2013 Further Assessment Report for City of Edinburgh Council

In fulfillment of Part IV of the
Environment Act 1995
Local Air Quality Management

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Executive Summary

This report sets out the Further Assessment of air quality within the following new designated and extended Air Quality Management Areas (AQMAs):

New AQMAs

- Glasgow Road/Ratho Station
- Inverleith Row/Ferry Road

Central AQMA extensions

- Cowgate/Grassmarket
- Easter Road
- London Road
- Gorgie Road

Great Junction Street AQMA extension

- Bernard Street

The report fulfils the requirements of the Local Air Quality Management (LAQM) process, as prescribed in Part IV Section 84 (1) of the Environment Act 1995. The report provides details of nitrogen dioxide monitoring data, the contribution from the following vehicle classes; car, light goods vehicle (LGV), heavy goods vehicle (HGV) and bus with respect to total measured concentration in the study areas in a source apportionment evaluation. The report also estimates the degree of improvement required to meet the annual mean air quality objective for nitrogen dioxide.

A number of hypothetical nitrogen oxide (NO_x) reduction scenarios have also been included for further discussion with respect to the Council's future action planning.

Source apportionment assessments in each study area have identified that the types of vehicle which contribute the most to the locally-generated road component of NO_2 is diverse. HGVs are the dominant source at Bernard Street, buses have the largest impacts at London Road, Gorgie Road/Chesser and Inverleith Row and a marginal role at Glasgow Road, Cowgate and Grassmarket. Cars have a significant impact in all areas with LGVs showing the least.

Local background concentrations contribute a substantial proportion of the measured overall NO_2 concentrations in the range 43% to 65% and comprise of emissions from domestic and commercial heating and emissions associated with traffic from the general road network in the vicinity of the AQMAs. Regional background contributed approximately 5% to 7% of the total NO_2.

Compared with initial source apportionment studies undertaken by the Council in 2001, cars now have a more significant role in terms of their contribution to the overall NO_2 concentrations measured in the study areas. This is partly due to engine technologies not delivering the expected level of emission improvements and a substantial increase of diesel vehicles in the national fleet, which emit more primary NO_2 than petrol vehicles. In 2013 51% of new cars were diesel with 47% petrol and 2% hybrid[1]

The required reduction in NOx emissions from local roads to attain the annual mean nitrogen dioxide Air Quality Objective are summarised as percentages below:

Glasgow Road/Ratho Station AQMA:

- Newbridge junction 43.3%
- Ratho Station 35%

Inverleith Row/Ferry Road AQMA:

- Inverleith Row 28.1%

Central AQMA extensions:

- Between the range of 12.3% at Gorgie Road/Chesser and 30.4% at London Road

Great Junction Street AQMA extension:

- Bernard Street 21.3%

The current measures in the Air Quality Action Plan regarding improving emissions from road freight vehicles (HGVs) and buses will continue to be appropriate for the new areas of declaration and extensions.

However, it will be necessary to keep car vehicles under consideration when exploring measures to include within the revised Air Quality Action Plan.

The revised Air Quality Action Plan will be aligned with relevant policies in The City of Edinburgh Council's Local Transport Strategy 2014 - 2019.

Table of Contents

List of Tables

List of Figures

1 Introduction

The City of Edinburgh Council designated two new Air Quality Management Areas (AQMAs) at Glasgow Road and Inverleith Row and extended the boundaries of the Central and Great Junction Street (Leith) AQMAs on 26 April 2013.

The AQMA designations and amendments to existing AQMA boundaries are due to exceedences of the annual mean nitrogen dioxide (NO_2) Air Quality Objective. The most significant contributory factor is local road traffic.

Air Quality Objectives are prescribed within the Air Quality (Scotland) Regulations 2000 and the Air Quality (Scotland) (Amendment) Regulations 2002. The objectives which are relevant to this report are summarised in Table 1.1.

Table 1.1: Air Quality Objectives for Nitrogen Dioxide

Pollutant	Status	Concentration in ambient air	Measured as	To be achieved by end
Nitrogen Dioxide	Statutory UK Objective	200 µg/m^3 not be exceeded more than 18 times a year	1 hour mean	2005
		40 µg/m^3	Annual mean	2005

Note: EU Limit Values are the same concentrations in ambient air, but required to be met by the start of 2010.

Part IV Section 84 (1) of the Environment Act 1995 requires local authorities to undertake a Further Assessment of air quality within the area of concern following an AQMA designation.

The main purpose of a Further Assessment under the Local Air Quality Management (LAQM) Framework is to allow local authorities to:

- confirm their original assessment and ensure they were correct to designate an AQMA in the first place.
- refine their knowledge of sources of pollution, so that the Air Quality Action Plan may be appropriately targeted.
- calculate more accurately the improvement in air quality and corresponding reduction in emissions which are required to comply with the air quality objectives within the AQMA.
- take account of new guidance and policy developments since the declaration of the AQMA.
- take account of new local developments, transport schemes, commercial and major housing developments that were not committed or known at time of preparing the Detailed Assessment.

The following new AQMA declarations and extensions studied for this Further Assessment report are listed below.

New AQMAs

- Glasgow Road/Ratho Station
- Inverleith Row/Ferry Road

Central AQMA extensions

- Cowgate/Grassmarket
- Easter Road
- London Road
- Gorgie Road

Great Junction Street AQMA extension

- Bernard Street

The report contains:

- an overview of NO_2 monitoring data gathered between 2009 and 2012 at relevant monitoring locations.
- new developments since the AQMA designations.
- an estimation of the relative contribution associated with the different vehicle types (source apportionment studies) operating at specific locations in the AQMAs
- the improvements in roadside NO_x emissions which are required to meet the NO_2 annual air quality objective of 40µg/m^3.
- an indication of the earliest dates for compliance with the annual mean NO_2 objective.

A summary discussion is also provided with respect to the key measures contained in the current Air Quality Action Plan together with a number of hypothetical NO_x emission reduction scenarios likely to deliver the degree of improvement required in the study areas.

2 Nitrogen Dioxide Monitoring Data and AQMAs

The requirement to designate and amend the boundaries of the AQMAs were based on monitoring data contained in the Air Quality Progress Report for City of Edinburgh Council 2011 as advised by the Scottish Government.[2]

The areas of exceedence are localised and generally occur where residential properties are located close to the roadside, in the canyon section of the road and adjacent to busy junctions.

The monitoring data contained in this report has been bias corrected and distance corrected where appropriate to relevant receptors. All data including calculations have been reported previously and approved by UK Department for Environment Food and Rural Affairs (DEFRA) and the Scottish Government.[3] Details on monitoring locations are shown in Appendix 1.

Concentrations which exceed the annual mean objective of 40µg/m^3 are highlighted in red and those which are at the objective are highlighted in bold black.

There are no annual mean concentrations greater than 60µg/m^3 at relevant locations, and therefore it is unlikely that the 1-hour objective for nitrogen dioxide will be exceeded.[4]

Monitoring data and relevant maps for each area are shown in Tables 2.1 to 2.6 and Figures 2.1 to 2.6.

The Central and Great Junction Street AQMAs are shown in Figures 2.8 and 2.9.

A description of the AQMAs and approximate locations of exceedence are summarised in Table 2.7.

Table 2.1: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Glasgow Road/Ratho Station 2009 to 2012

Site ID	2009 Bias Adjustment Factor = 0.86	2010 Bias Adjustment Factor = 0.85	2011 Bias Adjustment Factor = 0.81	2012 Bias Adjustment Factor = 0.76
15	42 (92%)	38 (83%)	41 (83%)	**40** (100%)
58*	51 (100%)	51 (83%)	52 (83%)	48 (100%)
16*	47 (83%)	45 (92%)	44 (100%)	47 (100%)

Notes
% data capture in brackets
* Duplicate tube

Figure 2.1: Glasgow Road/Ratho Station Monitoring Locations in Relation to AQMA

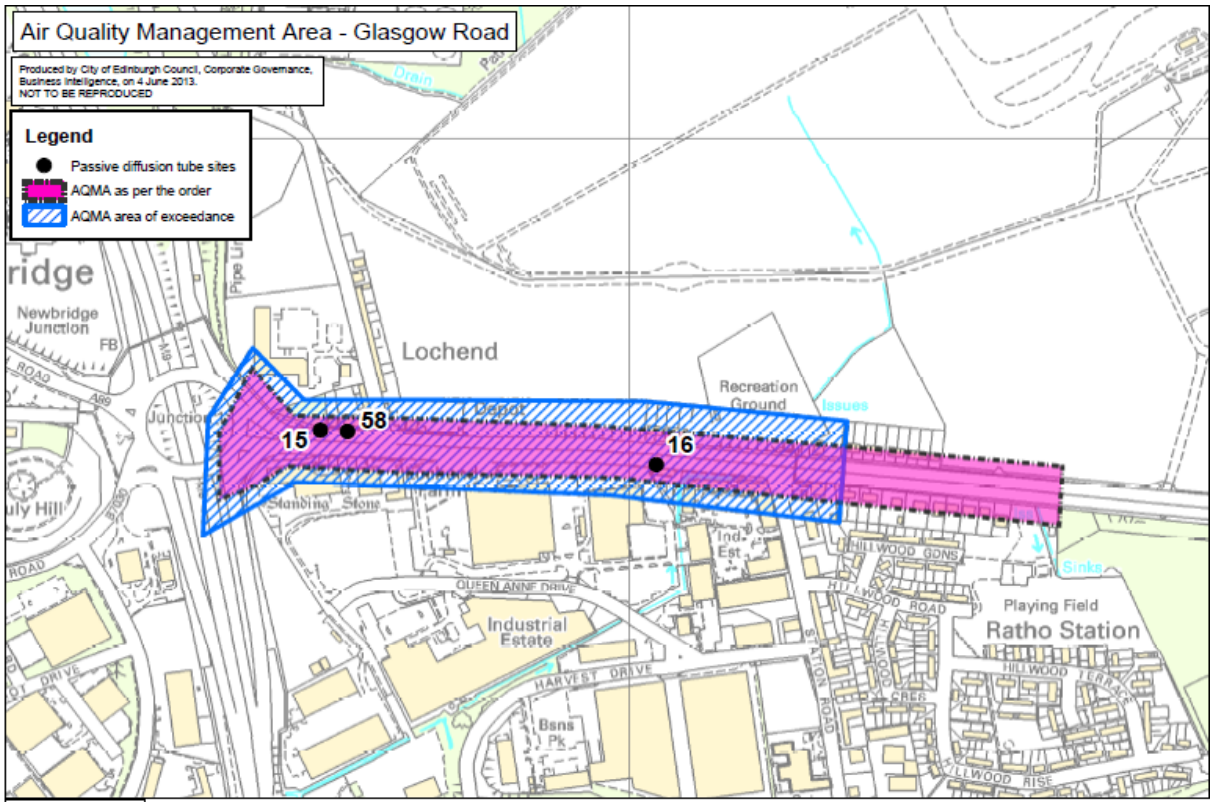

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Table 2.2: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Inverleith Row/Ferry Road Junction 2009 to 2012

Site ID	2009 Bias Adjustment Factor = 0.86	2010 Bias Adjustment Factor = 0.85	2011 Bias Adjustment Factor = 0.81	2012 Bias Adjustment Factor = 0.76
54	32 (83%)	32 (83%)	-	-
55*	43 (75%)	44 (100%)	44 (100%)	46 (100%)
55C	-	-	28 (100%)	32 (100%)
53	36 (92%)	35 (100%)	33 (100%)	35 (100%)
52	32 (67%)	32 (75%)	33 (100%)	34 (92%)

Notes
% data capture in brackets
* Duplicate tube

Figure 2.2: Inverleith Row and Ferry Road Monitoring Locations in Relation to AQMA

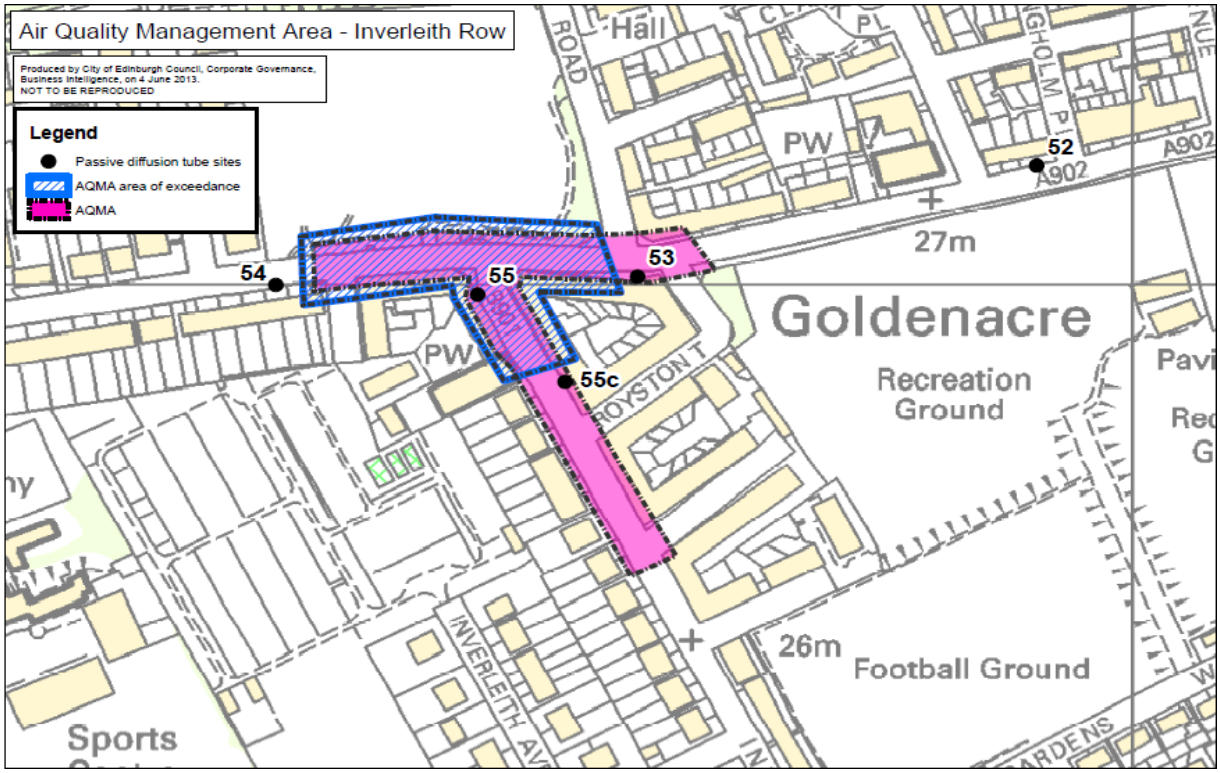

Table 2.3: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Easter Road and London Road 2009 to 2012

Site ID	2009 Bias Adjustment Factor = 0.86	2010 Bias Adjustment Factor = 0.85	2011 Bias Adjustment Factor = 0.81	2012 Bias Adjustment Factor = 0.76
Easter Road				
25G	28 (92%)	30 (83%)	27 (100%)	28 (75%)
25F	30 (100%)	33 (75%)	28 (67%)	-
25E	34 (92%)	34 (100%)	32 (100%)	33 (100%)
25D	37 (75%)	37 (92%)	33 (83%)	34 (100%)
25C	38 (92%)	38 (100%)	41 (92%)	41 (92%)
25B	39 (100%)	39 (92%)	36 (83%)	35 (100%)
25*	51 (83%)	50 (100%)	44 (92%)	45 (92%)
25H	38 (42%)	-	-	-
London Road				
81	-	-	51 (100%)	46 (100%)
46	43 (92%)	46 (100%)	**40** (92%)	41 (100%)
67	48 (67%)	51 (75%)	46 (75%)	46 (100%)
66	43 (58%)	41 (83%)	35 (67%)	36 (100%)
68	30 (100%)	37 (92%)	32 (100%)	33 (100%)
69	56 (83%)	51 (83%)	50 (100%)	42 (83%)
70	47 (75%)	46 (67%)	42 (75%)	41 (92%)
82	-	-	28 (92%)	28 (100%)

Notes % data capture in brackets * duplicate tube until 2011

Figure 2.3: Easter Road and London Road Monitoring Locations in Relation to Central AQMA extension

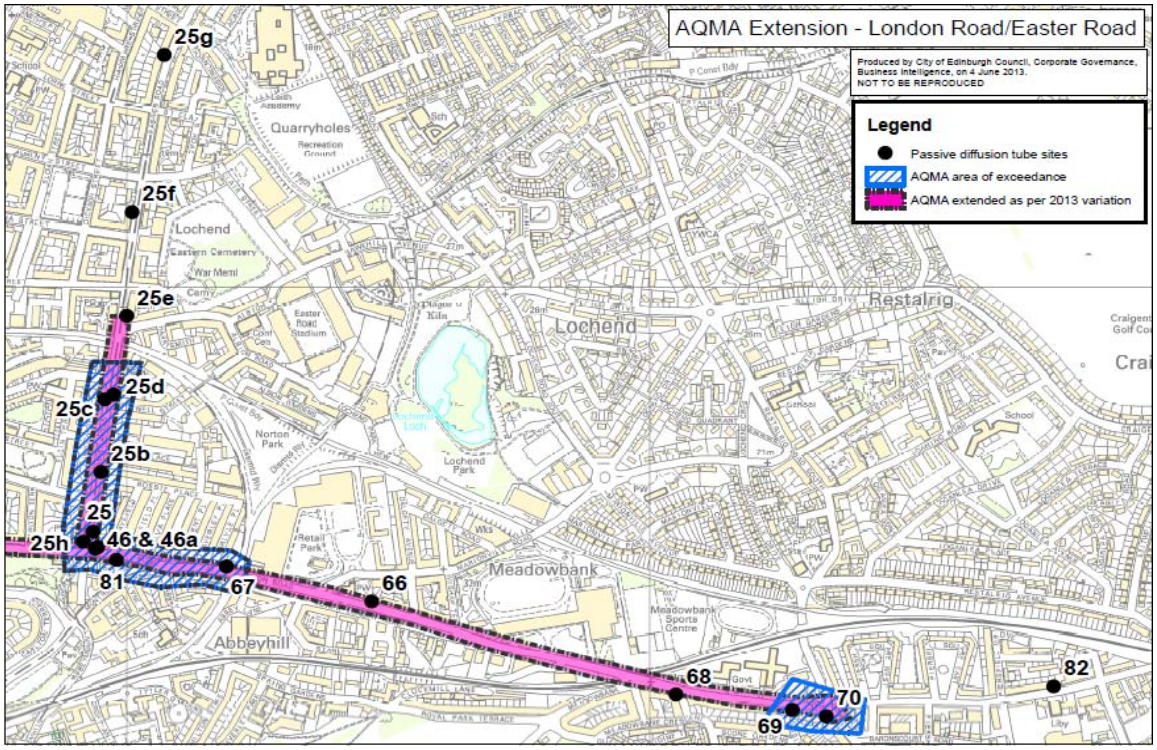

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Table 2.4: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Cowgate and Grassmarket 2009 to 2012

Site ID	2009 Bias Adjustment Factor = 0.86	2010 Bias Adjustment Factor = 0.85	2011 Bias Adjustment Factor = 0.81	2012 Bias Adjustment Factor = 0.76
37A*	41 (58%)	60 (42%)	42 (83%)	43 (92%)
37C	-	-	-	30 (92%)
37	35 (67%)	38 (58%)	33 (67%)	35 (83%)
37B	-	-	37 (100%)	39 (75%)
48E	-	-	-	- (58%)[b]
48D	-	-	-	- (17%)[b]
48	**40** (83%)	46 (50%)	**40** (83%)	**40** (92%)
48A	-	38 (83%)	31 (67%)	**40** (100%)
48C	-	-	-	43 (67%)[a]
48B	-	-	-	33 (83%)

Notes
% data capture in brackets
* Duplicate tube
[a] annualised mean
[b] sporadic data not suitable to annualise

Figure 2.4: Cowgate and Grassmarket Monitoring Locations in Relation to Central AQMA extension

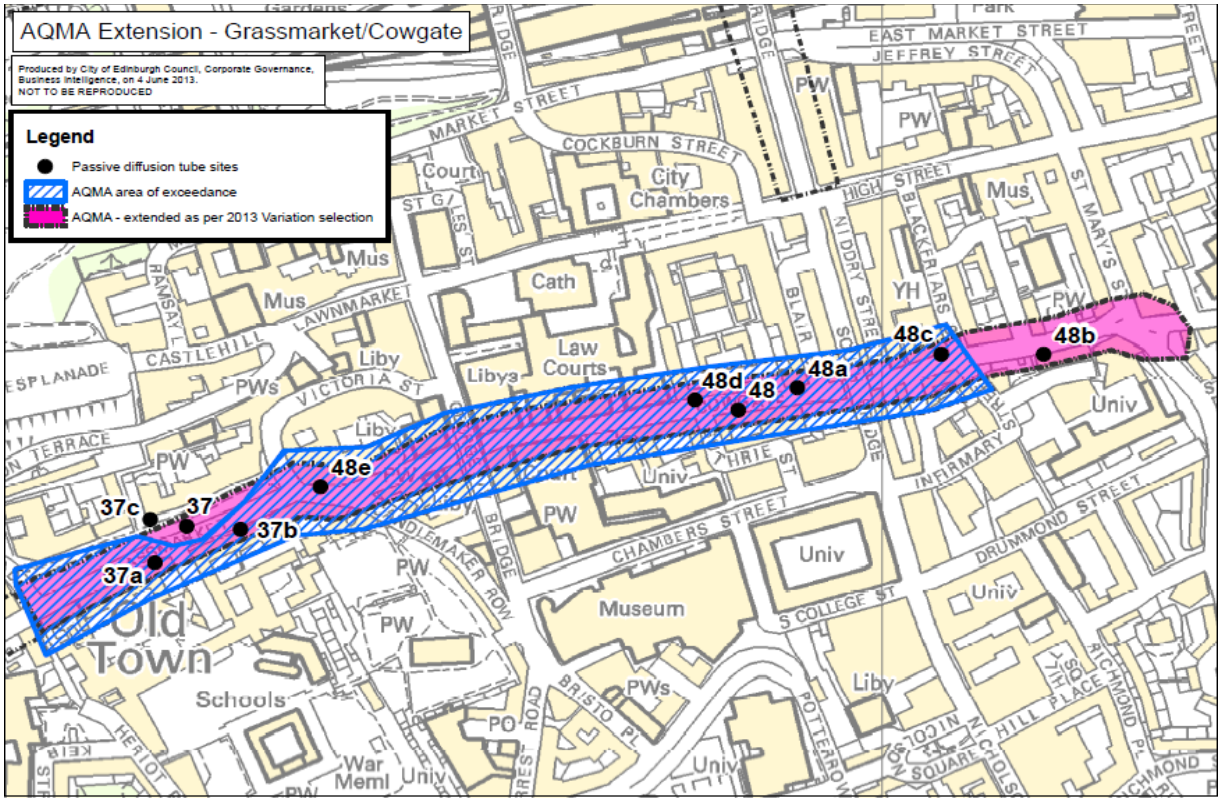

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Table 2.5: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Gorgie Road / Chesser Avenue 2009 to 2012

Site ID	2009 Bias Adjustment Factor = 0.86	2010 Bias Adjustment Factor = 0.85	2011 Bias Adjustment Factor = 0.81	2012 Bias Adjustment Factor = 0.76
Passive diffusion tube				
80B	-	-	-	33 (83%)
80	-	47 (100%)	42 (100%)	42 (100%)
80A	-	-	-	- (58%)[b]
80C	-	-	-	39 (67%)[a]
Automatic analyser				
Gorgie Road ID4	38 (85%)	41 (76%)	37 (93%)	39 (99%)

Notes
% data capture in brackets
[a] annualised mean
[b] sporadic data not suitable to annualise

Figure 2.5: Gorgie Road / Chesser Avenue Monitoring Locations in Relation to Central AQMA extension.

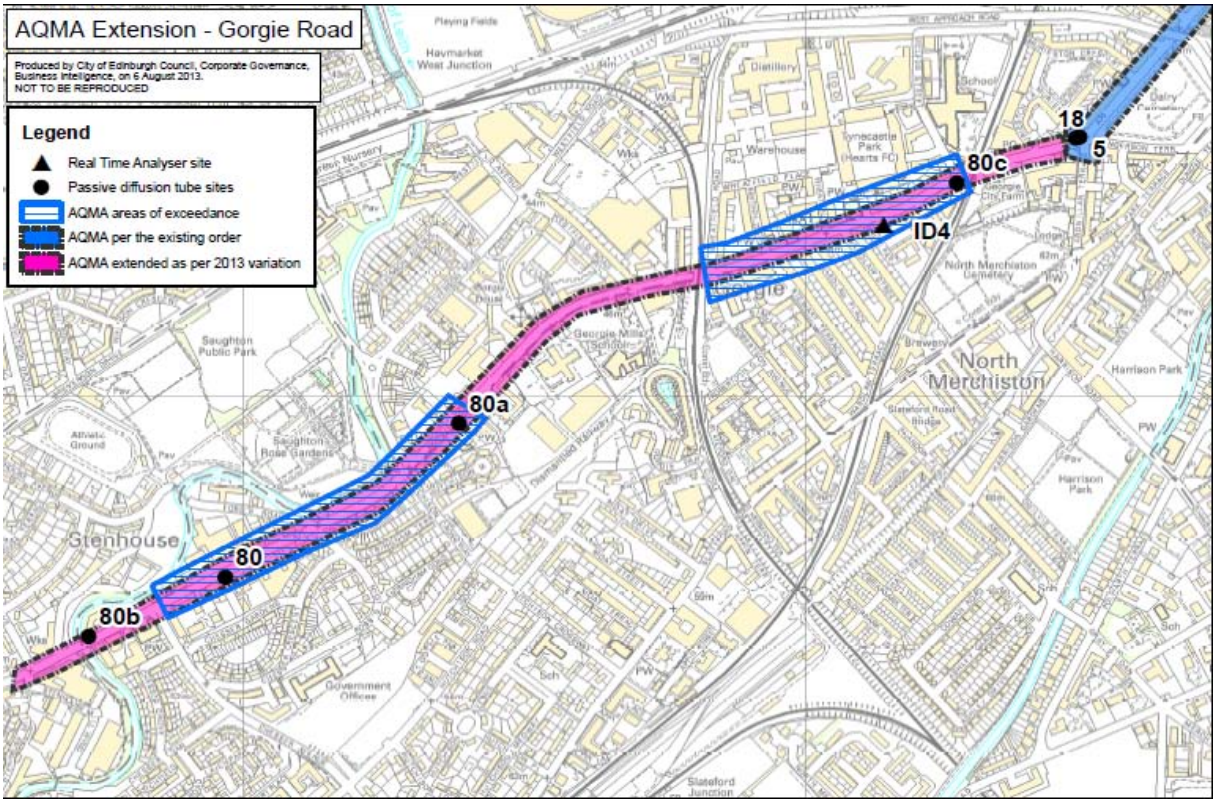

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Table 2.6: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Bernard Street / Commercial Street 2009 to 2012

Site ID	2009 Bias Adjustment Factor = 0.86	2010 Bias Adjustment Factor = 0.85	2011 Bias Adjustment Factor = 0.81	2012 Bias Adjustment Factor = 0.76
9B	-	33 (75%)	26 (83%)	32 (83%)
9A	-	38 (92%)	41 (67%)[a]	39 (92%)
9	32 (83%)	37 (67%)	31 (100%)	35 (100%)
7	35 (67%)	34 (92%)	32 (83%)	29 (92%)
29A*	42 (67%)	45 (100%)	42 (96%)	**40** (92%)
29C*	48 (50%)	49 (83%)	45 (88%)	44 (92%)
29	45 (50%)	44 (100%)	39 (92%)	37 (100%)
29B	33 (83%)	37 (100%)	33 (92%)	33 (100%)

Notes
% data capture in brackets
* Duplicate tube
[a] annualised data

Figure 2.6: Bernard Street and Commercial Street Monitoring Locations in Relation to Great Junction Street AQMA Extension

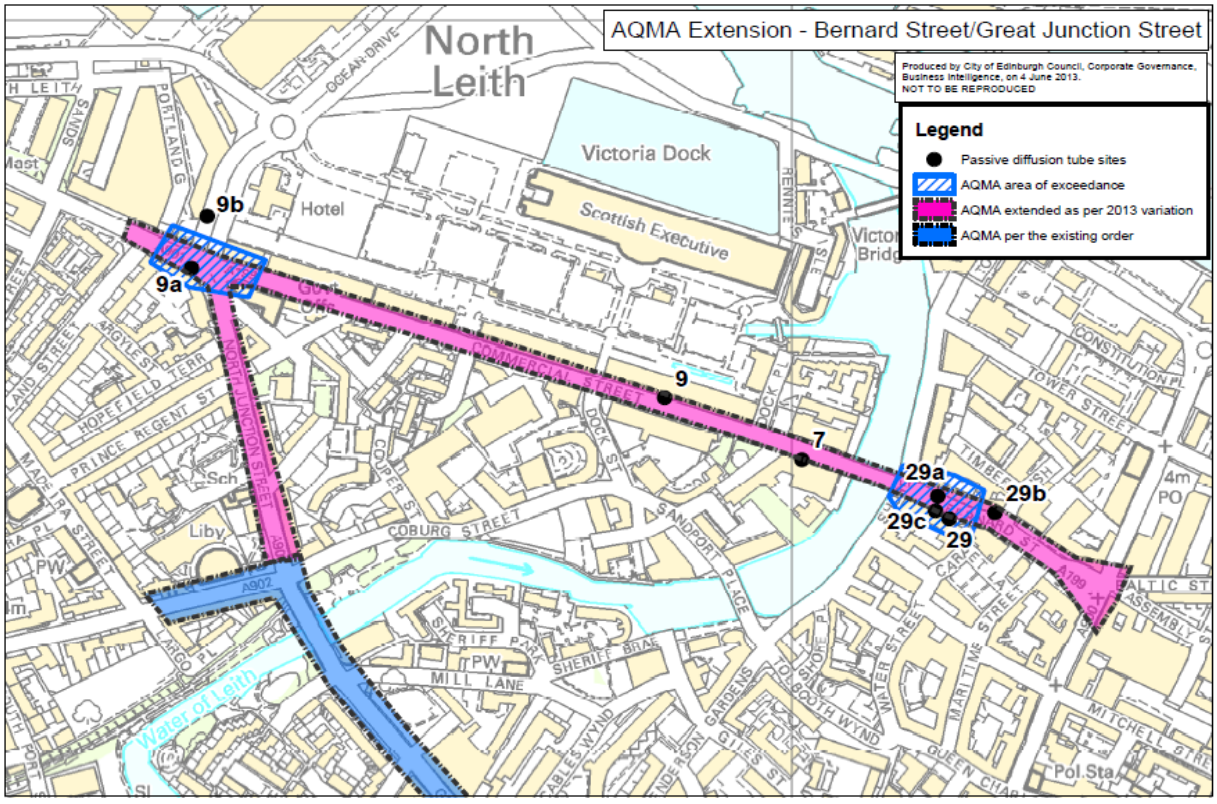

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Figure 2.7: Central AQMA Showing Extended Areas as per 2013 Order

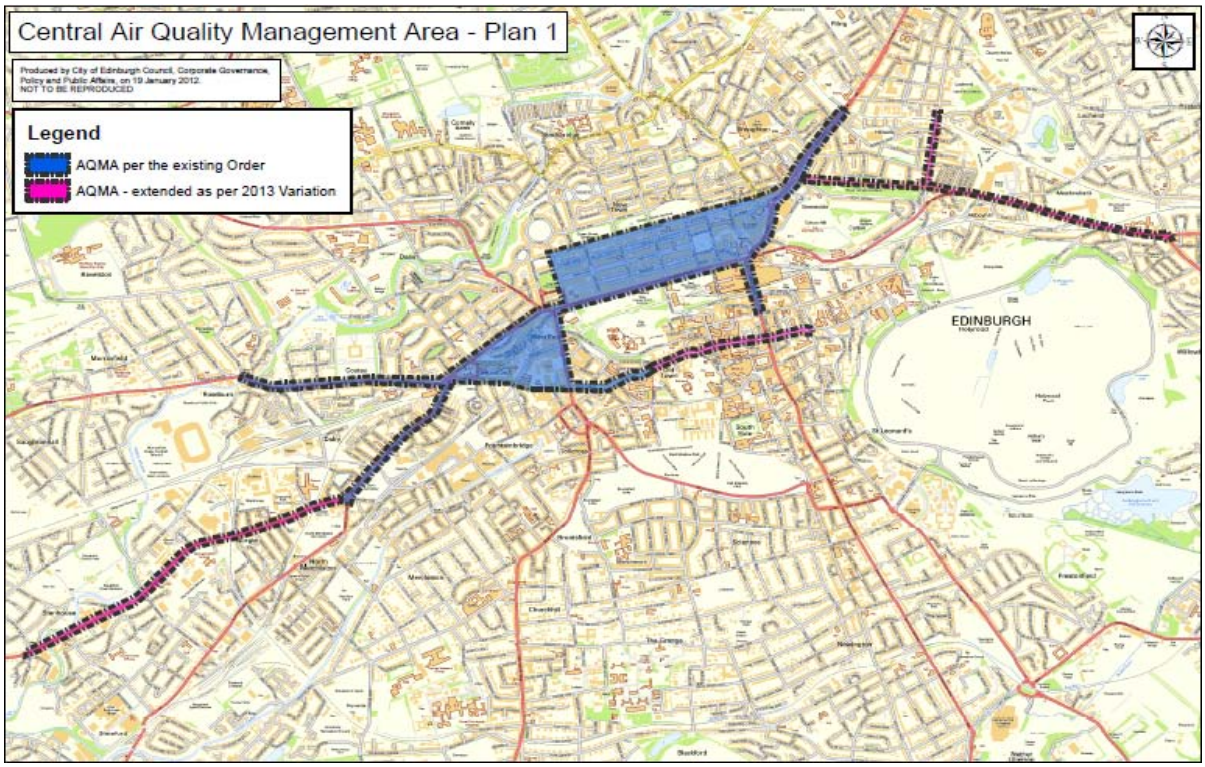

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Figure 2.8: Great Junction Street AQMA Showing Extended Area as per 2013 Order

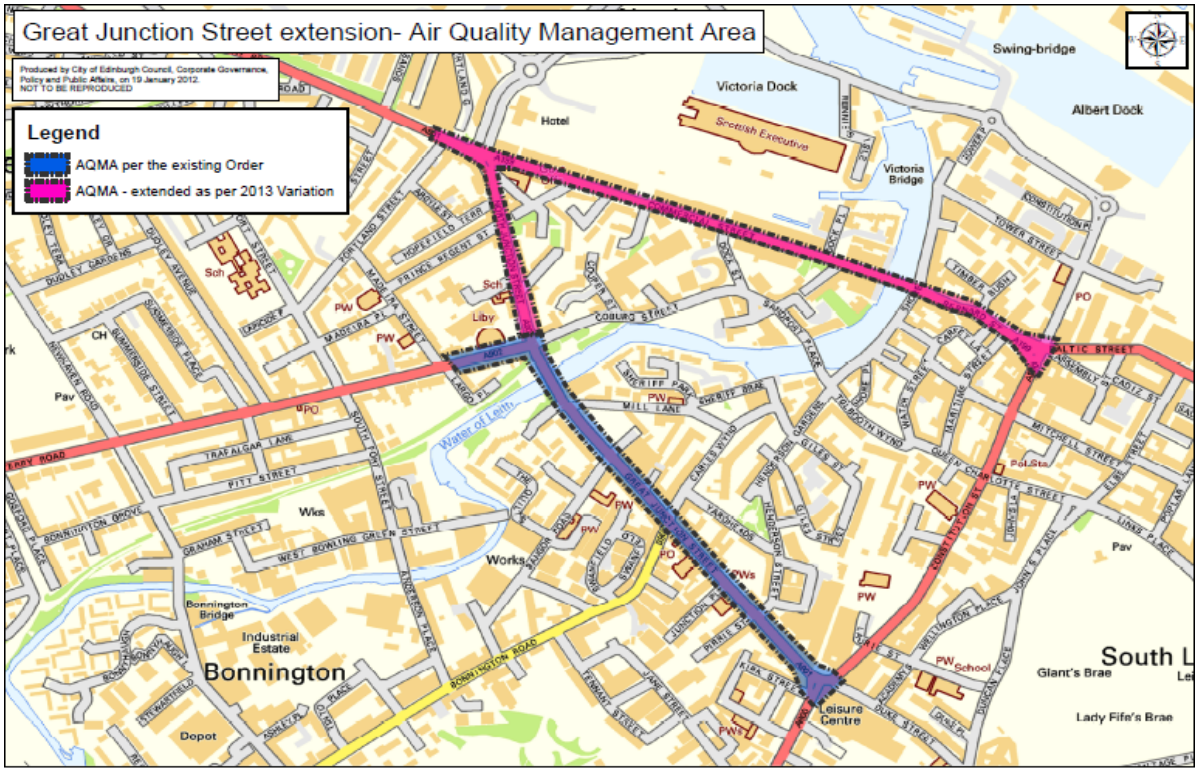

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Table 2.7: Description of AQMAs and Area of Exceedence

Location	AQMA Description and Areas of Exceedence
Glasgow Road AQMA	
16	Section of the A8 from Newbridge roundabout to Ratho Station. Main commuter route from the west into City Centre, which serves Edinburgh Airport. Area of exceedence is a row of residential cottage properties, close to road edge on westbound carriageway. Slow moving traffic, queuing at peak times on west approach to Newbridge roundabout.
15 & 58	A small number of residential properties on Eastbound carriageway, close to junction with Newbridge roundabout and M9/ M8 link. AADT = 46,111
Inverleith Row /Ferry Road	
55	Northerly most section of Inverleith Row and it's junction with Ferry Road. Most residential properties along the length of Inverleith Row and Ferry Road at Golden Acre, are set back from road edge with gardens to the front. Area of exceedence is at the busy junction on approach to Ferry Road which forms a street canyon, with residential tenemental properties with commercial and retail at ground floor level. There is slow moving congested traffic on Northbound carriageway on approach to Ferry Road junction and long queues on Ferry Road East bound carriageway. AADT= 12,386

Table 2.7 Description of AQMA and Area of Exceedence continued

Location	AQMA Description and Areas of Exceedence
Central AQMA extension	
48C Cowgate	Very narrow street canyon, congested at peak travel times. Residential tenemental properties close to road edge. Bars, clubs, hostel, hotels along route. Bridges with roads above. AADT = 13,395
25 Easter Road	Narrow street canyon. Residential tenemental properties. Shopping area close to junction with London Road, commercial and retail at ground level. Now a main route to and from North Leith/Ocean Terminal. Slow moving congested south bound traffic at junction with London Road. AADT =12,120
80 Gorgie Road/ Chesser	Many areas along extended section form street canyons with residential tenemental properties close to the road edge. Retail commercial shopping area on parts of route. Slow moving congested traffic on westerly approach to Chesser Avenue. Main route into city centre from the west. AADT = 25,878
37A Grassmarket	High density of commercial properties in the form of hotels, bars and restaurants, public space in centre Residential tenemental style properties close to road edge on west bound carriageway. Slow moving traffic congested at peak times. Route to Western Approach Road. AADT = 14,806
81 London Road	Residential tenement properties forming street canyons along sections of the road close to road edge. Retail area on sections of route. Meadowbank Retail Park with access from London Road. Area of exceedences adjacent to junction with Easter Road and Willowbrae Road where residential tenemental properties are sited close to road edge and at busy junctions. AADT= 16,072
Great Junction Street extension	
29C Bernard Street	Very narrow street canyon, residential tenemental properties close to junction with the Shore. Slow moving congested traffic on west approach to Commercial Street. Main HGV route for Leith Dock traffic. AADT= 17,442

3 New Developments

Local Developments

There have been no new roads or housing developments within close proximity to the extended and new AQMA designations since their declaration. The economic downturn meant that a number of planned residential developments were reduced in density. This is likely to have a positive impact on local air quality.

Leith Dock (East) was designated an Enterprise Area in January 2012. This is a major change from the previously planned residential focus in this zone, which would have resulted in up to 18,000 residential units being built. A development of this scale in an area with an existing AQMA at Great Junction Street and an already congested road network had the potential to further impact air quality in this locality.

The Council is currently considering views on proposed changes to traffic management within the core of the city centre. The proposals include a radical reorganisation of the road network and pavement availability which aim to reduce the detrimental impact of motor vehicles and increase space for pedestrians and cyclists. Options to review bus operations on Princes Street to facilitate commencement of Edinburgh Tram are also part of the proposals.[5]

Source apportionment studies will need to be revisited in the city centre areas of the Central AQMA following launch of the Tram and subsequent stabilisation of traffic flows and potential bus rerouting.

The Council is in the process of implementing a major infrastructure project which involves road, footway and environmental improvements to Leith Walk and Constitution Street. Traffic modelling predictions have concluded that more traffic is likely to be directed on to Easter Road and London Road and that queue length times will increase at Bernard Street.

Future expansion of Edinburgh Airport and increased surface traffic will need to be kept under review in terms of the impact on the A8 route and Glasgow Road AQMA.

National Developments

The updated Emission Factor Toolkit (EFT) V5.2C has been used to apportion the contribution from the different vehicle classes operating in the study areas and the latest guidance from DEFRA and the Devolved Administrations has been adopted regarding use of the NO_x to NO_2 calculator.

The updated roadside NO_2 projection factors were used in this assessment to estimate the earliest date of compliance with the annual mean air quality objective. These factors, have been amended in Box 2.1 of the PDF ‘Live’ document (available on the LAQM/DEFRA website) to take account of the recently revised vehicle emissions.

4 Source Apportionment

The advice in Technical Guidance LAQM TG (09) 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 prominent 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 the local authority can have some influence over

Local sources are the principle sources which the local authority can control through 'measures' in the Action Plan. They have the potential to cause areas of exceedence (hotspots) when combined with background concentrations.

In Edinburgh, road traffic has been identified as the principle contributor of local source NO_2 and NOx emissions.

Traffic data was collected for a 24 hour period over three consecutive week days which were considered representative of the average annual flow at each location using video cameras. The data was assessed by Sky High Traffic Surveys on behalf of the Council. The following vehicle split was used:

- Cars (car, private hire and black taxi hackney cab)
- Light goods vans (LGV)
- Heavy goods vehicles HGV rigid
- Heavy goods vehicles HGV articulated
- Buses
- Motor cycles

Traffic counts used for this study are summarised in Appendix 2.

The composition of the vehicle fleet in each of the locations show that the greatest percentage is comprised of cars, followed by LGVs. HGVs are more prominent than buses at the following locations: Bernard Street, Glasgow Road, Cowgate and Grassmarket.

The vehicle class composition as a percentage of the total fleet in each study area is shown in Table 4.1.

Table 4.1: Vehicle Class Composition as Percentage of Total Fleet for Each AQMA Location

AQMA Location	Car %	LGV %	HGV Rigid %	HGV Artic %	Bus %	MC %
Bernard Street	81.8	11.4	3.5	1.2	1.5	0.6
Cowgate	83.9	12.1	2.6	0.3	0.3	0.8
Easter Road	82.7	11.6	2.1	0.4	2.7	0.5
Ferry Road	82.6	11.6	1.7	0.7	2.6	0.8
Glasgow Rd/Ratho	85.2	8.9	3.2	1.0	1.4	0.3
Gorgie Rd/Chesser	79.9	12.4	2.8	0.5	4.0	0.4
Grassmarket*	84.2	11.7	2.7	0.1	0.9	0.4
Inverleith Row	81.0	11.4	1.6	0.3	4.9	0.8
London Road	79.6	10.3	1.8	0.1	7.6	0.6

* West Port Traffic Data 2011

The source apportionment work for this study was carried out in accordance with Box 7.1 (TG09) and the updated Emission Factor ToolKit (EFT) v5.2C (January 2013). The above vehicle composition percentages were used in the EFT spreadsheet to apportion the contribution of NOx from each of the vehicle classes.

The Scottish National Vehicle Fleet Profile was selected for 2012 in the Emission Spreadsheet apart from the local bus fleet profile which was known for each of the study areas. Table 4.2

Table 4.2: Bus Fleet Euro Standard Profile Operating in AQMAs During 2012

Location	Euro 2	Euro 3	Euro 4	Euro 5	EEV Euro3 + SCRT
Bernard Street	-	100%	-	-	-
Cowgate	100%	-	-	-	-
Easter Road	50%	50%	-	-	-
London Road	18%	30%	-	52%	-
Ferry Road	31%	69%	-	-	-
Grassmarket	67%	-	-	33%	-
Glasgow Road	-	6%	1%	93%	-
Gorgie Rd/Chesser	-	64%	-	16%	20%
Inverleith Row	11%	22%	-	67%	-

NO_x emission contributions from motor cycles were insignificant and therefore excluded from the source apportionment studies.

All calculations and additional data related to the source apportionment work are shown in Appendix 3.

Table 4.3 and Figures 4.1A, 4.1B and 4.2 illustrate that in all study areas, the local background concentrations contribute a large proportion to the overall concentration of nitrogen dioxide. The Grassmarket has the highest background, which is possibly due to a combination of the area being at a low elevation and high density massing of both commercial and residential properties.

For the Central AQMA Cowgate and Grassmarket extensions, the most significant proportions of the locally-generated road NO_2 component is attributed to cars and HGVs. Buses have a marginal impact. At Easter Road, London Road and Gorgie Road extensions the most significant contributions are from cars and buses, with buses having the largest impact at London Road.

With respect to Great Junction Street AQMA extension at Bernard Street, the greatest contributions are from HGVs and cars.

The new AQMA at Glasgow Road/Ratho Station is close to the M9/M8 link, and therefore the background concentration at Newbridge roundabout is higher due to the traffic contribution from the trunk road. At this location, cars and HGVs are the major source of locally generated road NO_2.

The most significant contributory sources at Inverleith Row/Ferry Road AQMA are buses and cars, with buses being the dominant vehicle class.

Table 4.3: Nitrogen Dioxide Concentrations at the Worst-case Receptors and the Contribution of Each Source Type to the Total

Annual Mean NO_2 Concentration ($\mu g/m^3$)								
Receptor		**Regional Backgrnd (RB)**	**Local Backgrnd (LB)**	**Cars**	**LGVs**	**HGVs**	**Buses**	**Total**
Central AQMA extensions								
48	Cowgate	2.8	21.2	7.8	2.6	4.8	0.8	40
48C	Cowgate	2.8	21.2	9.3	3.0	5.7	1.0	43
25	Easter Road	2.8	21.2	7.8	2.5	4.2	6.5	45
80	Gorgie/Chesser	2.2	21.8	5.6	2.0	4.2	6.2	42
37A	Grassmarket	2.0	28.0	6.0	1.9	3.4	1.7	43
81	London Road	2.8	21.2	5.5	1.8	2.2	12.5	46
Great Junction Street AQMA extension								
29C	Bernard Street	2.1	20.9	7.4	2.3	8.0	3.3	44
Glasgow Road AQMA								
58	Glasgow Road	2.2	25.8	8.2	2.0	6.5	3.3	48
16	Glasgow Road	2.1	22.9	9.0	2.2	7.2	3.6	47
Inverleith Row AQMA								
53	Ferry Road	2.2	19.8	4.8	1.6	2.7	3.9	35
55	Inverleith Row	2.2	19.8	7.7	2.4	3.4	10.6	46
% NO_2 Contribution to Total								
Receptor		**Regional Backgrnd (RB)**	**Local Backgrnd (LB)**	**Cars**	**LGVs**	**HGVs**	**Buses**	**Total**
Central AQMA extensions								
48	Cowgate	7.0	53.0	19.5	6.5	12.0	2.0	100
48C	Cowgate	6.5	49.3	21.6	7.0	13.3	2.3	100
25	Easter Road	6.2	47.1	17.3	5.6	9.3	14.4	100
80	Gorgie/Chesser	5.2	51.9	13.3	4.8	10.0	14.8	100
37A	Grassmarket	4.7	65.1	14.0	4.4	7.9	4.0	100
81	London Road	6.1	46.1	12.0	3.9	4.8	27.2	100
Great Junction Street AQMA extension								
29C	Bernard Street	4.8	47.5	16.8	5.2	18.2	7.5	100
Glasgow Road AQMA								
58	Glasgow Road	4.6	53.8	17.1	4.2	13.5	6.9	100
16	Glasgow Road	4.5	48.7	19.1	4.7	15.3	7.7	100
Inverleith Row AQMA								
53	Ferry Road	6.3	56.6	13.7	4.6	7.7	11.1	100
55	Inverleith Row	4.8	43.0	16.7	5.2	7.4	23.0	100

Figure 4.1A Relative Contribution of Each Source Type to the Total Annual Mean Nitrogen Dioxide Concentration at Relevant Receptor Locations in Central AQMA

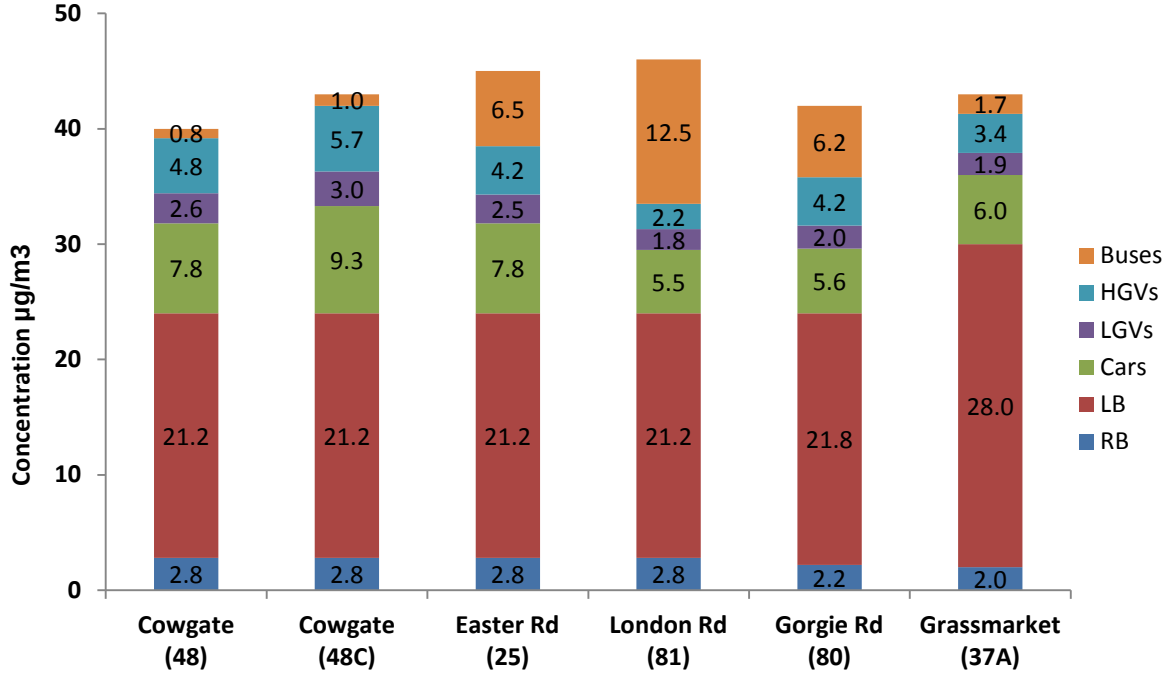


Figure 4.1B: Relative Contribution of Each Source Type to the Total Annual Mean Nitrogen Dioxide Concentration at Relevant Receptor Locations at Bernard Street and New AQMA Designations

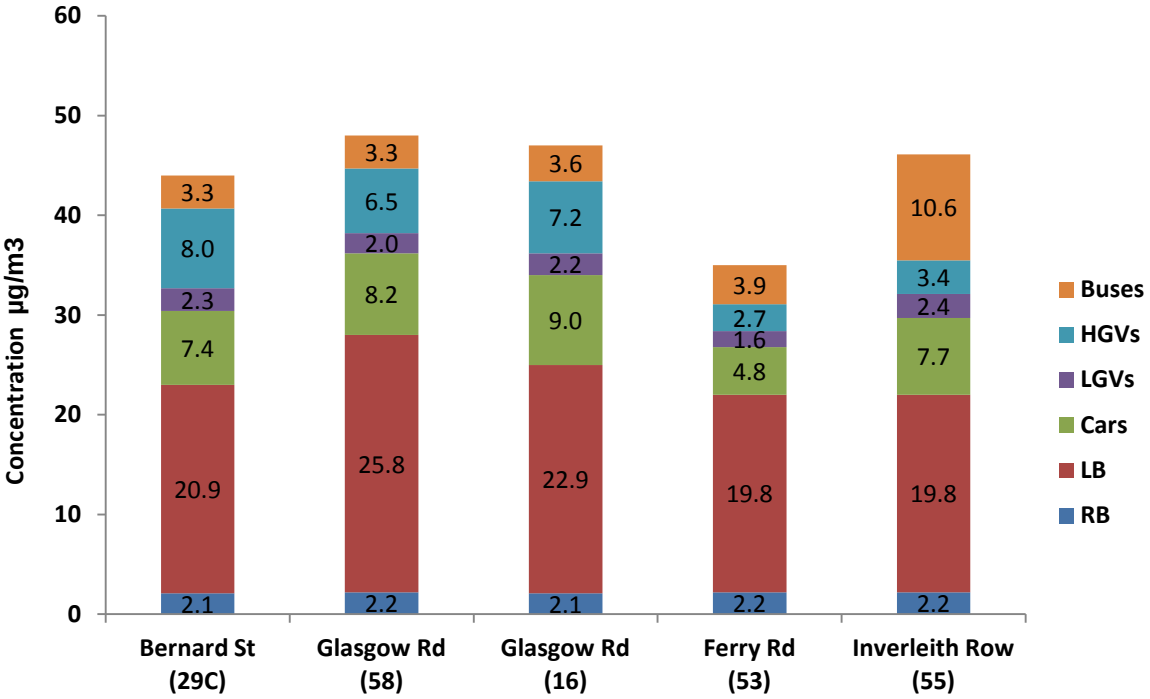
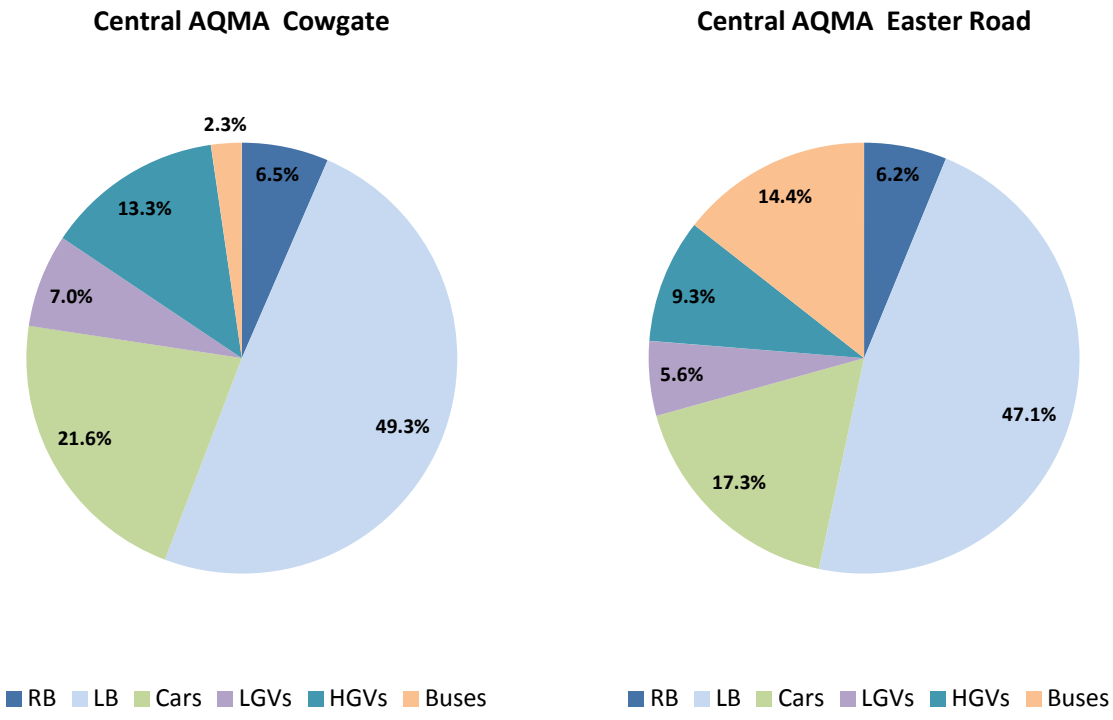


Figure 4.2 Source Apportionment of NO_2 as a Percentage of Total Concentration at Worse-case Receptors in AQMAs



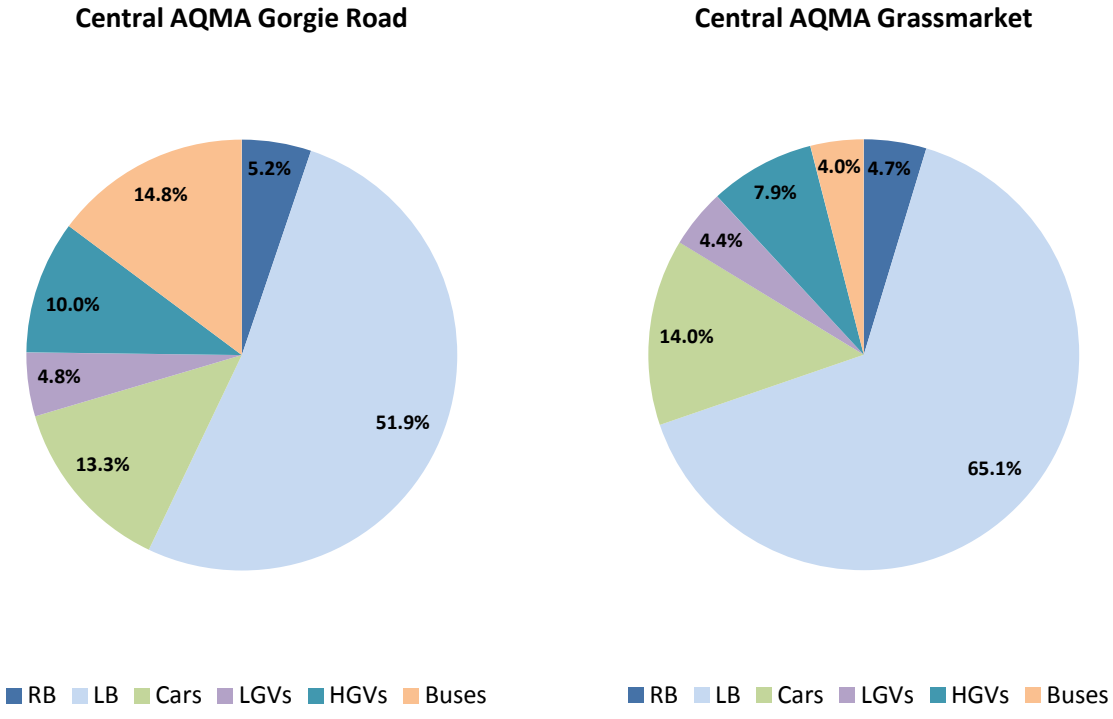
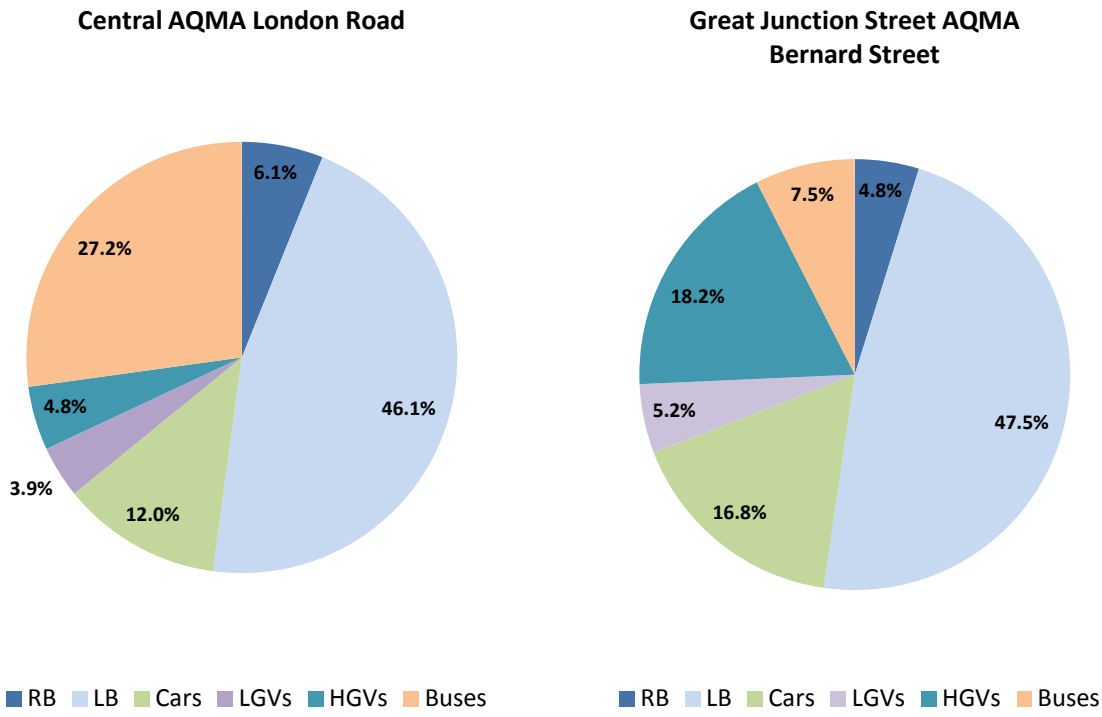
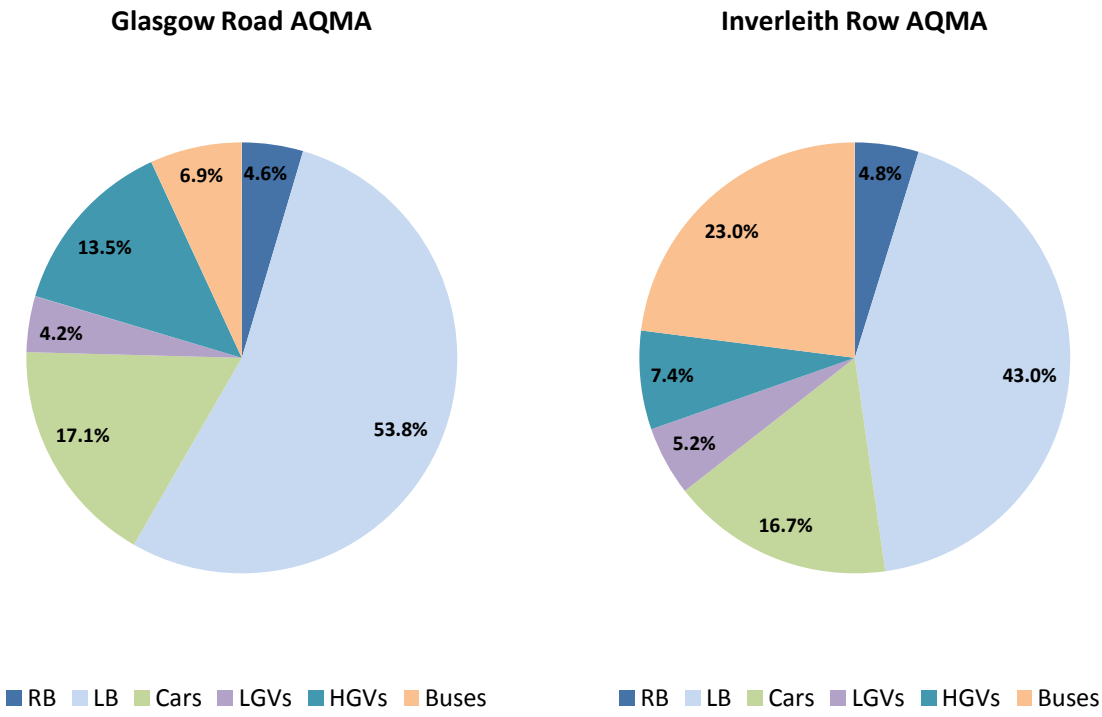


Figure 4.2 Source Apportionment of NO_2 as a Percentage of Total Concentration at Worst-case Receptors in AQMAs





5 Air Quality Improvements Required

The degree of improvement required to meet the 40µg/m^3 annual mean objective for nitrogen dioxide is defined by the difference between the highest concentration and the objective level. However, according to LAQM (TG09) it is considered more useful to calculate the road traffic reduction of nitrogen oxides (NOx) which is required to meet the 40µg/m^3 target.

The NO_x from NO_2 calculator (diffusion tube sheet) was used to obtain the equivalent roadside NO_x concentrations from measured annual mean nitrogen dioxide concentrations in 2012 and the relevant background data used for source apportionment. Data used in the spreadsheet is shown in Appendix 4.

To meet the 40µg/m^3 Air Quality Objective, local road NO_x emissions would need to fall between 12.3% and 30.4% within the extended Central AQMA, 21.3% at Bernard Street, 28.2% at Inverleith Row and 43.3% at Glasgow Road AQMAs as shown in Table 5.1.

Table 5.1: Reductions in Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) and Emissions of NO_x (%) required in AQMAs

Receptor		Required Reduction in Annual Mean NO_2 Concentration (µg/m^3)	Required Reduction in NO_x Emissions From Local Roads (%)
Central AQMA extension			
48C	Cowgate	3	17.5
25	Easter Road	5	26.5
80	Gorgie Road/Chesser	2	12.3
37A	Grassmarket	3	24.7
81	London Road	6	30.4
Great Junction Street AQMA extension			
29C	Bernard Street	4	21.3
New AQMA Glasgow Road/Ratho Station			
58	Glasgow Road	8	43.3
16	Glasgow Road	7	35.0
New AQMA Inverleith Row/Ferry Road junction			
55	Inverleith Row	6	28.2

The earliest date when the nitrogen dioxide objectives in the AQMAs are expected to be complied with are shown in Table 5.2.

The calculations are based on the roadside annual mean concentrations obtained in 2012 which have been projected to future years using the approach detailed in Box 2.1 of LAQM TG (09) PDF ‘Live’ document available on the LAQM /DEFRA website.

Table 5.2: Earliest Estimated Date when Air Quality Objectives for Nitrogen Dioxide are likely to be Achieved in AQMAs

Receptor		2012	2013	2014	2015	2016
Central AQMA extension						
48C	Cowgate	43	41.1	39.2	37.3	35.1
25	Easter Road	45	42.9	41.0	39.1	36.8
80	Gorgie Road/Chesser	42	**40.1**	38.3	36.5	34.3
37A	Grassmarket	43	41.1	39.2	37.3	35.1
81	London Road	46	44.0	42.0	**40.0**	37.6
Great Junction Street AQMA extension						
29C	Bernard Street	44	42.0	**40.1**	38.2	36.0
New AQMA Glasgow Road/Ratho						
58	Glasgow Road	48	45.9	43.8	41.7	39.2
New AQMA Inverleith Row						
55	Inverleith Row	46	44.0	42.0	**40.0**	37.6

The nitrogen dioxide annual mean objectives are expected to be met by the following years **based on concentrations obtained in 2012**:

- 2013 Gorgie Road/Chesser
- 2014 Cowgate, Grassmarket and Bernard Street
- 2015 Easter Road, London Road and Inverleith Row
- 2016 Glasgow Road

Using the revised projection factors the anticipated reduction in roadside NO_2 is approximately 2µg/m^3 per year. However, the projection of roadside NO_2 concentrations to future years is not an absolute and can only offer indicative values. Concentrations will vary from year to year due to meteorological conditions, the actual improvement of vehicles in the national fleet and will be dependent on new engine technology delivering the expected improvements in the 'real-driving world'.

6 Potential Future Actions

The focus of the current Air Quality Action Plan (AQAP) is to have cleaner bus and freight vehicles operating in the city by adopting a voluntary approach[6] . This measure was implemented following conclusions from earlier source apportionment work, a city-wide Low Emission Strategy Feasibility Study and a Bus Emission Analysis Study within each AQMA. The studies were undertaken by Transport and Travel Research Consultancy on behalf of the Council. [7 & 8]

It is widely recognised that improvements in vehicle engine technology have not delivered the expected reduction in NO_x emissions. There has also been a substantial increase of diesel cars into the national fleet which has resulted in more direct emissions of primary NO_2. The updated emission factors reflect these changes and therefore it will be prudent to reassess source apportionment in areas of concern in the Central AQMA, St John's Road and Great Junction Street.

However, due to proposed major traffic management changes in the city centre and commencement of Tram, there is uncertainty with respect to traffic displacement and volume flows in the core of the Central AQMA. Therefore, source apportionment in this area will be reassessed following traffic stabilisation and potential redistribution of bus services.

It is likely that current actions to reduce NO_2/NO_x emissions such as measures to improve the bus fleet will continue, especially along the following road corridors:

- Inverleith Row
- Gorgie Road
- London Road
- Easter Road

In an attempt to encourage road freight (HGV) operators to voluntarily reduce their emissions, in 2011 the Council became a partner in an EU-funded project, ECOSTARS Edinburgh. This is a voluntary, free to join Freight Recognition Scheme which provides guidance on environmental best-practice to operators of goods vehicles, buses and coaches whose fleets regularly serve the Edinburgh area. The current project is funded until May 2014 and opportunities for continuing the scheme beyond that date are now being explored.

This measure provides a relative low-cost partnership mechanism to assist the Council encourage and facilitate emission improvements from the road freight sector operating in the city.

The Scottish Government has indicated that they will engage in 2014 with stakeholders to develop a national Low Emission Strategy, which may include a Low Emission Zone (LEZ) option. Further direction from the Council's Transport and

Environment Committee will be required with respect to progressing LEZ feasibility in Edinburgh.

Traffic flow improvements will also be explored at the following road junctions:

- Inverleith Row
- Glasgow Road/Newbridge roundabout

Scottish Government air quality grant support funding has been secured by the Council to investigate the most appropriate option/s for improving traffic flows at Glasgow Road/Newbridge roundabout. The project brief for this work has now been specified and consultants engaged to take this forward.

The two main vehicle classes which contribute to NO_2 exceedences at Bernard Street are HGVs and cars. A potential 'relief road' through Leith Docks is identified in the Council's draft Local Development Plan (LDP). If constructed, this alternative route would bring benefit to local air quality in Bernard Street as the majority of HGVs would be diverted from this narrow, constrained route. This option will be explored further within the Council.

Based on source apportionment calculations, it will also be necessary to consider the contribution from car vehicles. Measures in the current AQAP focus on two main vehicle classes; buses and freight.

To provide a focus of potential measures to be included in the revised Air Quality Action Plan a range of hypothetical NO_x reduction scenarios have been assessed using the EFT (v5.2C) model. These demonstrate the likely percentage reduction in NO_x that could be achieved and hence a revised annual mean concentration of NO_2 has been calculated. Tables 6.1A, 6.1B, 6.1C and 6.1D

From these hypothetical scenarios the introduction of Euro 6 HGVs will give the biggest reductions in NO_x emissions. Reduction in numbers of cars also brings some benefit. Differing speeds also influences concentrations. The hypothetical scenarios and potential implementation are beyond the scope of this report but will be subject to further discussion within the Council.

The NO_x reduction scenario calculations were apportioned from a base case for each of the study areas and are detailed in Appendix 5.

Stakeholder consultation on Edinburgh's Draft Local Transport Strategy (LTS) 2014 – 2019 has recently concluded. The strategy contains a stronger focus on air quality issues than previously and recognises that behavioural change is required to reduce dependency on the car.

Relevant policies from the LTS will be aligned with the proposed revision of the Council's Air Quality Action Plan.

Table 6.1A: Revised Annual Mean Nitrogen Dioxide Concentrations in 2012 Assuming Hypothetical Emission Reductions Under Various Scenario Testing for Glasgow Road AQMA

Scenarios	% NO_x Reduction	2012 Annual Mean Concentration µg/m^3
Glasgow Road AQMA (1D58) NO_2 annual mean = 48 Reduction of NO_x required from local roads = 43.3% (Table 5.1)		
Increasing speed		
40 kph	16.5%	45
50 kph	27.1%	43
60 kph	33.6%	41
30% Reduction in car traffic		
30 kph	12.3%	46
40 kph	27.3%	43
50 kph	36.9%	41
60 kph	42.9%	39
40% Reduction in car traffic		
30 kph	16.9%	45
40 kph	31.3%	42
50 kph	40.5%	40
60 kph	46.2%	39
Improving HGV - Euro 6 standard (100%)		
30 kph	28.9%	42
40 kph	40.4%	40
50 kph	49.1%	38
60 kph	52.0%	38
30% Reduction in car traffic plus HGV Euro 6 standard (100%)		
30 kph	41.6%	40
40 kph	51.5%	38
50 kph	57.7%	37
60 kph	61.5%	36
40% Reduction in car traffic plus HGV Euro 6 standard (100%)		
30 kph	45.9%	39
40 kph	55.2%	37
50 kph	61.2%	36
60 kph	64.8%	35

Table 6.1B Revised Annual Mean Nitrogen Dioxide Concentrations in 2012 Assuming Hypothetical Emission Reductions under Various Scenarios Testing for Inverleith Row AQMA

Scenarios	% NO_x Reduction	2012 NO_2 Annual Mean Concentration ($\mu g/m^3$)
Inverleith Row (ID55) AQMA NO_2 annual mean = 46 Reduction of NO_x required from local roads = 28.2% (Table 5.1)		
Increasing Speed		
30 kph	22.8%	41
35 kph	30.7%	39
30 % Reduction in car traffic		
20 kph	9.5%	44
30 kph	31.0%	39
35 kph	38.3%	37
Improving bus - Euro 5 standard (100%)		
20 kph	3.1%	45
30 kph	26.7%	40
35 kph	38.3%	38
Improving HGVs Euro 6 standard (100%)		
20 kph	11.4%	43
30 kph	31.8%	38
35 kph	38.8%	37
30% Reduction in car traffic plus bus Euro 5 standard (100%)		
20 kph	12.6%	43
30 kph	32.5%	38
35 kph	42.7%	36
30% Reduction in car traffic plus bus Euro 5 (100%) and HGVs Euro 6 (100%)		
20 kph	23.7%	40
30 kph	43.5%	36
35 kph	50.5%	34

Table 6.1C Revised Annual Mean Nitrogen Dioxide Concentrations in 2012 Assuming Hypothetical Emission Reductions under Various Scenarios Testing for Central AQMA Extensions

Scenarios	% NO_x Reduction	2012 NO_2 Annual Mean Concentration ($\mu g/m^3$)
Cowgate (ID 48C) Central AQMA NO_2 annual mean = 43 Reduction of NO_x required from local roads = 17.5% (Table 5.1)		
Increasing speed		
30 kph	17.6%	40
35 kph	23.9%	39
30% Reduction in car traffic		
20 kph	14.2%	40
30 kph	29.7%	37
35 kph	35.1%	36
Improving bus standard Euro 5 (100%)		
20 kph	11.2%	41
30 kph	19.1%	39
35 kph	25.5%	38
Improving HGV standard Euro 6 (100%)		
20 kph	24.9%	38
30 kph	37.2%	36
35 kph	41.6%	35
Grassmarket (ID37A) Central AQMA NO_2 annual mean = 43 Reduction of NO_x required from local roads = 24.7% (Table 5.1)		
Increasing speed		
30 kph	17.8%	41
35 kph	24.0%	40
30% Reduction in car traffic		
20 kph	12.9%	41
30 kph	29.1%	39
35 kph	34.7%	39
40% Reduction in car traffic		
20 kph	16.9%	41
30 kph	32.6%	39
35 kph	38.0%	38
Improving bus standard Euro 5 (100%)		
20 kph	12.2%	41
30 kph	27.6%	39
35 kph	33.1%	39
Improving HGV standard Euro 6 (100%)		
20 kph	23.1%	40
30 kph	36.9%	38
35 kph	41.8%	38

Table 6.1C Revised Annual Mean Nitrogen Dioxide Concentrations in 2012 Assuming Hypothetical Emission Reductions under Various Scenario Testing for Central AQMA extensions

Scenarios	% NO_x Reduction	2012 NO_2 Annual Mean Concentration ($\mu g/m^3$)
Grassmarket (ID37A) Central AQMA NO_2 annual mean = 43 Reduction of NO_x required from local roads = 24.7% (Table 5.1)		
Improving bus standard- Euro 5 (100%) plus HGV standard- Euro 6 (100%)		
20 kph	33.8%	39
30 kph	44.8%	37
35 kph	48.7%	37
30% Reduction in car traffic plus bus standard- Euro 5 (100%)		
20 kph	15.1%	40
30 kph	31.9%	39
35 kph	37.9%	38
Easter Road (1D 25) Central AQMA NO_2 annual mean = 45 Reduction of NO_x required from local roads = 26.5% (Table 5.1)		
Increasing Speed		
30 kph	19.0%	41
35 kph	25.4%	40
30% Reduction in car traffic		
20 kph	10.1%	43
30 kph	27.6%	39
35 kph	33.4%	38
Improving bus standard - Euro 5 (100%)		
20 kph	6.3%	44
30 kph	27.0%	39
35 kph	34.3%	38
Improving HGV standard- Euro 6 (100%)		
20 kph	16.8%	42
30 kph	32.2%	38
35 kph	37.3%	37
Bus standard Euro 5 (100%) and HGV standard Euro 6 (100%)		
20 kph	23.0%	40
30 kph	40.1%	37
35 kph	46.2%	35
30% Reduction in car traffic plus bus standard Euro 5 (100%) HGV Euro 6 (100%)		
20 kph	33.1%	38
30 kph	48.6%	35
35 kph	54.1%	34

Table 6.1C Revised Annual Mean Nitrogen Dioxide Concentrations in 2012 Assuming Hypothetical Emission Reductions under Various Scenario Testing for Central AQMA extensions

Scenarios	% NO_x Reduction	2012 NO_2 Annual Mean Concentration ($\mu g/m^3$)
Gorgie Road/Chesser (ID 80) Central AQMA NO_2 annual mean = 42 Reduction of NO_x required from local roads = 12.3% (Table 5.1)		
Increasing Speed		
30 kph	21.1%	38
35 kph	28.1%	37
30% Reduction in car traffic		
20 kph	8.7%	40
30 kph	28.7%	37
35 kph	35.2%	36
Improving bus standard Euro 5 (80%) Euro 3 plus SCRT 20%		
20 kph	4.0%	41
30 kph	26.1%	37
35 kph	33.8%	36
Improving bus standard Euro 3 plus SCRT (100%)		
20 kph	14.7%	39
30 kph	31.6%	36
35 kph	37.2%	35
Improving HGV standard - Euro 6 (100%)		
20 kph	19.5%	39
30 kph	36.4%	35
35 kph	42.0%	34
30% Reduction in car traffic plus bus standard Euro 5 (80%) Euro 3 plus SCRT 20%		
20 kph	42.9%	34
30 kph	53.6%	32
35 kph	57.3%	32
London Road (ID81) Central AQMA NO_2 annual mean= 46 Reduction of NO_x required from local roads = 30.4% (Table 5.1)		
Increasing Speed		
30 kph	23.4%	41
35 kph	31.4%	39
30% Reduction in car traffic		
20 kph	7.2%	44
30 kph	29.6%	40
35 kph	37.1%	38
Improving bus standard Euro 5 (100%)		
20 kph	5.8%	45
30 kph	30.7%	39
35 kph	39.5%	37

Table 6.1C Revised Annual Mean Nitrogen Dioxide Concentrations in 2012 Assuming Hypothetical Emission Reductions under Various Scenario Testing for Central AQMA extensions

Scenarios	% NO_x Reduction	2012 NO_2 Annual Mean Concentration ($\mu g/m^3$)
London Road (ID81) Central AQMA NO_2 annual mean = 46 Reduction of NO_x required from local roads = 30.4% (Table 5.1)		
Improving bus standard Euro 5 (100%) and HGV standard Euro 6 (100%)		
20 kph	14.4%	43
30 kph	37.5%	38
35 kph	45.7%	36
30% reduction in car traffic plus bus standard Euro 5 (100%)		
20 kph	13.0%	43
30 kph	36.9%	38
35 kph	45.3%	36

Table 6.1D Revised Annual Mean Nitrogen Dioxide Concentrations in 2012 Assuming Hypothetical Emission Reductions Under Various Scenario Testing for Great Junction Street AQMA extension

Scenario	% NO_x Reduction	2012 NO_2 Annual Mean Concentration ($\mu g/m^3$)
Bernard Street (ID 29C) Great Junction Street AQMA NO_2 annual mean = 44 Reduction of NO_x required from local roads = 21.3% (Table 5.1)		
Increasing Speed		
30 kph	20.4%	40
30% reduction in car traffic		
20 kph	9.8%	42
30 kph	28.8%	38
Improving HGV standard – Euro 6 (100%)		
20 kph	32.0%	37
30 kph	45.2%	35
Removal of all HGVs		
20 kph	37.5%	36
30 kph	48.2%	34
Removal of all Artic HGVs		
20 kph	13.5%	41
30 kph	30.1%	38
Improvement in bus standard Euro 5 (100%)		
20 kph	2.6%	44
30 kph	23.5%	39

7 Conclusions

Nitrogen dioxide concentrations within the extended and new AQMAs show that the annual mean has been exceeded since 2009. The exceedences are not widespread, but tend to be in areas where relevant receptors are close to the road edge, in street canyons and close to busy junctions.

The AQMA boundaries are larger than the area of exceedence. It is recommended that they remain in their present form for AQAP purposes and that monitoring continues.

Source apportionment studies have identified that local background concentrations contribute a large proportion to the overall concentration of nitrogen dioxide. The contribution from each of the vehicle classes to the overall nitrogen dioxide concentration is diverse, with buses having a marginal role in Cowgate and Grassmarket to having the largest impacts at London Road, Gorgie Road/Chesser and Inverleith Row. Cars have a significant impact in all areas with LGVs showing the least. A simple visual comparison of the degree of contribution from each vehicle class is provided in Table 7.1

Table 7.1: Visual comparison of each vehicle class contribution to Overall Local Road NO_2 Concentrations in AQMAs

Degree of Contribution from Vehicle Classes operating in AQMAs					
Receptor		**Cars**	**LGVs**	**HGVs**	**Buses**
Central AQMA extensions					
48	Cowgate	■ ■ ■ ■	■ ■	■ ■ ■	■
37A	Grassmarket	■ ■ ■ ■	■ ■	■ ■ ■	■
25	Easter Road	■ ■ ■ ■	■	■ ■	■ ■ ■
80	Gorgie/Chesser	■ ■ ■	■	■ ■	■ ■ ■ ■
81	London Road	■ ■ ■	■	■ ■	■ ■ ■ ■
Great Junction Street AQMA extension					
29C	Bernard Street	■ ■ ■	■	■ ■ ■ ■	■ ■
Glasgow Road AQMA					
58	Glasgow Road	■ ■ ■ ■	■	■ ■ ■	■ ■
Inverleith Row AQMA					
53	Ferry Road	■ ■ ■ ■	■	■ ■	■ ■ ■
55	Inverleith Row	■ ■ ■	■	■ ■	■ ■ ■ ■

■ ■ ■ ■ = Most significant contribution to local road NO_2

■ ■ ■

■ ■

■ = Least significant contribution to local road NO_2

Future action planning will therefore need to keep most motor vehicle classes under consideration. Measures will continue to be evaluated and discussed corporately through the Council's Air Quality Working Group.

Measures to operate cleaner vehicles contained in the current Action Plan will be retained with respect to ECOSTARS Edinburgh and the Council will continue to work with the bus companies to accelerate fleet improvement.

The Council will also continue its efforts to ensure that its own operational fleet remains as clean and efficient as possible. This will include the introduction of new and electric vehicles wherever feasible.

The revised Action Plan will include all new and amended AQMAs. Further source apportionment in areas previously considered will require to be revisited to take account of the latest emission factors and future traffic changes in the Central AQMA.

Potential implementation of a Low Emission Zone will remain under consideration by the City of Edinburgh Council.

8 References

1 Society of Motor Manufacturers and Traders 2013 survey of new car market (www.smmt.co.uk).

2 2011 Air Quality Progress Report for City of Edinburgh Council

3 2013 Air Quality Progress Report for City of Edinburgh Council

4 Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites. Available From Defra and Devolved Administrations 2008 AEAT/ENV/R/2641

5 Building a Vision for the City Centre, Transport and Environment Committee, City of Edinburgh Council 19th March 2013.

6 Air Quality Action Plan (Revised 2008)

7 Edinburgh Low Emission Strategy Feasibility Study. Transport and Travel Research May 2007.

8 Edinburgh Low Emission Strategy- bus emission analysis. Transport and Travel Research March 2011.

9 APPENDICIES

Appendix 1

Details of Monitoring Locations Relevant to Source Apportionment

Table A1a: Passive Diffusion Tube Monitoring Details (Central AQMA extension)

Location		OS Grid X	OS Grid Y	Distance (m) To relevant exposure	Distance (m) To kerb of nearest road
48	Cowgate/Guthrie Street	325881	673471	Y facade	4.5
48A	Cowgate/ Blair Street	325929	673490	Y facade	3.2
48B	Cowgate 301	326132	673519	Y facade	3.8+2
48C	Cowgate Blackfriars	326047	673519	Y facade	2.4
48D	Cowgate 148	325845	673480	Y facade	2.0
48E	Cowgatehead 2	325537	673405	Y facade	1.9
37	Grassmarket PS	325427	673371	Y (5.0)	2.0+2.1
37A	Grassmarket 41	325401	673340	Y facade	3.4
37B	Grassmarket 75	325471	673369	Y facade	5.0
37C	Grassmarket Background	325397	673377	Y facade	N/A
80	Gorgie Road/Chesser	321967	671666	Y facade	2.6
80A	Gorgie Road/Glenlea	322381	671950	Y facade	2.6
80B	Gorgie Road	321724	671557	Y facade	2.5
80C	Gorgie Road 87	323265	672394	Y facade	2.5
25	Easter Road	326934	674503	Y facade	2.3
25B	Easter Road/Rossie Place	326950	674624	Y facade	3.3
25C	Easter Road	326958	674770	Y facade	3.25
25D	Easter Road	326974	674780	Y facade	2.8
25E	Easter Road	326999	674940	Y facade	3.95
25F	Easter Road 271	327010	675149	Y facade	2.8
25G	Easter Road 327	327071	675467	Y facade	3.0
25H	Easter Road/Church	326917	674483	Y facade	2.1
46	London Rd/Easter Rd junct	326944	674472	Y facade	5.6
66	London Road/Cadzow Place	327468	674362	Y facade	2.0+2.0
67	London Road/Earlston Place	327190	674433	Y facade	2.7
68	London Rd/Parson Gr Terr	328049	674174	Y facade	2.7
69	London Rd/Wolseley Place	328272	674143	Y facade	2.62
70	London Rd/Wolseley Terrace	328337	674129	Y facade	4.6
81	London Rd/East Norton Pl	326980	674446	Y facade	2.5
82	London Rd/Piersfield Terr	328771	674190	Y facade	4.0+2.4

Table A1b: Automatic Analyser Monitoring Location Details

Location		OS Grid X	Y	Distance (m) To relevant exposure	Distance (m) To kerb of nearest road
ID4	Gorgie Rd/White park	323121	672314	Y facade	2.5

Site description:
Roadside, Located in line with facade of adjacent residential tenement flats on perimeter of children's play park. Not in canyon area of road

Table A1c: Passive Diffusion Tube Monitoring Details (Great Junction Street AQMA Extension)

Location		OS Grid X	Y	Distance (m) To relevant exposure	Distance (m) To kerb of nearest road
29	Bernard Street	327148	676507	Y facade	2.2
29A	Bernard Street	327137	676529	Y facade	2.1
29B	Bernard Street	327192	676513	Y facade	2.2
29C	Bernard Street	327135	676515	Y facade	2.1
7	Commercial Street	327009	676565	Y facade	2.5
9	Commercial Street	326879	676626	Y facade	2.6
9A	Commercial Street	326430	676754	Y (3.90)	1.47
9B	Commercial St/Ocean Drive	326455	676805	Y facade	4.2

Table A1d: Passive Diffusion Tube Monitoring Details (Glasgow Road AQMA)

Location		OS Grid X	Y	Distance (m) To relevant exposure	Distance (m) To kerb of nearest road
15	Glasgow Road 9	312664	672672	Y (3.8)	1.6 +2.4
16*	Glasgow Road 68	313028	672633	Y (4.4)	1.8
58*	Glasgow Road /Newbridge	312693	672670	Y (5.2)	2.8

Table A1e: Passive Diffusion Tube Monitoring Details (Inverleith Row/Ferry Road Junction AQMA)

Location		OS Grid X	Y	Distance (m) To relevant exposure	Distance (m) To kerb of nearest road
53	Bowhill Terrace 6	324726	676004	Y (1.57)	1.75+2.85
52	Ferry Road 268	324946	676070	Y (4.6)	1.65
54	Inverleith Gardens	324527	675999	Y (8.7)	1.3
55*	Inverleith Row/Ferry Road	324638	675993	Y facade	4.65
55C	Inverleith Row/Montague	324686	675941	Y (1.06)	2.28+2.0

Appendix 2

Traffic data Summary

Combined Easter Road

	27/11/2012	28/11/2012	29/11/2012	Mean	%
Motor Cycle	67	58	72	66	0.5
Car and Private Taxi	8536	8770	9114	8807	72.7
Black Hackney Cab	1113	1192	1330	1212	10.0
LGV	1384	1330	1509	1408	11.6
HGV rigid 2 axle	193	196	196	195	1.6
HGV rigid 3 axle	72	43	33	49	0.4
HGV rigid 4 axle	16	10	0	9	0.1
HGV artic 3/4 axle	0	0	2	1	0.0
HGV artic 5 axle	11	13	4	9	0.1
HGV artic 6 axle	44	47	37	43	0.4
single deck bus	148	171	153	157	1.3
double deck bus	167	162	162	164	1.4

TOTAL AADT	**11751**	**11992**	**12612**	**12120**	**100**

Total HGVs	336	309	272	306
Total Bus	315	333	315	321

Total HGVs	2.86%	2.58%	2.16%
Total Bus	2.68%	2.78%	2.50%

Car/Taxi	LGV	HGV Rigid	HGV Artic	Bus	Motor Cycle
82.7%	11.6%	2.1%	0.4%	2.7%	0.5%

Speed 20 kph

Bus Profile
Euro 2 = 50%
Euro 3 = 50%
No coaches

Combined London Road

	27/11/2012	28/11/2012	29/11/2012	Mean	%
Motor Cycle	99	101	108	103	0.6
Car and Private Taxi	11740	11833	12238	11937	74.3
Black Hackney Cab	623	816	1116	852	5.3
LGV	1632	1631	1703	1655	10.3
HGV rigid 2 axle	232	197	214	214	1.3
HGV rigid 3 axle	64	60	52	59	0.4
HGV rigid 4 axle	8	16	25	16	0.1
HGV artic 3/4 axle	0	1	1	1	0.0
HGV artic 5 axle	6	10	8	8	0.0
HGV artic 6 axle	3	3	3	3	0.0
single deck bus	150	172	151	158	1.0
double deck bus	1074	1054	1072	1067	6.6

TOTAL AADT	15631	15894	16691	16072	100

Total HGV	313	287	303
Total Bus	1224	1226	1223

Total HGVs	2.00%	1.81%	1.82%
Total Bus	7.83%	7.71%	7.33%

Car/Taxi	LGV	HGV Rigid	HGV Artic	Bus	Motor Cycle
79.6%	10.3%	1.8%	0.1%	7.6%	0.6%

Speed 20 kph

Bus Profile
Euro 2 = 18%
Euro 3 = 30%
Euro 5 = 52%
No coaches

Combined West Port data January 2011 used as proxy for Grassmarket

	11/01/2011	12.01.2011	13.01.2011	Mean	%
Motor Cycle	64	53	82	66	0.5
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 axle	358	366	338	354	2.4
HGV rigid 3 axle	34	35	33	34	0.2
HGV rigid 4 axle	12	12	4	9	0.1
HGV artic 3/4 axle	7	8	17	11	0.1
HGV artic 5 axle	2	2	2	2	0.0
HGV artic 6 axle	5	5	2	4	0.0
single deck bus	125	131	131	129	0.9
double deck bus	3	5	3	4	0.0

TOTAL AADT	**14374**	**14864**	**15179**	**14806**	**100**

Total HGVs	418	428	396
Total Bus	128	136	134

Total HGVs %	2.90%	2.88%	2.61%
Total bus %	0.89%	0.91%	0.88%

Car/Taxi	LGV	HGV Rigid	HGV Artic	Bus	Motor Cycle
84.2%	11.7%	2.7%	0.1%	0.9%	0.4%

Speed 20 kph

Bus Profile
Euro 2 = 67%
Euro 5 = 33%
No coaches

Combined Cowgate

	19/02/2013	20/02/2013	21/02/2013	Mean	%
Motor Cycle	114	98	102	105	**0.78**
Car and Private Taxi	10321	10706	10455	10494	**78.34**
Black Hackney Cab	655	760	836	750	**5.6**
LGV	1566	1652	1661	1626	**12.14**
HGV rigid 2 axle	268	319	315	301	2.25
HGV rigid 3 axle	20	48	28	32	0.24
HGV rigid 4 axle	7	16	7	10	0.07
HGV artic 3/4 axle	2	7	1	3	0.02
HGV artic 5 axle	22	13	4	13	0.1
HGV artic 6 axle	11	28	30	23	0.17
single deck bus	42	17	29	29	0.22
double deck bus	12	3	13	9	0.07

TOTAL AADT	**13040**	**13667**	**13481**	**13395**	**100**

Total HGVs	330	431	385	382	
Total Bus	54	20	42	39	

Total HGVs %	2.53%	3.15%	2.86%	2.85%	
Total Bus %	0.41%	0.15%	0.31%	0.29%	

Car/Taxi	LGV	HGV Rigid	HGV Artic	Bus	Motor Cycle
83.9%	12.1%	2.6%	0.3%	0.3%	0.8%

Speed 20 kph

Bus Profile
Euro 2 = 100%
No coaches

Combined Gorgie Road

	19/02/2013	20/02/2013	21/02/2013	Mean	%
Motor Cycle	115	123	95	111	0.4
Car and Private Taxi	19941	20784	19770	20165	77.9
Black Hackney Cab	464	504	558	509	2.0
LGV	3164	3239	3195	3199	12.4
HGV rigid 2 axle	599	630	574	601	2.3
HGV rigid 3 axle	73	80	94	82	0.3
HGV rigid 4 axle	55	61	37	51	0.2
HGV artic 3/4 axle	34	27	21	27	0.1
HGV artic 5 axle	27	20	23	23	0.1
HGV artic 6 axle	69	78	102	83	0.3
single deck bus	286	261	299	282	1.1
double deck bus	755	739	740	745	2.9

TOTAL AADT	**25582**	**26546**	**25508**	**25878**	**100**

Total HGVs	857	896	851
Total Bus	1041	1000	1039

Total HGVs	3.35%	3.38%	2.94%	3.36%
Total Bus	4.07%	3.77%	4.01%	3.97%

Car/Taxi	LGV	HGV Rigid	HGV Artic	Bus	Motor Cycle
79.9%	12.4%	2.8%	0.5%	4.0%	0.4%

Speed 20 kph

Bus Profile
Euro 3 = 64%
Euro 5 = 16%
Euro 3 +SCRT = 20%
No coaches

Combined Bernard Street

	13/03/2012	14/03/2012	15/03/2012	Mean	%
Motor Cycle	106	110	122	113	0.6
Car and Private Taxi	13512	13683	13770	13655	78.3
Black Hackney Cab	535	591	686	604	3.5
LGV	2038	1992	1931	1987	11.4
HGV rigid 2 axle	484	456	452	464	2.7
HGV rigid 3 axle	101	76	73	83	0.5
HGV rigid 4 axle	47	60	73	60	0.3
HGV artic 3/4 axle	29	22	13	21	0.1
HGV artic 5 axle	51	18	33	34	0.2
HGV artic 6 axle	126	174	172	157	0.9
single deck bus	41	51	37	43	0.2
double deck bus	225	219	218	221	1.3

TOTAL AADT	**17295**	**17452**	**17580**	**17442**	**100**

Total HGVs	4.70%	4.62	4.64	4.7
Total Bus	1.50%	1.55	1.45	1.5

Car/Taxi	LGV	HGV Rigid	HGV artic	Bus	Motor Cycle
81.8%	11.4%	3.5%	1.2%	1.5%	0.6%

Speed 20 kph

Bus Profile
Euro 3 =100%
No coaches

Combined Glasgow Road

	19/02/2013	20/02/2013	21/02/2013	Mean	%
Motor Cycle	113	115	117	115	0.3
Car and Private Taxi	39062	38299	39894	39085	84.8
Black Hackney Cab	166	196	215	192	0.4
LGV	3979	4267	4199	4148	8.9
HGV rigid 2 axle	1139	1103	1081	1108	2.4
HGV rigid 3 axle	146	137	138	140	0.3
HGV rigid 4 axle	312	169	219	233	0.5
HGV artic 3/4 axle	23	95	123	80	0.2
HGV artic 5 axle	162	191	87	147	0.3
HGV artic 6 axle	223	190	294	236	0.5
single deck bus	499	496	497	497	1.1
double deck bus	128	124	137	130	0.3

TOTAL AADT	**45952**	**45382**	**47001**	**46111**	**100.0**

Total HGV	2005	1885	1942
Total Bus	627	620	634

Total HGVs	4.36%	4.15%	4.13%
Total Bus	1.36%	1.37%	1.35%

Car/Taxi	LGV	HGV Rigid	HGV artic	Bus	Motor Cycle
85.2%	8.9%	3.2%	1.0%	1.4%	0.3%

Speed 30 kph

Bus Profile
All coaches Citylink Services <18T 1.0
Euro 3 = 6%
Euro 4 = 1%
Euro 5 = 93%

Buses
Euro 3 = 50%
Euro 4 = 50%

Bus/Coach ratio = 0.21:0.79

Combined Inverleith Row

	07/05/2013	08/05/2013	09/05/2013	Mean	%
Motor Cycle	113	84	107	101	0.8
Car and Private Taxi	9391	9632	9813	9612	77.6
Black Hackney Cab	417	393	453	421	3.4
LGV	1313	1551	1379	1414	11.4
HGV rigid 2 axle	162	120	145	142	1.2
HGV rigid 3 axle	39	41	36	39	0.3
HGV rigid 4 axle	5	13	16	11	0.09
HGV artic 3/4 axle	7	4	4	5	0.04
HGV artic 5 axle	9	9	9	9	0.07
HGV artic 6 axle	25	24	24	24	0.19
single deck bus	58	52	46	52	0.41
double deck bus	551	559	554	555	4.5

TOTAL AADT	**12090**	**12482**	**12586**	**12386**

Total HGVs	247	211	234	231
Total Bus	609	611	600	607

Total HGVs %	2.0	1.7	1.9	1.9
Total bus %	5.0	4.9	4.8	4.9

Car/Taxi	LGV	HGV Rigid	HGV artic	Bus	Motor Cycle
81.0%	11.4%	1.6%	0.3%	4.9%	0.8%

Speed 20 kph

Bus Profile
Euro 2 = 11%
Euro 3 = 22%
Euro 5 = 67%
No Coaches

Combined Ferry Road

	07/05/2013	08/05/2013	09/05/2013	Mean	%
Motor Cycle	193	148	172	171	0.8
Car and Private Taxi	17678	17666	18109	17818	80.8
Black Hackney Cab	372	385	470	409	1.8
LGV	2374	2757	2545	2559	11.6
HGV rigid 2 axle	227	294	259	260	1.2
HGV rigid 3 axle	76	63	43	61	0.3
HGV rigid 4 axle	39	58	37	45	0.2
HGV artic 3/4 axle	17	8	18	14	0.1
HGV artic 5 axle	23	19	31	24	0.1
HGV artic 6 axle	102	133	104	113	0.5
single deck bus	192	178	166	179	0.8
double deck bus	392	394	381	389	1.8

TOTAL AADT	**21685**	**22103**	**22335**	**22041**	**100**

Total HGVs	484	575	492
Total Bus	584	572	547

Car/ Taxi	LGV	HGV Rigid	HGV artic	Bus	Motor Cycle
82.6%	11.6 %	1.7 %	0.7 %	2.6 %	0.8 %

Speed 20 kph

Bus Profile
Euro 2 = 31%
Euro 3 = 69%

No Coaches

Appendix 3

Source Apportionment Calculations

Table A3a: 2012 Background NO_2 and NO_x Data Used in the Study Areas.

Receptor		Northing	Easting	Local Background NO_2	Local Background NO_x	Regional Background NO_x
Central AQMA extensions						
48	Cowgate	325500	673500	24	34	4*
48C	Cowgate	325500	673500	24	34	4*
25	Easter Road	326500	674500	24	34	4*
80	Gorgie Road/Chesser	321500	671500	24*	43*	4*
37A	Grassmarket	325500	673500	30	61*	4*
81	London Road	326500	674500	24	34	4*
Great Junction Street AQMA extension						
29C	Bernard St*	327500	676500	23*	43*	4*
Glasgow Road AQMA						
58	Glasgow Road*	312500	672500	28*	51*	4*
16	Glasgow Road*	313500	672500	25*	47*	4*
Inverleith Row AQMA						
53	Ferry Road*	324500	675500	22*	40*	4*
55	Inverleith Row*	324500	675500	22*	40*	4*

* Data obtained from Scottish Government 2012 modelled NO_2 and NO_x background maps from the above Grid References.

Measured NO_2 and NO_x concentrations from the AURN urban background site at St Leonard's were used to represent local background concentrations for the majority of the receptor locations in the Central AQMA.

Measured background data was also available for the Grassmarket (site ID 37C). The equivalent modelled NO_x concentration was calculated by obtaining the ratio of modelled NO_x (67.95) to modelled NO_2 (33.57) from the Scottish background maps at this location. The derived factor of 2.02 was then used to multiply the measured NO_2 concentration of 30 to attain the equivalent NO_x concentration of 61. This approach was advised by the DEFRA Helpdesk.

The receptor location at Gorgie Road/Chesser was considered to be outwith the city centre zone and therefore the background maps were used to derive the local background concentrations at this location.

Table A3b: Source Apportionment Calculations (Box 7.1 LAQM TG09)

Receptor Location		TOTAL NO_2	STEP 1				STEP 2		STEP3
		T-NO_2	TB-NO_2	TB-NO_x	RB-NO_x	LB-NO_x	RB-NO_2	LB-NO_2	L-NO_2
Central AQMA Extension									
48C	Cowgate	43	24	34	4	30	2.8	21.2	19
48	Cowgate	40	24	34	4	30	2.8	21.2	16
25	Easter Road	45	24	34	4	30	2.8	21.2	21
80	Gorgie/Chesser	42	24	43	4	39	2.2	21.8	18
37A	Grassmarket	43	30	61	4	57	2.0	28.0	13
81	London Road	46	24	34	4	30	2.8	21.2	22
Great Junction St AQMA Extension									
29C	Bernard Street	44	23	43	4	39	2.1	20.9	21
Glasgow Road AQMA									
58	Glasgow Road	48	28	51	4	47	2.2	25.8	20
16	Glasgow Road	47	25	47	4	43	2.1	22.9	22
Inverleith Row AQMA									
53	Ferry Road	35	22	40	4	36	2.2	19.8	13
55	Inverleith Row	46	22	40	4	36	2.2	19.8	24

T-NO_2 = Total highest NO_2 measured at relevant receptor (worst-case)
TB-NO_2 = Total Background NO_2
RB-NO_x = Regional Background NO_x
LB-NO_x = Local Background NO_x (TB-NO_x) – (RB-NO_x)
RB-NO_2 = Regional Background NO_2 (TB-NO_2) x (RB-NO_x) / (TB-NO_x)
LB-NO_2 = Local Background NO_2 (TB-NO_2) x (LB-NO_x) / (TB-NO_x)
L-NO_2 = Local NO_2 contribution at worst-case location (T-NO_2) – (TB-NO_2)

Table A3b: Source Apportionment Calculations continued

Receptor Location		STEP 4 (% Emissions results for NO_x x (L-NO_2) /100)										
		Cars % EFT	LGVs % EFT	HGVs % EFT	Buses % EFT	Cars/Taxi µg/m^3	LGVs µg/m^3	HGVs µg/m^3	Buses µg/m^3	RB µg/m^3	LB µg/m^3	**Total µg/m^3**
Central AQMA Extension												
48C	Cowgate	49	16	30	5	9.3	3.0	5.7	1.0	2.8	21.2	**43**
48	Cowgate	49	16	30	5	7.8	2.6	4.8	0.8	2.8	21.2	**40**
25	Easter Road	37	12	20	31	7.8	2.5	4.2	6.5	2.8	21.2	**45**
80	Gorgie/Chesser	31.3	11.3	23.1	34.2	5.6	2.0	4.2	6.2	2.2	21.8	**42**
37A	Grassmarket	46	15	26	13	6.0	1.9	3.4	1.7	2.0	28.0	**43**
81	London Road	25	8	10	57	5.5	1.8	2.2	12.5	2.8	21.2	**46**
Great Junction St AQMA Extension												
29C	Bernard Street	35	11	38	16	7.4	2.3	8.0	3.3	2.1	20.9	**44**
Glasgow Road AQMA												
58	Glasgow Road	40.8	10.1	32.7	16.4	8.2	2.0	6.5	3.3	2.2	25.8	**48**
16	Glasgow Road	40.8	10.1	32.7	16.4	9.0	2.2	7.2	3.6	2.1	22.9	**47**
Inverleith Row AQMA												
53	Ferry Road	37	12	21	30	4.8	1.6	2.7	3.9	2.2	19.8	**35**
55	Inverleith Row	32	10	14	44	7.7	2.4	3.4	10.6	2.2	19.8	**46**

Note
EFT = Emission Factor Toolkit v5.2C
Percent emission results for NOx from each vehicle class were calculated by the EFT Toolkit (v5.2C)

Appendix 4: NOx Emission Reduction Calculations

GENERAL INPUT DATA

Year 2012
Local authority: Edinburgh
Traffic Mix - all other urban

	INPUT DATA			OUTPUT DATA		Road side - Objective Equivalent NOx
	Background NO2	Pdt conc NO_2	Pdt at 40 NO_2	Road side NOx Equivalent	Objective (40) Equivalent	
Central AQMA extension						
Cowgate 48C	24	43	40	43.4	35.8	7.6
Easter Road	24	45	40	48.7	35.8	12.9
Gorgie Road/Chesser	24	42	40	40.8	35.8	5.0
Grassmarket	30	43	40	29.6	22.3	7.3
London Road	24	46	40	51.4	35.8	15.6
Great Junction Street AQMA extension						
Bernard Street	23	44	40	48.4	38.1	10.3
Glasgow Road AQMA						
ID 58	28	48	40	47.3	26.8	20.5
ID 16	25	47	40	51.7	33.6	18.1
Inverleith Row AQMA						
ID 55	22	46	40	56.1	40.3	15.8

% Reduction

Central AQMA extension			
Cowgate 48C	7.6/43.4	x100	17.5%
Easter Road	12.9/48.7	x100	26.5%
Gorgie Road/Chesser	5.0/40.8	x100	12.3%
Grassmarket	7.3/29.6	x100	24.7%
London Road	15.6/51.4	x100	30.4%
Great Junction Street AQMA extension			
Bernard Street	10.3/48.4	x100	21.3%
Glasgow Road AQMA			
ID 58	20.5/47.3	x100	43.3%
ID 16	18.1/51.7	x100	35.0%
Inverleith Row AQMA			
ID 55	15.8/56.1	x100	28.2%

Appendix 5: Hypothetical NO_x Reduction Scenario Calculations

Glasgow Road 2012

Annual mean= 48

National fleet profile Scotland with bus std Coach E3(6%) E4(1%) E5 (93%) Bus E3 (50%) E4 (50%)

Speed increase	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µg reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
30 kph	34267	17450	16817							**Base**
40 kph	28602	15401	13201	16.5	20	3.3	16.7	2.2	25.8	**45**
50 kph	24989	14060	10929	27.1	20	5.4	14.6	2.2	25.8	**43**
60 kph	22756	13349	9407	33.6	20	6.7	13.3	2.2	25.8	**41**
30% car reduction										
30 kph	30067	13313	16754	12.3	20	2.5	17.5	2.2	25.8	**46**
40 kph	24912	11753	13159	27.3	20	5.5	14.5	2.2	25.8	**43**
50 kph	21630	10729	10901	36.9	20	7.4	12.6	2.2	25.8	**41**
60 kph	19577	10187	9390	42.9	20	8.6	11.4	2.2	25.8	**39**
40% car reduction										
30 kph	28483	11917	16566	16.9	20	3.4	16.6	2.2	25.8	**45**
40 kph	23542	10522	13020	31.3	20	6.3	13.7	2.2	25.8	**42**
50 kph	20399	9606	10793	40.5	20	8.1	11.9	2.2	25.8	**40**
60 kph	18424	9122	9302	46.2	20	9.2	10.8	2.2	25.8	**39**
Improving HGV E6 100% Bus local										
30 kph	24361	17450	6911	28.9	20	5.8	14.2	2.2	25.8	**42**
40 kph	20437	15401	5036	40.4	20	8.1	11.9	2.2	25.8	**40**
50 kph	17936	14060	3876	49.1	20	9.8	10.2	2.2	25.8	**38**
60 kph	16441	13348	3093	52.0	20	10.4	9.6	2.2	25.8	**38**

Glasgow Road continued

30% car reduction with HGVs E6 100% bus local	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µg reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
30 kph	20008	13313	6695	41.6	20	8.3	11.7	2.2	25.8	**40**
40 kph	16626	11753	4873	51.5	20	10.3	9.7	2.2	25.8	**38**
50 kph	14478	10729	3749	57.7	20	11.5	8.5	2.2	25.8	**37**
60 kph	13177	10187	2990	61.5	20	12.3	7.7	2.2	25.8	**36**
40% car reduction HGVs E6 100% bus local										
30 kph	18522	11917	6605	45.9	20	9.2	10.8	2.2	25.8	**39**
40 kph	15328	10522	4806	55.2	20	11.0	9	2.2	25.8	**37**
50 kph	13303	9606	3697	61.2	20	12.2	7.8	2.2	25.8	**36**
60 kph	12069	9122	2947	64.8	20	13.0	7	2.2	25.8	**35**

Inverleith Row 2012

Annual mean 46

National Fleet profile Scotland with bus std E2 (11%), E3 (22%) E5 (67%)

Speed increase	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µg reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	13022	5558	7464							**Base**
30 kph	10047	4770	5277	22.8	24	5.4	18.6	2.2	19.8	41
35 kph	9020	4465	4555	30.7	24	7.4	16.6	2.2	19.8	39
30% car reduction Bus std 11% E2, 22% E3, 67% E5 (local)										
20 kph	11788	4360	7428	9.5	24	2.3	21.7	2.2	19.8	44
30 kph	8994	3746	5248	31.0	24	7.4	16.6	2.2	19.8	39
35 kph	8035	3507	4528	38.3	24	9.2	14.8	2.2	19.8	37

Inverleith Row continued:

Improving bus 100% E5	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µg reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	12617	5558	7059	3.1	24	0.7	23.3	2.2	19.8	**45**
30 kph	9540	4770	4770	26.7	24	6.4	17.6	2.2	19.8	**40**
35 kph	8449	4465	3984	35.1	24	8.4	15.6	2.2	19.8	**38**
Improve HGV E6 (100%)										
20 kph	11537	5558	5979	11.4	24	2.7	21.3	2.2	19.8	**43**
30 kph	8885	4770	4115	31.8	24	7.6	16.4	2.2	19.8	**38**
35 kph	7968	4465	3503	38.8	24	9.3	14.7	2.2	19.8	**37**
30% car reduction with bus E5 (100%)										
20 kph	11381	4360	7021	12.6	24	3.0	21.0	2.2	19.8	**43**
30 kph	8487	3746	4741	32.5	24	7.8	16.2	2.2	19.8	**38**
35 kph	7464	3507	3957	42.7	24	10.2	13.8	2.2	19.8	**36**
30% car reduction with Bus E5 HGV E6										
20 kph	9935	4360	5575	23.7	24	5.7	18.3	2.2	19.8	40
30 kph	7357	3746	3611	43.5	24	10.4	13.6	2.2	19.8	36
35 kph	6442	3507	2935	50.5	24	12.2	11.8	2.2	19.8	34

Cowgate 2012

Annual mean 43

National fleet profile Scotland with bus std E2 (100%)

Speed increase	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µg reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	9549	6264	3285							**Base**
30 kph	7864	5375	2489	17.6	19	3.3	15.7	2.8	21.2	**40**
35 kph	7269	5032	2237	23.9	19	4.5	14.5	2.8	21.2	**39**
30% car reduction										
20 kph	8196	4963	3233	14.2	19	2.7	16.3	2.8	21.2	**40**
30 kph	6712	4263	2449	29.7	19	5.6	13.4	2.8	21.2	**37**
35 kph	6194	3992	2202	35.1	19	6.7	12.3	2.8	21.2	**36**
Improve bus std E5 100%										
20 kph	9442	6264	3178	11.2	19	2.1	16.9	2.8	21.2	**41**
30 kph	7724	5375	2349	19.1	19	3.6	15.4	2.8	21.2	**39**
35 kph	7115	5032	2083	25.5	19	4.8	14.2	2.8	21.2	**38**
Improve HGV std E6 100%										
20 kph	7171	6264	907	24.9	19	4.7	14.3	2.8	21.2	**38**
30 kph	5994	5375	619	37.2	19	7.1	11.9	2.8	21.2	**36**
35 kph	5572	5032	540	41.6	19	7.9	11.1	2.8	21.2	**35**

Grassmarket 2012

Annual mean =43

National fleet Scotland bus std E2 (67%) E5 (33%)

Speed increase	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µg reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	11268	6877	4391							**Base**
30 kph	9257	5901	3356	17.8	13	2.3	10.7	2	28	**41**
35 kph	8558	5523	3035	24	13	3.1	9.9	2	28	**40**
30% car reduction										
20 kph	9818	5481	4337	12.9	13	1.7	11.3	2	28	**41**
30 kph	7990	4707	3283	29.1	13	3.8	9.2	2	28	**39**
35 kph	7354	4407	2947	34.7	13	4.5	8.5	2	28	**39**
40% car reduction										
20 kph	9362	5015	4347	16.9	13	2.2	10.8	2	28	**41**
30 kph	7595	4309	3286	32.6	13	4.2	8.8	2	28	**39**
35 kph	6983	4034	2949	38	13	4.9	8.1	2	28	**38**
Improve bus std E5 100%										
20 kph	9893	6877	3016	12.2	13	1.6	11.4	2	28	**41**
30 kph	8156	5900	2256	27.6	13	3.6	9.4	2	28	**39**
35 kph	7541	5523	2018	33.1	13	4.3	8.7	2	28	**39**
Improve HGV E6 100%										
20 kph	8666	6877	1789	23.1	13	3	10	2	28	**40**
30 kph	7109	5901	1208	36.9	13	4.8	8.2	2	28	**38**
35 kph	6561	5523	1038	41.8	13	5.4	7.6	2	28	**38**

Grassmarket continued

Improving Bus E5 100% And HGV E6 100%	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µg reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	7454	6877	577	33.8	13	4.4	8.6	2	28	**39**
30 kph	6224	5901	324	44.8	13	5.8	7.2	2	28	**37**
35 kph	5781	5523	258	48.7	13	6.3	6.7	2	28	**37**
30% car reduction with Bus std E5 (100%)										
20 kph	9570	5481	4089	15.1	13	2	11	2	28	**41**
30 kph	7670	4707	2963	31.9	13	4.1	8.9	2	28	**39**
35 kph	7000	4407	2593	37.9	13	4.9	8.1	2	28	**38**

Easter Road 2012

Annual mean = 45

National fleet profile Scotland bus std E2 (50%), E3 (50%)

Speed increase	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µ reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	11385	5544	5841							**Base**
30 kph	9218	4757	4461	19.0	21	4.0	17.0	2.8	21.2	**41**
35 kph	8493	4452	4041	25.4	21	5.3	15.7	2.8	21.2	**40**
30% Car reduction										
20 kph	10232	4447	5785	10.1	21	2.1	18.9	2.8	21.1	**43**
30 kph	8238	3820	4418	27.6	21	5.8	15.2	2.8	21.1	**39**
35 kph	7578	3576	4002	33.4	21	7	14	2.8	21.1	**38**

Easter Road continued

Improve bus std E 5 (100%)	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µ reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	10669	5544	5125	6.3	21	1.3	19.7	2.8	21.2	**44**
30 kph	8314	4757	3557	27.0	21	5.7	15.3	2.8	21.2	**39**
35 kph	7480	4452	3028	34.3	21	7.2	13.8	2.8	21.2	**38**
Improving HGVs E6 (100%)										
20 kph	9470	5544	3926	16.8	21	3.5	17.5	2.8	21.2	**42**
30 kph	7721	4757	2964	32.2	21	6.8	14.2	2.8	21.2	**38**
35 kph	7138	4452	2686	37.3	21	7.8	13.2	2.8	21.2	**37**
Bus E5 100% plus HGV E6 (100%)										
20 kph	8754	5544	3210	23.0	21	4.8	16.2	2.8	21.2	**40**
30 kph	6817	4757	2060	40.1	21	8.4	12.6	2.8	21.2	**37**
35 kph	6125	4452	1673	46.2	21	9.7	11.3	2.8	21.2	**35**
30% Car reduction plus Bus E5 HGV E6										
20 kph	7614	4447	3167	33.1	21	7	14	2.8	21.1	**38**
30 kph	5852	3820	2032	48.6	21	10.2	10.8	2.8	21.1	**35**
35 kph	5226	3576	1650	54.1	21	11.4	9.6	2.8	21.1	**34**

Gorgie Road/Chesser 2012

Annual mean =42

National fleet profile Scotland bus std E3 (64%) E5 (16%) E3 (SCRT) 20%

Speed increase	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µ reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	27530	11732	15798							**Base**
30 kph	21709	10069	11640	21.1	18	3.8	14.2	2.2	21.8	**38**
35 kph	19786	9425	10361	28.1	18	5.1	12.9	2.2	21.8	**37**
30% car reduction										
20 kph	25122	9199	1523	8.7	18	1.6	16.4	2.2	21.8	**40**
30 kph	19635	7904	11731	28.7	18	5.2	12.8	2.2	21.8	**37**
35 kph	17841	7400	10441	35.2	18	6.3	11.7	2.2	21.8	**36**
Improve bus std E5 (80%) Bus E3 Scrt (20%)										
20 kph	26407	11732	14675	4	18	0.7	17.3	2.2	21.8	**41**
30 kph	20345	10069	10276	26.1	18	4.7	13.3	2.2	21.8	**37**
35 kph	18230	9425	8805	33.8	18	6.1	11.9	2.2	21.8	**36**
Bus E3 Scrt 100%										
20 kph	23494	11732	11762	14.7	18	2.6	15.4	2.2	21.8	**39**
30 kph	18840	10069	8771	31.6	18	5.7	12.3	2.2	21.8	**36**
35 kph	17285	9425	7860	37.2	18	6.7	11.3	2.2	21.8	**35**
Improve HGV E6 100%										
20 kph	22159	11732	10427	19.5	18	3.5	14.5	2.2	21.8	**39**
30 kph	17507	10069	7438	36.4	18	6.6	11.4	2.2	21.8	**35**
35 kph	15980	9425	6555	42	18	7.6	10.4	2.2	21.8	**34**

Gorgie Road/Chesser continued

30% Car reduction Bus E5 (80%) E3 SCRT (20%)	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µ reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	15726	9199	6527	42.9	18	7.7	10.3	2.2	21.8	**34**
30 kph	12780	7904	4876	53.6	18	9.6	8.4	2.2	21.8	**32**
35 kph	11752	7400	4352	57.3	18	10.3	7.7	2.2	21.8	**32**

London Road 2012

Annual mean = 46

National fleet profile Scotland bus std E2 (18%) E3 (30%) E5 (52%)

Increasing Speed	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µ reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	20984	6943	14041							**BASE**
30 kph	16059	5956	10103	23.4	22	5.1	16.9	2.8	21.2	**41**
35 kph	14401	5576	8825	31.4	22	6.9	15.1	2.8	21.2	**39**
30% car reduction										
20 kph	19472	5456	14016	7.2	22	1.6	20.4	2.8	21.2	44
30 kph	14770	4686	10084	29.6	22	6.5	15.5	2.8	21.2	40
35 kph	13196	4387	8809	37.1	22	8.2	13.8	2.8	21.2	38
Improve Bus E5 100%										
20 kph	19773	6943	12830	5.8	22	1.3	20.7	2.8	21.2	**45**
30 kph	14543	5957	8586	30.7	22	6.8	15.2	2.8	21.2	**39**
35 kph	12695	5576	7119	39.5	22	8.7	13.3	2.8	21.2	**37**

London Road continued

Bus E5 100% HGV E6 100%	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µ reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	17958	6943	11015	14.4	22	3.2	18.8	2.8	21.2	**43**
30 kph	13108	5956	7152	37.5	22	8.3	13.7	2.8	21.2	**38**
35 kph	11389	5576	5813	45.7	22	10.1	11.9	2.8	21.2	**36**
30% Car reduction Bus E5 100%										
20 kph	18258	5456	12802	13	22	2.9	19.1	2.8	21.2	43
30 kph	13250	4685	8565	36.9	22	8.1	13.9	2.8	21.2	38
35 kph	11486	4387	7099	45.3	22	10	12	2.8	21.2	36

Bernard Street 2012

Annual mean = 44

National fleet profile Scotland bus std E3 (100%)

Increasing Speed	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µ reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	17032	7881	9151							**BASE**
30 kph	13556	6762	6794	20.4	21	4.3	16.7	2.1	20.9	**40**
30% Car reduction										
20 kph	15357	6175	9182	9.8	21	2.1	18.9	2.1	20.9	**42**
30 kph	12119	5304	6815	28.8	21	6	15	2.1	20.9	**38**
Improving HGV std E6 (100%)										
20 kph	11578	7881	3697	32.0	21	6.7	14.3	2.1	20.9	**37**
30 kph	9331	6762	2569	45.2	21	9.5	11.5	2.1	20.9	**35**

Bernard Street continued

Removal of HGVs	g/km All veh	g/km All LDV	g/km All HGV	All vehicle % reduction	L-NO2	µ reduction L-NO2	Revised L-NO2	RB-NO2	LB-NO2	Total µg
20 kph	10643	7870	2773	37.5	21	7.9	13.1	2.1	20.9	**36**
30 kph	8815	6753	2062	48.2	21	10.1	10.9	2.1	20.9	**34**
Removal of Artics										
20 kph	14730	7876	6854	13.5	21	2.8	18.2	2.1	20.9	**41**
30 kph	11909	6758	5151	30.1	21	6.3	14.7	2.1	20.9	**38**
Improving Bus Std Euro 5 100%										
20 kph	16588	7881	8707	2.6	21	0.5	20.5	2.1	20.9	**44**
30 kph	13017	6762	6255	23.6	21	4.9	16.1	2.1	20.9	**39**

Note
Methodology approach approved by LAQM Helpdesk