Glasgow City Council Local Air Quality Management Progress Report 2008

Contents

Executive Summary

Local authorities are required to regularly review and assess air quality within their area. These reviews and assessments are the basis of local air quality management and are intended to compare current and future concentrations of key air pollutants with the objectives detailed in Regulations as part of the National Air Quality Strategy. In those years where an authority is not conducting either an Updating and Screening Assessment or a Detailed Assessment, they are required to produce a Progress Report to ensure continuity in the Review and Assessment process.

Glasgow City Council has declared three Air Quality Management Areas within the city and results of additional monitoring within this Progress Report show that NO_2 concentrations within the areas are likely to continue to exceed the National Air Quality Strategy Objectives. Monitoring and projection methodology has also shown that the 2010 objective for PM_{10} is likely to be exceeded at various locations.

Monitoring results for all other National Air Quality Strategy pollutants show that in Glasgow, levels of these pollutants are well below the Strategy objectives.

A number of new residential, commercial and industrial developments including roads have started or been proposed within the city. Some have been identified as having the potential for adverse effects on air quality. Further monitoring around developments such as the M74 extension will help quantify benefits or adverse effects.

1.0 Introduction

Progress Reports have been introduced into the Review and Assessment process to ensure continuity in the Local Air Quality Management (LAQM) process. The Environment Act 1995 and subsequent regulations requires that local authorities review the air quality within their boundaries. Progress Reports allow air quality monitoring data and local developments which may impact on air quality to be assessed on a regular basis and provide an early indication of whether measures are required to improve air quality.

Progress Reports are only required in years when the authority is not carrying out an Updating and Screening Assessment (USA) or a Detailed Assessment (DA) of Air Quality. In 2006 Glasgow conducted an USA, followed in 2007 by a DA for NO2.

1.1 Aim of this Progress Report

The aim of this progress report is to provide a review and update on air quality issues within the Glasgow City Council area since the previous review and assessment report. Updated information is used to identify those areas where there is a potential for exceedence of the National Air Quality Strategy objectives. The Progress Report will also monitor any progress in achieving, or maintaining, concentrations below the air quality objectives.

The Progress Report will provide a summary of all available monitoring data for the purpose of comparison with the relevant air quality objectives, detailing results of new monitoring sites and highlighting any evidence of trends over recent years. Data has also been collated for any local development changes that may affect air quality e.g. industry, traffic management schemes, developments granted (or applying for) planning permission and will provide

an update for any existing developments where further information has become available.

This report is the 2008 Progress Report of air quality within Glasgow City Council and follows the guidance set out in the LAQM.TG(03) technical guidance and LAQM.PRG(03) progress report guidance.

2.0 The Air Quality Objectives

There are seven pollutants of concern that have to be assessed as part of the National Air Quality Strategy. The current air quality objectives are shown in Figure 2.1 below.

The air quality objectives are only applicable where members of the public are likely to be regularly present and are likely to be exposed over the averaging time of the objective. For annual mean and 24-hour objectives, relevant exposure is limited to residential properties, schools and hospitals. The 1-hour objective applies at these locations as well as at any outdoor location where a member of the public may reasonably be expected to stay for 1-hour or more. In terms of public exposure, LAQM.TG(03) states that: *"Authorities should not consider exceedences of the objectives at any location where relevant public exposure would not be realistic"*.

Pollutant	Objective		Date to be achieved by
	Concentration	Measured as:	
Benzene	3.25 μg m^{-3}	Running annual mean	31.12.2010
1,3-butadiene	2.25 μg m^{-3}	Running annual mean	31.12.2003
Carbon monoxide	10 mg m^{-3}	Running 8 h mean	31.12.2003
Lead	0.5 μg m^{-3} 0.25 μg m^{-3}	Annual mean Annual mean	31.12.2004 31.12.2008
Nitrogen dioxide (NO_2)	200 μg m^{-3} not to be exceeded more than 18 times per year 40 μg m^{-3}	1 h mean Annual mean	31.12.2005 31.12.2005
Particles (PM_{10})	50 μg m^{-3}not to be exceeded more than 35 times per year 40 μg m^{-3} 50 μg m^{-3}not to be exceeded more than 7 times per year 18 μg m^{-3}	24 h mean Annual mean 24 h mean Annual mean	31.12.2004 31.12.2004 31.12.2010 31.12.2010
Particles ($PM_{2.5}$)	12 μg m^{-3} 15% Cut (target)	Annual mean (Urban background exposure reduction)	2020 Between 2010 and 2020
Sulphur dioxide	350 μg m^{-3}not to be exceeded more than 24 times a year 125 μg m^{-3}not to be exceeded more than 3 times a year 266 μg m^{-3}not to be exceeded more than 35 times a year	1 h mean 24 h mean 15 min mean	31.12.2004 31.12.2004 31.12.2005

Fig 2.1 The National Air Quality Strategy Objectives for Scotland

3.0 Air Pollution – Sources and Health Effects

Air quality legislation introduced following the smogs of the 1950s has brought about major improvements in air quality in the UK. More recently, restrictions on emissions from industry, road transport and domestic sources have further improved air quality. Despite this trend of general improvement it is currently estimated that air pollution reduces the life expectancy of every person in the UK by an average of 7-8 months with estimated equivalent health costs of up to £20 billion each year*.

There is therefore, still much to be done. The European Environment Agency describes air pollution as "the environmental factor with the greatest impact on health in Europe...responsible for the largest burden of environment-related disease"**.

In Glasgow city centre the pollutants identified to be of concern are NO_2 (nitrogen dioxide gas formed during the combustion process) and PM_{10} (very small air borne particulate matter less than 10μm in diameter). At both Parkhead Cross and the Byres Road and Dumbarton Road area, NO_2 is the only pollutant of concern at present although a further assessment of PM_{10} is to be carried out.

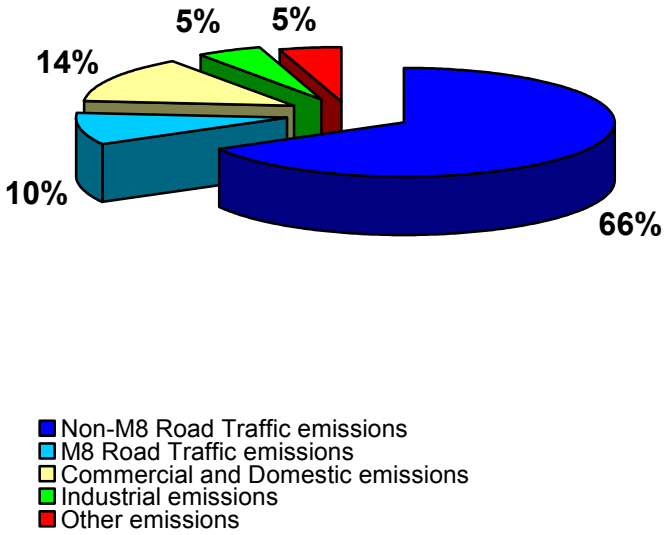
* Written Ministerial Statement by Jonathon Shaw on the Air Quality Strategy – 17 July 2007

** EEA Report No 10/2005

3.1 NO_2 and Oxides of Nitrogen

Nitrogen Oxides are produced by the burning of fossil fuels and biomass (e.g. forests or agriculture) and in some industrial processes. Oxides of nitrogen (NO_x) is a collective term for the two main nitrogenous gases that cause air pollution problems, nitric oxide (NO), and nitrogen dioxide (NO_2). NO reacts with oxygen or ozone in the air to produce nitrogen dioxide. Oxides of nitrogen occur both naturally as well as being produced by human activities. The largest source of NO_x in the UK is road traffic, although power generation also produces a significant amount. In Glasgow, like many other urban areas, motor vehicles are the dominant pollutant source, responsible for 76% of NO_x

Fig 3.1 Estimated contributions from sources to total NO_x emissions in Glasgow
(source : National Atmospheric Emissions Inventory)



Although NO is the primary pollutant the impact on human health is caused by the NO_2 formed when NO is oxidised. High levels of NO_2 can have impacts on sensitive people including children, the elderly and those who suffer from respiratory conditions like asthma and bronchitis.

3.2 PM_{10}

Particulate matter comes from a wide range of sources, some of which are naturally occurring (such as sea salt, dust, pollen, forest fires and even the Sahara desert). There are several sources of particulates emitted by human activity directly as primary particulates or through secondary particulates formed by reactions involving other pollutants. The main sources are combustion processes including industrial processes, vehicle exhausts and waste incineration, as well as quarrying processes and construction activities.

While UK emissions of PM_{10} declined by 48% between 1990 and 2004 urban development and increased traffic congestion has meant that some city locations are experiencing an increase in levels of PM_{10}. In Glasgow 73% of PM_{10} emissions are attributed to road traffic, mostly from diesel engines but also from tyre wear and brake dust.

High levels of PM_{10} pollution are associated with cardiovascular illness and mortality as well as other ill-health effects, and bring about an increase in hospital admissions for those with pre-existing lung or heart disease.

3.3 Carbon Monoxide (CO)

Carbon monoxide (CO) is a toxic gas that is produced by the incomplete combustion of solid, liquid and gaseous fuels. Emissions are dominated by road transport activities, especially prevalent when vehicles are idling or traffic is slow moving. Therefore, concentrations are found to be highest close to busy roads, particularly during rush hour periods.

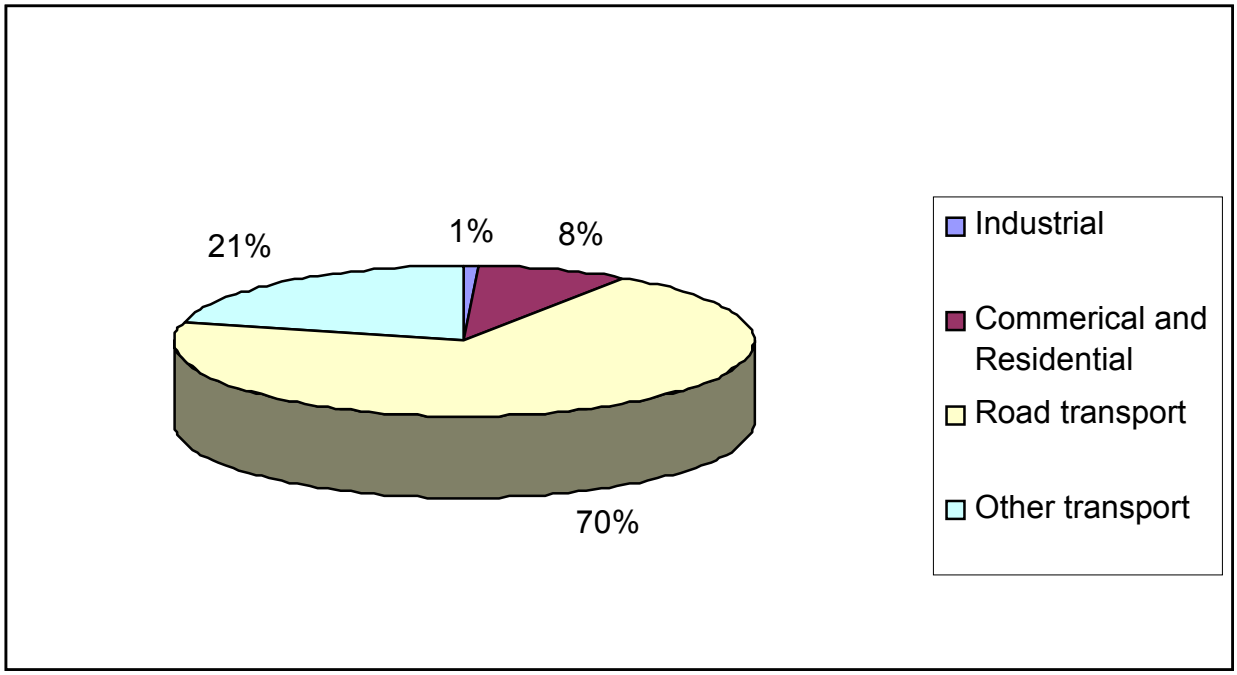


Fig 3.2 Estimated contributions from sources to total CO emissions in Glasgow

CO is one of the eight NAQS pollutants because of the potentially detrimental effects that it can have on human health. At worst case ambient levels e.g. in congested streets, car parks or tunnels exposure may reduce the oxygen carrying capacity of the blood and impair oxygen delivery to the brain and other organs, particularly affecting those suffering from cardiovascular disease. Since traffic is by far the most significant source of CO, it's special distribution will tend to follow that of traffic. This will generally result in the highest levels being found in the city centre, where the most congested areas tend to be found. Periods of cold, still atmospheric conditions during winter can further elevate levels by restricting the dispersion of this pollutant.

Large reductions in CO levels have been seen over the last few decades. Most of this improvement can be attributed to improvements in engine design and the widespread use of catalytic converters in motor vehicles.

3.4 Sulphur Dioxide (SO2)

Sulphur dioxide (SO_2) is a colourless gas, about 2.5 times as heavy as air. It naturally occurs in volcanic gases but is also produced from various metallurgical and chemical processes. Other sources of SO_2 emissions are due to the oxidation of sulphur impurities in fuels during combustion processes. Power stations are generally the main source of SO_2 in the UK but smaller sources may combine to produce hot spots. However, the NAEI for Glasgow contrasts this in that domestic and commercial combustion accounts for almost two thirds of total SO_2 emissions, with road transport the next most important source.

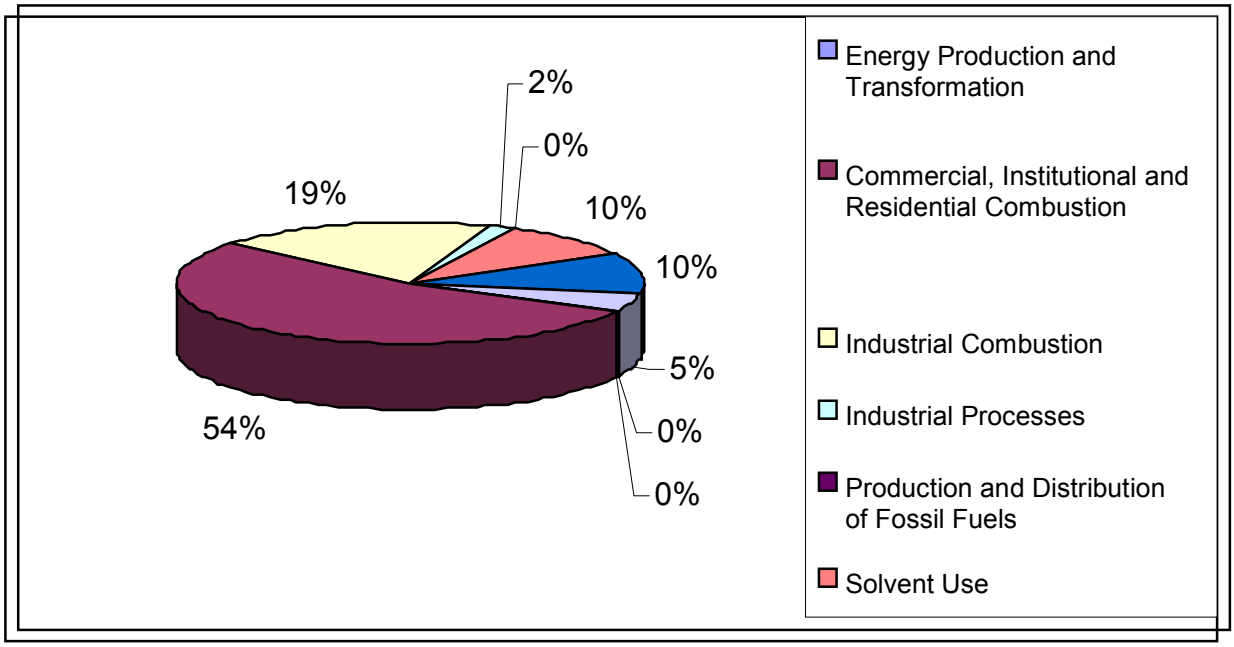


Fig 3.3 Estimated contributions from sources to total SO_2 emissions in Glasgow

Residential and commercial combustion sources that are likely to be significant will include small (>5MW) combustion plants and boilers from places including schools, hospitals and universities. These could lead to exceedence of the 15-minute objective in the immediate area. While road transport accounts for a large amount of total SO_2 emissions in Glasgow, it is not considered likely that it will result in exceedences of any air quality standards.

The greatest impact to human health from SO_2 comes from short-term exposure to large doses of this gas. There are three air quality objectives for SO_2; the 24 hour objective, 1 hour objective and 15-minute objective, details of these objectives are presented in Table 1.2. In the UK as a whole there has been a steady and substantial decline in the concentrations of both sulphur dioxide and associated black smoke since 1962. This decrease was initially achieved through controls on burning coal, introducing cleaner solid fuels and taller power station stacks. In recent years further decreases have been achieved through generating more electricity from gas and nuclear power, using low sulphur fuels and fitting flue gas desulphurisation equipment to certain power stations. SO_2 emissions contribute to various types of air pollution; acidification and eutrophication, secondary particulate formation, and both toxic and transboundary air pollution.

3.5 Benzene

Benzene is a Volatile Organic Compound (VOC) and is used as an additive in vehicle fuel. The main sources of benzene in the UK are petrol engine vehicles, petrol refining and the emissions from petrol station forecourts without vapour recovery systems. Benzene is also formed during the combustion process from aromatics in petrol and also from stack and fugitive emissions. Diesel fuel is a relatively small source. The amount of benzene in petrol is below 1%.

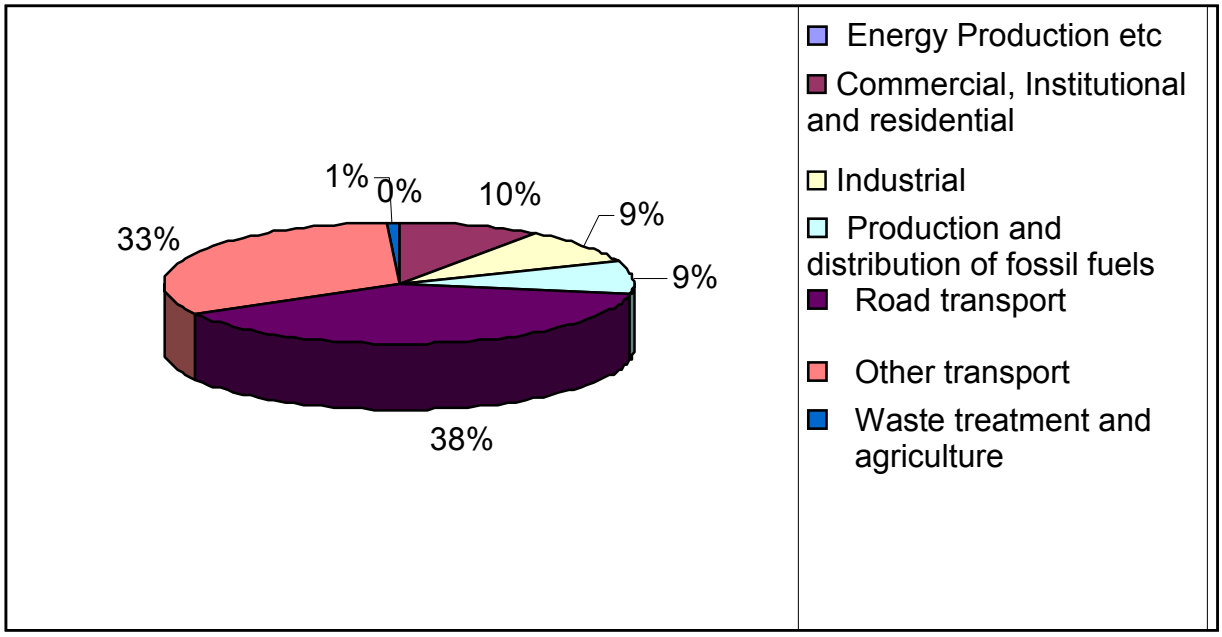


Fig 3.4 Estimated contributions from sources to total benzene emissions in Glasgow

Benzene is known to be carcinogenic and in light of health advice from the Expert Panel on Air Quality Standards (EPAQS) and the Department of Health, it is the aim to reduce concentrations of benzene in air to as low a level as possible.

3.6 1,3-butadiene

1,3-butadiene is a gas at normal temperatures and pressures and trace amounts are present in the atmosphere, derived mainly from the combustion of petrol and other materials. It is also an important chemical in certain industrial processes, mainly the manufacture of synthetic rubber for tyres, and is used in bulk in these procedures. However, there are no industrial sources like this in or around Glasgow; therefore motor vehicles are the dominant source of 1,3-butadiene.

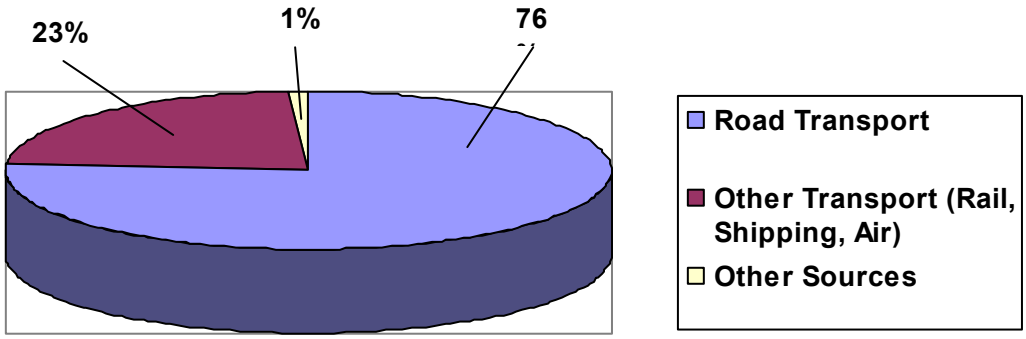


Fig 3.5 Estimated contributions from sources to total 1,3-butadiene emissions in Glasgow

Reductions in the 1,3-butadiene content of petrol and the increasing use of catalytic converters has resulted in greatly reduced concentrations of 1,3-butadiene.

Like benzene, 1,3-butadiene is a genotoxic carcinogen, and so no absolutely safe level can be defined.

3.7 Lead (Pb)

Lead is a naturally occurring element and is released by a variety of biogeochemical processes. However, anthropogenic activities represent the major sources of atmospheric lead; including processes such as ore mining and smelting, the manufacture, utilisation and disposal of lead-containing products and the combustion of fossil fuels. In recent decades road traffic emissions were the major source of atmospheric lead but since the sale of leaded petrol was banned in January 2000 emissions are now largely restricted to the industrial sector. It is thought that emissions have also declined due to the reduction in domestic coal burning. Therefore, lead has become a local rather than national problem.

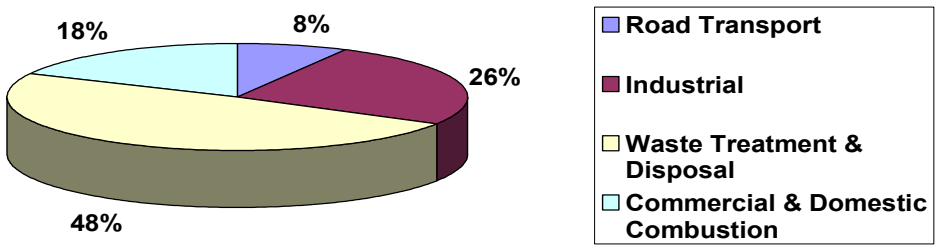


Fig 3.6 Estimated contributions from sources to total lead emissions in Glasgow

Lead is a heavy metal and exposure to which can have potentially serious effects on human health. Lead may enter the body via ingestion or through inhalation of lead-containing particles; after which it accumulates in various body tissues, such as bone, muscle and blood. The toxic effects of lead on humans vary depending on the extent of exposure; effects can include anaemia, osteoporosis and damage to the kidneys, liver and central nervous system.

The Air Quality objective was set at 0.5 µg m^{-3} to be met by 31 Dec 2004 but has since been tightened to 0.25 µg m^{-3}; as an annual mean, which has to be met by 31st December 2008.

4.0 Air Quality Management Areas in Glasgow

Following review and assessment of air pollution levels across the city, Glasgow City Council declared three new Air Quality Management Areas on 1st July 2007. The declared areas are as follows:

4.1 Parkhead Cross

Parkhead Cross is formed by the convergence of five roads in Glasgow's east end. The roads are Westmuir Street, Tollcross road, Springfield Road, Duke Street and Gallowgate. The area is a mixture of commercial and residential properties within mostly tenement properties.

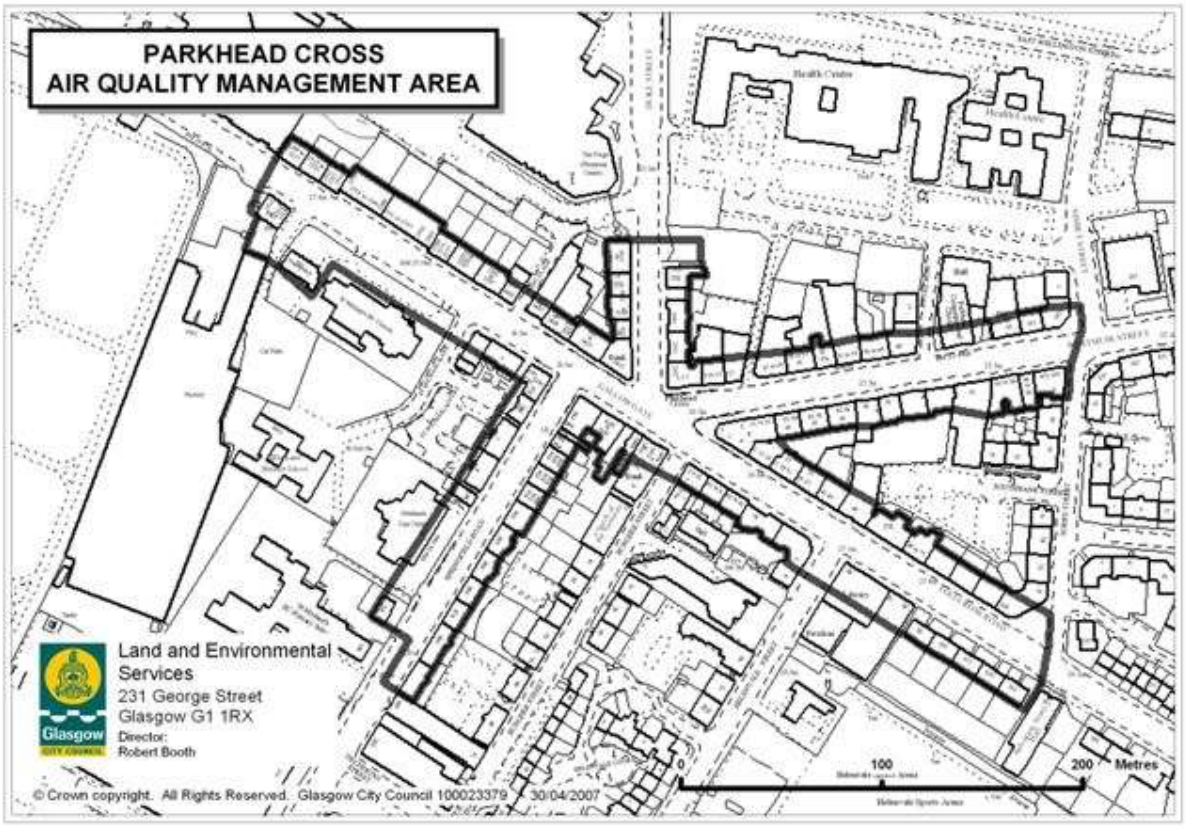


Fig 4.1 Parkhead Cross Air Quality Management Area

The detailed street listing for this AQMA can be found in the 1st July 2007 order.

4.2 Byres Road and Dumbarton Road

Byres Road and Dumbarton Road are at the heart of Glasgow's west end and comprise a mixture of residential and commercial properties within mostly tenement type properties. The Area covers from the junction of Byres Road and Great Western Road south to Dumbarton Road and west along Dumbarton Road as far as Thornwood Drive roundabout.

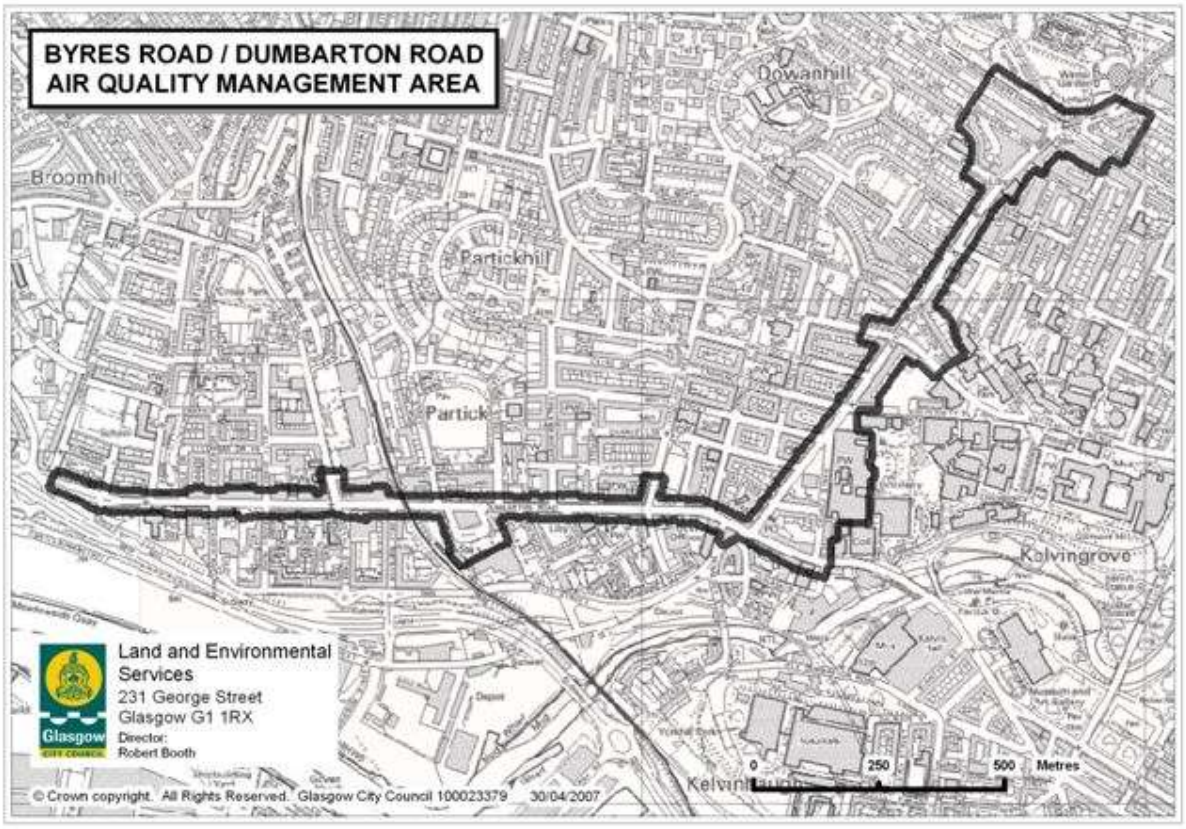


Fig 4.2 Byres Road and Dumbarton Road Air Quality Management Area

The detailed street listing for this AQMA can be found in the 1st July 2007 order.

4.3 City Centre Air Quality Management Area

The city centre area has been extensively developed with a large number of multi-storey properties for both commercial and residential use.

The city centre AQMA is loosely bound by the M8 motorway to the west and north (with slight protrusions at North Street and Royston Road), by High Street and Saltmarket to the east and by the river Clyde to the south.

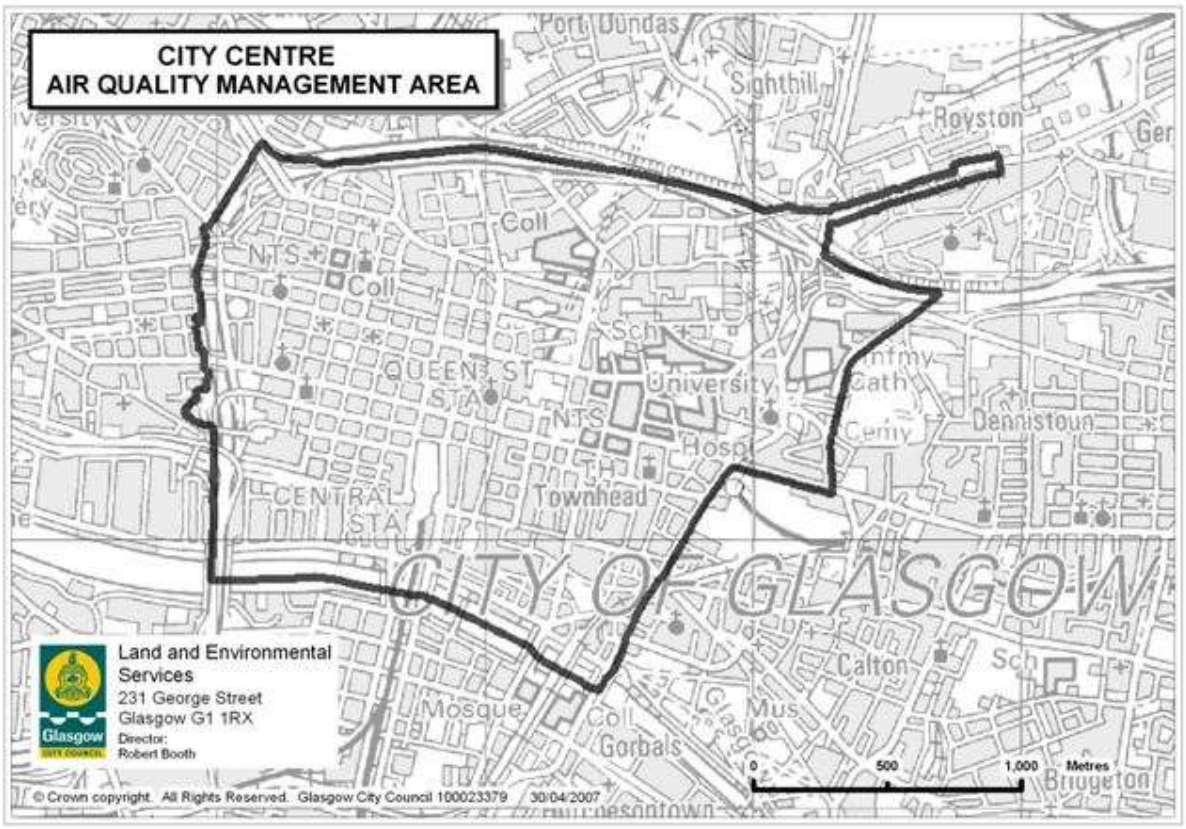


Fig 4.3 City Centre Air Quality Management Area

The detailed street listing for this AQMA can be found in the 1st July 2007 order.

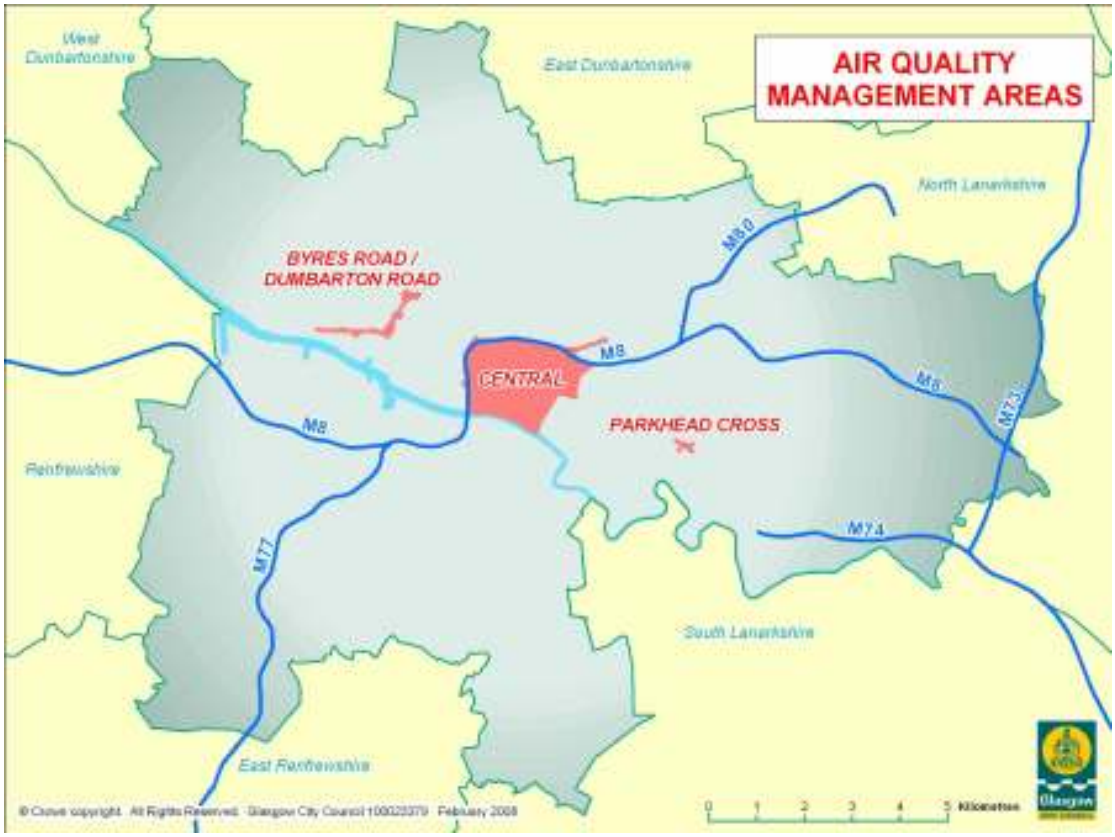


Fig 4.4 The City of Glasgow's Current Boundaries including AQMAs

5.0 Summary of Monitoring Undertaken

Monitoring Methodology

Glasgow City Council operates an extensive monitoring network across the city to measure ambient levels of air pollutants.

Automated monitoring equipment is located at eleven sites with three of the units (Hope Street, St Enoch Square and the City Chambers) forming part of the Department for Environment, Food and Rural Affairs (DEFRA) Automated Urban and Rural Network (AURN).

Equipment located at the sites measure a variety of air pollutants including NO_2, carbon monoxide, sulphur dioxide and PM_{10}. Hydrocarbons including benzene and 1,3-butadiene are monitored at the Glasgow Kerbside site. All of the automatic air quality data we gather is independently ratified by AEA Technology and made available for viewing by the public at the Scottish Government funded air quality website at: http://www.scottishairquality.co.uk

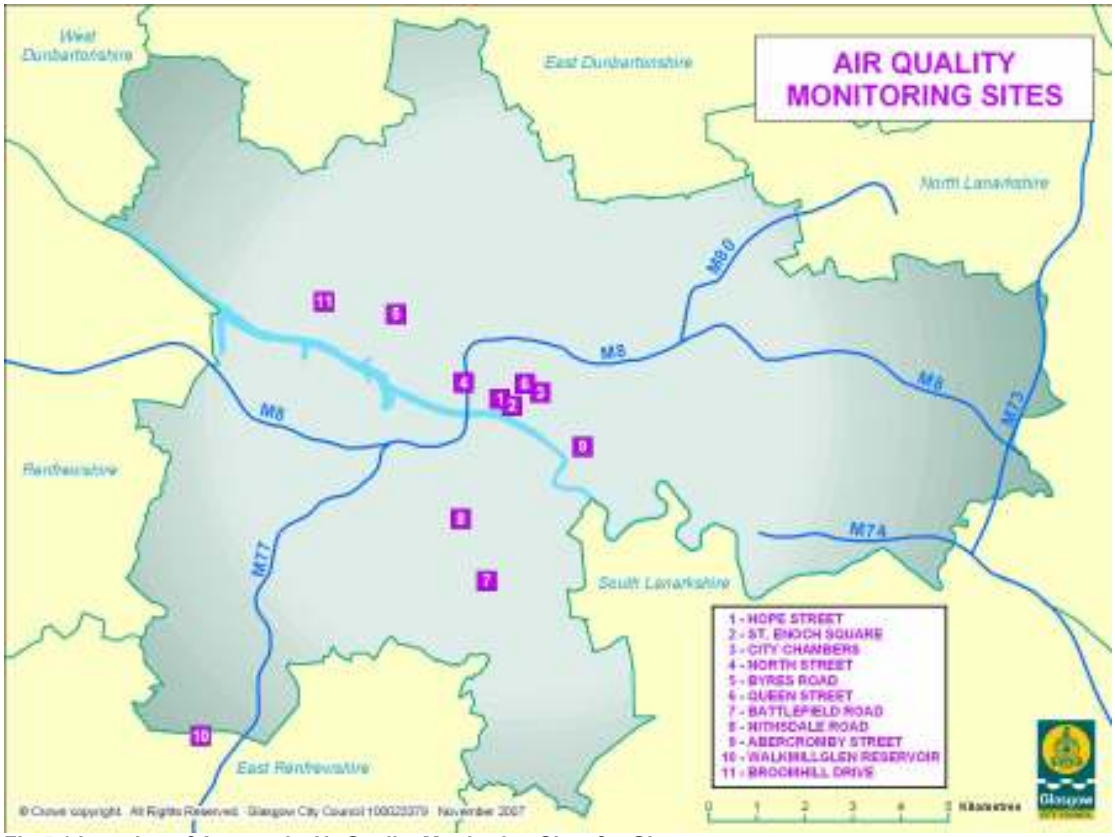


Fig 5.1 Location of Automatic Air Quality Monitoring Sites for Glasgow

The automatic monitoring sites located at Nithsdale Rd, Abercromby St and Broomhill Drive have all been in place for less than a year and therefore data from these sites has not been included in this Progress Report. These sites all contain TEOM analysers for monitoring PM_{10} concentrations and data from them will be used in future review and assessment reports.

Glasgow City Council also operate a non-automatic monitoring network of diffusion tubes which measure NO_2 levels at almost 100 sites around the city. NO_2 diffusion tubes represent a simple, effective and low cost method of monitoring ambient concentrations of nitrogen dioxide in a large number of locations. However, NO_2 concentration data provided by diffusion tubes is limited to fairly long-term exposure. Tubes are generally exposed for periods of a month, annual mean concentrations determined and compared with the annual mean objective. Furthermore, the accuracy of diffusion tubes can vary depending on the preparation methodology, handling procedures and the identity of the analysing laboratory.

To correct for this possible bias in tube data, results are corrected using information gained from co-location studies. Triplicate tubes are co-located with the automatic NO_2 analysers at Glasgow Centre, Glasgow Kerbside, Glasgow City Chambers, Glasgow Anderston and Byres Road. Concentrations detected by these tubes were compared against those recorded through chemiluminescent detection over the same sampling period and a bias-correction factor determined using the guidance outlined in LAQM.TG(03).Diffusion tubes utilised by Glasgow City Council are prepared and analysed by Glasgow City Council's Scientific Services.

In addition to these monitoring methods Glasgow City Council also operated benzene diffusion tubes at four sites across the city and lead levels are monitored by filter analysis at a further two locations.

5.1 Monitoring Data

5.1.1 Nitrogen Dioxide

Automatic Analysers

Nitrogen dioxide is monitored using automatic analysers at seven locations; the three AUN sites and Glasgow Anderson, Byres Road, Battlefield and Waulkmillglen reservoir. Table 4.1 shows the measured annual mean at the three AUN sites and the projected annual mean for 2010.

Location	Measured Annual Mean (μgm^{-3})								Projected 2010 Annual Mean (μgm^{-3})
	2000	2001	2002	2003	2004	2005	2006	2007	Base 2007
Glasgow Chambers	49	42	47	50	49	46	47	47	42
Glasgow Centre	37	33	32	38	36	33	31	31	28
Glasgow Kerbside	72	71	74	75	68	62	68	70	63

Table 5.1 Annual mean NO_2 concentrations measured at AURN sites

Figure 5.1 shows that both Glasgow Kerbside and Glasgow City Chambers AURN sites are recording concentrations of NO_2 which are continually breaching the annual mean objective.

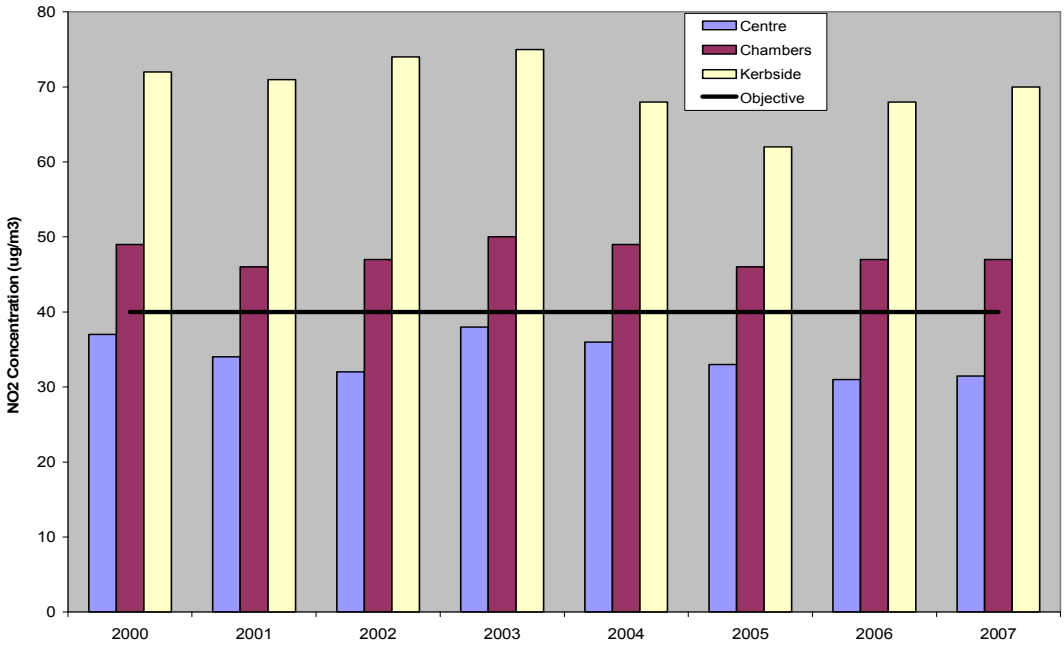


Fig 5.1 AURN Annual Mean NO_2 Levels 2001 – 2007

Table 5.2 shows the measured annual mean at the four other automatic sites and the projected annual mean for 2010.

Location	Measured Annual Mean (μgm^{-3})			Projected 2010 Annual Mean (μgm^{-3})
	2005	2006	2007	Base 2007
Glasgow Anderston	34	34	33	30
Byres Road	38	41	40	35
Battlefield	-	38	34	30
Waulkmillglen	9	10	9	8

Table 5.2 Annual mean NO_2 concentrations measured at automatic sites

Diffusion Tubes

Tables 5.3 – 5.9 show the annual mean NO_2 concentrations measured using diffusion tubes. The projected 2010 annual mean NO_2 concentrations are all calculated using the 2007 measured concentrations as the base year.

Location	Annual Mean/Year (µg/m3)		Projected 2010 Annual Mean (µg/m3)
	2006	2007	
Hope Street	69	77	68
George Square	45	53	47
Union Street	63	74	65
Bath Street	47	40	35
Glassford Street	55	63	56
Briggait	38	49	43
Castle Street	37	42	37
Hope Street 2 mid	77	82	72
Hope Street 3 (N)	56	64	56
Montrose Street	38	45	40
Cochrane Street	43	42	37

Renfield Street	60	74	65
George Street	51	35	31
North Street	58	59	52
Hope Street 1 (south)	83	90	79
Gordon Street	75	74	65
Heilan'man's Umbrella north	75	92	81
Heilan'man's Umbrella south	86	91	80
Saltmarket	41	46	41
High Street	53	59	52
Dobbies loan	29	35	31
Cathedral Bridge	59	56	49
Dundasvale Street	31	36	32
Royston Road	44	46	41
St Mungo Avenue	36	46	41
Brown Street	31	38	34

Table 5.3 Annual mean NO_2 concentrations measured at roadside sites within the city centre

Location	Annual Mean/Year (µg/m3)		Projected 2010 Annual Mean (µg/m3)
	2006	2007	
M^{c}Leod Street (UK)	34	42	38
M^{c}Leod Street	35	41	37
Sauchiehall Street	46	42	38
Kennedy Path	28	35	32

Table 5.4 Annual mean NO_2 concentrations measured at urban background sites within the city centre

Location	Measured Annual Mean (μgm^{-3})							Projected 2010 Annual Mean (µg/m3)
	2001	2002	2003	2004	2005	2006	2007	
Byres Rd	46	47	50	42	60	52	55	49
Dumbarton Rd	-	50	43	34	37	39	41	37
Lawrence St	-	-	-	23	37	39	30	27
Cooperswell St	-	-	-	23	35	34	30	27

Table 5.5 Annual mean NO_2 concentrations measured at roadside sites within the Byres Rd & Dumbarton Rd AQMA

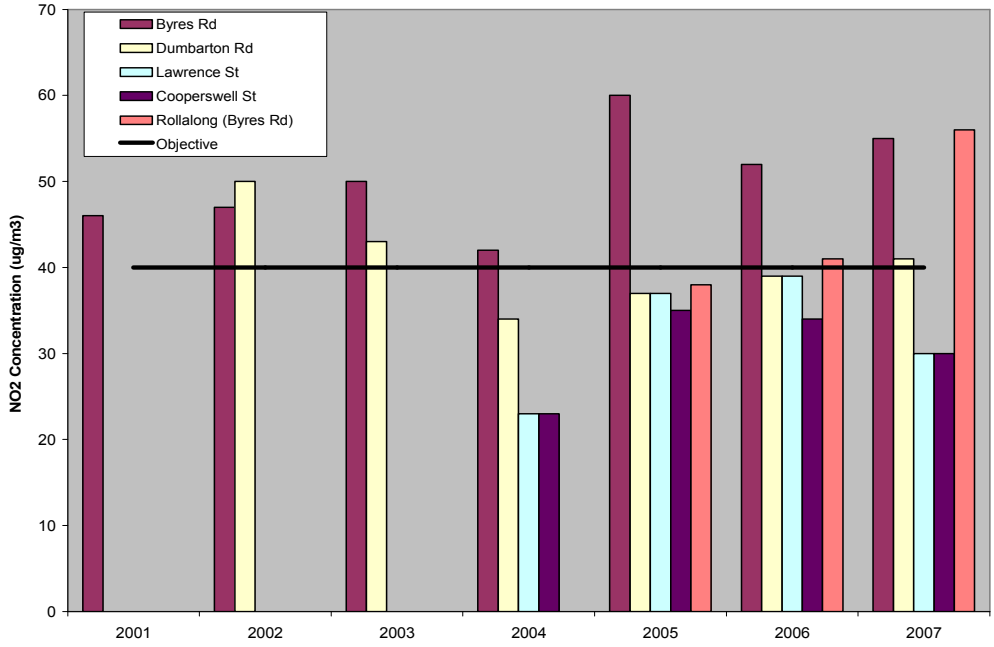


Fig 5.2 Byres Rd & Dumbarton Rd Annual Mean NO_2 Levels 2001 - 2007

Location	2001	2002	2003	2004	2005	2006	2007	Projected 2010 Annual Mean (µg/m3)
Westmuir Street	25	45	43	50	66	58	54	48

Table 5.6 Annual mean NO_2 concentrations measured at roadside site within the Parkhead Cross AQMA

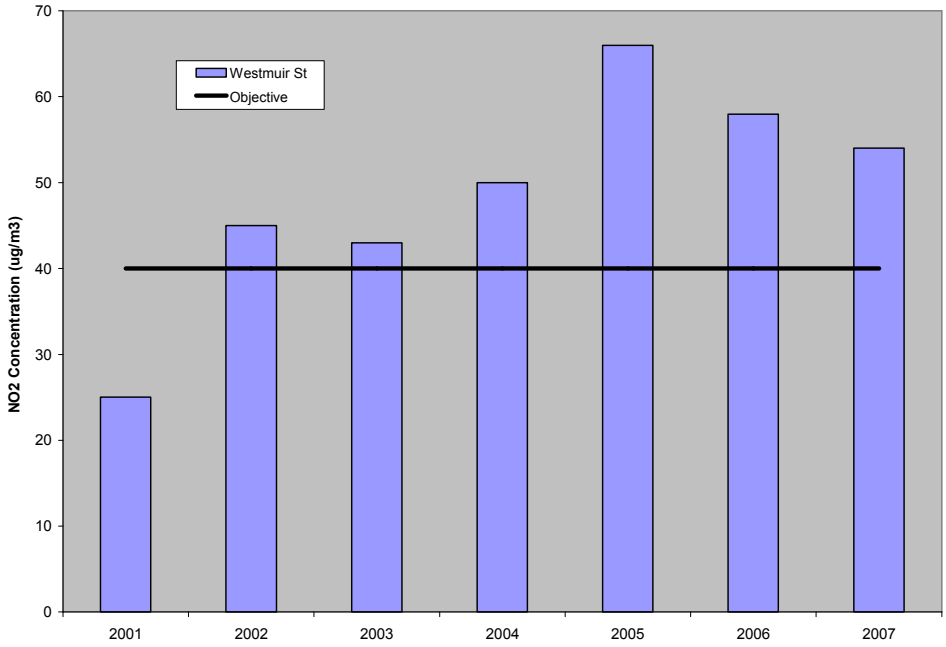


Fig 5.3 Parkhead Cross Annual Mean NO_2 Levels 2001 - 2007

Location	Annual Mean/Year (µg/m3)		Projected 2010 Annual Mean (µg/m3)
	2006	2007	
Mosside Road	29	38	34
Bridge St./ Norfolk St.	54	49	43
Finnieston St	37	44	39

Table 5.7 Annual mean NO_2 concentrations measured at kerbside sites outwith the existing AQMAs

Location	Annual Mean/Year (µg/m3)		Projected 2010 Annual Mean (µg/m3)
	2006	2007	
Hillcrest Road (UK)	21	26	23
Hillcrest Road	20	26	23
St Andrews Drive	20	26	23
Haggs Road	32	35	31
Pollokshaws Road	24	28	25
Queen Margaret Drive	29	35	31
Napiershall Street	35	38	34
Queen Margaret Drive 2	35	33	29
Queen Margaret Drive 3	39	45	40
Oxford Street	30	36	32
Anniesland Cross	33	45	40
Balshagray Avenue	27	33	29
Dougrie road	19	26	23
Main Street (Bridgeton)	25	29	26
Aikenhead Road	25	26	23
Langside Primary School	21	29	26
Thornwood Drive	22	29	26
Springburn Road	30	33	29
Paisley Road West	33	36	32

Table 5.8 Annual mean NO_2 concentrations measured at roadside sites outwith the existing AQMAs

Location	Annual Mean/Year (µg/m3)		Projected 2010 Annual Mean (µg/m3)
	2006	2007	
Sutherland Ave. (UK)	18	20	18
Belmont Street	22	26	24
Mallaig Place	22	24	22
Govanhill Street	32	32	29
Westercraigs	24	26	24
Inveresk Lane	21	23	21
Kippen Street	25	22	20
Sacone SW	23	26	24
Castlemilk	19	19	17
Invergarrie Road	16	22	20
Easterhouse	20	22	20
Dunn St	23	31	28
Glasgow Harbour	33	30	27
Mavisbank Gardens	27	37	34

Table 5.9 Annual mean NO_2 concentrations measured at urban background sites outwith the existing AQMAs

5.1.2 PM_{10}

Levels of PM_{10} recorded within the city centre AQMA are summarised in Figure 5.4. Glasgow meets the current 40µgm^{-3} National Air Quality Strategy objective for PM_{10} however in 2010 the objective is lowered to 18µgm^{-3}.

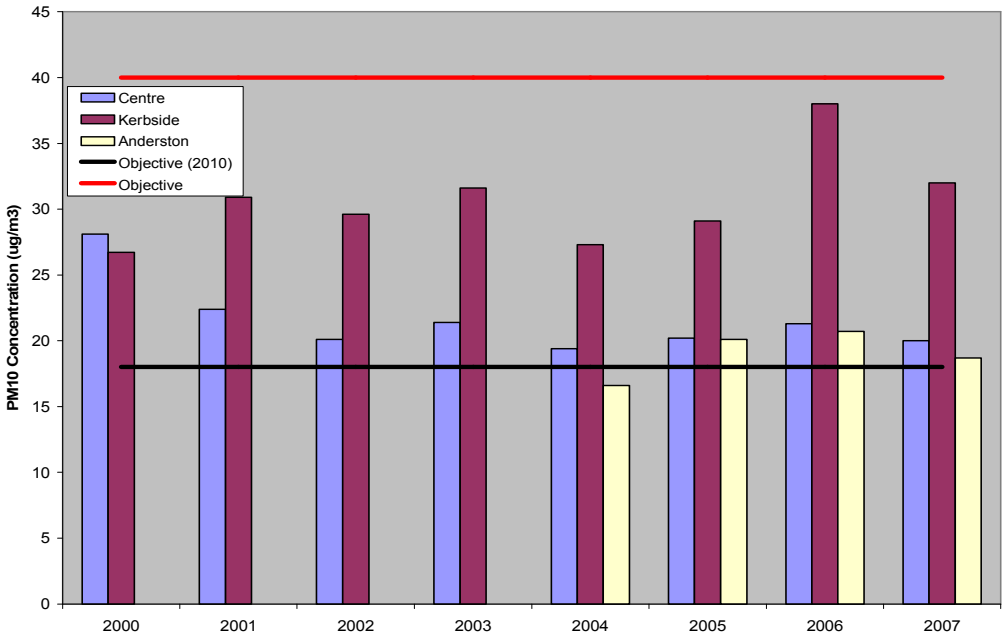


Fig 5.4 Annual Mean PM10 levels in Glasgow City Centre

As shown above, the current PM_{10} levels recorded in the city centre are above the objective level required by 2010. Future PM_{10} levels expected at these city centre sites (Table 5.10) have been calculated in accordance with LAQM. TG(03) and again show a similar trend to those currently observed with exceedences (in red) of the 2010 annual objective at each location. Similarly, only the Waulkmillglen site is expected to meet the 2010 objective for PM_{10} (Table 5.11).

More information on predicted PM_{10} levels (including dispersion modelling) at a number of locations in Glasgow can be found in Glasgow City Council's Local Air Quality Management, Detailed Assessment Report 2005.

City Centre AQMA	[PM_{10}] µg m^{-3} (Objective Level 18 µg m^{-3})			
	2005	2006	2007	2010 Predicted
Hope Street	29	38	32	30.7
St Enoch Square	20	21	20	19.5
Anderston	15	16	18.7	18.3

Table 5.10 Observed and predicted PM10 concentrations within the City Centre

	[PM_{10}] µg m^{-3} (Objective Level 18 µg m^{-3})			
	2005	2006	2007	2010 Predicted
Byres Rd	27	27	25	24.0
Battlefield Rd	-	23	23	22.2
Waulkmillglen	14	15	15	14.7

Table 5.11 Observed and predicted PM10 concentrations outwith the City Centre

Tables 5.12 and 5.13 show the number of days where the 24-hour mean PM_{10} concentration was measured to be greater than 50µg/m3. The air quality objectives for Scotland state that this 24-hour mean must not be exceeded more than 7 times a year.

City Centre AQMA	No. of days >50µg/m3		
	2005	2006	2007
Hope Street	29	70	41
St Enoch Square	7	2	4
Anderston	1	3	3

Table 5.12 No. of days where 24-hr mean PM_{10} is greater than 50 µg/m3

	No. of days >50µg/m3		
	2005	2006	2007
Byres Rd	8	6	10
Battlefield Rd	0	3	7
Waulkmillglen	0	1	3

Table 5.13 No. of days where 24-hr mean PM_{10} is greater than 50 µg/m3

5.1.3 Carbon Monoxide

Table 5.13 shows CO concentrations measured at five sites using automatic analysers. The air quality objective for Scotland for CO is a running 8-hour mean of 10.0 mg/m3. In Glasgow there have been no exceedences of this objective.

	Measured Annual Mean (mg/m3)			Maximum 8hr running mean (mg/m3)		
	2005	**2006**	**2007**	**2005**	**2006**	**2007**
Glasgow City Chambers	0.4	0.4	0.3	2.0	2.0	1.0
Glasgow Centre	0.3	0.3	0.3	2.3	2.0	1.1
Glasgow Kerbside	0.4	0.4	0.4	3.0	2.2	1.2
Glasgow Anderston	0.2	0.2	0.1	2.6	2.0	1.0
Byres Road	0.4	0.3	0.3	3.0	3.0	1.8

Table 5.14 Measured annual means and maximum 8hr running means for CO

At the end of September 2007, CO ceased to be monitored at Glasgow City Chambers and Glasgow Kerbside. The annual means reported for 2007 reflect the available data.

5.1.4 Sulphur Dioxide

SO_2 is measured at two sites in Glasgow using automatic analysers. Table 5.15 shows the measured annual mean concentrations of SO_2 measured at Glasgow Centre and Glasgow Anderston sites.

The air quality objectives for SO_2 are 15-minute, 1-hour and 24-hour means. There were no measured exceedences of these objectives in Glasgow.

Location	Measured Annual Mean (μgm^{-3})		
	2005	**2006**	**2007**
Glasgow Anderston	3.32	3.26	3.54
Glasgow Centre	1.12	1.56	2.19

Table 5.15 Measured annual mean SO_2

5.1.5 Benzene

Benzene is measured at Glasgow Kerbside using an automatic analyser, the results of which are shown in Figure 5.5. As can be seen the running annual mean is well below the objective level at this location.

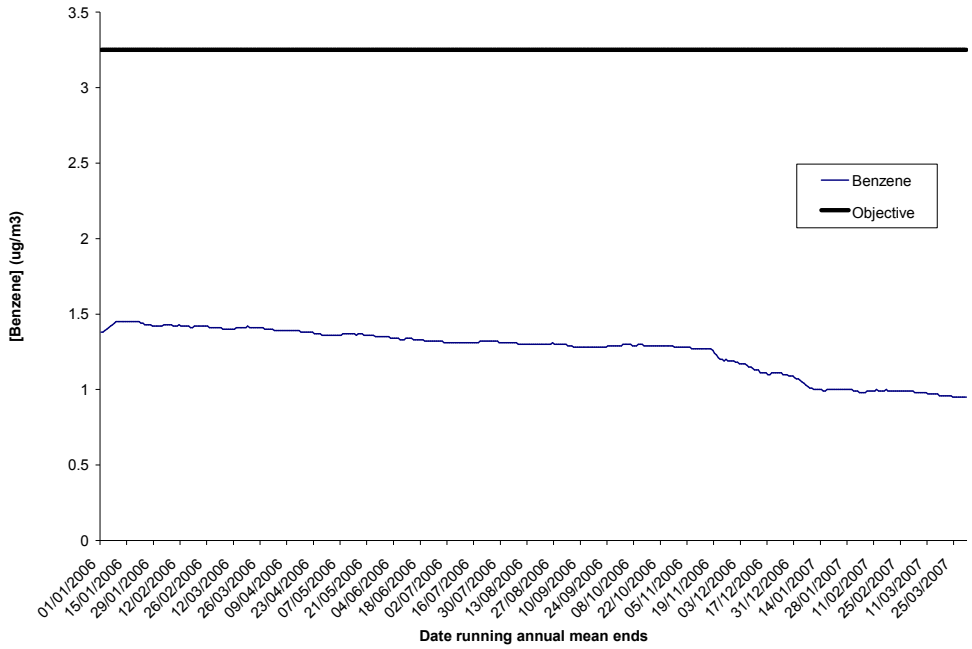


Fig 5.5 Running Annual Mean Benzene levels measured at Glasgow Kerbside

Benzene is also measured using diffusion tubes at 4 sites in the city. The tubes at these sites have been in operation since early 2006 and the tubes are exposed for one month at a time and then analysed. The results can be seen in Figure 5.6.

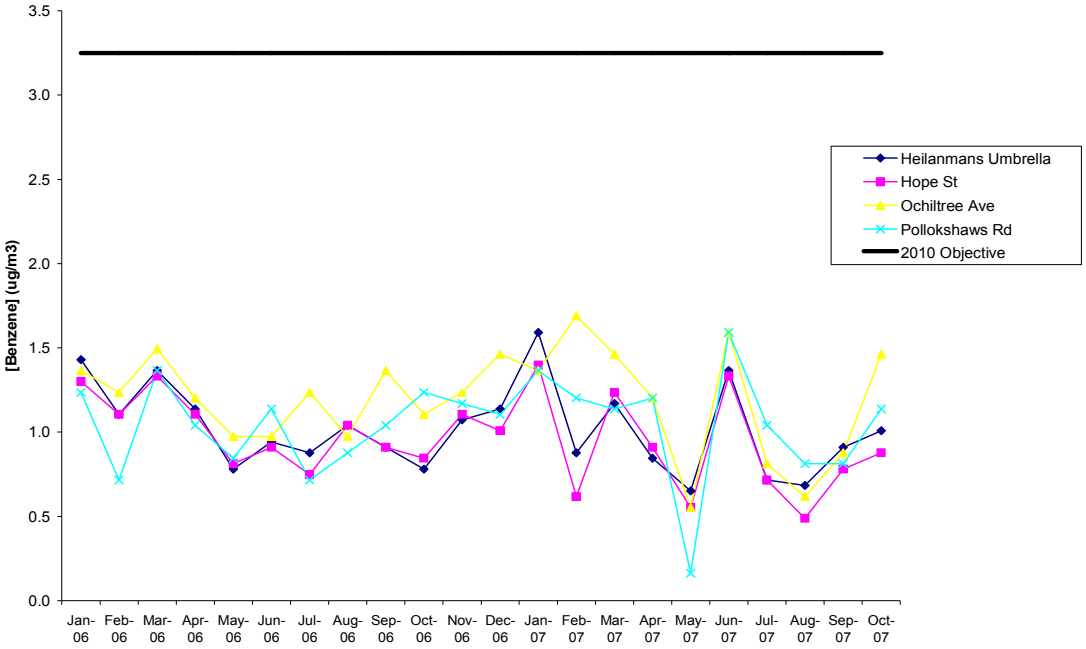


Fig 5.6 Monthly mean benzene levels measured by diffusion tube

5.1.6 1,3-butadiene

Benzene is measured at Glasgow Kerbside using the same automatic analyser which measures benzene, the results of which are shown in Figure 5.5. As can be seen the running annual mean is well below the objective level at this location.

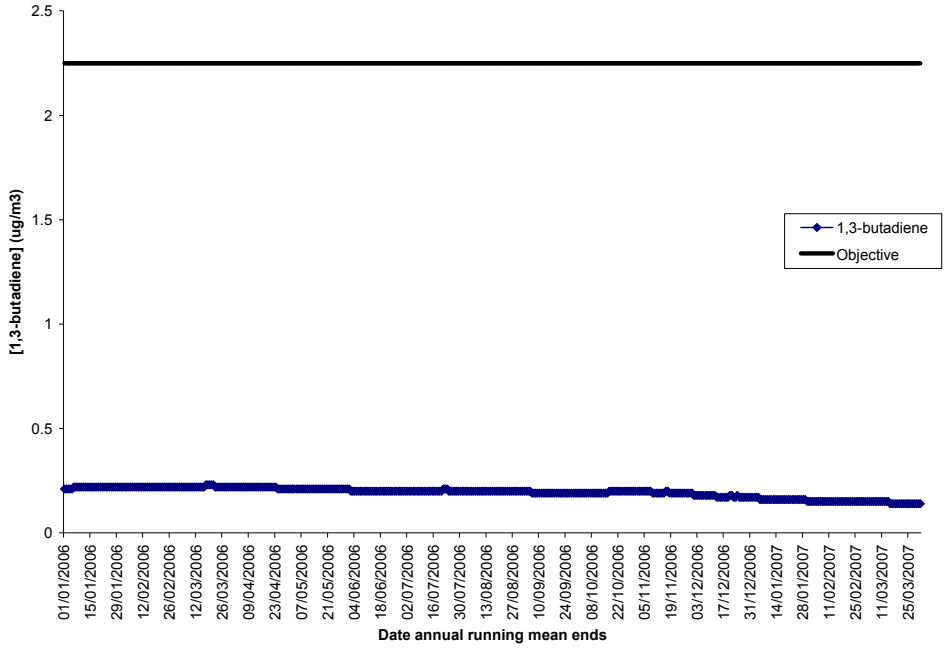


Fig 5.7 Running annual mean 1,3-butadiene levels measured at Glasgow Kerbside

5.1.7 Lead

Glasgow City Council operates 2 monitoring sites for lead. One is located within the City Chambers while the other is located close to the Patterson's tip in the east end of the city. A measured concentration is pulled through a filter. Particulate matter is gathered on the filter and analysed using wet chemical techniques to determine the concentration of lead deposited.

	Lead Concentration (µg/m3)		
	2005	**2006**	**2007**
City Chambers	0.030	0.015	0.026
Pattersons	0.021	0.031	0.028

Table 5.16 – Annual mean lead levels

Annual averages recorded at both sites are significantly below the Air Quality Strategy Objective of 0.25µg/m3.

6.0 New Developments

Since the completion of the Detailed Assessment 2007, there have been a number of developments in Glasgow that may have implications for local air quality. These range from small industrial processes through to major commercial/residential and road network development projects.

New developments which may have an effect on air quality are to be considered in the Progress Report. Following the guidance LAQM.PRG (03), these developments are noted for possible further assessment in the next round of review and assessment.

There are a wide range of developments which can have an effect on air quality, both positively and negatively. These could be such things as the building of a new industrial process or a change to the road network. Other developments which may impact on air quality include developments such as supermarkets with large car parks, airport expansions or residential developments within air quality management areas.

The impact of these developments on exposure must also be considered.

6.1 Industrial Processes and Developments

The Scottish Environment Protection Agency (SEPA) has responsibility over prescribed processes in Scotland. SEPA authorise Part A and B processes and set conditions to limit emissions from them, which places them under an obligation to use 'the best available techniques' to prevent or minimise pollution. The SEPA public register was examined and enquiries made to SEPA staff in order to determine if there were any new regulated processes or if any regulated processes had varied emissions significantly since the last round of review and assessment.

6.1.1 Part A installations

Industrial developments may result in the emission of a number of pollutants to the air. Such developments are detailed below. There are a small number of industrial processes in Glasgow that have the potential to emit significant quantities of NAQS pollutants but it is believed that no new industrial processes commenced operation or changed significantly since the last round of R & A.

These industrial processes were addressed during previous rounds of review and assessment. The conclusion reached in these reports was that these processes would not result in any exceedences of the air quality objectives.

The implementation of the IPPC directive means that the following sites are now regulated under PPC regulations as part A processes:

PPC/A/1003166 – Inbev UK Ltd, 161 Duke Street, Glasgow, G31 1JD

PPC/A/1018680 – 3M Hillington, 123 Johnstone Avenue, Glasgow, G52 4NZ

PPC/A/1016539 – Anglo Beef Processes, Old Shettleston Road, Glasgow, G32 7ES

PPC/A/1013441 – Norit, 45 Clydemill Place, Glasgow, G32 8RF

PPC/A0020053 – Clydeside Galvanisers, 96 Eastvale Place, Glasgow, G3 8QG

PPC/A/020054 – Scottish Galvanisers, MacLelland Street, Glasgow, G41 1RK

PPC/W/100165 – Princes Soft Drinks, 45-75 Bogmoor Road, Glasgow, G51 4TJ

It is not expected that these processes will result in any exceedences of the air quality objectives.

Glasgow City Council will continue to liaise with SEPA to collect information on the progression of such projects and any potential air quality impacts that could occur. This information will be presented, if appropriate, in future air quality review and assessment reports.

6.1.2 Part B Processes

All dry cleaners are now regulated under Part B with the implementation of the Solvent Emissions Directive. This has resulted in 18 dry cleaners now being authorised as Part B processes. Since these were pre-existing processes it is not expected that their addition will result in any exceedences of the air quality objectives.

Due to the implementation of the Paints Directive and associated thresholds, several vehicle resprayers are no longer regulated under PPC regulations.

6.2 New Transport Developments

Glasgow has developed as a major nodal point of the Scottish transport system. It has an extensive road network which is outlined on the map below. There are currently 40km of motorway and 1700km of other public roads.

The backbone of the road system is the M8 motorway which runs through the City and continues to Edinburgh (A8/M8). At the Baillieston Interchange the

M8 links, via the M73, with the M74/A74 route to Carlisle and the south, and with the M73/A80 route to Stirling and the north. The M77 (Ayr road route) was completed in November 1996 and runs through the south west of the City.

Several other major routes radiate from the city. These include the Clydeside Expressway, Great Western Road, Springburn Road, Cumbernauld Road, Edinburgh Road, London Road, Paisley Road West and the M80 Stepps bypass.

A large proportion of journeys along these routes are by private cars commuting to the City often from areas outwith the City boundary. As a result there is frequent overloading of routes leading to the City during peak periods.

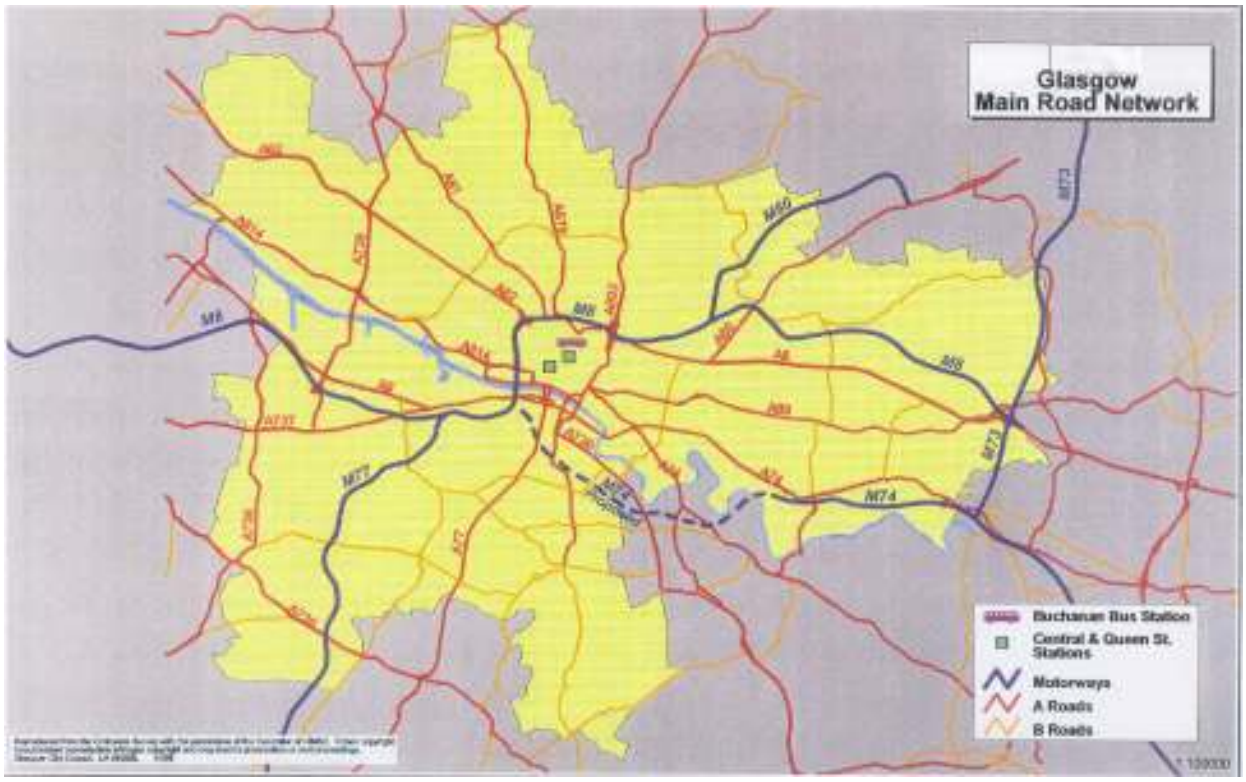


Figure 6.1 – Glasgow's main road network

6.2.1 M74 Extension

The proposal to extend the M74 motorway through the east of Glasgow to converge with the M8 to the south of the city centre has now been approved. This development has been discussed at length in previous review and assessment reports.

In terms of the predicted impact on NO_2 concentrations in Glasgow, an environmental impact assessment concluded that although a long term overall improvement in air quality is predicted with some 96% of residential properties in the wider study area expected to experience a reduction in NO_2 concentrations; detailed modelling identified some increases in NO_2 concentrations close to the road corridor which could potentially result in exceedences of the air quality objectives.

Glasgow City Council undertakes monitoring of PM_{10} particulate matter twice every year (2 weeks during both summer and winter periods) at relevant sites near to the proposed M74 extension. In addition, diffusion tube monitoring is being undertaken for NO_2 at 56 sites and benzene at 4 sites along the proposed route. Once the construction of the road is complete and it is open to traffic, monitoring results can be analysed to determine the impact of the road on local air quality.

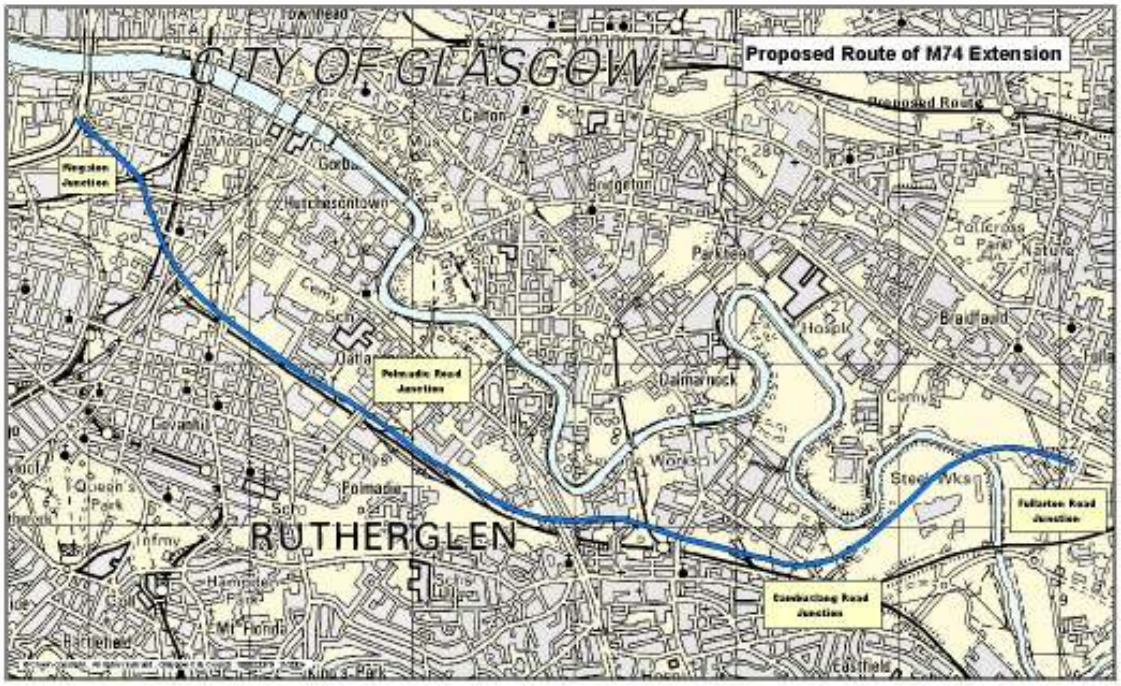


Figure 6.2 Proposed route of M74 extension

6.2.2 East End Regeneration Route (EERR)

As with the M74 extension, which it complements, the EERR has been discussed at length in previous review and assessment reports. The East End Regeneration Route (EERR) is another major road that is currently at the planning stage. Although the EERR is being introduced primarily to aid in the successful regeneration of the east end of Glasgow, it will have the benefit of improving congestion and will have some benefits for air quality.

The first element of what is now the EERR, the Parkhead Bypass, was opened in 1988 and runs from the Gallowgate roundabout to the forge roundabout. The development is currently at planning stage and has the potential to be completed in 2011.

The main benefits that a new road, such as the EERR would bring to the area are:

- Relief of traffic congestion on existing roads in the area, leading to reduced NOx emissions and improvements to NO_2 levels within the AQMA, especially at its eastern boundary
- Improved access for construction traffic to facilitate development
- Improved distribution of traffic from existing and new developments, including Celtic Park

Figure 6.3 – Aerial view of the proposed route of the EERR

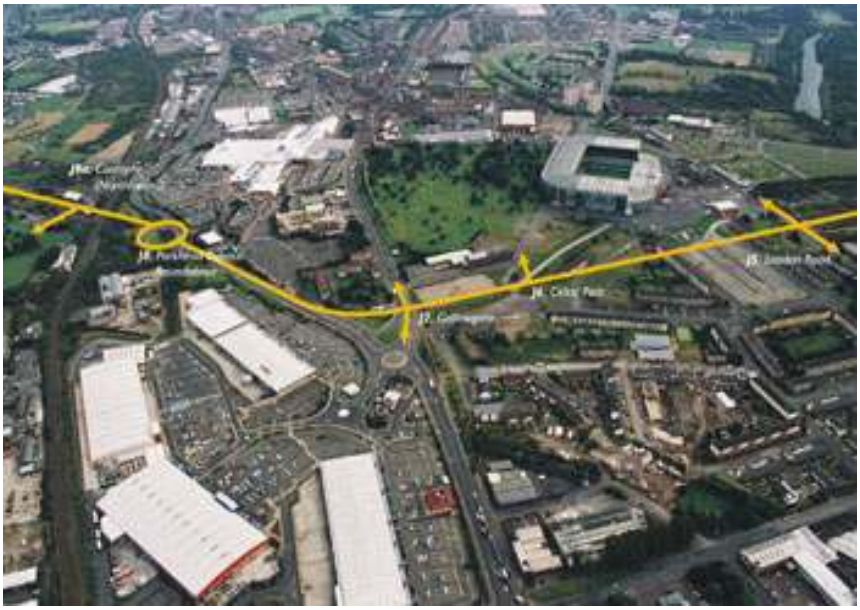


Figure 6.4 – Aerial photograph of the proposed route of the EERR

6.3 New Residential, Commercial and Public Developments

As is to be expected within a city the size of Glasgow, new developments frequently occur which may have an adverse impact on air quality.

Within City Centre

At the moment work is in progress on an extensive redevelopment of the St Enoch shopping centre and the adjoining St Enoch square. This redevelopment will not increase private car parking provision at the centre and it is expected there will be no increase in traffic using the site. An air quality assessment has been completed on the development which predicts no adverse effects within the air quality management area. However, the Glasgow Centre AUN site is located within St Enoch Square and results from this site will have to be viewed within the context of an increase in building site traffic in the local area for the duration of the development.

Within the AQMA there are also plans for a major redevelopment of the Buchanan Galleries shopping centre. The plans are to increase the size of the existing centre and provide more car parking spaces by building a new car park above the Buchanan bus station. The development will see an extensive redesign of the existing bus station. An air quality assessment has been conducted for this redevelopment which has identified the potential for a significant adverse impact on nearby dwellings. Mitigation measures for the predicted impact will be sought from the developer.

Outwith City Centre

A major proposed development which is in the planning stage at the moment is a major food, retail and residential park in Beith St, Partick, Glasgow. This proposal involves a Tesco supermarket, more than 500 car parking spaces and over 900 flats. An air quality assessment has been carried out for the proposed development which predicts the potential for an adverse impact within the nearby Dumbarton Rd – Byres Rd AQMA. At the time of writing this development is subject to a Public Local Inquiry.

Commonwealth Games

Glasgow has been successful in its bid to become the host city for the 2014 Commonwealth Games. Glasgow City Council has committed to introduce Low Emission Zones around the games venues which, along with other measures, hopes will mitigate any adverse affects of the games on air quality.

It is planned that this will be a “car free” games and that no extra parking for the public will be available at games venues. Extra public transport will be provided for those attending events.

7.0 Conclusions

Updated automatic analyser and diffusion tube monitoring of NO_2 within this Progress Report and indicates that concentrations of NO_2 are likely to continue to exceed the National Air Quality Objectives at several locations within the existing AQMAs. The diffusion tube results also show that there continues to be the potential for exceedences of the NO_2 objective around the Bridge Street / Norfolk Street area. This potential has been highlighted in previous review and assessment reports and additional monitoring using diffusion tubes has started in the area. The results of this monitoring will be available in future reports.

Monitoring of PM_{10} levels has shown the potential for breaches of the 2010 objective at all monitoring locations with the exception of Waulkmillglen reservoir (a rural site). This potential has been identified in previous rounds of review and assessment and Glasgow City Council has commenced monitoring at a number of locations across the city. The results of this monitoring will be available in future reports.

Monitoring results for CO,SO_2, Benzene,1,3-butadiene and lead continue to show that in Glasgow, levels of these pollutants are well below the Air Quality Strategy objectives.

While a number of new residential, commercial and industrial developments have started or been proposed since the 2006 U&SA, those with the potential for adverse effects are located within pre-existing AQMAs.

Glasgow City Council has prepared a Draft Air Quality Action Plan with a view to introducing measures to mitigate air pollution with the AQMAs and to try to bring pollutant levels to within the National Air Quality Strategy objectives.