



**NORWICH**  
City Council

In fulfilment of Part IV of the Environment Act 1995

Local Air Quality Management

# **Air quality review and assessment**

**Annual progress report 2014**

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## Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government Guidance when undertaking such work. This Progress Report is a requirement of the Fifth Round of Review and Assessment and is a requirement for all local authorities. The Report has been undertaken in accordance with the Technical Guidance LAQM.TG (09) and associated tools (as updated in 2010).

This Progress Report considers all new monitoring data and assesses the data against the Air Quality Strategy objectives. It also considers any changes that may have an impact on air quality.

Norwich City Council have carried out all past rounds of review and assessment and have consolidated all previous AQMAs into one larger central AQMA.

Proposed actions from this report are as follows:

- Continue with automatic and passive NO<sub>2</sub> monitoring within the city area
- Submit a revised Action Plan by the end of 2014 to work towards compliance with the air quality objectives within the Norwich Central AQMA
- Proceed to 2015 Updating and Screening Assessment.

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# 1 Introduction

## 1.1 Description of Local Authority Area

Norwich covers approximately 39 square kilometres in the heart of Norfolk with a population of circa 132,000 people. The population of the Norwich 'Travel to Work Area' ie the area of Norwich in which most people both live and work is circa 376,500. Norwich is the fourth most densely populated local authority district in the eastern region with approximately 34 people per hectare.

The City is home to more than 123,000 jobs, and more than 8,000 businesses. Almost one-third of Norfolk's workforce is based within the City Council area, and 40% are employed in the urban area. Approximately 73% of the City Council's working age resident population is economically active.

Employment in Norwich is predominantly service sector based reflecting the national picture. The Business & Financial Sector accounts for 31% of employment in Norwich. Around 26% of people employed in Norwich work in public services (Government, Health and Education). A further 12% of the workforce is employed in the retail sector and 7% work in tourism. The manufacturing sector accounts for almost 8% of employment in Norwich.

The City permits 43 'Part B' authorised processes, including petrol stations, road stone coating plant, vehicle re-sprayers and a crematorium. The major pollutant source in the city is road traffic.

## 1.2 Purpose of Progress Report

This report fulfils the requirements of the Local Air Quality Management (LAQM) 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.

Progress Reports are required in the intervening years between the three-yearly Updating and Screening Assessment reports. Their purpose is to maintain continuity in the LAQM process.

They are not intended to be as detailed as Updating and Screening Assessment Reports, or to require as much effort. However, if the Progress Report identifies the risk of exceedence of an Air Quality Objective, the Local Authority (LA) should undertake a Detailed Assessment immediately, and not wait until the next round of Review and Assessment.

### **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  $\mu\text{g}/\text{m}^3$  (milligrammes per cubic metre,  $\text{mg}/\text{m}^3$  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 LAQM in England**

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
	5.00 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
Carbon monoxide	10 $\text{mg}/\text{m}^3$	Running 8-hour mean	31.12.2003
Lead	0.50 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	0.25 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2005
Particulate Matter (PM <sub>10</sub> ) (gravimetric)	50 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu\text{g}/\text{m}^3$ , not to be exceeded more than 35 times a year	15-minute mean	31.12.2005



## 1.4 Summary of Previous Review and Assessments

Norwich City Council (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 (2004);  
Progress Report (2005);  
Updating and Screening Assessment (2006);  
Progress Report (2007);  
Detailed Assessment (2008);  
Updating and Screening Assessment (2009);  
Progress Report (2010);  
Further Assessment for Riverside Road AQMA (2010);  
Progress Report (2011);  
Updating and Screening Assessment (2012);  
Detailed Assessment (2012)  
Progress Report (2013)

### 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, benzene, 1,3-butadiene and lead. However, there were doubts as to whether the Government's objectives would be met with respect to nitrogen dioxide (NO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>) and particulate matter less than 10µm (PM10). The report recommended that the Norwich City Council progress to a Further Assessment for NO<sub>2</sub>, SO<sub>2</sub> and PM10.

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<sub>2</sub> and PM<sub>10</sub> concluded that the Air Quality objectives for 2005 would be achieved.

Nitrogen dioxide was taken straight to a Stage 3 review and assessment as Stage 1 indicated Norwich was unlikely to achieve the Air Quality objectives in 2005.

The Further Assessment for NO<sub>2</sub> concluded that the Air Quality Objective was unlikely to be achieved in certain areas of the city by 2005. As a result the council declared three AQMAs for exceedences of the NO<sub>2</sub> annual objective.

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 concluded that there could be an exceedence of the NO<sub>2</sub> objectives as a result of traffic sources. Declaration of three AQMAs was recommended. Norwich City Council 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 PM10 objective either by traffic or industrial sources. As such, there was no need for further review and assessment of PM10.

There were no sources that would result in predicted exceedences of the SO<sub>2</sub> objective by industrial sources.

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

Norwich City Council then proceeded to a Detailed Assessment for NO<sub>2</sub>. The findings of the 2003 Detailed Assessment are presented in greater detail in the following report:

Detailed Assessment (stage 4), Norwich City Council (2003)

The monitoring and modelling carried out at this stage of review and assessment showed that NO<sub>2</sub> 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<sub>x</sub>) from traffic on roads close to the AQMAs as the main source from which emissions could be reduced. Emissions of NO<sub>x</sub> 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.

#### 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<sub>2</sub>;

NO<sub>2</sub>; and

PM10.

2004 and 2006 Updating and Screening Assessments

These updating and screening assessment for Norwich City Council concluded that a Detailed Assessment was not required for NO<sub>2</sub>, PM10, benzene, CO, Lead, 1,3 – butadiene or SO<sub>2</sub>.

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.

The assessment concluded that on the basis of the modelled and measured results in the Grapes Hill AQMA, and also due to the fact that the NO<sub>2</sub> concentrations were predicted to fall in 2010, the Council could consider revoking this 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<sub>2</sub> results in King Street it was recommended that NCC should continue to monitor this site and review each year. Should the 2009 data exceed the objective it was recommend that this area should be declared an AQMA.

Modelling and measured results for Riverside Road suggested that the council consider implementing an improved synchronised fixed time traffic signalling system to reduce queuing effect in Riverside Road. It was recommended that NCC declare an AQMA in this area. This new area was declared in December 2009.

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, it was recommended that the Council continue to monitor the area around Boundary Road. An AQMA was not recommended for this location.

#### 2009 Updating and Screening Assessment

This updating and screening assessment concluded that a Detailed Assessment was not required for NO<sub>2</sub>, PM10, benzene, CO, Lead, 1,3 – butadiene or SO<sub>2</sub>.

#### 2010 Annual Progress Report

This report noted that NCC carried out diffusion tube monitoring for NO<sub>2</sub> at 34 locations throughout the city during 2009. The results indicated that concentrations of NO<sub>2</sub> exceeded the annual mean objective at several locations. These locations were:

King Street;  
St Stephens (Mid);  
St Augustines Street;  
Cattlemarket Street;  
Castle Meadow;

Castle Meadow 2;  
Bull Close Road; and  
Riverside Road.

Of the areas where the exceedences were found, St Augustines, Cattlemarket Street, both Castle Meadow sites and Riverside Road are within existing AQMAs. The site at St Stephens Street is not situated in a location representative of relevant exposure to the general public for the annual mean. The King Street site exceeded the objective level by  $4.2\mu\text{g}/\text{m}^3$ . The Bull Close Road location exceeded the objective level by  $0.5\mu\text{g}/\text{m}^3$ .

The Detailed Assessment carried out in King Street in 2008 stated that if the 2009 data confirmed an exceedence of the annual mean objective for  $\text{NO}_2$ , then this area should be declared as an AQMA. The Bull Close Road site had not been the subject of any previous detailed assessment. Therefore, in line with the recommendations of the 2008 DA, the report stated that NCC would declare an area of King Street as an AQMA and revoke the existing AQMA at Grapes Hill.

The Bull Close Road location exceeded the objective level by  $0.5\mu\text{g}/\text{m}^3$ . Since this was the first, very marginal, exceedence of the annual objective level for  $\text{NO}_2$  based on a single tube at this location, it was proposed to carry out a Detailed Assessment by increasing the monitoring in the area; to include the commencement of triplicate tubes at the existing site, and deployment of additional tubes at new nearby relevant locations. Should the monitoring results for the full 2010 calendar year show a continuing exceedence, then it was proposed to declare an AQMA in the area during 2011.

The report also concluded that, based upon the findings of previous assessments, the concentrations of 1,3-butadiene, benzene, carbon monoxide, lead,  $\text{PM}_{10}$  and  $\text{SO}_2$  were unlikely to be in excess of the air quality objectives at any location.

Subsequent to the production of the 2010 APR, discussion took place between the city council, county council and DEFRA. It was agreed in principle that rather than declare King Street as an additional AQMA, it would be preferable to replace the

existing four AQMAs with one larger area to encompass all of them plus King Street and Bull Close Road.

#### 2010 Further Assessment for Riverside Road

This report assessed concentrations of NO<sub>2</sub> in and around the Riverside Road AQMA for 2009 using a combination of available monitoring data and a dispersion modelling exercise. The study took account of traffic conditions in the area and the latest meteorological data available.

The study confirmed the findings of the previous detailed assessment, namely that there are exceedences of the annual mean NO<sub>2</sub> objective to the south of Riverside Road.

It was estimated that ambient NO<sub>x</sub> reductions of approximately 48% are required in the AQMA to achieve compliance with the annual mean NO<sub>2</sub> objective.

Source apportionment indicated that the primary source of emissions is derived from local moving traffic, although queuing vehicles are also particularly important near the junction. Light vehicles are thought to be the main source type although important contributions were also noted from buses and other heavy vehicles.

The report concluded that the monitoring and dispersion modelling showed that the AQMA boundary was appropriate and that Norwich City Council should proceed with air quality action planning for the area.

#### 2011 Annual Progress Report

The 2011 annual progress report confirmed the council's intention to declare an area of central Norwich as an AQMA to replace the existing areas and cover the potential areas at King Street and Bull Close Road. This new area came into force on 1st November 2012, and is shown in Figure 1.1.

#### 2012 Updating and Screening Assessment

The updating and screening assessment in 2012 identified an exceedence of the short term (hourly) mean objective for NO<sub>2</sub> on Castle Meadow. The report recommended that the council should proceed to a detailed assessment to understand the potential for a continuation of the exceedence in this area.

#### 2012 Detailed Assessment for Castle Meadow

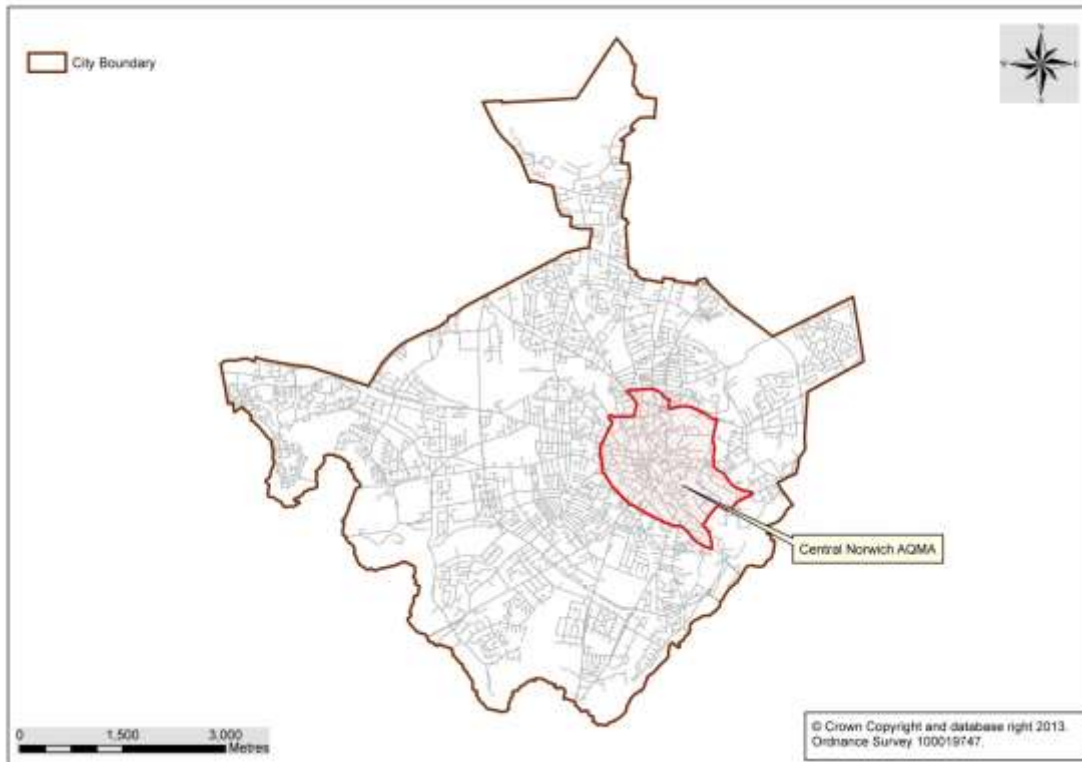
The detailed assessment concluded that there may have been a short-term set of circumstances that caused the exceedence of the hourly objective for NO<sub>2</sub>. It recommended that monitoring was to continue and reported in the 2013 annual progress report.

#### 2013 Annual Progress Report

The 2013 annual progress report confirmed that the proposed actions from the 2012 updating and screening assessment had been achieved. It proposed to continue with automatic and passive NO<sub>2</sub> monitoring within the city and to develop a revised Action Plan to work towards compliance with the air quality objectives within the Norwich Central AQMA.



Figure 1.1 Map showing Norwich Central AQMA Boundary



## **2 New Monitoring Data**

### **2.1 Summary of Monitoring Undertaken**

#### **2.1.1 Automatic Monitoring Sites**

Automatic monitoring was carried out at two locations in Norwich during 2013. The locations are shown in Figures 1.2 and 1.3. The Norwich Lakenfields site is an urban background location and is part of Defra's Automatic Urban and Rural Network (AURN). The SO<sub>2</sub> analyser was removed from the station at the start of 2013 as part of the network rationalisation. The Norwich Castle Meadow site is a mobile unit that currently monitors roadside concentrations within the City centre.

Data for 2013 is available for both the Castle Meadow site (93% NO<sub>2</sub> and PM<sub>10</sub> data capture) and the Lakenfields site (97% NO<sub>2</sub> and 80% PM<sub>10</sub> data capture).

The Norwich Lakenfields site incorporates an FDMS device on the PM<sub>10</sub> and PM<sub>2.5</sub> TEOMs to correct for loss of volatile components of particulate matter that occur due to the high sampling temperatures employed by these instruments. The Castle Meadow site does not incorporate an FDMS. Therefore, PM<sub>10</sub> data from this site has been corrected using the VCM.

Figure 1.2 Castle Meadow Automatic Monitoring Station

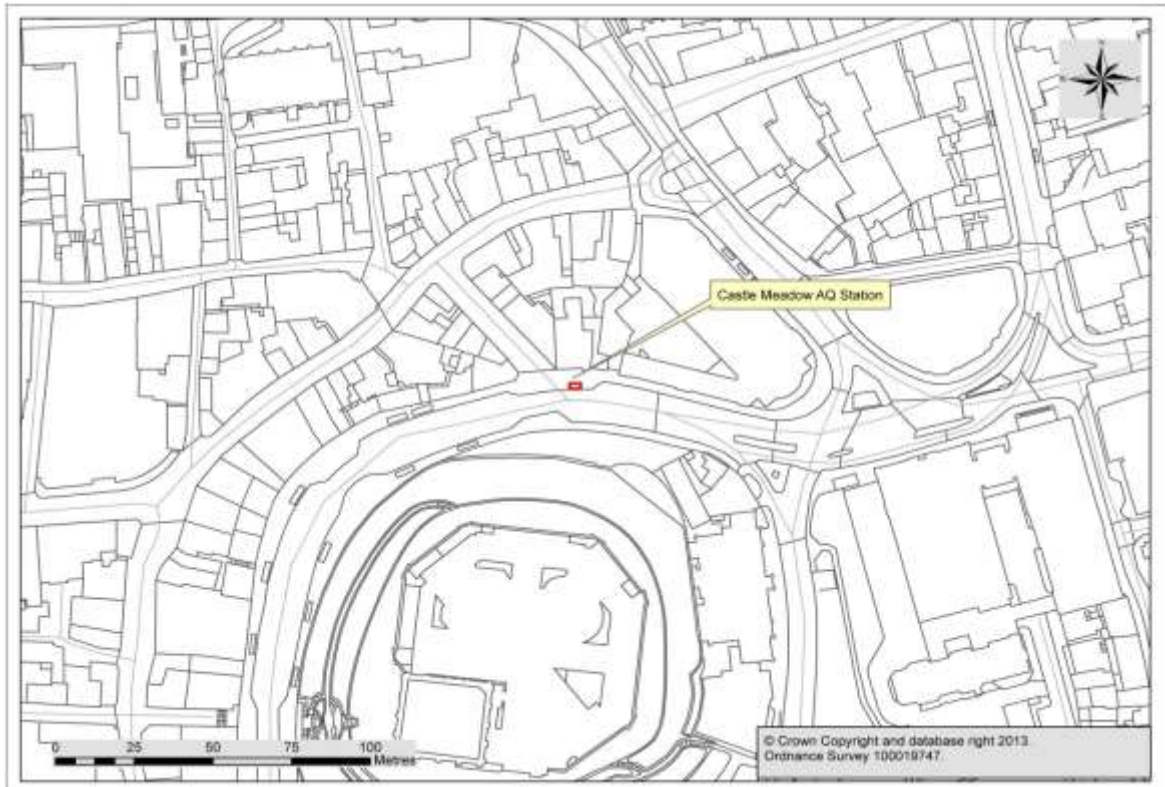
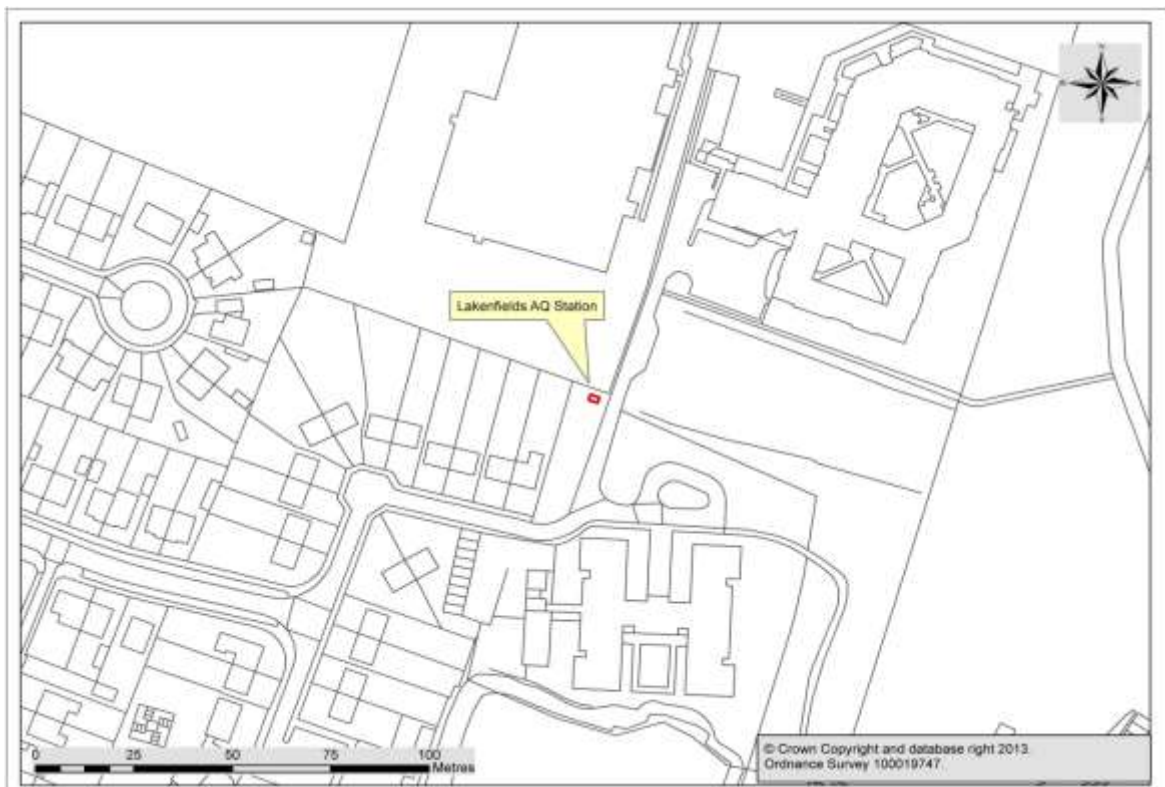


Figure 1.3 Lakenfields Automatic Monitoring Station



**Table 2.1 Details of Automatic Monitoring Sites**

Site Name & ID	Site Type	OS Grid Ref	Pollutants Monitored*	Monitoring Technique	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 exposure?
Norwich Castle Meadow (CM1)	Urban Roadside	X623202 Y308615	O <sub>3</sub> , CO, SO <sub>2</sub> , PM <sub>10</sub> , NO <sub>x</sub> , NO <sub>2</sub> , PM <sub>2.5</sub>	Ambirak TEOM	Y	N	1m	N/A
Norwich Lakenfields (CM2)	Urban Background	X623637 Y306940	O <sub>3</sub> , PM <sub>10</sub> , NO <sub>x</sub> , NO <sub>2</sub> , PM <sub>2.5</sub>	Thermo FDMS	N	Y (20m)	N/A	N

\* The O<sub>3</sub>, CO & SO<sub>2</sub>, analysers were removed from the Castle Meadow site during the reporting year

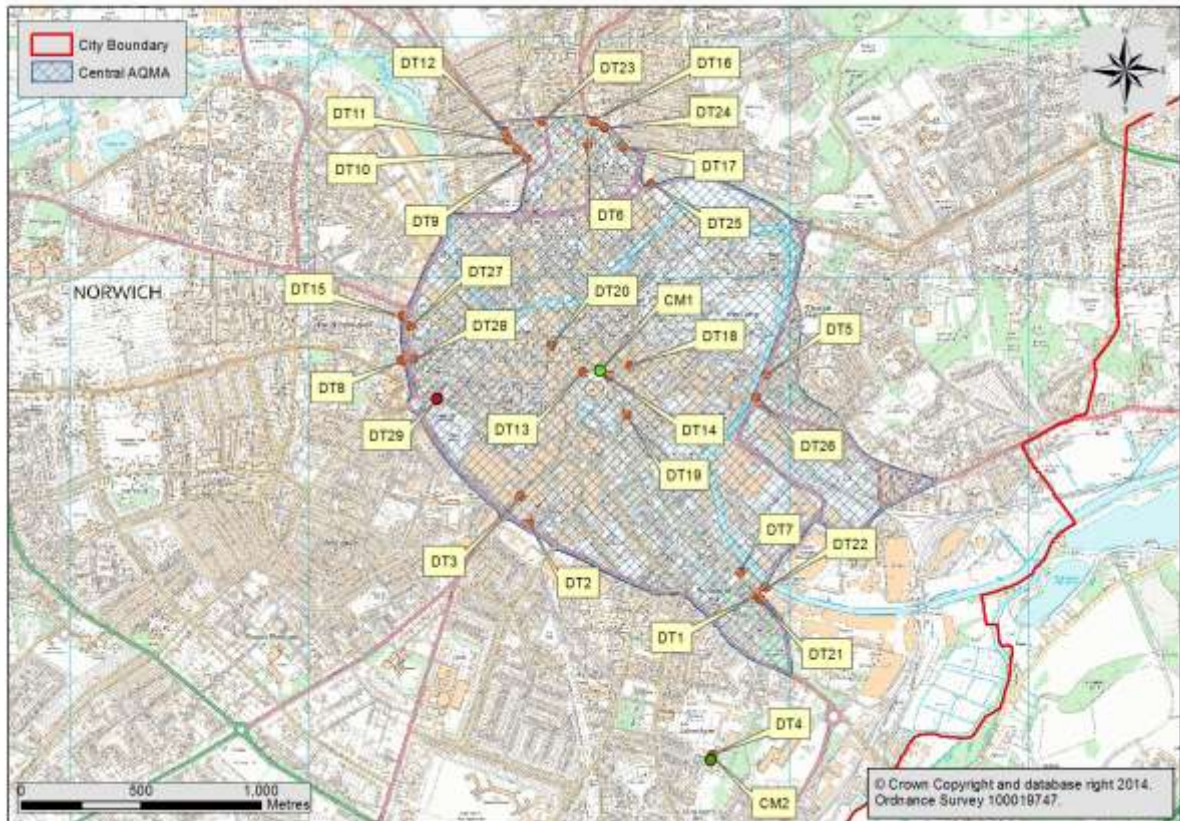
### 2.1.2 Non-Automatic Monitoring Sites

Norwich City Council carried out indicative monitoring of NO<sub>2</sub> by diffusion tubes at 26 sites throughout the city during 2013. Some rationalisation of the locations was carried out, resulting in the removal of three monitoring sites around Grapes Hill. A new monitoring position was established at 4 Chapelfield North. Triplicate tubes were located at 130 Magdalen Street, 26 Bull Close Road, 5 Riverside, 256 King Street and 4 Chapelfield North. A co-location study was also carried out using triplicate tubes at the Lakenfields AURN site.

Details of the diffusion tube monitoring locations are provided in Table 2.2, and shown in figure 1.4. The locations include kerbside, roadside and urban background sites. Non-bias corrected diffusion tube data is presented in Appendix B.

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

Figure 1.4 Map showing automatic and non-automatic monitoring locations



**Table 2.2 Details of Non- Automatic NO<sub>2</sub> Monitoring Sites**

Site ID	Site Name	Site Type	OS Grid Ref	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road	Worst-case Location?
DT1	256 King Street	R	X 623863.04 Y 307678.60	Y	Y (1m)	3.5m	Y
DT2	Queens Rd Travelodge	R	X 622917.08 Y 307974.49	Y	N	N/A	N/A
DT3	St Stephens (mid)	K	X 622879.16 Y 308089.96	Y	N	N/A	N/A
DT4	Lakenfields	UB	X 623681.24 Y 307015.82	N	Y (20m)	N/A	N
DT5	Chalk Hill Road	R	X 623906.97 Y 308596.92	Y	Y (1m)	7m	Y
DT6	130 Magdalen Street	R	X 623160.89 Y 309550.43	Y	Y (1m)	4m	Y
DT7	Reads Flour Mill	K	X 623796.25 Y 307772.13	Y	Y (1m)	1m	Y
DT8	Deleted						
DT9	13 St Augustines St	K	X 622905.81 Y 309496.11	Y	N	1m	Y
DT10	32 St Augustines St	K	X 622865.96 Y 309529.93	Y	Y (1m)	2m	Y
DT11	50 St Augustines St	K	X 622825.87 Y 309573.17	Y	Y (1m)	1m	Y
DT12	65 St Augustines St	K	X 622813.72 Y 309609.96	Y	N	1m	Y
DT13	Castle Meadow	R	X 623141.06 Y 308606.69	Y	N	N/A	N/A
DT14	Castle Meadow 2	R	X 623250.50 Y 308590.12	Y	N	N/A	N/A
DT15	Deleted						
DT16	Zipfel House	R	X 623185.69 Y 309649.68	Y	Y (1m)	3m	Y
DT17	68 Bull Close Road	R	X 623305.49 Y 309543.95	Y	Y (1m)	4m	Y
DT18	Upper King Street	K	X 623337.40 Y 308632.52	Y	N	N/A	N/A
DT19	Cattlemarket Street	R	X 623320.58 Y 308430.88	Y	Y (1m)	2m	Y
DT20	Exchange St	K	X 623007.27 Y 308716.34	Y	N	N/A	N/A
DT21	Rotary House King Street	R	X 623879.53 Y 307658.91	Y	Y (3m)	2m	Y
DT22	Carrow Bridge House	R	X 623900.96 Y 307709.56	Y	Y (1m)	5m	Y
DT23	62 Magpie Road	R	X 622970.72 Y 309652.02	Y	Y (1m)	2m	Y
DT24	26 Bull Close Road	R	X 623228.63 Y 309625.14	Y	Y (1m)	5.5m	Y
DT25	24 Bargate Court	R	X 623422.42 Y 309388.23	Y	Y (1m)	4m	Y
DT26	5 Riverside Road	R	X 623870.26 Y 308515.77	Y	Y (1m)	3m	Y
DT27	Deleted						
DT28	71 Dukes Court	R	X 622431.35 Y 308663.05	Y	Y (1m)	4m	Y
DT29	4 Chapelfield North	K	X 622532.23 Y 308490.36	Y	Y (1m)	1m	Y

## 2.2 Comparison of Monitoring Results with Air Quality Objectives

### 2.2.1 Nitrogen Dioxide (NO<sub>2</sub>)

#### Automatic Monitoring Data

The annual mean concentration at the Castle Meadow automatic monitoring site was recorded as **64** µg/m<sup>3</sup> for 2013, which exceeds the annual mean objective by 24µg/m<sup>3</sup>. This monitoring site is within the central AQMA, although it does not represent any nearby relevant exposure. There were **72** exceedences of the 1-hour mean on 39 days during 2013.

The Norwich Lakenfields urban background automatic monitoring site measured an annual mean concentration of 15 µg/m<sup>3</sup>. There were no exceedences of the 1-hour mean.

**Table 2.3 Results of Automatic Monitoring for NO<sub>2</sub>: Comparison with Annual Mean Objective**

Site ID	Location	Within AQMA?	Valid Data Capture for Monitoring Period (%)	Valid Data Capture 2013 (%)	Annual Mean Concentration (µg/m <sup>3</sup> )				
					2009	2010	2011	2012	2013
CM 2	Norwich Lakenfields	N	97	97	16	13	13	14	15
CM 1	Norwich Castle Meadow (mobile)	Y	93	93	41	53	52	53	64

**Table 2.4 Results of Automatic Monitoring for NO<sub>2</sub>: Comparison with 1-hour Mean Objective**

Site ID	Location	Within AQMA?	Valid Data Capture for Monitoring Period (%)	Valid Data Capture 2013 (%)	Number of Exceedences of hourly mean (200 µg/m <sup>3</sup> ) (99.8 <sup>th</sup> percentile of hourly means in brackets)				
					2009	2010	2011	2012	2013
CM 2	Norwich Lakenfields	N	97	97	0 (80)	0	0	0	0
CM 1	Norwich Castle Meadow (mobile)	Y	93	93	1	15	34	4	72

## Diffusion Tube Monitoring Data

Table 2.5 shows the diffusion tube results for 2013, corrected for bias using a national bias adjustment factor of 1.01 using Gradko Labs for analysis and the 50% TEA in Acetone method.

The national bias spreadsheet is shown in Appendix A and is available here: [http://laqm.defra.gov.uk/documents/Database\\_Diffusion\\_Tube\\_Bias\\_Factors-v06\\_14-Final.xls](http://laqm.defra.gov.uk/documents/Database_Diffusion_Tube_Bias_Factors-v06_14-Final.xls)

The precision and accuracy spreadsheet used to calculate the local bias correction is also shown in Appendix A.

**Table 2.5 Results of NO<sub>2</sub> Diffusion Tubes 2013**

Site ID	Site Name	Site Type	TriPLICATE or Co-located Tube?	Within AQMA?	Data Capture 2013 (%)	2013 Annual Mean Concentration (µg/m <sup>3</sup> ) Bias Adjustment factor = 1.01	
						Uncorrected	Bias-adjusted
DT1	256 King Street	R	Triplicate	Y	100	39.3	39.7
DT2	Queens Rd Travelodge	R	N	Y	100	38.4	38.8
DT3	St Stephens (mid)	K	N	Y	100	<b>54.9</b>	<b>55.4</b>
DT4	Lakenfields	UB	Triplicate & co-located	N	92	13.1	13.2
DT5	Chalk Hill Road	R	N	Y	100	32.5	32.9
DT6	130 Magdalen Street	R	Triplicate	Y	100	32.4	32.7
DT7	Reads Flour Mill	K	N	Y	83	23.3	23.5
DT8	Deleted				100		
DT9	13 St Augustines St	K	N	Y	100	<b>44.6</b>	<b>45.1</b>
DT10	32 St Augustines St	K	N	Y	92	<b>42.4</b>	<b>42.8</b>
DT11	50 St Augustines St	K	N	Y	100	<b>50.7</b>	<b>51.2</b>
DT12	65 St Augustines St	K	N	Y	100	32.8	33.2
DT13	Castle Meadow	R	N	Y	100	<b>62.8</b>	<b>63.5</b>
DT14	Castle Meadow 2	R	N	Y	92	<b>51.9</b>	<b>52.4</b>
DT15	Deleted				100		
DT16	Zipfel House	R	N	Y	100	<b>40.5</b>	<b>40.9</b>
DT17	68 Bull Close Road	R	N	Y	100	29.5	29.8
DT18	Upper King Street	K	N	Y	100	35.3	35.6
DT19	Cattlemarket Street	R	N	Y	92	<b>46.3</b>	<b>46.7</b>
DT20	Exchange St	K	N	Y	100	30.0	30.3
DT21	Rotary House King Street	R	N	Y	100	36.3	36.7
DT22	Carrow Bridge House	R	N	Y	100	26.9	27.2
DT23	62 Magpie Road	R	N	Y	100	32.8	33.1
DT24	26 Bull Close Road	R	Triplicate	Y	100	31.9	32.2
DT25	24 Bargate Court	R	N	Y	100	36.8	37.2
DT26	5 Riverside Road	R	Triplicate	Y	100	<b>51.9</b>	<b>52.4</b>
DT27	Deleted				100		
DT28	71 Dukes Court	R	N	Y	100	27.8	28.1
DT29	4 Chapelfield North	K	Triplicate	Y	100	<b>60.3</b>	<b>60.9</b>



Using the National bias correction, a total of ten sites exceeded the NO<sub>2</sub> annual mean objective of 40 µg/m<sup>3</sup> during 2013. These sites were:

- St Stephens (Mid);
- 13 St Augustines Street;
- 32 St Augustines Street;
- 50 St Augustines Street;
- Castle Meadow;
- Castle Meadow 2;
- Zipfel House;
- Cattlemarket Street;
- Riverside Road; and
- Chapelfield North

All of these sites are within the existing Norwich Central AQMA. Although the tubes at St Stephens Street, Castle Meadow and Castle Meadow 2 are not situated at locations representative of relevant exposure for the annual mean, the Castle Meadow tube indicated an annual mean of 63.5µg/m<sup>3</sup>, which could indicate a potential risk to the 1-hour objective. This location has been monitored for many years using a single diffusion tube, and is located approximately 60m along the road from our mobile automatic analyser. This is the first occasion that a potential threat to the hourly mean has been indicated by the tube, though the automatic analyser has recorded exceedences also this year.

The Chapelfield North site is a new triplicate site for 2013. It shows an indicated annual mean of 60.9µg/m<sup>3</sup>. This road is included in a major change of road layout/traffic flow in central Norwich, designed to increase cycle usage and improve bus access. At the time of writing the road is closed to traffic and is being widened to allow two-way (though restricted) traffic access.

Monitoring will continue to establish whether a continuing threat to either the annual or 1-hour objectives exists at both of these locations.

Fig 1.5 displays the bias adjusted diffusion tube monitoring results across the time series 2008 to 2013. This data is also shown in Table 2.6.

Non bias-corrected monthly diffusion tube results are shown in Appendix B.

Fig 1.5 Chart showing NO<sub>2</sub> trends 2008 to 2013

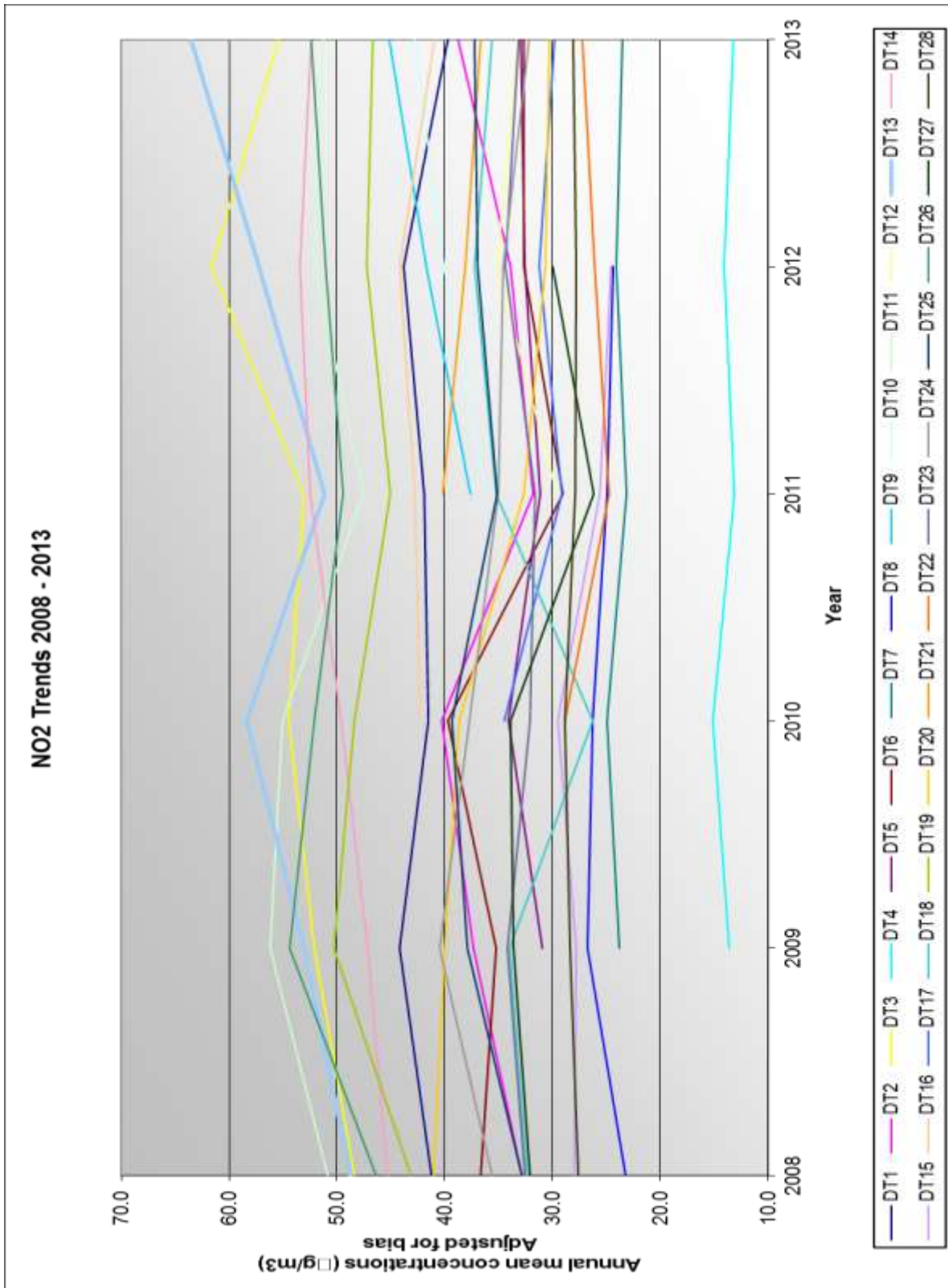


Table 2.6 Results of NO<sub>2</sub> Diffusion Tubes (2008 to 2013)

Site ID	Site Name	Within AQMA?	Annual mean concentrations (µg/m <sup>3</sup> ) Adjusted for bias					
			Bias Adjustment Factors					
			2008	2009	2010	2011	2012	2013
			<b>0.93</b>	<b>0.99</b>	<b>1.03</b>	<b>0.93</b>	<b>1.02</b>	<b>1.01</b>
DT1	256 King Street	Y	<b>41.2</b>	<b>44.2</b>	<b>41.5</b>	<b>41.9</b>	<b>43.8</b>	39.7
DT2	Queens Rd Travelodge	Y	32.8	37.3	<b>40.3</b>	31.8	33.9	38.8
DT3	St Stephens (mid)	Y	<b>48.4</b>	<b>52.1</b>	<b>54.5</b>	<b>53.0</b>	<b>61.6</b>	<b>55.4</b>
DT4	Lakenfields	N	N/A	13.6	15.1	13.1	14.1	13.2
DT5	Chalk Hill Road	Y	N/A	30.9	34.1	31.1	32.6	32.9
DT6	130 Magdalen Street	Y	36.7	35.2	39.7	29.0	32.7	32.7
DT7	Reads Flour Mill	Y	N/A	23.8	24.9	23.1	24.1	23.5
DT8	Grapes Hill (upper)	Y	23.2	26.7	26.3	24.9	24.4	
DT9	13 St Augustines St	Y	N/A	N/A	N/A	37.6	<b>41.7</b>	<b>45.1</b>
DT10	32 St Augustines St	Y	N/A	N/A	N/A	36.2	<b>40.1</b>	<b>42.8</b>
DT11	50 St Augustines St	Y	<b>50.9</b>	<b>56.2</b>	<b>55.0</b>	<b>47.5</b>	<b>52.1</b>	<b>51.2</b>
DT12	65 St Augustines St	Y	N/A	N/A	N/A	29.6	35.1	33.2
DT13	Castle Meadow	Y	<b>48.8</b>	<b>53.0</b>	<b>58.4</b>	<b>51.1</b>	<b>57.2</b>	<b>63.5</b>
DT14	Castle Meadow 2	Y	<b>45.3</b>	<b>47.1</b>	<b>49.6</b>	<b>52.5</b>	<b>53.4</b>	<b>52.4</b>
DT15	Grapes Hill (lower)	Y	28.0	27.8	29.5	25.6	24.6	
DT16	Zipfel House	Y	N/A	N/A	<b>42.3</b>	<b>42.8</b>	<b>44.2</b>	<b>40.9</b>
DT17	68 Bull Close Road	Y	N/A	N/A	34.5*	29.1	31.2	29.8
DT18	Upper King Street	Y	32.4	34.0	26.3	35.2	37.2	35.6
DT19	Cattlemarket Street	Y	<b>43.1</b>	<b>50.3</b>	<b>48.4</b>	<b>45.0</b>	<b>47.2</b>	<b>46.7</b>
DT20	Exchange St	Y	<b>41.0</b>	40.0	38.7	32.7	30.7	30.3
DT21	Rotary House King Street	Y	N/A	N/A	N/A	<b>40.2</b>	38.1	36.7
DT22	Carrow Bridge House	Y	N/A	N/A	28.8*	24.7	26.1	27.2
DT23	62 Magpie Road	Y	32.6	34.2	32.1	31.6	34.4	33.1
DT24	26 Bull Close Road	Y	35.6	<b>40.5</b>	37.7	35.0	34.6	32.2
DT25	24 Bargate Court	Y	32.8	37.9	39.3	35.1	36.9	37.2
DT26	5 Riverside Road	Y	<b>46.4</b>	<b>54.4</b>	<b>52.1</b>	<b>49.4</b>	<b>51.0</b>	<b>52.4</b>
DT27	Wellington Lane (lower)	Y	32.1	33.6	33.9	26.2	30.0	
DT28	71 Dukes Court	Y	27.6	28.4	28.8	27.9	27.8	28.1
DT29	4 Chapelfield North	Y						<b>60.9</b>

\* Not based on full year's measurements

## 2.2.2 Particulate Matter (PM<sub>10</sub>)

The annual mean concentration of PM<sub>10</sub> at the Castle Meadow automatic monitoring site was recorded as 25µg/m<sup>3</sup>, which is below the annual mean objective of 40µg/m<sup>3</sup>. There were 15 exceedences of the 24-hour mean of 50µg/m<sup>3</sup> (35 allowed), and the maximum daily mean recorded was 75µg/m<sup>3</sup> (93% data capture). Since the station does not incorporate an FDMS device, the data was corrected using the Volatile Correction Method (VCM). This is discussed further in Appendix A.

For the Norwich Lakenfields urban background automatic monitoring site, there were three exceedences of the 24-hour mean, and the maximum daily mean recorded was 68µg/m<sup>3</sup>. The annual mean concentration was 15µg/m<sup>3</sup> (80% data capture).

**Table 2.7 Results of Automatic Monitoring for PM<sub>10</sub>: Comparison with Annual Mean Objective**

Site ID	Location	Within AQMA ?	Valid Data Capture for Monitoring Period (%)	Valid Data Capture 2012 (%)	Confirm Gravimetric Equivalent (Y or N/A)	Annual mean concentrations (µg/m <sup>3</sup> )				
						2009	2010	2011	2012	2013
CM 2	Norwich Lakenfields	N	80	80	Y	17	18	19	14	15
CM 1	Norwich Castle Meadow (mobile)	Y	93	93	N/A	21	19	25	17	25

**Table 2.8 Results of Automatic Monitoring for PM<sub>10</sub>: Comparison with 24-hour Mean Objective**

Site ID	Location	Within AQMA ?	Valid Data Capture for Monitoring Period (%)	Valid Data Capture 2012 (%)	Confirm Gravimetric Equivalent (Y or N/A)	Number of Exceedences of daily mean objective (50 µg/m <sup>3</sup> ) (90 <sup>th</sup> percentile of daily means in brackets)				
						2009	2010	2011	2012	2013
CM 2	Norwich Lakenfields	N	80	80	Y	0 (26)	4	13 (37)	1	3
CM 1	Norwich Castle Meadow (mobile)	Y	93	93	N/A	2	3	17	7	15

### 2.2.2 Sulphur Dioxide (SO<sub>2</sub>)

There are no longer any automatic sites that monitor SO<sub>2</sub> in Norwich. The analysers at Lakenfields and Castle Meadow were removed either prior to or during the reporting year. This was done as part of the rationalisation of the network. Norwich has not had any exceedences of the objectives for SO<sub>2</sub>, and it was therefore decided to discontinue the monitoring. The Castle Meadow site did achieve 23% data capture for the year prior to being removed however. Therefore, the following is given for information only, as it has not been annualised etc:

There were no exceedences of the 15-minute mean during the calendar year, the maximum being 74µg/m<sup>3</sup>. There were no exceedences of the 1-hour or 24-hour means at this site either, with maximums being 59µg/m<sup>3</sup> and 31µg/m<sup>3</sup> respectively. The recorded annual mean at Norwich Castle Meadow was 17µg/m<sup>3</sup>.

### 2.2.3 Benzene

Norwich City Council no longer monitors benzene as it has been determined that ambient levels in Norwich are insignificant in terms of the Air Quality Objective.

### 2.2.4 Other Pollutants Monitored

As for sulphur dioxide, the analysers for carbon monoxide and ozone were removed from the Castle Meadow station during the year of reporting. However, the site did achieve 22 and 23% data capture respectively for the year prior to being removed. Therefore, the following is given for information only, and has not been annualised etc:

#### **Carbon Monoxide**

There were no exceedences of the air quality objective of 10mg/m<sup>3</sup> (8-hour running mean) for carbon monoxide during the period of measurement. The recorded data shows a maximum 8-hour running mean of 0.8mg/m<sup>3</sup>.

#### **Ozone**

Ozone is not included in the regulations for air quality management for local authorities due to its trans-boundary nature, and thus the limited effectiveness of action on a local scale. There is however a provisional objective level for this pollutant of 100µg/m<sup>3</sup> as a running 8-hour mean that is not to be exceeded more than 10 times per year. The recorded data for Castle Meadow shows a maximum 8-hour

running mean of  $105\mu\text{g}/\text{m}^3$  and two occasions where the 8-hour running mean was above  $100\mu\text{g}/\text{m}^3$ . There was therefore no exceedence of this provisional objective.

**PM<sub>2.5</sub>**

Monitoring data is available for PM<sub>2.5</sub> from the Norwich mobile monitoring unit at Castle Meadow for the 2013 calendar year. PM<sub>2.5</sub> is not included in the regulations for air quality management for local authorities. The recorded data shows an annual mean of  $11\mu\text{g}/\text{m}^3$  and a maximum daily mean of  $33\mu\text{g}/\text{m}^3$ . PM<sub>2.5</sub> data is also available for the Lakenfields site. The recorded data shows an annual mean of  $13\mu\text{g}/\text{m}^3$  and a maximum daily mean of  $68\mu\text{g}/\text{m}^3$ .

## 2.2.5 Summary of Compliance with AQS Objectives

Norwich City Council has examined the results from monitoring in the district.

Concentrations within the AQMA still exceed the annual mean objective for nitrogen dioxide at ten monitoring sites (seven with relevant exposure), and the AQMA should remain.

Concentrations outside of the AQMA are all below the objectives at relevant locations, therefore there is no need to proceed to a Detailed Assessment.

### 3 New Local Developments

Norwich City Council confirms that there are no new or newly identified local developments which may have an impact on air quality within the Local Authority area that have not been adequately considered in previous rounds of Review and Assessment.

Norwich City Council confirms that all of the following have been considered:

- **Road traffic sources**
- **Other transport sources**
- **Industrial sources**
- **Commercial and domestic sources**
- **New developments with fugitive or uncontrolled sources.**

#### 3.1 Road Traffic Sources

At the time of writing, works have commenced to implement new road layout and junction arrangements in the Chapelfield area of Norwich. This area is within the Central AQMA. Revised traffic flow and direction in the surrounding roads aims to improve bus access and reduce through-traffic in the city centre. This scheme will be considered in the next Updating and Screening Assessment.



## 4 Planning Applications

As reported last year, two major developments are proposed within the city that could potentially impact on air quality. These are the sites at the 'Deal Ground' and at 'Three Score'. These sites are on the fringes of the city and are not within the Central AQMA. Both applications were granted outline planning permission subject to conditions.

As part of the application process for both sites an air quality assessment report was submitted. The reports concluded that the developments were unlikely to cause any exceedence of the relevant air quality objectives or any significant change in local pollutant concentrations. As such it is not envisaged that either will give rise to the need for a Detailed Assessment.

At the time of writing neither scheme has progressed in terms of the development commencing.

## 5 Air Quality Planning Policies

### National policy

The [National Planning Policy Framework](#) in paragraph 109, 110, and 120 requires local plans to ensure that development is appropriate for its location taking account of the need to minimise risk of and prevent unacceptable harm from pollution. NPPF paragraph 122 makes clear that local planning authorities should focus on whether the **development itself** is an acceptable use of the land, and the impact of the use, rather than the control of processes or emissions which are the subject of separate legislation (which local planning authorities should assume will operate effectively).

[National Planning Practice Guidance](#) (NPPG) was published in March 2014 and supports the NPPF. In relation to air quality, it states that local plans may need to consider:

- the potential cumulative impact of a number of smaller developments on air quality as well as the effect of more substantial developments;
- the impact of point sources of air pollution (pollution that originates from one place); and,
- ways in which new development would be appropriate in locations where air quality is or likely to be a concern and not give rise to unacceptable risks from pollution. This could be through, for example, identifying measures for offsetting the impact on air quality arising from new development including supporting measures in an air quality action plan or low emissions strategy where applicable.

### The adopted and emerging Local Plan for Norwich

The local plan for Norwich sets out policies and proposals to shape and manage new development in the city. It provides policy guidance for developers, the general public and other stakeholders on what kind of development may be permitted and where. The plan's policies help to inform decisions and recommendations made by the city council's development management service on planning applications.

The adopted *City of Norwich replacement local plan (RLP)* dates from 2004. It is shortly to be superseded by a new local plan for Norwich, comprising two documents, the *Site Allocations Plan* and the *Development Management Policies Plan*. The documents have been through independent examination and are expected to be adopted in the autumn of 2014. They will supersede the RLP when adopted, but the majority of are already being used in planning decisions.

Policy DM11 of the Development Management Policies Plan supersedes the environmental protection policies in the RLP. It sets out a range of policy guidance on safeguarding development from environmental hazards, including advice in relation to air quality,

**Policy DM11 – Environmental hazards  
(extract)**

**Air and Water Quality**

In areas where an Air Quality Management Area (AQMA) has been declared (under the Environment Act, 1995), development which is likely to have an impact on air quality will be required to take particular account of the air quality action plan for that area. Where the action plan identifies poor or deteriorating air quality as an issue in localised areas within the AQMA, development will be required to incorporate measures which will mitigate against the effects of existing or potential further deterioration in local air quality through design, density, disposition of uses or travel demand management as appropriate, on a case-by-case basis.

In addition, policy DM2 sets out general considerations in relation to amenity:

**Policy DM2 – Amenity  
(extract)**

**Existing occupiers**

Development will be permitted where it would not result in an unacceptable impact on the amenity of the area or the living or working conditions or operations of neighbouring occupants. Particular regard will be given to:

- a) the prevention of overlooking and the loss of privacy;
- b) the prevention of overshadowing and loss of light and outlook; and
- c) the prevention of disturbance from noise, odour, vibration, air or artificial light pollution.

**Future occupiers**

Development will only be permitted where

- a) it provides for a high standard of amenity, satisfactory living and working conditions, adequate protection from noise and pollution and adequate levels of light and outlook for future occupiers; and

b) such a standard can be achieved and maintained without preventing or unreasonably restricting the continued operation of established authorised uses and activities on adjacent sites.

[...]

In order to comply with the NPPF the more balanced approach set out in emerging DM policies DM2 and DM11 focuses on planning issues, acknowledging the interrelationship of neighbouring uses and recognising that impacts may need to be addressed from existing, as well as proposed, sources of air pollution.

## 6 Local Transport Plans and Strategies

Norfolk's 3<sup>rd</sup> transport plan has been adopted. This describes the county's strategy and policy framework for delivery up to 2026. It will be used as a guide for transport investment and considered by other agencies when determining planning or delivery decisions.

### **Norfolk's Transport Vision:**

A transport system that allows residents and visitors a range of low carbon options to meet their transport needs and attracts and retains business investment in the county.

The plan reflects the views of local people and stakeholders, identifying six priorities for transport:

- Maintaining and managing the highway network
- Delivering sustainable growth
- Enhancing strategic connections
- Reducing emissions
- Improving road safety
- Improving accessibility

It is important that the Local Transport Plan takes adequate regard of sustainability considerations, such as its impact on biodiversity, social exclusion, carbon emissions and health of the population.

For this reason a Sustainability Appraisal, Carbon Impact Assessment and Health Impact Assessment were undertaken. These have influenced the plan and helped to ensure the end result is a more balanced strategy.

Final versions of the Strategy and Implementation plan are available on the following links:

<http://www.norfolk.gov.uk/view/NCC153941>

<http://www.norfolk.gov.uk/view/NCC153939>

## 7 Implementation of Action Plans

**Table 7.1 Action Plan Progress**

Action plan measure	Implemented	Outcome	Brief Comments	Responsibility
<b>Infrastructure</b>				
Declare area inside inner ring road an AQMA for NO <sub>2</sub> and revoke existing AQMAs	Nov-12	All existing AQMAs, plus those under review, have been amalgamated into a single AQMA. This encourages a more holistic approach to AQ when planning infrastructure changes.	Declaration of AQMA initiates requirement to generate an Action Plan.	Norwich City Council
Castle Meadow Low Emission Zone	Designed 2004/05, phased implementation 2006/07, completing in 2009	Continuous automatic monitoring showed a reduction in year on year NO <sub>2</sub> levels from 2007 to 2009. By contrast, 2010 to date shows a relatively stable, though increased, annual mean level. There have been increased hourly mean episodes during the same period also. Individual tubes on Castle Meadow show relatively stable levels.	Low Emission Zone includes application of Road Traffic Regulation Order & bus retro-fit programme. Measures still being implemented.	Norwich City Council & Norfolk County Council
Bus/Rail Interchange	2009/10	Greater use of bus/rail link up	Part of Civitas funding	Norfolk County Council
St Augustine's Road Layout Changes	2011	One-way gyratory system to reduce traffic levels in St Augustine's Street. In first 2 years of operation NO <sub>2</sub> levels reduced by approx 8µg/m <sup>3</sup> and 4µg/m <sup>3</sup> respectively	Air quality has shown improvement on St Augustine's Street following completion of the scheme. It has not yet achieved the objective, but NO <sub>2</sub> levels show a marked reduction over the preceding two years. Has also delivered regeneration and road safety benefits	Norwich City Council Planning & County transport planners

## Norwich City Council

Grapes Hill Road Layout Changes	Designed 2004/05, Implemented 2006	Layout and traffic light sequence changes resulted in reduced queuing on Grapes Hill. As a result, the 2008 detailed assessment concluded that the AQMA could be revoked.	AQMA now included in new central AQMA	Norwich City Council & Norfolk County Council
<b>Area Wide Measures, Initiatives &amp; Policy Changes</b>				
Bus Partnerships in LEZ	2009	Voluntary joint investment partnership established between First Bus, County Council and City Council during 2007 - 2010 period. This has delivered new Euro IV buses and improved fleet management.	Ongoing review of LEZ - Possible joint investment partnership to achieve minimum Euro V compliance in LEZ	Norfolk County Council
Freight Distribution Centre	2009/10	Foulgers taking project forward. Increasing no. of companies using distribution centre resulting in fewer HGV's in city.	Distribution vehicles can use bus lanes. Funded by Civitas.	Norwich City Council & Norfolk County Council
Park and Ride	2005	6 Park and Rides sites in Norwich with over 5,000 spaces - the most in the country. Circa 2.5 million passengers using Park and Ride each year Coach parking at Harford P&R	Along with promotions to use P&R, Norfolk County Council is developing a SMART ticketing system, meaning that those who travel more often pay less. NCC are also currently implementing a coach parking facility at Harford P&R. City centre parking tariffs encourage short/medium stay use which reduces peak hour movement, and consequently reduces congestion and traffic queues.	Norfolk County Council

## Norwich City Council

Norfolk Car Club - <a href="http://www.norfolkcarclub.com/">http://www.norfolkcarclub.com/</a>	implemented in 2011 but ongoing	16 car club cars in Norwich & further 12 locations designated for use within 2 years. All planning developments >200 units will be required to fund at least one new car but in time expect to achieve funding for every 100 units. Research shows every new car club car equates to 12 cars not bought. Now contracted out to "Common Wheels".	Success grows membership numbers as users can be confident car will always be available when required.	Norwich City Council & Norfolk County Council
Norfolk Liftshare <a href="https://norfolk.liftshare.com/default.asp">https://norfolk.liftshare.com/default.asp</a>		Norfolk Liftshare was set up by Norfolk County Council to help residents get around the county by sharing car journeys. The service is free and is available to all who live, work and travel in and around Norfolk. This site matches residents up with potential partners as a driver or passenger. Residents can choose to share car journeys as little or as often as they like.	Ongoing	Norfolk County Council
School Travel Plans	Ongoing process	All existing schools now have travel plans. New schools must have a travel plan implemented through their planning application. Norfolk County Council monitor these travel plans	Norfolk County Council to re-visit progress of school travel plans for schools located in new AQMA.	Norfolk County Council
Parking Permits priced according to vehicle size	2007-08	Aim is for residents to opt for smaller, more fuel efficient car.	Pricing policy still in place	Norwich City Council
Real time bus smartphone App	-	Aim is for more people to use buses due to reliable timetabling information being readily available.	Buses fitted with a transmitter send a signal to a satellite that locates the exact position of the bus. This information is then sent to a real-time system.	Norfolk County Council
Land Use Planning	Ongoing	High density developments encouraged in areas of high accessibility to encourage sustainable travel. Concept retained in emerging LDF.	Ongoing	Norwich City Council



<b>Alternative Fuels</b>				
Retro-fit	2005-2009	Bus fleet using Castle Area AQMA refitted to comply with Euro III standards or better. No further action	<a href="#">Retro-fit evaluated as part of CIVITAS SMILE project as part of wider project to introduce a Low Emission Zone</a>	Norfolk County Council
Bio-diesel	2005+	CIVITAS funded research identified up to 20% bio-diesel blends have no negative impact on engines but potentially improves NOx emissions.	<a href="#">Trials evaluated as part of CIVITAS SMILE project.</a>	
Bio-gas	2013+	Currently 7 biogas buses powered by gas sourced from food waste. Bio-gas has CO <sub>2</sub> and NOx benefits.	County encouraging introduction of more biogas fuelled buses.	Norfolk County Council
<b>Leading by Example</b>				
Vehicle Fleet	2012	Norwich City Council car fleet now includes electric as well as petrol efficient cars. County Council intend making better use of alternative fuels in its vehicle fleet.	4 Electric hook up points installed in St Giles car park for NCC electric vehicles.	Norwich City Council & Norfolk County Council
Workplace Travel Plans & Initiatives	Ongoing process	Travel to work survey undertaken annually. Cycling and pedestrian routes reviewed and improvements made including increased cycle storage facilities. Increased promotion of buses serving County Hall. Financial incentives to encourage staff to cycle to work. A Travel Plan officer, sponsored through LSTF, was employed by Norfolk County Council to work on both the Council's Travel Plan and promote Travel Planning in key businesses.	Work is ongoing to install alternative technologies to promote remote working.	Norfolk County Council

## ACTION PLAN GOING FORWARD - 2014 ONWARDS

Action plan measure	Original Timescale	Outcome to date/AQ Progress	Comments	Responsibility
<b>Infrastructure Changes</b>				
Castle Meadow Low Emission Zone	Complete 2009 but ongoing improvement	Castle Meadow LEZ fully introduced with application of Traffic Regulation Condition & bus retro-fit programme. Outcome unclear as in recent years NO <sub>2</sub> been increasing but probably would have been worse without LEZ.	Ongoing review of LEZ and the requirement to further reduce bus emissions. We will work with the bus companies and aim to achieve Euro V compliance within a time period of 3 years. Review of ticketing procedure to reduce passenger queuing. Partnership with taxi companies to be investigated with aim to include minimum emission standards.	Norwich City Council & Norfolk County Council
Establish central AQMA for NO <sub>2</sub> to incorporate existing AQMAs	2012	Implemented Nov 2012. Declaration requires Action Plan to be drafted within 18 months. Air quality is a material planning consideration for all developments inside AQMA which could have impact on NO <sub>2</sub> . Promoted AQ consideration in infrastructure changes.	Allows more holistic approach to improving AQ and reducing NO <sub>2</sub> levels in areas where exceedences of AQ objective.	Norwich City Council Environmental Protection
Chapelfield North/St Giles/Bethel St area scheme	New road layout to be implemented starting in 2014	Diffusion tubes installed on Chapelfield North to determine existing conditions prior to road changes being implemented.	Diffusion tubes expected to show improvement in NO <sub>2</sub> concentrations if new road layout reduces congestion as expected. Reduced congestion onto Chapelfield roundabout would have beneficial impact on congestion on Grapes Hill also.	Norwich City Council & Norfolk County Council
Two way on Cleveland Road and a new junction arrangement at Cleveland Road/Chapelfield North	2014-2018	Detailed scheme approved. Linked with work to deliver Norwich Area Transport Scheme Implementation Plan (NATS IP)	New junction arrangements to facilitate Chapelfield North scheme.	Norwich City Council & Norfolk County Council

## Norwich City Council

Bus only through-traffic on Theatre Street and removal of general traffic except buses, taxis and cyclists from Rampant Horse Street	2013-2019	Detailed scheme approved. Linked with work to deliver NATS IP	Part of city centre measures to reduce through traffic	Norwich City Council & Norfolk County Council
Little Bethel Street closure	2013-2020	Detailed scheme approved. Linked with work to deliver NATS IP	Part of Chapelfield North scheme and city centre measures.	Norwich City Council & Norfolk County Council
Southbound bus lane on Grapes Hill	2013-2017	Detailed scheme approved. Linked with work to deliver NATS IP	Improvements to facilitate bus rapid transit on Dereham road bus corridor.	
St Stephens Street and Surrey Street bus only	2013-2021	Detailed scheme approved. Linked with work to deliver NATS IP	Part of Chapelfield North scheme and city centre measures.	Norwich City Council & Norfolk County Council
Westlegate - removal of straight ahead traffic movement	2013-2022	Detailed scheme approved. Linked with work to deliver NATS IP	Part of city centre measures to reduce through traffic	Norwich City Council & Norfolk County Council
Extension of Postwick Park and Ride site	2013-2023	Linked with work to deliver NATS IP	Capacity Improvements	Norfolk County Council
Review of traffic light times/synchronisation to optimise traffic flow for all new road layout schemes	2014/15	Review congestion patterns before and after new road layout schemes. Yet to be implemented	Congestion should be minimised	Norfolk County Council
Construction of Northern Distributor Road (NDR)	2018+	Moving traffic out of city will help relieve congestion in the city. Yet to be implemented	Diffusion tube monitoring will show any generic decline in NO <sub>2</sub> levels once NDR complete	Norfolk County Council
Bus only on All Saints Green	2017 Long term	Waiting detailed design. Linked with work to deliver NATS IP	Closure of All Saints Green to all general traffic except buses.	Norfolk County Council

## Norwich City Council

Golden Ball Street and Farmers Avenue two-way	2017 onwards	Awaiting detailed design. Linked with work to deliver NATS IP	To reduce congestion and facilitate city centre road layout changes	Norfolk County Council
Removal of general traffic except buses, taxis and cyclists from Red Lion Street	2017 onwards	Awaiting detailed design. Linked with work to deliver NATS IP	To reduce congestion and facilitate city centre road layout changes	Norfolk County Council
Full closure of Westlegate	2017 onwards	Awaiting detailed design. Linked with work to deliver NATS IP	To reduce congestion and facilitate city centre road layout changes	Norfolk County Council
Removal of general traffic except buses, cyclists and taxis from Prince of Wales Road (except Eastern section)	Long term - post NDR	Awaiting detailed design.	Long term goal once NDR has been completed	Norfolk County Council
Bus only on Prince of Wales Road and Agricultural Plain	Long term - post NDR	Awaiting detailed design.	Long term goal once NDR has been completed	Norfolk County Council
Removal of some non-bus, taxi or cycle through traffic from Tombland	Long term - post NDR	Awaiting detailed design	To reduce congestion and facilitate city centre road layout changes	Norfolk County Council

Cycling City Roads bid for funds complete and successful	Funds secured 2013	Funding has been secured from DoT & local money for a £5.55 million transformation of the pedalway connecting the Norfolk and Norwich University Hospital in the west of the city to Heartsease and Salhouse Road in the east. This will enable the whole eight-mile route to be ridden confidently and safely by everyone.	Cycle routes extended and more joined up. Will encourage cycling as improved road safety.	Norwich City Council & Norfolk County Council
<b>Informative Measures</b>				
Signage to inform of AQMA in known congested areas. Signage to also encourage engine switch-off and display waiting time at traffic lights.	2014	Secure funding from County to implement signage.	Signage educates road users & reinforces AQMA	Norfolk County Council
<b>Area Wide Measures &amp; Procedural Changes</b>				
Relocation of diffusion tubes to more representative locations, in accordance with best practice.	Completed	More representative assessment of NO <sub>2</sub> levels with respect to exceedences of annual objective.	Typical monitoring locations for sensitive receptors to give more accurate assessment of NO <sub>2</sub> concentrations.	Norwich City Council
School Travel Plans	Implemented but requires updating	To date 88 school travel plans in place. County to request updated travel plans for schools inside new AQMA. Travel Plan to focus on using buses, cycling and walking to school to ensure travel by private car is minimised.	New schools must have a travel plan implemented through their planning application.	Norfolk County Council
Biogas	2013+	Anglian buses currently have 7 biogas buses powered by gas sourced from food waste. Biogas has both Nox, CO <sub>2</sub> and particulates benefits. Aim is to increase the number of biogas buses in operation and encourage more bus companies to follow suit.	-	Norfolk County Council

Table 7.1 partially refers to the AQMAs that existed prior to the declaration of the Central Norwich AQMA (though they are all within that area). A revised Action Plan has been produced that refers to measures to be applied to the central AQMA as a whole, rather than individual hotspots. This is in line with anticipated guidance that is expected to be produced following Defra's recent consultation on options to improve air quality management in England. It is possible there will be a further consultation also. The likely outcome from these consultations is that there will be no reporting requirements on local hotspots outside of the national assessment of EU air quality standards, but a stronger interest and reporting on local measures which help to improve air quality and bring England closer to compliance with EU air quality standards. Local authorities will focus on action planning and public health, and report on measures taken to improve air quality, and these would be included in reports to the EU on compliance.

The revised Action Plan will shortly be made available on the council's website on the following link:

<http://www.norwich.gov.uk/Environment/Pollution/Pages/AirPollutionAndAirQuality.aspx>

## 8 Conclusions and Proposed Actions

### 8.1 Conclusions from New Monitoring Data

NCC undertakes both continuous and diffusion tube nitrogen dioxide monitoring in their administrative area. Continuous monitoring carried out at Castle Meadow in 2013 showed that the NO<sub>2</sub> concentration exceeded the annual mean objective of 40 µg/m<sup>3</sup>. The monitoring also showed that the 1-hour mean objective for NO<sub>2</sub> was exceeded 72 times during the year (18 allowed). Automatic monitoring carried out at Norwich Lakenfields did not indicate any exceedence of the annual mean or the 1-hour mean objectives.

NCC also carried out diffusion tube monitoring for NO<sub>2</sub> at 26 locations throughout the city. The 2013 national bias-adjusted results indicated that concentrations of NO<sub>2</sub> exceeded the annual mean objective at ten locations. These locations were:

- St Stephens (Mid);
- 13 St Augustines Street;
- 32 St Augustines Street;
- 50 St Augustines Street;
- Castle Meadow;
- Castle Meadow 2;
- Zipfel House;
- Cattlemarket Street;
- Riverside Road; and
- Chapelfield North

All of these locations are within the Norwich Central AQMA. Last year it was reported that the tube at St Stephens Street indicated a potential threat to the 1-hour mean objective. This was the first occasion that a potential threat to the hourly mean had been indicated, and it was stated that monitoring would continue to establish whether a continuing threat existed. This year, the site recorded an annual mean of 55.4µg/m<sup>3</sup> which does not indicate a continuing threat, though it is intended to continue monitoring at this location to assess any future likelihood.

Another potential threat to the hourly objective was indicated at the Chapelfield North site. This was a new site for 2013, and it recorded a concentration of 60.9µg/m<sup>3</sup>. The road is currently closed as work is being carried out to change the access and traffic

flow through it. It is therefore intended to continue to monitor at this location to establish whether a threat exists after the road works are completed.

The automatic analyser at Castle Meadow recorded 72 exceedences of the 1-hour mean objective for NO<sub>2</sub> in 2013. This is greater than the number allowed of 18. A detailed assessment was carried out for Castle Meadow following an exceedence of the hourly objective in 2011. The detailed assessment concluded that there may have been a short-term set of circumstances that caused the exceedence. It recommended that monitoring was to continue and be reported in the 2013 annual progress report. In the following year (2012) there were only 4 exceedences. It is considered that a similar scenario existed for this reporting year, and that a further detailed assessment will not shed additional information upon the likely causes of the exceedence for 2013. Instead, it is proposed to continue monitoring with the automatic station at this location, and to consider the situation in the next USA. The location is within the Central AQMA, and proposals for the road have been included in the updated Action Plan.

Based upon the findings of previous assessments, the concentrations of 1,3-butadiene, benzene, carbon monoxide, lead, PM<sub>10</sub> and SO<sub>2</sub> are unlikely to be in excess of the air quality objectives at any location



## 8.2 Other Conclusions

The 2013 Annual Progress Report proposed the following actions:

- Continue with automatic and passive NO<sub>2</sub> monitoring within the city area
- Develop a revised Action Plan to work towards compliance with the air quality objectives within the Norwich Central AQMA. This plan should draw upon the results of the monitoring program, DA's and FA's carried out previously.
- Proceed to 2014 Annual Progress Report.

All of the above proposals have been achieved. The pollutants measured at the Castle Meadow automatic station were rationalised in early 2013, with the removal of the SO<sub>2</sub>, O<sub>3</sub> and CO analysers. Monitoring of NO<sub>2</sub> and particulates continues at this location.

## 8.3 Proposed Actions

This Progress Report concludes that Norwich City Council is currently not required to carry out a Detailed Assessment for nitrogen dioxide, carbon monoxide, benzene, 1,3-butadiene, lead, PM<sub>10</sub> or sulphur dioxide.

Concentrations within the AQMA still exceed the annual mean objective for nitrogen dioxide at ten monitoring sites (seven with relevant exposure), and the AQMA should remain. An exceedence of the short-term objective was recorded again by the automatic analyser on Castle Meadow, though none was recorded in 2012. It is therefore proposed to continue monitoring with the automatic station at this location, and to consider the situation in the next USA. An updated Action Plan will include measures relevant to Castle Meadow, and will be submitted to Defra by the end of 2014.

Proposed actions from this report are therefore as follows:

- Continue with automatic and passive NO<sub>2</sub> monitoring within the city area
- Submit a revised Action Plan by the end of 2014 to work towards compliance with the air quality objectives within the Norwich Central AQMA
- Proceed to 2015 Updating & Screening Assessment.

## 9 References

DEFRA (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Department of the Environment, Food and Rural Affairs, Cm 7169, NIA 61/06-07

DETR (2000) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Department of the Environment, Transport and the Regions, Cm 4548, SE 2000/3, NIA 7

LAQM.TG(09) *Local Air Quality Management Technical Guidance*, Part IV of the Environment Act 1995, February 2009

Local Air Quality Management, Review and assessment of Air Quality – Stages 2 & 3, Consultation Document, City of Norwich, 2001

Air Quality Review and Assessment Stage 3 Update, Norwich City Council, 2003

Air Quality Review and Assessment Annual Progress Report, City of Norwich, 2004

Air Quality Review and Assessment Annual Progress Report, City of Norwich, 2005

Air Quality Updating and Screening Assessment, Norwich City Council, 2006

Air Quality Review and Assessment Annual Progress Report, City of Norwich, 2007

Air Quality Detailed Assessment (2008), Norwich City Council, 2009

Air Quality Updating and Screening Assessment, Norwich City Council, 2009

Air Quality Review and Assessment Annual Progress Report, Norwich City Council, 2010

Air Quality Further Assessment for Riverside Road AQMA, 2010

Air Quality Review and Assessment Annual Progress Report, Norwich City Council, 2011

Air Quality Updating and Screening Assessment, Norwich City Council, 2012

Air Quality Detailed Assessment (2012), Norwich City Council, 2012

Air Quality Review and Assessment Annual Progress Report, Norwich City Council, 2013

Connecting Norfolk Implementation Plan for 2011 – 2015, Norfolk County Council,  
<http://www.norfolk.gov.uk/view/NCC153941>  
Accessed in 2014

Connecting Norfolk Transport Plan for 2026, Norfolk County Council,  
<http://www.norfolk.gov.uk/view/NCC153939>  
Accessed in 2014

Gov.UK Website, <https://www.gov.uk/government/policies/protecting-and-enhancing-our-urban-and-natural-environment-to-improve-public-health-and-wellbeing>  
Accessed in 2014

DEFRA LAQM Air Quality Information Resource, <http://uk-air.defra.gov.uk>  
Accessed in 2014

# Appendices

Appendix A: QA/QC Data

Appendix B: 2013 Monthly Uncorrected NO<sub>2</sub> Concentrations (µg/m<sup>3</sup>)

# Appendix A: QA:QC Data

## National Diffusion Tube Bias Adjustment Factors

Supplier/ Analyst: Gradko

Preparation Method: 50% TEA in Acetone

National Bias Adjustment Factor (from spreadsheet v06/14): **1.01**

## Factor from Local Co-location Studies (Local Bias Adjustment Factor)

Norwich Lakenfields urban background AURN site (based on 10 periods of data)

Bias Factor A: **1.11** (1.07 – 1.16)

Bias B: -10% (-14% - 6%)

Diffusion Tubes Mean: 13µg/m<sup>3</sup>

Automatic Mean: 15µg/m<sup>3</sup>

Data Capture for periods used: 98%

Adjusted Tubes Mean: 15 (14-15) µg/m<sup>3</sup>

A copy of the precision and accuracy spreadsheet used to calculate the local bias correction is shown below:

### Checking Precision and Accuracy of Triplicate Tubes

From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm <sup>-3</sup>	Tube 2 µgm <sup>-3</sup>	Tube 3 µgm <sup>-3</sup>	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	03/01/2013	01/02/2013	20.5	21.3	21.1	21	0.4	2	1.1	22.34	99.9	Good	Good
2	01/02/2013	28/02/2013	16.3	16.6	15.6	16	0.6	3	1.4	18.9	94.6	Good	Good
3	28/02/2013	28/03/2013	15.2	16.3	15.0	16	0.7	4	1.7	18.7	99.7	Good	Good
4	28/03/2013	26/04/2013	10.5	11.0	10.2	11	0.4	4	1.0	11.6	99.2	Good	Good
5	26/04/2013	30/05/2013	8.4	8.8	7.8	8	0.5	6	1.2	9.85	98.7	Good	Good
6	30/05/2013	26/06/2013	8.1	8.6	8.4	8	0.3	3	0.7	8.89	98.3	Good	Good
7	26/06/2013	03/08/2013	10.5	9.8	10.4	10	0.4	4	0.9	10.25	93.1	Good	Good
8	03/08/2013	02/09/2013	11.0	9.5	9.6	10	0.9	9	2.1	10.7	99.9	Good	Good
9	02/09/2013	28/09/2013	12.4	11.9	11.5	12	0.5	4	1.1	12.74	71.7	Good	or Data Capture
10	28/09/2013	04/11/2013	13.6	13.5	12.8	13	0.4	3	1.1	14.4	94.8	Good	Good
11	04/11/2013	27/11/2013	19.3	19.3	17.8	19	0.9	5	2.3	21.75	99.8	Good	Good
12	27/11/2013	09/01/2014											
13													

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Site Name/ ID:	Norwich Lakenfields
Accuracy (with 95% confidence interval)	without periods with CV larger than 20%
Bias calculated using 10 periods of data	Bias factor A 1.11 (1.07 - 1.16)
Bias B	-10% (-14% - -6%)
Diffusion Tubes Mean:	13 µgm <sup>-3</sup>
Mean CV (Precision):	4
Automatic Mean:	15 µgm <sup>-3</sup>
Data Capture for periods used:	98%
Adjusted Tubes Mean:	15 (14 - 15) µgm <sup>-3</sup>

Precision	11 out of 11 periods have a CV smaller than 20%
Accuracy (with 95% confidence interval)	WITH ALL DATA
Bias calculated using 10 periods of data	Bias factor A 1.11 (1.07 - 1.16)
Bias B	-10% (-14% - -6%)
Diffusion Tubes Mean:	13 µgm <sup>-3</sup>
Mean CV (Precision):	4
Automatic Mean:	15 µgm <sup>-3</sup>
Data Capture for periods used:	98%
Adjusted Tubes Mean:	15 (14 - 15) µgm <sup>-3</sup>

Overall survey -->

Good precision	Good Overall DC
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(Check average CV & DC from Accuracy calculations)

Jaume Targa, for AEA  
Version 04 - February 2011

If you have any enquiries about this spreadsheet please contact the LAQM Helpdesk at:

[LAQMHelpdesk@uk.bureauveritas.com](mailto:LAQMHelpdesk@uk.bureauveritas.com)

Discussion of Choice of Factor to Use

With regard to the selection of a bias adjustment factor for diffusion tubes, Technical Guidance LAQM.TG(09) and the LAQM Support website recommend the use of a local bias adjustment factor where available and relevant to diffusion tube sites. The co-location site at Lakenfields was therefore used to derive a local bias correction factor to be considered and applied if appropriate.

However, the technical guidance also states that where the survey consists of tubes exposed over a range of settings, which differ from the co-location site (eg the co-location site is in a very exposed setting and the tubes being assessed are on a building façade in a canyon-like street), then this indicates that the national adjustment factor may be more representative.

Therefore, to be as accurate as is reasonably possible using diffusion tubes, it has been decided to use a correction derived from many surveys (including that from Norwich), and apply the nationally derived bias adjustment factor of 1.01. The Spreadsheet of National Bias Adjustment Factors (v.06/14) is shown below.

National Diffusion Tube Bias Adjustment Factor Spreadsheet							Spreadsheet Version Number: 06/14			
Follow the steps below <b>in the correct order</b> to show the results of <b>relevant</b> co-location studies							This spreadsheet will be updated at the end of September 2014			
Data only apply to tubes exposed monthly and are not suitable for correcting individual short-term monitoring periods							LAQM National Database			
Whenever presenting adjusted data, you should state the adjustment factor used and the version of the spreadsheet							Spreadsheet maintained by the National Physical Laboratory. Original compiled by Air Quality Consultants Ltd.			
This spreadsheet will be updated every few months: the factors may therefore be subject to change. This should not discourage their immediate use.										
The LAQM Helpdesk is operated on behalf of Defra and the Devolved Administrations by Bureau Veritas, in conjunction with contract partners AECOM and the National Physical Laboratory.										
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 <sup>3</sup> 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 <sup>2</sup>	If you have your own co-location study then see footnote <sup>1</sup> . If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@uk.bureauveritas.com or 0800 0327953							
Analysed By <sup>1</sup>	Method <sup>2</sup>	Year <sup>2</sup>	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m <sup>3</sup> )	Automatic Monitor Mean Conc. (Cm) (µg/m <sup>3</sup> )	Bias (B)	Tube Precision <sup>3</sup>	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	50% TEA in acetone	2013	R	West Berkshire Council	12	39	42	-6.8%	G	1.07
Gradko	50% TEA in acetone	2013	R	West Berkshire Council	10	21	24	-9.5%	G	1.10
Gradko	50% TEA in acetone	2013	R	London Borough of Richmond upon Thames	11	41	40	4.4%	G	0.96
Gradko	50% TEA in acetone	2013	R	London Borough of Richmond upon Thames	9	50	43	15.8%	G	0.86
Gradko	50% TEA in acetone	2013	B	London Borough of Richmond upon Thames	11	26	25	4.7%	G	0.95
Gradko	50% TEA in Acetone	2013	SU	London Borough of Bexley	12	28	27	2.2%	G	0.98
Gradko	50% TEA in Acetone	2013	R	London Borough of Bexley	11	60	51	16.8%	G	0.86
Gradko	50% TEA in acetone	2013	R	East Hampshire District Council	12	24	24	3.7%	G	0.96
Gradko	50% TEA in acetone	2013	R	Royal Borough Windsor and Maidenhead	10	35	46	-23.4%	G	1.30
Gradko	50% TEA in acetone	2013	R	Royal Borough Windsor and Maidenhead	12	41	46	-10.3%	G	1.11
Gradko	50% TEA in acetone	2013	R	Worthing Borough Council	12	41	40	2.7%	G	0.97
Gradko	50% TEA in acetone	2013	R	London Borough of Croydon	9	48	50	-4.3%	P	1.05
Gradko	50% TEA in acetone	2013	KS	London Borough of Croydon	10	69	71	-2.5%	G	1.03
Gradko	50% TEA in acetone	2013	UB	Norwich City Council	11	13	15	-9.9%	G	1.11
Gradko	50% TEA in acetone	2013	KS	Marylebone Road Intercomparison	11	90	81	10.6%	G	0.90
Gradko	50% TEA in acetone	2013	R	Wolverhampton CC	10	43	41	6.3%	G	0.94
Gradko	50% TEA in acetone	2013	R	Wolverhampton CC	12	35	32	8.6%	G	0.92
Gradko	50% TEA in acetone	2013	UB	Reading Borough Council	12	23	27	-12.3%	G	1.14
Gradko	50% TEA in acetone	2013	R	Reading Borough Council	12	41	44	-6.5%	G	1.07
Gradko	50% TEA in acetone	2013		<b>Overall Factor<sup>3</sup> (19 studies)</b>				<b>Use</b>		<b>1.01</b>

## 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 these instruments. 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<sub>10</sub> from the TEOM; this value is then added back onto the TEOM measurements.

The VCM model was applied to the Castle Meadow TEOM data to calculate the Indicative Gravimetric Equivalent PM<sub>10</sub> for the annual mean and 24-hour mean readings.

The Norwich Lakenfields site incorporates an FDMS device on the PM<sub>10</sub> and PM<sub>2.5</sub> TEOMs.

## QA/QC of Automatic Monitoring

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

- 2-weekly calibrations of the analysers;
- Annual audits;
- 6-monthly servicing of the monitoring site; and
- Data ratification.

Calibration of the analysers was 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 gaseous and TEOM analysers and any faults were identified, thus minimising data loss.

Audits of the monitoring site were carried out by AEA Technology and consisted of a number of performance checks to identify any faults with the equipment. The calibration cylinders were 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, thereby ensuring that the data sets are of a high quality. The data was ratified by Air Quality Data Management.

### **QA/QC of Diffusion Tube Monitoring**

The diffusion tubes are supplied and analysed by Gradko International utilising a 50% Triethanolamine (TEA) in Acetone preparation method. Gradko participate in the Workplace Analysis Scheme for Proficiency (WASP) for NO<sub>2</sub> diffusion tube analysis (scoring 100% in each of the last 23 rounds of testing), and also the Annual Field Inter-Comparison Exercise. The lab follows the procedures set out by the Harmonisation Practical Guidance.

More information and results of the WASP testing is available on the following link:

<http://laqm.defra.gov.uk/diffusion-tubes/qa-qc-framework.html>

## Appendix B: 2013 Monthly Uncorrected NO<sub>2</sub> Concentrations (µg/m<sup>3</sup>)

	2013 Monthly Uncorrected NO <sub>2</sub> Concentrations (µg/m <sup>3</sup> )												Annual Average	2013 Bias Corrected 1.01
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
256 King Street (x3)	46.8	37.5	40.4	34.3	29.5	29.3	39.8	35.9	37.9	41.9	44.6	53.7	39.3	39.7
Queens Rd Travelodge	42.2	40.7	46.3	36.1	35.5	34.1	39.3	35.0	41.4	28.7	49.4	31.7	38.4	38.8
St Stephens (mid)	54.6	52.2	59.1	56.4	42.6	44.2	64.0	50.1	49.7	66.7	54.0	64.9	54.9	55.4
130 Magdalen Street (x3)	35.8	32.7	29.2	28.8	27.8	24.9	27.7	30.5	34.9	31.1	45.6	39.8	32.4	32.7
Exchange St	37.4	35.2	38.0	26.6	20.9	20.5	28.4	23.8	25.8	29.0	39.4	35.5	30.0	30.3
50 St Augustines	55.0	48.0	43.2	40.0	45.3	41.8	52.4	54.7	52.9	57.5	59.0	59.0	50.7	51.2
32 St Augustines	41.4	38.6	40.4	32.7	31.2	28.6	43.5	41.3		71.3	49.1	48.3	42.4	42.8
13 St Augustines	44.1	43.6	49.4	43.2	43.8	37.1	50.1	41.9	44.3	42.4	56.0	39.6	44.6	45.1
65 St Augustines	40.4	32.4	28.5	29.3	25.1	23.0	30.7	31.0	33.0	36.9	39.4	44.6	32.8	33.2
Upper King Street	41.6	41.2	30.8	32.5	26.1	26.9	32.8	36.3	38.8	34.8	43.1	38.7	35.3	35.6
Cattlemarket Street	49.2	45.5	44.1	47.9	34.8		52.5	40.0	47.4	45.4	46.6	55.7	46.3	46.7
Castle Meadow	58.6	53.0	70.8	53.4	54.0	56.0	76.8	69.4	62.8	69.7	68.0	61.3	62.8	63.5
Castle Meadow 2	57.2	52.6	44.9	51.0	45.5	40.9	55.5	49.8	56.5	62.5	54.6		51.9	52.4
Lakenfields (x3)	21.0	16.2	15.5	10.6	8.4	8.5	10.2	10.1	11.9	13.3	18.8		13.1	13.2
62 Magpie Road	35.7	32.1	32.8	33.1	28.7	22.3	29.2	26.8	29.1	40.3	36.4	47.2	32.8	33.1
26 Bull Close Road (x3)	40.2	33.1	27.6	27.5	27.9	22.8	28.1	31.3	30.2	34.7	40.7	38.1	31.9	32.2
24 Bargate Court	39.1	34.2	34.2	30.3	33.1	33.8	37.8	37.5	38.9	35.8	47.6	39.3	36.8	37.2
5 Riverside Road (x3)	59.1	48.8	52.5	47.6	40.0	39.4	58.3	46.7	51.0	62.8	50.8	65.5	51.9	52.4
4 Chapelfield North (x3)	48.5	55.7	64.1	52.4	53.5	55.2	73.5	64.4	62.4	60.0	78.9	54.8	60.3	60.9
71 Dukes Court	31.2	28.3	31.4	25.5	19.9	17.4	23.8	23.0	25.7	32.3	37.5	37.3	27.8	28.1
Chalk Hill Road	39.5	31.8	30.1	31.0	25.8	24.9	31.1	29.5	32.0	35.4	39.2	40.0	32.5	32.9
Reads Flour Mill	32.8	30.0	26.3	21.2	17.1	15.5	21.2	18.3		22.6	28.2		23.3	23.5
Carrow Bridge House	34.9	29.0	32.9	26.7	24.7	18.2	22.8	22.8	25.7	24.3	30.3	30.8	26.9	27.2
Zipfel House	47.5	36.6	37.3	34.7	34.0	29.8	35.8	34.3	41.7	44.2	53.2	56.5	40.5	40.9
68 Bull Close Road	36.1	30.3	27.0	26.5	24.1	20.0	26.9	25.6	31.2	31.6	38.4	36.6	29.5	29.8
Rotary House King Street	39.7	37.2	32.5	37.6	31.1	28.4	36.6	35.4	33.2	38.2	36.4	49.8	36.3	36.7



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