DERRY CITY COUNCIL

LAQM FURTHER ASSESSMENT

DALE'S CORNER AIR QUALITY MANAGEMENT AREA

BV/AQ/AGGX3995788/EC/2696

APRIL 2011

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DOCUMENT CONTROL SHEET

Issue/Revision	Issue 1	Final
Remarks	Draft v1 for Comment	
Date	21/04/2011	19/07/2011
Submitted to	Mark McChrystal	
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Project number	3995788	
File reference	BV/AQ/AGGX3995788/EC/2696	

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Executive Summary

Environment (Northern Ireland) Order 2002 places a statutory duty on local authorities to review and assess the air quality within their area under the Local Air Quality Management (LAQM) regime, and take account of Government Guidance when undertaking such work.

An Air Quality Management Area (AQMA) for nitrogen dioxide (NO_2) was declared in Derry at Dale's Corner junction in 2010 following conclusions of a Detailed Assessment, which confirmed exceedences of the NO_2 annual mean Air Quality Strategy (AQS) objective at several locations representative of public exposure at the junction.

Bureau Veritas has been commissioned by Derry City Council to prepare the Further Assessment of air quality for the Dale's Corner AQMA, as required under the LAQM regime. The Further Assessment has been undertaken in accordance with the latest Defra Technical Guidance. The Further Assessment aims, through assessment of pollutant concentrations from monitoring data and modelled predictions:

- to confirm the original assessment of air quality in the Dale's Corner AQMA, against the prescribed AQS objectives;
- to refine knowledge of the sources of pollution so that air quality action plan measures can be properly targeted;
- to calculate more accurately how much of an improvement in air quality would be needed to meet the AQS objectives within the AQMA;

The information from the Further Assessment is required to assist the preparation of an Air Quality Action Plan (AQAP) for the AQMA in order that the measures may be targeted and focused, thereby prioritising the most cost-effective approach to reducing air pollutant concentrations.

Moreover, the impact of several potential mitigation measures likely to be included in the Derry AQAP has been assessed, based on comparison of predicted concentrations with the current air quality levels in the AQMA. Measures assessed included:

- The realignment of the A2 Limavady Road;
- A change in traffic lights sequence to allow more free-moving traffic; and
- Reduction of Heavy Goods Vehicles (HGVs).

The findings of this report are the following:

- Monitoring data from diffusion tube monitoring sites indicate that exceedences of the NO_2 annual mean AQS objective are still being measured within the AQMA;
- Updated modelled results confirm the exceedences of the NO_2 annual mean AQS objective within the AQMA, and indicate there is also a risk of exceeding the objective at a property outside the AQMA on Melrose Terrace. The extents of the AQMA may need to be revised based on the results of the modelling as provided in this assessment;
- The exposure assessment estimates that there are 24 residents likely to be exposed to exceedence of the NO_2 annual mean AQS objective at Dale's Corner;
- A maximum reduction of 41% (59µg/m^3) in NO_x concentration is required within the AQMA to comply with the NO_2 AQS objective, equivalent to a 28% (15µg/m^3) improvement in NO_2. This is the worst-case modelled location and all other modelled receptors require a lower reduction of NO_x / NO_2.
- Source apportionment of NO_X indicates that road traffic emissions account for 84% of the total NO_X concentrations at the worst-case receptor. Of these emissions, cars account for nearly 30% of the overall pollution levels, while HGVs and buses both contribute around 22%.
- The assessment of potential mitigation measures show that, although they would not lead to compliance with the objective if implemented separately, it is likely that their combined effect would result in significant reductions in NO_2 levels, which would be sufficient to meet the objective.

1 Introduction

1.1 Project Background

Environment (Northern Ireland) Order 2002 places a statutory duty on local authorities to review and assess air quality within their area and take account of Government Guidance when undertaking such work. This Further Assessment has been carried out to review air quality at Dale's Corner junction, following the declaration of an Air Quality Management Area (AQMA) in 2010, due to exceedences of the nitrogen dioxide (NO_2) annual mean Air Quality Strategy (AQS) objective.

This Further Assessment also includes the impact of several traffic measures that could be implemented at the junction to tackle air pollution, in order to support the Derry City Air Quality Action Plan (AQAP).

1.2 Legislative Background

The air quality objectives applicable to Local Air Quality Management (LAQM) in Northern Ireland are set out in the Air Quality Regulations (Northern Ireland) 2003, Statutory Rules of Northern Ireland 2003 (No. 342). The objectives are shown in Table 1. This table shows the objectives in units of micrograms per cubic metre ($\mu g/m^3$). For carbon monoxide, the units used are milligrammes per cubic metre (mg/m^3). Table 1 includes the number of permitted exceedences in any given year (where applicable).

Table 1 - Air Quality Strategy Objectives Included in the Regulations for LAQM in Northern Ireland

Pollutant	Objective		Date to be Achieved By
	Concentration	Measured As	
Benzene	16.25 $\mu g/m^3$	Running annual mean	31.12.2003
	3.25 $\mu g/m^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon Monoxide (CO)	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen Dioxide (NO_2)	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur Dioxide (SO_2)	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.3 Local Air Quality Management (LAQM) Review and Assessment

As established by the Environment Act 1995 Part IV, the Environment (Northern Ireland) Order 2002 Part III, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives set down by Government for a number of pollutants. The process of Review and Assessment of air quality undertaken by local authorities is set out under the Local Air Quality Management (LAQM) regime and involves a phased three yearly assessment of local air quality. Where the results of the Review and Assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high levels of pollution and exceedences of the AQS objectives.

The LAQM regime was first set down in the 1997 National Air Quality Strategy (NAQS)[1] and introduced the idea of local authority 'Review and Assessment'. The Government subsequently published policy and technical guidance related to the Review and Assessment processes in 1998. This guidance has since been reviewed and the latest documents include Policy Guidance (LAQM.PG (09))[2] and Technical Guidance (LAQM.TG (09))[3]. The guidance lays down a progressive, but continuous, framework for the local / district authorities to carry out their statutory duties to monitor, assess and review air quality in their area and produce action plans to meet the air quality objectives.

Defra and the Devolved Administrations released the latest Policy and Technical Guidance in February 2009, in anticipation of the fourth round of Review and Assessment and updated LAQM tools and emissions factors in 2010.

1.4 Summary of Review and Assessment in Derry City

Table 2 provides a summary of the previous reports completed by Derry City Council as part of the LAQM Review and Assessment process. An AQMA was declared in February 2005 at the Creggan Road / Infirmary Road junction in Derry. Two other AQMAs were declared in 2010 at Dale's Corner at the Buncrana Road / Racecourse Road junction. All AQMAs are due to the exceedence of the NO_2 annual mean AQS objective.

Table 2 - Summary of LAQM Review & Assessment Reports in Derry

Report	Summary
2004 Detailed Air Quality Modelling of Domestic Fuel Use and Road Traffic Emissions in Derry (Stage 3)	Exceedences of the annual mean NO_2 concentrations were modelled at the Creggan Road / Infirmary Road junction, and Derry City Council subsequently declared an AQMA in February 2005, and a draft Air Quality Action Plan was released in November 2006. The 2004 Detailed Assessment concluded that PM_{10} exceedences were not expected; however it was not possible to rule out potential exceedences of the SO_2 or PM_{10} objectives due to the resolution of the modelling undertaken.
2005 Progress Report	The 2005 Progress Report provided a review of the most recent monitoring data within the local authority. Automatic monitoring of SO_2 and PM_{10} at Brandywell indicated a large drop

1 DoE, 1997, 'The United Kingdom National Air Quality Strategy', The Stationary Office

2 Policy Guidance LAQM.PG(09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

3 Technical Guidance LAQM.TG (09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

Report	Summary
	in the number of 15-minute and daily mean exceedences, reflecting the decreased use of solid fuel in the area.
2006 Updating & Screening Assessment	The Updating & Screening Assessment identified 2 locations to consider for the Detailed Assessment of NO_2: Dale's Corner and the Buncrana Road / Racecourse Road Junction. It was concluded that no further assessment was required for carbon monoxide, benzene, 1,3-butadiene, lead or sulphur dioxide, however assessment was required for PM_{10} at a rural area near Claudy, and in the Culmore Point area.
2007 Detailed Assessment and Further Assessment	A Detailed Assessment was undertaken for Dale's Corner and Buncrana Road / Racecourse Road Junction following measured exceedence of the NO_2 annual mean objective. It was determined that a declaration of an AQMA at either location was not required at the time, as the modelling did not confirm exceedences of the air quality objectives at locations of relevant exposure. A Further Assessment was undertaken for the existing AQMA at Creggan Road / Infirmary Road, and it was concluded that there was a continuing need for the AQMA, though no extension was considered necessary.
2008 Progress Report	Review of updated NO_2 monitoring data for the Creggan Road / Infirmary Road junction confirmed the continuing need for the AQMA. Decreases were seen in concentrations of SO_2. The Progress Report proposed that a new detailed dispersion modelling be undertaken at the Dale's Corner junction due to exceedences of the NO_2 annual mean objective recorded at a new monitoring diffusion tube site at no.5 Glendermott Road
2008 Final Air Quality Action Plan	The final Air Quality Action Plan, released in September 2008, included detailed dispersion modelling to quantify the potential impact of a number of traffic measures, which may be implemented to reduce air pollution in the area of the Creggan Road / Infirmary Road junction. Proposals included the removal of HGVs on specific road links within the AQMA.
2008 Dale's Corner Detailed Assessment	The assessment confirmed that exceedences of the NO_2 annual mean AQS objective were likely at the façade of properties along Glendermott Road and Limavady Road close to the junction and it was recommended that an AQMA encompassing these properties be declared. The Council declared the Dale's Corner AQMA in 2010.
2009 Updating & Screening Assessment	The Updating & Screening Assessment reviewed and assessed new monitoring data and potential new sources of pollutants within the area. There were no new or significantly changed sources identified which may cause potential exceedences of the AQS objectives. However, the assessment highlighted that a new Detailed Assessment was required with regard to NO_2 at Buncrana Road / Racecourse Road junction based on updated monitoring data.
2010 Air Quality Progress Report and Buncrana Road Detailed Assessment	Based on updated 2009 monitoring data, the air quality Progress Report 2010 confirmed exceedences of the NO_2 annual mean objective at several monitoring sites within the Creggan Road / Infirmary Road and Dale's Corner AQMAs and at the junction of Buncrana Road and Racecourse Road. The Detailed Assessment of Buncrana Road confirmed that a third AQMA was required at the junction for NO_2. The Council declared an AQMA at the junction in 2010.

1.5 Scope and Methodology of the Further Assessment

The approach of the Further Assessment is to provide the Local Authority with an opportunity to supplement the information gathered in the previous LAQM reports and confirm whether the AQMA is still required or if its extent needs to be amended (increased or reduced).

The methodology is based on dispersion modelling and includes the following:

- Review of additional monitoring since the Detailed Assessment – including continuous monitoring and diffusion tubes,
- Assessment of the reduction in pollutant concentrations that is required to meet the AQS objectives in the AQMA,
- Source apportionment of pollutants; including relevance of background contributions and the different vehicle classification on the roads of concern.
- Estimation of the population exposed to exceedences of the AQS objectives in the AQMA.

Moreover, potential measures aimed at improving air quality within the Dale's Corner AQMA have been modelled, to quantify their impact on pollutant concentrations. The following scenarios were therefore included in the dispersion modelling:

- Realignment of the A2 Limavady Road 5m away from the nearest properties
- Traffic lights sequence change to permit more free-moving traffic on the A2 Limavady Road
- Reduction in Heavy Goods Vehicles (HGVs) – several scenarios considered

For each scenario, the impact on air quality was estimated by comparing the predicted NO_2 concentrations with the baseline scenario, based on detailed dispersion modelling using the Cambridge Environmental Research Consultants (CERC) ADMS-Roads (v2.3) atmospheric dispersion model. Results from nitrogen dioxide monitoring sites located in the assessment area were used to verify and adjust the modelled results. Concentrations of NO_x and NO_2 were predicted for the year 2009.

The dispersion modelling was undertaken in accordance with the methodologies provided in the Technical Guidance (LAQM.TG (09)) for detailed and further assessments and amended tools released in 2010.

2 Baseline Information

2.1 Traffic Data

The following roads at Dale's Corner Junction were included in the modelling:

- The A2 King Street,
- The A2 Limavady Road,
- The A6 Glendermott Road, and
- Clooney Terrace.

Derry City District Council provided updated manual and automatic traffic counts for 2009 for these roads. Data included the annual average daily traffic (AADT), speed data and breakdown of traffic flows into the following vehicle categories: cars, Light Goods Vehicles (LGVs), buses, and Heavy-Goods Vehicles (HGVs).

The average speed of vehicles was assumed to be the speed limit, although speed was reduced by half near junctions and along congested sections of the road to account for stop / start emissions.

Traffic data from the A6 Dungiven Road (in the continuity of Glendermott Road further east of the junction) and A2 Limavady Road were used to derive diurnal profiles of traffic flows for an average weekday, Saturday and Sunday, and were applied to the modelled roads. The average pattern from the A2 Limavady Road and the A6 Dungiven Road was used for King Street and Clooney Terrace. The diurnal patterns used are provided in Figure 1 and Figure 2 below. Modelled roads are shown on Figure A1 in Appendix 3. All traffic data used in the assessment are provided in the Appendix 1.

Figure 1 – Limavady Road Diurnal Traffic Pattern

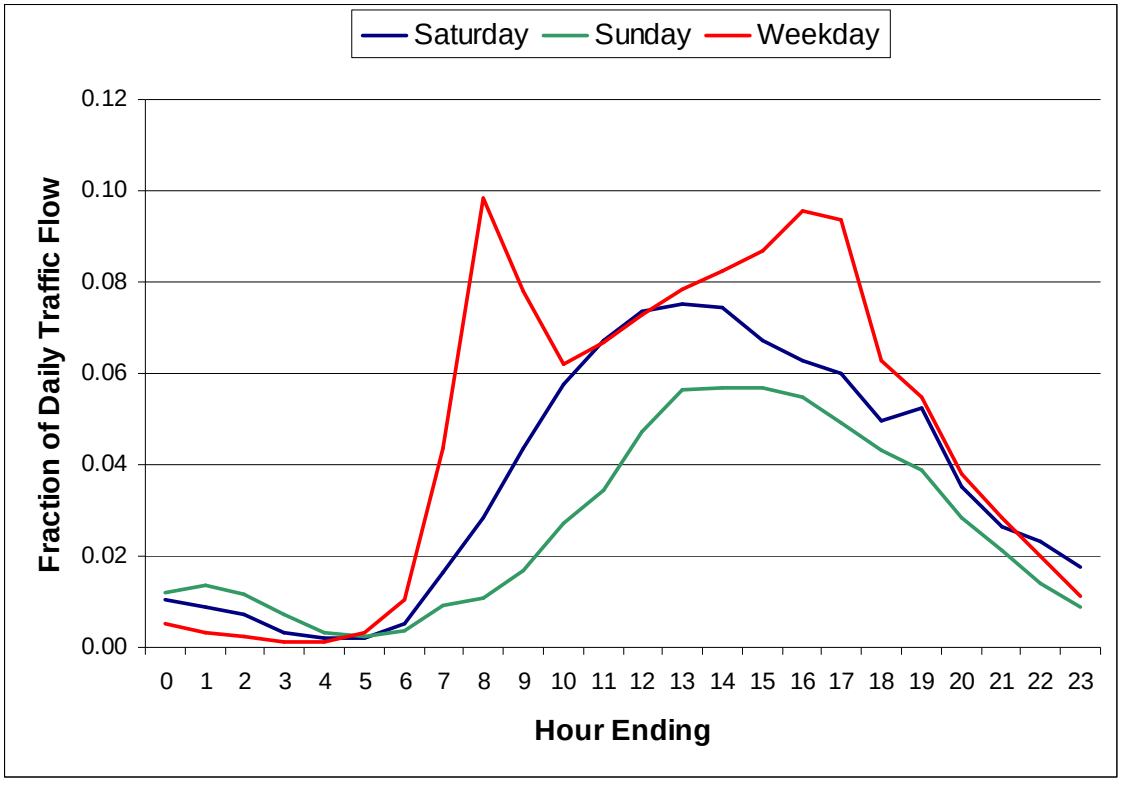
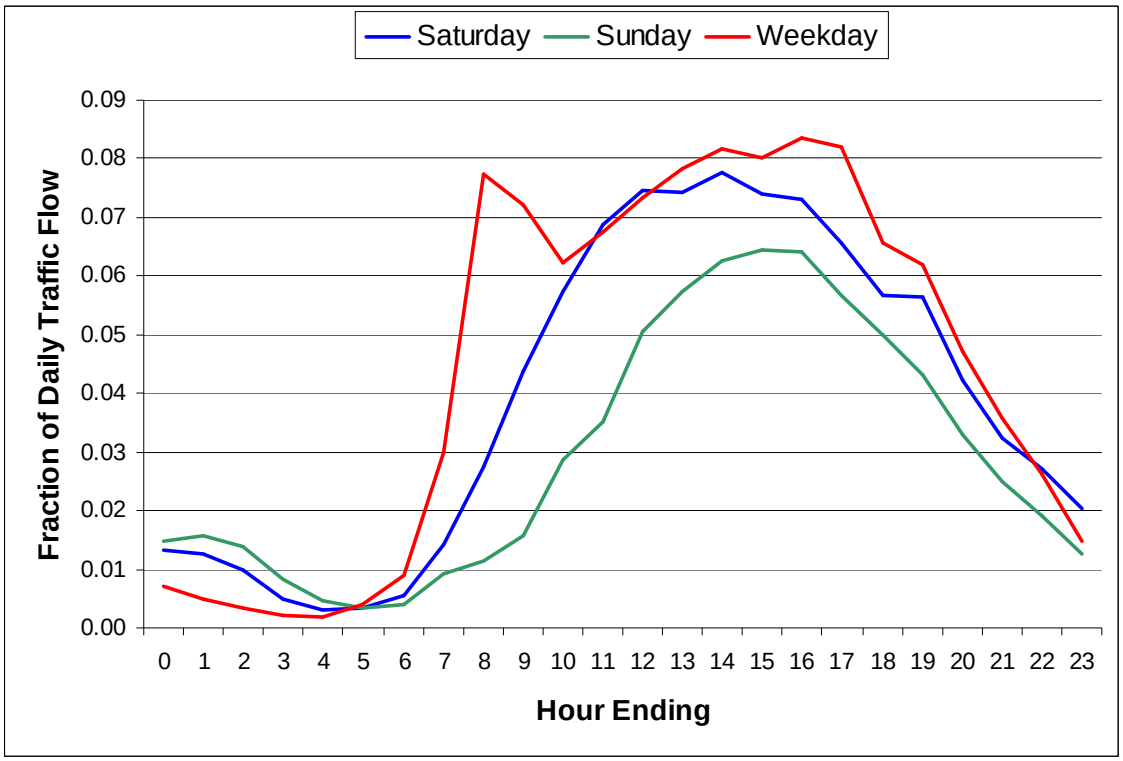


Figure 2 – Dungiven Road Diurnal Traffic Pattern



2.2 Air Quality Monitoring Data

2.2.1 Automatic Monitoring Data

There is a roadside automatic monitoring site installed at Dale's Corner, on the southwest corner of the junction.

Manual calibration of the automatic analyser is undertaken every two weeks by Derry City Council officers. The QA/QC procedures are then conducted by the National Physical Laboratory. The analyser is checked and serviced every six months by suppliers Air Monitors.

Details of the monitoring results between 2007 and 2009 are provided in Table 3. Results for year 2010 recently made available show an NO_2 annual mean of 45.7µg/m^3 , and 8 hourly means > 200µg/m^3. Although data capture for 2010 was lower than previous years (76%), it suggests that the annual mean AQS objective is still exceeded at the junction.

Table 3 – Dale's Corner Continuous Monitoring Results

Air Quality Monitoring Station	Site Type	Location (NI OS Grid Coordinates)	Distance to Kerb (m)	Relevant Exposure?	Year	NO_x Annual Mean ($\mu g/m^3$)	NO_2 Annual Mean ($\mu g/m^3$)	No. of NO_2 Hourly Means > 200$\mu g/m^3$	% Data Capture
Dale's Corner	Roadside	X 244178 Y 416760	2m	Yes (3m - Worst Case Exposure)	2007	83.0	38.5	0	88
					2008	88.7	**40.2**	0	97
					2009	83.0	39.0	0	97

In bold exceedence of the NO_2 annual mean AQS objective of 40 $\mu g/m^3$

2.2.2 Nitrogen Dioxide Diffusion Tube Data

The Council monitored NO_2 at 36 sites across the city in 2009, using passive NO_2 diffusion tubes, many of which are either duplicate or triplicate sites. Four of these sites are located near Dale's Corner, for which results between 2007 and 2009 are provided in Table 4.

Diffusion tubes are prepared and analysed by Gradko International Ltd using the 20% TEA in water method. Gradko International Ltd currently holds UKAS accreditation and participates in the Workplace Analysis Scheme for Proficiency (WASP) for NO_2 diffusion tube analysis and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO_2 concentrations reported are of a high calibre.

Diffusion tube results from year 2007 to 2009 have been taken from previous LAQM reports. The 2007 and 2008 bias adjustment factors were derived from the national bias factor adjustment spreadsheet, compiling numerous UK diffusion tube co-location surveys and available on the LAQM Support website[4]. The 2009 bias factor was derived from the results of triplicate diffusion tubes co-located with the Dale's Corner continuous monitoring station. Location of the monitoring sites is provided in Figure A1 in Appendix 3.

Sites D5 in Glendermott Road and E1/2 in Ebrington Terrace both exceeded the NO_2 annual mean AQS objectives over the past few years. Both sites are located within the AQMA. Other sites outside the AQMA south of the junction are well below the objective.

[4] http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

Table 4 – Dale's Corner NO_2 Diffusion Tube Results

Site ID	Name	Within AQMA	Location (NI OS Grid Coordinates)		Distance to Kerb (m)	Relevant Exposure?	Data Capture 2009 %	NO_2 Annual Average (µg/m^3 - Bias Adjusted)		
			X	Y				2007 (Bias Factor 0.88, National)	2008 (Bias Factor, 0.83 National)	2009 (Bias Factor, 0.93 Local)
D4	52 Clooney Terrace *	N	244210	416714	5m	Yes (0m - Worst Case Exposure)	67	25	27	29.8
D5	5 Glendermott Road	Y	244238	416753	1m		75	**44**	**53**	**47.8**
E1	4 Ebrington Terrace *	Y	244219	416794	4m		58	-	**47**	**53.4**
E2										
E4	17 Melrose Terrace *	N	244190	416754	3m		25	-	**-**	27.0

* Annualised as data capture <75%

In bold exceedence of the NO_2 annual mean AQS objective of 40 µg/m^3

2.2.3 Background Concentrations

Local monitoring data and LAQM.TG (09) updated background pollutant maps[5] were considered to determine appropriate NO_x and NO_2 background concentrations for this assessment. Table 5 shows the comparison of background concentrations from the Brooke Park AURN[6] continuous monitoring site and the nearest background maps 1km × 1km grid square. Brooke Park monitoring station is an urban background site located about 1km northwest of Dale's Corner. For this assessment, the background concentrations from this monitoring site have been used to be conservative and consistent with previous assessments. As shown in Table 6, annual mean concentrations have been in the same range over the past few years.

Table 5 - Background Concentrations

Source	Location (NI OS Grid Coordinates)	Pollutant	2009 Background (µg/m^3)
Brooke Park AURN Site	X 242962	NO_x	23.6
	Y 417217	NO_2	15.8
LAQM Background Maps	X 242500	NO_x	13.1
	Y 417500	NO_2	9.6

Table 6 - Monitoring Trend at Brooke Park AURN Station

Year	NO_x Annual Mean (µg/m^3)	NO_2 Annual Mean (µg/m^3)	Data Capture (%)
2004	22	15	92
2005	18	12	92
2006	19	12	88
2007	18	13	89
2008	28	18	96
2009	23.6	15.8	87

[5] Available at http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

[6] UK Automatic Urban and Rural Network

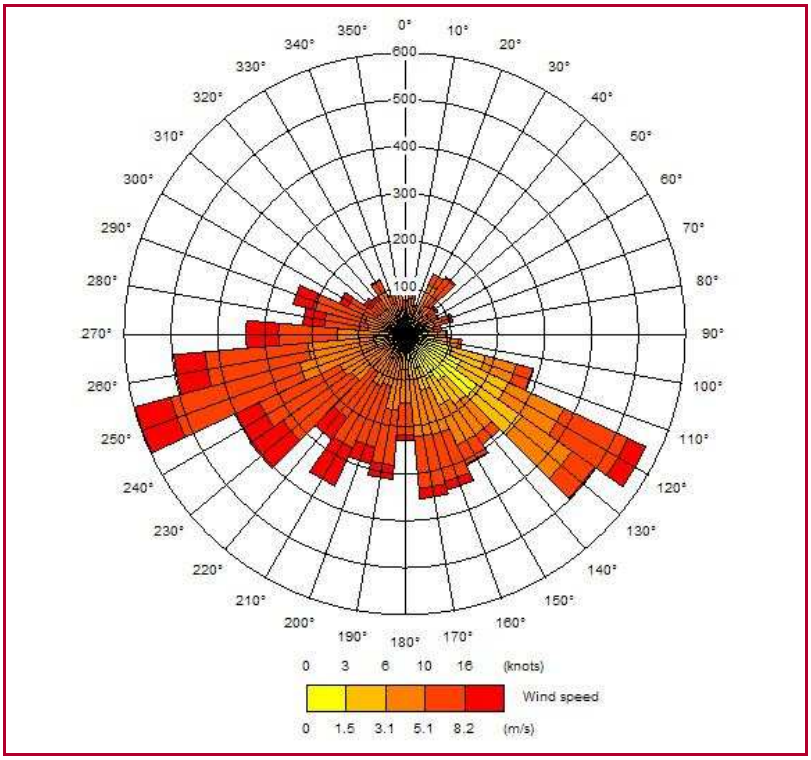
3 Dispersion Modelling Methodology

Detailed dispersion modelling of road-NO_x emissions was undertaken based on ADMS-Roads (version 2.3) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC). Conversion to NO_2 was based on the updated NO_X/NO_2 conversion model released by Defra in January 2010 as part of the updated LAQM.TG (09) tools[7].

ADMS-Roads is an advanced Gaussian dispersion model, which has been extensively used in local air quality management and has formed the basis for many AQMA declarations. A number of validation studies have been completed, showing overall good agreement between model outputs and observations at continuous monitoring sites.

Dispersal of pollutant emissions is dependent (amongst other factors like topography and street canyon effects) upon the prevailing meteorological conditions at the time of emissions release. Hourly sequential meteorological data for 2009 from the closest Met Office station (Ballykelly, 10 miles Northeast of Derry) has been used in this assessment. The wind rose derived from meteorological data is shown in Figure 3.

Figure 3 – Ballykelly 2009 Hourly Sequential Meteorological Data



[7] http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php

4 Results

4.1 Model Verification and Adjustment

Model verification was carried out prior to predicting concentrations within the assessment area at sensitive receptor locations. The objectives of the model verification are:

- to evaluate model performance;
- to show that the baseline is well established; and
- to provide confidence in the assessment.

Comparison of the modelled and monitored results was carried out based on local NO_2 monitoring data from diffusion tubes and the continuous analyser in the assessment area. Site E4 off Melrose Terrace was not used in the model verification, as, although results were annualised, only 3-month worth of data was available in 2009 and therefore results at the site are more uncertain. Predicted NO_2 was derived based on the latest NO_x/NO_2 conversion model released by Defra in January 2010[7].

During the verification process, Bureau Veritas aim to ascertain whether all final modelled NO_2 concentrations are within 25% of the monitored NO_2 concentrations. Modelled results may not compare as well at some locations for a number of reasons including:

- Errors in traffic flow and speed data estimates;
- Model setup (including street canyons, road widths, receptor locations);
- Model limitations (treatment of roughness and meteorological data);
- Uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors and annualisation of short-term data);
- Uncertainty in emission factors.

The above factors were investigated as part of the model verification process to minimise the uncertainties as far as practicable. The model verification results are provided in Table 7.

Predicted concentrations are in good agreement with monitoring data, with all modelled NO_2 results are within ±25% of monitored concentrations. The full verification methodology is shown in Appendix 2.

Table 7 – Model Verification Results at Monitoring Sites in the Assessment Area

Site	Within AQMA?	Modelled NO_2 2009 ($\mu g/m^3$)	Monitored NO_2 2009 ($\mu g/m^3$)	Difference (Modelled - Monitored) ($\mu g/m^3$)	Percentage Difference
Dales Corner CM Station	N	37.0	39.0	-2.0	-5.1%
D4	Y	29.6	29.8	-0.2	-0.5%
D5	Y	**53.8**	**47.8**	6.0	12.5%
E1/E2	N	**46.0**	**53.4**	-7.5	-14.0%
Summary					
Number of sites		Within ±10%		2	
		Between ± 10-25%		2	
		Exceeds ±25%		0	
		Total		**4**	

In bold: exceedence of NO_2 annual mean AQS objective of $40\mu g/m^3$

4.2 Modelled NO_2 Concentrations

Annual average NO_2 concentrations were predicted for 2009 at a number of specific receptors representing relevant public exposure, located at the facade of properties. Additionally, predictions were made to a 3m-grid spacing across the assessment areas to produce NO_2 concentration contour maps for year 2009. NO_2 concentrations were modelled at a height of 1.5m above ground, which represents the average respirable height of an adult.

The results at specific receptors are presented in Table 8 below. The location of the specific receptors is provided in Figure A1 in Appendix 3. NO_2 concentration contours for 2009 are illustrated in Appendix 4.

The model predicted exceedences of the AQS objective for annual NO_2 in 2009 at several receptors in the AQMA, along Glendermott Road (receptors 5 and 6) and Ebrington Terrace (receptor 9), with concentrations around 50µg/m^3.

The NO_2 annual mean is also predicted to exceed the AQS objective at receptor 1 in Melrose Terrace, which is currently outside the AQMA boundaries. Although the predicted concentration is only slightly above the AQS objective (41.1µg/m^3), this suggests that the AQMA may need to be extended to the property at the southwest corner of the junction along Melrose Terrace. This is confirmed by the NO_2 concentration contour of 40µg/m^3 illustrated in Figure A2 in Appendix 4.

Analysis of UK continuous NO_2 monitoring data has shown that it is unlikely that the hourly mean NO_2 objective, of 18 hourly means over 200µg/m^3, would be exceeded where the annual mean objective is below 60µg/m^3 [8]. The maximum predicted annual average for NO_2 at sensitive receptors is below 60µg/m^3; therefore, the NO_2 hourly mean AQS objective is expected to be met at all relevant locations near the junction.

Table 8 – Predicted NO_2 Concentrations at Specific Receptors

ID	Name	X	Y	Z	In AQMA?	Total Modelled NO_2 2009 µg/m^3
1	MelroseTerrace1	244190	416755	1.5	N	**41.1**
2	MelroseTerrace2	244181	416727	1.5	N	29.2
3	AlfredStreet1	244161	416756	1.5	N	30.6
4	AlfredStreet2	244102	416744	1.5	N	25.8
5	GlendermottRd1	244244	416749	1.5	Y	**55.6**
6	GlendermottRd2	244275	416725	1.5	Y	**53.3**
7	CarlinTerrace1	244421	416557	1.5	N	25.6
8	ColumbaTerrace1	244255	416888	1.5	Y	28.3
9	EbringtonTerrace1_4m *	244212	416772	4	Y	**49.7**
10	LimavadyRd1	244383	417078	1.5	N	23.6
11	ClooneyTerrace1	244210	416719	1.5	N	31.1
12	ClooneyTerrace2	244207	416661	1.5	N	25.3
13	ClooneyTerrace3	244207	416485	1.5	N	20.7
14	ClooneyTerrace4	244186	416600	1.5	N	26.4
15	ClooneyTerrace5	244183	416532	1.5	N	25.1
16	BondsHill1	244094	416506	1.5	N	27.1

* Receptor modelled at 4m height as ground level is not a residential property
In bold: exceedence of NO_2 annual mean AQS objective of 40µg/m^3

[8] Analysis of the relationship between annual mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective – AEA - 2008

4.3 Source Apportionment

The breakdown of vehicle classification was taken into account in the model set-up. This has allowed determining NO_x source apportionment at specific (worst case) receptors in the AQMA where exceedences were predicted. The source apportionment was carried out for the following vehicle classes:

- Cars;
- Light Goods Vehicles (LGVs);
- Buses; and
- Heavy Goods Vehicles (HGVs).

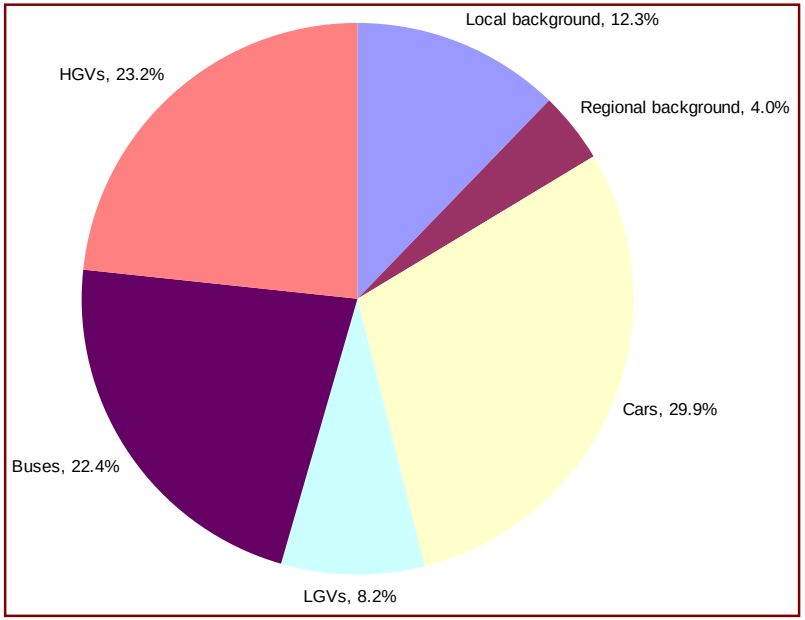
To enable source apportionment of the background contribution, the modelled maps from the air quality archive have been utilised, as these incorporate a break down of background concentrations of NO_x by source. Proportions of each background source category have been used to categorise the total background NO_x in the assessment area.

Table 9 summarises the results at (worst case) receptors representing public exposure in the exceedence area. The source apportionment indicates that, at the worst-case receptor:

- Road traffic emissions of NO_x account for 84% of the total NO_x concentration;
- Local background sources contribute to 12% of the total NO_x concentration, while regional background sources (outside the local authority's control) contribute to 4% of the total NO_x
- Of the overall road-traffic contribution, cars account for near 30% of the overall NO_x concentration, followed by buses and HGVs (about 22-23% each) and LGVs (8%)
- Combined contribution of HDVs (Heavy Duty Vehicles, based on both buses and HGVs) account for 45% of the total NO_x concentration.

Table 9 - Source Apportionment of NO_X Concentrations

Receptor (Maximum Modelled Concentration)	Receptor 5 (GlendermottRd1)
Total NO_x 2009 in µg/m^3 (Total Background + Local Road Source)	144.7
NO_x Total Background (Local + Regional) in µg/m^3	23.6
NO_x Local Background in µg/m^3	17.88
NO_x Regional Background in µg/m^3	5.72
Local Road Source Contributions in µg/m^3	121.1
▪ NO_x CAR	43.3
▪ NO_x LGV	11.8
▪ NO_x BUS	32.4
▪ NO_x HGV	33.6
% Local background	12.3%
% Regional background	4.0%
% Road traffic	83.7%
▪ % due to CAR traffic	29.9%
▪ % due to LGV traffic	8.2%
▪ % due to BUS traffic	22.4%
▪ % due to HGV traffic	23.2%
▪ % CAR contribution of total road traffic	35.8%
▪ % LGV contribution of total road traffic	9.8%
▪ % BUS contribution of total road traffic	26.8%
▪ % HGV contribution of total road traffic	27.8%



4.4 Required Reduction in NO_2 and NO_x to Comply with Objectives

A requirement of the Further Assessment is to determine the amount of NO_2 reduction required at the worst-case receptors within an AQMA. This approach highlights the maximum reduction in NO_2 required (as NO_x, in µg/m^3) to comply with the AQS objective, and assumes that other receptors will require less of a reduction. For the current assessment, the approach to estimate the required NO_2 reduction was to determine the levels of NO_x for the highest concentrations predicted at sensitive receptors relevant of public exposure.

The methodology to determine the required reduction in NO_x and NO_2 is described in LAQM.TG(09) Section 7.21[9]. For NO_x, it requires the calculation of "current" and "required" road-NO_x concentrations. The results are shown in Table 10.

The maximum predicted road-NO_x reduction required within Dale's Corner AQMA to comply with the NO_2 AQS objective is 59.3µg/m^3 in Glendermott Road (equivalent to a reduction of 49% in road-NO_x concentrations). This equates to a 15.6µg/m^3 reduction in NO_2 (equivalent to a reduction of 28% in total NO_2 concentrations). This is at the worst-case location, and therefore required reductions at all other receptors will be less.

Consequently, the formulation of the Action Plan should aim to reduce the levels of NO_x / NO_2 within the AQMA by this amount.

[9] An erratum in Box 7.2 of LAQM.TG(09) was corrected and is available at http://laqm.defra.gov.uk/supporting-guidance.html

Table 10 - Required NO_x and NO_2 Reduction

Receptor Name	Concentration (µg/m^3)				Required Reduction in Local Road-NO_x		Modelled NO_2 (µg/m^3)	NO_2 AQS Objective (µg/m^3)	Required Reduction in NO_2	
	Modelled Total NO_x	Background NO_x	Road NO_x-current	Road NO_x-required (equivalent to 40µg/m^3 NO_2)	µg/m^3	%			µg/m^3	%
GlendermottRd1	144.7	23.6	121.1	61.8	59.3	49%	55.6	40	15.6	28%
GlendermottRd2	134.8		111.2		49.3	44%	53.3		13.3	25%
EbringtonTerrace1_4m	119.9		96.3		34.5	36%	49.7		9.7	19%
MelroseTerrace1	89.0		65.4		3.6	5%	41.1		1.1	3%

4.5 Expected Date of Compliance with Objectives

As mentioned in Technical Guidance LAQM.TG(09), local authorities should provide an indication of the date by which the objectives are expected to be met. For this purpose, the guidance refers to a series of adjustment factors that can be used to project annual mean roadside nitrogen dioxide concentration to future years, up to 2020 (Box 2.1 page 2-4). These factors have been recently updated and are available on the LAQM Support website[10].

Using these factors in combination with the highest concentration (55.6µg/m^3) modelled at receptor 5 in Glendermott Road; concentrations would meet the NO_2 AQS objective in 2014, with an annual mean of 38.8µg/m^3.

However, analysis of recent NO_2 roadside monitoring data has shown that concentrations have not decreased as previously expected and that NO_2 urban levels have remained stable[11]. Therefore, this result should be taken with caution, as projected concentrations are likely to be underestimated.

4.6 Population Exposure

Technical Guidance LAQM.TG(09) requires local authorities to estimate the number of people exposed to pollutant concentrations above the relevant air quality objectives.

The Council provided population statistics from the Northern Ireland Neighbourhood Information Service (NINIS) website. This information was combined with the number of residential properties located in the area of exceedence, determined by means of a Geographical Information System (GIS).

Based on the NINIS data, an estimation of 2 residents per house is made for the Dale's Corner area (2008 estimate). As there are 12 residential properties in the AQMA, it is estimated that 24 people are exposed to exceedences of the NO_2 annual mean AQS objective in the Dale's Corner AQMA.

[10] http://laqm.defra.gov.uk/supporting-guidance.html - Errata to LAQM.TG(09) – "Is the example in Box 2.1 of TG(09) correct?"

[11] http://laqm.defra.gov.uk/faqs/faqs.html - Recent FAQs - "Measured NO_x / NO_2 not declining in line with national forecasts"

5 Mitigation Measures – Scenarios

Following declaration of the AQMA, the Council has elaborated several potential mitigation measures that could be implemented at the Dale's Corner junction to improve air quality. As part of this Further Assessment, three measures have been modelled to determine their likely impact on NO_2 annual mean concentrations. These are:

- The realignment of the A2 Limavady Road 5m away from the nearest properties;
- A change in traffic lights sequence to allow more free-moving traffic on the A2 Limavady Road; and
- Several scenarios of reduction in Heavy Goods Vehicles (HGVs) at the junction.

For each scenario, the impact on air quality was estimated by comparing the predicted NO_2 concentrations with the baseline scenario presented in Section 4.2.

5.1 Scenario 1 – Realignment of Limavady Road

Scenario 1 (S1) would involve moving the A2 Limavady Road further away from the properties located on the East side of the road. This would be possible as the land directly to the West of the A2 is about to be redeveloped – as currently occupied by Ebrington Barracks, an old military base.

As such, a realignment of the road 5m to the West has been modelled. This change would have no impact on Glendermott Road.

The proposed realignment is illustrated in Figure A3 in Appendix 5. Predicted concentration results and comparison with the baseline scenario are provided in Table 11.

Results show that the realignment of the road would lead to a reduction in concentrations at receptors 8, 9 and 10, all of which representing the façade of properties along the A2 Limavady Road. The highest reduction is predicted at receptor 9 off Ebrington Terrace. Although the NO_2 annual mean is still predicted to exceed the AQS objective at this location after the realignment (41.7µg/m^3), it would represent a drop of about 8µg/m^3 from the current level of 49.7µg/m^3, which represents a 16% reduction in NO_2 concentration.

The other roads would not be impacted by the realignment, and therefore concentrations at other receptors are predicted to remain the same.

Table 11 - Predicted NO_2 Concentrations – Scenario S1

Receptor ID	Receptor name	NO_2 Annual Mean – µg/m^3	Difference with Baseline (µg/m^3)	Difference with Baseline (%)
1	MelroseTerrace1	**41.3**	0.2	0.4%
2	MelroseTerrace2	29.2	0.0	0.1%
3	AlfredStreet1	30.7	0.1	0.2%
4	AlfredStreet2	25.9	0.1	0.2%
5	GlendermottRd1	**55.5**	-0.1	-0.1%
6	GlendermottRd2	**53.2**	-0.1	-0.1%
7	CarlinTerrace1	25.5	-0.0	-0.1%
8	ColumbaTerrace1	25.8	-2.4	-8.6%
9	EbringtonTerrace1_4m	**41.7**	-7.9	-15.9%
10	LimavadyRd1	21.8	-1.9	-7.9%
11	ClooneyTerrace1	31.1	-0.1	0.0%
12	ClooneyTerrace2	25.3	0.0	0.1%
13	ClooneyTerrace3	20.8	0.1	0.3%
14	ClooneyTerrace4	26.4	-0.1	-0.3%
15	ClooneyTerrace5	25.0	-0.1	-0.2%
16	BondsHill1	27.1	0.1	0.2%

In bold: exceedence of NO_2 annual mean AQS objective of 40µg/m^3

5.2 Scenario 2 – Traffic Lights Sequence Change

Scenario 2 (S2) would include a change in traffic lights sequence at the junction to try and ease vehicle flows in the AQMA, especially for vehicles moving southbound on the A2 Limavady Road and turning left to the A6 Glendermott Road.

This has been modelled by altering the average vehicle speed on the northbound and southbound road links on the Limavady Road, and the eastbound road link on Glendermott Road. In the baseline, average vehicle speed was considered 30kph for all links, excepted at the approach of the junction, where speed was reduced to 15kph to take into account the increase in exhaust emissions due to queuing traffic.

For Scenario S2, three different vehicle speeds have been considered for the road links mentioned above:

- Increase of +5kph, from 15kph to 20kph (Scenario S2A)
- Increase of +10kph, from 15kph to 25kph (Scenario S2B)
- Increase of +15kph, from 15kph to 30kph (Scenario S2C)

Predicted concentration results for these scenarios and comparison with the baseline scenario are provided in Table 12, Table 13 and Table 14 below.

Results show that:

- Overall, the implementation of this measure would result in a significant reduction in NO_2 concentrations at the façade of properties along Glendermott Road and Ebrington Terrace.
- The scale of the reduction would be from 2-3µg/m^3 (equivalent to a 5% reduction - Scenario S2A) up to 5-6µg/m^3 (10% reduction - Scenario S2C).
- This would not prevent exceedences at the worst-case receptors already identified along Glendermott Road (receptors 5 and 6) and Ebrington Terrace (receptor 9), although predicted reduction in Scenario S2C show that receptor 1 off Melrose Terrace would meet the objective following a decrease of about 1.5µg/m^3.

Table 12 - Predicted NO_2 Concentrations – Scenario S2A

Average Speed at Junction Approach = 20kph				
Receptor ID	**Receptor name**	**NO_2 Annual Mean – µg/m^3**	**Difference with Baseline (µg/m^3)**	**Difference with Baseline (%)**
1	MelroseTerrace1	**40.4**	-0.7	-1.7%
2	MelroseTerrace2	28.9	-0.3	-1.0%
3	AlfredStreet1	30.2	-0.4	-1.3%
4	AlfredStreet2	25.7	-0.1	-0.3%
5	GlendermottRd1	**52.8**	-2.8	-5.0%
6	GlendermottRd2	**51.0**	-2.2	-4.2%
7	CarlinTerrace1	25.5	0.0	-0.1%
8	ColumbaTerrace1	28.1	-0.2	-0.6%
9	EbringtonTerrace1_4m	**47.2**	-2.4	-4.9%
10	LimavadyRd1	23.6	-0.1	-0.3%
11	ClooneyTerrace1	30.7	-0.4	-1.3%
12	ClooneyTerrace2	25.2	-0.1	-0.3%
13	ClooneyTerrace3	20.8	0.0	0.2%
14	ClooneyTerrace4	26.4	-0.1	-0.3%
15	ClooneyTerrace5	25.0	-0.1	-0.2%
16	BondsHill1	27.1	0.0	0.1%

In bold: exceedence of NO_2 annual mean AQS objective of 40µg/m^3

Table 13 - Predicted NO_2 Concentrations – Scenario S2B

Average Speed at Junction Approach = 25kph				
Receptor ID	**Receptor name**	**NO_2 Annual Mean – µg/m^3**	**Difference with Baseline (µg/m^3)**	**Difference with Baseline (%)**
1	MelroseTerrace1	**40.0**	-1.1	-2.7%
2	MelroseTerrace2	28.8	-0.5	-1.6%
3	AlfredStreet1	30.0	-0.6	-2.1%
4	AlfredStreet2	25.7	-0.2	-0.6%
5	GlendermottRd1	**51.0**	-4.5	-8.2%
6	GlendermottRd2	**49.6**	-3.6	-6.8%
7	CarlinTerrace1	25.5	0.0	-0.2%
8	ColumbaTerrace1	28.0	-0.3	-0.9%
9	EbringtonTerrace1_4m	**45.7**	-4.0	-8.1%
10	LimavadyRd1	23.6	-0.1	-0.3%
11	ClooneyTerrace1	30.4	-0.6	-2.0%
12	ClooneyTerrace2	25.2	-0.1	-0.5%
13	ClooneyTerrace3	20.8	0.0	0.2%
14	ClooneyTerrace4	26.3	-0.1	-0.5%
15	ClooneyTerrace5	25.0	-0.1	-0.3%
16	BondsHill1	27.1	0.0	0.1%

In bold: exceedence of NO_2 annual mean AQS objective of 40µg/m^3

Table 14 - Predicted NO_2 Concentrations – Scenario S2C

Average Speed at Junction Approach = 30kph				
Receptor ID	**Receptor name**	**NO_2 Annual Mean – µg/m^3**	**Difference with Baseline (µg/m^3)**	**Difference with Baseline (%)**
1	MelroseTerrace1	39.7	-1.4	-3.4%
2	MelroseTerrace2	28.6	-0.6	-2.0%
3	AlfredStreet1	29.8	-0.8	-2.6%
4	AlfredStreet2	25.6	-0.2	-0.8%
5	GlendermottRd1	**49.8**	-5.7	-10.3%
6	GlendermottRd2	**48.7**	-4.6	-8.6%
7	CarlinTerrace1	25.5	0.0	-0.2%
8	ColumbaTerrace1	28.0	-0.3	-1.1%
9	EbringtonTerrace1_4m	**44.6**	-5.1	-10.2%
10	LimavadyRd1	23.6	-0.1	-0.3%
11	ClooneyTerrace1	30.3	-0.8	-2.5%
12	ClooneyTerrace2	25.1	-0.2	-0.7%
13	ClooneyTerrace3	20.8	0.0	0.1%
14	ClooneyTerrace4	26.3	-0.1	-0.5%
15	ClooneyTerrace5	25.0	-0.1	-0.3%
16	BondsHill1	27.1	0.0	0.1%

In bold: exceedence of NO_2 annual mean AQS objective of 40µg/m^3

5.3 Scenario 3 – Reduction in HGVs

Scenario 3 (S3) aim is to determine the likely impact of a reduction in Heavy-Goods Vehicles (HGVs) transiting through the junction on the air quality levels in the AQMA. Several hypothetical scenarios were modelled, considering the following:

- Reduction of 50% in HGVs (Scenario S3A)
- Reduction of 70% in HGVs (Scenario S3B)
- Reduction of 100% in HGVs (Scenario S3C)

The impact of lower reductions was also investigated, but the predicted benefit on air quality was not deemed significant and therefore they have not been reported.

Predicted concentration results for these scenarios and comparison with the baseline scenario are provided in Table 15, Table 16 and Table 17 below.

Results show that:

- Overall, predicted NO_2 concentrations show that no reduction of HGV alone could result in compliance with the AQS objectives at receptors currently exceeding along Glendermott Road and Ebrington Terrace. A reduction of 50% or more would however result in receptor 1 off Melrose Terrace to meet the objective.
- Consideration of a full ban on HGV (Scenario S3C - unlikely to be technically feasible) would result in a reduction in NO_2 levels by 7-8µg/m^3 at the façade of properties within the AQMA (up to 15% reduction at receptors 5, 6 and 9) and 2-4 µg/m^3 for properties along other roads.
- A more realistic 50% reduction in HGVs (Scenario S3A) would lead to typical reductions of about 3-4µg/m^3 at the façade of properties within the AQMA (up to 15% reduction at receptors 5, 6 and 9) and 1-2 µg/m^3 for properties along other roads.

Table 15 - Predicted NO_2 Concentrations – Scenario S3A

50% Reduction in HGVs				
Receptor ID	**Receptor name**	**NO_2 Annual Mean – µg/m^3**	**Difference with Baseline (µg/m^3)**	**Difference with Baseline (%)**
1	MelroseTerrace1	38.4	-2.7	-6.6%
2	MelroseTerrace2	27.7	-1.6	-5.3%
3	AlfredStreet1	28.7	-1.9	-6.3%
4	AlfredStreet2	24.4	-1.4	-5.4%
5	GlendermottRd1	**51.7**	-3.9	-7.0%
6	GlendermottRd2	**49.5**	-3.7	-7.0%
7	CarlinTerrace1	24.2	-1.3	-5.2%
8	ColumbaTerrace1	26.5	-1.8	-6.4%
9	EbringtonTerrace1_4m	**46.3**	-3.4	-6.8%
10	LimavadyRd1	22.4	-1.2	-5.1%
11	ClooneyTerrace1	29.4	-1.7	-5.5%
12	ClooneyTerrace2	24.2	-1.1	-4.3%
13	ClooneyTerrace3	20.2	-0.5	-2.6%
14	ClooneyTerrace4	25.3	-1.2	-4.5%
15	ClooneyTerrace5	24.0	-1.0	-4.1%
16	BondsHill1	25.4	-1.6	-6.0%

In bold: exceedence of NO_2 annual mean AQS objective of 40µg/m^3

Table 16 - Predicted NO_2 Concentrations – Scenario S3B

70% Reduction in HGVs				
Receptor ID	**Receptor name**	**NO_2 Annual Mean – µg/m^3**	**Difference with Baseline (µg/m^3)**	**Difference with Baseline (%)**
1	MelroseTerrace1	37.3	-3.8	-9.3%
2	MelroseTerrace2	27.0	-2.2	-7.5%
3	AlfredStreet1	27.9	-2.7	-8.8%
4	AlfredStreet2	23.8	-2.0	-7.7%
5	GlendermottRd1	**50.0**	-5.5	-10.0%
6	GlendermottRd2	**48.0**	-5.3	-9.9%
7	CarlinTerrace1	23.7	-1.9	-7.3%
8	ColumbaTerrace1	25.7	-2.5	-9.0%
9	EbringtonTerrace1_4m	**44.8**	-4.9	-9.8%
10	LimavadyRd1	22.0	-1.7	-7.1%
11	ClooneyTerrace1	28.7	-2.4	-7.7%
12	ClooneyTerrace2	23.8	-1.5	-6.0%
13	ClooneyTerrace3	20.0	-0.8	-3.7%
14	ClooneyTerrace4	24.8	-1.7	-6.2%
15	ClooneyTerrace5	23.6	-1.4	-5.7%
16	BondsHill1	24.8	-2.3	-8.5%

In bold: exceedence of NO_2 annual mean AQS objective of 40µg/m^3

Table 17 - Predicted NO_2 Concentrations – Scenario S3C

100% Reduction in HGVs				
Receptor ID	**Receptor name**	**NO_2 Annual Mean – µg/m^3**	**Difference with Baseline (µg/m^3)**	**Difference with Baseline (%)**
1	MelroseTerrace1	35.6	-5.6	-13.5%
2	MelroseTerrace2	26.1	-3.1	-10.7%
3	AlfredStreet1	26.8	-3.9	-12.6%
4	AlfredStreet2	23.0	-2.9	-11.1%
5	GlendermottRd1	**47.4**	-8.2	-14.7%
6	GlendermottRd2	**45.5**	-7.8	-14.6%
7	CarlinTerrace1	22.9	-2.6	-10.3%
8	ColumbaTerrace1	24.6	-3.6	-12.8%
9	EbringtonTerrace1_4m	**42.5**	-7.2	-14.5%
10	LimavadyRd1	21.2	-2.4	-10.2%
11	ClooneyTerrace1	27.7	-3.4	-11.0%
12	ClooneyTerrace2	23.1	-2.2	-8.7%
13	ClooneyTerrace3	19.6	-1.1	-5.4%
14	ClooneyTerrace4	24.1	-2.4	-8.9%
15	ClooneyTerrace5	23.0	-2.1	-8.2%
16	BondsHill1	23.7	-3.3	-12.3%

In bold: exceedence of NO_2 annual mean AQS objective of 40µg/m^3

5.4 Overall Impact

Results presented above show that each potential measure implemented separately would be unlikely to result in a reduction in NO_2 level significant enough to meet the annual mean AQS objective. This is due to the relatively high NO_2 concentrations measured and modelled at Dale's Corner (around 55µg/m^3 on Glendermott Road, and close to 50µg/m^3 on Ebrington Terrace.

However, it is likely that a combination of these measures would result in compliance with the objectives, as shown by the range of reduction in concentrations predicted for each scenario. It is therefore recommended to investigate further the feasibility of these measures with a view to include them in Derry's Air Quality Action Plan.

6 Conclusions and Recommendations

Environment (Northern Ireland) Order 2002 places a statutory duty on local authorities to review and assess the air quality within their area under the Local Air Quality Management (LAQM) regime, and take account of Government Guidance when undertaking such work.

An Air Quality Management Area (AQMA) for nitrogen dioxide (NO_2) was declared in Derry at Dale's Corner junction in 2010 following conclusions of a Detailed Assessment, which confirmed exceedences of the NO_2 annual mean Air Quality Strategy (AQS) objective at several locations representative of public exposure at the junction.

Bureau Veritas has been commissioned by Derry City Council to prepare the Further Assessment of air quality for the Dale's Corner AQMA, as required under the LAQM regime. The Further Assessment has been undertaken in accordance with the latest Defra Technical Guidance. The Further Assessment aims, through assessment of pollutant concentrations from monitoring data and modelled predictions:

- to confirm the original assessment of air quality in the Dale's Corner AQMA, against the prescribed AQS objectives;
- to refine knowledge of the sources of pollution so that air quality action plan measures can be properly targeted;
- to calculate more accurately how much of an improvement in air quality would be needed to meet the AQS objectives within the AQMA;

The information from the Further Assessment is required to assist the preparation of an Air Quality Action Plan (AQAP) for the AQMA in order that the measures may be targeted and focused, thereby prioritising the most cost-effective approach to reducing air pollutant concentrations.

Moreover, the impact of several potential mitigation measures likely to be included in the Derry AQAP has been assessed, based on comparison of predicted concentrations with the current air quality levels in the AQMA. Measures assessed included:

- The realignment of the A2 Limavady Road;
- A change in traffic lights sequence to allow more free-moving traffic; and
- Reduction of Heavy Goods Vehicles (HGVs).

The findings of this report are the following:

- Monitoring data from diffusion tube monitoring sites indicate that exceedences of the NO_2 annual mean AQS objective are still being measured within the AQMA;
- Updated modelled results confirm the exceedences of the NO_2 annual mean AQS objective within the AQMA, and indicate there is also a risk of exceeding the objective at a property outside the AQMA on Melrose Terrace. The extents of the AQMA may need to be revised based on the results of the modelling as provided in this assessment;
- The exposure assessment estimates that there are 24 residents likely to be exposed to exceedence of the NO_2 annual mean AQS objective at Dale's Corner;
- A maximum reduction of 41% (59µg/m^3) in NO_x concentration is required within the AQMA to comply with the NO_2 AQS objective, equivalent to a 28% (15µg/m^3) improvement in NO_2. This is the worst-case modelled location and all other modelled receptors require a lower reduction of NO_x / NO_2.
- Source apportionment of NO_X indicates that road traffic emissions account for 84% of the total NO_X concentrations at the worst-case receptor. Of these emissions, cars account for nearly 30% of the overall pollution levels, while HGVs and buses both contribute around 22%.
- The assessment of potential mitigation measures show that, although they would not lead to compliance with the objective if implemented separately, it is likely that their combined effect would result in significant reductions in NO_2 levels, which would be sufficient to meet the objective.

Appendix 1 – Traffic Data

Traffic data for the Further Assessment were derived using the manual counts and Automatic Traffic Count (ATC) data provided by the Council.

Table A1 – Derry Dale's Corner Traffic Data 2009

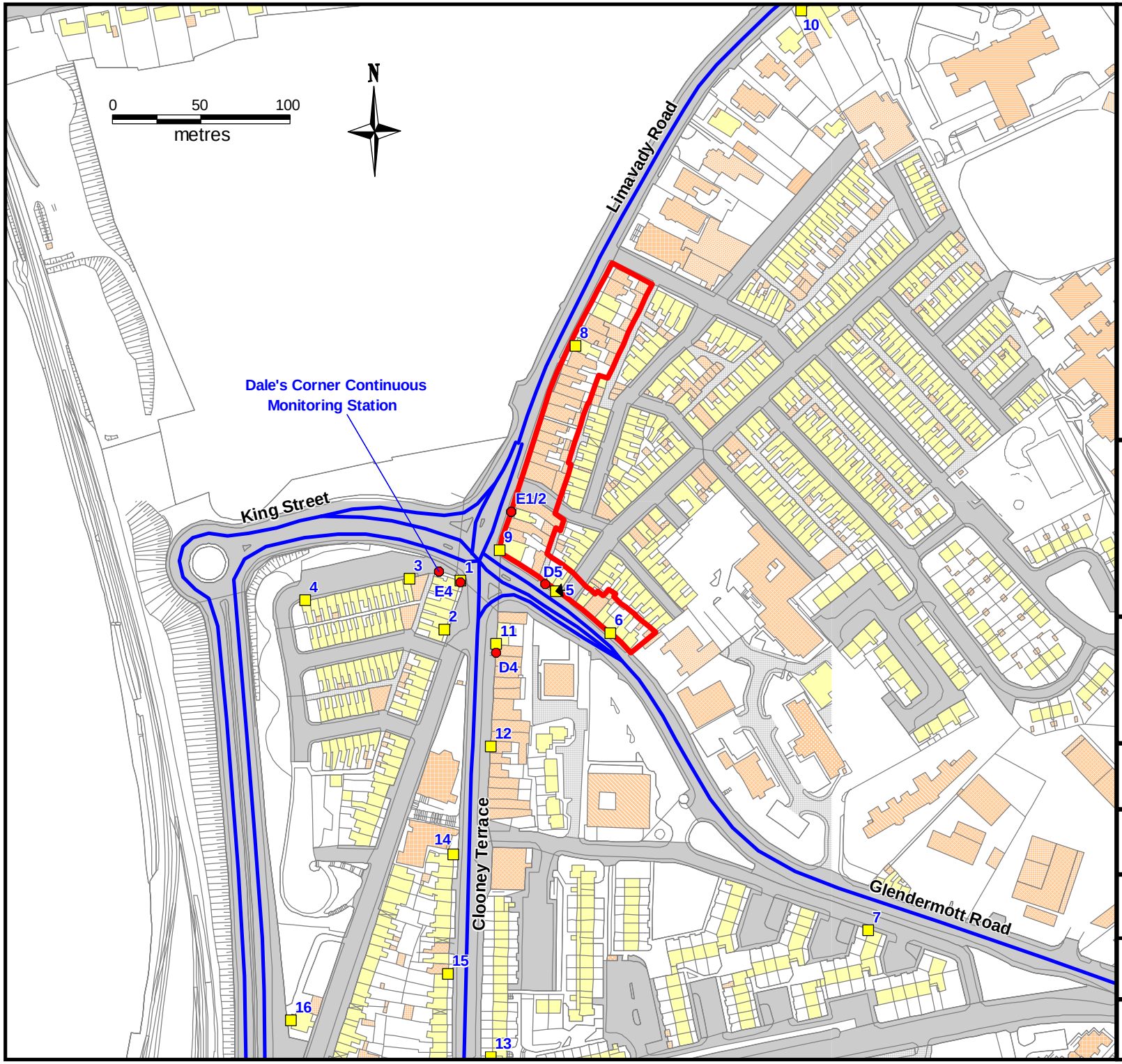
Road Link	AADT 2009	% Cars	%LGVs	%Buses	%HGVs
KingSt1_W	13588	86.3%	9.8%	1.0%	2.9%
KingSt2_W_J	13588	86.3%	9.8%	1.0%	2.9%
KingSt1_E	15839	87.6%	7.3%	1.8%	3.3%
KingSt2_E_J	10680	88.1%	7.3%	1.7%	3.0%
Glendermott2	26636	86.6%	8.6%	1.9%	2.9%
Glendermott1_E_J	16326	87.6%	7.8%	1.7%	2.9%
Glendermott1_W_J	9377	86.5%	9.7%	1.1%	2.7%
GlenderClooney_J	932	72.2%	10.9%	13.9%	3.0%
Clooney1_J	6907	82.4%	12.7%	2.8%	2.2%
Clooney2	6907	82.4%	12.7%	2.8%	2.2%
Clooney2_J	6262	83.4%	12.8%	1.6%	2.1%
Limavady2	13732	85.5%	10.2%	1.3%	3.0%
Limavady3	13732	85.5%	10.2%	1.3%	3.0%
Limavady1_S_J	7848	86.1%	10.4%	1.1%	2.4%
Limavady1_N_J	5884	84.8%	9.9%	1.5%	3.8%
Limavady0_N_J	1830	80.8%	15.4%	0.6%	3.1%
KingStLimavady_J	4055	86.6%	7.4%	1.9%	4.1%

Appendix 2 – Model Verification

Table A2 – NO_2 Model Verification - Details

Site	Background NO_2 ($\mu g/m^3$)	Background NO_x ($\mu g/m^3$)	Monitored Road Contribution NO_x ($\mu g/m^3$)	Modelled Road Contribution NO_x ($\mu g/m^3$)	Ratio of Monitored Road NO_x / Modelled Road NO_x	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO_x ($\mu g/m^3$)	Modelled Total NO_2 ($\mu g/m^3$)	Monitored Total NO_2 ($\mu g/m^3$)	% Difference NO_2 [(Modelled - Monitored)/ Monitored]
Dales Corner CM Station	15.8	23.6	58.7	17.4	3.38	3.029	52.6	37.0	39.0	-5.1%
D4			32.3	10.5	3.07		31.9	29.6	29.8	-0.5%
D5			89.3	37.5	2.38		113.6	53.8	47.8	12.5%
E1/E2			111.7	27.2	4.12		82.2	46.0	53.4	-14.0%

Appendix 3 – Modelled Area



Legend

- Air Quality Management Area
- Modelled Road
- Modelled Sensitive Receptor
- Monitoring Site

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Telephone: 0207 902 6100
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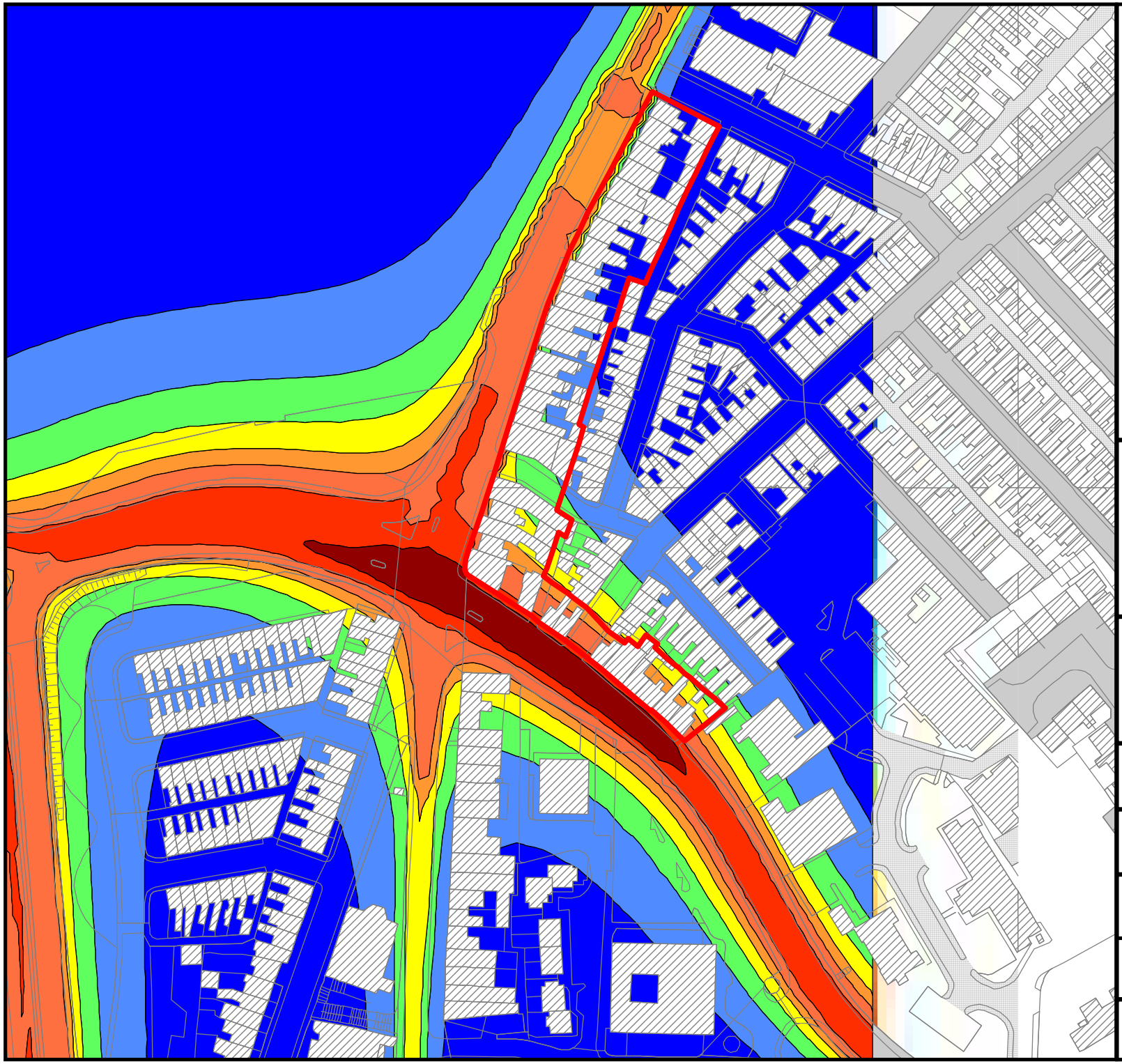
Location	**Derry - Dale's Corner**
Title	**Dale's Corner Modelled Area**

By	Checked	Approved
EC	**EC**	**LL**

Scale	Date
N.T.S.	**April 2011**

Job No.	Fig. No.
AGGX3995788	**Figure A1**

Appendix 4 – Modelled Contour Results



NO2 Annual Average Concentrations 2009 - ug/m3

- 18 to 24
- 24 to 28
- 28 to 32
- 32 to 36
- 36 to 40
- 40 to 50
- 50 to 60
- > 60

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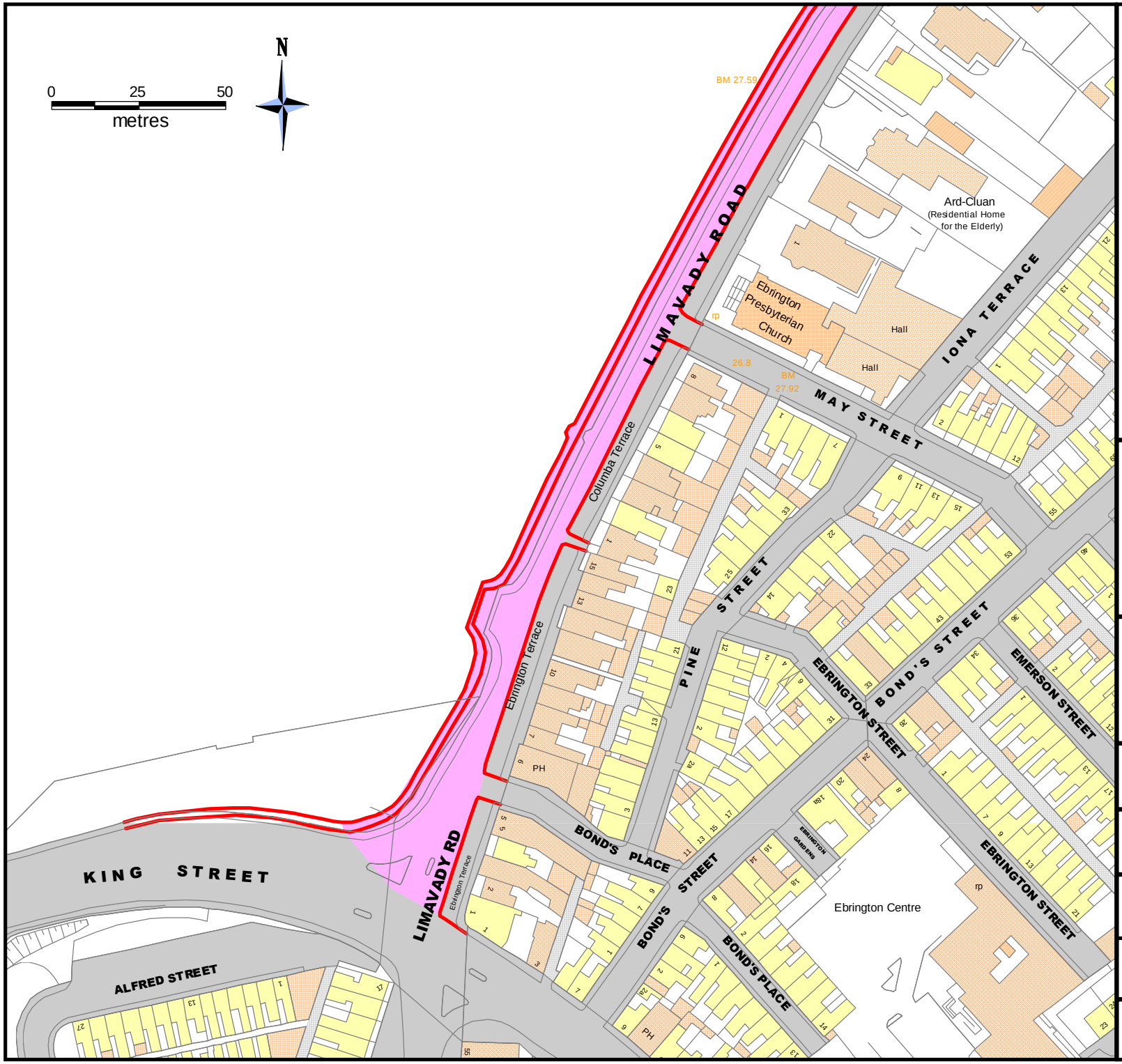
Location	**Derry - Dale's Corner**	
Title	**NO2 Concentration Contours**	
By **EC**	Checked **EC**	Approved **LL**
Scale **N.T.S.**	Date **April 2011**	
Job No. **AGGX3995788**	Fig. No. **Figure A2**	

Appendix 5 – Proposed Realignment of Limavady Road (A2)



Legend

Proposed Realignment

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Location **Derry - Dale's Corner**

Title **Proposed Realignment of Limavady Road (A2)**

By	Checked	Approved
EC	EC	LL

Scale	Date
N.T.S.	April 2011

Job No.	Fig. No.
AGGX3995788	Figure A3