Ambient Air Monitoring

In

Ferbane, Co. Offaly

4th October 2006 to 29th March 2007

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Summary

An air quality assessment was carried out in Ferbane, Co. Offaly from 4th October 2006 until 29th March 2007. No limit values were exceeded during the assessment period.

Concentrations of carbon monoxide, sulphur dioxide, nitrogen dioxide and lead were below their respective lower assessment thresholds. Concentrations of PM_{10} exceeded the upper assessment threshold for this parameter.

	Below Lower Assessment Threshold	**Below Upper Assessment Threshold**	**Above Upper Assessment Threshold**	**Above Limit**
PM_{10}				
NO_2				
CO				
SO_2				
Pb				

Ferbane is in Zone D of the country. The implications of this assessment are that within Zone D (rural areas of the country and urban centres with a population less than 15,000)

- Levels of PM_{10} will need to be monitored continuously
- Levels of CO, SO_2, NO_2, and lead can be assessed using modelling or objective estimation techniques.

The European Union framework directive on air quality states that modelling or objective estimation techniques may be used to assess ambient air quality if levels of the pollutant in question in that zone are below the lower assessment threshold. Continuous monitoring is required if levels exceed the upper assessment threshold.

Introduction

The European Union introduced a new approach to the monitoring, assessment and management of air quality in 1996 when it introduced a framework directive on air quality (96/62/EC, 2nd September 1996). The basic principle of the framework directive is that each country should be divided into zones and that the monitoring, assessment, management and reporting of air quality will be undertaken in relation to these zones. For the purposes of the directive, Ireland has been divided into four zones; Dublin (Zone A), Cork Urban Area (Zone B), specified population centres > 15,000 inhabitants (Zone C) and non-urban areas (Zone D).

Limit values are set for each individual pollutant which need to be met by a specific attainment date. Upper and lower assessment thresholds are also set for each pollutant, assessment thresholds are levels below the limit value, used solely in the determination of the level of monitoring needed for that pollutant in a particular zone. The extent of monitoring in any zone is determined by population size and air quality status. Measurement is mandatory in agglomerations (population >250,000) and where concentrations are above the lower assessment threshold. The greatest monitoring effort applies if concentrations are above the upper assessment threshold. Less intensive monitoring is required when concentrations are between the two assessment thresholds.

Limit values, assessment thresholds, measurement techniques and other specifics for each pollutant are defined in a series of daughter directives. The first Daughter Directive was adopted in April 1999 (1999/30/EC) and covered SO_2, NO_X, particulate matter and lead. The second Daughter Directive was adopted in November 2000 (2000/69/EC) and covers CO and Benzene. The third Daughter Directive relates to ozone (2002/3/EC) while the fourth Daughter Directive relates to heavy metals and polycyclic aromatic hydrocarbons (2004/107/EC). The first three Directives were transposed into Irish law as the Air Quality Standard Regulations 2002 (S.I. No 271 of 2002) and the Ozone in Ambient Air Regulations 2004 (S.I. No 53 of 2004).

To comply with the directive the Environmental Protection Agency uses mobile laboratories to carry out assessments in areas with no history of air pollution measurements. These trailers contained the following instruments:

- Monitoring instruments which continuously measure and record concentrations of the pollutants sulphur dioxide, nitrogen oxides, carbon monoxide and PM_{10}.
- Sampler for lead and other metals in air (collection on filter for determination in the laboratory).

The sample inlets are at a height of ~3m.
For further information please contact

John Finnan, Barbara O' Leary or Ciaran O' Donnell.

Siting

The trailer was originally sited at the town sewerage works on the western edge of the town at which location the trailer was sited approximately 500m from the centre of Ferbane. The trailer was subsequently moved to the premises of Offaly County County at the disused railway station on the southern edge of town. The trailer was moved as it was felt that the council premises was more representative of air quality in the town. The council premises are located beside the N62 road which passes through Ferbane. The second location was approximately 500m from the centre of the town.

Time Period

The trailer was positioned at the the sewerage works on 4th October 2006 and remained at that location until 31st January 2006 when the trailer was moved to the council premises. Monitoring finished on 29th March 2006.

Fig. 1 Map of site location

Monitoring Methods

Carbon Monoxide

Carbon monoxide was monitored using a Gas Filter Correlation CO Analyser (Model 300, Advanced Pollution Instrumentation, 6565 Nancy Ridge Drive, San Diego, California). This is a continuous analyser whose measurement technique is based on the absorption of infrared radiation by CO molecules at wavelengths near 4.7μm.

Sulphur Dioxide

Sulphur dioxide was monitored using an Advanced Pollution Instrumentation SO_2 Fluorescent Analyser - Model 100A. This is a continuous analyser which measures the fluorescence of SO_2 molecules after excitation by ultraviolet radiation.

Nitrogen Dioxide and Oxides of Nitrogen

NO_x species were monitored using an Advanced Pollution Instrumentation Chemiluminescent $NO/NO_2/NO_x$ Analyser - Model 200A. This is a continuous analyser which utilises the chemiluminescent reaction between nitric oxide in the sample and ozone to measure NO concentrations. Any NO_2 present is then reduced to NO by a molybdenum converter giving a second value for total NO_x concentration. The amount of NO_2 present is found by subtraction.

Particulate Matter

Concentrations of PM_{10} were measured using an instrument which employed tapered element oscillating microbalance technology (TEOM, Rupprecht & Patashnick Co. Inc., 25 Corporate Circle, Albany, New York). This is a continuous method in which the air from the sampling head is passed through a filter placed on a tapered element. A mass transducer relates changes in the frequency of the tapered element to changes in particulate matter on the filter, the difference between the filter's current weight and its initial weight gives the total mass of collected particulate matter. An inertial impactor sampling head restricted the sampled particles to those with a diameter less than 10μm. PM_{10} concentrations measured by the TEOM were multiplied by a correction factor of 1.3 to compensate for the loss of volatile matter as recommended by the EC working group on particulate matter.

Lead and Other Metals

Ambient air was pumped through a Metricel membrane filter (Gelman, 37mm, 0.8μm) situated in a calming chamber. The filters were changed every 3-4 weeks. They were digested in conc. HNO_3 and analysed for lead and other metals using ICP-MS (Inductively Coupled Plasma-Mass Spectrometry).

All results for CO, SO_2, NO_X and the continuous particulate monitor were integrated to give 1-hour average values as required for comparison with the Directive limit values.

Results

Carbon Monoxide

No. of hours	4210	
Missing values	547	
(including routine maintenance)	31	
No. of measured values	3663	
Percentage covered	87.6	
Maximum hourly value	1.7	mg/m^3
98 percentile for hourly values	0.7	mg/m^3
Mean hourly value	0.2	mg/m^3
Maximum 8-hour mean	1.4	mg/m^3
98 percentile for 8-hour mean	0.6	mg/m^3

Directive Limits (2000/69/EC)

	Averaging Period	Limit Value	Date by which limit value is to be met
Limit Value for the protection of human health	8-hour running average	10 mg m^{-3}	1 January 2005
Upper assessment threshold	8-hour running average	7 mg m^{-3}	
Lower assessment threshold	8-hour running average	5 mg m^{-3}	

The lower assessment threshold was not exceeded during the measurement period (Figure 2). Levels of carbon monoxide were slightly higher at the council yard.

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Fig. 2 Carbon Monoxide 8hr Running Average
Ferbane 4/10/06 - 29/3/07

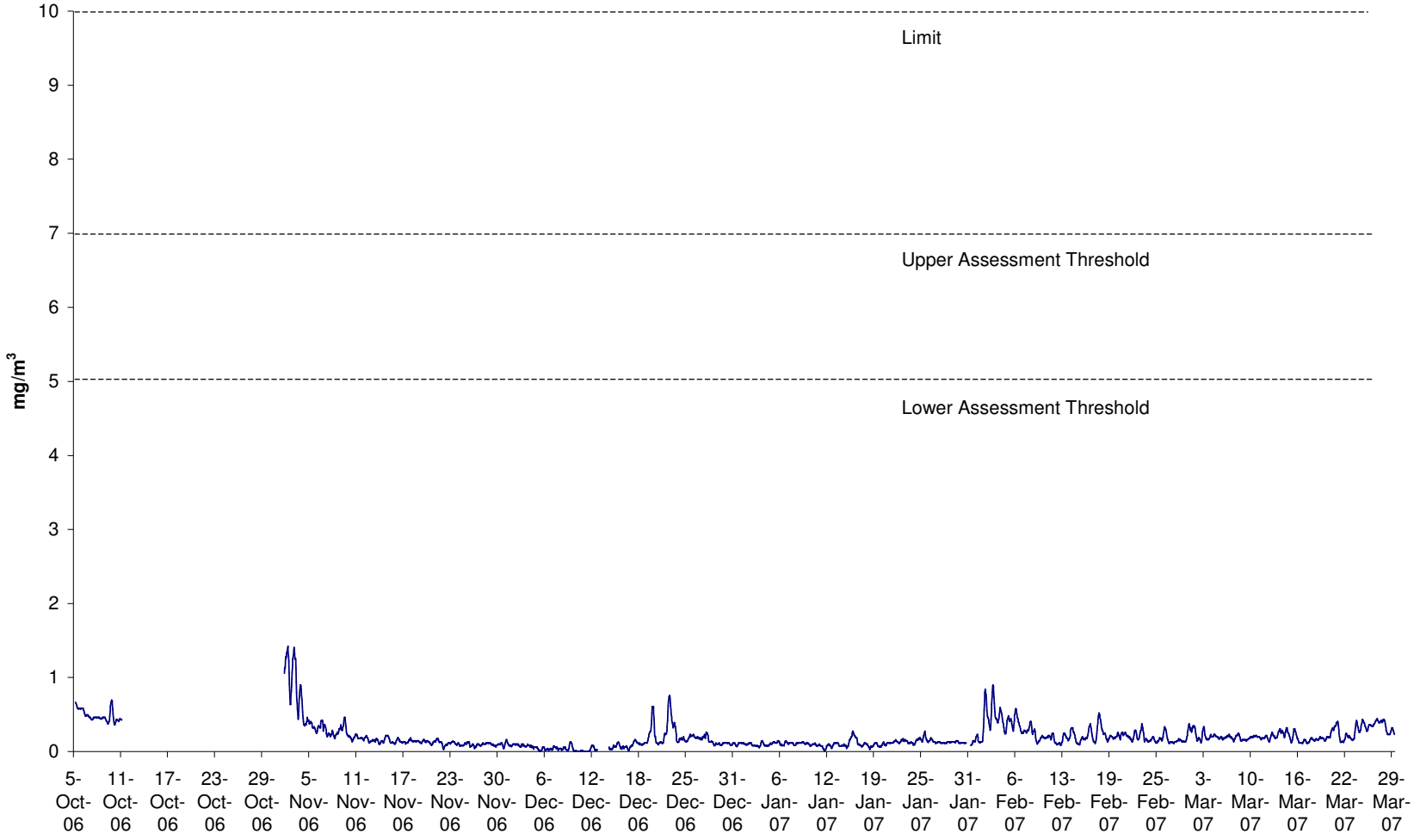
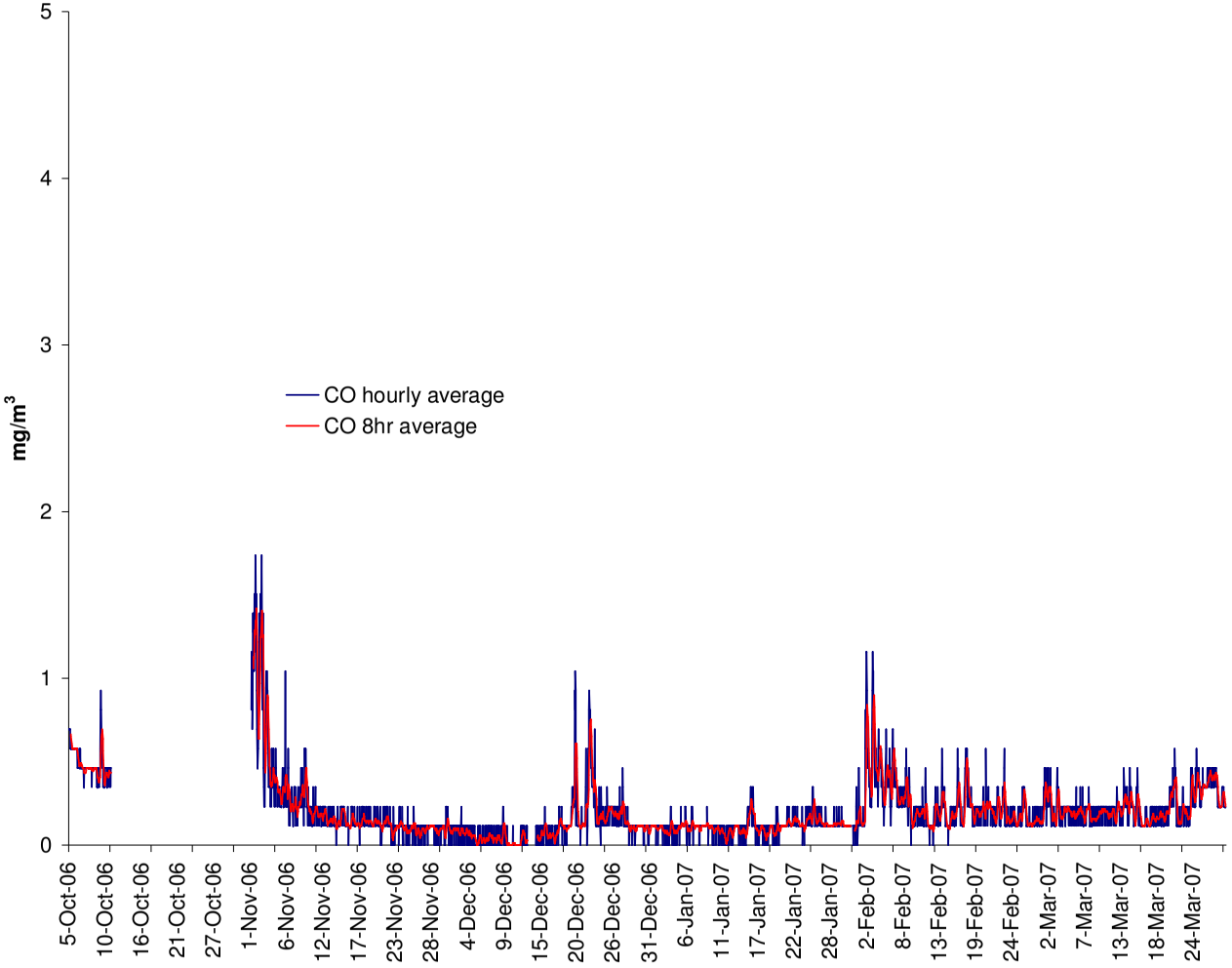


Fig. 3 Carbon Monoxide
Ferbane 4/10/06 - 29/3/07



Sulphur Dioxide

No. of hours	4210	
Missing values	107	
(including routine maintenance)	28	
No. of measured values	4103	
Percentage covered	98.1	
Maximum hourly value	15.1	$\mu g/m^3$
99.7 percentile for hourly values	13.5	$\mu g/m^3$
Mean hourly value	3.2	
Maximum 24-hour value	3.0	$\mu g/m^3$
99.2 percentile for 24-hour values	2.9	$\mu g/m^3$

Directive Limits (1999/30/EC)

	Averaging Period	Limit Value	Date by which limit value is to be met
Hourly limit value for the protection of human health	1 hour	350 $\mu g\ m^{-3}$ not to be exceeded more than 24 times a calendar year	1 January 2005
Daily limit value for the protection of human health	24 hours	125 $\mu g\ m^{-3}$ not to be exceeded more than 3 times a calendar year	1 January 2005
Limit value for the protection of ecosystems	Calendar year and winter (1 October to 31 March)	20 $\mu g\ m^{-3}$	19 July 2001
Alert threshold		500 $\mu g\ m^{-3}$ over three consecutive hours	

Directive Limits (1999/30/EC) continued

	Averaging Period	Limit Value	Date by which limit value is to be met
Upper assessment threshold for the protection of human health	24 hours	75 μg m^{-3} not to be exceeded more than 3 times a calendar year	
Lower assessment threshold for the protection of human health	24 hours	50 μg m^{-3} not to be exceeded more than 3 times a calendar year	
Upper assessment threshold for the protection of ecosystems	Calendar year and winter (1 October to 31 March)	12 μg m^{-3}	
Lower assessment threshold for the protection of ecosystems	Calendar year and winter (1 October to 31 March)	8 μg m^{-3}	

The lower assessment thresholds for the protection of human health and for the protection of ecosystems were not exceeded during the assessment (Figure 4). Levels of sulphur dioxide at the council yard site were slightly higher than levels at the sewerage works.

Fig. 4 Sulphur Dioxide 24 hour Averages
Ferbane 4/10/06 - 29/3/07

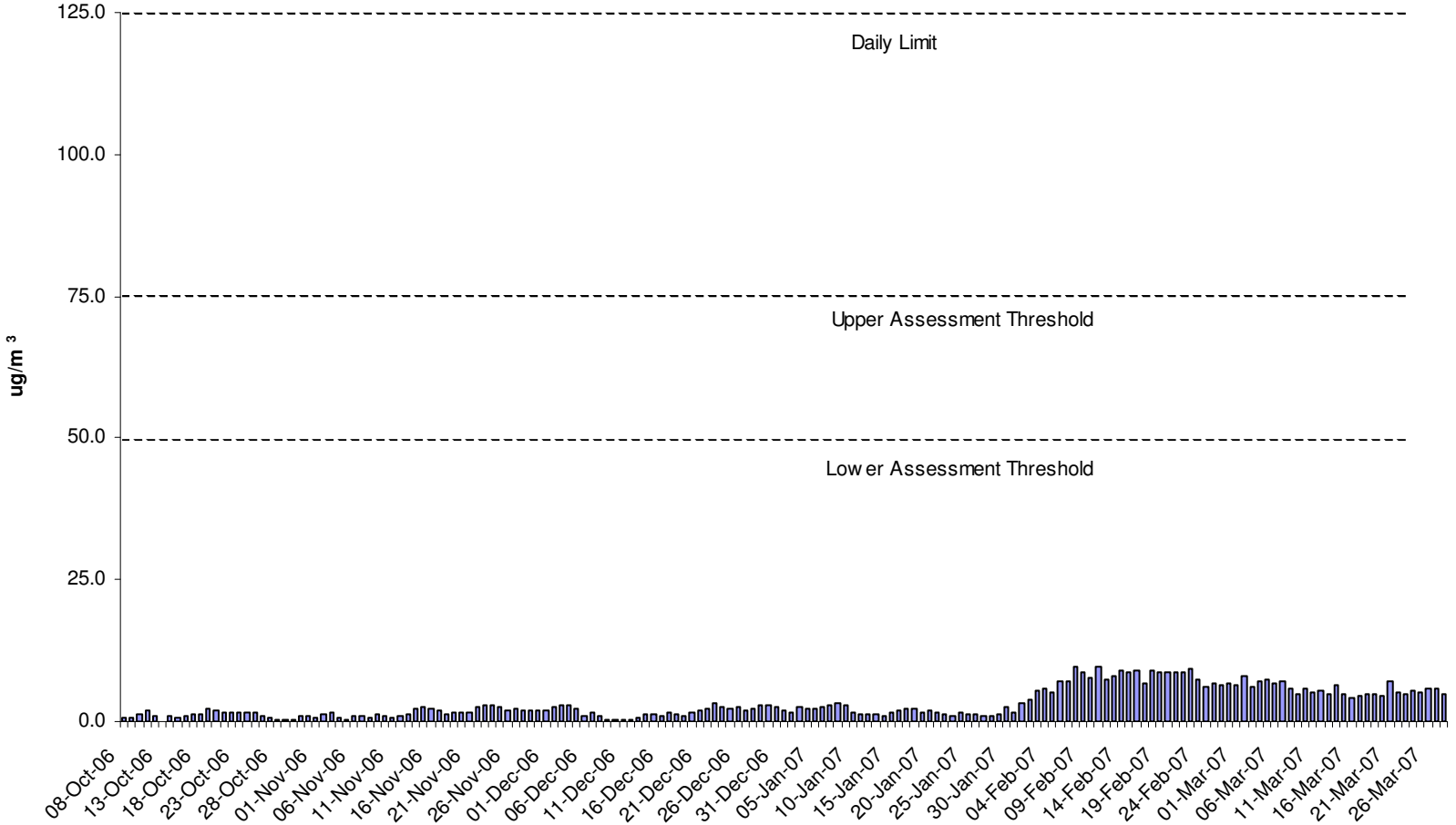
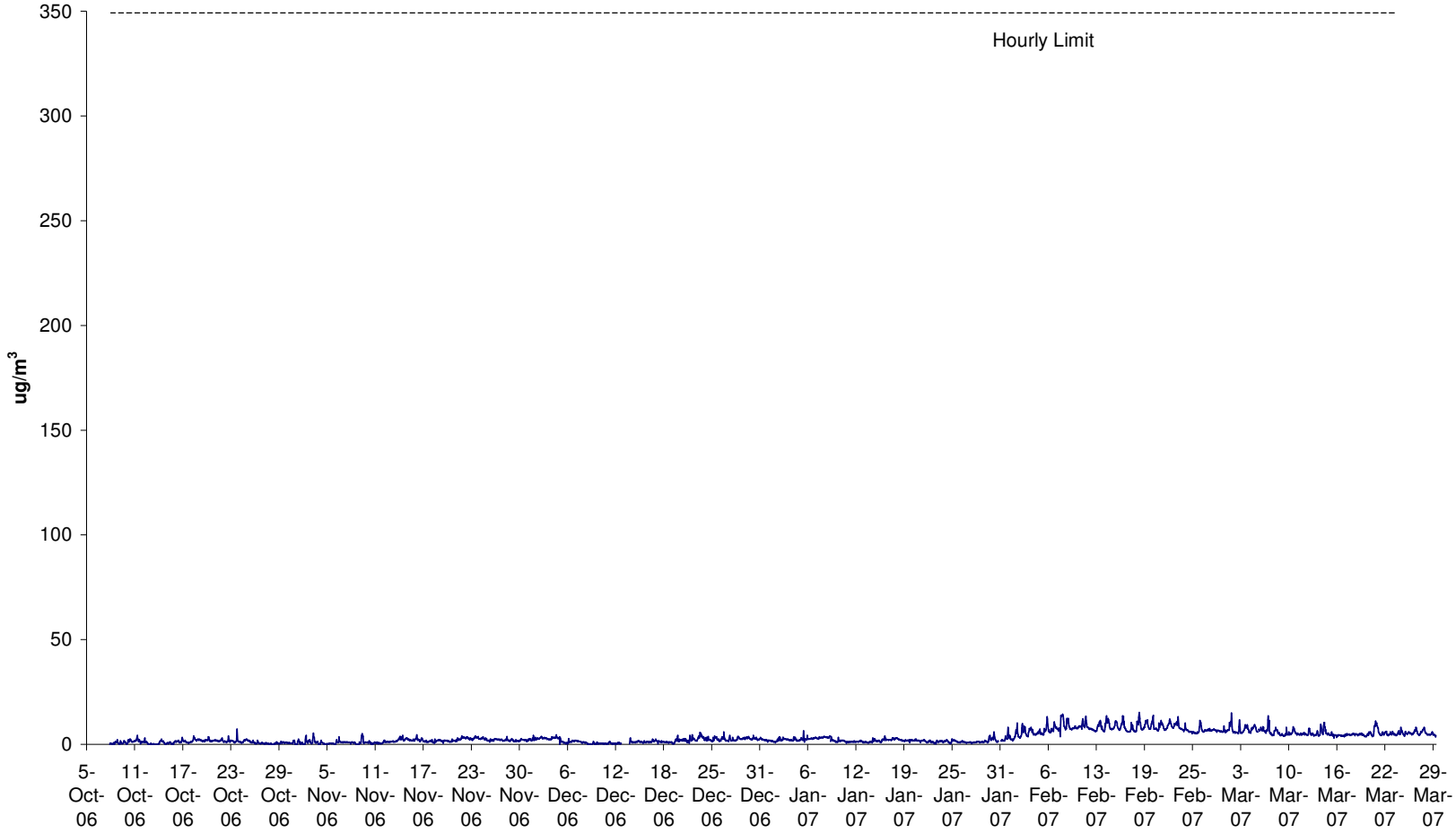


Fig. 5 Sulphur Dioxide Hourly Averages
Ferbane 4/10/06 - 29/3/07



Nitrogen Dioxide and Oxides of Nitrogen

No. of hours	4210	
Missing values	57	
(including routine maintenance)	35	
No. of measured values	4153	
Percentage covered	99.5	
Maximum hourly value (NO_2)	106.4	$\mu g/m^3$
99.8 percentile for hourly values (NO_2)	42.6	$\mu g/m^3$
Mean hourly value (NO_2)	5.2	$\mu g/m^3$
Mean hourly value (NO_x)	6.7	$\mu g/m^3$

Directive Limits (1999/30/EC)

	Averaging Period	Limit Value	Date by which limit value is to be met
Hourly limit value for the protection of human health	1 hour	200 $\mu g\ m^{-3}$ NO_2 not to be exceeded more than 18 times a calendar year	1 January 2010
Annual limit value for the protection of human health	Calendar year	40 $\mu g\ m^{-3}$ NO_2	1 January 2010
Annual limit value for the protection of vegetation	Calendar year	30 $\mu g\ m^{-3}$ NO_x	19 July 2001
Alert threshold		400 $\mu g\ m^{-3}$ NO_2 over three consecutive hours	

Directive Limits (1999/30/EC) continued

	Averaging Period	Limit Value	Date by which limit value is to be met
Upper assessment threshold for the protection of human health	1 hour	140 μg m^{-3} NO_2 not to be exceeded more than 18 times a calendar year	
Upper assessment threshold for the protection of human health	Calendar year	32 μg m^{-3} NO_2	
Lower assessment threshold for the protection of human health	1 hour	100 μg m^{-3} NO_2 not to be exceeded more than 18 times a calendar year	
Lower assessment threshold for the protection of human health	Calendar year	26 μg m^{-3} NO_2	
Upper assessment threshold for the protection of vegetation	Calendar year	24 μg m^{-3} NO_x	
Lower assessment threshold for the protection of vegetation	Calendar year	19.5 μg m^{-3} NO_x	

The lower assessment threshold for the protection of human health was exceeded on one occasion during the six month assessment period. However, eighteen exceedances in a calendar year are permitted before the threshold is deemed to be exceeded. Ferbane is thus classified as below the lower assessment threshold for the protection of human health. Similarly, the lower assessment threshold for the protection of ecosystems was not exceeded. Oxides of nitrogen levels were slightly higher at the council yard site compared to the sewerage works site.

NO, NO_2 and NO_X are measured as ppb (parts per billion) by volume. To convert to $\mu g.m^{-3}$, a factor (1.25 for NO, 1.91 for NO_2) is used. No formula is specified for NO_X, the directive requires it to be expressed as NO_2 (i.e. ppb*1.91). This applies even when most of the NO_X is present as NO.

Fig. 6 NO_2 Hourly Values
Ferbane 4/10/06 - 29/3/07

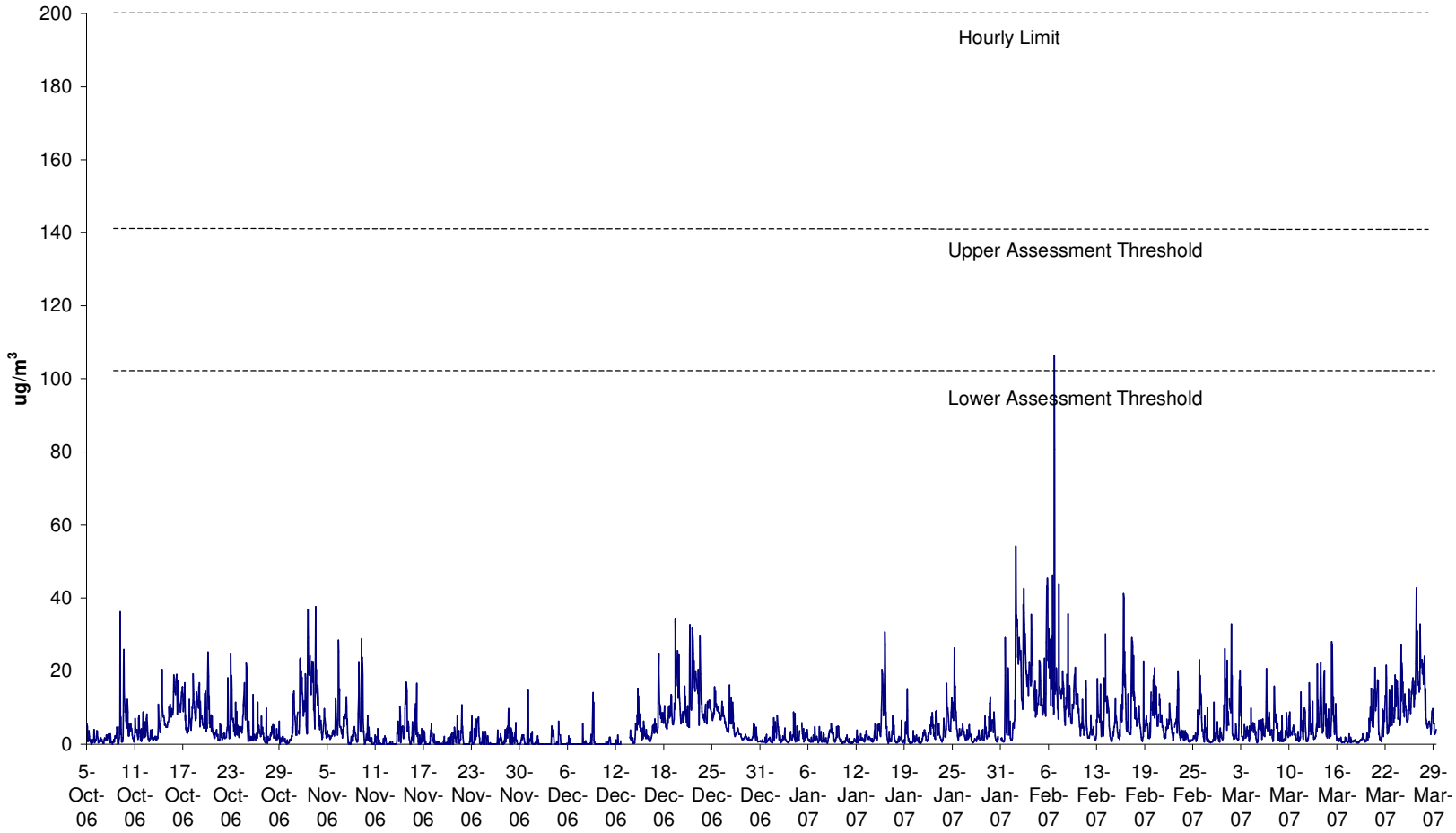
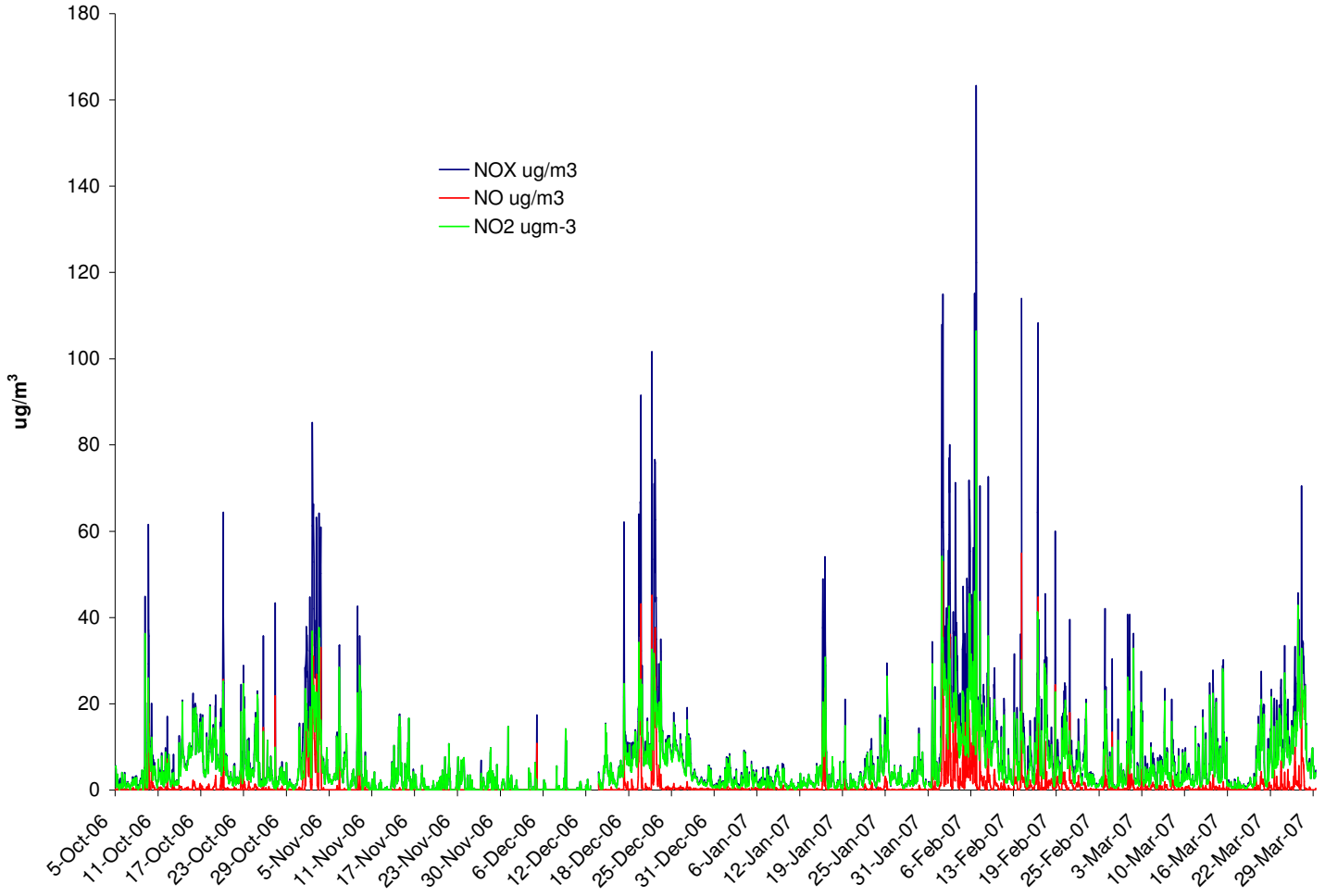


Fig. 7 NO_X Hourly Values
Ferbane 4/10/06 - 29/3/07



Particulate Matter

PM_{10} : Oscillating Microbalance Method

No. of days	175	
Missing values	0	
(including routine maintenance)	0	
No. of measured values	175	
Percentage covered	100	
Maximum daily value	63.6	$\mu g/m^3$
90.4 percentile for daily values	31.1	$\mu g/m^3$
Mean daily value	18.7	$\mu g/m^3$

Directive Limits (1999/30/EC)

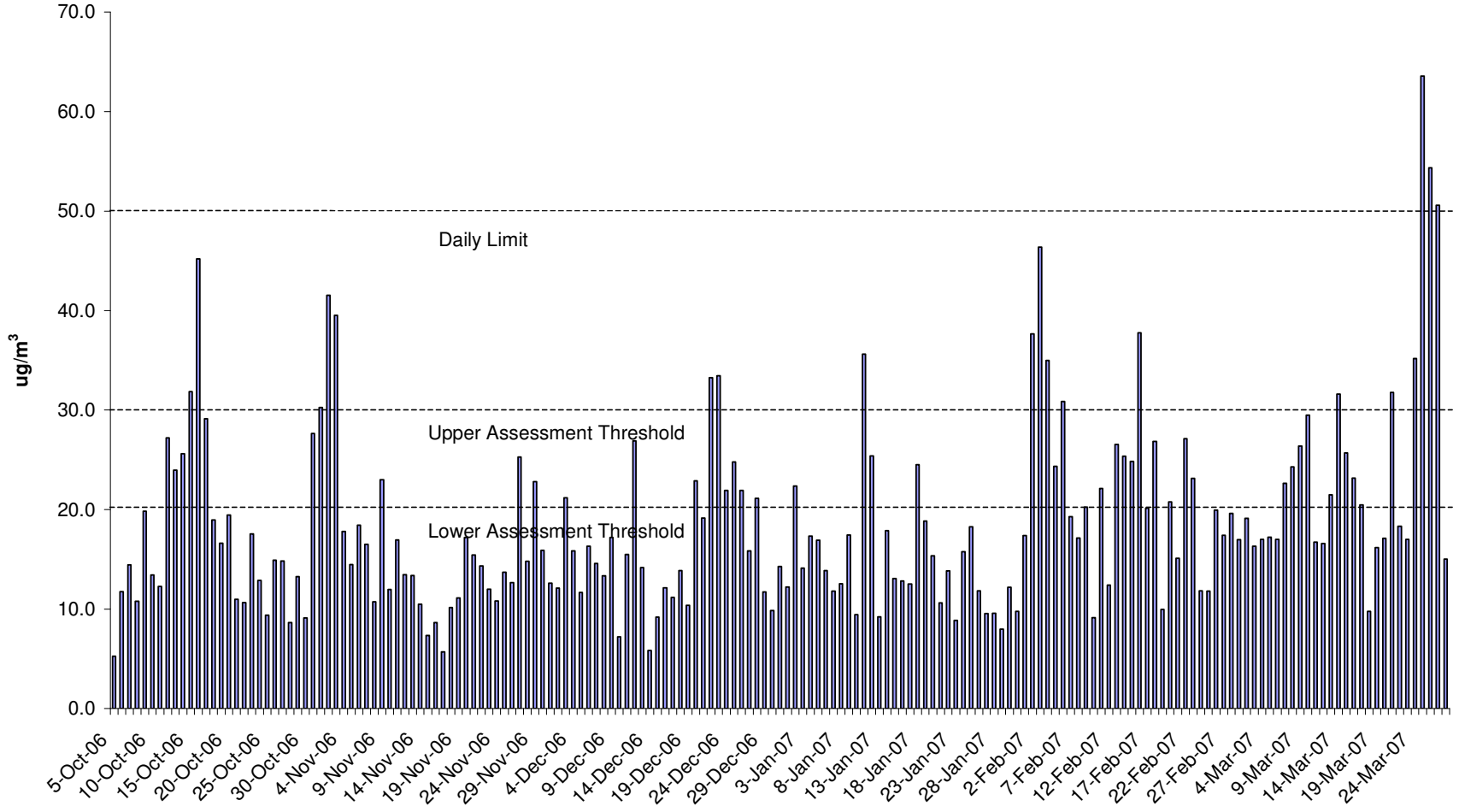
	Averaging Period	Limit Value	Date by which limit value is to be met
24-hour limit value for the protection of human health	24 hour	50 $\mu g\ m^{-3}$ PM_{10} not to be exceeded more than 35 times a calendar year	1 January 2005
Annual limit value for the protection of human health	Calendar year	40 $\mu g\ m^{-3}$ PM_{10}	1 January 2005
Upper assessment threshold for the protection of human health	24 hour	30 $\mu g\ m^{-3}$ PM_{10} not to be exceeded more than 7 times a calendar year	*based on the indicative limit values for 1 January 2010*
Upper assessment threshold for the protection of human health	Calendar year	14 $\mu g\ m^{-3}$ PM_{10}	*based on the indicative limit values for 1 January 2010*

Directive Limits (1999/30/EC) continued

	Averaging Period	Limit Value	Date by which limit value is to be met
Lower assessment threshold for the protection of human health	24 hour	20 μg m^{-3} PM_{10} not to be exceeded more than 7 times a calendar year	*based on the indicative limit values for 1 January 2010*
Lower assessment threshold for the protection of human health	Calendar year	10 μg m^{-3} PM_{10}	*based on the indicative limit values for 1 January 2010*

The daily limit value was exceeded on three occasions during the assessment, 35 exceedances are permitted in a calendar year. The lower assessment threshold was exceeded on 56 occasions while the upper assessment threshold was exceeded on 19 occasions. Ferbane is thus classified as being above the upper assessment threshold as the Directive only permits assessment thresholds to be exceeded 7 times in a calendar year. Levels of PM_{10} at the council yard site were slightly higher than levels at the sewerage works site (Figure 8).

Fig. 8 PM_{10} Daily Values
Ferbane 4/10/06 - 29/3/07



Lead

No. of days	176	
Missing days	62	
(including routine maintenance)	0	
No. of measured days	114	
Percentage covered	64.8	
Concentration of Pb	0.002	$\mu g/m^3$

Directive Limits (1999/30/EC)

	Averaging Period	Limit Value	Date by which limit value is to be met
Annual limit value for the protection of human health	Calendar year	0.5 $\mu g\ m^{-3}$	1 January 2005
Upper assessment threshold	Calendar year	0.35 $\mu g\ m^{-3}$	
Lower assessment threshold	Calendar year	0.25 $\mu g\ m^{-3}$	

The lower assessment threshold was not exceeded.

Other Metals:

Annex I of council Directive 96/62/EC (Air Framework Directive) lists four metals other than lead to be taken into consideration in the assessment and management of ambient air quality. These are cadmium, arsenic, nickel and mercury . Limit values and measurement methods for these metals as well as certain polycyclic aromatic hydrocarbons were subsequently set out in the fourth Daughter Directive 92004/107/EC).

An indicative method was used during this assessment to measure prevailing concentrations of cadmium, nickel and arsenic in air. This method is detailed above and essentially involves pumping air through a filter for several weeks before digesting the filter and analysing the digest for lead and other metals using ICP-MS. With this method, the detection limit is influenced by any traces of metal in the filter paper as well as by the volume of air passed through the filter.
The results, although indicative, do provide some indication of the concentrations of these metals in air.

During this assessment

The maximum concentration of arsenic in air was lower than trace levels of arsenic known to exist on the filter papers

The maximum concentration of cadmium in air was lower than trace levels of cadmium known to exist on the filter papers

The maximum concentration of nickel in air was lower than trace levels of nickel known to exist on the filter papers