



WORKING FOR A HEALTHY FUTURE

Glasgow City Council 2009 Detailed Assessment for Local Air Quality Management

Date: 26th October 2010
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IOM Consulting Contract: 611-000428

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Summary

This Detailed Assessment was intended to inform the City Council as to whether further Air Quality Management Areas (AQMAs) are required in Glasgow. The aims of the assessment were to predict annual mean concentrations of NO₂ for Bridge Street and for Queen Margaret Drive between Hamilton Drive and Maryhill Road and annual mean concentrations of PM₁₀ at Bridgeton Cross and surrounds, Springburn Road, Sauchiehall Street, Dumbarton Road, Argyle Street, Byres Road, University Avenue, Woodlands Road, Great Western Road, Anniesland Cross, Balshagray Avenue, Hyndland Road, Finnieston Street, Maryhill Road, Paisley Road West / Govan Road, Pollokshaws Road / Kilmarnock Road, Parkhead Cross and Baillieston Road / Barrachnie Road.

This assessment was based on modelling undertaken with ADMS-urban and traffic and weather data supplied by Glasgow City Council. Some comparison modelling was undertaken using the DMRB screening model. A validation and calibration exercise was performed using 2008 measurement data. The modelling was undertaken using only one year's weather data for the City Chambers (2008) as the data for other years was incomplete. The results of a limited comparison of model results generated using weather data for 2007 versus data for 2008 suggest that the use of another set of weather data could have led to substantially lower predicted concentrations of PM₁₀ and NO₂. The traffic data were generally counts undertaken on a single day between 2004 and 2009 in order to inform traffic management rather than air quality. There is no information about the day to day variability of traffic flow or how traffic flow has changed at individual locations since the counts were undertaken. There is therefore considerable uncertainty as to whether the traffic data are representative of 2010 traffic flows. No traffic data were available for University Avenue and it was therefore not included in the modelling exercise. Comparison with other locations indicates that it is unlikely that annual mean concentrations of PM₁₀ exceed 18 $\mu\text{g m}^{-3}$ at this location.

The results of the limited calibration exercise for PM₁₀ suggested that the modelling under-predicted concentrations by about 25%. It was judged that this was due to uncertainties in both the predicted impact of traffic emissions and in the modelled background concentrations. Although the guidance in TGD(09) indicates that the model calibration should be based solely on the traffic component, the importance of the predicted background in determining the predicted total concentration for these locations in Glasgow, suggests that it for the purposes of air quality assessment in Glasgow, it would be more logical to develop a calibration factor based on total PM₁₀ concentrations. It was therefore determined that predicted concentrations based on increasing both the modelled traffic component of PM₁₀ and background concentrations of PM₁₀ by 25% provide the most appropriate estimate of future concentrations of PM₁₀ for the purposes of air quality management.

The results of the modelling exercise suggest that there is a risk that the 18 $\mu\text{g m}^{-3}$ annual mean objective for PM₁₀ may be exceeded at a number of locations across Glasgow in 2010. Exceedences of the objective in 2010 are most likely at Bridgeton Cross, Sauchiehall Street, Dumbarton Road (at junction with Byres Road), Argyle Street, Byres Road, Woodlands Road, Great Western Road, Hyndland Road, Finnieston Street, Maryhills Road, Paisley Road West, Pollokshaws Road and Parkhead Cross. In 2015, exceedences are still likely at Sauchiehall Street, Dumbarton Road, Argyle Street, Maryhills Road and Paisley Road West.

Given the uncertainty in the predicted concentrations, it is difficult to demonstrate that the objective will not be met at locations where exceedences are predicted or met at locations where exceedences are not predicted. Given this uncertainty and the limitations of the input data available for modelling, it is recommended that further monitoring is undertaken in order to confirm that exceedences are likely at the predicted locations.

The results of the modelling exercise also indicate that the 40 $\mu\text{g m}^{-3}$ annual mean objective for NO₂ will be exceeded in 2010 in Bridge Street but is likely to be met in Queen Margaret Drive north of Hamilton Drive. The model output also suggests that concentrations of NO₂ are likely to still exceed the annual mean objective in 2015 in Bridge Street. It is recommended that the city centre AQMA is extended to include Bridge Street and monitoring is continued in Queen Margaret Drive.

1 Introduction

1.1 BACKGROUND

This Detailed Assessment was undertaken to enable Glasgow City Council to meet their Review and Assessment obligations under the Local Air Quality Management (LAQM) regime. The 2005 Detailed Assessment identified likely areas of exceedence of PM₁₀¹ objectives but the modelled results could not be verified and further monitoring was required. This monitoring has now been undertaken and the 2009 Updating and Screening Assessment (USA) has confirmed that there are likely exceedences of the 2010 objective for PM₁₀. The 2009 USA has also identified a number of areas requiring further assessment of nitrogen dioxide (NO₂) concentrations. The Detailed Assessment was intended to inform the City Council as to whether further Air Quality Management Areas are required in Glasgow.

1.2 SCOPE

Based on the 2009 USA, a Detailed Assessment was required in respect of annual mean concentrations of NO₂ for the following roads:

- Bridge Street;
- Queen Margaret Drive between Hamilton Drive and Maryhill Road

and in respect of annual mean concentrations of PM₁₀ for the following roads:

- Bridgeton Cross and surrounds
- Springburn Road
- Sauchiehall Street
- Dumbarton Road
- Argyle Street
- Byres Road
- University Avenue
- Woodlands Road
- Great Western Road
- Anniesland Cross
- Balshagray Avenue
- Hyndland Road
- Finnieston Street
- Maryhill Road
- Paisley Road West / Govan Road
- Pollokshaws Road / Kilmarnock Road
- Parkhead Cross
- Baillieston Road / Barrachnie Road

No traffic data were available for University Avenue and it was therefore not included in the modelling exercise.

1.3 AIR QUALITY LEGISLATION AND GUIDANCE

Statutory air quality objectives are set out in the Air Quality (Scotland) Regulations 2007. The objectives for PM₁₀ and NO₂ are shown below (Table 1.1).

¹ PM₁₀ is approximately equivalent to the ISO thoracic fraction (i.e. those particles small enough to penetrate to the lung) and represents a log normal sampling efficiency (with respect to particle size) with a median cut off of 10 um aerodynamic diameter.

Table 1.1: Objectives for PM₁₀ and NO₂ outlined in the Air Quality (Scotland) Regulations 2007

Pollutant	Objective	Measured As	Date to be achieved by & maintained thereafter
Nitrogen dioxide (NO ₂)	200 $\mu\text{g m}^{-3}$ (105ppb) not to be exceeded more than 18 times a year	1 hour mean	31/12/05
	40 $\mu\text{g m}^{-3}$ (21ppb)	annual mean	31/12/05
Nitrogen oxides	30 $\mu\text{g m}^{-3}$	Annual mean	31/12/00
Particles (PM ₁₀)	50 $\mu\text{g m}^{-3}$ not to be exceeded more than 7 times a year	24 hour mean	31/12/10
	18 $\mu\text{g m}^{-3}$	annual mean	31/12/10

2 Methods

2.1 MODEL

The air dispersion modelling was undertaken using ADMS-urban version 2.2 supplied by Cambridge Environmental Research Consultants Ltd. The DMRB screening model was used in reviewing some ADMS predictions that were particularly unexpected.

The ADMS model was used to predict annual mean concentrations for NO₂ and PM₁₀ over the period 2010 based on the year-specific traffic emission factors integral to the software. Traffic impacts were modelled by location for specific receptors where pollutant concentrations were expected to be greatest. By examining each location separately in turn, it was possible to identify the potential problem areas that require further investigation.

In addition annual mean concentrations of NO₂ were modelled for locations where diffusion tube monitoring data are available.

2.2 DATA

All the candidate locations were visited in order to assess building heights, canyon continuity, building use and extent of congestion. Road and canyon widths were also estimated during the site visit and confirmed using satellite view in multimap. Given the uncertainty in the estimation of building height, an investigation was undertaken of the impact of canyon height on predicted concentrations. Table 2.1 shows the assumed building heights used in the modelling exercise.

Table 2.1: Assumed building heights used in dispersion modelling

Type of building	Estimated typical height*
One storey building	10 m
Two storey building	15 m
Three storey traditional tenement/ Four storey modern flats	20 m
Four storey traditional tenement/ Five storey modern flats	25 m

*These estimates were adjusted if buildings looked particularly tall or squat

Traffic flow information was provided by Glasgow City Council and this was processed in order to establish annual average hourly counts for light and heavy vehicles. The data were generally provided as 12 hour counts or as 3 two hour counts – peak morning, middle of the day and peak afternoon. Where 3 two hour counts were provided, the two peak counts were summed together with 4 times the middle of the day count in order to get an approximate 12 hour count. The 12 hour counts were converted to 24 hour counts using a factor of 1.26 in order to be consistent with earlier assessments undertaken for Glasgow City. The traffic flow data was originally collected in order to inform road planning/management and this means that not all the relevant data for air quality modelling were available. Where data were not available, traffic flows were estimated using data from adjacent segments of road, but these estimates are highly uncertain. In addition, some of the traffic data are several years old and it is likely that vehicle numbers have increased in the interim period. There was no information available about the day to day variability of traffic flow or about how traffic flows have changed at individual locations during recent years. The possible under-estimation of traffic flow was offset to some extent by the use of annualised traffic flow rates in the modelling exercise that were based on weekday flows without specifically allowing for lower traffic flows at weekends. Vehicle emission rates were as estimated within the ADMS model for 2008 in order to be consistent with the meteorological and measurement data available. Predicted concentrations for 2010 and years to 2015 were calculated using the procedures outlined in TG(09), taking account of the more recent year adjustment factors for NO₂ published by DEFRA in January 2010. Vehicle speeds were estimated as 15 kph for most of the streets in order to allow for the hour by hour variability in traffic speed with greater speeds being estimated for roads likely Balshagray Avenue where traffic is clearly free flowing and reasonably fast through much of the day. Some investigation was undertaken of the impact of estimated vehicle speed on model outputs.

Background concentrations of NO_x, NO₂ and PM₁₀ for 2010 (the objective year), 2008 and 2015 were downloaded from www.airquality.co.uk.

Hourly weather data for central Glasgow for 2008 was provided by Glasgow City Council. The data do not include cloud cover which would ideally have been included as part of the input data to ADMS. The weather data for 2008 are a complete set whereas more recent data for 2009 were incomplete. The data for 2007 were also incomplete but more complete than the data for 2008. It was not possible, therefore, to fully investigate the impact of using multiple years of weather data in the ADMS modelling. Although it would have been possible to have used weather data collected at Glasgow airport, it was considered that the measurements made by Glasgow City Council at the City Chambers were of greater relevance to the areas of Glasgow for which modelling was undertaken.

2.3 MODEL VALIDATION AND CALIBRATION

The performance of the ADMS model was validated for NO₂ against the results of diffusion tube measurements made at relevant locations following the procedure outlined in TG(09). There are insufficient data to allow a valid comparison of predicted PM₁₀ concentrations derived using ADMS against measurement data. It is assumed that the model performance for NO₂ will provide a reasonable indication of its likely performance for PM₁₀.

The outcome of the validation exercise suggested that ADMS severely under predicts NO₂ concentrations in streets that are not street canyons and it was anticipated that a similar under prediction might occur for PM₁₀. It was therefore decided to use the PM₁₀ measurement data that was available at a limited number of locations to generate separate calibration factors for streets that are canyons and streets that are not canyons. The monitoring data for 2008 in Byres Road was used to calibrate the model results for street canyons and the 2008 data for Battlefield Road were used for streets that are not canyons. Given the limited database on which the calibration factors have been established, there is some uncertainty as to the general applicability of the calibration factors, particularly given the very variable relationship between modelled and measured concentrations of NO₂ (see results). It was therefore appropriate to report both the calibrated and uncalibrated model results, although as it is likely that the relationship between measured and modelled concentrations is less variable for PM₁₀ than NO₂ because NO₂ forms partly as a secondary pollutant.

2.4 SENSITIVITY ANALYSIS

Given that the traffic data used in the modelling was based on single traffic counts on single days on dates ranging from 2004 to 2009, there is considerable uncertainty as to the representativeness of the traffic flows used in modelling air quality impacts. In addition there is no verification of the 1.26 factor used to convert 12 hour traffic flows to average 24 hour values. Typical traffic flows between 2010 and 2015 may be substantially different than at the time of traffic censuses, particularly if new traffic management measures have been introduced as a result of the traffic census information. In order to allow for the uncertainty in the input data two sensitivity analyses were undertaken:

Results were recalculated with the traffic component of predicted concentrations increased by 50%;

Results were recalculated with both the background and traffic components increased by 25%.

The first sensitivity analysis acknowledged the particular uncertainties in the prediction of traffic impacts whereas the second sensitivity analysis addressed the combined uncertainties in the predicted background and traffic contributions, assuming that the model output just met the 25% limits of tolerance indicated in TG(09).

3 Results

3.1 MODEL VALIDATION AND CALIBRATION

3.1.1 Nitrogen dioxide

Table 3.1 below shows the comparison of modelled and measured concentrations of NO₂. The vehicle speeds used in the modelling exercise were estimated as 15 kph except for Paisley Road West, Balshagray Avenue and Springburn Road where traffic flow was relatively unrestricted and speeds of 25, 50 and 70 kph were estimated respectively for each location, taking account of the nature of the road in the vicinity of the diffusion tube site. There is no consistent relationship between modelled and measured concentrations. In general the modelled concentrations for street canyons are closer to the measured concentrations than for the roads that do not have a canyon like geometry. The difference between measured and predicted concentrations at most locations could be explained by uncertainties in the traffic data and in the assumed average vehicle speed. The anomalously low modelled NO₂ concentration for Finnieston Street is thought to be due to changes in the road configuration since the traffic data were collected (2004 and 2005) and the model output is not a reliable indicator of current air quality in this area. The cause of the underestimation of NO₂ concentrations at either end of Queen Margaret Drive and at Anniesland is unclear but it is apparent that for roads that do not have a canyon geometry, the model consistently underestimates impact by a considerable but variable quantity. This under-estimation of impact is much greater than can be explained by the uncertainty in the traffic data. In principle, it would be possible to use the ratio of measured to modelled concentrations of NO₂ at a given location in order to calibrate the model output for NO₂. In practice, the uncertainties in both model input data and the measurement data give rise to considerable uncertainty.

Table 3.1: Comparison of modelled and measured NO₂ concentrations (ugm⁻³) for 2008 at roadside monitoring sites

Location	x	y	Measured NO ₂	Modelled NO ₂	%measured concentration due to traffic	%modelled concentration due to traffic
Byres Road	256526	666933	57	49.0	60.0%	53.5%
Dumbarton Road	256209	666525	38	57.1	40.0%	60.1%
Cooperswell Street	256154	666478	33	41.2	19.9%	35.9%
Westmuir Street	262589	664139	49	48.8	60.4%	60.3%
Bridge Street	258702	664480	50	52.0	43.9%	46.0%
Finnieston Street	257235	665108	48	32.1	39.9%	10.1%
Queen Margaret Drive 1	257216	6672363	35	22.9	40.1%	8.4%
Queen Margaret Drive 2	257216	667639	33	47.6	36.5%	56.0%
Queen Margaret Drive 3	256941	667363	45	23	53.6%	9.2%
Anniesland Cross	254613	668885	45	29.3	58.2%	35.9%
Balshagray Avenue	254497	667298	33	25.2	37.2%	17.7%
Main Road Bridgeton	260654	663429	29	32.1	35.0%	41.3%
Springburn Road	269540	669268	33	35.26	53.0%	56.0%
Paisley Road West	255705	664325	36	34.6	30.9%	28.1%

If all locations are included in the comparison, the root mean square of the differences between modelled and measured concentrations is 11.5 which is 28.6% of the objective, indicating that the model is not performing to the specifications required in TG(09). Given that the traffic data for Finnieston Street is unlikely to have reflected traffic flow in 2008, it is reasonable to take Finnieston Street out of the comparison. This reduces the root mean square to 11.1 which is 27.8% of the objective and just outside the specification outlined in TG(09). On examining the remaining locations, the model appears to perform particularly badly for the sampling location Queen Margaret Drive 3. The under-prediction of NO₂ by the model at this location is thought to reflect the impact of various buildings at this location on dispersion, although neither Queen Margaret Drive nor the western segment of the Great Western Road at this location are canyons. If Queen Margaret Drive 3 is taken out of the comparison on the basis that the complexity of building geometry at this location was not captured in the model configuration, the root mean square reduces to 9.5, 23.9% of the objective and within specification.

3.1.2 PM₁₀ calibration

TEOM monitoring data is available for 2008 for Byres Road and Battlefield Road from the Scottish Air Quality website (www.scottishairquality.co.uk). Table 3.2 shows the comparison of modelled and measured results and the calculated calibration factors for model results at locations with and without canyon geometry based on this comparison. The traffic data for Battlefield Road were for 2004 and an estimate of 2008 flows was made by assuming a year on year increase of 1.3% in line with the UK average rate of increase over recent years. The impact on the model output was small with the predicted concentration based on the estimated 2008 flow being 13.4 ugm⁻³ compared with 13.2 ugm⁻³ based on the 2004 figures.

Table 3.2: Comparison of modelled and measured concentrations of PM₁₀ (ugm⁻³) for 2008 and the calculated calibration factor for conversion of model results to estimated concentrations.

Location	Modelled PM ₁₀	Measured PM ₁₀	Ratio of measured to model total concentration	Background	Inferred traffic component		Calibration factor for traffic component
					Model	Measured	
Byres Road	15.5	19.7	1.27	12.30	3.16	7.40	2.34
Battlefield Road	13.4*	16.3	1.22	11.37	2.01	4.93	2.45

*based on estimated 2008 traffic flows

3.2 PM₁₀ BY LOCATION

3.2.1 Model results

Table 3.3 tabulates the uncalibrated results for the air quality modelling for 2010 and 2015 and Table 3.4 shows the calibrated results for the same years. National grid references for each location are given in the Appendix. Table 3.5 shows the predicted concentrations of PM₁₀ for the intervening years (based on the calibrated model outputs). The absence of any traffic data for University Avenue meant that it was impossible to model concentrations of PM₁₀ for this location. Given that traffic flow appears to be lower than on other local routes and that it is a relatively open location, comparison with the other locations, suggest that it is relatively unlikely that the 18 ugm⁻³ objective would not be met at this location.

Table 3.3: Predicted concentrations of PM₁₀ (ugm⁻³) for candidate locations based on output of ADMS model – not calibrated against measurement data

Location	Receptor - description	Receptor	2010	2015
Bridgeton Cross (canyon)	Tenement corner London Road/Orr Street	1	13.60	12.39
	Tenement corner Orr Street/Olympia Street	2	12.21	11.37
	Tenement west side cross opposite subway	3	15.73	13.96
	Tenement north side James Street at junction with Main Street	4	13.21	12.10
	Tenement, east side of Main Street at junction with Dalmarnock Road	5	12.84	11.83
	Tenement at junction Olympia Street/Dalmarnock Road	6	14.72	13.21
	S side Dalmarnock Road, 3 blocks from Main Street	7	13.09	12.02
	N side Dalmarnock Road, 3 blocks from Main Street	8	12.20	11.37
	Flats south side of London Road, 200 m east of junction with Olympia Street	9	12.53	11.61
Springburn Road (not canyon)	Flats west of Lenzie Street above Springburn Road	1	12.06	11.35
	House Springburn Park –closest property to Springburn Road	2	12.03	11.33
	Flats at corner of Atlas Road/Springburn Road (south of junction)	3	14.20	12.92

Location	Receptor - description	Receptor	2010	2015
	Tenement at corner of Keppochill Road/Springburn Road (south of junction)	4	13.12	12.13
	Tenement north side of Keppoch Road, 120 m west of junction	5	14.39	13.07
	Tenement south side of Keppoch Road, 120 east of junction	6	14.43	13.09
Sauchiehall Street – junction with Elderslie Street (canyon)	Sauchiehall St west of junction: Terrace north side	1	15.78	14.64
	Sauchiehall St west of junction: Terrace south side	2	17.51	15.91
	Elderslie St north of junction: Terrace east side	3	16.24	14.98
	Elderslie St north of junction: Terrace west side	4	16.42	15.11
	Elderslie St south of junction: Terrace east side	5	15.46	14.41
	Elderslie St south of junction: Terrace west side	6	16.83	15.41
	Sauchiehall St east of junction: Terrace north side	7	15.42	14.38
	Sauchiehall St east of junction: Terrace south side	8	16.11	14.89
Sauchiehall Street – junction with Claremont (canyon)	Sauchiehall St west of junction: Terrace South side	9	16.85	15.42
	Sauchiehall St west of junction: Terrace west end of Crescent	10	15.52	14.45
	Sauchiehall St west of junction: Terrace middle of Crescent	11	16.29	15.02
	Sauchiehall St east of junction: Terrace south side	12	16.40	15.10
	Sauchiehall St east of junction: Terrace north side	13	15.46	14.41
Sauchiehall Street, junction with North Street (canyon)	Tenement, south side Sauchiehall St	14	18.00	16.26
	Terrace, north side, Newton Place	15	17.14	15.64
Dumbarton Road (canyon)	Intersection with Byres Road, tenement on west corner	1	17.18	15.36
	Intersection with Byres Road, tenement on east corner	2	18.52	16.39
	Intersection with Crow Road, tenement on east corner	3	13.55	12.60
Argyle Street (canyon)	Tenement on north side of Argyle Street, west of Kent Road	1	17.14	15.10
	Tenement on north side of Argyle Street, east of Kent Road	2	17.65	15.47
	Tenement on north side of Argyle Street, east of Claremont Street	3	17.69	15.49
	Tenement on north side of Argyle Street, east of Breadlebane Street	4	16.68	14.77
	Tenement on north side of Argyle Street, between Gray Street and Derby Street	5	13.55	12.53
	Tenement on south side of Argyle Street, between Gray Street and Derby Street	6	17.51	15.37
	Tenement on north side of Argyle Street, between Kelvingrove Street and Berkeley Street	8	19.04	16.46
	Tenement on south side of Argyle Street, between Kelvingrove Street and Berkeley Street	4	16.67	14.77
Byres Road (canyon)	Tenement, west side between Church Street and University Avenue	1	13.86	12.83
	Tenement, east side between Church Street and University Avenue	2	14.62	13.42

Location	Receptor - description	Receptor	2010	2015
University Avenue (not canyon)	no data	no data	0.00	0.00
Woodlands Road (canyon)	Tenement – west side of Woodlands Road, north of Barrington Drive	1	13.74	12.67
	Tenement –east side of Woodlands Road, north of Barrington Drive	2	15.20	13.71
	Tenement, east side of Woodlands Road, south of Lynedoch Street	3	13.66	12.61
	Tenement in Woodside Crescent, backing onto Woodlands Road, closest property	4	15.06	13.61
	Tenement on corner of St. Georges Road	5	16.05	14.32
Great Western Road – intersection with Dorchester Avenue (not canyon)	Flats – corner of Great Western Rd W/Dorchester Avenue	1	11.44	10.73
	Villa – corner of Great Western Rd W/Cranborne Rd	2	16.92	14.82
Great Western Road – intersection with Shelley Road (not canyon)	House on corner of Leicester Ave/Great Western Rd E	3	11.00	10.40
Great Western Road at junction with Hyndland Road (not canyon)	Terrace, south side of Gt Western Rd, at intersection with Hyndland Rd (East of)	4	15.39	13.81
	Terrace, north side of Gt Western Rd, west of intersection with Cleuden Rd	5	12.12	11.38
Great Western Road – between Hyndland Road and Queen Margaret Drive (not canyon)	Bellhaven Terrace – junction with Horselet Hill, end terrace	6	13.53	12.43
	Kirklee Terrace – junction with Kirklee Rd – end Terrace	7	11.60	10.98
	Terrace – corner Queen Margaret Drive	8	11.50	11.31
	Tenement, south side Great Western Road E	9	11.50	11.31
Anniesland Cross (not canyon)	Anniesland Rd – flats on roundabout	1	14.18	12.91
	Bearsden Road – flats on W side	2	14.19	12.91
	Crow Rd – tenement on east side	3	12.78	11.82
	Great Western Rd NW-Flats on N side	4	12.44	11.56
	Great Western Rd Flats on S side	5	13.38	12.29
	Great Western Rd SE Tenements on N side	6	11.36	10.73
	Great Western Rd SE Tenements on S side	7	13.57	12.44
Balshagray Avenue (not canyon)	House, corner of Victoria Park Drive North/Balshagray Avenue	1	12.87	11.92
	House, Balshagray Ave, 50 m north of Victoria Park Drive	2	12.42	11.57
	House, corner of Victoria Park Gdns/Balshagray Avenue	3	12.60	11.71
Hyndland Road (canyon)	Terrace west side, north end Hyndland Road	1	15.48	14.15
	Terrace east side, north end Hyndland Road	2	12.81	12.13
	Terrace, west side Hyndland Road – two houses down from Queensborough Gdns	3	13.80	12.34
	Terrace directly opposite on east side	4	14.33	12.74
Finnieston Street (not canyon)	Flats east side of Finnieston Street, 50 m from junction with Argyle Street	1	15.02	13.58
	Flats east side of Finnieston Street at corner opposite bridge	2	14.49	13.20
	Flats east side of Finniston Street – north end of block facing bridge	3	14.33	13.09
Maryhill Road at Maryhill (canyon)	At Maryhill, north of Kilmun Street - Tenement east side	1	16.05	14.28
	At Maryhill, north of Kilmun Street - Tenement west side	2	16.31	14.48

Location	Receptor - description	Receptor	2010	2015
Maryhill Road at intersection with Garrioch Street (complex)	At intersection with Garrioch Street - Flats opposite shopping centre	3	12.40	11.48
	Flats on E side Maryhill Road, north of intersection	4	13.37	12.20
Maryhill Road - intersection with Hopehill Road (complex)	Tenements on Maryhill Rd, north of intersection, W side	5	16.03	14.69
	Tenements on Maryhill Rd, north of intersection, W side	6	17.80	15.97
Paisley Road West Canyon in parts	Crookston Road intersection, house north-west corner	1	12.87	12.22
	Crookston Road intersection, house north-east corner	2	14.33	13.34
	Crookston Road intersection, first house to east on Paisley Road West	3	13.40	12.63
	Crookston Road intersection, first house to west on Paisley Road West	4	13.60	12.78
	First house on west-side Berryknowes Road, north of junction	5	17.48	15.66
	First house east of Morrisons on north side Paisley Road West	6	18.07	16.11
	Mosspark Boulevard intersection, tenement, south-west corner	7	14.82	13.62
	Corkerhill Road junction– tenement south-east corner	8	17.50	15.68
	Corkerhill Road junction – tenement south-west corner	9	16.69	15.07
	Corkhill Road junction, tenement directly opposite junction on north-side Paisley Road West	10	17.90	15.98
	Tenement 100 m east of Corkerhill Road, north side Paisley Road West	11	15.87	14.45
	Tenement 100 m east of Corkerhill Road, south side Paisley Road West	12	17.66	15.80
	Balhouston Drive junction, tenement south-west corner	13	18.94	16.76
	Jura Street junction, tenement north-east corner	14	16.39	14.84
Pollokshaws Road (canyon)	Tenement west side, midway between Calder Street and Alison Street	1	14.63	13.16
	Tenement east side, midway between Calder Street and Alison Street	2	16.88	14.83
	Tenement on opposite side of road from pond in Queens Park	3	15.31	13.66
Parkhead Cross (canyon)	Tenement, south side of Gallowgate, first block east of Springfield Road	1	21.01	20.31
	Tenement, west side of Springfield Road, 30 m south of junction	2	15.81	16.46
	Tenement, east side of Springfield Road, 30 m at junction	3	16.28	16.81
	Tenement, corner of Duke Street, Westmuir Street	4	13.48	14.74
	Tenement, east side Westmuir Street at junction	5	11.67	13.40
	Tenement, north side Tollcross Road, 30 m east of junction	6	12.20	13.79
Baillieston Road / Barrachnie Road (not canyon)	Corner house Baillieston Road/Barrachnie Road	1	13.67	12.41
	First house, east side of Barrachnie Road	2	11.63	10.86

Location	Receptor - description	Receptor	2010	2015
	First house, east side of Garrowhill Drive	3	11.02	10.40
	Pub, at corner, Glasgow Road	4	11.62	10.86
	Corner house Mount Vernon Road/Baillestone Road	5	13.87	12.56
	Corner house Mount Vernon road, Glasgow Road	6	11.93	11.09

Table 3.4: Predicted concentrations of PM₁₀ (ugm⁻³) for candidate locations based on output of ADMS model –**traffic component** calibrated against measurement data

Location	Receptor - description	Receptor	Traffic correction	2010	2015
Bridgeton Cross (canyon)	Tenement corner London Road/Orr Street	1	2.34	15.93	14.10
	Tenement corner Orr Street/Olympia Street	2	2.34	12.68	11.71
	Tenement west side cross opposite subway	3	2.34	20.90	17.76
	Tenement north side James Street at junction with Main Street	4	2.34	15.00	13.42
	Tenement, east side of Main Street at junction with Dalmarnock Road	5	2.34	14.14	12.79
	Tenement at junction Olympia Street/Dalmarnock Road	6	2.34	18.54	16.02
	S side Dalmarnock Road, 3 blocks from Main Street	7	2.34	14.73	13.23
	N side Dalmarnock Road, 3 blocks from Main Street	8	2.34	12.66	11.70
	Flats south side of London Road, 200 m east of junction with Olympia Street	9	2.45	13.49	12.31
Springburn Road (not canyon)	Flats west of Lenzie Street above Springburn Road	1	2.45	12.27	11.50
	House Springburn Park –closest property to Springburn Road	2	2.45	12.21	11.46
	Flats at corner of Atlas Road/Springburn Road (south of junction)	3	2.45	17.51	15.36
	Tenement at corner of Keppochill Road/Springburn Road (south of junction)	4	2.45	14.87	13.42
	Tenement north side of Keppoch Road, 120 m west of junction	5	2.34	17.71	15.51
	Tenement south side of Keppoch Road, 120 east of junction	6	2.34	17.80	15.57
Sauchiehall Street – junction with Elderslie Street (canyon)	Sauchiehall St west of junction: Terrace north side	1	2.34	16.31	15.03
	Sauchiehall St west of junction: Terrace south side	2	2.34	20.37	18.00
	Elderslie St north of junction: Terrace east side	3	2.34	17.40	15.83
	Elderslie St north of junction: Terrace west side	4	2.34	17.82	16.13

Location	Receptor - description	Receptor	Traffic correction	2010	2015
	Elderslie St south of junction: Terrace east side	5	2.34	15.57	14.49
	Elderslie St south of junction: Terrace west side	6	2.34	18.77	16.83
	Sauchiehall St east of junction: Terrace north side	7	2.34	15.48	14.42
	Sauchiehall St east of junction: Terrace south side	8	2.34	17.10	15.61
Sauchiehall Street – junction with Claremont (canyon)	Sauchiehall St west of junction: Terrace South side	9	2.34	18.82	16.86
	Sauchiehall St west of junction: Terrace west end of Crescent	10	2.34	15.71	14.59
	Sauchiehall St west of junction: Terrace middle of Crescent	11	2.34	17.52	15.91
	Sauchiehall St east of junction: Terrace south side	12	2.34	17.77	16.10
	Sauchiehall St east of junction: Terrace north side	13	2.34	15.57	14.49
Sauchiehall Street, junction with North Street (canyon)	Tenement, south side Sauchiehall St	14	2.34	21.51	18.83
	Terrace, north side, Newton Place	15	2.34	19.51	17.37
Dumbarton Road (canyon)	Intersection with Byres Road, tenement on west corner	1	2.34	23.77	20.39
	Intersection with Byres Road, tenement on east corner	2	2.34	26.91	22.79
	Intersection with Crow Road, tenement on east corner	3	2.34	15.28	13.91
Argyle Street (canyon)	Tenement on north side of Argyle Street, west of Kent Road	1	2.34	17.16	15.11
	Tenement on north side of Argyle Street, east of Kent Road	2	2.34	24.44	20.34
	Tenement on north side of Argyle Street, east of Claremont Street	3	2.34	24.53	20.40
	Tenement on north side of Argyle Street, east of Breadlebane Street	4	2.34	22.17	18.71
	Tenement on north side of Argyle Street, between Gray Street and Derby Street	5	2.34	25.65	21.21
	Tenement on south side of Argyle Street, between Gray Street and Derby Street	6	2.34	24.12	20.11
	Tenement on north side of Argyle Street, between Kelvingrove Street and Berkeley Street	7	2.34	27.68	22.67
	Tenement on south side of Argyle Street, between Kelvingrove Street and Berkeley Street	8	2.34	22.15	18.70
	Byres Road (canyon)	Tenement, west side between Church Street and University Avenue	1	2.34	16.01
Tenement, east side between Church Street and University Avenue		2	2.34	17.79	15.83
University Avenue (not canyon)	no data	no data		0.00	0.00
Woodlands Road (canyon)	Tenement – west side of Woodlands Road, north of Barrington Drive	1	2.34	15.30	13.78

Location	Receptor - description	Receptor	Traffic correction	2010	2015
	Tenement –east side of Woodlands Road, north of Barrington Drive	2	2.34	18.71	16.23
	Tenement, east side of Woodlands Road, south of Lynedoch Street	3	2.34	15.10	13.64
	Tenement in Woodside Crescent, backing onto Woodlands Road, closest property	4	2.34	18.37	15.98
	Tenement on corner of St. Georges Road	5	2.34	20.70	17.66
Great Western Road – intersection with Dorchester Avenue (not canyon)	Flats – corner of Great Western Rd W/Dorchester Avenue	1	2.45	12.09	11.22
	Villa – corner of Great Western Rd W/Cranborne Rd	2	2.45	25.51	21.25
Great Western Road – intersection with Shelley Road (not canyon)	House on corner of Leicester Ave/Great Western Rd E	3	2.45	11.01	10.41
Great Western Road at junction with Hyndland Road (not canyon)	Terrace, south side of Gt Western Rd, at intersection with Hyndland Rd (East of)	4	2.45	20.92	17.95
	Terrace, north side of Gt Western Rd, west of intersection with Cleuden Rd	5	2.45	12.93	11.98
Great Western Road – between Hyndland Rd and Queen Margaret Dr (not canyon)	Bellhaven Terrace – junction with Horselet Hill, end terrace	6	2.45	16.39	14.56
	Kirklee Terrace – junction with Kirklee Rd – end Terrace	7	2.45	11.64	11.01
	Terrace – corner Queen Margaret Drive	8	2.45	12.19	11.82
	Tenement, south side Great Western Road E	9	2.45	12.19	11.82
Anniesland Cross (not canyon)	Anniesland Rd – flats on roundabout	1	2.45	18.28	16.07
	Bearsden Road – flats on W side	2	2.45	18.30	16.09
	Crow Rd – tenement on east side	3	2.45	14.84	13.42
	Great Western Rd NW-Flats on N side	4	2.34	13.89	12.68
	Great Western Rd Flats on S side	5	2.34	16.10	14.39
	Great Western Rd SE Tenements on N side	6	2.34	11.36	10.73
	Great Western Rd SE Tenements on S side	7	2.34	16.54	14.73
Balshagray Avenue (not canyon)	House, corner of Victoria Park Drive North/Balshagray Avenue	1	2.45	14.59	13.25
	House, Balshagray Ave, 50 m north of Victoria Park Drive	2	2.45	13.49	12.40
	House, corner of Victoria Park Gdns/Balshagray Avenue	3	2.45	13.93	12.74
Hyndland Road (canyon)	Terrace west side, north end Hyndland Road	1	2.34	21.14	18.42
	Terrace east side, north end Hyndland Road	2	2.34	14.89	13.70
	Terrace, west side Hyndland Road – two houses down from Queensborough Gdns	3	2.34	16.79	14.58
	Terrace directly opposite on east side	4	2.34	18.03	15.50

Location	Receptor - description	Receptor	Traffic correction	2010	2015
Finnieston Street (not canyon)	Flats east side of Finnieston Street, 50 m from junction with Argyle Street	1	2.45	18.55	16.11
	Flats east side of Finnieston Street at corner opposite bridge	2	2.45	17.26	15.19
	Flats east side of Finniston Street – north end of block facing bridge	3	2.45	16.88	14.91
Maryhill Road at Maryhill (canyon)	At Maryhill, north of Kilmun Street - Tenement east side	1	2.34	23.19	19.75
	At Maryhill, north of Kilmun Street - Tenement west side	2	2.34	23.82	20.23
Maryhill Road at intersection with Garrioch Street (complex)	At intersection with Garrioch Street - Flats opposite shopping centre	3	2.45	14.43	13.00
	Flats on E side Maryhill Road, north of intersection	4	2.45	16.79	14.77
Maryhill Road - intersection with Hopehill Road (complex)	Tenements on Maryhill Rd, north of intersection, W side	5	2.45	18.00	16.11
	Tenements on Maryhill Rd, north of intersection, W side	6	2.45	22.34	19.25
Paisley Road West Canyon in parts	Crookston Road intersection, house north-west corner	1	2.45	16.64	15.10
	Crookston Road intersection, house north-east corner	2	2.45	20.21	17.84
	Crookston Road intersection, first house to east on Paisley Road West	3	2.45	17.94	16.10
	Crookston Road intersection, first house to west on Paisley Road West	4	2.45	18.42	16.47
	First house on west-side Berryknowes Road, north of junction	5	2.45	24.63	21.15
	First house east of Morrisons on north side Paisley Road West	6	2.45	26.07	22.26
	Mosspark Boulevard intersection, tenement, south-west corner	7	2.34	17.86	15.96
	Corkerhill Road junction – tenement south-east corner	8	2.34	23.16	19.95
	Corkerhill Road junction – tenement south-west corner	9	2.34	21.27	18.52
	Corkhill Road junction, tenement directly opposite junction on north-side Paisley Road West	10	2.34	24.09	20.65
	Tenement 100 m east of Corkerhill Road, north side Paisley Road West	11	2.34	19.35	17.07
	Tenement 100 m east of Corkerhill Road, south side Paisley Road West	12	2.34	23.54	20.24
	Balhouston Drive junction, tenement south-west corner	13	2.45	27.15	22.96
	Jura Street junction, tenement north-east corner	14	2.45	20.90	18.24
Pollokshaws Road (canyon)	Tenement west side, midway between Calder Street and Alison Street	1	2.34	19.63	16.88

Location	Receptor - description	Receptor	Traffic correction	2010	2015
	Tenement east side, midway between Calder Street and Alison Street	2	2.34	24.87	20.80
	Tenement on opposite side of road from pond in Queens Park	3	2.45	21.70	18.43
Parkhead Cross (canyon)	Tenement, south side of Gallowgate, first block east of Springfield Road	1	2.34	34.07	29.97
	Tenement, west side of Springfield Road, 30 m south of junction	2	2.34	21.90	20.97
	Tenement, east side of Springfield Road, 30 m at junction	3	2.34	23.01	21.79
	Tenement, corner of Duke Street, Westmuir Street	4	2.34	16.46	16.94
	Tenement, east side Westmuir Street at junction	5	2.34	12.22	13.80
	Tenement, north side Tollcross Road, 30 m east of junction	6	2.34	13.45	14.71
Baillieston Road / Barrachnie Road (not canyon)	Corner house Bailliestone Road/Barrachnie Road	1	2.45	18.13	15.78
	First house, east side of Barrachnie Road	2	2.45	13.13	12.00
	First house, east side of Garrowhill Drive	3	2.45	11.64	10.87
	Pub, at corner, Glasgow Road	4	2.45	13.11	11.98
	Corner house Mount Vernon Road/Bailliestone Road	5	2.45	18.61	16.14
	Corner house Mount Vernon road, Glasgow Road	6	2.45	13.87	12.56

Table3.5: Predicted annual mean concentrations of PM₁₀ (ugm⁻³) for years between 2010 and 2015 at receptor locations –**traffic component** calibrated against measurement data

Location	Receptor	2010	2011	2012	2013	2014	2015
Bridgeton Cross	1	15.93	15.56	15.20	14.83	14.47	14.10
	2	12.68	12.48	12.29	12.10	11.91	11.71
	3	20.90	20.27	19.65	19.02	18.39	17.76
	4	15.00	14.69	14.37	14.05	13.74	13.42
	5	14.14	13.87	13.60	13.33	13.06	12.79
	6	18.54	18.04	17.53	17.03	16.52	16.02
	7	14.73	14.43	14.13	13.83	13.53	13.23
	8	12.66	12.47	12.27	12.08	11.89	11.70
	9	13.49	13.26	13.02	12.78	12.55	12.31
Springburn Road	1	12.27	12.12	11.97	11.81	11.66	11.50
	2	12.21	12.06	11.91	11.76	11.61	11.46
	3	17.51	17.08	16.65	16.22	15.79	15.36
	4	14.87	14.58	14.29	14.00	13.71	13.42
	5	17.71	17.27	16.83	16.39	15.95	15.51
	6	17.80	17.35	16.91	16.46	16.02	15.57
Sauchiehall Street	1	16.31	16.06	15.80	15.54	15.29	15.03
	2	20.37	19.90	19.42	18.95	18.47	18.00
	3	17.40	17.09	16.77	16.46	16.14	15.83

Location	Receptor	2010	2011	2012	2013	2014	2015
	4	17.82	17.48	17.15	16.81	16.47	16.13
	5	15.57	15.35	15.14	14.92	14.71	14.49
	6	18.77	18.38	17.99	17.61	17.22	16.83
	7	15.48	15.27	15.06	14.84	14.63	14.42
	8	17.10	16.80	16.50	16.21	15.91	15.61
	1	18.82	18.43	18.04	17.65	17.25	16.86
	2	15.71	15.49	15.26	15.04	14.82	14.59
	3	17.52	17.20	16.88	16.56	16.24	15.91
	4	17.77	17.44	17.10	16.77	16.44	16.10
	5	15.57	15.35	15.14	14.92	14.71	14.49
	1	21.51	20.97	20.44	19.90	19.37	18.83
	2	19.51	19.09	18.66	18.23	17.80	17.37
	Dumbarton Road	1	23.77	23.09	22.41	21.74	21.06
	2	26.91	26.08	25.26	24.44	23.61	22.79
	1	15.28	15.01	14.73	14.46	14.19	13.91
Argyle Street	1	17.16	16.75	16.34	15.93	15.52	15.11
	2	24.44	23.62	22.80	21.98	21.16	20.34
	3	24.53	23.70	22.88	22.05	21.23	20.40
	4	22.17	21.48	20.79	20.10	19.40	18.71
	5	25.65	24.76	23.87	22.99	22.10	21.21
	6	24.12	23.31	22.51	21.71	20.91	20.11
	7	27.68	26.68	25.68	24.67	23.67	22.67
	8	22.15	21.46	20.77	20.08	19.39	18.70
Byres Road	1	16.01	15.70	15.40	15.09	14.78	14.47
	2	17.79	17.40	17.01	16.62	16.22	15.83
University Avenue	no data	0.00	0.00	0.00	0.00	0.00	0.00
Woodlands Road	1	15.30	15.00	14.69	14.39	14.09	13.78
	2	18.71	18.22	17.72	17.22	16.73	16.23
	3	15.10	14.81	14.52	14.23	13.93	13.64
	4	18.37	17.89	17.41	16.94	16.46	15.98
	5	20.70	20.09	19.48	18.88	18.27	17.66
Great Western Road	1	12.09	11.92	11.74	11.57	11.39	11.22
	2	25.51	24.66	23.81	22.95	22.10	21.25
	3	11.01	10.89	10.77	10.65	10.53	10.41
	4	20.92	20.33	19.73	19.14	18.55	17.95
	5	12.93	12.74	12.55	12.36	12.17	11.98
	6	16.39	16.02	15.66	15.29	14.93	14.56
	7	11.64	11.51	11.39	11.26	11.14	11.01
	8	12.19	12.12	12.04	11.97	11.90	11.82
	9	12.19	12.12	12.04	11.97	11.90	11.82
Anniesland Cross	1	18.28	17.84	17.40	16.96	16.52	16.07
	2	18.30	17.86	17.42	16.98	16.53	16.09
	3	14.84	14.56	14.27	13.99	13.70	13.42
	4	13.89	13.65	13.40	13.16	12.92	12.68
	5	16.10	15.75	15.41	15.07	14.73	14.39
	6	11.36	11.24	11.11	10.98	10.85	10.73
	7	16.54	16.18	15.81	15.45	15.09	14.73
Balshagray Avenue	1	14.59	14.33	14.06	13.79	13.52	13.25
	2	13.49	13.27	13.05	12.84	12.62	12.40
	3	13.93	13.69	13.46	13.22	12.98	12.74
Hyndland Road	1	21.14	20.60	20.05	19.51	18.96	18.42

Location	Receptor	2010	2011	2012	2013	2014	2015
	2	14.89	14.65	14.41	14.17	13.94	13.70
	3	16.79	16.35	15.91	15.46	15.02	14.58
	4	18.03	17.52	17.02	16.51	16.01	15.50
Finnieston Street	5	18.55	18.06	17.58	17.09	16.60	16.11
	6	17.26	16.85	16.43	16.02	15.60	15.19
	7	16.88	16.48	16.09	15.70	15.30	14.91
Maryhill Road	1	23.19	22.50	21.82	21.13	20.44	19.75
	2	23.82	23.10	22.38	21.66	20.95	20.23
	3	14.43	14.14	13.86	13.57	13.28	13.00
	4	16.79	16.39	15.98	15.58	15.17	14.77
	5	18.00	17.62	17.25	16.87	16.49	16.11
	6	22.34	21.73	21.11	20.49	19.87	19.25
Paisley Road West	1	16.64	16.33	16.02	15.71	15.41	15.10
	2	20.21	19.74	19.26	18.79	18.31	17.84
	3	17.94	17.58	17.21	16.84	16.47	16.10
	4	18.42	18.03	17.64	17.25	16.86	16.47
	5	24.63	23.93	23.24	22.54	21.85	21.15
	6	26.07	25.31	24.54	23.78	23.02	22.26
	7	17.86	17.48	17.10	16.72	16.34	15.96
	8	23.16	22.52	21.87	21.23	20.59	19.95
	9	21.27	20.72	20.17	19.62	19.07	18.52
	10	24.09	23.40	22.71	22.03	21.34	20.65
	11	19.35	18.89	18.44	17.98	17.53	17.07
	12	23.54	22.88	22.22	21.56	20.90	20.24
	13	27.15	26.31	25.48	24.64	23.80	22.96
	14	20.90	20.37	19.83	19.30	18.77	18.24
Pollokshaws Road	1	19.63	19.08	18.53	17.98	17.43	16.88
	2	24.87	24.06	23.24	22.43	21.62	20.80
	3	21.70	21.05	20.39	19.74	19.09	18.43
Parkhead Cross	1	34.07	33.25	32.43	31.61	30.79	29.97
	2	21.90	21.72	21.53	21.34	21.16	20.97
	3	23.01	22.77	22.52	22.28	22.03	21.79
	4	16.46	16.55	16.65	16.75	16.84	16.94
	5	12.22	12.53	12.85	13.17	13.49	13.80
	6	13.45	13.70	13.95	14.21	14.46	14.71
Baillieston Road / Barrachnie Road	1	18.13	17.66	17.19	16.72	16.25	15.78
	2	13.13	12.91	12.68	12.45	12.22	12.00
	3	11.64	11.48	11.33	11.18	11.02	10.87
	4	13.11	12.88	12.66	12.43	12.21	11.98
	5	18.61	18.12	17.62	17.13	16.64	16.14
	6	13.87	13.61	13.34	13.08	12.82	12.56

The uncalibrated outcome of the modelling predicts annual mean concentrations of PM₁₀ in 2010 that exceed 18 µg m⁻³ at locations in Sauchiehall Street (close to the M8), Argyle Street, Dumbarton Road (at the intersection with Byres Road), Paisley Road West (towards the eastern end), and Parkhead Cross. Based on the anticipated fall in emissions and concentrations of PM₁₀ by 2015, the predicted annual mean concentrations of PM₁₀ in 2015 only exceed 18 µg m⁻³ at Parkhead Cross.

The impact of calibrating the traffic component of the model output using measurement data is to greatly increase the predicted concentrations of PM₁₀. When the calibration factors derived from measurement data are applied to the predicted increment in PM₁₀ due to traffic

emissions, the results suggest that annual mean concentrations of PM₁₀ will exceed 18 $\mu\text{g m}^{-3}$ in 2010 at locations in Bridgeton Cross, Sauchiehall Street, Argyle Street, Woodlands Road, the Great Western Road, Anniesland, Hyndland Road, Finneston Street, Maryhill Road, Dumbarton Road (at the intersection with Byres Road), Paisley Road West, Pollokshaws Road, Parkhead Cross and the Bailleston Road/Barrachnie Avenue intersection. Even allowing for the anticipated fall in emissions and concentrations of PM₁₀ by 2015, the calibrated predicted annual mean concentrations of PM₁₀ in 2015 exceed 18 $\mu\text{g m}^{-3}$ at Parkhead Cross, at locations in Bridgeton Cross, Sauchiehall Street, Argyle Street, the Great Western Road, Hyndland Road, Finneston Street, Maryhill Road, Dumbarton Road (at the intersection with Byres Road), Paisley Road West, Pollokshaws Road and Parkhead Cross. It must be noted that as the calibration is based on only single measurements for a canyon and noncanyon situation and assumes that the true background concentrations equal the predicted background concentrations, the uncertainty associated with the calibrated results is almost as great as for the uncalibrated model output.

At most locations, the uncalibrated model output predicts that traffic only contributes to a small proportion of concentrations of PM₁₀ such that the predicted background concentrations of PM₁₀ have a much greater impact on predicted total levels of PM₁₀ than traffic. The contribution of local traffic emissions to total predicted concentrations of PM₁₀ varies from less than 1% to >40% but exceeded 15% for almost 50% of the modelled locations (Fig. 3.1; Table 3.6).

Figure 3.1: Contribution of traffic emissions to total predicted concentrations of PM₁₀ in 2010 (uncalibrated model results)

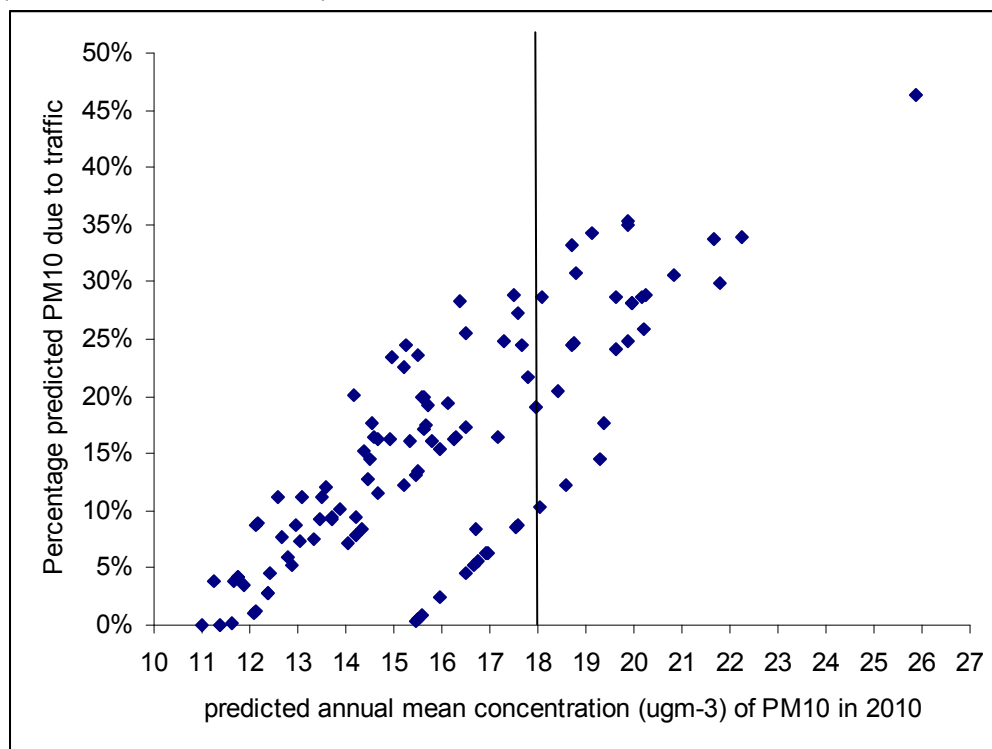


Table 3.6: Percentage contribution of traffic emissions to total predicted concentrations of PM₁₀ at each location

Location	Receptor	Proportion of predicted PM ₁₀ attributable to traffic			
		Uncalibrated model output		Calibrated model output	
		2010	2015	2010	2015
Bridgeton Cross	1	12.8%	10.3%	29.95%	24.10%
	2	2.8%	2.2%	6.55%	5.15%
	3	24.6%	20.3%	57.56%	47.50%
	4	10.1%	8.1%	23.63%	18.95%
	5	7.6%	6.0%	17.78%	14.04%
	6	19.4%	15.9%	45.40%	37.21%
	7	9.4%	7.5%	22.00%	17.55%
	8	2.8%	2.2%	6.55%	5.15%
	9	5.3%	4.2%	12.99%	10.29%
Springburn Road	1	1.2%	0.9%	2.94%	2.21%
	2	1.0%	0.8%	2.45%	1.96%
	3	16.1%	13.0%	39.45%	31.85%
	4	9.2%	7.3%	22.54%	17.89%
	5	17.2%	14.0%	40.25%	32.76%
	6	17.4%	14.1%	40.72%	32.99%
Sauchiehall Street	1	2.5%	2.0%	5.85%	4.68%
	2	12.2%	9.8%	28.55%	22.93%
	3	5.3%	4.2%	12.40%	9.83%
	4	6.4%	5.0%	14.98%	11.70%
	5	0.5%	0.4%	1.17%	0.94%
	6	8.6%	6.9%	20.12%	16.15%
	7	0.3%	0.2%	0.70%	0.47%
	8	4.6%	3.6%	10.76%	8.42%
	9	8.7%	7.0%	20.36%	16.38%
	10	0.9%	0.7%	2.11%	1.64%
	11	5.6%	4.4%	13.10%	10.30%
	12	6.2%	5.0%	14.51%	11.70%
	13	0.5%	0.4%	1.17%	0.94%
	14	14.6%	11.8%	34.16%	27.61%
	15	10.3%	8.3%	24.10%	19.42%
Dumbarton Road	1	28.6%	24.4%	66.92%	57.10%
	2	33.8%	29.1%	79.09%	68.09%
	3	9.5%	7.8%	22.23%	18.25%
Argyle Street	1	13.4%	10.6%	31.36%	24.80%
	2	28.7%	23.5%	67.16%	54.99%
	3	28.9%	23.6%	67.63%	55.22%
	4	24.6%	19.9%	57.56%	46.57%
	5	7.1%	5.5%	16.61%	12.87%
	6	28.1%	23.0%	65.75%	53.82%
	7	33.9%	28.1%	79.33%	65.75%
	8	24.5%	19.9%	57.33%	46.57%
Bryes Road	1	11.6%	9.5%	27.14%	22.23%
	2	16.2%	13.4%	37.91%	31.36%
Woodlands Road	1	8.4%	6.6%	0.00%	0.00%
	2	17.2%	13.7%	40.25%	32.06%

Location	Receptor	Proportion of predicted PM ₁₀ attributable to traffic			
		Uncalibrated model output		Calibrated model output	
		2010	2015	2010	2015
	3	7.9%	6.1%	18.49%	14.27%
	4	16.4%	13.0%	38.38%	30.42%
	5	21.6%	17.4%	50.54%	40.72%
	1	3.9%	3.1%	9.13%	7.25%
	2	35.0%	29.9%	85.75%	73.26%
Great Western Road	3	0.1%	0.1%	0.25%	0.25%
	4	24.8%	20.7%	60.76%	50.72%
	5	4.6%	3.7%	11.27%	9.07%
	6	14.5%	11.8%	35.53%	28.91%
	7	0.3%	0.2%	0.74%	0.49%
	8	4.1%	3.1%	10.05%	7.60%
	9	4.1%	3.1%	10.05%	7.60%
	1	19.9%	16.9%	48.76%	41.41%
Anniesland Cross	2	20.0%	17.0%	49.00%	41.65%
	3	11.1%	9.3%	27.20%	22.79%
	4	8.7%	7.2%	21.32%	17.64%
	5	15.1%	12.7%	35.33%	29.72%
	6	0.0%	0.0%	0.00%	0.00%
	7	16.3%	13.8%	38.14%	32.29%
	Balshagray Avenue	1	9.2%	7.7%	21.53%
2		6.0%	5.0%	14.70%	12.25%
3		7.3%	6.1%	17.89%	14.95%
Hyndland Road	1	27.3%	22.5%	66.89%	55.13%
	2	12.1%	9.7%	28.31%	22.70%
	3	16.2%	13.5%	37.91%	31.59%
	4	19.3%	16.2%	45.16%	37.91%
Finnieston Street	1	16.2%	12.9%	37.91%	30.19%
	2	13.2%	10.4%	32.34%	25.48%
	3	12.2%	9.6%	29.89%	23.52%
Maryhill Road	1	33.2%	28.6%	81.34%	70.07%
	2	34.3%	29.6%	80.26%	69.26%
	3	11.3%	9.1%	26.44%	21.29%
	4	17.7%	14.5%	43.37%	35.53%
	5	8.5%	6.7%	20.83%	16.42%
	6	17.6%	14.2%	43.12%	34.79%
Paisley Road West	1	20.2%	16.3%	49.49%	39.94%
	2	28.3%	23.3%	69.34%	57.09%
	3	23.4%	19.0%	57.33%	46.55%
	4	24.5%	19.9%	60.03%	48.76%
	5	28.2%	24.2%	69.09%	59.29%
	6	30.5%	26.3%	74.73%	64.44%
	7	15.3%	12.8%	37.49%	31.36%
	8	24.1%	20.3%	56.39%	47.50%
	9	20.5%	17.1%	47.97%	40.01%
	10	25.8%	21.8%	60.37%	51.01%
	11	16.4%	13.6%	38.38%	31.82%
	12	24.8%	21.0%	58.03%	49.14%
	13	29.9%	25.5%	69.97%	59.67%

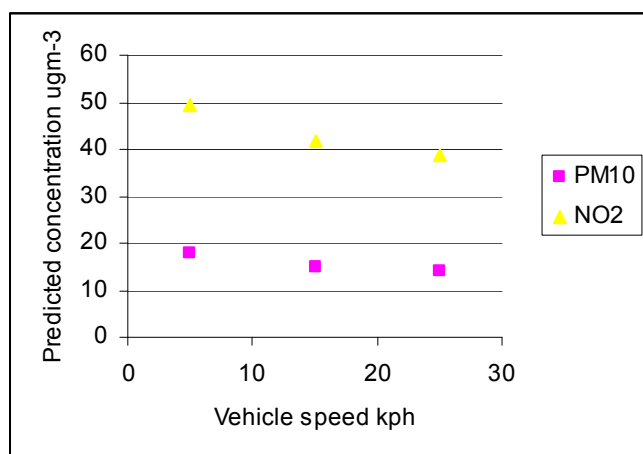
Location	Receptor	Proportion of predicted PM ₁₀ attributable to traffic			
		Uncalibrated model output		Calibrated model output	
		2010	2015	2010	2015
	14	19.0%	15.8%	46.55%	38.71%
Pollokshaws Road	1	25.5%	21.1%	62.48%	51.70%
	2	35.4%	30.1%	82.84%	70.43%
	3	28.8%	24.1%	67.39%	56.39%
Parkhead Cross	1	46.4%	35.5%	113.68%	86.98%
	2	28.8%	20.4%	67.39%	47.74%
	3	30.8%	22.1%	72.07%	51.71%
	4	16.5%	11.1%	38.61%	25.97%
	5	3.5%	2.2%	8.19%	5.15%
	6	7.6%	5.0%	17.78%	11.70%
Baillieston Road / Barrachnie Road	1	22.5%	18.8%	52.65%	43.99%
	2	8.9%	7.2%	21.81%	17.64%
	3	3.8%	3.1%	9.31%	7.60%
	4	8.8%	7.1%	21.56%	17.40%
	5	23.6%	19.7%	57.82%	48.27%
	6	11.2%	9.1%	27.44%	22.30%

3.3.2 Sensitivity analysis

Impact of estimated vehicle speed on air quality predictions

The estimated average vehicle speed used in modelling has a profound impact on predicted concentrations of PM₁₀ and NO₂ (Fig 3.2) and this contributes to a substantial uncertainty in the interpretation of the model output. It is likely that some of the mismatch between modelled and measured NO₂ concentrations for 2008 is due to inaccuracies in the estimated vehicle speeds in addition to uncertainty about the representativeness of the traffic flow data used in the model.

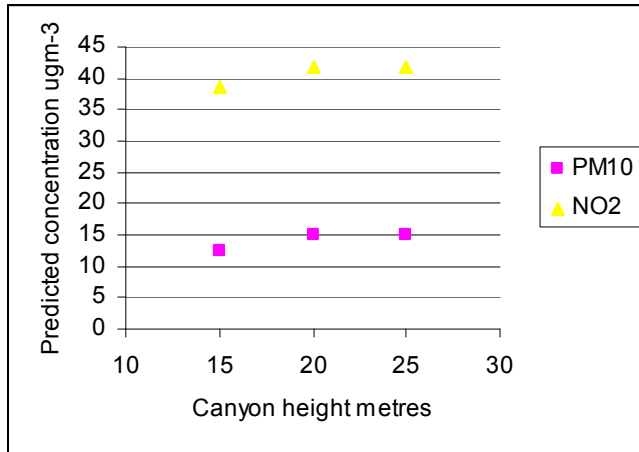
Figure 3.2: Effect of assumed vehicle speed on modelled concentrations of PM₁₀



Impact of estimated canyon height on air quality predictions

The estimated canyon height has a relatively small impact on predicted concentrations of PM₁₀ and NO₂, but the impact could be important where predicted concentrations are close to the annual mean objective (Fig. 3.3). Uncertainties in the determination of building height only contribute to a relatively small component of the overall uncertainty in the model output.

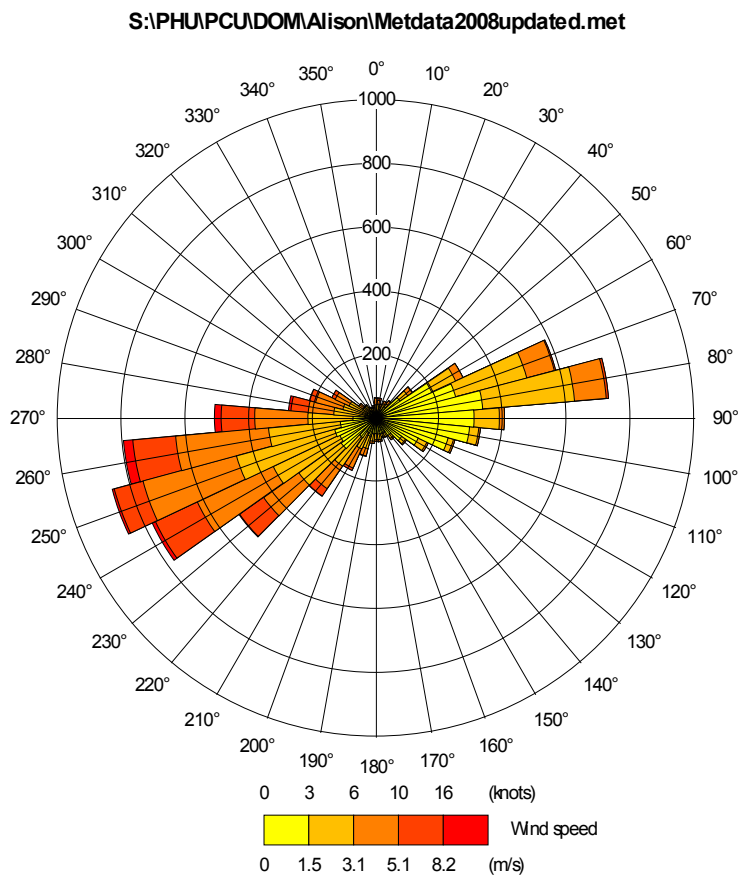
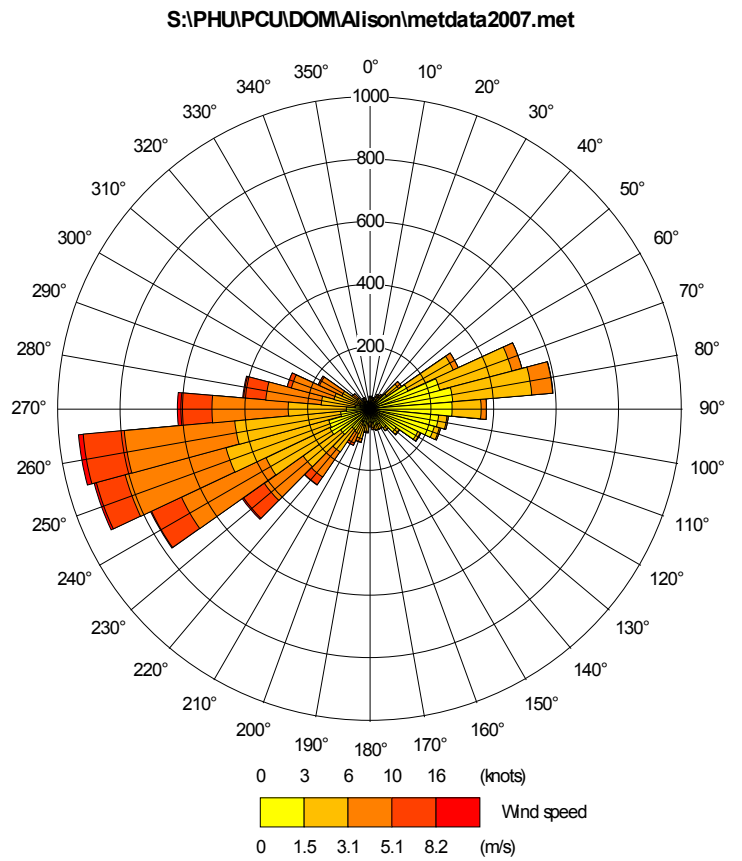
Figure 3.3: Effect of estimated canyon depth on modelled concentrations of PM₁₀



Weather data

Ideally the modelling would have been undertaken using 3 years weather data but there were significant problems with the weather station during 2009 and some minor problems during 2007 (665 hours of data missing out of 8760 hours). Complete data were only available for 2008. It is unclear how representative the 2008 data are of long average conditions in central Glasgow. In order to investigate the influence of the selected year on modelled results, a limited comparison was undertaken of the model output derived using the 2008 data and the output derived using the 2007 data. The wind roses for the two years are shown below. At first sight, the data do not look substantially different (Fig. 3.4).

Figure 3.4: Wind roses for 2007 (above) and 2008 (below)



Despite the similar appearance of the two wind roses, the model output based on the 2007 data predicted consistently lower annual mean concentrations of PM₁₀ in 2010 than the model output based on 2008 (Table 3.7). This was true at both canyon locations – Argyle Street, Pollokshaws Road and Parkhead Cross and at more open sites – Baillieston Road/Barrachnie Avenue. If the 2007 data had been used as the basis of the main modelling exercise, then it seems unlikely that the raw model output would have predicted exceedences of the 18 µg m⁻³ objective at any location. The use of measurement data to calibrate the model output would however have led to fairly similar conclusions to those based on the 2008 weather data.

Table 3.7: comparison of results modelled using 2008 weather data and with those modelled using 2007 weather data (uncalibrated model output)

Location	Receptor	2008 weather data	2007 weather data
Argyle Street	4	18.17	14.25
	5	17.51	13.71
	6	19.04	15.89
	8	16.67	15.66
Pollokshaws Road	1	14.63	12.09
	2	16.88	14.20
	3	15.31	14.07
Parkhead Cross	1	21.01	13.06
	2	15.81	12.11
	3	16.28	12.74
	4	13.48	13.16
	5	11.67	12.75
	6	12.20	11.86
Baillieston Road / Barrachnie Road	1	13.67	11.93
	2	11.63	11.57
	3	11.02	11.08
	4	11.62	11.47
	5	13.87	11.49
	6	11.93	11.63
Battlefield Road*	Monitor	13.17*	13.00*

*Modelled for 2008 based on 2004 traffic data

Possible under-estimation of traffic flows in main analysis

The traffic data used in the modelling exercise was typically based on a single set of observations on a single day and it is unclear how variable traffic flow might be on other days or how much traffic flow may have grown since the count was undertaken. The 1.26 factor used to convert 12 hour counts to 24 hour averages was also uncertain as were the assumptions about vehicle speed. Given, the importance of the contribution of local traffic emissions at some locations, the uncertainty underlying the input traffic data and the potential for traffic growth, a sensitivity analysis was appropriate. In the first instance, this involved recalculation of predicted annual mean concentrations of PM₁₀ on the basis that the traffic contribution in the table above had been under-predicted by 50%. The revised predicted annual mean concentrations of PM₁₀ in 2010 based on traffic contributions that were 150% of those underlying the predictions in Table 3.3 are shown in Table 3.8 below. The predicted annual mean concentrations of PM₁₀ in 2010 exceed 18 µg m⁻³ at most of the modelled receptors in Argyle Street, at a single receptor on the Great Western Road near Anniesland, at receptors on Maryhill Road at Maryhill and near the M8, at receptors on Paisley Road West, Pollokshaws Road and Parkhead Cross. The predicted concentrations in 2015 exceed 18 µg m⁻³ at some locations in Argyle Street, along Paisley Road West and at Parkhead Cross.

Table 3.8: Predicted PM₁₀ concentrations (ugm⁻³) based on traffic contributions that are 50% higher than those used in the main analysis (results not calibrated against measurement data)

Location	Receptor	2010	2011	2012	2013	2014	2015
Bridgeton Cross	1	14.47	14.18	13.89	13.61	13.32	13.03
	2	12.39	12.21	12.03	11.85	11.68	11.50
	3	17.66	17.20	16.75	16.29	15.83	15.37
	4	13.88	13.62	13.36	13.11	12.85	12.60
	5	13.32	13.10	12.87	12.64	12.41	12.19
	6	16.14	15.77	15.39	15.01	14.64	14.26
	7	13.70	13.46	13.21	12.96	12.72	12.47
	8	12.37	12.20	12.02	11.84	11.67	11.49
	9	12.86	12.66	12.46	12.25	12.05	11.85
Springburn Road	1	12.13	11.99	11.84	11.69	11.55	11.40
	2	12.09	11.95	11.81	11.66	11.52	11.37
	3	15.34	15.02	14.71	14.39	14.08	13.76
	4	13.72	13.49	13.26	13.03	12.80	12.57
	5	15.63	15.30	14.97	14.64	14.31	13.98
	6	15.68	15.35	15.02	14.68	14.35	14.02
Sauchiehall Street	1	15.98	15.74	15.50	15.26	15.03	14.79
	2	18.58	18.20	17.82	17.45	17.07	16.69
	3	16.68	16.40	16.12	15.85	15.57	15.30
	4	16.94	16.65	16.36	16.07	15.78	15.49
	5	15.50	15.29	15.08	14.86	14.65	14.44
	6	17.55	17.23	16.91	16.59	16.26	15.94
	7	15.44	15.23	15.02	14.81	14.61	14.40
	8	16.48	16.22	15.95	15.69	15.42	15.16
	9	17.58	17.26	16.93	16.61	16.29	15.96
	10	15.59	15.37	15.16	14.94	14.72	14.51
	11	16.75	16.47	16.19	15.91	15.63	15.35
	12	16.91	16.63	16.34	16.05	15.76	15.47
	13	15.50	15.29	15.08	14.86	14.65	14.44
	14	19.31	18.89	18.47	18.06	17.64	17.22
	15	18.03	17.68	17.33	16.98	16.64	16.29
Dumbarton Road	1	19.64	19.16	18.68	18.20	17.72	17.24
	2	21.65	21.08	20.50	19.93	19.35	18.77
	3	14.19	13.97	13.75	13.53	13.31	13.09
Argyle Street	1	15.52	15.20	14.88	14.57	14.25	13.94
	2	20.18	19.60	19.02	18.45	17.87	17.29
	3	20.24	19.66	19.07	18.49	17.91	17.33
	4	18.73	18.23	17.73	17.24	16.74	16.24
	5	14.03	13.80	13.57	13.34	13.11	12.87
	6	19.98	19.41	18.84	18.27	17.71	17.14
	7	22.26	21.56	20.87	20.17	19.47	18.78
	8	18.72	18.22	17.72	17.23	16.73	16.23
Byres Road	1	14.66	14.42	14.18	13.93	13.69	13.45
	2	15.81	15.51	15.21	14.91	14.62	14.32
Woodlands Road	1	14.32	14.08	13.83	13.58	13.33	13.08
	2	16.51	16.14	15.77	15.40	15.02	14.65
	3	14.20	13.96	13.72	13.48	13.23	12.99
	4	16.29	15.93	15.57	15.21	14.85	14.49
	5	17.79	17.34	16.90	16.45	16.01	15.57

Location	Receptor	2010	2011	2012	2013	2014	2015
Great Western Road	1	11.67	11.51	11.36	11.20	11.05	10.90
	2	19.88	19.31	18.74	18.18	17.61	17.04
	3	11.00	10.88	10.76	10.64	10.52	10.40
	4	17.29	16.88	16.47	16.06	15.65	15.24
	5	12.40	12.24	12.08	11.91	11.75	11.58
	6	14.52	14.25	13.98	13.71	13.44	13.17
	7	11.61	11.49	11.36	11.24	11.12	10.99
	8	11.74	11.69	11.64	11.59	11.54	11.49
	9	11.74	11.69	11.64	11.59	11.54	11.49
Anniesland Cross	1	15.60	15.28	14.96	14.64	14.32	14.00
	2	15.61	15.29	14.97	14.65	14.33	14.01
	3	13.49	13.27	13.04	12.82	12.60	12.37
	4	12.98	12.78	12.58	12.38	12.18	11.98
	5	14.40	14.13	13.87	13.60	13.34	13.07
	6	11.36	11.23	11.11	10.98	10.85	10.73
	7	14.68	14.40	14.12	13.85	13.57	13.29
Balshagray Avenue	1	13.46	13.25	13.03	12.81	12.59	12.38
	2	12.79	12.60	12.41	12.23	12.04	11.85
	3	13.06	12.86	12.66	12.46	12.26	12.06
Hyndland Road	1	17.59	17.22	16.85	16.48	16.11	15.74
	2	13.59	13.41	13.24	13.06	12.89	12.71
	3	14.92	14.57	14.22	13.87	13.53	13.18
	4	15.71	15.32	14.93	14.55	14.16	13.77
Finnieston Street	1	16.24	15.88	15.52	15.17	14.81	14.45
	2	15.45	15.13	14.82	14.51	14.20	13.89
	3	15.21	14.91	14.61	14.32	14.02	13.72
Maryhill Road	1	18.71	18.23	17.76	17.28	16.80	16.32
	2	19.11	18.62	18.12	17.62	17.12	16.63
	3	13.10	12.88	12.66	12.44	12.22	12.00
	4	14.55	14.26	13.96	13.67	13.38	13.09
	5	16.71	16.40	16.10	15.79	15.48	15.18
	6	19.37	18.92	18.46	18.01	17.55	17.10
Paisley Road West	1	14.17	13.98	13.79	13.60	13.40	13.21
	2	16.36	16.06	15.77	15.48	15.18	14.89
	3	14.97	14.74	14.51	14.28	14.06	13.83
	4	15.26	15.02	14.78	14.54	14.29	14.05
	5	19.95	19.47	18.99	18.51	18.03	17.56
	6	20.83	20.31	19.79	19.27	18.75	18.23
	7	15.96	15.67	15.37	15.08	14.79	14.49
	8	19.61	19.14	18.67	18.21	17.74	17.27
	9	18.40	17.99	17.58	17.17	16.76	16.35
	10	20.21	19.71	19.21	18.72	18.22	17.72
	11	17.17	16.82	16.47	16.12	15.78	15.43
	12	19.86	19.38	18.90	18.42	17.94	17.46
	13	21.77	21.20	20.62	20.05	19.47	18.90
	14	17.94	17.55	17.17	16.78	16.40	16.01
Pollokshaws Road	1	16.50	16.11	15.72	15.33	14.94	14.55
	2	19.86	19.30	18.74	18.18	17.62	17.06
	3	17.52	17.08	16.63	16.19	15.75	15.31
Parkhead Cross	1	25.88	25.49	25.10	24.70	24.31	23.91
	2	18.09	18.10	18.11	18.12	18.13	18.14

Location	Receptor	2010	2011	2012	2013	2014	2015
	3	18.79	18.77	18.74	18.72	18.69	18.67
	4	14.59	14.79	14.98	15.17	15.37	15.56
	5	11.88	12.21	12.55	12.88	13.22	13.55
	6	12.66	12.96	13.25	13.55	13.84	14.13
Baillieston Road / Barrachnie Road	1	15.21	14.88	14.56	14.23	13.90	13.57
	2	12.15	11.97	11.79	11.61	11.43	11.26
	3	11.24	11.10	10.97	10.83	10.70	10.56
	4	12.14	11.96	11.78	11.60	11.42	11.25
	5	15.50	15.16	14.82	14.48	14.14	13.79
	6	12.60	12.40	12.20	12.00	11.80	11.60

Combined uncertainty in traffic emissions and background concentrations

Given that there are uncertainties in both the traffic and background components of predicted PM₁₀ concentrations, and the importance of the background in determining total concentrations at most locations, it seems prudent to assume that both or either component could be under-estimated. If allowance is made for uncertainties in the predicted background levels of PM₁₀ as well as in the traffic data and predicted impact of traffic emissions, then the number of locations where concentrations of PM₁₀ might exceed 18 µg m⁻³ in 2010 and in subsequent years is potentially very much greater than predicted by the main analysis. The guidance in TG(09) indicates that model concentrations should be within 25% of measured concentrations. The limited measurement data shown in Table 3.2 indicates that a calibration factor based on the total modelled concentrations would be about 1.24. Table 3.9 below shows the impact of increasing the uncalibrated predicted concentrations by 25% to give an estimate of worst case impact. Table 3.6 indicates that in the short term, concentrations of PM₁₀ could exceed 18 µg m⁻³ at Bridgeton Cross, Sauchiehall Street, Argyle Street and at locations along Dumbarton Road, Byres Road, Woodlands Road, Hyndland Road, Great Western Road, Maryhill Road, Paisley Road West, Finnieston Street, Pollokshaws Road and Parkhead Cross. In the longer term, concentrations may still exceed 18 µg m⁻³ in 2015 at locations in Sauchiehall Street, Argyle Street, Dumbarton Road, Maryhill Road, Pollokshaws Road, Paisley Road West and Parkhead Cross. The predicted concentrations shown in Table 3.9 are marginally (<1%) higher than the concentrations that would be calculated using a calibration factor of 1.24 for the total modelled concentration of PM₁₀. Although the guidance in TGD(09) indicates that the model calibration should be based solely on the traffic component, the importance of the predicted background in determining the predicted total concentration for these locations in Glasgow, suggests that it for the purposes of air quality assessment in Glasgow, it would be more logical to develop a calibration factor based on total PM₁₀ concentrations.

Table 3.9: Predicted PM₁₀ concentrations (µg m⁻³) based on traffic contributions and background concentrations that are 25% higher than those used in the main analysis (results not calibrated against measurement data)

Location	Receptor	2010	2011	2012	2013	2014	2015
	1	17.00	16.70	16.40	16.09	15.79	15.49
	2	15.26	15.05	14.84	14.63	14.42	14.21
	3	19.66	19.22	18.78	18.34	17.89	17.45
	4	16.51	16.24	15.96	15.68	15.40	15.13
	5	16.05	15.80	15.55	15.29	15.04	14.79
	6	18.40	18.02	17.65	17.27	16.89	16.51
	7	16.36	16.10	15.83	15.56	15.29	15.03
	8	15.25	15.04	14.84	14.63	14.42	14.21
Bridgeton Cross	9	15.66	15.43	15.20	14.97	14.74	14.51
Springburn Road	1	15.08	14.90	14.72	14.54	14.37	14.19

Location	Receptor	2010	2011	2012	2013	2014	2015
	2	15.04	14.86	14.69	14.51	14.34	14.16
	3	17.75	17.43	17.11	16.79	16.47	16.15
	4	16.40	16.15	15.91	15.66	15.41	15.16
	5	17.99	17.66	17.33	17.00	16.67	16.34
	6	18.04	17.70	17.37	17.03	16.70	16.36
Sauchiehall Street	1	19.73	19.44	19.16	18.87	18.59	18.30
	2	21.89	21.49	21.09	20.69	20.29	19.89
	3	20.30	19.99	19.67	19.36	19.04	18.73
	4	20.53	20.20	19.87	19.54	19.22	18.89
	5	19.33	19.06	18.80	18.54	18.28	18.01
	6	21.04	20.68	20.33	19.97	19.62	19.26
	7	19.28	19.02	18.76	18.50	18.24	17.98
	8	20.14	19.83	19.53	19.22	18.92	18.61
	9	21.06	20.71	20.35	19.99	19.63	19.28
	10	19.40	19.13	18.87	18.60	18.33	18.06
	11	20.36	20.05	19.73	19.41	19.09	18.78
	12	20.50	20.18	19.85	19.53	19.20	18.88
	13	19.33	19.06	18.80	18.54	18.28	18.01
	14	22.50	22.07	21.63	21.20	20.76	20.33
	15	21.43	21.05	20.68	20.30	19.93	19.55
Dumbarton Road	1	21.48	21.02	20.57	20.11	19.66	19.20
	2	23.15	22.62	22.09	21.55	21.02	20.49
	3	16.94	16.70	16.46	16.23	15.99	15.75
Argyle Street	1	21.43	20.92	20.41	19.90	19.39	18.88
	2	22.06	21.52	20.97	20.43	19.88	19.34
	3	22.11	21.56	21.01	20.46	19.91	19.36
	4	20.85	20.37	19.90	19.42	18.94	18.46
	5	16.94	16.68	16.43	16.17	15.92	15.66
	6	21.89	21.35	20.82	20.28	19.75	19.21
	7	23.80	23.16	22.51	21.87	21.22	20.58
	8	20.84	20.36	19.89	19.41	18.94	18.46
Byres Road	1	17.33	17.07	16.81	16.55	16.30	16.04
	2	18.28	17.98	17.68	17.38	17.08	16.78
Woodlands Road	1	17.18	16.91	16.64	16.37	16.11	15.84
	2	19.00	18.63	18.26	17.88	17.51	17.14
	3	17.08	16.81	16.55	16.29	16.03	15.76
	4	18.83	18.46	18.10	17.74	17.38	17.01
	5	20.06	19.63	19.20	18.77	18.33	17.90
Great Western Road	1	14.30	14.12	13.95	13.77	13.59	13.41
	2	21.15	20.63	20.10	19.58	19.05	18.53
	3	13.75	13.60	13.45	13.30	13.15	13.00
	4	19.24	18.84	18.45	18.05	17.66	17.26
	5	15.15	14.97	14.78	14.60	14.41	14.23
	6	16.91	16.64	16.36	16.09	15.81	15.54
	7	14.50	14.35	14.19	14.04	13.88	13.73
	8	14.38	14.33	14.28	14.23	14.19	14.14
	9	14.38	14.33	14.28	14.23	14.19	14.14
Anniesland Cross	1	17.73	17.41	17.09	16.77	16.46	16.14
	2	17.74	17.42	17.10	16.78	16.46	16.14
	3	15.98	15.74	15.50	15.26	15.02	14.78
	4	15.55	15.33	15.11	14.89	14.67	14.45

Location	Receptor	2010	2011	2012	2013	2014	2015
	5	16.73	16.45	16.18	15.91	15.64	15.36
	6	14.20	14.04	13.89	13.73	13.57	13.41
	7	16.96	16.68	16.40	16.12	15.83	15.55
Balshagray Avenue	1	16.09	15.85	15.61	15.38	15.14	14.90
	2	15.53	15.31	15.10	14.89	14.68	14.46
	3	15.75	15.53	15.31	15.08	14.86	14.64
Hyndland Road	1	19.35	19.02	18.69	18.35	18.02	17.69
	2	16.01	15.84	15.67	15.50	15.33	15.16
	3	17.25	16.89	16.52	16.16	15.79	15.43
	4	17.91	17.52	17.12	16.72	16.32	15.93
Finnieston Street	1	18.78	18.42	18.06	17.70	17.34	16.98
	2	18.11	17.79	17.47	17.15	16.82	16.50
	3	17.91	17.60	17.29	16.98	16.67	16.36
Maryhill Road	1	20.06	19.62	19.18	18.74	18.29	17.85
	2	20.39	19.93	19.47	19.02	18.56	18.10
	3	15.50	15.27	15.04	14.81	14.58	14.35
	4	16.71	16.42	16.13	15.84	15.54	15.25
	5	20.04	19.70	19.37	19.03	18.70	18.36
	6	22.25	21.79	21.34	20.88	20.42	19.96
Paisley Road West	1	16.09	15.93	15.76	15.60	15.44	15.28
	2	17.91	17.67	17.42	17.17	16.92	16.68
	3	16.75	16.56	16.37	16.17	15.98	15.79
	4	17.00	16.80	16.59	16.39	16.18	15.98
	5	21.85	21.40	20.94	20.49	20.03	19.58
	6	22.59	22.10	21.61	21.12	20.63	20.14
	7	18.53	18.23	17.93	17.63	17.33	17.03
	8	21.88	21.42	20.97	20.51	20.06	19.60
	9	20.86	20.46	20.05	19.65	19.24	18.84
	10	22.38	21.90	21.42	20.94	20.46	19.98
	11	19.84	19.48	19.13	18.77	18.42	18.06
	12	22.08	21.61	21.15	20.68	20.22	19.75
	13	23.68	23.13	22.59	22.04	21.50	20.95
	14	20.49	20.10	19.71	19.33	18.94	18.55
Pollokshaws Road	1	18.29	17.92	17.55	17.19	16.82	16.45
	2	21.10	20.59	20.08	19.56	19.05	18.54
	3	19.14	18.73	18.31	17.90	17.49	17.08
Parkhead Cross	1	26.26	26.09	25.91	25.74	25.56	25.39
	2	19.76	19.93	20.09	20.25	20.41	20.58
	3	20.35	20.48	20.62	20.75	20.88	21.01
	4	16.85	17.17	17.48	17.80	18.11	18.43
	5	14.59	15.02	15.45	15.89	16.32	16.75
	6	15.25	15.65	16.05	16.44	16.84	17.24
Baillieston Road / Barrachnie Road	1	17.09	16.77	16.46	16.14	15.83	15.51
	2	14.54	14.35	14.15	13.96	13.77	13.58
	3	13.78	13.62	13.47	13.31	13.16	13.00
	4	14.53	14.34	14.15	13.96	13.77	13.58
	5	17.34	17.01	16.68	16.36	16.03	15.70
	6	14.91	14.70	14.49	14.28	14.07	13.86

Comparison with output from DMRB model

Given that the comparison of the measured and modelled concentrations of NO₂ indicated that ADMS substantially under-estimates concentrations at locations that are not street canyons, the traffic data was used in conjunction with the DMRB screening model to develop an alternative set of predicted concentrations for some of the street canyon locations and some of the locations that are not canyons. As expected the DMRB model tends to give lower predicted concentrations for street canyons and ADMS and higher predicted concentrations for locations that are not canyons (Table 3.10). Although DMRB is a relatively crude tool for predicting pollutant concentrations, the output did provide re-assurance that the 18 µg m⁻³ is likely to be met at locations that are not street canyons.

Table 3.10: Predicted concentrations (µg m⁻³) derived using the DMRB screening model³ for selected locations (both canyons and noncanyons) for 2010 and comparison with the ADMS output (not calibrated against measurement data)

Location	Receptor	ADMS	DMRB
Bridgeton Cross	1	13.60	15.54
	2	12.21	15.29
	3	15.73	15.98
	4	13.21	16.19
	5	12.84	14.32
	6	14.72	15.43
	7	13.09	13.27
	8	12.20	13.32
	9	12.53	10.85
Argyle Street	1	17.14	15.29
	2	17.65	15.90
	3	17.69	14.91
	4	16.68	14.68
	5	13.55	15.46
	6	17.51	15.31
	7	19.04	15.31
	8	16.67	15.26
Great Western Road – intersection with Dorchester Avenue	1	11.44	14.68
	2	16.92	14.79
Great Western Road at junction with Hyndland Road	4	15.39	16.74
	5	12.12	15.61
Annie'sland Cross	1	14.18	16.13
	2	14.19	15.06
	3	12.78	14.00
	4	12.44	14.63
	5	13.38	15.52
	6	11.36	15.06
	7	13.57	15.30
Balshagray Avenue	1	12.87	14.48
	2	12.42	14.40
	3	12.60	14.92
Hyndland Road	1	15.48	14.69
	2	12.81	15.04
Pollokshaws Road	1	14.63	17.48
	2	16.88	17.54
	3	15.31	13.5
Baillieston Road / Barrachnie Road	1	13.67	14.36
	2	11.63	12.96
	3	11.02	12.61
	4	11.62	14.52

	5	13.87	14.11
	6	11.93	14.67

3.2.3 Summary of PM₁₀ findings

The results of the modelling exercise suggest that there is a risk that the 18 $\mu\text{g m}^{-3}$ annual mean objective for PM₁₀ may be exceeded at a number of locations across Glasgow in 2010 (Table 3.11). Given the considerable uncertainty in the predicted concentrations, it is difficult to demonstrate that the objective will not be met at the various locations included in the assessment. The use of 2007 weather data in the ADMS model, for example, could have led to much lower predicted concentration of PM₁₀ and a smaller number of locations where the objective may be exceeded. Provided that the anticipated reduction in particulate emissions from vehicles is realised over the next five years, annual mean concentrations of PM₁₀ in 2015 would be anticipated to be significantly lower than in 2010, provided that weather and traffic flows are not significantly different between the two years.

Table 3.11: Summary of model output – predicted locations where annual mean locations of PM₁₀ may exceed 18 $\mu\text{g m}^{-3}$ in 2010 and 2015 taking account of the sensitivity analysis

	Year	Locations where 18 $\mu\text{g m}^{-3}$ objective exceeded
ADMS model output – without calibration against measurement data	2010	Sauchiehall Street within 200m west of M8, Dumbarton Road, Argyle Street, Paisley Road West, Parkhead Cross
	2015	Parkhead Cross
ADMS model output – traffic component calibrated against measurement data (assuming modelled background concentrations are realistic)	2010	Bridgeton Cross, Sauchiehall Street, Argyle Street, Woodlands Road, the Great Western Road, Anniesland, Hyndland Road, Finneston Street, Maryhill Road, Dumbarton Road (at the intersection with Byres Road), Paisley Road West, Pollokshaws Road, Parkhead Cross, the Bailleston Road/Barrachnie Avenue intersection
	2015	Bridgeton Cross, Sauchiehall Street, Argyle Street, the Great Western Road, Hyndland Road, Finneston Street, Maryhill Road, Dumbarton Road (at the intersection with Byres Road), Paisley Road West, Pollokshaws Road, Parkhead Cross.
ADMS model with traffic component increased by 50%	2010	Sauchiehall Street, Dumbarton Road, Argyle Street, Great Western Road (Anniesland), Maryhill Road (at Maryhill and within 200 m of M8), Paisley Road West, Pollokshaws Road (around Nithsdale Street intersection), Parkhead Cross
	2015	Argyle Street, Paisley Road West, Parkhead Cross
ADMS model with traffic and background increased by 25% (or calibrated against total measured concentrations of PM ₁₀)*	2010	Bridgeton Cross, Sauchiehall Street, Dumbarton Road, Argyle Street, Byres Road, Woodlands Road, Great Western Road, Hyndland Road, Finnieston Street, Maryhills Road, Paisley Road West, Pollokshaws Road, Parkhead Cross
	2015	Sauchiehall Street, Dumbarton Road, Argyle Street, Maryhills Road, Paisley Road West

*The calibration exercise suggested that measured total PM₁₀ concentrations were about 25% greater than modelled total PM₁₀ concentrations

On the basis of the limited calibration exercise that was undertaken for PM₁₀, it is recommended that the ADMS results generated by increasing both the background and traffic components of PM₁₀ by 25% are used for the purposes of forward planning. Although the guidance in TGD(09) indicates that the model calibration should be based solely on the traffic component, the importance of the predicted background in determining the predicted total concentration for these locations in Glasgow, suggests that it for the purposes of air quality assessment in Glasgow, it would be more logical to develop a calibration factor based on total

PM₁₀ concentrations. These predictions indicate exceedences of the objective in 2010 are most likely at Bridgeton Cross, Sauchiehall Street, Dumbarton Road (at junction with Byres Road), Argyle Street, Byres Road, Woodlands Road, Great Western Road, Hyndland Road, Finnieston Street, Maryhills Road, Paisley Road West, Pollokshaws Road and Parkhead Cross. In 2015, exceedences are still likely at Sauchiehall Street, Dumbarton Road, Argyle Street, Maryhills Road and Paisley Road West.

3.3 NITROGEN DIOXIDE

The output from the ADMS model is shown in Tables 3.9 and 3.10. The model results indicate a clear exceedence of the 40 $\mu\text{g m}^{-3}$ annual mean objective in 2010 in Bridge Street. Using the year on year adjustment factors provided by DEFRA (2010) as an update to TG(09), however, it is apparent that the 40 $\mu\text{g m}^{-3}$ objective should be met before 2015. The comparison of modelled and measured NO₂ concentrations in 2008 in Bridge Street (Table 3.1) suggests that it is unlikely that ADMS has substantially underestimated NO₂ concentrations in this street canyon, and the predicted levels in Table 3.9 and 3.10 are more likely to be over rather than under estimates. The predicted concentrations of NO₂ in Queen Margaret Drive north of Hamilton Drive are well below the 40 $\mu\text{g m}^{-3}$ objective. Comparison of modelled and measured NO₂ concentrations in Queen Margaret Drive suggests that the ADMS model is likely to have under-estimated NO₂ concentrations close to the intersection with Maryhill Road by a factor of about 1.5. Taking account of this under-estimation of concentrations, the model results for the Maryhill Road intersection are consistent with the 40 $\mu\text{g m}^{-3}$ objective being met in 2010 (ie the modelled concentrations are less than two thirds of the objective). Conversely, in the section of Queen Margaret Drive where there are tenements on both sides of the road (receptors 5 and 6), the ADMS model is likely to have overestimated NO₂ concentrations by a factor of over 40% and the model results indicate that the 40 $\mu\text{g m}^{-3}$ objective is likely to be met.

Table 3.12: Predicted annual mean concentrations of NO₂ ($\mu\text{g m}^{-3}$) at roadside locations based on ADMS model

Location	Receptor		2010	2015
Bridge Street	Tenement – corner Bridge Street/Norfolk Street (N side)	1	43.16	30.66
	Tenements west side Bridge Street, north of junction with Nelson Street	2	45.56	32.36
	Tenements east side Bridge Street, north of junction with Norfolk Street	3	44.93	31.91
	Tenement corner Bridge Street/Oxford Street (N side)	4	46.60	33.10
	Tenement corner Bridge Street/Oxford Street (S side)	5	48.93	34.76
Queen Margaret Drive	Tenement corner Maryhill Road/Bilsland Drive (NW side)	1	19.54	13.88
	Tenement corner Maryhill Road/Bilsland Drive (SE side)	2	19.37	13.76
	House corner Maryhill Road/QMD	3	21.62	15.36
	West side QMD – first house parallel to road, S of junction with Maryhill Road	4	23.96	17.02
	Tenement midblock, W side QMD between Clouston Street and Oban Lane	5	30.04	21.34
	Tenement immediately opposite 5	6	28.50	20.24

Table 3.13: Predicted concentrations of NO₂ (ugm⁻³) as annual mean 2010-2015 based on ADMS model output

Location	Receptor	2010	2011	2012	2013	2014	2015
Bridge Street	1	43.16	40.62	38.13	35.64	33.15	30.66
	2	45.56	42.87	40.25	37.62	34.99	32.36
	3	44.93	42.28	39.69	37.10	34.50	31.91
	4	46.60	43.85	41.17	38.48	35.79	33.10
	5	48.93	46.05	43.22	40.40	37.58	34.76
Queen Margaret Drive	1	19.54	18.39	17.26	16.13	15.01	13.88
	2	19.37	18.23	17.12	16.00	14.88	13.76
	3	21.62	20.35	19.10	17.85	16.60	15.36
	4	23.96	22.55	21.16	19.78	18.40	17.02
	5	30.04	28.27	26.53	24.80	23.07	21.34
	6	28.50	26.82	25.17	23.53	21.89	20.24

As with the PM₁₀ predictions, a sensitivity analysis was undertaken in which the impacts of increasing the traffic component by 50% or both the traffic and background components by 25% was investigated. (Tables 3.14 and 3.15). The outcome of the sensitivity analysis indicated that it is possible that the 40 ugm⁻³ would still be exceeded in 2015 in Bridge Street. Although it also suggested that the objective may be exceeded in 2010 in the canyon section of Queen Margaret Drive, this seems highly unlikely given the model validation exercise demonstrated that ADMS severely over-predicts concentrations in street canyons.

Table 3.14: Predicted annual mean concentrations (ugm⁻³) based on an assumed traffic contribution that is 50% higher than in the main analysis shown in Table 3.12

Location	Receptor	2010	2011	2012	2013	2014	2015
Bridge Street	1	72.88	68.59	64.39	60.18	55.98	51.77
	2	78.87	74.23	69.68	65.13	60.58	56.03
	3	77.29	72.74	68.28	63.82	59.36	54.90
	4	81.47	76.68	71.98	67.28	62.58	57.87
	5	87.30	82.16	77.12	72.08	67.05	62.01
Queen Margaret Drive	1	26.50	24.94	23.41	21.88	20.35	18.82
	2	26.08	24.54	23.04	21.54	20.03	18.53
	3	31.70	29.83	28.00	26.17	24.34	22.52
	4	37.54	35.33	33.16	31.00	28.83	26.67
	5	48.92	46.04	43.22	40.40	37.57	34.75
	6	45.08	42.42	39.82	37.22	34.62	32.02

Table 3.15: Predicted annual mean concentrations (ugm⁻³) based on a traffic contribution and background that are 25% higher than in the main analysis shown in Table 3.14

Location	Receptor	2010	2011	2012	2013	2014	2015
Bridge Street	1	53.95	50.77	47.66	44.55	41.44	38.32
	2	56.95	53.59	50.31	47.02	43.74	40.45
	3	56.16	52.85	49.61	46.37	43.13	39.89
	4	58.25	54.82	51.46	48.10	44.74	41.38
	5	61.16	57.56	54.03	50.50	46.97	43.44
Queen Margaret Drive	1	24.43	22.99	21.58	20.17	18.76	17.35
	2	24.22	22.79	21.39	20.00	18.60	17.20
	3	27.03	25.43	23.87	22.32	20.76	19.20
	4	29.95	28.18	26.46	24.73	23.00	21.27
	5	37.54	35.33	33.17	31.00	28.84	26.67
	6	35.62	33.52	31.47	29.41	27.36	25.30

Given the uncertainty in the ADMS output, the DMRB screening model was used to investigate whether this might give a more robust indication of NO₂ concentrations in Queen Margaret Drive. As would be expected, given the canyon geometry of Bridge Street, the output from the DMRB model predicted slightly lower concentrations of NO₂ in Bridge Street than obtained using ADMS, although the model output still indicates that the annual mean objective is unlikely to be met in 2010 (Table 3.16). Much more surprisingly, the DMRB model also predicted concentrations of NO₂ at the Maryhill Road/Queen Margaret Drive intersection that were generally slightly lower than those predicted using ADMS. This was an unexpected result, given that in the absence of canyon geometry, DMRB would be anticipated to over rather than under predict.

Table 3.16: Predicted concentrations of NO₂ (ugm⁻³) at roadside locations in 2010 based on DMRB screening model

Location	Receptor	2010
Bridge Street	1	44.2
	2	39.1
	3	40.5
	4	37.9
	5	38.5
Queen Margaret Drive	1	20.7
	2	21.1
	3	17.0
	4	15.5
	5	22.6
	6	22.6

3.4 SOURCES OF UNCERTAINTY IN MODEL PREDICTIONS

These model outputs described in this chapter are based on limited traffic data and meteorological data for only one year. There is uncertainty in how representative the traffic data are for each location and additional uncertainty where no traffic data was available and flows were calculated on the basis of flow along adjoining roads. The appropriateness of the 1.26 conversion factor used to convert 12 hour measurements to annual hourly averages is uncertain as is the method used to convert traffic counts made over periods of less than 12 hours into approximate 12 hour counts. It is also uncertain how representative the weather conditions in 2008 were of long term norms. The sensitivity analysis that has been undertaken does however allow for the potential underestimation of concentrations in the main analysis. It is of course, possible that the main analysis has actually over-estimated impacts.

4 Conclusions

4.1 PM₁₀

The results of the modelling exercise suggest that there is a risk that the 18 ugm⁻³ annual mean objective for PM₁₀ may be exceeded at a number of locations across Glasgow in 2010 and that the objective may still be exceeded at some locations in 2015. There are substantial uncertainties in the model predictions arising from uncertainties in the extent of year to year variability in weather conditions, the day to day and longer term variability in traffic flow and the accuracy of predicted background concentrations.

The results of the limited calibration exercise that was undertaken for PM₁₀, suggest that measured concentrations are about 25% higher than modelled concentrations. It is therefore recommended that the ADMS results generated by increasing both the background and traffic components of PM₁₀ by 25% are used for the purposes of forward planning. This allows for uncertainty in both the predicted impact of traffic emissions and background concentrations.

These predictions indicate exceedences of the objective in 2010 are most likely at Bridgeton Cross, Sauchiehall Street, Dumbarton Road (at junction with Byres Road), Argyle Street, Byres Road, Woodlands Road, Great Western Road, Hyndland Road, Finnieston Street, Maryhills Road, Paisley Road West, Pollokshaws Road and Parkhead Cross. In 2015, exceedences are still likely at Sauchiehall Street, Dumbarton Road, Argyle Street, Maryhills Road and Paisley Road West. Given the uncertainties in the model input parameters, it is not possible to be certain that exceedences will occur at these locations and would not occur at some of the other candidate locations.

Given the high degree of uncertainty in the output of the modelling exercise that arises from the uncertainties in the input data, it is recommended that further monitoring is undertaken in order to confirm, or otherwise, that predicted exceedences exist.

NITROGEN DIOXIDE

The results of the modelling exercise indicate that the 40 ugm^{-3} annual mean objective will be exceeded in 2010 in Bridge Street but it is likely to be met in the section of Queen Margaret Drive north of Hamilton Drive. The model output also suggests that concentrations of NO_2 are likely to still exceed the annual mean objective in 2015 in Bridge Street, whereas it is likely that the objective will be met in Queen Margaret Drive, north of Hamilton Drive.

Given the high degree of uncertainty in the output of the modelling exercise that arises from the uncertainties in the input data, it is recommended that further monitoring is undertaken in Queen Margaret Drive in order to confirm that the objective is met. Given the greater level of certainty that the annual mean objective is exceeded in Bridge Street, it is recommended that the city centre AQMA is extended to include Bridge Street.

Appendix

Grid References for receptors

Location	Receptor	x	y
Bridgeton Cross	Tenement corner London Road/Orr Street	260680	664030
	Tenement corner Orr Street/Olympia Street	260710	664030
	Tenement west side cross opposite subway	260680	664000
	Tenement north side James Street at junction with Main Street	260220	663950
	Tenement, east side of Main Street at junction with Dalmarnock Road	260700	663930
	Tenement at junction Olympia Street/Dalmarnock Road	260710	663950
	S side Dalmarnock Road, 3 blocks from Main Street	260760	663920
	N side Dalmarnock Road, 3 blocks from Main Street		
	Flats south side of London Road, 200 m east of junction with Olympia Street	261025	663975
Springburn Road	Flats west of Lenzie Street above Springburn Road	260550	668075
	House Springburn Park –closest property to Springburn Road	260500	667800
	Flats at corner of Atlas Road/Springburn Road (south of junction)	260380	667450
	Tenement at corner of Keppochill Road/Springburn Road (south of junction)	260340	667425
	Tenement north side of Keppoch Road, 120 m west of junction	260250	667432
	Tenement south side of Keppoch Road, 120 east of junction	260250	667418
Sauchiehall Street – junction with Elderslie Street	Sauchiehall St west of junction: Terrace north side	257600	666025
	Sauchiehall St west of junction: Terrace south side	257625	665970
	Elderslie St north of junction: Terrace east side	257650	666025
	Elderslie St north of junction: Terrace west side	257625	666050
	Elderslie St south of junction: Terrace east side	257670	665950
	Elderslie St south of junction: Terrace west side	257650	665950
	Sauchiehall St east of junction: Terrace north side	257700	665950
	Sauchiehall St east of junction: Terrace south side	257725	666040
Sauchiehall Street – junction with Claremont	Sauchiehall St west of junction: Terrace South side	257375	665975
	Sauchiehall St west of junction: Terrace west end of Crescent	257300	665950
	Sauchiehall St west of junction: Terrace middle of Crescent	257325	666000
	Sauchiehall St east of junction: Terrace south side	257450	665975
	Sauchiehall St east of junction: Terrace north side	257475	666015
Sauchiehall Street, junction with North Street	Tenement, south side Sauchiehall St	257875	666000
	Terrace, north side, Newton Place	257875	666050
Dumbarton Road	Intersection with Byres Road, tenement on west corner	255198	666544
	Intersection with Byres Road, tenement on east corner	255215	666535
	Intersection with Crow Road, tenement on east corner	255500	66600
Argyle Street	Tenement on north side of Argyle Street, west of Kent Road	257270	665790
	Tenement on north side of Argyle Street, east of Kent Road	257200	665825
	Tenement on north side of Argyle Street, east of Claremont Street	257475	665675

Location	Receptor	x	y
	Tenement on north side of Argyle Street, east of Breadlebane Street	257575	665655
	Tenement on north side of Argyle Street, between Gray Street and Derby Street	257000	665970
	Tenement on south side of Argyle Street, between Gray Street and Derby Street	257000	665950
	Tenement on north side of Argyle Street, between Kelvingrove Street and Berkeley Street	257182	665850
	Tenement on south side of Argyle Street, between Kelvingrove Street and Berkeley Street	257162	665845
Bryes Road	Tenement, west side between Church Street and University Avenue	256457	666825
	Tenement, east side between Church Street and University Avenue	256	666875
University Avenue	no data		
Woodlands Road	Tenement – west side of Woodlands Road, north of Barrington Drive	257520	666680
	Tenement – east side of Woodlands Road, north of Barrington Drive	257530	666700
	Tenement, east side of Woodlands Road, south of Lynedoch Street	257860	666275
	Tenement in Woodside Crescent, backing onto Woodlands Road, closest property	257900	666190
	Tenement on corner of St. Georges Road	257950	666170
Great Western Road – intersection with Dorchester Avenue	Flats – corner of Great Western Rd W/Dorchester Avenue	255150	668500
	Villa – corner of Great Western Rd W/Cranborne Rd	255100	668425
Great Western Road – intersection with Shelley Road	House on corner of Leicester Ave/Great Western Rd E	255650	668150
Great Western Road at junction with Hyndland Road	Terrace, south side of Gt Western Rd, at intersection with Hyndland Rd (East of)	256010	667850
	Terrace, north side of Gt Western Rd, west of intersection with Cleuden Rd	256000	667925
Great Western Road – between Hyndland Rd and Queen Margaret Dr	Bellhaven Terrace – junction with Horselet Hill, end terrace	256365	667575
	Kirklee Terrace – junction with Kirklee Rd – end Terrace	256475	667650
	Terrace – corner Queen Margaret Drive	256325	667875
	Tenement, south side Great Western Road E	256975	667250
Anniesland Cross	Anniesland Rd – flats on roundabout	254525	668810
	Bearsden Road – flats on W side	254625	668900
	Crow Rd – tenement on east side	254700	668725
	Great Western Rd NW-Flats on N side	254525	668925
	Great Western Rd Flats on S side	254510	668850
	Great Western Rd SE Tenements on N side	254750	668775
	Great Western Rd SE Tenements on S side	254700	668740
Balshagray Avenue	House, corner of Victoria Park Drive North/Balshagray Avenue	254480	667300
	House, Balshagray Ave, 50 m north of Victoria Park Drive	254475	667350
	House, corner of Victoria Park Gdns/Balshagray Avenue	254530	667260
Hyndland Road	Terrace west side, north end Hyndland Road	255950	667800
	Terrace east side, north end Hyndland Road	255975	667775
	Terrace, west side Hyndland Road – two houses down from Queensborough Gdns	255828	667375
	Terrace directly opposite on east side	255852	667375
Finnieston St	Flats east side of Finnieston Street, 50 m from junction with Argyle Street	257390	665650

Location	Receptor	x	y
	Flats east side of Finnieston Street at corner opposite bridge	257300	665090
	Flats east side of Finniston Street – north end of block facing bridge	257310	665175
Maryhill Road at Maryhill	At Maryhill, north of Kilmun Street - Tenement east side	256260	669532
	At Maryhill, north of Kilmun Street - Tenement west side	256250	669532
Maryhill Road at intersection with Garrioch Street	At intersection with Garrioch Street - Flats opposite shopping centre	257150	668400
	Flats on E side Maryhill Road, north of intersection	257075	668500
Maryhill Road -t intersection with Hopehill Road	Tenements on Maryhill Rd, north of intersection, W side	25800	667075
	Tenements on Maryhill Rd, north of intersection, E side	258025	667075
Paisley Road West	Crookston Road intersection, house north-west corner	253025	663900
	Crookston Road intersection, house north-east corner	253075	663920
	Crookston Road intersection, first house to east on Paisley Road West	253080	663875
	Crookston Road intersection, first house to west on Paisley Road West	253060	663850
	First house on west-side Berryknowes Road, north of junction	254350	663875
	First house east of Morrisons on north side Paisley Road West	254780	663900
	Mosspark Boulevard intersection, tenement, south-west corner	254915	663875
	Corkerhill Road junction– tenement south-east corner	255200	663950
	Corkerhill Road junction – flats south-west corner	255150	663875
	Corkhill Road junction, tenement directly opposite junction on north-side Paisley Road West	255150	663950
	Tenement 100 m east of Corkerhill Road, north side Paisley Road West	255325	664000
	Tenement 100 m east of Corkerhill Road, south side Paisley Road West	255325	663975
	Balhouston Drive junction, tenement south-west corner	255500	664005
	Jura Street junction, tenement north-east corner	255650	664070
Pollokshaws Road	Tenement west side, midway between Calder Street and Alison Street	256005	662800
	Tenement east side, midway between Calder Street and Alison Street	256005	662780
	Tenement on opposite side of road from pond in Queens Park	255650	662450
Parkhead Cross	Tenement, south side of Gallowgate, first block east of Springfield Road	262470	664190
	Tenement, west side of Springfield Road, 30 m south of junction	262467	664175
	Tenement, east side of Springfield Road, 30 m at junction	262482	664170
	Tenement, corner of Duke Street, Westmuir Street	262517	664200
	Tenement, east side Westmuir Street at junction	262535	664175
	Tenement, north side Tollcross Road, 30 m east of junction	262625	664130
Baillieston Road / Barrachnie Road	Corner house Baillieston Road/Barrachnie Road	266570	663950
	First house, east side of Barrachnie Road	266600	663980

Location	Receptor	x	y
	First house, east side of Garrowhill Drive	266650	663970
	Pub, at corner, Glasgow Road	266350	663955
	Corner house Mount Vernon Road/Baillestone Road	266560	663930
	Corner house Mount Vernon road, Glasgow Road	266590	663930

Location	Receptor		x	y
Bridge Street	Tenement – corner Bridge Street/Norfolk Street (N side)	1	258705	664480
	Tenements west side Bridge Street, north of junction with Nelson Street	2	258680	664500
	Tenements east side Bridge Street, north of junction with Norfolk Street	3	258700	664500
	Tenement corner Bridge Street/Oxford Street (N side)	4	258730	664595
	Tenement corner Bridge Street/Oxford Street (S side)	5	258725	664580
Queen Margaret Drive	Tenement corner Maryhill Road/Bilsland Drive (NW side)	1	257440	668060
	Tenement corner Maryhill Road/Bilsland Drive (SE side)	2	257440	668040
	House corner Maryhill Road/QMD	3	257410	668050
	West side QMD – first house parallel to road, S of junction with Maryhill Road	4	257360	668000
	Tenement midblock, W side QMD between Clouston Street and Oban Lane	5	257249	667650
	Tenement immediately opposite 5	6	257250	667660