

Oxford City Council

Environmental Health

Airwatch Annual Report
1998

**Environmental Health
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Contents

1 Introduction.....	2
2 Air Quality Standards and Guidelines.....	3
3 Summary of Results	4
Nitrogen Dioxide.....	4
Diffusion Tube Survey	4
Continuous Monitoring.....	5
Sulphur Dioxide.....	5
Carbon Monoxide.....	6
Ozone	6
PM ₁₀ Particulate Matter	7
4 Comparison with other sites	9
5 Conclusions	10
6 Future Developments	11
Appendix 1 Air Quality Standards and Guidelines	12
Appendix 2 Oxford Airwatch Results.....	13
Table 1 - St Aldates Summary:.....	13
Table 2 - Cornmarket Street Summary.....	14
Table 3 - East Oxford Summary	15
Table 4 - St Ebbes Summary	16
Table 5 - Nitrogen Dioxide St Aldates.....	17
Table 6 - Nitrogen Dioxide East Oxford.....	18
Table 7 - Nitrogen Dioxide St Ebbes	19
Table 8 - Carbon Monoxide St Aldates.....	20
Table 9 - Sulphur Dioxide St Aldates.....	21
Table 10 - Ozone East Oxford.....	22
Table 11 - Ozone St Ebbes	23
Table 12 - PM10 Cornmarket Street.....	24
Table 13 - PM10 East Oxford	25
Table 14 - PM10 St Ebbes	26
Table 15 - Nitrogen Dioxide Diffusion Tube Data	27
Appendix 3 Maps Showing Monitoring sites.....	30
Appendix 4 Validation of data from continuous monitoring stations.....	32
Appendix 5 Glossary	33

1 Introduction

1. This is the fifth Airwatch Annual Report produced by the Environmental Health Service. Results are compared to the standards and objectives contained in the United Kingdom Air Quality Strategy and Air Quality Regulations 1997. These standards are explained in section 2 and Appendix 1.
2. Four continuous monitoring sites are operated under the Airwatch Programme. The Town Hall kerbside site in St Aldates measures nitrogen dioxide, sulphur dioxide and carbon monoxide. Two urban background continuous monitoring stations are operated at sites in East Oxford and St Ebbes. These sites measure nitrogen dioxide, ozone and PM₁₀ (particulate matter less than 10 microns in diameter). A further PM₁₀ analyser is operated at the kerbside in Cornmarket Street. The analysers at the St Aldates site were replaced with a new system in July. This system was off line between 14th September and 18th November due to building works at the Town Hall.
3. The Town Hall site is included in the Department of the Environment Transport and Regions (DETR) Automated Urban Network and data is presented daily on teletext page 106, ceefax pages 410 to 417 and on the Internet site <http://www.aeat.co.uk/netcen/airqual>.
4. The nitrogen dioxide diffusion tube survey involves 45 sites at kerbside, intermediate and background locations. These sites have been chosen to assess the impact of the implementation of the Oxford Transport Strategy (OTS) on traffic pollution. The diffusion tubes are changed monthly.
5. Air quality data is provided to the EMITS project¹.
6. Maps showing the location of continuous monitoring and diffusion tube sites are provided in Appendix 3.
7. Details of data validation procedures are given in Appendix 4 and a Glossary is included in Appendix 5. The complete data set from the continuous monitoring sites has been independently validated by the National Environmental Technology Centre, AEA Technology Environment.

¹ EC funded Environmental Monitoring of Integrated Transport Strategies in partnership with Oxfordshire County Council, University of Oxford, Transport Studies Unit and Heart and Lung Foundation. [Http://www.oxfordshire.gov.uk/emitsdx.htm](http://www.oxfordshire.gov.uk/emitsdx.htm).

2 Air Quality Standards and Guidelines

8. Data is assessed in accordance with the air quality standards contained in the Air Quality Regulations² and the United Kingdom Air Quality Strategy³. The standards are expressed as objective levels to be achieved by the end of the year 2005.
9. In addition, measurements are compared to the air pollution banding system introduced by the DETR in November 1997. Air pollution levels are categorised as low, moderate, high and very high. This system provides guidance as to the effects of air pollutants on health and is based on advice from the Department of Health. At low levels of pollution it is unlikely that anyone will experience any adverse effects. The system is linked very closely to the air quality objective levels in that the threshold between low and moderate has been set at the objective level for each pollutant.
10. Full details of the air quality objectives and air pollution bands used for assessing the results in this report are given in Appendix 1.

²Air Quality Regulations 1997 SI 3043.

³The United Kingdom Air Quality Strategy: Department of the Environment 1997.

3 Summary of Results

11. This section comments on the results for individual pollutants. More detailed data is given in Appendix 2. Results are compared to relevant air quality standards and objectives. The Air Quality Regulations 1997 set out the air quality objectives to be achieved by 31 December 2005.

Nitrogen Dioxide

12. Two air quality objective levels have been set for nitrogen dioxide, 150 parts per billion (ppb) or less, when expressed as an hourly mean, and 21ppb when expressed as an annual mean. These objectives are to be measured against likely human exposure. Therefore the annual mean is more appropriate for assessing longer term exposure from background concentrations and the hourly mean for assessing short term exposure from kerbside concentrations.
13. Hourly measurements made at continuous sites can be used to assess against both objective levels. Data from diffusion tube monitoring, is compared to the annual mean objective level.

Diffusion Tube Survey

14. The diffusion tube survey set up under EMITS has now been running for four years. Data for the four years has been presented together in the charts in Appendix 2. The charts show a general decrease in concentrations of nitrogen dioxide as new lower polluting catalyst cars and Euro II standard buses and goods vehicles are replacing older vehicles.
15. This part of the monitoring programme comprises forty five sites at a mixture of kerbside, intermediate and background locations including areas representative of residential streets. Of the forty five sites, twenty nine exceeded the air quality objective level of 21ppb compared to thirty last year and thirty three in 1996. Although the annual mean objective level should not strictly be used for kerbside locations, comparison to this standard is a good indicator of progress in the improvement of air quality. The average concentration across all sites has shown a 16% improvement from 28.1ppb in 1995 to 23.6ppb in 1998.
16. The general levels of air pollutants tend to fall significantly with distance from the roadside. This can be illustrated by data from the survey for Shirelake Close (18.6ppb) which is 25 metres from Thames Street (30.6ppb); and for Sadler Walk (15.1ppb) and Trinity Street (15.5ppb) which are 120 metres and 25 metres respectively from Oxpens Road (21.4ppb).

Continuous Monitoring

17. The two sites at St Ebbes and East Oxford are both background sites and are representative of the exposure to people living in the area. At St Ebbes the mean concentration was 12ppb and the maximum hour was 54ppb in February. At East Oxford the mean was 15ppb and the maximum hour was 132ppb in November.
18. The maximum hour at St Aldates kerbside site was recorded at 86ppb in May. The mean concentration was 27ppb.

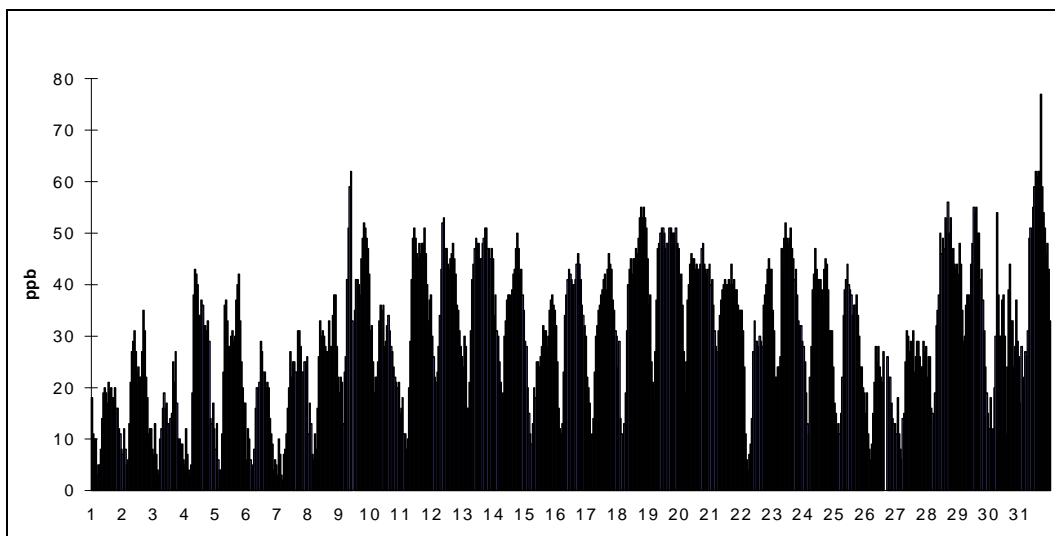


Figure 1 St Aldates hourly mean nitrogen dioxide concentrations for March

Sulphur Dioxide

19. The air quality objective level set for sulphur dioxide is 100ppb or less, when expressed as the 99.9th percentile of 15 minute means. Sulphur dioxide was monitored continuously at St Aldates. The 99.9th percentile of 15 minute means was 55ppb which is within the air quality objective level. The mean concentration was 7ppb, the maximum hour was 68ppb and the maximum 15 minute mean of 73ppb, occurred in March.

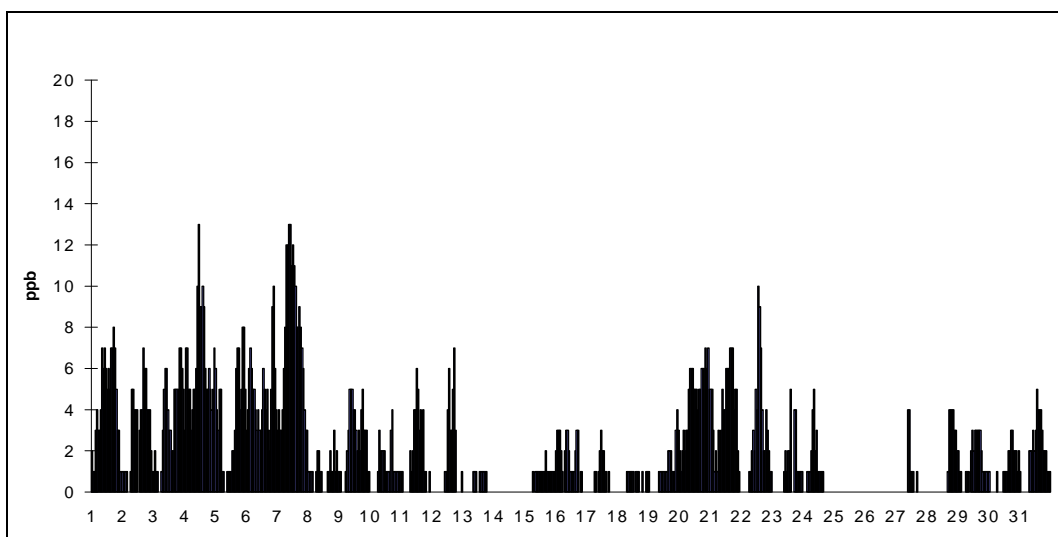


Figure 2 St Aldates hourly mean sulphur dioxide concentrations for December

Carbon Monoxide

20. The air quality objective level set for carbon monoxide is 10 parts per million (ppm) or less, when expressed as a running 8 hour mean. Carbon monoxide was monitored continuously at St Aldates. The mean concentration was 0.8ppm and the maximum hour was 6.1ppm in February. The maximum running 8 hour mean was 3.7ppm in April which is within the air quality objective level.

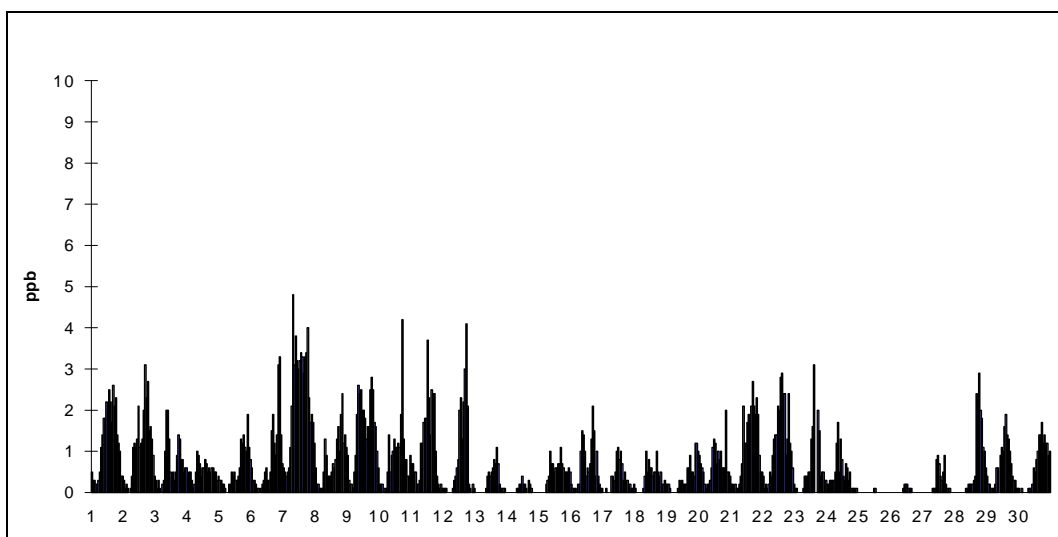


Figure 3 St Aldates hourly mean carbon monoxide concentrations for June

Ozone

21. The Air Quality Regulations 1997 did not set an objective level for ozone. However the UK National Air Quality Strategy suggested the objective level of 50ppb or less, when expressed as the 97th percentile of daily

maximum running 8 hour means. Ozone was monitored continuously at St Ebbes and East Oxford. At St Ebbes the 97th percentile of daily maximum running 8 hour means was 49ppb. The mean concentration was 21ppb, the maximum hour was 72ppb and the maximum running 8 hour mean was 63ppb both in August. At East Oxford the 97th percentile of daily maximum running 8 hour means was 54ppb. The mean concentration was 22ppb, the maximum hour was 84ppb in June and the maximum running 8 hour mean was 72ppb in May.

22. Ozone is a secondary pollutant and is produced by chemical reactions in the atmosphere primarily between nitrogen oxides and hydrocarbons in the presence of sunlight. It is a transboundary pollutant and elevated concentrations are often caused in the summer months by air masses originating in Central Europe. Ozone episodes were recorded in Oxford during the summer months of this year. During May and June, 53 hours of moderate ozone pollution were recorded at St Ebbes and 147 hours were recorded at East Oxford. During August and September 42 hours of moderate ozone pollution were recorded at St Ebbes and 26 hours were recorded at East Oxford. The objective level was exceeded at St Ebbes on 8 days and East Oxford on 14 days. The 97th percentile objective allows exceedences on 10 days a year.

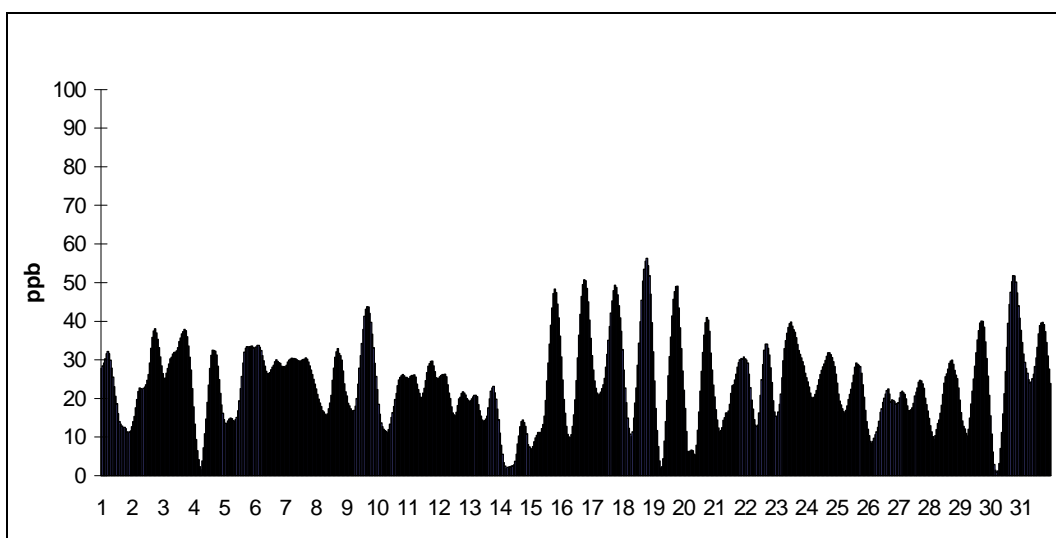


Figure 4 St Ebbes running 8 hour mean ozone concentrations for May

PM₁₀ Particulate Matter

23. The air quality objective level set for PM₁₀ is 50 micrograms per cubic metre ($\mu\text{g}/\text{m}^3$) or less, when expressed as the 99th percentile of daily maximum running 24 hour means. PM₁₀ was monitored continuously at St Ebbes, East Oxford and Cornmarket Street. At St Ebbes the 99th percentile of daily maximum running 24 hour means was $51\mu\text{g}/\text{m}^3$. The mean concentration was $18\mu\text{g}/\text{m}^3$, the maximum hour was $318\mu\text{g}/\text{m}^3$ and the maximum running 24 mean was $95\mu\text{g}/\text{m}^3$, both in January. At East Oxford the 99th percentile of daily maximum running 24 hour means was

$60\mu\text{g}/\text{m}^3$. The mean concentration was $21\mu\text{g}/\text{m}^3$, the maximum hour was $204\mu\text{g}/\text{m}^3$ in July and the maximum running 24 mean was $77\mu\text{g}/\text{m}^3$ in January. At Cornmarket Street the 99th percentile of daily maximum running 24 hour means was $64\mu\text{g}/\text{m}^3$. The mean concentration was $28\mu\text{g}/\text{m}^3$, the maximum hour was $218\mu\text{g}/\text{m}^3$ in May and the maximum running 24 mean was $84\mu\text{g}/\text{m}^3$ in January.

24. At St Ebbes 52 hours of moderate PM_{10} pollution were recorded during January and March and 15 hours of high PM_{10} during January. At East Oxford 165 hours of moderate PM_{10} pollution were recorded during the year and 7 hours of high PM_{10} during January. At Cornmarket Street 264 hours of moderate PM_{10} pollution were recorded during the year and 22 hours of high PM_{10} during January and May. The air quality objective level was exceeded at Cornmarket on 21 days, East Oxford on 18 days and St Ebbes on 5 days. The 99th percentile objective allows exceedences on 4 days a year.
25. PM_{10} is produced both locally and some distance away from the monitoring site. Because of its buoyancy, PM_{10} can be transported long distances on air masses and episodes in the UK have been attributed to air masses travelling from Central Europe. St Ebbes and East Oxford are urban background sites and Cornmarket Street is a kerbside site in a street that is restricted to bus traffic (diesel fuel). The East Oxford site is close to a builders yard and although the mean is not excessive, sporadically there are very high hourly measurements. The Southern Gas offices at Grandpont were demolished at the beginning of 1998 and this is thought to be responsible for elevated PM_{10} at St Ebbes.

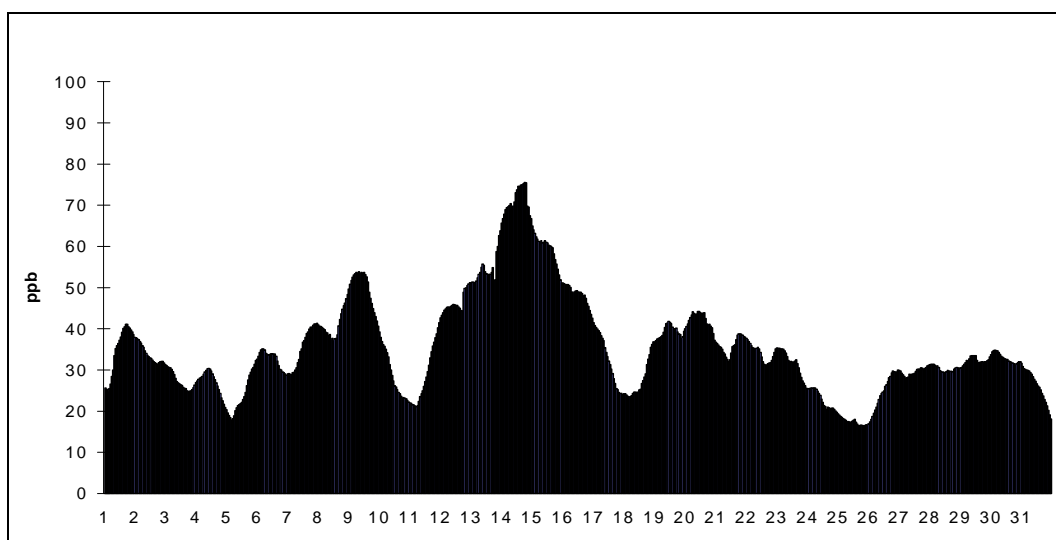


Figure 5 Cornmarket running 24 hour mean PM_{10} concentrations for May

4 Comparison with other sites

26. Data from the Oxford sites is compared to selected other sites in the table below. All of the other sites are part of or affiliated to the automatic urban network and data was downloaded from the NETCEN internet site <http://www.aeat.co.uk/netcen/airqual/>.

	NO2 ppb		PM10 ug/m3		SO2 ppb		O3 ppb		CO ppm	
	1 hour		running 24 hour		15 minutes		running 8 hour		running 8 hour	
	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean
Oxford St Aldates (Roadside)	86	27	-	-	73	7	-	-	3.7	0.8
Oxford St Ebbes (Urban background)	54	12	95	18	-	-	63	21	-	-
Oxford East Oxford (Urban background)	132	15	77	21	-	-	72	22	-	-
Oxford Cornmarket (Roadside)	-	-	84	28	-	-	-	-	-	-
Reading (Urban background - 20 metres from A4)	91	27	-	-	75	3	66	19	4.7	0.7
Norwich Centre (Urban centre - on edge of city centre)	67	13	47	20	50	4	61	17	5.2	0.4
Norwich Roadside (Roadside - located in the Guildhall)	97	17	-	-	-	-	-	-	-	-
Marlyebone Road (Roadside - 1m from busy main road)	152	48	75	32	71	7	40*	6*	6.2	2.0
Leamington Spa (Urban background - 10m from main road)	61	17	65	18	-	-	65	20	2.7	0.3
Harwell (Rural)	55	10	-	-	213	1	69	26	-	-
Bristol Centre (Urban centre - 40m from major road)	121	21	66	22	113	3	58	19	3.3	0.5
Bath Roadside (Roadside - on A4 London Rd)	114	33	-	-	-	-	-	-	4.1	1.4

*Provisional data.

5 Conclusions

27. In summary:

- results for annual diffusion tube monitoring showed that out of a mixture of 45 sites sampled, 29 exceeded the 2005 air quality objective level of 21ppb annual mean, compared to 30 sites last year and 33 in 1996,
- there has been an overall reduction in annual mean concentrations of nitrogen dioxide over the last 4 years (average reduction 16%),
- the hourly mean nitrogen dioxide air quality objective of 150ppb was achieved,
- the air quality objectives for sulphur dioxide and carbon monoxide and were achieved,
- the air quality objective level for ozone (50ppb 97th percentile of daily maximum 8 hour running means) was achieved at St Ebbes but exceeded at East Oxford (54ppb),
- the air quality objective level for PM₁₀ (50µg/m³ 99th percentile of daily maximum 24 hour running means) was exceeded at Cornmarket Street (64µg/m³), East Oxford (60µg/m³) and at St Ebbes (51µg/m³).

6 Future Developments

28. There is increasing concern over the impact of air pollution on human health. The UK Government has adopted the approach of integrated pollution control, now encompassed in the UK National Air Quality Strategy. In progressing the strategy, the Government passed Air Quality Regulations in December 1997 initiating the system of local air quality management under Part IV Environment Act 1995. The Environment Act requires local authorities to carry out a review and assessment of air quality and where appropriate declare Air Quality Management Areas (AQMAs). The Regulations set the air quality standards and objectives for seven key pollutants. These standards and objectives are to be achieved by 31st December 2005. Local authorities will have powers to declare AQMAs where they are not likely to be achieved.
29. The initial Stage 1-2 Air Quality Review and Assessment was completed in December 1998. It recommended that a third stage review and assessment should be undertaken for nitrogen dioxide and particulate matter (PM₁₀). It also recommended that a robust assessment of the small boilers in Oxford with the potential to result in exceeding the national sulphur dioxide objective should also be undertaken.
30. The Council's Health & Environment (Environmental Protection) Sub Committee at their meeting on 3rd December agreed these recommendations and to consult widely on the air quality review and assessment being carried out in Oxford. We are now well into the EMITS project (see section 1) and air quality data is being used to assess the impact of the Oxford Transport Strategy (OTS) on the environment in Oxford. Air quality and health are key issues in taking the OTS forward and the Airwatch programme provided essential air quality evidence for the OTS Public Inquiry.

Appendix 1 Air Quality Standards and Guidelines

Air Quality Regulations 1997.

The air quality objective levels are to be achieved by the end of 2005.

Substance	Air quality objective levels
Benzene	5ppb or less, when expressed as a running annual mean
1,3-Butadiene	1ppb or less, when expressed as a running annual mean
Carbon monoxide	10ppm or less, when expressed as a running 8 hour mean
Lead	0.5µg/m ³ or less, when expressed as an annual mean
Nitrogen dioxide	150ppb or less, when expressed as an hourly mean, and 21ppb or less, when expressed as an annual mean
PM ₁₀	50µg/m ³ or less, when expressed as the 99 th percentile of daily maximum running 24 hour means
Sulphur dioxide	100ppb or less, when expressed as the 99.9 th percentile of 15 minute means
Ozone*	50ppb or less, when expressed as the 97 th percentile of daily maximum 8 hour running means

* UK National Air Quality Strategy (not included in Air Quality Regulations)

DETR Air Pollution Bands

Pollutant	DETR Air Pollution Bands				Measured as
	Low	Moderate	High	Very High	
Nitrogen dioxide	150ppb or less	150-299ppb	300-399ppb	equal to or greater than 400ppb	hourly mean
Ozone	50ppb or less	50-89ppb	90-179ppb	equal to or greater than 180ppb	running 8 hour mean*
Carbon monoxide	10ppm or less	10-14ppm	5-19ppm	equal to or greater than 20ppm	running 8 hour mean
Sulphur dioxide	100ppb or less	100-199ppb	200-399ppb	equal to or greater than 400ppb	15 minute mean
PM ₁₀	50µg/m ³ or less	50-74µg/m ³	75-99µg/m ³	equal to or greater than 100µg/m ³	running 24 hour mean

* Running 8 hour mean for low pollution, hourly mean for the remainder

Appendix 2 Oxford Airwatch Results

Table 1 - St Aldates Summary:

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM ₁₀ µg/m ³
Mean	27	0.8	-	7	-
99.9th percentile 15 min mean	-	-	-	55	-
Max 15 min mean	-	-	-	73	-
Max Hour	86	6.1	-	68	-
Max running 8-hr mean	-	3.7	-	-	-
Data Capture %	71	75	-	46	-
DETR Band (hrs)	6227	6541	-	4035	-
Low	6227	6541	-	4035	-
Moderate	0	0	-	0	-
High	0	0	-	0	-
Very High	0	0	-	0	-
Air Quality Regulations Number of exceedences	0	0	-	0	-

Data from AUN Internet Site

Appendix 2 (continued)

Table 2 - Cornmarket Street Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM ₁₀ µg/m ³
Mean	-	-	-	-	28
Max Hour	-	-	-	-	218
Max running 24-hr mean	-	-	-	-	84
99th percentile daily max running 24-hr means	-	-	-	-	64*
Data Capture %	-	-	-	-	96%
DETR Band (hrs)	-	-	-	-	8339
Low	-	-	-	-	8053
Moderate	-	-	-	-	264
High	-	-	-	-	22
Very High	-	-	-	-	0
Air Quality Regulations					
Number of exceedences (hours)	-	-	-	-	286
On number of days	-	-	-	-	21*

*The air quality objective for PM₁₀ is 50µg/m³ when expressed as the 99th percentile of daily maximum running 24 hour means. The 99th percentile was 64µg/m³. 50µg/m³ was exceeded on 21 days, 4 days are allowed under the regulations.

Appendix 2 (continued)

Table 3 - East Oxford Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM ₁₀ µg/m ³
Mean	15	-	22	-	21
Max Hour	132	-	84	-	204
97th percentile daily max running 8-hr mean	-	-	54***	-	-
Max running 8-hr mean	-	-	72	-	-
99th percentile daily max running 24-hr means	-	-	-	-	60****
Max running 24-hr mean	-	-	-	-	77
Data Capture %	87	-	91	-	94
DETR Band (hrs)	7586	-	7940	-	8268
Low	7586	-	7847	-	8096
Moderate	0	-	193	-	165
High	0	-	0	-	7
Very High	0	-	0	-	0
Air quality objectives	*		**		*
Number of exceedences	0	-	40	-	172
On number of days	-	-	14***	-	18****

*Air Quality Regulations

**National Air Quality Strategy

***The air quality objective for ozone is 50ppb when expressed as the 97th percentile of running daily maximum 8 hour means. The 97th percentile was 54ppb. 50ppb was exceeded on 14 days, 10 days are permitted under the National Air Quality Strategy.

****The air quality objective for PM₁₀ is 50µg/m³ when expressed as the 99th percentile of daily maximum running 24 hour means. The 99th percentile was 60µg/m³. 50µg/m³ was exceeded on 18 days, 4 days are allowed under the Air Quality Regulations.

Appendix 2 (continued)

Table 4 - St Ebbes Summary

Standard	Nitrogen Dioxide ppb	Carbon Monoxide ppm	Ozone ppb	Sulphur Dioxide ppb	Particulates PM ₁₀ µg/m ³
Mean	12	-	21	-	18
Max Hour	54	-	72	-	318
97th percentile running 8-hr mean	-	-	49***	-	-
Max running 8-hr mean	-	-	63	-	-
99th percentile max daily running 24-hr means	-	-	-	-	51****
Max running 24-hr mean	-	-	-	-	95
Data Capture %	93	-	95	-	86
DETR Band (hrs)	8139	-	8340	-	7375
Low	8139	-	8261	-	7323
Moderate	0	-	79	-	37
High	0	-	0	-	15
Very High	0	-	0	-	0
Air quality objectives	*		**		*
Number of exceedences	0	-	21	-	52
On number of days	-	-	8***	-	5****

*Air Quality Regulations

**National Air Quality Strategy

***The air quality objective for ozone is 50ppb when expressed as the 97th percentile of daily maximum running 8 hour means. The 97th percentile was 49ppb. 50ppb was exceeded on 8 days, 10 days are permitted under the National Air Quality Strategy.

****The air quality objective for PM₁₀ is 50µg/m³ when expressed as the 99th percentile of daily maximum running 24 hour means. The 99th percentile was 51µg/m³. 50µg/m³ was exceeded on 5 days, 4 days are allowed under the Air Quality Regulations.

Appendix 2 (continued)

Table 5 - Nitrogen Dioxide St Aldates

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	28	25	30	32	34	22	23	25	25	-	-	27
Max hour ppb	72	57	77	80	86	72	53	66	77	-	-	82
% Data Capture	74	91	100	99	89	99	61	99	42	-	-	94
DETR Band (hours)	554	633	741	717	663	716	452	735	313	-	-	703
Low	554	633	741	717	663	716	452	735	313	-	-	703
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs Number of hours>150ppb	0	0	0	0	0	0	0	0	0	0	0	0

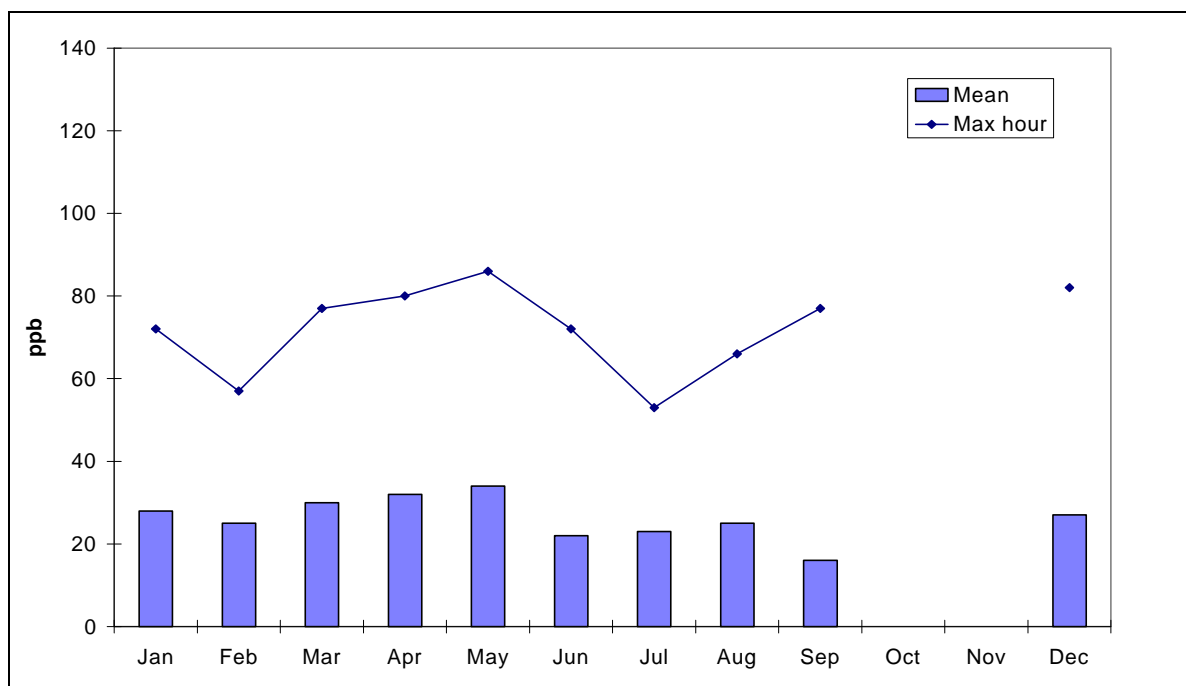


Figure 6: St Aldates nitrogen dioxide concentrations

Appendix 2 (continued)

Table 6 - Nitrogen Dioxide East Oxford

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	18	21	15	14	10	10	9	12	13	11	21	19
Max hour ppb	68	104	49	88	44	53	36	44	109	58	132	88
% Data Capture	100	96	94	99	99	79	56	63	88	92	99	70
DETR Band (hours)	742	670	695	713	740	569	413	470	657	684	712	521
Low	742	670	695	713	740	569	413	470	657	684	712	521
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs Number of hours>150ppb	0	0	0	0	0	0	0	0	0	0	0	0

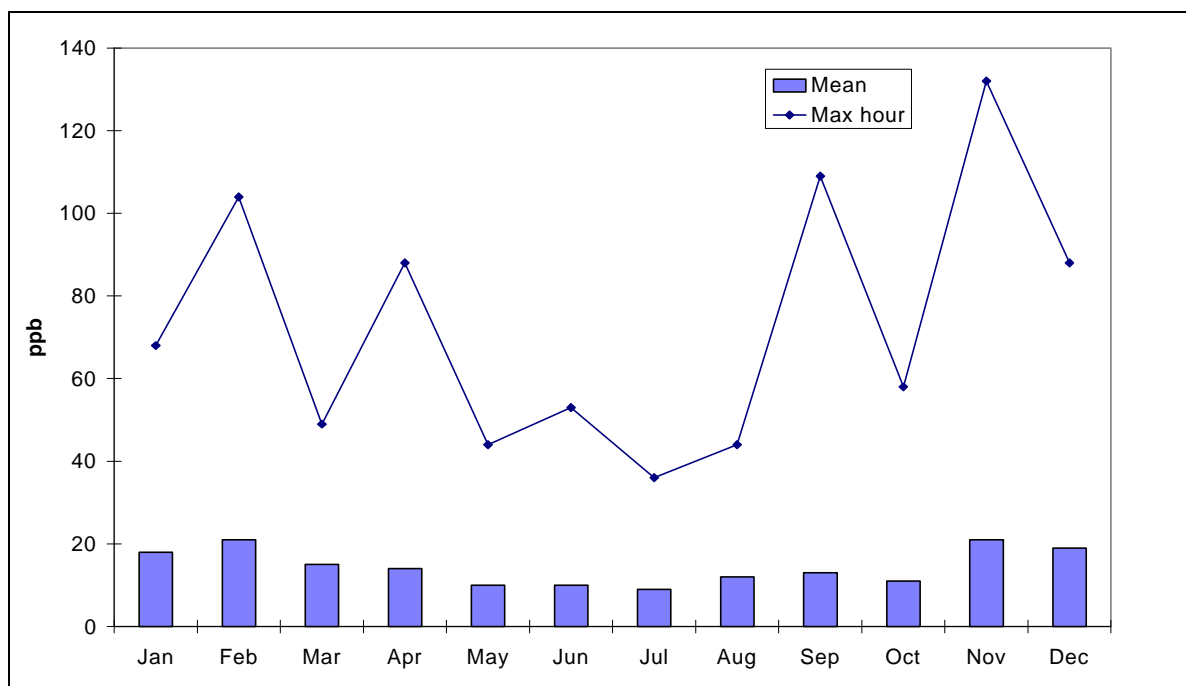


Figure 7: East Oxford nitrogen dioxide concentrations

Appendix 2 (continued)

Table 7 - Nitrogen Dioxide St Ebbes

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	14	14	11	12	11	7	8	10	12	10	16	15
Max hour ppb	43	54	43	47	42	31	27	42	46	33	43	36
% Data Capture	99	96	78	99	100	99	95	86	88	100	99	70
DETR Band (hours)	739	671	576	712	740	716	709	641	658	742	712	523
Low	739	671	576	712	740	716	709	641	658	742	712	523
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs Number of hours>150ppb	0	0	0	0	0	0	0	0	0	0	0	0

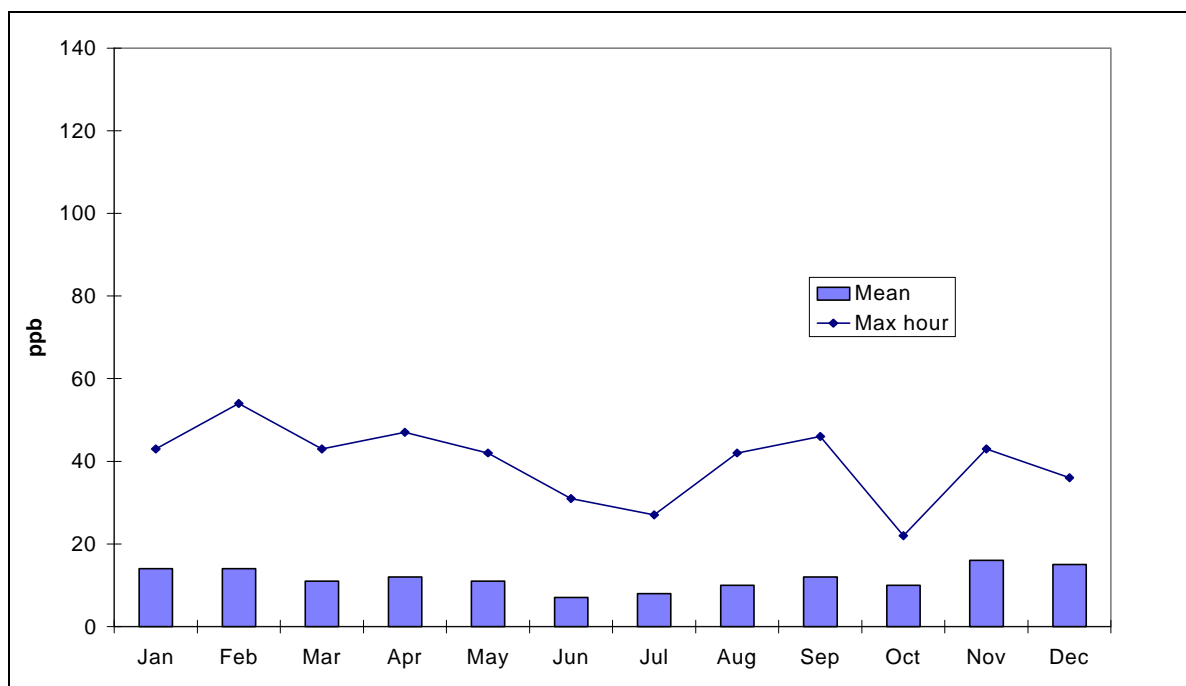


Figure 8: St Ebbes nitrogen dioxide concentrations

Appendix 2 (continued)

Table 8 - Carbon Monoxide St Aldates

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppm	1.1	0.9	0.8	0.9	1.0	0.7	0.5	0.4	0.5	-	1.2	0.7
Max hour ppm	5.2	6.1	4.4	5.3	3.3	4.6	2.8	2.3	2.5	-	4.0	4.8
Max running 8 hour mean ppm	3.5	2.8	2.7	3.7	2.4	2.8	1.9	2.0	2.1	-	3.1	3.5
% Data Capture	93	91	100	99	89	99	62	78	42	-	41	99
DETR Band (hours)	696	627	744	717	658	714	455	580	316	-	290	744
Low	696	627	744	717	658	714	455	580	316	-	290	744
Moderate	0	0	0	0	0	0	0	0	0	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number of running 8-hr means >10ppm	0	0	0	0	0	0	0	0	0	-	0	0

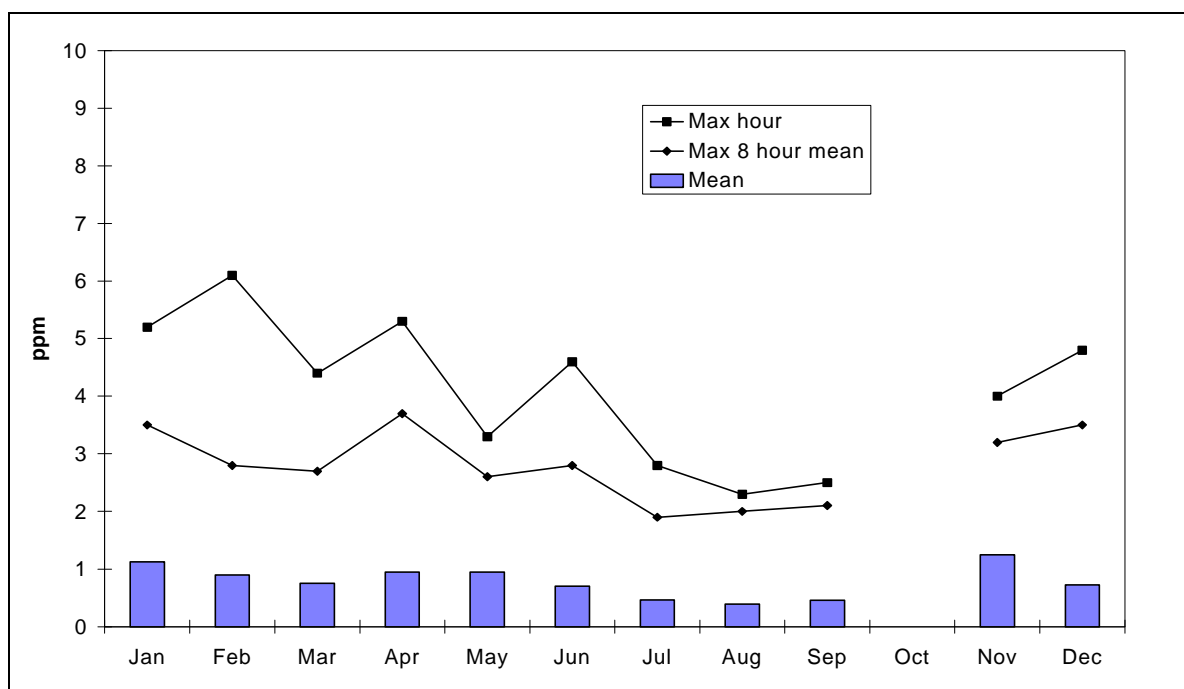


Figure 9: St Aldates carbon monoxide concentrations

Appendix 2 (continued)

Table 9 - Sulphur Dioxide St Aldates

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	14	11	16	-	-	-	2	1	1	-	5	2
Max hour ppb	60	25	68	-	-	-	53	16	7	-	21	13
Max 15 min mean ppb	64	28	73	-	-	-	64	30	9	-	23	23
% Data Capture	92	57	100	-	-	-	35	99	25	-	41	99
DETR Band (hours)	681	397	741	-	-	-	263	734	185	-	295	739
Low	681	397	741	-	-	-	263	734	185	-	295	739
Moderate	0	0	0	-	-	-	0	0	0	-	0	0
High	0	0	0	-	-	-	0	0	0	-	0	0
Very High	0	0	0	-	-	-	0	0	0	-	0	0
Air Quality Regs												
Number 15 minute means >100ppb	0	0	0	-	-	-	0	0	0	-	0	0

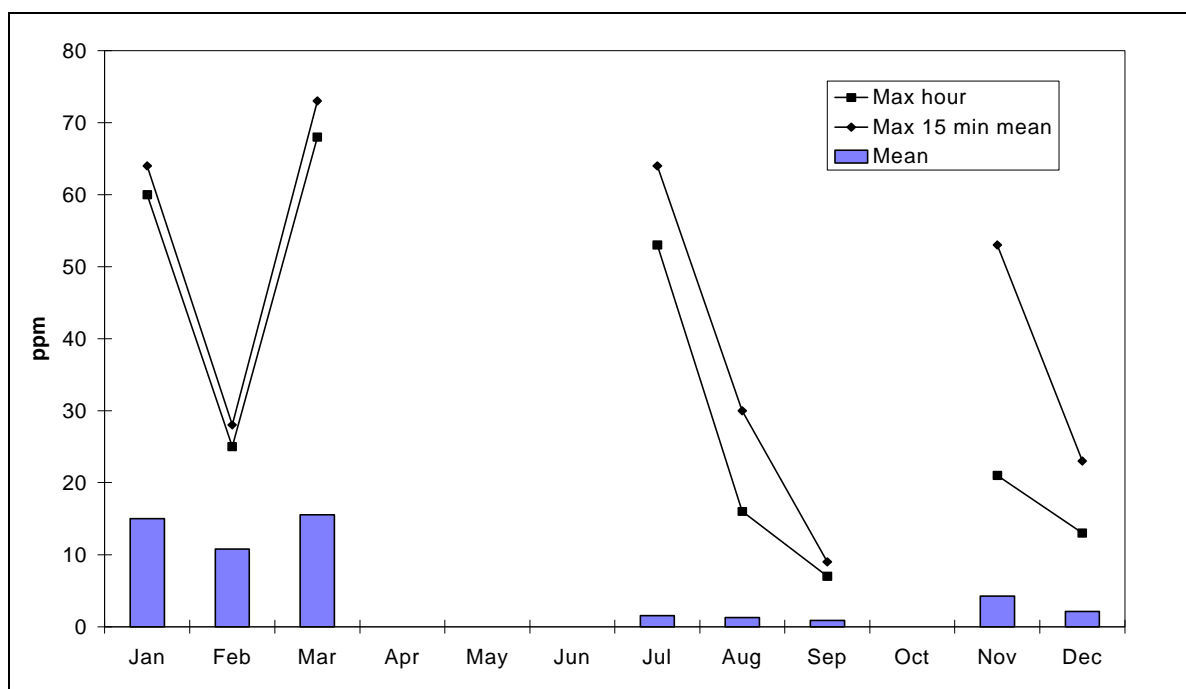


Figure 10: St Aldates sulphur dioxide concentrations

Appendix 2 (continued)

Table 10 - Ozone East Oxford

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	17	20	19	27	32	27	23	24	22	24	14	14
Max hour ppb	38	54	40	50	78	84	49	77	55	49	41	41
Max running 8 hr mean ppb	35	38	35	45	72	65	44	66	44	45	36	39
% Data Capture	100	68	72	99	100	98	97	100	89	92	100	71
DETR Band (hours)	743	475	527	709	742	703	717	744	657	682	720	521
Low	743	474	527	706	518	680	717	705	654	682	720	521
Moderate	0	1	0	3	124	23	0	39	3	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
National Air Quality Strategy												
Number of running 8 hr means >50ppb	0	0	0	0	26	4	0	10	0	0	0	0
On number of days*	0	0	0	0	9	2	0	3	0	0	0	0

*The air quality objective for ozone is based on the maximum daily running 8 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence

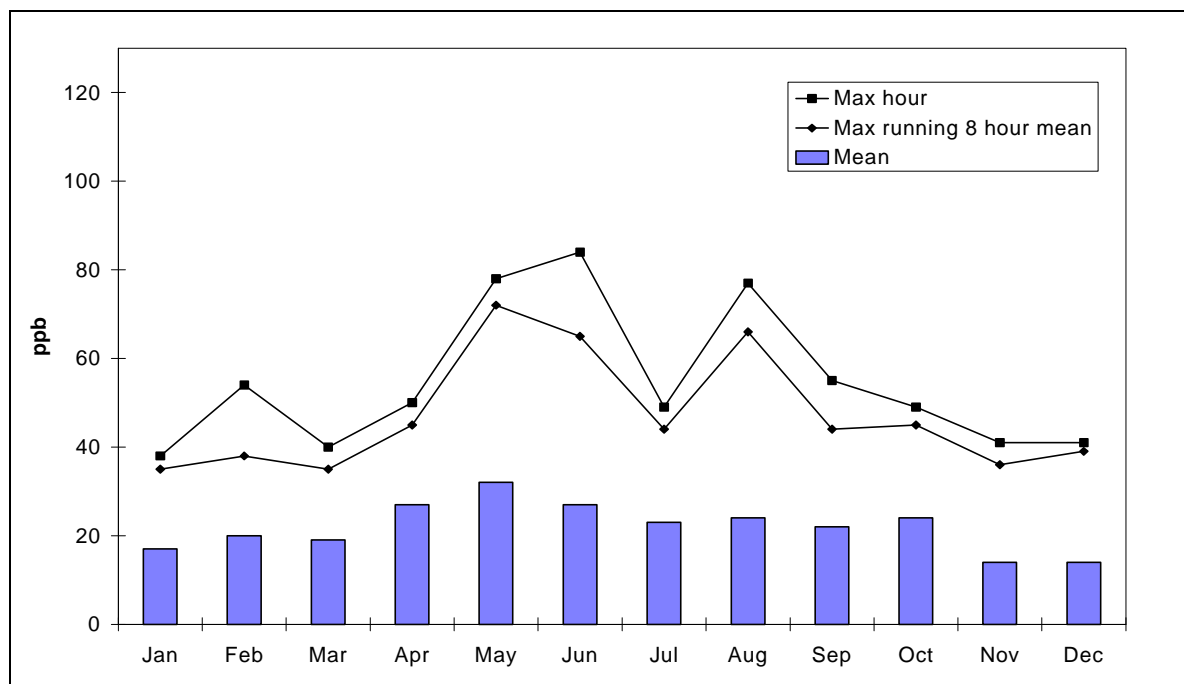


Figure 11: East Oxford ozone concentrations

Appendix 2 (continued)

Table 11 - Ozone St Ebbes

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean ppb	18	21	23	25	26	23	20	21	21	23	15	15
Max hour ppb	41	49	46	45	66	66	41	72	54	48	40	40
Max running 8 hr mean ppb	38	44	42	41	59	54	37	63	42	43	37	38
% Data Capture	100	97	100	99	100	100	96	86	93	100	100	71
DETR Band (hours)	744	672	743	713	744	720	713	641	661	744	720	525
Low	744	672	743	713	700	711	713	617	659	744	720	525
Moderate	0	0	0	0	44	9	0	24	2	0	0	0
High	0	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
National Air Quality Strategy												
Number of running 8 hr means >50ppb	0	0	0	0	11	4	0	6	0	0	0	0
On number of days*	0	0	0	0	5	1	0	2	0	0	0	0

*The air quality objective for ozone is based on the maximum daily running 8 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence

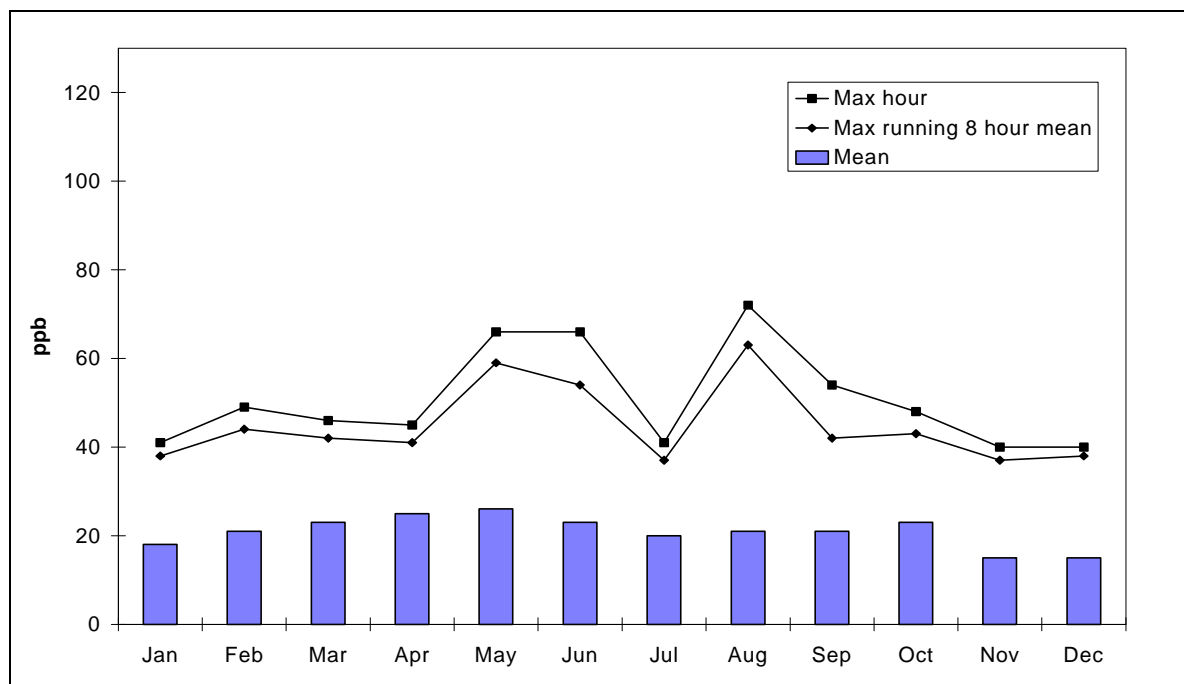


Figure 12: St Ebbes ozone concentrations

Appendix 2 (continued)

Table 12 - PM10 Cornmarket Street

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	30	31	29	26	35	26	22	27	31	22	28	24
Max hour $\mu\text{g}/\text{m}^3$	120	69	136	66	218	101	51	123	182	64	81	63
Max running 24 hr mean $\mu\text{g}/\text{m}^3$	84	56	64	47	76	43	33	48	55	39	52	42
% Data Capture	100	97	100	88	100	77	90	100	97	97	100	100
DETR Band (hours)	744	672	744	619	727	560	634	744	720	711	720	744
Low	682	645	707	619	627	560	634	744	669	711	711	744
Moderate	47	27	37	0	93	0	0	0	51	0	9	0
High	15	0	0	0	7	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number hours running 24 hr mean $>50\mu\text{g}/\text{m}^3$	62	27	37	0	100	0	0	0	51	0	9	0
On number of days	5	2	3	0	6	0	0	0	4	0	1	0

*The air quality objective for PM₁₀ is based on the maximum daily running 24 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence.

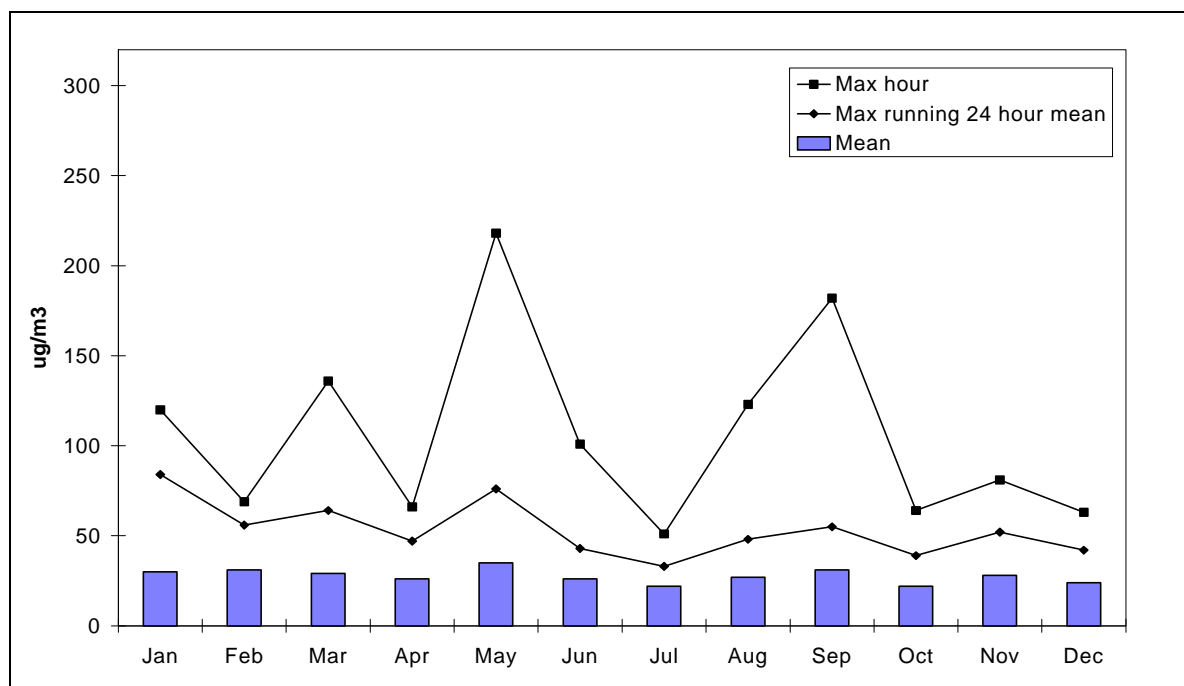


Figure 13: Cornmarket PM₁₀ concentrations

Appendix 2 (continued)

Table 13 - PM10 East Oxford

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	20	29	21	15	25	19	20	24	24	14	21	17
Max hour $\mu\text{g}/\text{m}^3$	121	134	128	68	174	175	204	175	123	102	97	68
Max running 24 hr mean $\mu\text{g}/\text{m}^3$	77	55	51	29	63	49	60	60	54	31	50	30
% Data Capture	100	96	98	99	99	98	97	100	80	92	100	70
DETR Band (hours)	744	672	744	720	744	699	707	744	562	675	720	537
Low	720	645	712	720	713	699	686	703	547	675	717	537
Moderate	17	27	10	0	31	0	21	41	15	0	3	0
High	7	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number hours running 24 hr mean $>50\mu\text{g}/\text{m}^3$	24	27	10	0	31	0	21	41	15	0	3	0
On number of days	2	3	1	0	3	0	2	5	1	0	1	0

*The air quality objective for PM₁₀ is based on the maximum daily running 24 hour mean. Therefore the number of days on which the objective level was exceeded is a better indicator of exceedence.

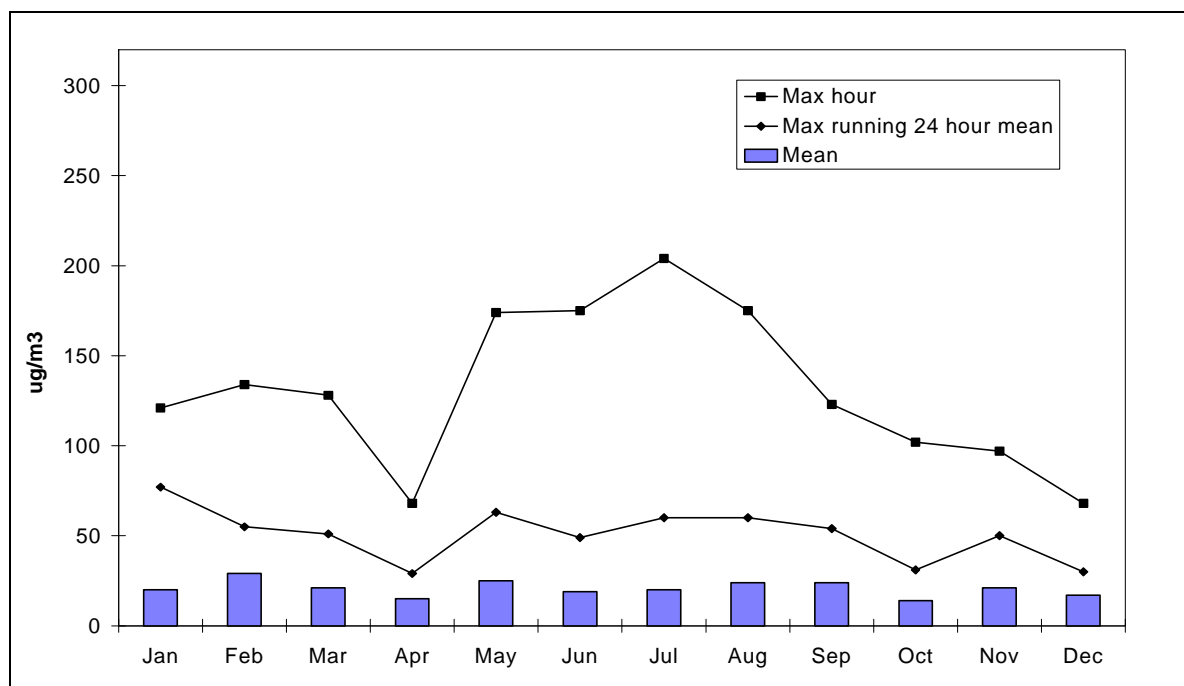


Figure 14: East Oxford PM₁₀ concentrations

Appendix 2 (continued)

Table 14 - PM10 St Ebbes

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Mean $\mu\text{g}/\text{m}^3$	23	22	23	13	23	14	15	17	19	13	18	15
Max hour $\mu\text{g}/\text{m}^3$	318	68	72	52	117	41	47	64	54	74	60	55
Max running 24 hr mean $\mu\text{g}/\text{m}^3$	95	43	51	31	46	27	30	38	39	24	44	31
% Data Capture	82	72	76	92	89	84	90	80	93	100	98	70
DETR Band (hours)	605	487	537	659	643	584	649	580	651	744	701	535
Low	565	487	525	659	643	584	649	580	651	744	701	535
Moderate	25	0	12	0	0	0	0	0	0	0	0	0
High	15	0	0	0	0	0	0	0	0	0	0	0
Very High	0	0	0	0	0	0	0	0	0	0	0	0
Air Quality Regs												
Number hrs running 24 hr mean $>50\mu\text{g}/\text{m}^3$	40	0	12	0	0	0	0	0	0	0	0	0
On number of days	3	0	2	0	0	0	0	0	0	0	0	0

*The air quality objective for PM₁₀ is based on the maximum daily running 24 hour mean. Therefore the number of days on which the objective level was exceeded is a truer measure of exceedence.

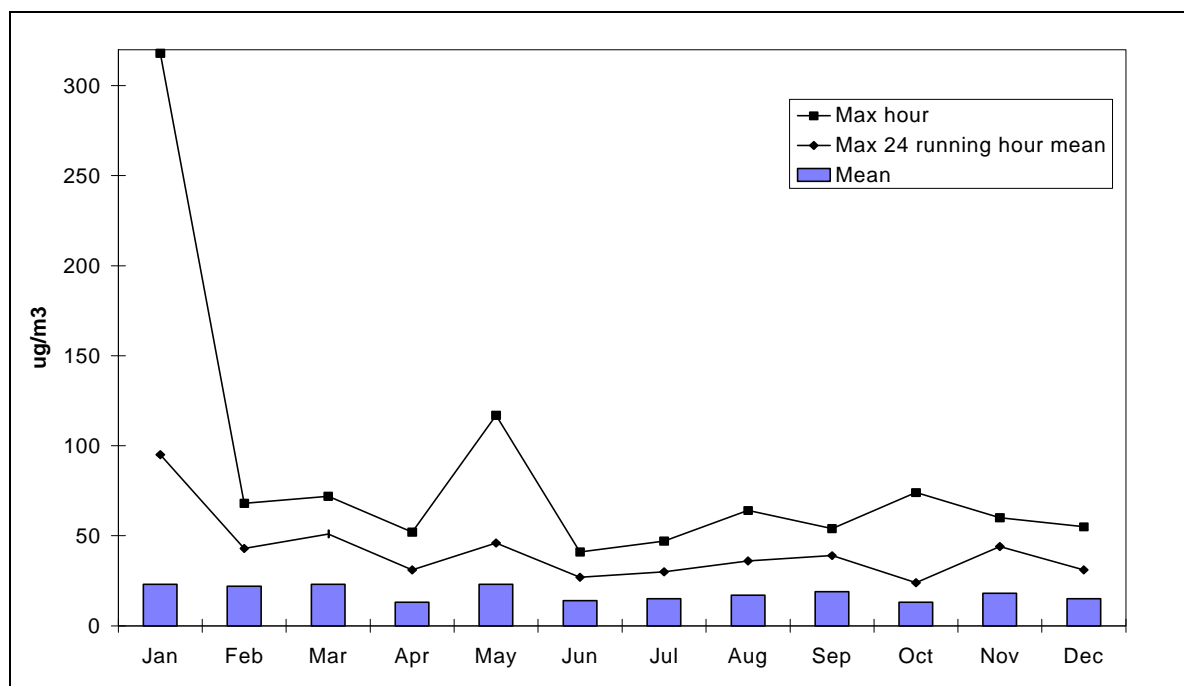


Figure 15: St Ebbes PM₁₀ concentrations

Appendix 2 (continued)

Table 15 - Nitrogen Dioxide Diffusion Tube Data

Location	Cat*	Annual mean ppb	Location	Cat*	Annual mean ppb
High Street	K	39.9	Broad Street	K	23.7
Green Road Roundabout	K	32.5	Norfolk Street	K	22.7
Cornmarket Street	K	33	Beckett Street	K	21.1
St Giles	K	37.7	Hollybush Row	K	19.9
St Aldates	K	31.4	Parks Road (Science Library)	K	23.7
Longwall Street	K	35.4	Pike Terrace	I	22.9
Bonn Square	K	29	Pusey Street	I	19.5
Thames Street	K	30.6	Parks Road (Wadham College)	K	22.5
Worcester Street	K	33.6	Shirelake Close	I	18.6
Beaumont Street	K	29.7	Lyndworth Close	B	19.2
New Road	K	28.8	Butterwyke Place	I	17.8
Speedwell Street	K	27	Woodbine Place	B	17.1
Rewley Road	K	30.1	St Cross Road	K	18.8
Folly Bridge	K	25.6	Mansfield Road	B	18
Magdalen Bridge	K	21.5	Duke Street	I	16.2
Park End Street	K	27.3	Beaumont Buildings	B	17.5
Oxpens Road	K	21.4	Walton Street	K	17.8
York Place	I	25.7	Trinity Street	I	15.5
Floyd's Row	K	24.2	Paradise Sq	B	16.1
Blue Boar Street	I	24.5	Sadler Walk	B	15.1
Iffley Road	K	23.2	Binsey Lane	B	9.6
Gloucester Street	I	22.9	Lenthall Road	B	10.1
Keble Road	K	25			

* Category **K**erbside 1-5 metres from a major road, **I**ntermediate 20-30 metres from a major road, urban **B**ackground in residential area greater than 50 metres from a major road.

Appendix 2 (continued)

Nitrogen Dioxide Diffusion Tube Charts

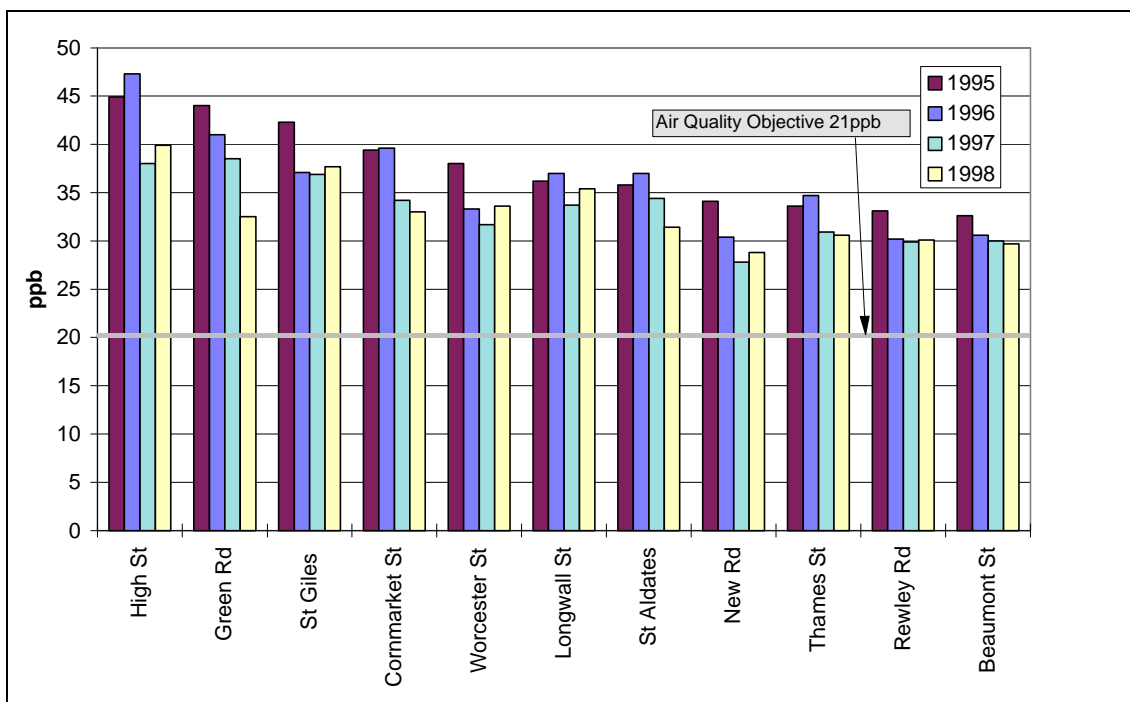


Figure 16: Annual mean nitrogen dioxide concentrations 1995-98

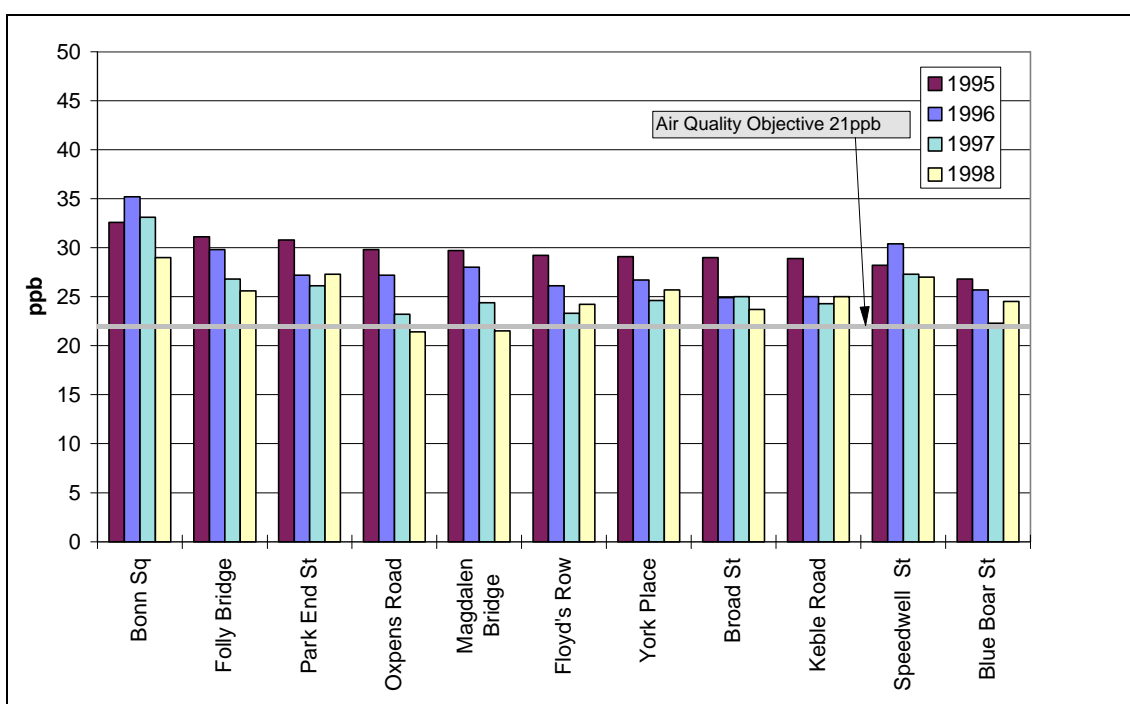


Figure 17 : Annual mean nitrogen dioxide concentrations 1995-98

Appendix 2 (continued)

Nitrogen Dioxide Diffusion Tube Data Continued

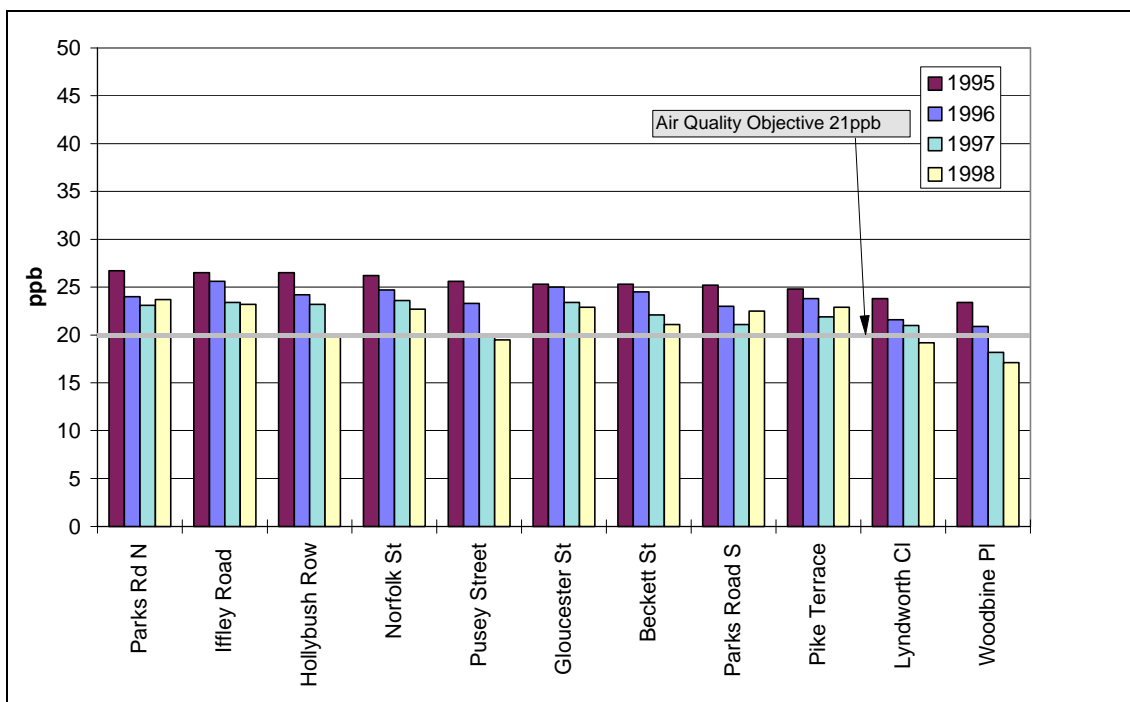


Figure 18: Annual mean nitrogen dioxide concentrations 1995-98

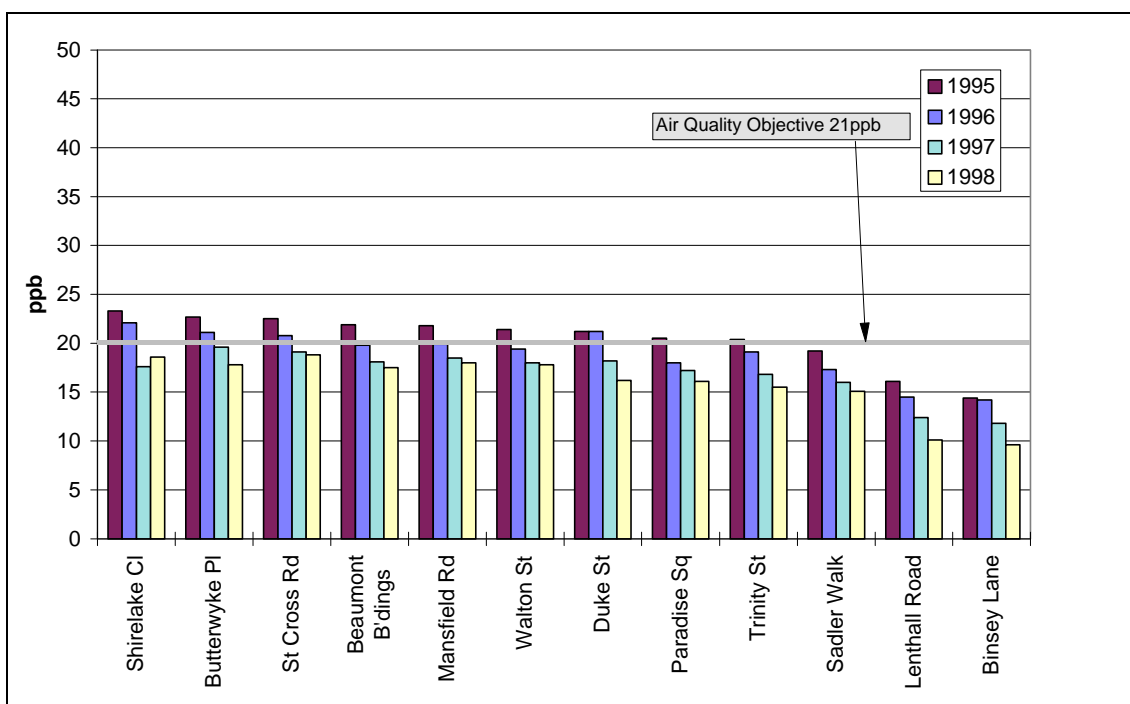


Figure 19: Annual mean nitrogen dioxide concentrations 1995-98

Appendix 3 Maps Showing Monitoring sites

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Figure 20: Continuous Monitoring Sites

Appendix 3 (continued)

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Figure 21: NO2 Diffusion Tube Sites

Appendix 4 Validation of data from continuous monitoring stations

1. All routine calibration and maintenance is carried and recorded as per manufacturers and Automated Urban Monitoring Network site operators manuals.
2. Instrument drift is routinely checked by :-
 - a daily internal instrument calibration which is carried out automatically using an electronic calibration check,
 - every 2 weeks a manual external instrument calibration is carried out using gas cylinders that can be traced back to reference standards for each pollutant,
 - every 6 months an audit of instrument response is carried out by an external organisation using independent gas calibration standards.
3. The above checks enable data to be examined subsequently for instrument drift which is expected or for faulty data which is usually not expected. Instrument drift is routinely adjusted by means of the 2 weekly external gas calibrations. Computer software (Siemens EMD) collects the raw data automatically. Scaled data is calculated using the gas calibrations for each analyser. Instrument response is also recorded on a chart recorder along with response to calibration gases. These chart records are also used to check the normal response as part of the data validation process.
4. Raw data from each site is automatically collected daily by EMD and stored as 15 minute averages. Data is checked and any errors or missing data is followed up. At the end of each month hourly data from each site is looked at line by line and checked for errors, bad data etc. Data is cross-referenced with records of calibration and incidents during the month.
5. At the end of each month, EMD is used to produce Standard Hourly and Daily Calibrated Data Reports for each site in Hourly and DETR formats. Hourly format expresses the data as hourly averages. DETR format expresses the data using the averaging periods for each pollutant in the DETR air pollution bands. (NO₂ - hourly averages, CO - running 8 hour averages, SO₂ - 15 minute averages, O₃ - hourly averages and running 8 hour averages, PM₁₀ - 24 hour running averages). If any data points are subsequently classified as bad data the reports are re-run.
6. The annual report is compiled from the monthly reports produced in EMD.
7. Data from the continuous monitoring sites has been independently validated by the National Environmental Technology Centre, AEA Technology Environment.

Appendix 5 Glossary

Air quality: usually refers to the concentration in air of one or more pollutants.

Air quality objectives: policy targets of what the Government intends should be achieved in the light of the air quality standards.

Air quality standards: the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. Air quality standards are based on the assessment of the effects of each pollutant on health.

Carbon monoxide (CO): a colourless, odourless flammable gas produced by the incomplete combustion of the fuels containing carbon.

Concentration: the amount of substance in a given volume (for gaseous pollutants usually in parts per million or parts per billion)

Dispersion: the way in which pollution spreads from its point of emission and becomes diluted in the atmosphere.

Emission: the process of discharging into the atmosphere.

Episode: an air pollution incident in a given area caused by a combination of circumstances, e.g. meteorological, topographical, accidental escape of pollution from industry.

Guideline: indicates levels and durations of air pollution above which adverse effects may be produced on the health of humans or animals or on vegetation.

Guide value: target air quality standard to improve the protection of human health and contribute to the long term protection of the environment.

Limit value: legally enforceable air quality standard to help protect human beings against the effects of the pollutant in the environment.

Monitoring: measuring pollution.

Nitrogen dioxide (NO₂): acid irritant gas.

Ozone (O₃): the reactive molecular form of oxygen, it is very poisonous.

Particulate matter: fine solid particles found in the air or emissions such as smoke.

PM₁₀: particulate matter less than 10 microns in diameter (10 millionths of a metre).

Parts per billion (ppb) / million (ppm): units of volume of the pollutant for every billion or million units of air. For example, an ozone guideline of 50ppb would recommend a maximum volume of 50 units of ozone for every billion volume units of air.

Percentile (expressed as *n*th percentile): the level which is not exceeded for a *n* percent of the time.

Running 8 hour mean: a mean which is calculated on an hourly basis, yielding one running 8 hour mean per hour. It is calculated from the hourly mean for that hour and the preceding 7 hours.

Running 24 hour mean: a mean which is calculated on an hourly basis, yielding one running 24 hour mean per hour. It is calculated from the hourly mean for that hour and the preceding 23 hours.

Sulphur dioxide (SO₂): colourless, acid irritant gas with a pungent odour.