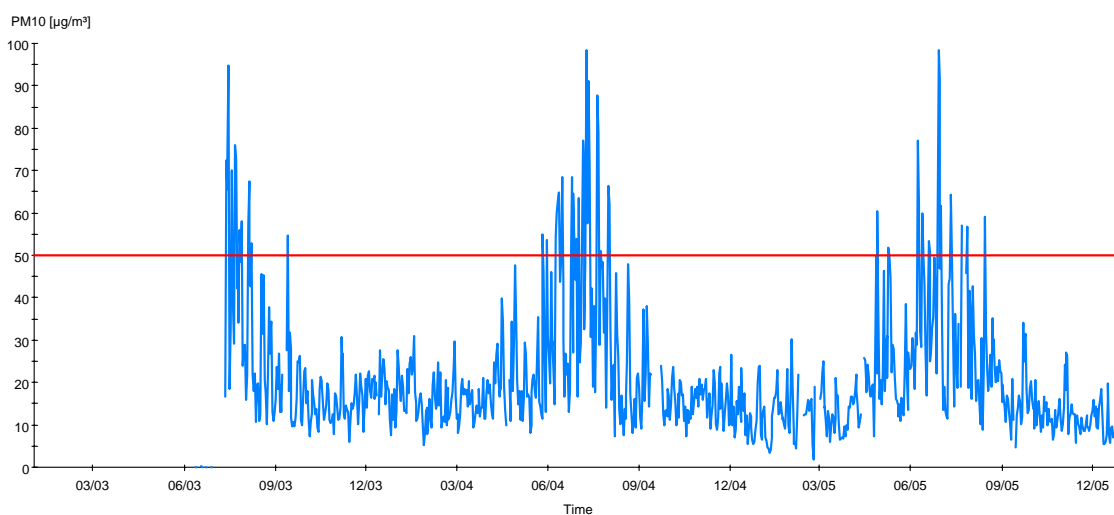
**Figure 35: MfE Gavin Street PM<sub>10</sub> 24-hour fixed average 1 January 2003 – 31 December 2005**



**Figure 36: MfE Burnside PM<sub>10</sub> 24-hour fixed average January – December 2005**



**Figure 37: MfE Burnside PM<sub>10</sub> 24-hour fixed average 1 January 2003 – 31 December 2005**



## 7.9 Analysis of exceedances

### 7.9.1 PM<sub>10</sub> exceedances at Greers Road, Burnside

Environment Canterbury noted one of the mildest winters on record for Christchurch in 2005. Although light winds and clear sunny days were prevalent during the winter period, evening cloud brought about by a series of anticyclones created warmer temperatures. These favourable conditions may have contributed to a reduction in PM<sub>10</sub> exceedances (25 exceedances in 2004 compared with 18 exceedances in 2005).<sup>3</sup>

A 72-hour period from 7 to 9 June 2005 was chosen as a typical example of winter diurnal trends coinciding with PM<sub>10</sub> exceedances to describe the relationship between pollution levels and meteorological conditions. Figure 38 provides an example of the typical diurnal trend in air pollution during this period. Figures 39 to 41 present the meteorological conditions that influence the diurnal trend. It is apparent when comparing wind speed (Figure 39) and PM<sub>10</sub> concentrations (Figure 38) that low wind speeds coincide with PM<sub>10</sub> peaks and conversely higher wind speeds coincide with low PM<sub>10</sub> concentrations. Reduced air mixing caused by low wind speeds results in poor dispersion of pollution while an unstable atmosphere caused by high wind speeds is conducive to pollution dispersion.

Low temperatures, often coinciding with still atmospheric conditions, can cause temperature inversions. This can contribute to higher PM<sub>10</sub> concentrations being measured as pollution is trapped at ground level. A comparison of temperatures measured at 1.5 and 10 m (Figure 40) does not indicate the presence or absence of a temperature inversion as the inversion height may be greater than 10m, however, a diurnal trend is apparent. As the temperature drops during the evening, Christchurch residents light their heating appliances causing particle emissions to increase and PM<sub>10</sub> levels to peak just before midnight. As the fires die down and the atmosphere becomes more unstable toward morning, concentrations of PM<sub>10</sub> drop off.

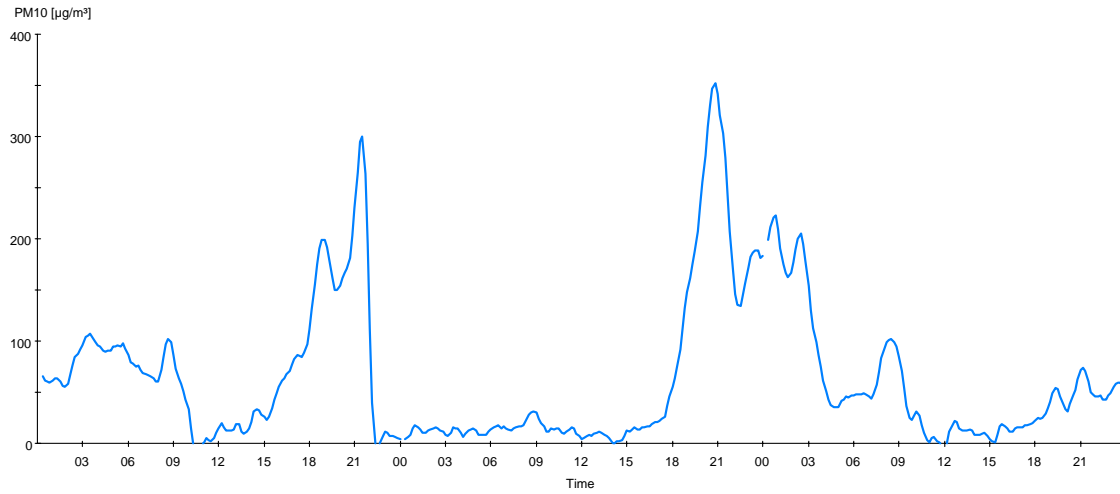
A pollution rose for the same 72-hour period (Figure 41) that describes the relationship between wind direction and PM<sub>10</sub> concentrations shows no obvious pattern. This would suggest that the incidents are not directly related to very localised sources of PM<sub>10</sub> but are perhaps more related to prevailing meteorological conditions such as temperature inversions.

Temperature inversions occur when the ground temperature falls below the surrounding air temperature. Air in contact with the ground is cooled to a lower temperature than the air layers above it. As an inversion continues air becomes stagnant and pollution becomes trapped in the mixing layer close to the ground.

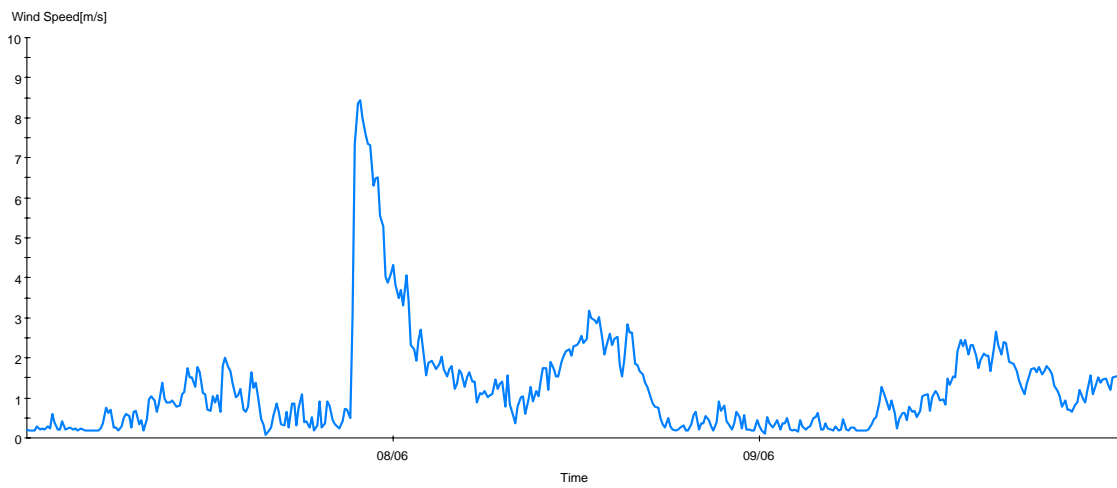
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<sup>3</sup> Environment Canterbury. 2005. Winter Air Report. <http://www.ecan.govt.nz/Our+Environment/Air/Winter+Reports>.

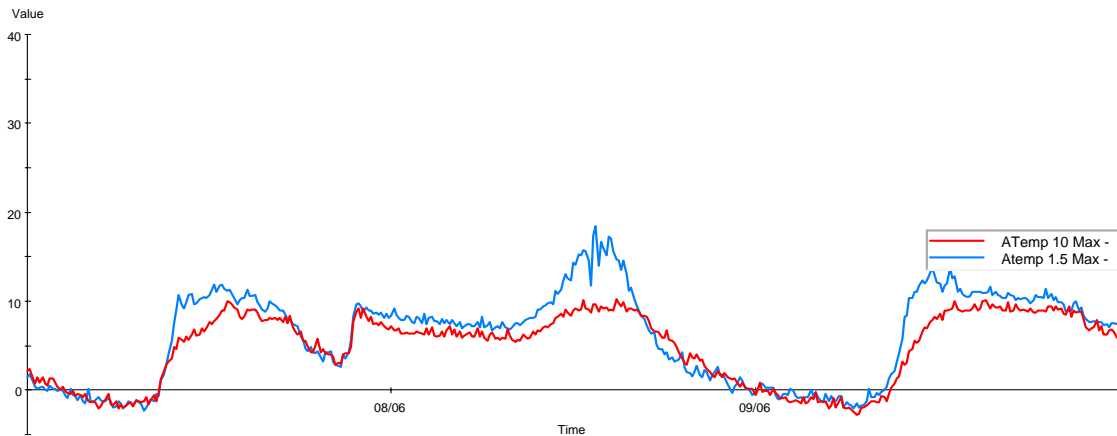
**Figure 38: MfE Burnside PM<sub>10</sub>, typical winter diurnal trend, 10-minute fixed average 7–9 June 2005**



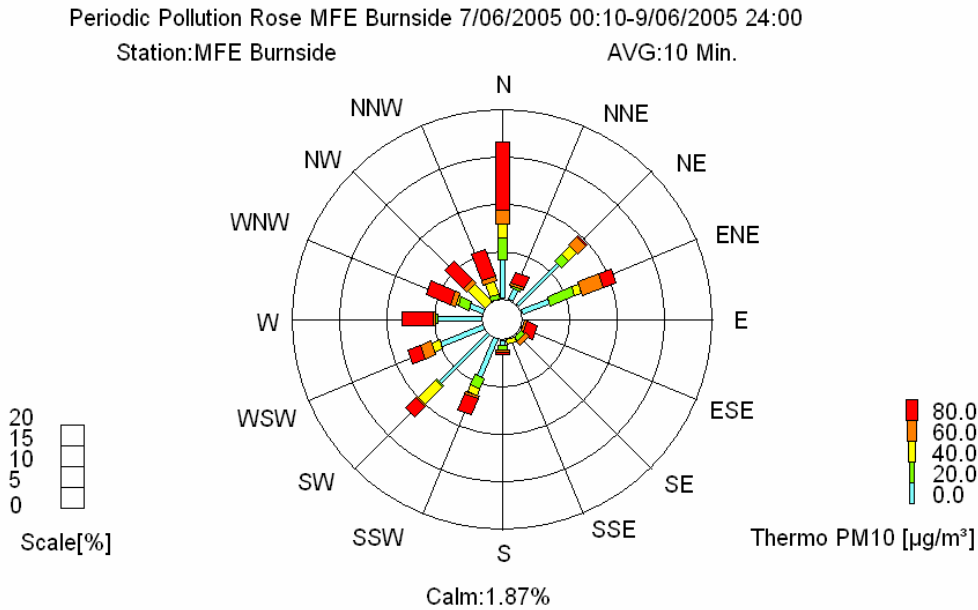
**Figure 39: MfE Burnside wind speed, typical winter diurnal trend, 10-minute fixed average 7–9 June 2005**



**Figure 40: MfE Burnside ambient temperature, typical winter diurnal trend, 10-minute fixed average 7–9 June 2005**



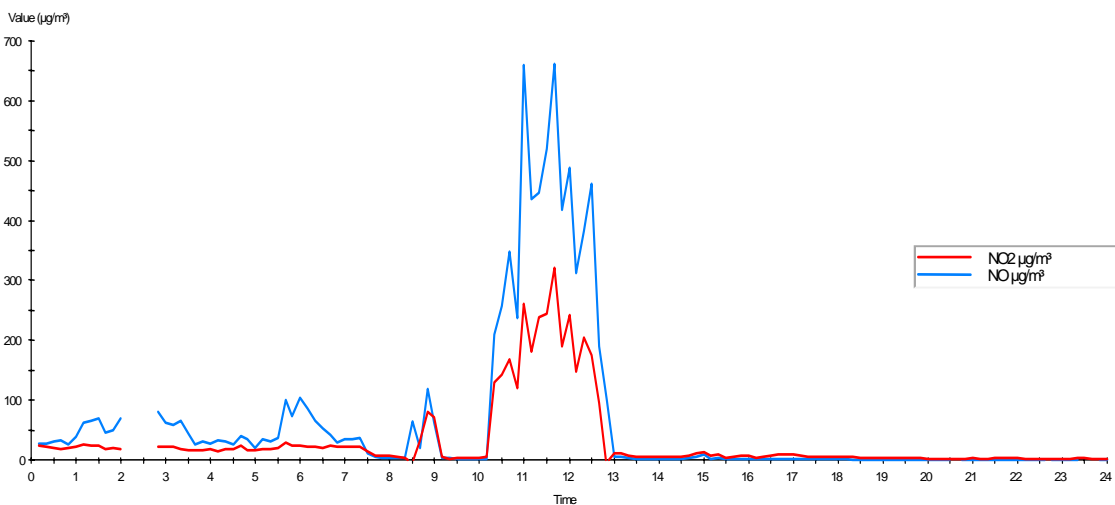
**Figure 41: MfE Burnside pollution rose, 10-minute average 7–9 June 2005**



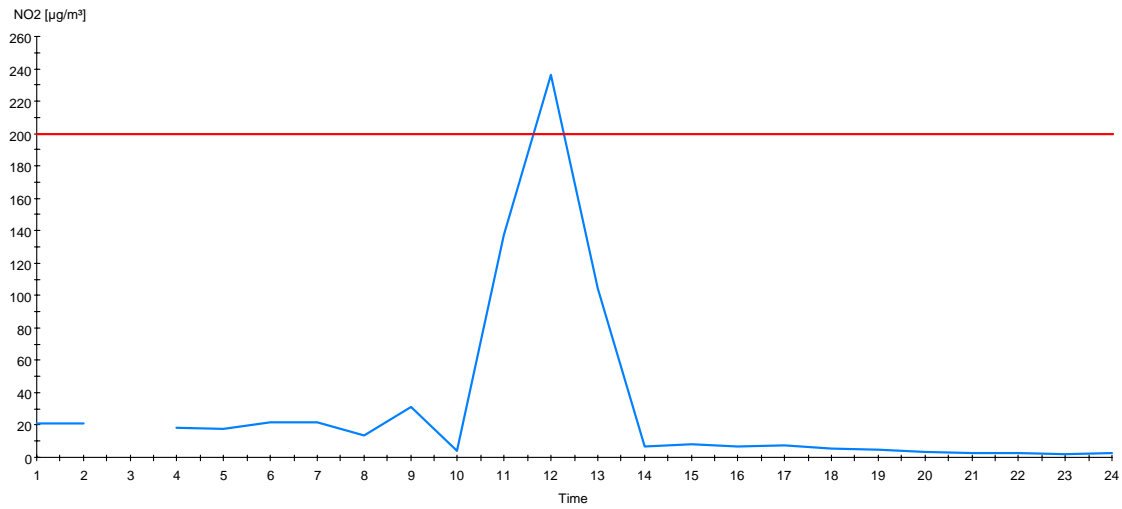
## 7.9.2 NO<sub>2</sub> exceedance at Gavin Street, Penrose

The NO<sub>2</sub> exceedance occurring on 19 December 2005 was investigated and found to be caused by machinery and trucks operating during construction works at the Gavin Street substation, several metres to the east and northeast of the air quality monitoring shed. Figures 42 and 43 provide NO<sub>2</sub> exceedance data for 19 December 2006. Other pollutants were also elevated at Gavin Street during this time (PM<sub>10</sub> and SO<sub>2</sub>), as described in Figures 44 and 45 below. Figure 46 shows the relationship between wind direction and pollution levels monitored on 19 December 2005.

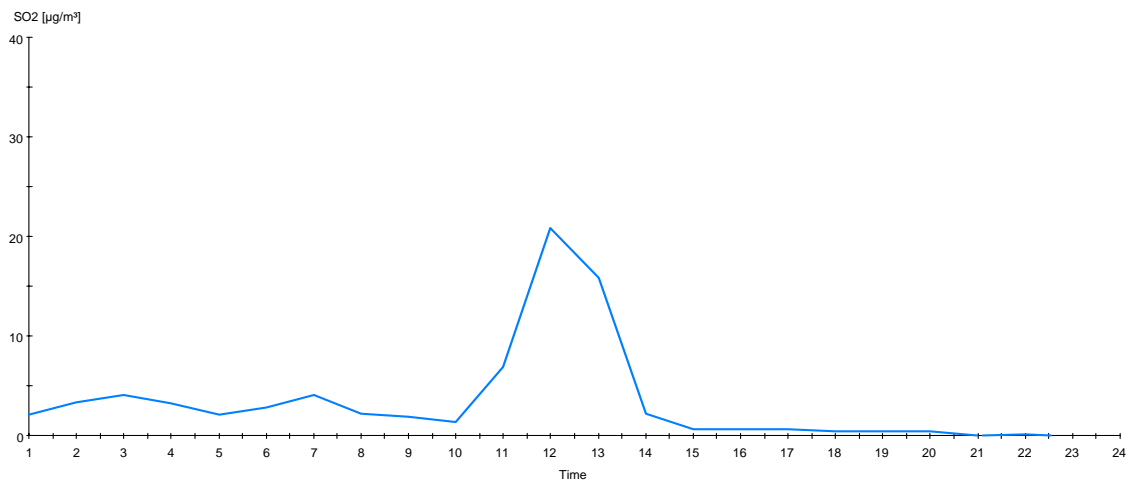
**Figure 42: MfE Gavin Street NO<sub>2</sub> exceedance 10-minute average 19 December 2005**



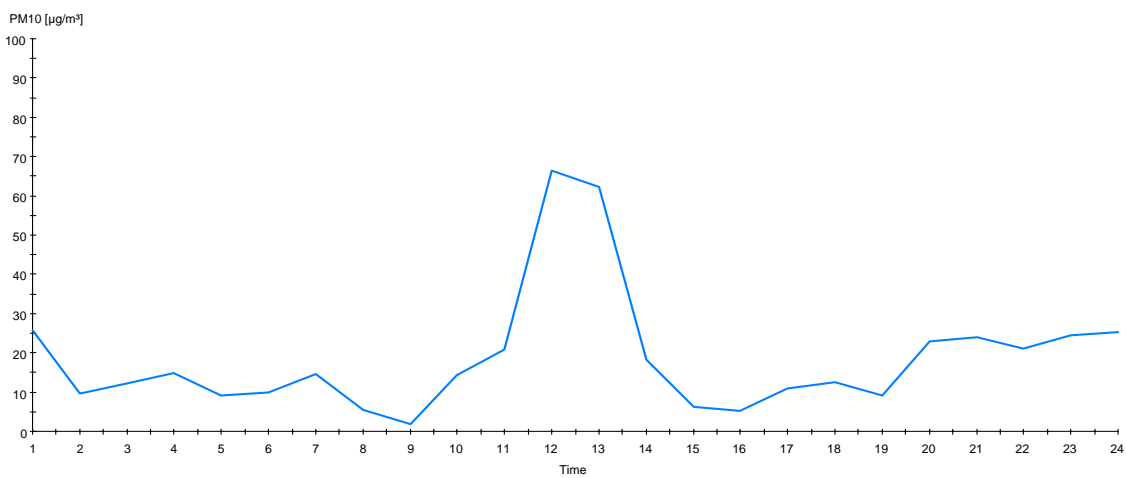
**Figure 43: MfE Gavin Street NO<sub>2</sub> exceedance 1-hour average 19 December 2005**



**Figure 44: MfE Gavin Street SO<sub>2</sub> 1-hour average 19 December 2005**



**Figure 45: MfE Gavin St PM<sub>10</sub> 1-hour average 19 December 2005**



**Figure 46: MfE Gavin Street pollution rose 10-minute average 19 December 2005**

