Environment Act 1995 Part IV

Local Air Quality Management

Updating and Screening Assessment 2009

City of Norwich

NORWICH
City Council

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Executive Summary

The UK Government published its strategic policy framework for air quality management in 1995 establishing national strategies and policies on air quality, which culminated in the Environment Act, 1995. The Air Quality Strategy provides a framework for air quality control through air quality management and air quality standards. These and other air quality standards and their objectives have been enacted through the Air Quality Regulations in 1997, 2000 and 2002. The Environment Act 1995 requires Local Authorities to undertake air quality reviews. In areas where an air quality objective is not anticipated to be met Local Authorities are required to establish Air Quality Management Areas and implement action plans to improve air quality.

Norwich City Council (NCC) has completed the second and third rounds of air quality review and assessments. The Council is now required to proceed to the fourth round of review and assessment. This involves sources of emissions to air being reassessed to identify whether the situation has changed since the third round, and if so, what impact this may have on predicted exceedences of the air quality objectives.

The fourth round of review and assessment is to be undertaken in two steps, essentially following the format of the third round. The first step is an Updating and Screening Assessment (USA), which updates the findings of the previous Review and Assessment cycle, undertaken for all sources of pollutants identified in the Air Quality Regulations. Where a significant risk of exceedence is identified for source of pollutant it will be necessary for the local authority to proceed to a Detailed Assessment the following year. Where a local authority does not need to undertake a Detailed Assessment, a progress report is required instead.

This report is an USA for NCC as outlined in the Government's published guidance Local Air Quality Management Technical Guidance (LAQM TG) (09).

This USA has concluded that NCC is not required to carry out a Detailed Assessment for nitrogen dioxide (NO_2), carbon monoxide, benzene, 1,3-butadiene, lead, particulate matter (PM_{10}) or sulphur dioxide (SO_2).

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1 Introduction

1.1 Description of Local Authority Area

Norwich is a city in Norfolk, East Anglia, which is in Eastern England. The suburban area expands far beyond its boundary, with extensive suburban areas outside the city on the western, northern and eastern sides, including Costessey, Hellesdon, Old Catton, Sprowston and Thorpe St Andrew.

In 2006, an estimated 121,600 people lived in the NCC area.

NCC has previously declared three AQMAs in the city. Source apportionment studies have confirmed road traffic, and HDVs in particular, as being the main contributor to NO_2 in the City of Norwich.

1.2 Purpose of Report

This report fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedences are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM **in England** are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table 1.1. This table shows the objectives in units of microgrammes per cubic metre $\mu g/m^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table 1.1 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene			
	16.25 $\mu g/m^3$	Running annual mean	31.12.2003
	5.00 $\mu g/m^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.4 Summary of Previous Review and Assessments

NCC has completed the following review and assessments of air quality to date:

- Review and Assessment of Air Quality (1998),
- Further Assessment (1999);
- Further Assessment update (2002),
- Detailed Assessment (2003);
- Updating and Screening Assessment (January 2004);
- Progress Report (2005);
- Updating and Screening Assessment (2006);
- Progress Report (2007); and
- Detailed Assessment (2008).

The previous assessments of the air quality in Norwich concluded that there were likely exceedences of the annual mean objective for nitrogen dioxide (NO_2) as a result of both industrial and traffic sources. Three AQMAs were declared in the city - Grapes Hill, Castle and St Augustines following the third stage of review and assessment. The locations of the AQMAs are illustrated in Figure 1.1. The later Updating and Screening Assessment and Progress Report concluded that there was no need to make any changes to the AQMAs already in place. No action was required for any of the other pollutants considered.

1.4.1 First Round of Air Quality Review and Assessment

The first stage of the review and assessment process concluded that within the City the Government's objectives were likely to be met for carbon monoxide (CO), benzene, 1,3-butadiene and lead. However, there were doubts as to whether the Governments objectives would be met with respect to NO_2, sulphur dioxide (SO_2) and particulate matter less than 10μm (PM_{10}). The report recommended that the Norwich City Council progress to a Further Assessment for NO_2, SO_2 and PM_{10}.

The findings are presented in greater detail in the following report:

- **Review and Assessment of the Air Quality, Norwich City Council (1998)**

The findings of the Further Assessment are presented in greater detail in the following report:

- **Review and Assessment of Air Quality – Further Assessment, Norwich City Council (2001)**

The Further Assessment included estimation, modelling/ measurement of pollutants and indicated which national objectives would not be achieved.

The assessment for SO_2 and PM_{10} concluded that Air Quality Standard for 2005 would be achieved.

Nitrogen dioxide (NO_2) was taken straight to a Stage 3 review and assessment as Stage 1 indicated NCC was unlikely to achieve the set Air Quality standard in 2005.

The Further Assessment for NO_2 concluded that the Air Quality Objective was unlikely to be achieved in certain areas of the city by 2005.

As a result of the Further Assessment the council concluded that three AQMAs (shown in Figure 1.1) would be declared to tackle the issue of NO_2 Air Quality Bbjective exceedences.

An update to the Further Assessment was produced in 2002. The findings of the report are presented in greater detail in the following report:

- **Air Quality Review and Assessment Further Assessment Update, Norwich City Council (2002)**

The Further Assessment update concluded that there could be an exceedence of the NO_2 objectives as a result of traffic sources. Declaration of three AQMAs was recommended. NCC considered the likelihood of receptor exposure to exceedences based on the modelling and decided the appropriate locations of AQMAs in the city. Three AQMAs were proposed, Castle, Grapes Hill and St Augustines.

There were no predicted exceedences of the PM_{10} objective either by traffic or industrial sources. As such, there was no need for further review and assessment of PM_{10}.

There were no sources that would result in predicted exceedences of the SO_2 objective by industrial sources.

There were no sources that would result in predicted exceedences of the lead objective by industrial sources.

NCC then proceeded to a Detailed Assessment for NO_2. The findings of the 2003 Detailed Assessment are presented in greater detail in the following report:

- **Detailed Assessment, Norwich City Council (2003)**

The monitoring and modelling carried out at this stage of review and assessment showed that NO_2 concentrations were expected to exceed the annual mean objective at certain locations in each of the three declared AQMAs.

The source apportionment work identified emissions of oxides of nitrogen (NO_x) from traffic on roads close to the AQMAs as the main source from which emissions could be reduced. Emissions of NO_x from local traffic accounted for approximately 68-79 % of the total modelled oxides of nitrogen concentration at the most affected properties within the AQMAs.

This assessment also considered a number of options in order to assess their potential to reduce the nitrogen dioxide concentration at the most sensitive receptors in the Norwich AQMAs.

1.4.2 Further Stages of Review and Assessment

A summary of conclusions from the second and third rounds of review and assessment reports is provided below.

2004, 2005 and 2007 Progress Reports
Each report concluded that no further action was required in respect of the pollutants:

- CO;
- Benzene;
- 1,3-Butadiene;
- Lead;
- SO_2;
- NO_2; and
- PM_{10}.

2004 and 2006 Updating and Screening Assessments
These updating and screening assessment for NCC concluded that a Detailed Assessment was **not** required for NO_2, PM_{10}, benzene, CO, lead, 1,3 – butadiene or SO_2.

2008 Detailed Assessment
As part of this Detailed Assessment air dispersion modelling was carried out for NCC covering the following locations:

- Grapes Hill;
- King Street;
- Riverside Road;
- Magdalen Street; and
- Boundary Road.

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The assessment concluded that on the basis of the modelled and measured results in the Grapes Hill AQMA and that the NO_2 concentrations are predicted to fall in 2010 the Council could consider revoking Grapes Hill AQMA. However, as pollution concentrations are variable due to meteorological conditions from year to year, it was recommended that this AQMA be retained at the moment.

On the basis of the modelled and measured NO_2 results in King Street it was recommended that the NCC should continue to monitor this site and review each year. Should the 2009 data exceed the objective it is recommend that this area is declared an AQMA.

Modelling results for Riverside Road suggested that the Council consider implementing an improved synchronised fixed time traffic signaling system to reduce queuing effect in Riverside Road. It was recommended that NCC declare an AQMA in this area.

The concentration measured at the location of the diffusion tube in Magdalen Street marginally exceeded the objective in 2007 and was under the objective in 2008. As such, it was recommended that NCC continue to monitor the area. It was not recommended to declare this area as an AQMA.

Finally, the 2008 monitoring results in Boundary Road it is recommended that the Council continue to monitor the area. An AQMA is not recommended for this location at present.

Figure 1.1 AQMAs within City of Norwich

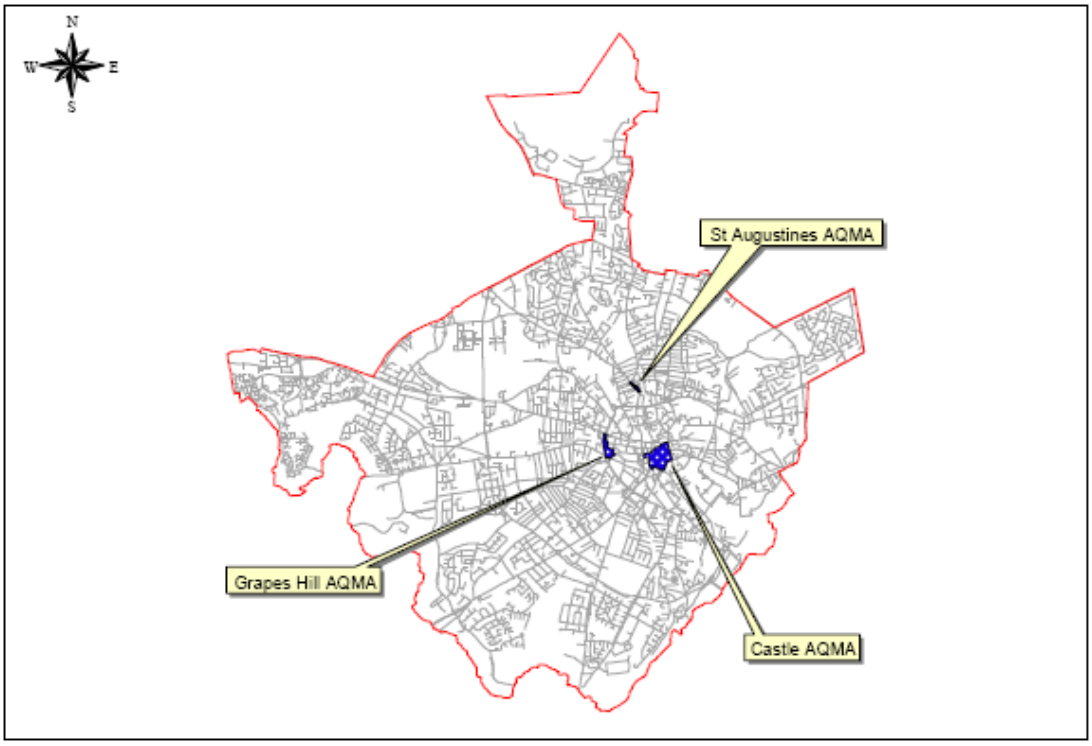


Figure 1.2 Grapes AQMA

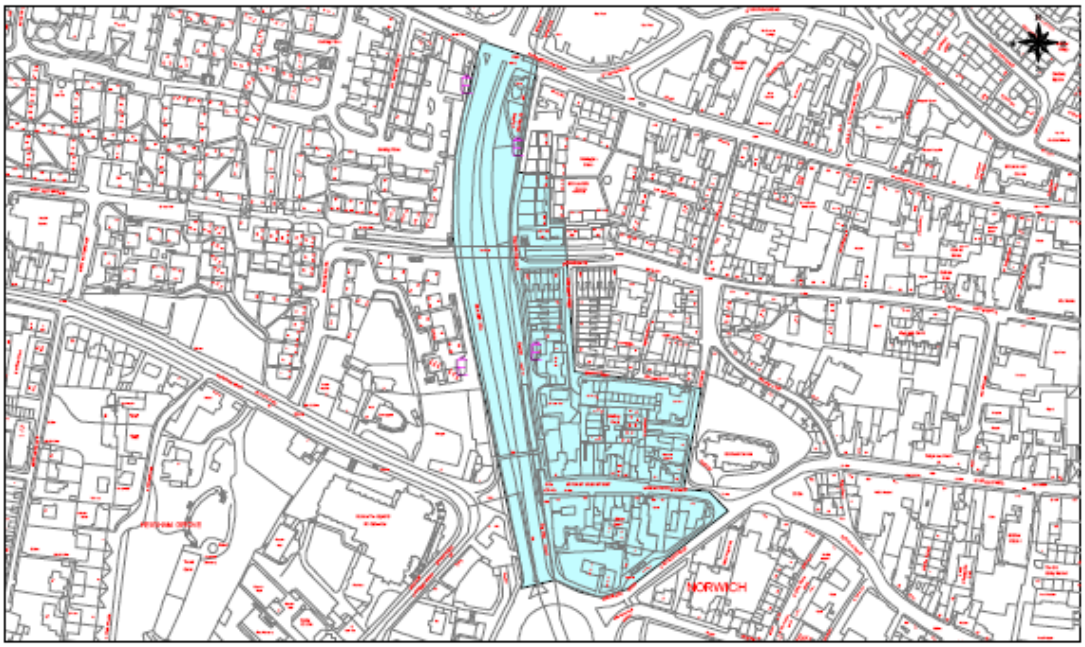


Figure 1.3 St Augustines AQMA

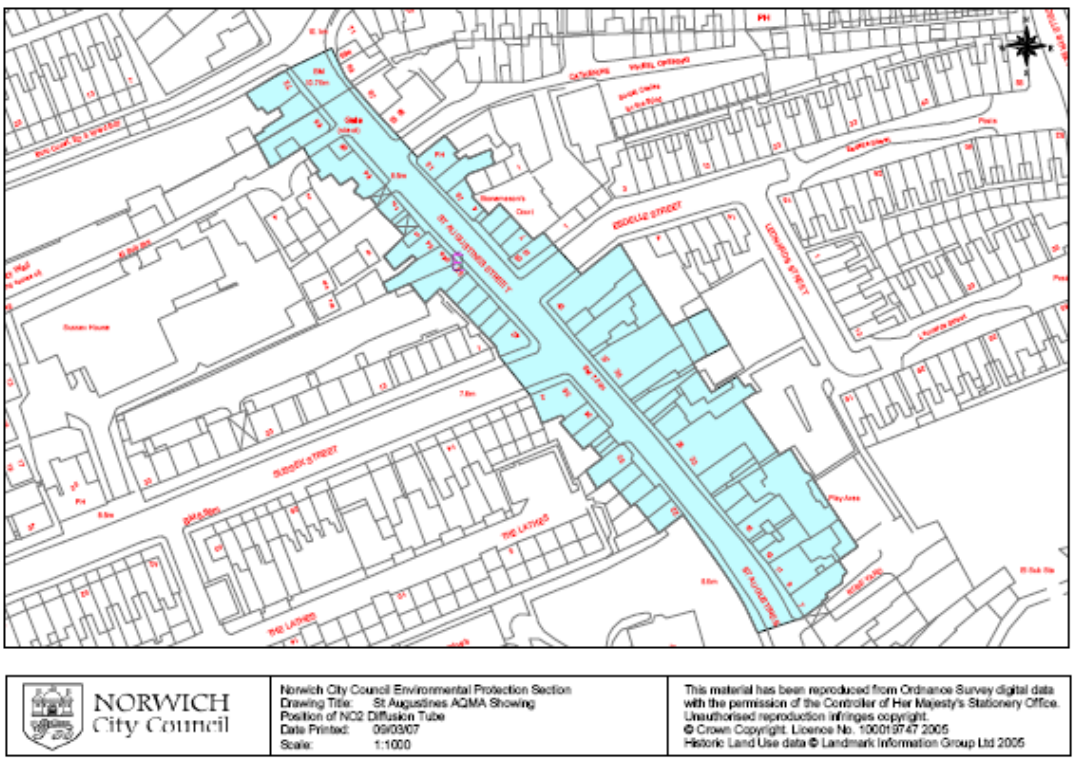
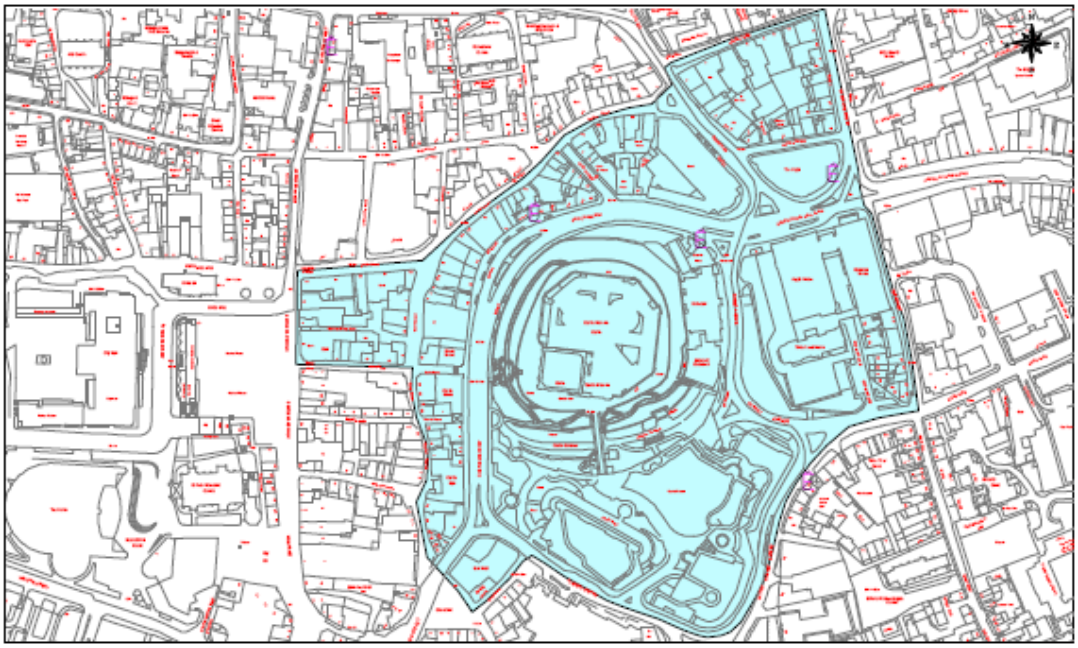


Figure 1.4 Castle AQMA



2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

Automatic monitoring was carried out during 2008 at two locations in Norwich. Each location is shown in Table 2.1. The Norwich Centre site is an urban background location, and the Norwich Castle Meadow site is a mobile unit that monitors roadside concentrations within the Norwich Castle AQMA.

Data for the full calendar year of 2008 is only available for the Norwich Castle Meadow (95% data capture) site. The Norwich Centre site, which is part of DEFRA's Automatic Urban and Rural Network (AURN), provided data between 1st January 2008 until 13th May 2008 (36% data capture) after which the monitoring site was removed and relocated at another site which, at the time of reporting, is still to become operational.

A period adjustment calculation (detailed in Box 3.2 of LAQM TG (09) guidance) has been carried out for the Norwich Centre site, for pollutants NO_2 and PM_{10}, as a result of the site having less than one year's data. The results of these calculations are presented in Section 2.2.1 and 2.2.2 respectively.

Due to poor data capture for Norwich Centre the Volatile Correction Model (VCM) cannot be applied to the data set as a data capture of more than 50% for the calendar year is required. As such, a factor of 1.3 has been applied to the TEOM data from PM_{10} Norwich Centre readings in order to estimate an annual mean reading. PM_{10} data from Norwich Castle Meadow has been corrected using the VCM providing a corrected annual mean and corrected 24-hour mean readings.

Table 2.1 Details of Automatic Monitoring Sites

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	In AQMA ?	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location ?
Norwich Centre	Urban background	X 623079 Y 308905	O_3,CO,SO_2, PM_{10},NO_x	N	Y (34m)	12m	N
Norwich Castle Meadow	Urban Roadside	X 623202 Y 308615	O_3,CO,SO_2, PM_{10},NO_x, NO_2, $PM_{2.5}$	Y	N	1m	N/A

Since the previous 2007 Progress Report, NCC closed the Norwich Forum Roadside site, instead utilising the data provided by the Norwich Centre and Norwich Castle Meadow sites as the permanent/ semi permanent monitoring stations. Defra will commission a new monitoring site in 2009 to replace Norwich Centre.

2.1.2 Non-Automatic Monitoring

Norwich City Council carried out indicative monitoring of NO_2 by diffusion tubes at 35 sites throughout the city during 2008. Sites at Colman Road, Vulcan Road, Heartsease, St Vedast Street, Eastbourne Place, Victoria Street, Ipswich Road, Unthank Road, Bignold School, Chantry Road, Theatre Street, Wellington Lane (upper), Guildhall and Ber Street have been removed and replaced with diffusion tube sites at 256 King Street, Queens Road Travelodge, 63 Earlham Road, 130 Magdalen Street, 73 Prince of Wales Road, 32 Key & Castle Yard, 29 St Martins Road, Boundary PH 414 Aylsham Road, Kerrisons 353 Aylsham Road, 221 Mile Cross Lane, 13 Aylsham Road, 158 Waterloo Road, 62 Magpie Road, 26 Bull Close Road, 24 Bargate Court, 124 Barrack Street and 71 Dukes Court.

Diffusion tube data from the 2007 Progress Report at the Vulcan Road and St Vedast Street sites predicted an exceedence of the 2005 annual mean objective of 40 µg/m^3. However, the 2007 Progress Report states that there is no relevant public expose at these sites and as such they have

been removed. The other sites that have been removed did not threaten the annual mean objective of 40 µg/m^3.

It should be noted that three months worth of data was captured at three of the 35 monitoring sites; these include Chapelfield/ The Crescent, 63 Earlham Road and 278 Bluebell Road. As stated in LAQM TG (09), it may be possible to use data from shorter periods of monitoring in order to assess against the annual mean objective for NO_2, although a minimum period of three months should always be used. Details of the diffusion tube monitoring locations are provided in Table 2.1. The locations include roadside and urban background sites. Non-bias corrected diffusion tube data is presented in Appendix C.

Co-location diffusion tubes were not used during the 2008 calendar year. As such, bias correction was carried out using a national bias correction factor of 0.93 based on using Gradko Labs for analysis, applying the 50% TEA in Acetone method, when carrying out the analysis in 2008. Discussion of the most appropriate bias correction method is presented in the following section and Appendix A.

Appendix A also contains information on automatic and non-automatic monitoring QA/ QC procedures.

Table 2.2 Details of Non- Automatic Monitoring Sites

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	In AQMA?	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location?
1. 256 King Street	Y	X 623863.04 Y 307678.60	NO_2	N	Y (1m)	3.5m	Y
2. Queens Rd Travelodge	Y	X 622917.08 Y 307974.49	NO_2	N	N	N/A	N/A
3. 25 Surrey Street	Y	X 623060.33 Y 308034.28	NO_2	N	N	N/A	N/A
4. St Stephens (mid)	Y	X 622879.16 Y 308089.96	NO_2	N	N	N/A	N/A
5. Chapelfield / Wessex St	Y	X 622741.68 Y 308054.79	NO_2	N	N	N/A	N/A
6. Chapelfield 1 The Crescent	Y	X 622584.86 Y 308207.64	NO_2	N	Y (1m)	9m	Y
7. 26 Johnson Place	Y	X 622440.96 Y 308415.09	NO_2	N	Y (1m)	15m	N
8. 63 Earlham Road	Y	X 621910.97 Y 308715.67	NO_2	N	Y (1m)	8m	Y
9. 130 Magdalen Street	Y	X 623160.89 Y 309550.43	NO_2	N	Y (1m)	4m	Y
10. 557 Earlham Road	Y	X 620000.91 Y 308430.20	NO_2	N	Y (1m)	16m	Y
11. Grapes Hill (upper)	Y	X 622383.05 Y 308653.15	NO_2	Y	Y (1m)	14m	Y
12. Exchange St	Y	X 623007.27 Y 308716.34	NO_2	N	N	N/A	N/A
13. St Augustines	Y	X 622825.70 Y 309572.99	NO_2	Y	Y (1m)	1m	Y
14. Tombland	Y	X 623325.49 Y 308857.07	NO_2	N	Y (1m)	1m	Y
15. Upper King Street	Y	X 623337.40 Y 308632.52	NO_2	Y	N	N/A	N/A
16. 73 Prince of Wales Road	Y	X 623610.05 Y 308577.12	NO_2	N	Y (1m)	3m	Y
17. Cattlemarket Street	Y	X 623320.58 Y 308430.88	NO_2	Y	Y (1m)	2m	Y
18. Castle Meadow	Y	X 623141.06 Y 308606.69	NO_2	Y	N	N/A	N/A
19. Castle Meadow 2	Y	X 623250.50 Y 308590.12	NO_2	Y	N	N/A	N/A
20. St Georges St	Y	X 623079.80 Y 308905.00	NO_2	N	Y (34m)	12m	N
21. Grapes Hill (lower)	Y	X 622386.31 Y 308838.52	NO_2	Y	N	N/A	N/A
22. 32 Key & Castle Yard	Y	X 622616.95 Y 309385.95	NO_2	N	Y (1m)	5.5m	Y
23. 29 St Martins Road	Y	X 622551.54 Y 309780.86	NO_2	N	Y (1m)	7m	Y
24. Boundary PH 414 Aylsham Rd	Y	X 621740.97 Y 311534.55	NO_2	N	Y (1m)	12m	Y
25. Kerrisons 353 Aylsham Rd	Y	X 621803.79 Y 311500.49	NO_2	N	Y (1m)	6m	Y
26. 221 Mile Cross lane	Y	X 621805.30 Y 311594.73	NO_2	N	Y (1m)	6m	Y
27. 13 Aylsham Road	Y	X 622661.32 Y 309805.12	NO_2	N	Y (1m)	9m	Y
28. 158 Waterloo Road	Y	X 622859.37 Y 309725.91	NO_2	N	Y (1m)	8m	Y
29. 62 Magpie Road	Y	X 622970.72 Y 309652.02	NO_2	N	Y (1m)	2m	Y
30. 26 Bull Close Road	Y	X 623228.63 Y 309625.14	NO_2	N	Y (1m)	5.5m	Y
31. 24 Bargate Court	Y	X 623422.42 Y 309388.23	NO_2	N	Y (1m)	4m	Y
32. 124 Barrack Street	Y	X 623694.61 Y 309420.59	NO_2	N	N	N/A	N/A
33. 5 Riverside Road	Y	X 623870.26 Y 308515.77	NO_2	N	Y (1m)	3m	Y
34. Wellington Lane (lower)	Y	X 622419.52 Y 308797.22	NO_2	Y	Y (15m)	1m	Y
35. 71 Dukes Court	Y	X 622431.35 Y 308663.05	NO_2	Y	Y (1m)	4m	Y

2.2 Comparison of Monitoring Results with AQ Objectives

2.2.1 NO_2

Automatic Monitoring Data

The annual mean concentration at the Castle Meadow automatic monitoring site was recorded as 45 μg/m^3 for 2008, which exceeds the annual mean objective. This monitoring site is within the Castle Meadow AQMA. There was no exceedence of the 1-hour mean during 2008 at this site. For the Norwich Centre urban background automatic monitoring site the annual mean concentration for 2008 was 24.7 μg/m^3. For the period of data available from 1 January 2008 till 13 May 2008 there was no exceedence of the 1-hour mean (99.8th percentile is 108 μg/m^3).

Table 2.3a Results of Automatic Monitoring for NO_2: Comparison with Annual Mean Objective

Site ID	Location	Within AQMA?	Proportion of year with valid data 2008 %	Annual mean concentrations (μg/m^3)		
				2006	2007	2008
N/A	Norwich Centre	N	36	22.5	20.6	24.7
N/A	Norwich Castle Meadow (Mobile site)	Y	91	**51.6***	**46.0**	**45.0**

**Data capture for Norwich Castle Meadow for 2006 was < 66%.*

Table 2.3b Results of Automatic Monitoring for NO_2: Comparison with 1-hour Mean Objective

Site ID	Location	Within AQMA?	Proportion of year with valid data 2008 %	Number of Exceedences of hourly mean (200 μg/m^3) *If the period of valid data is less than 90% of a full year, include the 99.8th %ile of hourly means in brackets.*		
				2006	2007	2008
N/A	Norwich Centre	N	36	0	0	0 (108)
N/A	Norwich Castle Meadow (Mobile site)	Y	91	1	1	0

Diffusion Tube Monitoring Data

Table 2.4a displays the diffusion tube monitoring results for 2008, corrected and uncorrected for bias using a national bias adjustment factor of 0.93 based on using Gradko Labs for analysis, applying the 50% TEA in Acetone method for 2008. The national bias spreadsheet is available via www.airquality.co.uk/archive/laqm/tools.php. Table 2.4b displays the bias adjusted diffusion tube monitoring results across the time series 2006 to 2008. Non-bias corrected monthly diffusion tube results can be found in Appendix C.

A total of eight sites exceeded the NO_2 annual mean objective of 40 μg/m^3. These sites were:

- King Street;
- St Stephens (Mid);

- Exchange Street;
- St Augustines;
- Cattlemarket Street;
- Castle Meadow;
- Castle Meadow 2; and
- Riverside Road.

Of the areas where the exceedences are found St Augustines, Cattlemarket Street, and both Castle Meadow sites are within existing AQMAs. Diffusion tubes located at St Stephens Street and Exchange Street are not situated at locations representative of relevant exposure to the general public.

Table 2.4a Results of Nitrogen Dioxide Diffusion Tubes

Location	Within AQMA?	Data Capture 2008%	Annual mean concentrations	
			Unadjusted 2008 (μg/m^3)	2008 (μg/m^3) Adjusted for bias
1. 256 King Street	N	100	**44.3**	**41.2**
2. Queens Rd Travelodge	N	100	35.3	32.8
3. 25 Surrey Street	N	100	29.3	27.3
4. St Stephens (mid)	N	100	**52.0**	**48.4**
5. Chapelfield / Wessex St	N	100	32.8	30.5
6. Chapelfield 1 The Crescent	N	**33**	23.1	21.4
7. 26 Johnson Place	N	100	26.1	24.3
8. 63 Earlham Road	N	**33**	25.2	23.4
9. 130 Magdalen Street	N	100	39.5	36.7
10. 557 Earlham Road	N	**33**	27.9	25.9
11. Grapes Hill (upper)	Y	100	25.0	23.2
12. Exchange St	N	100	**44.1**	**41.0**
13. St Augustines	Y	100	**54.7**	**50.9**
14. Tombland	N	100	29.9	27.8
15. Upper King Street	Y	100	34.8	32.4
16. 73 Prince of Wales Road	N	100	34.2	31.8
17. Cattlemarket Street	Y	100	**46.3**	**43.1**
18. Castle Meadow	Y	100	**52.4**	**48.8**
19. Castle Meadow 2	Y	100	**48.7**	**45.3**
20. St Georges St	N	**42**	22.4	20.9
21. Grapes Hill (lower)	Y	100	30.1	28.0
22. 32 Key & Castle Yard	N	100	34.3	31.9
23. 29 St Martins Road	N	100	24.4	22.7
24. Boundary PH 414 Aylsham Rd	N	**67**	26.8	25.0
25. Kerrisons 353 Aylsham Rd	N	**67**	38.2	35.5
26. 221 Mile Cross lane	N	**67**	35.5	33.0
27. 13 Aylsham Road	N	100	28.8	26.8
28. 158 Waterloo Road	N	100	25.8	23.9
29. 62 Magpie Road	N	100	35.1	32.6
30. 26 Bull Close Road	N	100	38.2	35.6
31. 24 Bargate Court	N	100	35.2	32.8
32. 124 Barrack Street	N	100	26.8	24.9
33. 5 Riverside Road	N	100	**49.9**	**46.4**
34. Wellington Lane (lower)	Y	100	34.5	32.1
35. 71 Dukes Court	Y	100	29.7	27.6

Eight of the diffusion tube monitoring sites experienced exceedences of the annual mean objective for NO_2. Four of the sites that encountered exceedences of the annual mean objective, which include St Augustines, Cattlemarket Street and both sites on Castle Meadow are within AQMAs. Sites including 256 King Street, St Stephens (mid), Exchange Street and Riverside Road are not within AQMAs. The 2008 Detailed Assessment concluded that Riverside Road should be declared as an AQMA and if the

monitoring data for 2009 calendar year shows 256 King Street to exceed the annual mean objective for NO_2, this area should also be designated as an AQMA.

With regards to the exceedences around St Stephens and Exchange Street, the 2007 Progress report advised that there is no public exposure relevant to the annual mean objective at either of these sites. The 2008 Detailed Assessment also confirmed that the diffusion tube at the St Stephens site is not at the building façade, and further investigation by NCC confirmed that there is no relevant exposure and therefore no Detailed Assessment or AQMA is required at this site.

It should also be noted that the Grapes Hill AQMA may be revoked as the monitoring carried out at Grapes Hill (Upper& Lower), Wellington Lane, Johnson Place and Dukes Court shows that NO_2 levels within this AQMA remain below the annual mean objective. However, it is recommended that the AQMA remain in place at the moment. Further discussion is provided in section 1.4.5.

Table 2.4b Results of Nitrogen Dioxide Diffusion Tubes

Location	Within AQMA?	Annual mean concentrations (μg/m^3) Adjusted for bias		
		2006[1]	2007[2]	2008
1. 256 King Street	N	N/A	**45.2**	**41.2**
2. Queens Rd Travelodge	N	N/A	**41.9**	32.8
3. 25 Surrey Street	N	N/A	33.5	27.3
4. St Stephens (mid)	N	**46.0**	**46.4**	**48.4**
5. Chapelfield / Wessex St	N	32.0	35.6	30.5
6. Chapelfield / The Crescent	N	**40.0**	27.3	21.4
7. 26 Johnson Place	Y	**41.0**	33.7	24.3
8. 63 Earlham Road	N	38.0	38.0	23.4
9. 130 Magdalen Street	N	N/A	**40.1**	36.7
10. 557 Earlham Road	N	N/A	26.3	25.9
11. Grapes Hill (upper)	Y	25.0	28.4	23.2
12. Exchange St	N	**42.0**	**42.3**	**41.0**
13. St Augustines	Y	**50.0**	**52.1**	**50.9**
14. Tombland	N	**42.0**	**47.7**	27.8
15. Upper King Street	Y	32.0	37.8	32.4
16. 73 Prince of Wales Road	N	N/A	39.1	31.8
17. Cattlemarket Street	Y	**42.0**	**52.8**	**43.1**
18. Castle Meadow	Y	**46.0**	**52.9**	**48.8**
19. Castle Meadow 2	Y	**46.0**	**46.6**	**45.3**
20. St Georges St	N	21.0	21.3	20.9
21. Grapes Hill (lower)	Y	29.0	30.7	28.0
22. 32 Key & Castle Yard	N	N/A	35.6	31.9
23. 29 St Martins Road	N	N/A	25.3	22.7
24. Boundary PH 414 Aylsham Rd	N	N/A	N/A	25.0
25. Kerrisons 353 Aylsham Rd	N	N/A	N/A	35.5
26. 221 Mile Cross lane	N	N/A	N/A	33.0
27. 13 Aylsham Road	N	N/A	32.7	26.8
28. 158 Waterloo Road	N	N/A	**41.1**	23.9
29. 62 Magpie Road	N	N/A	34.9	32.6
30. 26 Bull Close Road	N	N/A	39.9	35.6
31. 24 Bargate Court	N	N/A	38.4	32.8
32. 124 Barrack Street	N	N/A	32.1	24.9
33. 5 Riverside Road	N	47.0	**48.6**	**46.4**
34. Wellington Lane (lower)	Y	32.4	36.7	32.1
35. 71 Dukes Court	Y	N/A	31.1	27.6

[1] Bias correction factor applied was 0.98
[2] Bias correction factor applied was 1.051

- 2007 figures are quoted from Detailed Assessment for Norwich City Council, 2008.
- 2006 figures are quoted from Progress Report for Norwich City Council, 2007.

2.2.2 PM_{10}

The annual mean concentration at the Castle Meadow automatic monitoring site was record as 19 μg/m^3 for 2008, which is below the annual mean objective. There were four exceedences of the 1-hour mean during 2008 at this site, the maximum daily mean recorded as 84 μg/m^3. For the Norwich Centre urban background automatic monitoring site the annual mean concentration for 2008 was 21 μg/m^3. Based on the data available from 1 January 2008 till 13 May 2008 the 90th percentile was 35 μg/m^3.

Table 2.5a Results of PM_{10} Automatic Monitoring: Comparison with Annual Mean Objective

Location	Within AQMA?	Proportion of year with valid data 2008 %	Annual mean concentrations (μg/m^3)		
			2006	2007	2008
Norwich Centre	N	36	16.9	24.0	27.8
Norwich Castle Meadow (Mobile site)	Y	94	24.0	23.0	19.0

Table 2.5b Results of PM_{10} Automatic Monitoring: Comparison with 24-hour Mean Objective

Location	Within AQMA?	Data Capture 2008 %	Number of Exceedences of daily mean objective (50 μg/m^3) *If data capture < 90%, include the 90th %ile of daily means in brackets.*		
			2006	2007	2008
Norwich Centre	N	36	0	2	11 (35)
Norwich Castle Meadow (Mobile site)	Y	94	6	12	4

2.2.3 SO_2

Two sites in Norwich monitor for SO_2. Norwich Centre had less than 90% data capture for the calendar year. As such the following information is provided to show that there are no issues with regards to SO_2 in the area of Norwich Centre monitoring site.

- 99.9th percentile of 15-minute mean was 16 μg/m^3.
- 99.7th percentile of 1-hour mean was 13 μg/m^3.
- 99th percentile of 24-hour mean was 7 μg/m^3.

The other automatic monitoring site in Norwich, Castle Meadow, had 94% data capture for SO_2. There were 2 exceedences of the 15-minute mean during the calendar year, the maximum being 492 μg/m^3. There were no exceedences of the 1-hour or 24-hour means at this site. The recorded annual mean at Norwich Castle Meadow was 12 μg/m^3.

2.2.4 Benzene

NCC no longer monitor benzene as it has been determined that levels affecting Norwich are extremely small and insignificant in terms of the Air Quality Objective.

2.2.5 Carbon Monoxide

There were no exceedences of the air quality strategy objective of 10 mg/m^3 for carbon monoxide in Norwich during 2008. Monitoring data is available for carbon monoxide from the Norwich mobile monitoring unit (Castle Meadow) for the 2008 calendar year. The recorded data shows a maximum 8-hour running mean of 2.7 mg/m^3.

Further monitoring data for carbon monoxide is available for the NCC area on the UK National Air Quality Information Archive website at www.airquality.co.uk.

NCC has examined the results from monitoring in the City. Concentrations of all pollutants outside AQMAs are all below the objectives; therefore there is no need to proceed to a Detailed Assessment.

3 Road Traffic Sources

3.1 Narrow Congested Streets with Residential Properties Close to the Kerb

NCC confirms that there are no new/ newly identified congested streets with a flow above 5,000 vehicles per day and residential properties close to the kerb, that have not been adequately considered in previous rounds of Review and Assessment.

3.2 Busy Streets Where People May Spend 1-hour or More Close to Traffic

NCC confirms that there are no new/newly identified busy streets where people may spend 1 hour or more close to traffic.

3.3 Roads with a High Flow of Buses and/or HGVs.

NCC confirms that there are no new/newly identified roads with high flows of buses/HDVs.

3.4 Junctions

The majority of junctions highlighted in the checklist have been considered during previous assessments. The reports carried out during the First Stage of Review and Assessment provides detail of ADMS modeling which assessed all but two of the junctions highlighted in the checklist. Furthermore, the 2008 Detailed Assessment assessed Boundary Road and the junction with Aylsham Road (A140/ A1042) using LADS to predict dispersion.

The Constitution Hill/ Chartwell Road (B1150/ A1042) roundabout meets the checklist criteria for further investigation. DMRB modelling has been carried out at this junction to predict whether the PM_{10} or NO_2 Air Quality Objectives may be threatened at receptors (housing) located around the roundabout. Coordinates of receptors are detailed in Appendix B.

DMRB modelling has shown that the NO_2 and PM_{10} objectives are not under threat at the modelled receptors in this area and as such, a Detailed Assessment need not be carried out. Levels of NO_2 modelled at receptor one and two are 29.6 $\mu g/m^3$ and 29.3 $\mu g/m^3$ respectively. DMRB calculations show road traffic in the area contributes to around 3 $\mu g/m^3$ to the overall PM_{10} concentration in the local area. Therefore, when background concentration is added the resulting modelled concentrations at receptor one and two are 23.1 $\mu g/m^3$ and 23.0 $\mu g/m^3$ respectively. Appendix B shows the details of the DMRB calculations carried out.

NCC has assessed new/newly identified junctions meeting the criteria in Section A.4 of Box 5.3 in TG (09), and concluded that it will not be necessary to proceed to a Detailed Assessment.

3.5 New Roads Constructed or Proposed Since the Last Round of Review and Assessment

NCC confirms that there are no new/proposed roads.

3.6 Roads with Significantly Changed Traffic Flows

NCC confirms that there are no new/newly identified roads with significantly changed traffic flows.

3.7 Bus and Coach Stations

NCC confirms that there are no relevant bus stations in the Local Authority area.

4 Other Transport Sources

4.1 Airports

NCC confirms that there are no airports in the Local Authority area that meet the criteria outlined in Box 5.4 of LAQM TG (09).

4.2 Railways (Diesel and Steam Trains)

4.2.1 Stationary Trains

NCC confirms that there are no locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.

4.2.2 Moving Trains

NCC confirms that there are no locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.

4.3 Ports (Shipping)

NCC confirms that there are no ports or shipping that meet the specified criteria within the Local Authority area.

5 Industrial Sources

5.1 Industrial Installations

5.1.1 New or Proposed Installations for which an Air Quality Assessment has been Carried Out

A new CHP engine generator is to be installed at the University of East Anglia during the autumn of 2009. The UEA and the developer provided information on emission rates of NO_x based on HMIP technical guidance. The data provided indicates that the expected maximum emission of NO_x resulting from operating the CHP engine will be 0.964 g/sec from a stack of diameter 0.4 m.

Guidance from LAQM TG (09) Box 5.5, Approach 3 (paragraphs 5.39 and paragraph 5.40) enabled the determination of whether a Detailed Assessment would be required for the CHP at UEA.

The installation has been assessed and is not likely to give rise to significant NO_x emissions which would exceed the limit values shown in nomograms (LAQM TG (09) Figure 5.1 and Figure 5.2) for stack emissions for the 1-hour NO_2 mean objective and the annual mean objective for NO_2.

As the installation has not been commissioned a survey of the area could be introduced to monitor emissions from the stack when operational which will provide data that can be used to assess emissions from the installation.

NCC has assessed new/proposed industrial installations, and concluded that it will not be necessary to proceed to a Detailed Assessment.

5.1.2 Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been introduced

NCC confirms that there are no industrial installations with substantially increased emissions or new relevant exposure in their vicinity within its area or nearby in a neighbouring authority.

5.1.3 New or Significantly Changed Installations with No Previous Air Quality Assessment

NCC confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.2 Major Fuel (Petrol) Storage Depots

There are no major fuel (petrol) storage depots within the Local Authority area.

5.3 Petrol Stations

NCC confirms that there are no petrol stations meeting the specified criteria**.**

5.4 Poultry Farms

NCC confirms that there are no poultry farms meeting the specified criteria.

6 Commercial and Domestic Sources

6.1 Biomass Combustion – Individual Installations

NCC confirms that there are no biomass combustion plants in the Local Authority area.

6.2 Biomass Combustion – Combined Impacts

NCC confirms that there are no biomass combustion plants in the Local Authority area.

6.3 Domestic Solid-Fuel Burning

NCC confirms that there are no areas of significant domestic fuel use in the Local Authority area.

7 Fugitive or Uncontrolled Sources

There are no new or newly identified landfills, quarries, open cast mines, handling of dusty cargo or industrial sites with unpaved haul roads, processing plants and materials handling that have started operation or significantly changed since the last Review and Assessment report.

NCC confirms that there are no potential sources of fugitive particulate matter emissions in the Local Authority area.

8 Air Quality Plans and Policies

8.1 Air Quality Action Plan

NCC produced an Air Quality Action Plan in March 2004. The Council has progressed steadily with the implementation of measures from this plan. NCC reports progress with implementation of measures in the action plan annually.

8.2 Local Transport Plan

Norfolk Local Transport Plan 2 (LTP) 2006-2011 is currently in place. Three of the thematic strategies prioritise transport and associated environmental impacts resulting from transport sources within the LTP2 and aim to improve air quality and minimising congestion by talking transport issues across the region.

The LTP2 will spearhead actions aimed at ensuring good air quality is maintained in respect of national air quality objectives and introducing more integrated transport solutions to tackle any identified air quality hotspots. The thematic strategies include plans to Improve connections by road and particularly public transport within sub-regions, Improve local connections and promote better accessibility to jobs and services, especially by public transport, cycling and walking. Furthermore the LTP2 seeks to prioritise improvements in those deprived areas of the county with low car ownership and poor public transport whilst ensuring sufficient provision is made for cars, freight and other traffic to give it access on the most appropriate routes. Additionally the LTP aims to reduce emissions from transport at source by enabling a shift to alternative fuels and low emission vehicles while also protecting the environment by integrating environmental considerations into plans and programs, and decision making processes.

9 Conclusions and Proposed Actions

9.1 Conclusions from New Monitoring Data

NCC undertakes both continuous and diffusion tube nitrogen dioxide monitoring throughout their area. Continuous monitoring carried out at Norwich Castle Meadow showed that the 2008 NO_2 concentration exceeded the NO_2 annual mean objective of 40 $\mu g/m^3$. However, the monitoring also showed that the 1-hourly mean NO_2 objective was not exceeded during 2008. Automatic monitoring carried out at Norwich Centre did not experience any exceedence of the annual mean objective or the 1-hourly mean objective.

NCC carried out diffusion tube monitoring for NO_2 at 35 locations throughout the city. The 2008 bias adjusted results indicated that concentrations of NO_2 exceeded the NO_2 annual mean objective at several locations. These locations were:

- 256 King Street;
- St Stephens (Mid);
- Exchange Street;
- St Augustines;
- Cattlemarket Street;
- Castle Meadow;
- Castle Meadow 2; and
- 5 Riverside Road.

Of the areas where the exceedences are found St Augustines, Cattlemarket Street, and both Castle Meadow sites these locations are within existing AQMAs. St Stephens Street and Exchange Street are not considered to be locations of relevant exposure to the general public.

A Detailed Assessment was carried out around the locations of diffusion tubes at King Street and Riverside Road in 2008. The Detailed Assessment concluded that the area surrounding Riverside Road should be declared as an AQMA and that if 2009 monitoring data confirms King Street to exceed the annual mean objective for NO_2, then this area should also be declared as an AQMA.

Due to the limitations of diffusion tubes, Local Authorities are advised not to rely upon diffusion tube data alone as a basis of a Detailed Assessment or declaration of an AQMA for NO_2. It is recognized that automatic monitoring is not always possible and therefore if diffusion tube monitoring is the practicable monitoring method it should be ensured that:

- Monitoring is carried out for a full year as concentrations of some pollutants exhibit seasonal patterns (as a minimum six consecutive months should be monitored (3 in summer and 3 in winter) for example January to June or July to December to ensure they are representative of the full year);
- Tubes are deployed at several sites in the vicinity (for example several points around the roundabout and roads leading to the roundabout at locations of public exposure, as well as a range of urban background sites (3 to 4 sites typically)) to obtain a representative background concentration for the area and roadside or kerbside sites for model validation;
- Diffusion tubes have good precision (triplicate tubes could be positioned at a selected sub-set of the sites in order to gather information on diffusion tube precision); and
- Diffusion tubes are appropriately bias corrected.

Based upon the findings of the previous assessments, the concentrations of 1,3-butadiene, benzene, carbon monoxide, lead, PM_{10} and SO_2 are unlikely to be in excess of the air quality objectives at any location.

It should also be noted that the Grapes Hill AQMA could be revoked as the monitoring carried out at Grapes Hill (Upper& Lower), Wellington Lane, Johnson Place and Dukes Court shows that NO_2 levels within this AQMA remain below the annual mean objective of 40$\mu g/m^3$. However, it is recommended that the AQMA remain in place at the moment.

9.2 Conclusions from Assessment of Sources

9.2.1 Road Traffic Sources

There is no requirement to proceed to a Detailed Assessment for the following sources:

- Congested streets with a flow above 5,000 vehicles per day and residential properties close to the kerb that have not previously been assessed;
- Busy Streets Where People May Spend 1-hour or More Close to Traffic;
- Roads with a High Flow of Buses and/or HGVs;
- Junctions;
- New Roads Constructed or Proposed Since the Last Round of Review and Assessment;
- Roads with Significantly Changed Traffic Flows and; and
- Bus and Coach Stations.

9.2.2 Other Transport Sources

There is no requirement to proceed to a Detailed Assessment for the following sources:

- Airports;
- Railways (Diesel and Steam Trains); and
- Ports (Shipping).

9.2.3 Industrial Sources

There is no requirement to proceed to a Detailed Assessment for the following sources:

- Industrial Installations;
- Major Fuel (Petrol) Storage Depots;
- Petrol Stations; and
- Poultry Farms.

9.2.4 Commercial and Domestic Sources

There is no requirement to proceed to a Detailed Assessment for the following sources:

- Biomass Combustion – Individual Installations;
- Biomass Combustion – Combined Impacts; and
- Domestic Solid-Fuel Burning.

9.2.5 Fugitive or Uncontrolled Sources

There is no new or newly identified source or potential sources of fugitive particulate matter therefore there is requirement to proceed to a Detailed Assessment for the this source.

9.3 Proposed Actions

This USA has concluded that NCC is not required to carry out a Detailed Assessment for NO_2, carbon monoxide, benzene, 1,3-butadiene, lead, PM_{10} or SO_2.

10 References

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Air Quality Review and Assessment Help desk: http://www.uwe.ac.uk/aqm/review/index.html

UK Air Quality Archive: http://www.airquality.co.uk/archive/index.php

Appendices

Appendix A: QA/QC Procedures

Appendix B: DMRB Calculations

Appendix C: Non Bias-Adjusted Diffusion Tube Data

Appendix A: QA:QC Procedures

Diffusion Tube Bias Adjustment Factors

Supplier/ Analyst: Gradko

Preparation Method: 50% TEA in Acentone

National Bias Adjustment Factor: 0.93

Discussion of Choice of Factor to Use

National Bias Adjustment Factor was used as there is no triplicate site in Norwich that could have been used to calculate local Bias Adjustment Factor. National Bias Adjustment Factor of 0.93 applied to all uncorrected diffusion tube annual mean values. National Spreadsheet of Bias Adjustment Factors (v.03/09) is shown below.

Step 1:	Step 2:	Step 3:	Step 4:							
Select the Laboratory that Analyses Your Tubes from the Drop-Down List	Select a Preparation Method from the Drop-Down List	Select a Year from the Drop-Down List	Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor[3] shown in blue at the foot of the final column.							
If a laboratory is not shown, we have no data for this laboratory.	If a preparation method is not shown, we have no data for this method at this laboratory	If a year is not shown, we have no data[2]	If you have your own co-location study then see footnote[4]. If uncertain what to do then contact the Review and Assessment Helpdesk 0117 328 3668 aqm-review@uwe.ac.uk.							
Analysed By[4]	Method To undo your selection, choose (All) from the pop-up list	Year[5] To undo your selection, choose (All)	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m3)	Automatic Monitor Mean Conc. (Cm) (µg/m3)	Bias (B)	Tube Precision[6]	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	50% TEA in Acetone	2008	R	Boston BC	12	45	36	27.3%	G	**0.79**
Gradko	50% TEA in Acetone	2008	R	LB Hammersmith and Fulham	10	90	68	32.4%	S	**0.76**
Gradko	50% TEA in Acetone	2008	UB	Reading BC	12	26	23	13.4%	G	**0.88**
Gradko	50% TEA in Acetone	2008	UC	Uttlesford DC	11	26	28	-7.0%	G	**1.08**
Gradko	50% TEA in Acetone	2008	R	Stevenage BC	12	37	29	27.5%	G	**0.78**
Gradko	50% TEA in Acetone	2008	R	LB Hounslow	12	58	59	-0.2%	G	**1.00**
Gradko	50% TEA in Acetone	2008	R	LB Hounslow	12	69	72	-4.6%	G	**1.05**
Gradko	50% TEA in Acetone	2008	UB	LB Hounslow	10	38	30	24.9%	G	**0.80**
Gradko	50% TEA in Acetone	2008	R	LB Redbridge	12	46	46	-0.2%	G	**1.00**
Gradko	50% TEA in Acetone	2008	R	LB Redbridge	11	50	55	-10.1%	G	**1.11**
Gradko	50% TEA in Acetone	2008	UB	LB Redbridge	12	37	32	13.9%	G	**0.88**
Gradko	50% TEA in Acetone	2008	K	LB Redbridge	10	52	53	-2.4%	G	**1.03**
Gradko	50% TEA in Acetone	2008	K	AEA Tech Intercomparison	12	103	116	-10.7%	G	**1.12**
Gradko	50% TEA in Acetone	2008	R	Horsham DC	11	34	30	12.7%	G	**0.89**
Gradko	50% TEA in Acetone	2008		**Overall Factor[3] (14 studies)**				**Use**		**0.93**

PM Monitoring Adjustment

The Volatile Correction Method (VCM) allows corrections to be made to TEOM measurements for the loss of volatile components of particulate matter that occur due to the high sampling temperatures employed by this instrument. The resulting corrected measurements have been demonstrated as equivalent to the gravimetric reference equivalent.

The VCM works by using the volatile particulate matter measurements provided by nearby FDMS instruments (within 130 km) to assess the loss of PM_{10} from the TEOM; this value is then added back onto the TEOM measurements.

VCM Model was applied to results from TEOM measurements recorded at Castle Meadow.

The Norwich Centre site experienced poor data capture (36%) during 2008. As such, the VCM could not be applied to these data as it requires greater than 50% data capture for data over any 12-month period. For PM_{10} data collected at Norwich Centre a correction factor of 1.3 has been applied to the uncorrected TEOM data from this site.

Short-term to Long-term Data adjustment

For NO_2 the following three sites were used to calculate an average ratio, which was then applied to the period mean for NO_2 from the Norwich Centre site for data captured during the period 1st January 2008 to 13th May 2008. The estimated annual mean for NO_2 using this method was 24.7 $\mu g/m^3$. A 99.8th%ile of 108 $\mu g/m^3$ was also calculated. All three sites used had data capture greater than 80% for the 12 month period 1st Jan to 31st Dec.

Site	Site Type	Annual Mean	Period Mean	Ratio
Northampton		21	25	0.84
Thurrock		32	35	0.91
Southend on Sea		23	28	0.82
			Average =	**0.86**

For PM_{10} the following two sites in the area were used as they had data capture greater than 80% for the 12-month period. The average ratio was calculated from these sites and applied to the period mean for PM_{10} for the Norwich Centre site for data captured during the period 1st January 2008 to 13th May 2008. The estimated annual mean for PM_{10} using this method was 27.8 $\mu g/m^3$. A 90th%ile of 35 $\mu g/m^3$ was also calculated. Both listed sites had data capture greater than 80% for the 12-month period 1st Jan to 31st Dec.

Site	Site Type	Annual Mean	Period Mean	Ratio
Southend on Sea		20	24	0.83
Thurrock		16	17	0.94
			Average =	**0.89**

QA/QC of automatic monitoring

In order to satisfy the requirement outlined in the LAQM TG (09), the following QA/QC procedures were implemented:

- 3-weekly calibrations of the NO_x analyser;
- 6-monthly audits and servicing of the monitoring site; and
- Data ratification.

Calibrations of the NO_x analyser were carried out using certified compressed gas standards (ISO17025). This ensured that the calibration gas was traceable to national and international standards. In addition to the calibration sample filters were changed for both NO_x and TEOM analysers and any faults were identified thus minimising data loss.

Audits of the monitoring site consisted of a number of performance checks to identify any faults with the equipment. The calibration cylinder was also checked against another gas standard in order to confirm the gas concentration. Any identified faults were forwarded on to the service unit for repair.

The final stage of the QA/QC process was to ratify the data. During ratification, all calibration, audit and service data are collated and the data is appropriately scaled. Any suspect data identified are deleted therefore ensuring that the data are of a high quality.

QA/QC of diffusion tube monitoring

The Workplace Analysis Scheme for Proficiency (WASP) is an independent analytical performance-testing scheme, operated by the Health and Safety Laboratory (HSL). WASP formed a key part of the former UK NO_2 Network's QA/QC, and remains an important QA/QC exercise for laboratories supplying diffusion tubes to Local Authorities for use in the context of Local Air Quality Management (LAQM). The laboratory participants analyse four spiked tubes, and report the results to HSL. HSL assign a performance score to each laboratory's result, based on their deviation from the known mass of nitrite in the analyte.

The Performance criteria are due to be changed, at present the criteria are based on the z-score method, and equates to the following:

- GOOD: Results obtained by the participating laboratory are on average within 13% of the assigned value. This equates to a Rolling Performance Index (RPI) of 169 or less.
- ACCEPTABLE: Results obtained by the participating laboratory are on average within 13- 26% of the assigned value. This equates to an RPI of 169 - 676.
- WARNING: Results obtained by the participating laboratory are on average within 26 – 39% of the assigned value. This equates to an RPI of 676 - 1521.
- FAILURE: Results obtained by the participating laboratory differ by more than 39% of the assigned value. This equates to an RPI of greater than 1521.

However from April 2009, the criteria will be based upon the Rolling Performance Index (RPI) statistic and will be tightened to the following:

- GOOD: Results obtained by the participating laboratory are on average within 7.5% of the assigned value. This equates to an RPI of 56.25 or less.
- ACCEPTABLE: Results obtained by the participating laboratory are on average within 15% of the assigned value. This equates to an RPI of 225 or less.
- UNACCEPTABLE: Results obtained by the participating laboratory differ by more than 15% of the assigned value. This equates to an RPI of greater than 225.

Appendix B: DMRB Calculations

Input Data

DMRB: Assessment of Local Air Quality — **INPUT SHEET**

Step 1	Receptor name	A1040/B1052	Receptor number	1	
Step 2	Year	2008			
Step 3	Number of links	2			

Step 6: CALCULATE

Step 7: STORE RESULTS FOR THIS RECEPTOR

CLEAR INPUT DATA

RUN COMPLETE

Step 4 — Background concentrations for 2008

CO (mg/m³)	Benzene (µg/m³)	1,3-butadiene (µg/m³)	NO_x (µg/m³)	NO_2 (µg/m³)	PM_{10} (µg/m³)
0.412	0.656	0.265	25.17	18.98	20.65

Step 5

Link number	Distance from link centre to receptor (m)	Traffic flow & speed		Traffic composition							
		AADT (combined, veh/day)	Annual average speed (km/h)	Road type (A,B,C,D)	Vehicles <3.5t GVW (LDV)			Vehicles>3.5t GVW (HDV)			
					% passenger cars	% light goods vehicles	Total % LDV	% buses and coaches	% rigid HGV	% articulated HGV	Total % HDV
1	7	13153	30	A			95.5				4.5
2	10	5286	25	B			96.4				3.6
3											
4											
5											
6											
7											

DMRB: Assessment of Local Air Quality — **INPUT SHEET**

Step 1	Receptor name	A1040/B1052	Receptor number	2	
Step 2	Year	2008			
Step 3	Number of links	2			

Step 6: CALCULATE

Step 7: STORE RESULTS FOR THIS RECEPTOR

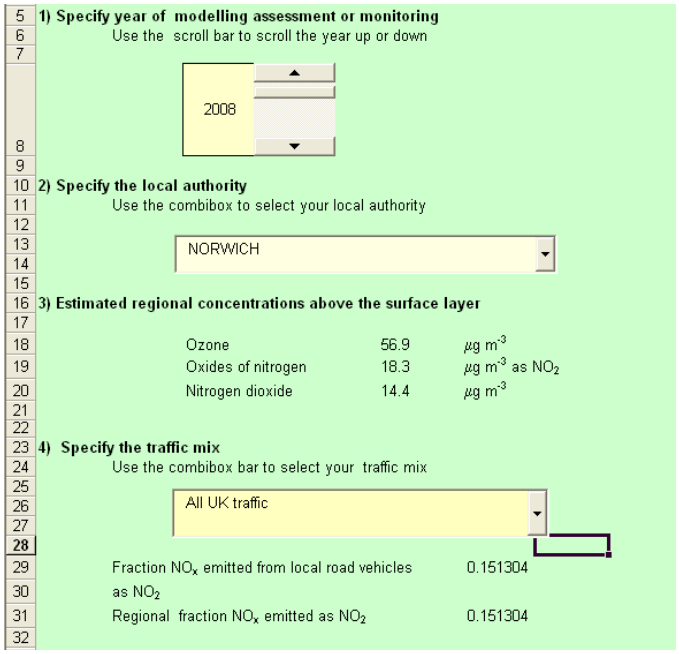
CLEAR INPUT DATA

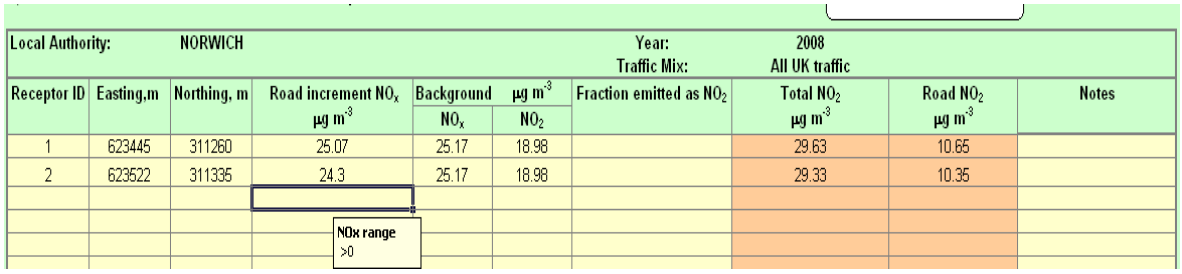
Step 4 — Background concentrations for 2008

CO (mg/m³)	Benzene (µg/m³)	1,3-butadiene (µg/m³)	NO_x (µg/m³)	NO_2 (µg/m³)	PM_{10} (µg/m³)
0.412	0.656	0.265	25.17	18.98	20.65

Step 5

Link number	Distance from link centre to receptor (m)	Traffic flow & speed		Traffic composition							
		AADT (combined, veh/day)	Annual average speed (km/h)	Road type (A,B,C,D)	Vehicles <3.5t GVW (LDV)			Vehicles>3.5t GVW (HDV)			
					% passenger cars	% light goods vehicles	Total % LDV	% buses and coaches	% rigid HGV	% articulated HGV	Total % HDV
1	12	13409	30	A			95.5				4.5
2	12	6763	25	B			96.4				3.6
3											
4											
5											
6											
7											





Local Authority:	NORWICH					Year: Traffic Mix:	2008 All UK traffic		
Receptor ID	Easting,m	Northing, m	Road increment NO_x µg m^{-3}	Background µg m^{-3} NO_x	Background µg m^{-3} NO_2	Fraction emitted as NO_2	Total NO_2 µg m^{-3}	Road NO_2 µg m^{-3}	Notes
1	623445	311260	25.07	25.17	18.98		29.63	10.65	
2	623522	311335	24.3	25.17	18.98		29.33	10.35	

NOx range >0

Verification

Verification of the DMRB modelling results is not possible in this case as there are no diffusion tubes positioned close to the junction.

Results

Location/ Receptor	Name	Year	Total NO_x [1]	Rd NOx [2]	Adj Rd NOx [3]	Adj Total NOx [4]	Adj Rd NO_2 [5]	Adj Total NO_2 [6]	PM_{10}	
			Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Annual mean µg/m^3	Days >50µg/m^3
1	A1040/B1052	2008	50.2	25.1	N/A	N/A	10.7	29.6	23.8	9.8
2	A1040/B1052	2008	49.5	24.3	N/A	N/A	10.4	29.3	23.7	10.0

[1] Total NOx = direct from DMRB local output sheet
[2] Rd NOx = Total NOx – Background NOx
[3] Adj Rd NOx = Rd NOx x verification factor (state verification factor used)
[4] Adj Total NOx = Adj Rd NOx + Background NOx
[5] Adj Rd NO_2 = from NOx to NO_2 calculator (available LAQM Tools)
[6] Adj Total NO_2 = Adj Rd NO_2 + Background NO_2

Appendix C: 2008 Monthly NO_2 Concentrations ($\mu g/m^3$)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Uncorrected	Bias Adjusted*
256 King Street	51.3	49.9	35.1	41.6	44.0	41.0	41.4	45.2	47.9	44.5	46.4	43.0	44.3	**41.2**
Queens Rd Travelodge	30.9	34.2	31.1	38.6	46.3	39.6	18.4	28.8	42.2	27.0	45.3	40.8	35.3	32.8
25 Surrey Street	29.0	40.4	23.0	30.3	24.3	27.5	24.6	27.5		28.6	34.0	33.5	29.3	27.3
St Stephens (mid)	55.8	61.3	31.8	55.6	56.8	47.2	52.2	54.7	56.3	43.2	54.4	54.8	52.0	**48.4**
Chapelfield/Wessex St	29.2	36.7	26.0	35.0	40.4	31.3	30.8	27.1	39.5	25.8	35.3	35.9	32.8	30.5
Chapelfield 1 The Crescent	21.0	25.7	22.5										23.1	21.4
26 Johnson Place	29.0	39.2	25.6	27.9	25.7	22.7	20.0	18.3	25.3	22.2	33.3	24.3	26.1	24.3
63 Earlham Road	22.3	31.3	22.0										25.2	23.4
130 Magdalen Street	43.5	43.0	40.8	39.5	30.4	42.8	38.3	34.4	39.1	34.0	42.9	45.0	39.5	36.7
557 Earlham Road	28.3	30.2	25.1										27.9	25.9
Grapes Hill (upper)	27.9	31.5	21.0	25.8	25.2	18.7	18.4	22.1	27.1	23.3	25.8	32.9	25.0	23.2
Exchange St	63.9	39.4	31.4	41.3	26.7	32.4	32.5	24.8	43.0	74.9	62.3	56.6	44.1	**41.0**
St Augustines	60.1	55.2	46.9	54.7	40.7	60.3	56.9	53.6	55.5	51.9	62.2	58.9	54.7	**50.9**
Tombland	49.6	34.4	24.4	27.8	22.5	28.4	26.1	29.0	26.4	26.5	32.8	31.4	29.9	27.8
Upper King Street	36.7	38.7	37.8	33.1	26.4	32.0	31.8	32.2	34.3	37.4	40.7	36.9	34.8	32.4
73 Prince of Wales Road	40.1	37.8	28.6	35.5	29.0	32.7	31.5	34.8	31.5	34.2	37.5	37.6	34.2	31.8
Cattlemarket Street	50.9	53.6	41.3	46.7	46.0	47.2	51.9	46.4	33.5	44.0	49.0	45.4	46.3	**43.1**

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Uncorrected	Bias Adjusted*
Castle Meadow	56.1	56.2	49.8	51.3	52.1	52.7	50.8	53.2	54.0	42.1	56.1	54.6	52.4	**48.8**
Castle Meadow 2	54.1	53.4	42.0	49.4	46.8	50.6	56.7	52.2	44.4	43.8	48.1	42.7	48.7	**45.3**
St Georges St	28.1	29.0	19.3	20.2	15.7								22.4	20.9
Grapes Hill (lower)	27.3	31.1	27.6	29.8	39.2	25.7	26.4	26.5	31.4	24.2	34.7	37.8	30.1	28.0
32 Key & Castle Yard	37.8	43.8	29.5	35.5	26.9	29.2	30.9	34.7	31.4	36.2	38.1	37.6	34.3	31.9
29 St Martins Road	24.9	28.8	16.9	22.2	27.3	19.6	18.5	35.4	27.2	19.3	27.9	25.3	24.4	22.7
Boundary PH/414 Aylsham Rd				28.7	34.8	24.5	21.2	19.0	28.8	19.9	31.9	32.9	26.8	25.0
Kerrisons/ Aylsham Rd				42.9		35.3	37.1	36.4	39.5	35.5	39.1	39.9	38.2	35.5
221 Mile Cross lane				34.9	31.9	34.9	36.0	26.0	35.1	34.4	46.8	39.7	35.5	33.0
13 Aylsham Road	27.1	31.1	23.7	30.4	31.7	27.3	26.1	25.5	31.6	28.4	34.3	28.7	28.8	26.8
158 Waterloo Road	27.8	29.5	20.8	23.9	21.8	22.6	23.3	24.2		30.4	31.7	27.4	25.8	23.9
62 Magpie Road	37.8	40.2	31.0	35.9	33.1	32.9	32.9	31.3	33.7	34.8	37.4	39.6	35.1	32.6
26 Bull Close Road	44.9	43.5	36.2	34.9	25.3	39.5	39.5	39.4	33.7	36.9	41.3	43.8	38.2	35.6
24 Bargate Court	13.7		33.0	37.0	38.8	38.4	37.2	34.0	37.5	35.9	43.7	38.6	35.2	32.8
124 Barrack Street	33.4	30.3	22.7	28.4	22.7	21.6	22.7	19.4	25.1	30.4	31.2	33.2	26.8	24.9
5 Riverside Road	54.2	58.1	33.4	49.8	52.9	50.8	55.8		52.4	43.8	48.3	49.4	49.9	**46.4**
Wellington Lane (lower)		35.6	27.5	28.8	33.0	29.2		30.3	38.9	39.6	38.9	43.6	34.5	32.1
71 Dukes Court	32.0	33.9	27.3	26.9	29.9	27.0	24.7	27.5	28.8	29.9	32.6	36.1	29.7	27.6

* Bias correction factor applied was 0.93

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