City of Edinburgh Council

Further Assessment Report for the following Air Quality Management Area declarations:

Great Junction Street
St Johns Road
West Port (extension of Central AQMA)

August 2011

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Executive Summary

This report has been completed to fulfil the requirement of Part IV Section 84 (1) of the Environment Act 1995. The report details the main sources which contribute to nitrogen dioxide exceedences in the following Air Quality Management Areas:

West Port (Extension of Central AQMA)

St Johns Road

Great Junction Street

A Further Assessment is undertaken to enable appropriate actions to be pursued in the Council's Air Quality Action Plan. The report also addresses the percentage reductions of roadside nitrogen oxides (NO_x) required to meet the annual mean objective of 40µg/m^3 and the earliest date of compliance.

The report concludes that within the AQMAs at Great Junction Street and St Johns Road the greatest percentage of nitrogen dioxide within the local traffic fleet is attributed to buses, whilst at West Port the largest contribution of nitrogen dioxide within the local fleet is derived from cars, followed by HGVs.

A greater percentage of the measured nitrogen dioxide is associated with high local background levels at Great Junction Street and West Port when the Scottish background maps are used in the source apportionment calculations compared with the national UK background maps.

The greatest percentage reduction in roadside NO_x emissions to meet the annual 40µg/m^3 are required at West Port (74.9% to 86.4%), followed by St Johns Road (70.6% to 76.8%) and Great Junction Street (40.7% to 49.9%).

Based on the latest projection factors, the earliest dates for compliance with the annual mean objective within the AQMAs at Great Junction Street, West Port Extension and St Johns Road will be 2012, 2017 and 2019 respectively.

However, it is established that the anticipated emission reductions associated with improved vehicle technology have not been delivered with the current Euro standard vehicles and therefore calculated compliance dates are likely to be optimistic.

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1.0 Introduction

Part IV Section 84 (1) of the Environment Act 1995 requires a local authority to undertake a Further Assessment following declaration of an Air Quality Management Area (AQMA).

The main purpose of the Further Assessment is to allow local authorities to

- confirm their original assessment and thus ensure they were correct to designate an AQMA in the first place.

- calculate more accurately what improvement in air quality and corresponding reduction in emissions would be required to attain the air quality objectives within the AQMA.

- refine their knowledge of sources of pollution, so that the Air Quality Action Plan may be appropriately targeted.

- take account of new guidance and policy developments that may have come to light since declaration of the AQMA.

- take account of new local developments, transport schemes, commercial major housing developments that were not committed or known at the time of preparing the Detailed Assessment.

This Further Assessment includes the following AQMA declarations:

St Johns Road

Great Junction Street (Leith)

West Port (extension of Central AQMA)

The report contains monitoring data gathered since 2007, source apportionment studies for each of the AQMAs and the reduction in roadside NOx emissions required to meet the nitrogen dioxide annual air quality objective of 40 μgm^3 .

An indication of the earliest date by which the nitrogen dioxide objectives are expected to be met has also been calculated, based on current projection factors provided by Department for Environment Food and Rural Affairs (DEFRA) and the Devolved Administrations.

2.0 Summary of Detailed Assessment and associated AQMAs

2.1 St Johns Road

Detailed Assessment undertaken for St Johns Road concluded that there was a risk of exceeding the annual mean nitrogen dioxide objective on the westbound corridor. The exceedence was due to traffic sources of nitrogen dioxide. Traffic data provided by City of Edinburgh Council (CEC) Transport showed that 9.8% of traffic was comprised of HGVs. [1]

2.2 Great Junction Street and West Port

Detailed Assessment work undertaken for Great Junction Street and West Port concluded that the annual mean nitrogen dioxide air quality objective was being exceeded and that the hourly objective was also likely to be exceeded at West Port. Exceedences were due to traffic sources of NOx.

Traffic data provided by CEC (Transport) was based on a 12 hour manual count during 2004 which identified that HGVs represented 25.7% of the total fleet at Great Junction Street and 17.8% at West Port.[2]

2.3 Description of AQMAs

AQMAs in Edinburgh have been declared for non compliance with the nitrogen dioxide objectives. Maps of City of Edinburgh Council's three AQMAs are shown in Figures 2.1, 2.2 and 2.3. A description of each of the AQMAs is detailed in Table 2.1

Figure 1 Central AQMA (amended to include West Port).

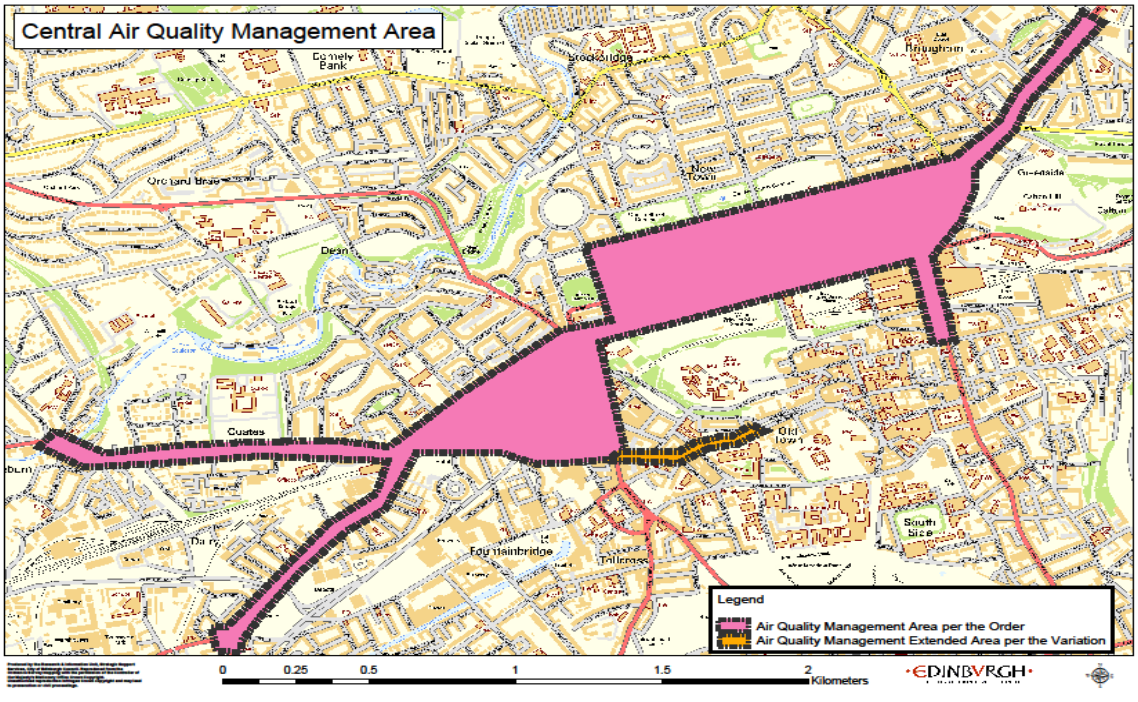


Figure 2 St Johns Road AQMA

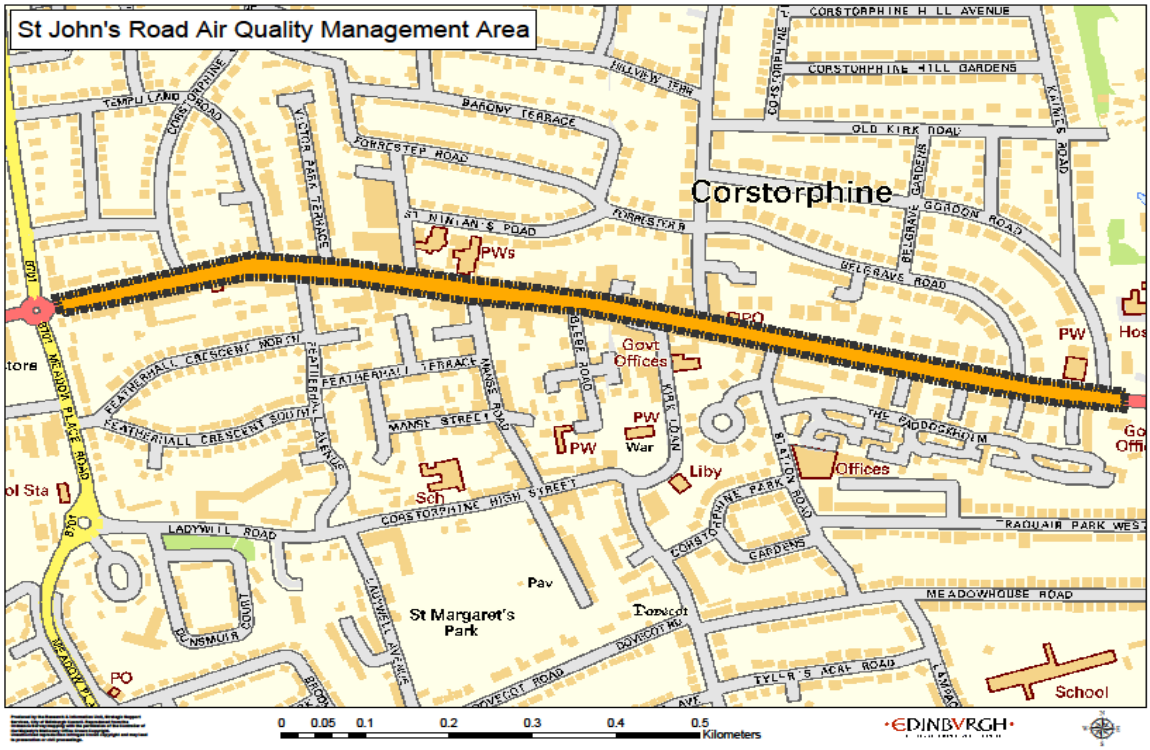


Figure 3 Great Junction Street AQMA

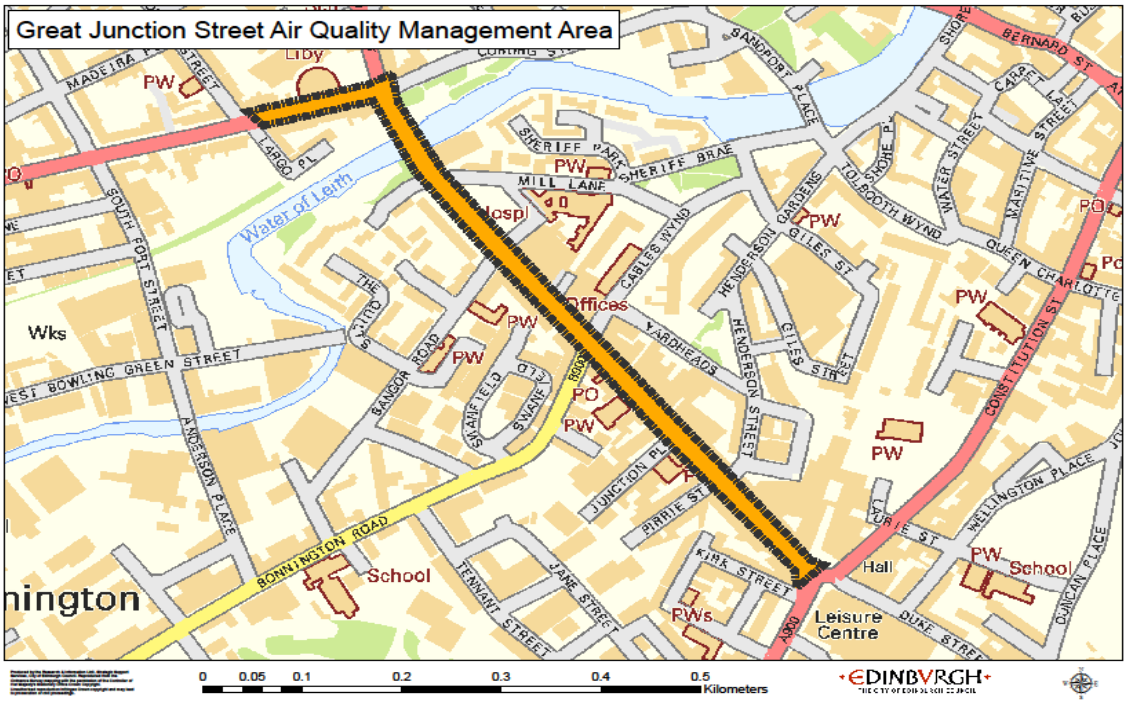


Table 2.1 Description of Air Quality Management Areas (AQMAs)

AQMA Location	Description	Declared
Central AQMA	Covers city centre and main arterial routes into the city centre. Exceedences mostly in locations where there are street canyons, high percentage of buses and congested traffic Residential and commercial properties within 2 to 4m of road edge. Road gradient ↑ Leith Walk / North Bridge (south bound) Main shopping locations include Princes St, George St, Gorgie Rd, Roseburn Terrace, Leith Walk, North Bridge.	31/12/2002 *Amended 09/03/2009
St Johns Road	Road flat. Main shopping street /residential at ground and first floor level within 2m of road edge. Street canyon (in part) congested road.	31/12/2006 *Amended 09/03/2009
West Port (extension of Central AQMA)	Road gradient ↑ (west bound) Residential properties at ground level. Street canyon with exposure within 2m of the kerb edge Street canyon	09/03/2009
Gt Junction Street	Road flat Main shopping street with residential at first floor level Street canyon Congested junction at foot of Leith Walk	09/03/2009

* Central and St Johns Road AQMA amended to include exceedence of hourly nitrogen dioxide objective.

3.0 Monitoring data

Nitrogen dioxide monitoring using passive diffusion tubes has continued in each of the AQMAs since their declaration. In addition, an automatic station was installed at St Johns Road. All monitoring locations represent relevant exposure. Grid references of monitoring locations including distances from the road are detailed in Appendix 1.

Maps detailing monitoring locations are shown in Appendix 7.

Nitrogen dioxide monitoring data has been gathered and assessed in accordance with government guidance. Methodology and calculations are contained in the annual Air Quality Review and Assessment reports. [3 / 4]

All reports containing monitoring data have been approved by Scottish Government, DEFRA and Scottish Environment Protection Agency (SEPA) apart from the Air Quality Progress report 2011 containing 2010 data which is work in progress [5]

Nitrogen dioxide monitoring data gathered since Detailed Assessment studies and subsequent declaration of AQMAs continues to exceed the Air Quality Objectives at St Johns Road, Great Junction Street and West Port.

The data for each of the AQMAs is shown in Tables 3.1 to 3.4 below.

Table 3.1 Nitrogen dioxide automated monitoring data St Johns Road (µg/m^3)

Location	2007	2008	2009	2010*
St Johns Road (Roman)				
Annual mean µg/m^3	93	75	70	71
Number of hourly exceedences	362	166	114	60
% Data Capture	95%	90.6%	95.6%	93.7%

Table 3.2 Nitrogen dioxide passive diffusion tube monitoring data St Johns Road (µg/m^3)

Location St Johns Road	2007	2008	2009	2010*
Passive diffusion tubes Annual mean and (% data capture)				
1 (East bound carriageway)	52 (92%)	41 (92%)	37 (92%)	39 (75%)
1b (East bound carriageway)	51 (83%)	49(100%)	44 (83%)	44 (92%)
1c (West bound carriageway)	**82** (83%)	**74**(100%)	N/A	N/A
1d (West bound carriageway)	**96** (83%)	**85**(100%)	58 (83%)	59 (83%)
1e (West bound carriageway)	**80** (83%)	**77** (50%)	N/A	N/A
1f (West bound carriageway)	**94**(100%)	**77** (92%)	N/A	N/A
39 (East bound carriageway)	37(100%)	32 (82%)	28 (92%)	31 (92%)

Table 3.3 Nitrogen dioxide passive diffusion tube monitoring data Great Junction Street (µg/m^3)

Location Great Junction Street	2007	2008	2009	2010*
Passive diffusion tubes Annual mean and (% data capture)				
30	49 (83%)	45 (83%)	44 (75%)	42 (92%)
30b	37(100%)	38(100%)	39 (67%)	40 (92%)
30c	44 (83%)	50(100%)	43 (67%)	44 (92%)
30d	38 (92%)	39(100%)	37 (92%)	40 (92%)
30e	44(100%)	43(100%)	42 (75%)	39 (92%)

Table 3.4 Nitrogen dioxide passive diffusion tube monitoring data West Port (µg/m^3)

Location West Port	2007	2008	2009	2010*
Passive diffusion tubes Annual mean and (% data capture)				
28	45 (83%)	53 (58%)	48 (50%)	50 (33%)
28b	**65** (67%)	**73** (67%)	**67** (83%)	**62** (75%)
28c	48 (92%)	51 (75%)	44 (58%)	42 (83%)
28d	**73** (83%)	**67** (92%)	**60** (83%)	55 (58%)

Notes

***** 2011 Air Quality Progress Report containing 2010 data is work in progress. Expected submission date is September 2011. All passive diffusion tube data has been bias corrected and represents exposure at the building façade.

Data highlighted in red indicates an exceedence of the annual mean nitrogen dioxide objective.

Data highlighted in red bold indicates a potential exceedence of the hourly objective due to annual mean concentration being 60 or above.

Data capture highlighted in blue indicates less than 90% data capture.

Annual mean nitrogen dioxide objectives:

Pollutant	Concentration	Measured as	Date to be achieved by
Nitrogen dioxide	**40 µg/m^3**	Annual mean	31.12.2005
	200 µg/m^3 not to be exceeded more than **18** times a year	1-hour mean	31.12.2005

4.0 New Local Developments

Edinburgh Tram

Edinburgh tram has had various set backs and the route now falls short of the initial proposals. Operational aspects of the tram with current bus services and potential bus displacement will require to be assessed with regard to impacts on air quality.

5.0 Source Apportionment

Initial source apportionment work (2002) identified that the majority of NO_X emissions within the Central AQMA was associated with the local bus fleet. Details of source apportionment are contained in the Council's initial Action Plan (published July 2003) and Review and Assessment of Air Quality Stage 4 Report (2002).

Technical Guidance LAQM TG (09) advice is that source apportionment work need not be carried out with absolute precision, but should be sufficiently detailed to allow the authority to identify the predominant sources that contribute to the air quality exceedences within its AQMA.

Apportionment requires to be broken down into the following:

Regional background, which the authority is unable to influence

Local background, which local authority should have some influence over.

Local sources, which will add to the background and give rise to the hotspot area of exceedences. These are the principle sources which the local authority is able to control through measures in the Action Plan.

In Edinburgh, traffic has been identified as the major contributor of NO_X emissions. Therefore, NOX emissions from the different vehicle classes have been apportioned for cars (including taxis), light goods vehicles (LGVs), Heavy goods vehicles (HGV) and buses.

The source apportionment work for this study was carried out in accordance with Box 7.1 (TG09). The Emission Factor Toolkit (EFT) v 4.2.2 (November 2010) was used to apportion the contribution of NO_X from each of the vehicle classes. The calculations for each of the three areas are detailed in Appendix 4.

The approach adopted by Edinburgh Council has been approved by the Local Air Quality Management (LAQM) Helpdesk.

Traffic data used for this work was collected for a 24 hour period over three week days which were considered representative of the average annual flow at each location. The data was collected using video camera and assessment made by Sky High Traffic Surveys. The vehicle split which was used in the apportionment study is detailed below and summary of combined flows are contained in appendix 2

Cars (car private car hire,Taxi hackney cab)
LGV (light vans)
HGV (HGV rigid 2 axle, 3 axle, 4 axle and HGV artic 3/4)
Buses (buses)
MC (motor cycles)

For the purposes of this work, taxis were grouped with the car fleet, and the four HGVs classes were grouped together. The national emission profiles of the vehicle classes contained in the EFT spread sheet were used, apart from the bus fleet, whereby local knowledge of the fleet profile at each of the locations was used.

The break down of individual vehicles as a percentage of the local fleet at each of the locations is listed in Table 5.1

Table 5.1 Vehicle class break down as a percentage of local fleet

AQMA	Car /taxi %	LGV %	Bus %	HGVs %	MC %
Gt Junction Street	80.7	9.0	7.0	2.7	0.6
St Johns Road	82.7	8.1	6.3	2.7	0.2
West Port (extension)	84.2	11.7	0.9	2.8	0.4

At all locations cars dominate the local fleet 80.7% to 84.2%, followed by light goods vehicles (vans) 8.1% to 11.7%, Buses are the next highest at Great Junction Street and St Johns Road. However, buses form a small percentage of the vehicle fleet at West Port 0.9%. HGVs represent 2.7% to 2.8 % of the total fleet.

At the request of the Scottish Government, source apportionment work was undertaken using both UK and Scottish background maps. Modelled concentrations of NO_2 and NO_X are consistently higher for each of the Km squares in the Scottish maps compared with the background mapping undertaken for the UK. Summary of the findings are shown in tables 5.2, 5.3 and 5.4 and represented in figures, 1A/1B, 2A/2B and 3A/3B. Motor cycles were considered insignificant and therefore this vehicle class was not included in the final source apportionment study.

Table 5.2 Final source apportionment of worst-case NO_2 concentration of 44 µg/m^3 at Great Junction Street

Sources Great Junction Street	UK maps µg/m^3	%	SG maps µg/m^3	%
Regional background	2.5	6%	2.9	6%
Local background	18.5	42%	23.1	53%
Local bus traffic	13.8	31%	10.8	25%
Local car traffic	4.4	10%	3.4	8%
Local HGV traffic	3.5	8%	2.7	6%
Local LGV traffic	1.4	3%	1.1	3%
Pdt concentration	**44**	**100%**	**44**	**101%**

Table 5.3 Final source apportionment of worst-case NO_2 concentration of 71 µg/m^3 at St Johns Road

Sources St Johns Road	UK maps µg/m^3	%	SG maps µg/m^3	%
Regional background	2.7	4%	3.1	4%
Local background	13.3	19%	18.9	27%
Local bus traffic	29.2	41%	26.0	37%
Local car traffic	12.7	18%	11.3	16%
Local HGV traffic	9.9	14%	8.8	12%
Local LGV traffic	3.3	5%	2.9	4%
RT concentration	**71**	**101**	**71**	**100**

Table 5.4 Final source apportionment of worst-case NO_2 concentration of 62 µg/m^3 at West Port

Sources **West Port**	**UK maps µg/m^3**	**% NO_2**	**SG maps µg/m^3**	**% NO_2**
Regional background	2.4	4%	2.7	4%
Local background	22.6	36%	30.3	49%
Local bus traffic	4.8	8%	3.8	6%
Local car traffic	14.8	24%	11.6	19%
Local HGV traffic	11.8	19%	9.3	15%
Local LGV traffic	5.6	9%	4.4	7%
pdt concentration	**62**	**100**	**62**	**100**

The greatest percentage of nitrogen dioxide within the local traffic fleet at Great Junction Street and St Johns Road is attributed to buses (25% to 31% and 37% to 41% respectively). At West Port the greatest contribution is from the local car traffic (19% to 24%) followed by HGV traffic (15% to 19%).

Fig 1A NO_2 source apportionment Great Junction Street (UK background maps)

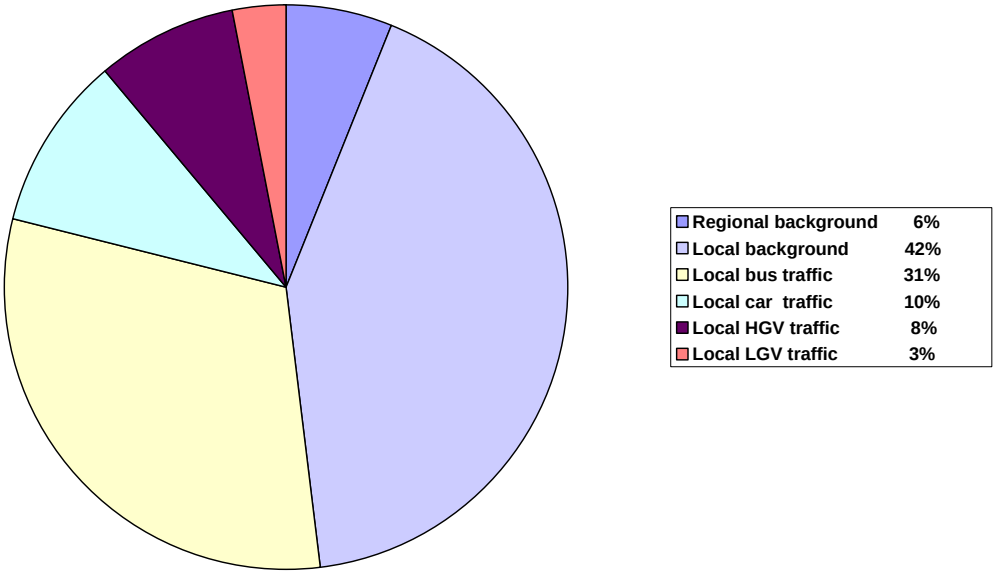


Fig 1B NO_2 source apportionment Great Junction Street (SG background maps)

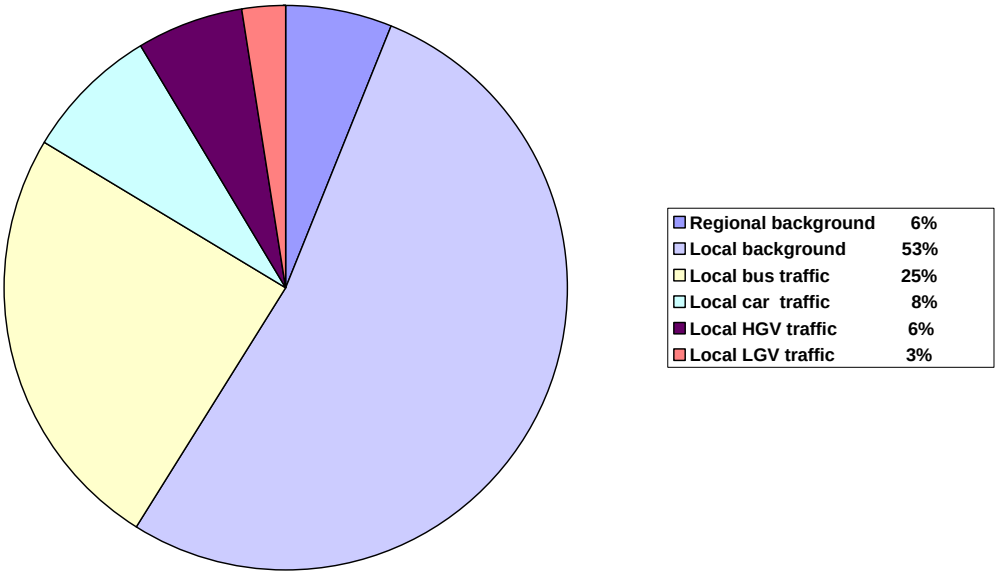


Fig 2A NO_2 source apportionment St Johns Road (UK background maps)

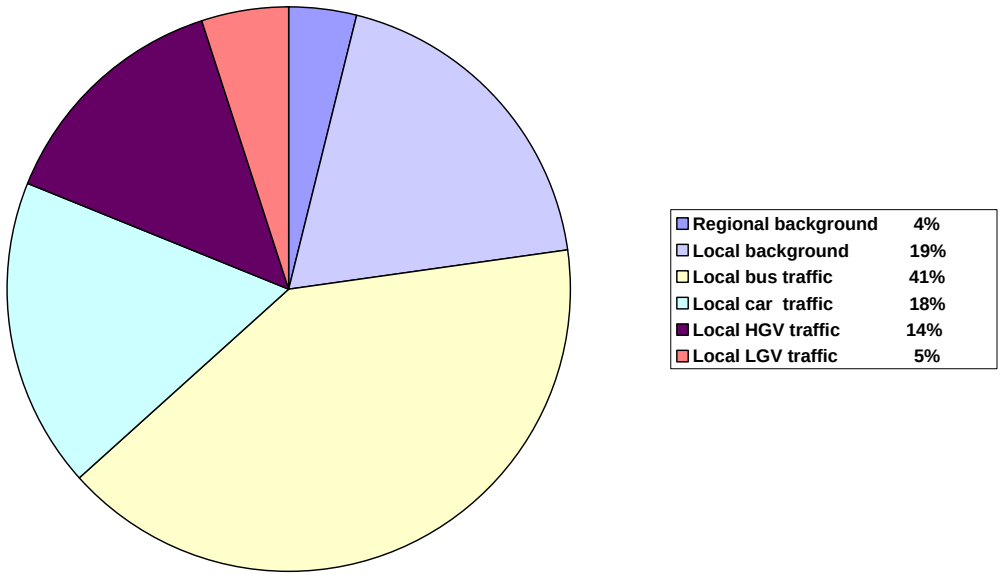


Fig 2B NO_2 source apportionment St Johns Road (SG background maps)

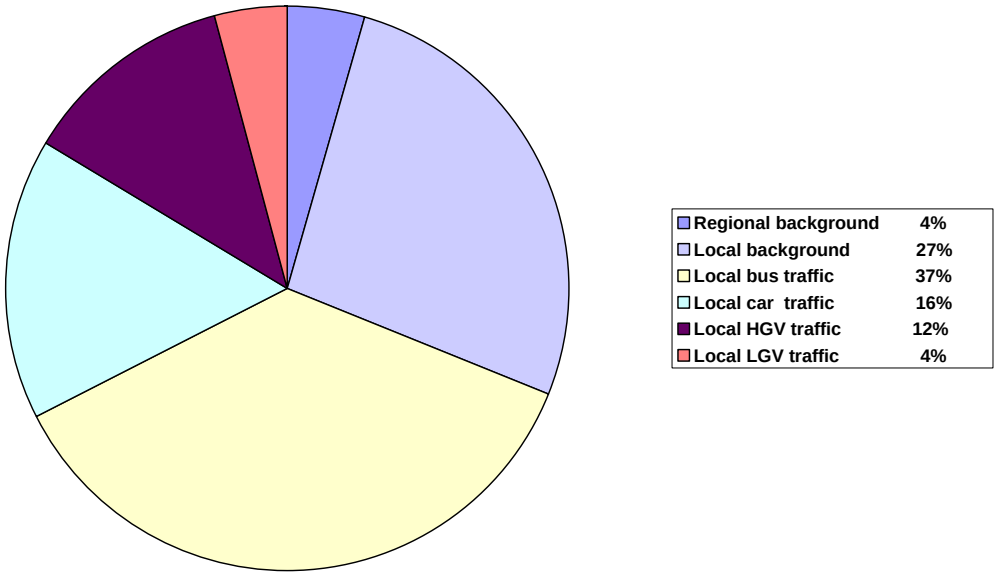


Fig 3A NO_2 source apportionment West Port (UK background maps)

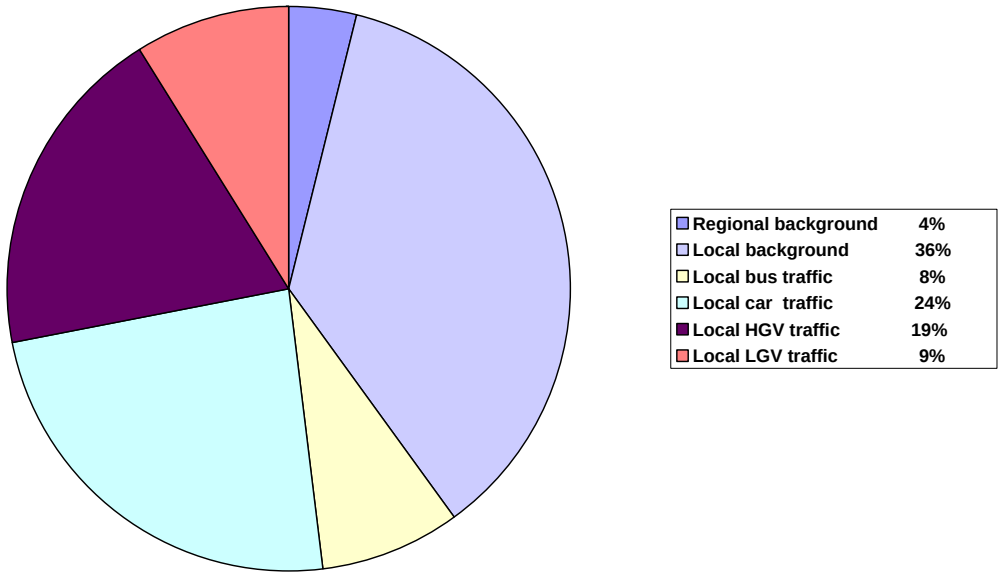
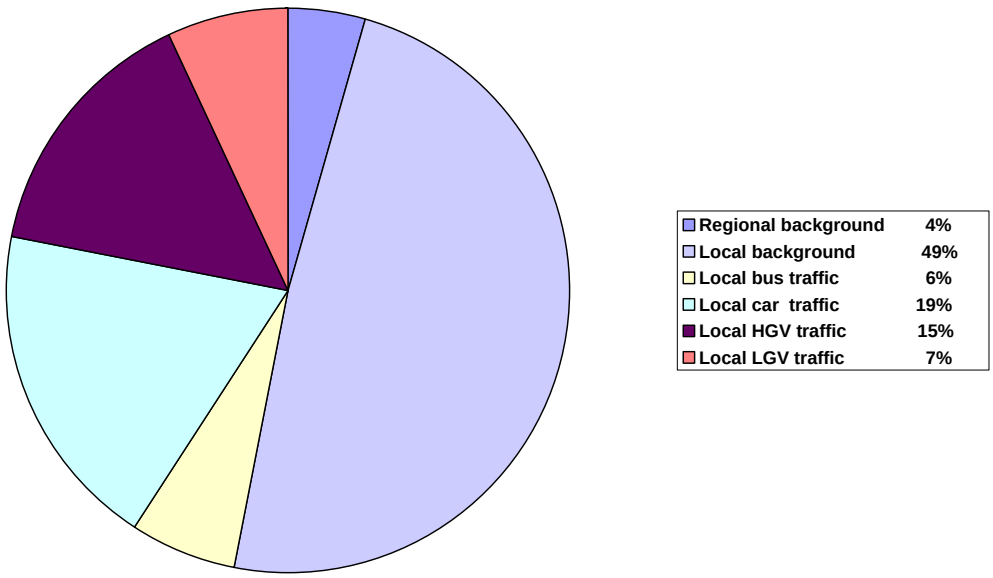


Fig 3B NO_2 source apportionment West Port (SG background maps)



6.0 Reduction required in roadside nitrogen oxide (NOx)

Calculation of road traffic reduction of nitrogen oxide required to meet the 40 μg/m^3 was undertaken in accordance with Box 7.2 LAQMA TG (09) and updated guidance for Step 4 and 5. Both these stages were found to contain an error which was amended on the Review and Assessment Helpdesk web site (October 2010).

The NO_X from NO_2 calculator was used to obtain the equivalent NO_X concentration for the nitrogen dioxide concentrations measured by passive diffusion tubes apart from St Johns Road, where the measurement from the automated air quality monitoring station was used.

Calculations were undertaken using background data from both the UK and Scottish Government maps and have been represented as a range at the request of the Scottish Government.

All calculations and parameters used are shown in Appendix 5.

Summary of the percentage reduction in roadside NO_x emissions required based on the worst-case concentrations of nitrogen dioxide at Great Junction Street, St Johns Road and West Port are detailed in Table 6.1.

Table 6.1 Percentage reduction in road NO_x emissions required within the AQMAs represented for both UK and Scottish Government (SG) background maps.

Location	% Reduction in road NOx emissions (UK)	% Reduction in road NOx emissions (SG)
Great Junction Street	40.7%	49.9%
St Johns Road	70.6%	76.8%
West Port	74.9%	86.4%

7.0 Expected Compliance date for nitrogen dioxide air quality objectives.

When undertaking Further Assessment, authorities are advised to provide an indication of the date when objectives are expected to be met using year adjustment factors provided by the government.

The adjustment factors have been revised and are required to be used for all LAQM Review and Assessment work from January 2010. Guidance in Box 2.1 of TG 09 (updated) was followed to calculate the compliance date at each of the 'hot spot' areas within the AQMAs.

The earliest date for compliance with 40µg/m^3 annual mean objective for each of the AQMA locations is shown in Table 7.1

Calculations are shown in Appendix 6

Table 7.1 Earliest date for compliance with the nitrogen dioxide annual mean objective

AQMA Location	2010 Annual NO_2 mean	Earliest date of compliance
Great Junction Street	44 µg/m^3	2012 (39 µg/m^3)
West Port extension	62 µg/m^3	2017 (39 µg/m^3)
St Johns Road	71 µg/m^3	2019 (39 µg/m^3)

The revised factors are based on emissions of NO_X and primary NO_2 expected from improvements in vehicle technology as a percentage of newer vehicles enter the UK fleet each year. However, it has been established that the anticipated reductions have not been delivered in 'real life' driving situations. Therefore, the above calculated earliest compliance dates are likely to be optimistic.

8.0 Conclusion

Previous source apportionment work identified buses as being the main contributors of NO_X emissions in the Central AQMA. Therefore, the main focus of the Action Plan (Revised September 2008) is to reduce emissions from the bus fleet via voluntary agreements.

Local knowledge identified that the bus fleet was also likely to be the main contributors of NO_X within the AQMAs at St Johns Road and Great Junction Street. Both these areas have been included in bus emission improvement work and were reported in 2010 Air Quality Progress report. [4]

Source apportionment work undertaken for this Further Assessment has shown that the majority of nitrogen dioxide from the vehicle fleet is derived from local bus traffic at Great Junction Street and St Johns Road, (between 25% and 35% and 37% and 41% respectively). Therefore, the measure in the Action Plan of improving emissions from the bus fleet is valiid for both of these AQMAs.

However, the majority of emissions associated with the vehicle fleet at West Port are derived from local car traffic (19% to 24%) followed by HGVs (15% to 19%).

Source apportionment work using the Scottish background maps compared with the UK national maps has identified that local background contributes more than local traffic at West Port and Great Junction Street. Table 8.1

Table 8.1 Summary of NO_2 apportionment of regional, local background and local traffic calculated using both Scottish Government and UK background maps.

AQMA	Regional Background %	Local Background %	Local Traffic %
West Port extension			
Scottish BG	4	49	47
UK BG	4	36	60
Great Junction Street			
Scottish BG	6	53	42
UK BG	6	42	52
St Johns Road			
Scottish BG	4	27	69
UK BG	4	19	78

West Port and Great Junction Street AQMAs are in more densely populated areas of the city centre compared with St Johns Road AQMA and therefore higher background concentrations of nitrogen dioxide are expected.

The greatest road NO_X emission reductions are required at West Port 74.9% to 86.4%, followed by St Johns Road 70.6% to 76.8% and Great Junction Street 40.7% to 49.9%.

Based on the latest projection factors, the earliest dates for compliance with the annual mean objective within the AQMAs at Great Junction Street, West Port Extension and St Johns Road will be 2012, 2017 and 2019 respectively.

References

1 Detailed Assessment Report (Local Air Quality Management Round 2) December 2004.

2 Detailed Assessment Report for nitrogen dioxide at Gt Junction Street and West Port. Round 3 of local Air Quality Management April 2007

3 2009 Air Quality Updating and Screening Assessment for City of Edinburgh Council. (August 2009)

4 2010 Air Quality Progress Report for City of Edinburgh Council September 2010

5 2011 Air Quality Progress Report for City of Edinburgh Council (in process of completion)

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Appendix 1

Grid References and distances to road edge of monitoring locations.

Site Name	Site Type	OS Grid Ref	Site ID	In AQMA ?	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location ?
St Johns Rd	Kerbside RT	X 320101 Y 672907	5	Y	Y (1.35m)	(0.5m)	Y
St Johns Rd	Kerbside pdt	X 320122 Y 672917	1	Y	Y (1.8m)	(0.54m)	Y
St Johns Rd	Roadside pdt	X 320154 Y 672911	1b	Y	Y facade	(2.0m)	Y
St Johns Rd	Roadside pdt	X 320084 Y 672910	1c	Y	Y facade	(2.1m)	Y
St Johns Rd	Roadside pdt	X 320096 Y 672907	1d	Y	Y facade	(2.1m)	Y
St Johns Rd	Roadside pdt	X 320070 Y 672912	1e	Y	Y facade	(2.1m)	Y
St Johns Rd	Kerbside pdt	X 320099 Y 672907	1f	Y	Y (1.9m)	(0.2m)	Y
St Johns Rd/Vict	Kerbside pdt	X 319677 Y 672991	39	Y	Y (9.0m)	(1.7m)	Y
West Port	Roadside pdt	X 325192 Y 673261	28	Y	Y facade	(1.7m)	Y
West Port	Roadside pdt	X 325166 Y 673242	28b	Y	Y facade	(1.4m)	Y
West Port	Roadside pdt	X 325184 Y 678261	28c	Y	Y facade	(3.0m)	Y
West Port	Roadside pdt	X 325203 Y 673250	28d	Y	Y facade	(2.7m)	Y
Great Junction St	Roadside pdt	X 326884 Y 675997	30	Y	Y facade	(2.8m)	Y
Great Junction St	Roadside pdt	X 326740 Y 676138	30b	Y	Y facade	(2.9m)	Y
Great Junction St	Roadside pdt	X 326925 Y 675949	30c	Y	Y facade	(2.8m)	Y
Great Junction St	Roadside pdt	X 326757 Y 676144	30d	Y	Y facade	(2,8m)	Y
Great Junction St	Roadside pdt	X 326845 Y 676015	30e	Y	Y facade	(2.7m)	Y

Monitoring locations which are highlighted in blue were selected for source apportionment and roadside reduction of NOx.

Appendix 2

Traffic data (summary of combined flows)

Notes

Traffic data was gathered in November 2010 and January 2011. It has been assumed that the traffic flows and vehicle class break down have not changed in the areas studied. Therefore the EFT model was run using 2010 for the emission profile year. Using this year is compatible with the nitrogen dioxide monitoring data collected in 2010.

Great Junction Street

Combined flows

	16-Nov	17-Nov	18-Nov	Mean	%
Motor Cycle	126	106	101	111	0.61
Car and Private Taxi	13466	13742	14014	13741	76.40
Black Hackney Cab	668	830	806	768	4.30
LGV	1643	1567	1625	1612	8.90
HGV rigid 2 axile	445	410	358	404	2.20
HGV rigid 3 axile	41	42	49	44	0.24
HGV rigid 4 axile	17	8	15	13	0.07
HGV artic 3/4 axile	18	11	18	16	0.09
HGV artic 5 axile	8	5	4	6	0.03
HGV artic 6 axile	2	7	11	7	0.04
single decker bus	176	175	179	177	0.98
double decker bus	1095	1075	1079	1083	6.02
Mean AADT				17982	**99.88**

Traffic data % used in Emission Factor Toolkit

Motor Cycle	111	0.6
Car PH andBlack cab	14509	80.7
LGV	1612	9.0
HGVs	490	2.7
Bus	1260	7.0
	17982	100%

St Johns Road

Combined flows

	11-Jan	12-Jan	13-Jan	Mean	%
Motor Cycle	25	36	50	37	0.16
Car and Private Taxi	16069	15970	16649	16229	73.6
Black Hackney Cab	1836	2193	2042	2024	9.2
LGV	1811	1818	1726	1785	8.1
HGV rigid 2 axile	511	481	406	466	2.1
HGV rigid 3 axile	41	88	60	63	0.3
HGV rigid 4 axile	14	26	17	19	0.09
HGV artic 3/4 axile	20	19	22	20	0.09
HGV artic 5 axile	6	6	7	6	0.02
HGV artic 6 axile	13	15	12	13	0.06
single decker bus	334	328	335	332	1.5
double decker bus	1067	1054	1057	1059	4.8
Mean AADT				22055	100.02

Traffic data % used in Emission Factor Toolkit

Motor Cycle	37	0.2
Cars PH and Black Cab	18253	82.7
LGV	1785	8.1
HGV	587	2.7
buses	1391	6.3
	22053	100%

West Port

Combined flows

	11-Jan	12-Jan	13-Jan	Mean	%
Motor Cycle	64	53	82	66	0.45
Car and Private Taxi	10826	11217	11394	11146	75.3
Black Hackney Cab	1176	1323	1440	1313	8.9
LGV	1762	1707	1733	1734	11.7
HGV rigid 2 axile	358	366	338	354	2.4
HGV rigid 3 axile	34	35	33	34	0.2
HGV rigid 4 axile	12	12	4	9	0.1
HGV artic 3/4 axile	7	8	17	11	0.1
HGV artic 5 axile	2	2	2	2	0.0
HGV artic 6 axile	5	5	2	4	0.0
single decker bus	125	131	131	129	0.9
double decker bus	3	5	3	4	0.0
Total mean AADT				14806	100.0

Traffic data % used in Emission Factor Toolkit

Motor Cycle	66	0.4
Cars PH and Black Cab	12459	84.2
LGV	1734	11.7
HGV	414	2.8
buses	133	0.9
	14806	100.0%

Appendix 3

Calculation of NOx emissions using Emission Factor Toolkit Version 4.2.2 November 2010.

Great Junction Street

Inputs

Gt Junction Street	AADT	Spd kph	car tax %	LGV %	HGV%	Bus	MC	Total
	17982	20	80.7%	9	2.7	7	0.6	100.0%
Total HGV	9.70%							

Euro Standard bus fleet % Great Junction Street

Euro 3	Euro4	Euro 5
66.2%	8.6%	25.2%

Data obtained from details submitted by all bus providers operating in Great Junction Street. Information provided to assess projected NOx improvement from bus fleet bi directional flow in each of AQMAs

Road Type 1 (urban)

Year of assessment 2010

Output NOx g/km

Pollutant_Name	Petrol Cars (g/km)	Diesel Cars (g/km)	Taxi (g/km)	Petrol LGV (g/km)	Diesel LGV (g/km)
NOx	1431.6	2228.8	0	51.9	1022.9

Rigid HGV (g/km)	Artic HGV (g/km)	Buses (g/km)	MC (g/km)
2177.8	710.8	11630.6	15.6

NOx Total = 19270.2 g/km

% NOx vehicle class

	g/km	%
Cars	3660.4	19
LGVs	1074.8	6
HGVs	2888.6	15
buses	11630.6	60
mc	15.6	0
Total	**19270**	**100.0**

St Johns Road

Inputs

St Johns Rd	AADT	Spd kph	Car Taxi %	LGV %	HGV%	Bus	MC	Total
	22055	20	82.7	8.1	2.7	6.3	0.2	100
Total HGV	9.0%							

Euro Standard bus fleet % St Johns Road

Euro2	Euro3	Euro4	Euro5
1.9%	37.3%	20.9%	39.9%

Data obtained from details submitted by all bus providers operating in St Johns Road . Information used to assess projected NOx improvement from bus fleet bidirectional flows in each of AQMAs

Road Type 1 (urban)

Year of assessment 2010

Output NOx g/km

Pollutant_Name	Petrol Cars (g/km)	Diesel Cars (g/km)	Taxi (g/km)	Petrol LGV (g/km)	Diesel LGV (g/km)
NOx	1803.8	2808.2	0	56.7	1115.3

Rigid HGV (g/km)	Artic HGV (g/km)	Buses (g/km)	MC (g/km)
2671.0	871.8	10531.9	5.5

NOx Total = 19864 g/km

% NOx vehicle class

	g/km	%
Cars	4612	23
LGVs	1172	6
HGVs	3542.8	18
buses	10531.9	53
mc	5.5	0
Total	**19864**	**100**

West Port
Inputs

West Port	AADT	Spd kph	Car/ Taxi %	LGV %	HGV%	Bus %	MC %	Total
	14806	20	84.2	11.7	2.8	0.9	0.4	100
Total HGV	3.70%							

Euro standard bus fleet % West Port

Euro2	Euro3	Euro4	Euro5
10%	34.8%	N/A	55.2%

Data provided by Lothian bus (sole operator in West Port)

Road Type 1 (urban)

Year of assessment 2010

Output NOX g/km

Pollutant_Name	Petrol Cars (g/km)	Diesel Cars (g/km)	Taxi (g/km)	Petrol LGV (g/km)	Diesel LGV (g/km)
NOX	1231.4	1917.1	0.0	55.6	1095.0

Rigid HGV (g/km)	Artic HGV (g/km)	Bus (g/km)	MC (g/km)
1859.5	607.0	1008.1	7.3

NOx Total = 7780.9 g/km

% NOx vehicle class

	g/km	%
Cars	3148.4	40
LGVs	1150.6	15
HGVs	2466.5	32
buses	1008.1	13
mc	7.3	0
Total	**7780.9**	**100.0**

Appendix 4

Calculation Source Apportionment using both UK and Scottish Government (SG) NO_2 and NO_x background maps.

Box 7.1 Technical Guidance LAQM. TG (09)

Great Junction Street	**2010**	
T-NO2 2010		
Measured pdt conc ug/m3	**44**	
DC %	91.6%	
Step 1		
TB-NO2 2010	**UK**	**SG**
Background NO2	21	26
TB-NOX 2010		
Background NOX	33	45
RB-NOX 2010		
Rural from map	4	5
LB-NOX		
TB-NOX - RB-NOX	29	40
Step 2		
RB-NO2		
TB-NO2 x RB-NOX/ TB-NOX	2.5	2.9
LB-NO2		
TB-NO2 x LB-NOX/TB-NOX	18.5	23.1
Step 3		
L-NO2		
T-NO2 -TB-NO2	23	18

Step 4

% x L-NO2/100		**UK**	**SG**
L-NO2		23	18
Buses	**60%**	13.8	10.8
Cars	**19%**	4.37	3.42
HGV's	**15%**	3.45	2.7
LGVs	**6%**	1.38	1.08
Total		**23**	18

From EFT		g/km	%
	Cars	3660.4	19
	LGVs	1074.8	6
	HGVs	2888.6	15
	buses	11630.6	60
	mc	15.6	0
	Total	**19270**	**100.0**

Final source apportionment of the worst-case NO_2 44µg/m^3 for Great Junction Street is

	UK	%	**SG**	**%**
Regional background	2.5	6	2.9	6
Local background	18.5	42	23.1	53
Local bus traffic	13.8	31	10.8	25
Local car traffic	4.4	10	3.4	8
Local HGV traffic	3.5	8	2.7	6
Local LGV traffic	1.4	3	1.1	3
pdt conc worst case	44	100	44	101

Notes

Grid Reference used to obtain background NO_2 and NO_x concentrations from both UK and SG background maps

Great Junction Street	**X**	**Y**
Grid reference selected	326500	676500
Actual	326925	676144

St Johns Road		
T-NO2 2010		
Measured RT conc ug/m3	**71**	
DC%	93.7%	
Step 1		
	UK	**SG**
TB-NO2 2010	16	22
Background NO2		
TB-NOX 2010		
Background NOX	24	36
RB-NOX 2010		
Rural from map	4	5
LB-NOX		
TB-NOX - RB-NOX	20	31
Step 2		
RB-NO2		
TB-NO2 x RB-NOX/ TB-NOX	2.7	3.1
LB-NO2		
TB-NO2 x LB-NOX/TB-NOX	13.3	18.9
Step 3		
L-NO2	55	49
T-NO2 -TB-NO2		

Step 4			
% x L-NO2/100		**UK**	**SG**
L-NO2		55	49
Bus	**53%**	29.15	25.97
Car	**23%**	12.65	11.27
HGVs	**18%**	9.90	8.82
LGVs	**6%**	3.30	2.94
Total		**55**	49

From EFT			
		g/km	%
	Cars	4612	23
	LGVs	1172	6
	HGVs	3542.8	18
	buses	10531.9	53
	mc	5.5	0
	Total	**19864**	**100**

Final source apportionment of worst-case 71µg/m^3 for St Johns Road

	UK	%	SG	%
Regional background	2.7	4%	3.1	4%
Local background	13.3	19%	18.9	27%
Local bus traffic	29.2	41%	26.0	37%
Local car traffic	12.7	18%	11.3	16%
Local HGV traffic	9.9	14%	8.8	12%
Local LGV traffic	3.3	5%	2.9	4%
RT conc worst case	71	101%	71	100%

Notes

Grid Reference used to obtain background NO_2 and NO_x concentrations from both UK and SG background maps

St Johns Rd	X	Y
Grid reference selected	320500	672500
Actual	320101	672907

West Port 28b	**2010**	
T-NO2 2010		
Measured pdt conc ug/m3	**62**	
DC%	75%	
Step 1	**UK**	**SG**
TB-NO2 2010 Background NO2	25	33
TB-NOX 2010 Background NOX	41	60
RB-NOX 2010 Rural from map	4	5
LB-NOX TB-NOX - RB-NOX	37	55
Step 2 **RB-NO2** TB-NO2 x RB-NOX/ TB-NOX	2.4	2.7
LB-NO2 TB-NO2 x LB-NOX/TB-NOX	22.6	30.3
Step 3 **L-NO2** T-NO2 -TB-NO2	37	29

Step 4		**UK**	**SG**
% x L-NO2/100			
L-NO2		37	29
Bus	**13%**	4.81	3.77
Car	**40%**	14.8	11.6
HGVs	**32%**	11.84	9.28
LGVs	**15%**	5.55	4.35
Total		37	29

From EFT	**g/km**	**%**
Cars	3148.4	40
LGVs	1150.6	15
HGVs	2466.5	32
buses	1008.1	13
mc	7.3	0
Total	**7780.9**	**100.0**

Final source apportionment of the worst-case NO_2 62µg/m^3 for West Port

	UK	%	SG	%
Regional background	2.4	4%	2.7	4%
Local background	22.6	36%	30.3	49%
Local bus traffic	4.8	8%	3.8	6%
Local car traffic	14.8	24%	11.6	19%
Local HGV traffic	11.8	19%	9.3	15%
Local LGV traffic	5.6	9%	4.4	7%
pdt conc worst case	62	100%	62	100%

Notes

Grid Reference used to obtain background NO_2 and NO_x concentrations from both UK and SG background maps

West Port	X	Y
Grid reference selected	325500	673500
Actual	325166	673242

Appendix 5

NOX reduction calculations.

NOX to NO2 calculator

Parameters selected for all AQMAS

Input year 2010
Area City Edinburgh
All other urban traffic Traffic Mix

Gt Junction St		
Step 1		
Diffusion tube NO2 concentration	**44**	
Equivalent NOX concentration	**113.5**	
Step 2		
Local background conc (maps)	**SG**	**UK**
NOX	44.8	33.1
NO2	26.0	20.7
Step 3		
Current road NOX		
Total NOX - local background NOX		
113.5 - 44.8 SG	68.7	
113.5 - 33.1 UK	80.4	
Step 4		
Road NOX conc required to give NO2 conc of 40	**SG**	**UK**
Background NO2 used in NOX- NO2 calculator	26.0	20.7
Equivalent NOX concentration	34.4	47.7
Step 5		
Road NOX reduction required		
Current road NOX - Road NOX required		
68.7 - 34.4 (SG)	34.3	
80.4 - 47.7 (UK)	32.7	
% reduction		
34.3/68.7 x 100 (SG)	**49.9%**	
32.7/80.4 x 100 (UK)	**40.7%**	

St Johns Road

Step 1		
RT NO2 concentration	**71**	
RT NOX concentration	**228**	
Step 2		
Local background conc (maps)		
	SG	**UK**
NOX	36.3	24.1
NO2	22.0	16.0
Step 3		
Current road NOX		
Total NOX - local background NOX		
228 - 36.3 (SG)	191.7	
228 - 24.1 (UK)	203.9	
Step 4		
Road NOX conc required to give NO2 conc of 40		
	SG	**UK**
Background NO2 used in NOX- NO2 calculator	22.0	16.0
Equivalent NOX concentration	44.4	59.6
Step 5		
Road NOX reduction required		
Current road NOX - Road NOX required		
191.7 - 44.4 (SG)	147.3	
203.9 - 59.6 (UK)	143.4	
% reduction		
147.3/191.7 x 100 (SG)	**76.8%**	
143.4/203.9 x 100 (UK)	**70.6%**	

West Port

Step 1 Diffusion tube NO2 concentration Equivalent NOX concentration	**62** **193.7**	
Step 2 Local background conc (maps)	**SG**	**UK**
NOX NO2	59.5 32.6	40.7 24.5
Step 3 Current road NOX Total NOX - local background NOX 193 - 59.5 (SG) 193 - 40.7 (UK)	 133.5 152.3	
Step 4 Road NOX conc required to give NO2 conc of 40	**SG**	**UK**
Background NO2 used in NOX- NO2 calculator Equivalent NOX concentration	32.6 18.1	24.5 38.1
Step 5 Road NOX reduction required Current road NOX - Road NOX required 133.5 - 18.1 (SG) 152.3 - 38.1 (UK) **% reduction** 115.4/133.5 x 100 (SG) 114.2/152.3 x 100 (UK)	 115.4 114.2 **86.4%** **74.9%**	

Appendix 6

Box 2.1 Projecting measured annual mean roadside nitrogen dioxide concentrations.

Adjustment factors used from updated guidance January 2010.

Year	Rest of UK
2010	0.832
2011	0.783
2012	0.735
2013	0.687
2014	0.639
2015	0.591
2016	0.557
2017	0.523
2018	0.489
2019	0.454
2020	0.420

Example of calculation

Great Junction Street

Concentration 2010 = 44 µg/m^3

Projected concentration in 2012

44x 0.735/0.832 = 38.9 µg/m^3

Appendix 7 Maps of monitoring locations

Map 1

AQM Bernard Street, Ferry Road and Great Junction Street Passive Diffusion Tube sites

Map 2

AQM Passived diffusion tube and real time analyser sites – St Johns Road

Map 3

AQM Passive diffusion tubes – West Port