DERRY CITY COUNCIL

LOCAL AIR QUALITY MANAGEMENT – DALE'S CORNER JUNCTION DETAILED ASSESSMENT

REPORT 1400079/EC/2582

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Executive Summary

As part of the Local Air Quality Management (LAQM) regime a Detailed Assessment of air quality at Dale's Corner Junction, Derry, was carried out following monitored exceedences of the NO_2 annual mean objective in 2007.

The Detailed Assessment was based on advanced atmospheric dispersion modelling of NO_x traffic emissions using ADMS-Roads. The assessment includes consideration to the latest background pollutant, monitoring and traffic data.

The findings of this report are the following:

- Updated monitoring results for year 2008 confirmed that exceedences of the NO_2 annual mean AQS objective were likely near properties along Glendermott Road and Limavady Road, close to the junction.
- The dispersion modelling results show good agreement with monitoring data, and confirm the exceedences monitored at diffusion tube sites at Dale's Corner junction. Therefore, an Air Quality Management Area (AQMA) should be declared at Dale's Corner for the NO_2 annual mean.
- Mapping of pollutant concentration has determined the geographic extent of exceedence, which includes properties on Glendermott Road close to the junction, and on Limavady Road along Ebrington Terrace and Columba Terrace, up to the junction with May Street. Consequently, an AQMA should encompass these properties.
- Both monitored and modelled results show that properties along Clooney Terrace are below the NO_2 AQS objective and therefore may not be included in the AQMA. However, it may be justified to include those properties on Clooney Terrace close to the junction to be conservative and account for uncertainties in both monitoring data and modelling results.

1 Introduction

1.1 Description of Local Authority Area

Bureau Veritas was commissioned by Derry City Council to undertake the air quality Detailed Assessment of Dale's Corner junction in Derry, in the waterside district of the city, following identified exceedences of the nitrogen dioxide (NO_2) annual mean Air Quality Strategy (AQS) objective at monitoring sites installed at the junction. The assessment is required by the Department of Environment in Northern Ireland (DoE(NI)) as part of the Local Air Quality Management (LAQM) system, introduced under the Environment (NI) Order 2002.

Part III of the Environment (NI) Order 2002 places a statutory duty on Local Authorities in Northern Ireland to periodically review and assess the air quality within their area. The Detailed Assessment is a requirement of the Second Round of Review and Assessment for Local Authorities that have identified areas where there is a risk of exceedence of an AQS objective.

1.2 Air Quality Strategy Objectives

The significance of existing and future pollutant levels are assessed in relation to the national air quality standards and objectives, established by Government. The revised Air Quality Strategy (AQS)[1] for the UK (released in July 2007) provides the over-arching strategic framework for air quality in the UK and contains national air quality standards and objectives established by the UK Government and devolved administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from the Limit Values prescribed in the EU Directives transposed into national legislation by member states.

The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The Directive 2008/50/EC[2] introduces new obligatory standards for $PM_{2.5}$ for Government but places no statutory duty on local Government to work towards achievement.

The Air Quality Standards Regulations (Northern Ireland) 2007[3] came into force on 28th May 2007 in order to align and bring together in one statutory instrument the Governments obligations to fulfil the requirements of the CAFE Directive.

The objectives for ten pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide particulates - PM_{10} and $PM_{2.5}$, ozone and PAHs - Polycyclic Aromatic Hydrocarbons) have been prescribed within the Air Quality Strategy[1] based on the Air Quality Regulations (NI) 2003[4]

This assessment focuses on those pollutants included in the Air Quality Regulations for the purpose of Local Air Quality Management, in respect of pollutant sources affecting air quality within the Council's administrative area. The objectives set out in the AQS for these pollutants are presented in Table 1.

The UK Government and the Devolved Administrations have also set new national air quality objectives for $PM_{2.5}$. These objectives have not been incorporated into LAQM Regulations, and authorities have no statutory obligation to review and assess air quality against them.

The locations where the AQS objectives apply are defined in the AQS as locations outside buildings or other natural or man-made structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed [to pollutant concentrations] over

[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007), Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

[2] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

[3] Statutory Rule 2007 No. 265

[4] Statutory Rule 2003 No. 342

the relevant averaging period of the AQS objective. Typically these include residential properties and schools/care homes for longer period (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives.

Table 1 - AQS Objectives and Standards

Pollutant	Objective	Concentration measured as	Date to be achieved by and maintained thereafter
Benzene All authorities	16.25 µg/m^3	running annual mean	31.12.2003
Authorities in England and Wales only	5.00 µg/m^3	annual mean	31.12.2010
Authorities in Scotland and Northern Ireland only	3.25 µg/m^3	running annual mean	31.12.2010
1,3 Butadiene All authorities	2.25 µg/m^3	running annual mean	31.12.2003
Carbon monoxide Authorities in England, Wales and Northern Ireland only	10.0 µg/m^3	maximum daily running 8-hour mean	31.12.2003
Authorities in Scotland only	10.0 µg/m^3	running 8-hour mean	31.12.2003
Lead All authorities	0.5 µg/m^3	annual mean	31.12.2004
	0.25 µg/m^3	annual mean	31.12.2008
Nitrogen dioxide [a] All authorities	200 µg/m^3, not to be exceeded more than 18 times a year	hourly mean	31.12.2005
	40 µg/m^3	annual mean	31.12.2005
Particles (PM_{10}) (gravimetric) [b] All authorities	50 µg/m^3, not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 µg/m^3	annual mean	31.12.2004
Authorities in Scotland only [c]	50 µg/m^3 not to be exceeded more than 7 times a year	24 hour mean	31.12.2010
	18 µg/m^3	annual mean	31.12.2010
Sulphur dioxide All authorities	350 µg/m^3 not to be exceeded more than 24 times a year	1 hour mean	31.12.2004
	125 µg/m^3 not to be exceeded more than 3 times a year	24 hour mean	31.12.2004
	266 µg/m^3 not to be exceeded more than 35 times a year	15 minute mean	31.12.2005

a- EU Limit values in respect of nitrogen dioxide to be achieved by 1st January 2010. There are, in addition, separate EU limit values for carbon monoxide, sulphur dioxide, lead and PM_{10}, to be achieved by 2005, and benzene by 2010.

b- Measured using the European gravimetric transfer sampler or equivalent.

c- These 2010 air quality objectives for PM_{10} apply in Scotland only, as set out in the Air Quality (Scotland) Amendment Regulations 2002.

1.3 LAQM Review and Assessment Summary

1.3.1 The First Round of Review and Assessment

Between 2001 and 2004, Derry CC undertook its 3 Stages of the First Round of Review and Assessment of air quality, which assessed the sources of seven air pollutants of concern to health: carbon monoxide, benzene, 1,3 butadiene, lead, nitrogen dioxide, sulphur dioxide and fine particulates (PM_{10}).

Stages 1, 2 and 3 were completed in August 2001, February 2004 and November 2004 respectively. The conclusions were that the NO_2 annual mean AQS objective was likely to be exceeded at the Creggan Road/Infirmary Road junction in Derry city centre; therefore, an AQMA was required at this junction for NO_2. The AQMA was declared in February 2005, and Derry CC produced an Action Plan (draft) in November 2006. In parallel, Derry CC produced its air quality Progress report in June 2005, which provided a review on all air quality issues in Derry.

1.3.2 The Second Round of Review and Assessment

The Second Round of Review and Assessment began with an Updating and Screening Assessment (USA), in 2006. Derry CC completed this stage in September 2006. The report concluded that NO_2 concentrations were likely to breach the annual mean AQS objective at two new locations outside the existing AQMA: in Dale's Corner and at the Buncrana Road/Racecourse Road junction. Therefore, a Detailed Assessment was required at these junctions. Moreover, the report suggested that the AQMA in Creggan Road/Infirmary Road might need to be extended. Therefore, it was recommended to carry out a Further Assessment in parallel to determine the need for an extension of the AQMA.

Both Detailed and Further Assessments were prepared in a joint report published in August 2007[5]. Conclusions were that there was no need to extend the AQMA on Creggan Road/Infirmary Road, while no new AQMA was required at Buncrana Road/Racecourse Road or Dale's Corner junctions. However, the modelling showed potentially high levels of NO_2 in Dale's Corner approaching the AQS objective (annual mean) and therefore the Council installed a new diffusion tube monitoring site in Ebrington Terrace.

Derry CC submitted an air quality Progress Report in October 2008, which included updated monitoring results for year 2007 and provisional results for 2008. The report confirmed that the AQMA at the Creggan Road/Infirmary Road junction should remain, as NO_2 levels were still exceeding the AQS objective. It also provided further evidence that NO_2 concentrations at monitoring sites in Dale's Corner Junction were higher than in previous years, and that the annual mean NO_2 objective was breached at a diffusion tube site on Glendermott Road. Provisional data for 2008 at the new diffusion tube installed in Ebrington Terrace also showed potential exceedence at this location. Therefore, it was recommended to carry out a new Detailed Assessment in Dale's Corner in the light of these updated monitoring results.

1.4 Scope and Methodology of the Detailed Assessment

The approach to the Detailed Assessment is to provide the local authority with an opportunity to supplement the information they have gathered in their earlier review and assessment work and more accurately assess the impact of pollution sources on local receptors at identified hotspots through dispersion modelling. The aim of the dispersion modelling is to reflect the results from local monitoring sites across the whole assessment area and allow comparison of pollutant concentrations against the AQS objectives.

The Detailed Assessment will identify with reasonable certainty whether or not there is likely to be an exceedence of the AQS objectives and if so, define the extent and magnitude of the exceedence.

[5] Derry City Council - Local Air Quality Management - Detailed Assessment and Further Assessment Technical Report No: BV/AQ/AGGX0813/EC/2486 - August 2007

2 Baseline Information

2.1 Traffic Data

The following roads at Dale's Corner Junction were included in the modelling (see Figure 2):

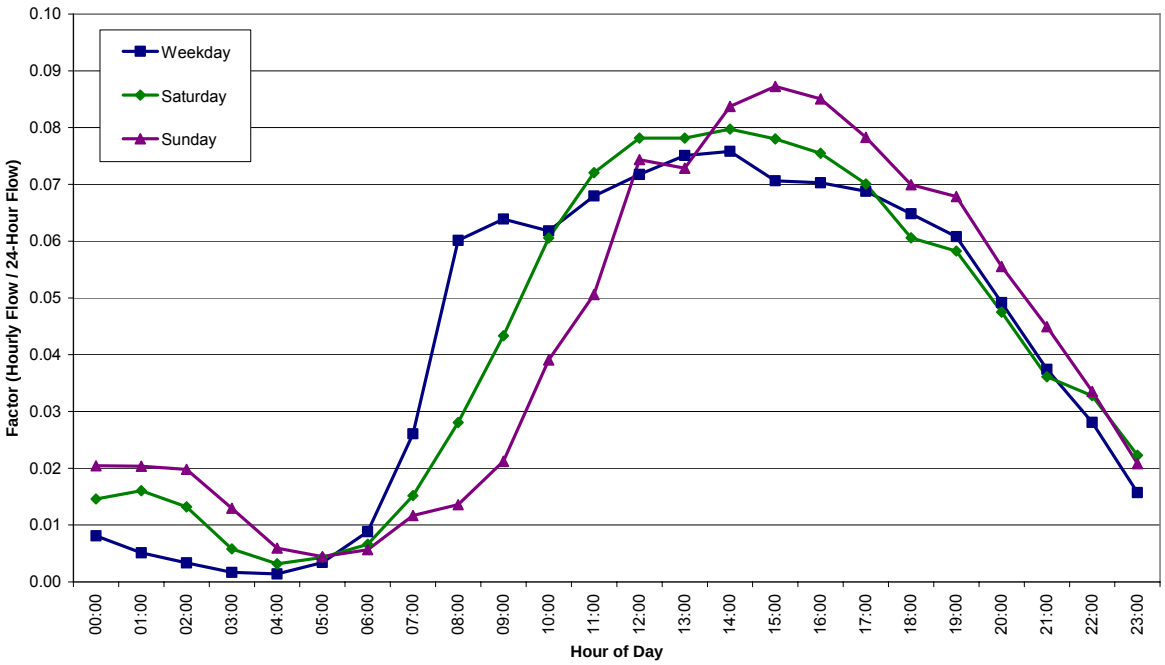
- King Street,
- Limavady Road,
- Glendermott Road, and
- Clooney Terrace.

Updated traffic data for these roads were used in the model, based on a manual turning count carried out by Derry CC in January 2009. The data, covering am and pm peak and off-peak hours for a typical week, were converted to Annual Average Daily Traffic (AADT), using 24-hour automatic traffic count (ATC) data available on Glendermott Road.

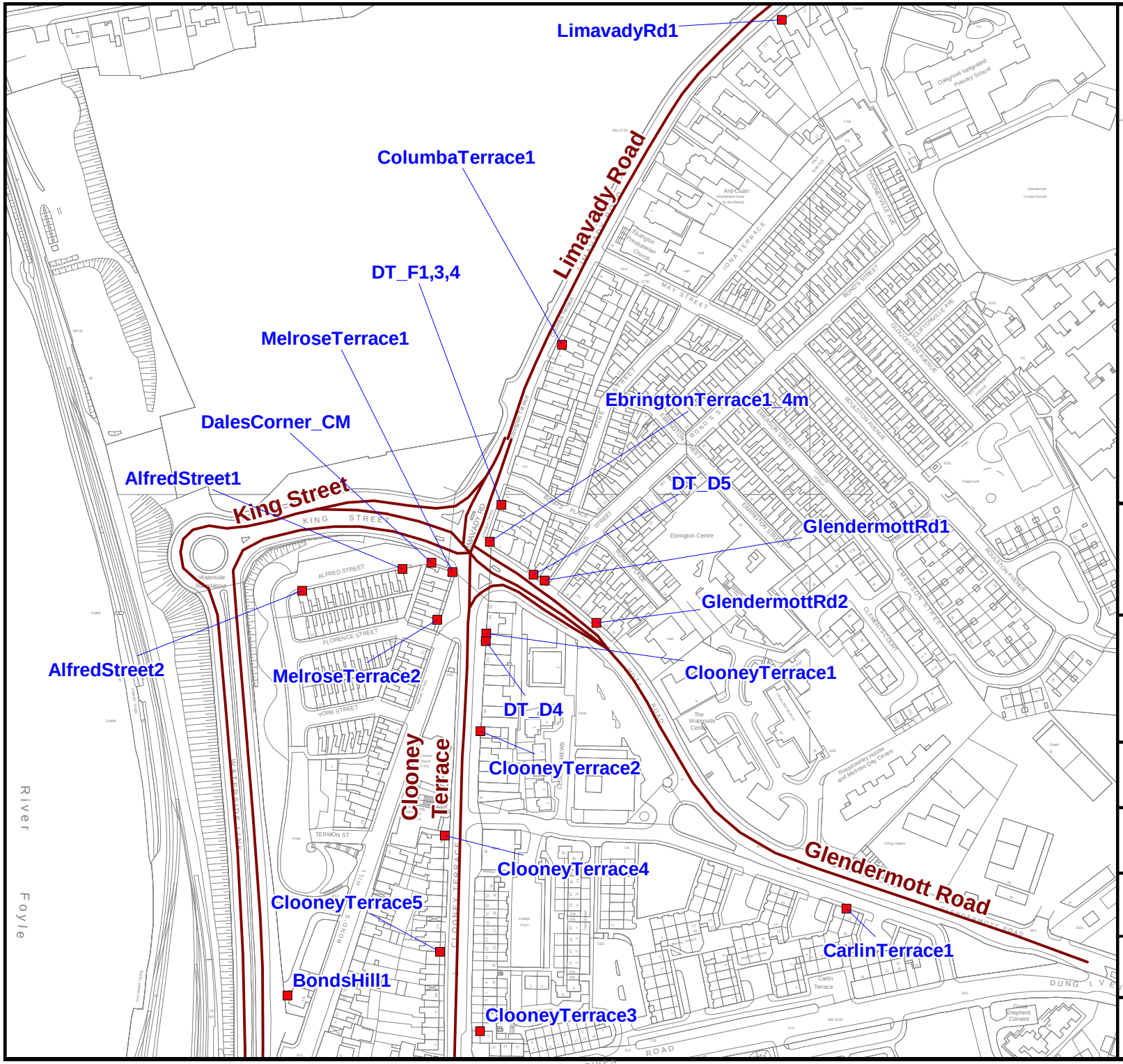
The turning count was deemed representative of 2008 traffic conditions. AADT were projected to 2010 based on a local traffic growth estimate provided by the DRD Roads Service.

Proportions of Light Duty Vehicles (cars and vans) and Heavy-Duty Vehicles (buses and heavy-goods vehicles) on the roads mentioned above were taken into account in the modelling assessment. As in the previous Detailed Assessment 2007[6], vehicle speeds were based on speed limits, and decreased at the approach of the junction to account for traffic congestion and queuing. Traffic data from the 24-hour ATC in Glendermott Road were used to derive diurnal profiles of traffic flows for weekday, Saturday and Sunday, which have been applied to all modelled roads. The diurnal pattern is provided in Figure 1 below. Modelled roads are shown on Figure 2. All traffic data used in the assessment are provided in the Appendix 1.

Figure 1 - Diurnal Pattern of Traffic near Dale's Corner (Glendermott Road)



[6] Derry City Council - Local Air Quality Management - Detailed Assessment and Further Assessment - Technical Report No: BV/AQ/AGGX0813/EC/2486 - August 2007



Legend

- Modelled Specific Receptor
- Modelled Road

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Location	**Derry - Dale's Corner Junction**
Title	**Modelled Roads and Specific Receptors**

By	Checked	Approved
EC	**AG**	**AG**

Scale	Date
N.T.S.	**April 2009**

Job No.	Fig. No.
1400079	**Figure 2**

2.2 Air Quality Monitoring Data

2.2.1 Continuous Monitoring

A NO_x/NO_2 continuous monitoring analyser is located at Dale's Corner about 10m further back from King Street. Monitoring results at the site for the past years is provided in Table 2 below. Data capture over the past three years has improved significantly and was 97% in 2008. NO_2 annual mean over the last three years was below but very close to the AQS objective of 40µg/m^3.

Table 2 – Dale's Corner NO_2 Continuous Monitoring Results 2006 –2008

Location (NI OS Grid coordinates)	Year	NO_x Annual Mean (µg/m^3)	NO_2 Annual Mean (µg/m^3)	No. of NO_2 Hourly Means > 200µg/m^3	% Data Capture
X=244178, Y=416760	2006	76.0	37.0	1	67
	2007	83.0	39.0	0	88
	2008	88.7	39.8	0	97

2.2.2 NO_2 Diffusion Tubes

There are four sites at Dale's Corner monitoring NO_2 based on passive diffusion tube method. Triplicate tubes are co-located with the continuous analyser in order to assess the accuracy and precision of diffusion tube measurements against a more accurate method. The other sites are also near the junction on Glendermott Road, Clooney Terrace, and Limavady Road (Ebrington Terrace), where triplicate tubes were installed in January 2008.

The diffusion tubes are supplied and analysed by Bureau Veritas Laboratories and, in 2008, were prepared based on the 10% TEA[7] in water method[8]. Bureau Veritas Laboratories 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 and in compliance with the necessary quality assurance and control procedures.

A bias adjustment factor has been applied to the data, which is an estimate of the difference between diffusion tube concentrations and continuous monitoring. Both local bias adjustment factor (derived from triplicate diffusion tubes co-located with the Dale's Corner continuous monitoring station) and national bias adjustment factor (provided by the Air Quality Review and Assessment Helpdesk[9]) for year 2008 have been considered. The national bias adjustment factor of 0.83 (for this supplier and preparation method) was used in this assessment. Further details in relation to the choice of the bias factor are provided in Appendix 2.

All 2008 results for year 2008 are provided in

[7] TEA-Triethanolamine

[8] This has changed to 20% TEA in water starting January 2009

[9] www.uwe.ac.uk/aqm/review/

Table 3. Results from 2006 and 2007 are also provided for comparison.

Data capture for 2008 was good at all sites, being between 11 and 12 month worth of data. 2008 results confirm that site D5 on Glendermott Road exceeds the annual mean AQS objective, with a concentration of 52.8µg/m^3. This is slightly higher than the 2007 results (49.8µg/m^3). An exceedence is also measured at triplicates F1, F3, and F4 on Ebrington Terrace (47.0µg/m^3).

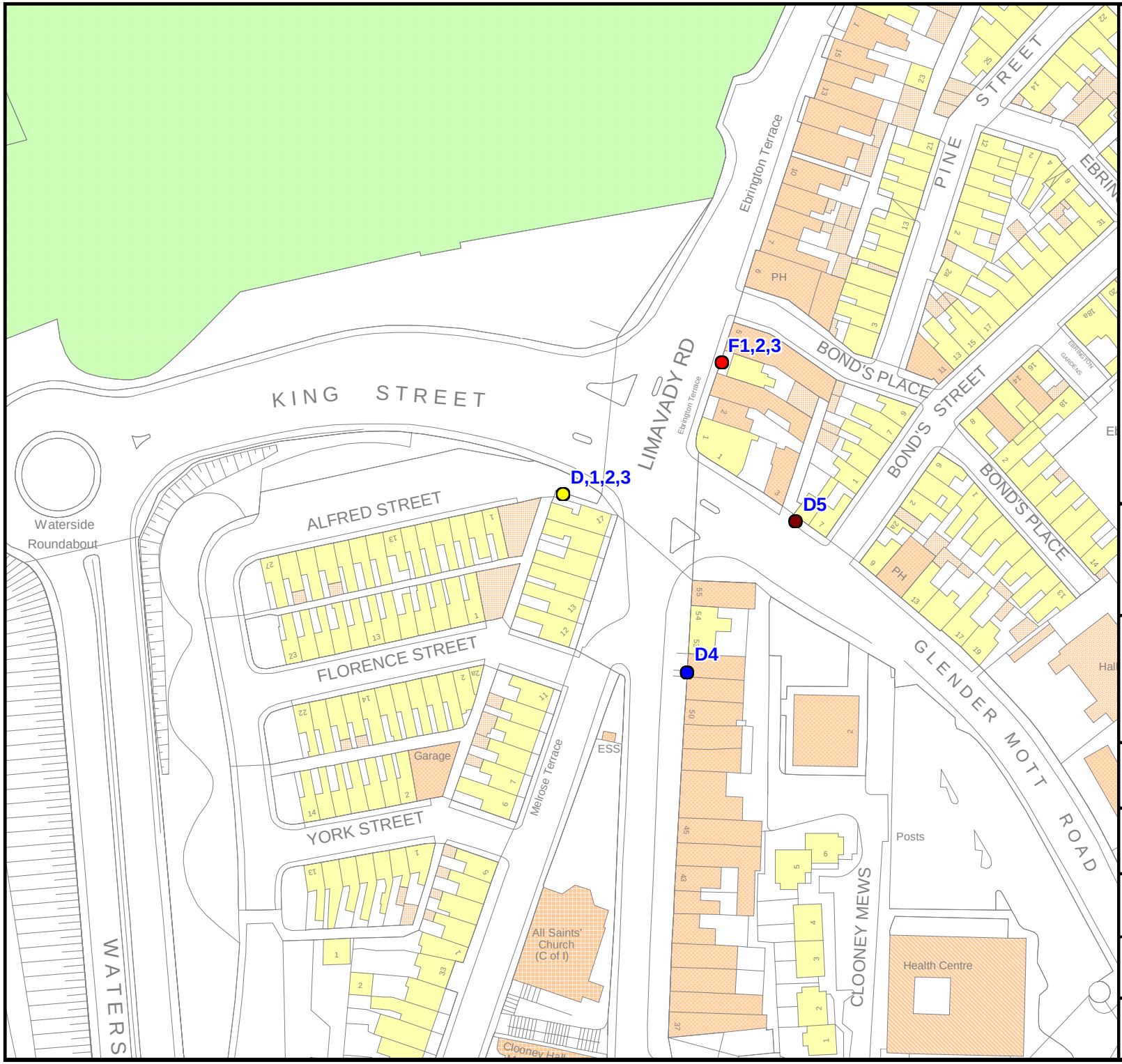
Concentrations in 2010 were estimated based on the roadside NO_2 projection factors provided in the new Technical Guidance LAQM.TG(09)[10] and using the 2008 results (corrected with the national bias adjustment factor) as the projection basis. Projected results show that NO_2 annual means are still likely to exceed the AQS objective by this date at Dale's Corner.

[10] LAQM.TG(09) – Box 2.1 – Projecting measured annual mean roadside nitrogen dioxide concentrations to future years

Table 3 – Results of NO_2 Diffusion Tubes at Dale's Corner Junction

ID	Name	X	Y	NO_2 Annual Average (µg/m^3 - Bias Adjusted)			Data Capture 2008 (Months)	2008 NO_2 Projected to 2010 (µg/m^3)
				2006	2007	2008 (Bias Factor 0.83)		
D1	Dale's Corner Monitor	244178	416760	28.8	34.3	32.7	12	30.1
D2	Dale's Corner Monitor	244178	416760	26.8	29.9	32.9	12	30.3
D3	Dale's Corner Monitor	244178	416760	30.3	30.2	33.1	12	30.5
Average D1,2,3	Triplicate Average	244178	416760	28.6	31.5	32.9	12	30.3
D4	52 Clooney Terrace	244210	416714	21.4	25.4	24.8	12	22.9
D5	5 Glendermott Road	244238	416753	34.2	**49.8**	**52.8**	12	**48.7**
F1	4 Ebrington Terrace	244219	416794	Not Installed		**46.0**	12	**42.4**
F3	4 Ebrington Terrace	244219	416794			**48.4**	12	**44.6**
F4	4 Ebrington Terrace	244219	416794			**46.1**	11	**42.5**
Average F1,3,4	Triplicate Average	244219	416794			**47.0**	11	**43.3**

In bold, exceedence of the NO_2 annual mean Air Quality Strategy objective (40µg/m^3)



NO2 Diffusion Tubes 2008

Annual Mean - ug/m3

- > 50
- 40 to 50
- 36 to 40
- 32 to 36
- 28 to 32
- < 28

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Title **NO2 Diffusion Tube Results 2008**

By	Checked	Approved
EC	**AG**	**AG**

Scale	Date
N.T.S.	**April 2009**

Job No.	Fig. No.
1400079	**Figure 3**

2.2.3 Background Concentrations

Local monitoring from Derry Brooke Park AURN monitoring station and updated Defra background maps released with the Technical Guidance LAQM.TG(09)[11] have been considered to determine appropriate background for this assessment. Brooke Park air quality monitoring station, located about 1km West of Dale's Corner, is classified as an Urban Background site and has been used in the previous Detailed and Further Assessments 2007 to determine NO_x and NO_2 background concentrations. Monitoring results over the past years at Brooke Park are provided in Table 4, and show that the NO_2 annual mean in 2008 was 18µg/m^3, which is slightly higher than previous years. Data capture has been consistently close or above 90% over the past few years.

Table 4 – Monitoring Results 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

In comparison, background NO_2 at Dale's Corner estimated from the background maps is 10.4µg/m^3 for 2008[12]. To be consistent with previous LAQM work, background concentrations have been derived from Brooke Park AURN Station, which is conservative. Projected background concentrations to year 2010 were determined using the ratio between 2008 and 2010 background values from the background maps, following the methodology described in LAQM.TG(09)[13]. Background data used in this assessment are summarised in Table 5 below.

Table 5 - Background Concentrations for Derry Dale's Corner Junction

Pollutant	2008 Background (µg/m^3)	2010 background (µg/m^3)
NO_x	28.0	25.1
NO_2	18.0	16.4

[11] Estimated Background Air Pollution Data - www.airquality.co.uk/archive/laqm/tools.php?tool=background06

[12] Concentration from the 1km × 1km grid cell encompassing Dale's Corner - OS NI coordinates (X,Y)=(244500,416500)

[13] LAQM.TG(09) – Section 2.10 – Future Year Projections

3 Dispersion Modelling Methodology

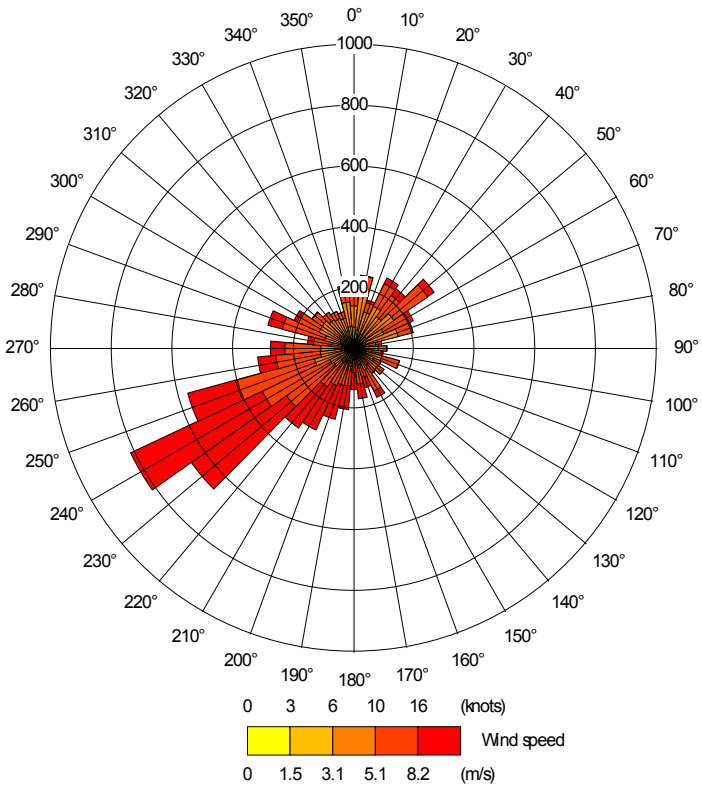
Pollutant concentrations have been predicted for the baseline year, assumed 2008, and future year 2010 for NO_2, in line with the relevant UK Air Quality Objectives and EU Air Quality Limit Values. The dispersion modelling has been undertaken in accordance with the guiding principles methodology provided in the new Technical Guidance (LAQM.TG(09)).

Detailed dispersion modelling of NO_x has been undertaken using the Cambridge Environmental Research Consultants (CERC) ADMS-Roads (version 2.2) advanced Gaussian air dispersion model. ADMS-Roads is used extensively 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.

NO_2 monitoring data from both diffusion tubes and the continuous analyser at near Dale's Corner junction have been used to verify and adjust the modelled results. Predicted NO_2 concentrations have been derived from modelled NO_x results, based on the new NO_x to NO_2 converter released with Technical Guidance LAQM.TG(09) and available on the Air Quality Archive website[14].

Hourly sequential meteorological data for 2007[15] from the closest Met Office station (Ballykelly, 10 miles North East of Derry) has been used in this assessment. The wind rose derived from meteorological data is shown in Figure 4.

Figure 4 - Ballykelly 2007 Hourly Sequential Meteorological Data



Traffic flow diurnal patterns described in Section 2.1 were applied to all modelled roads. The emission factors database for LDVs and HDVs built-in ADMS-Roads was used to calculate the NO_x emission rates, based on vehicle speeds and traffic flows provided.

[14] www.airquality.co.uk/archive/laqm/tools.php

[15] As 2008 data were not available at the time

4 Results

4.1 Model Verification and adjustment

Model verification at specific locations was carried out prior to predicting concentrations within the whole domain. 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 modelled and monitored results was carried out based on local NO_2 monitoring data from Dale's Corner continuous monitoring analyser, as well as diffusion tubes D4, D5 and triplicates installed at Ebrington Terrace (F1,F3,F4). The details of the model verification are provided in Appendix 3.

During the verification process, Bureau Veritas aim to show that 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).

The above factors were all investigated as part of the model verification process to minimise the uncertainties as much as practicable.

The model verification results are provided in Table 6. Predicted road NO_x concentrations were adjusted by a factor of 2.48. Overall, resulting predicted NO_2 concentrations are in good agreement with monitoring data, with 3 sites out of 4 being within 10%. Predicted NO_2 results at site D5 in Glendermott Road and F1,3,4 at Ebrington Terrace are especially consistent with the monitoring results, showing less than 1% difference between modelled and monitored concentrations. The model over predicts by just over 25% at site D4 in Clooney Terrace. However, both modelled and monitored results at this site are well below the annual mean AQS objective.

Table 6 - Model verification results at monitoring sites near Dale's Corner junction

ID	Monitored NO_2 2008 (µg/m^3)	Predicted Total NO_2 2008 (µg/m^3)	Difference predicted / monitored NO_2 2008 (µg/m^3)	Difference predicted / monitored NO_2 2008 (%)
CM Dales Corner	39.8	36.1	-3.7	-9.3%
D4	24.8	31.2	6.3	25.5%
D5	**52.8**	**52.8**	0.0	0.0%
F1,3,4	**47.0**	**47.2**	0.2	0.4%
Summary				
Number of sites	Within ±10%		3	
	Between ± 10-25%		0	
	Exceeds ±25%		1	
	Total		4	

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

4.2 Modelled NO_2 Concentrations

Annual average NO_2 concentrations were predicted for the baseline year 2008 and future year 2010 at a number of specific receptors representing locations relevant of public exposure, located at the facade of properties. The specific receptors are shown in Figure 2. Additionally, predictions were made on a 4m-grid spacing across the assessment area to produce an NO_2 concentration contour map for year 2008. All results were predicted at 1.5m from the ground, except stated otherwise. Table 7 summarises predicted NO_2 results at specific receptor locations and diffusion tubes (if representative of public exposure). NO_2 concentration contours are also illustrated in Figure 5.

The dispersion modelling results confirm that the NO_2 annual mean AQS objective is likely to be exceeded in Dale's Corner at facades of properties along Glendermott Road (as evidenced by results of the diffusion tube D5 but also confirmed with receptors GlendermottRd1 and GlendermottRd2, where NO_2 is predicted to be above 50µg/m^3). Figure 5 also shows that exceedences are likely on Limavady Road (properties along Ebrington Terrace and Columba Terrace).

All receptors along Clooney Terrace are unlikely to exceed the AQS objective, as predicted concentrations at façades of properties are in the range of 25µg/m^3 to 30µg/m^3 in this area. Properties in Alfred Street (facing King Street) are also unlikely to be of concern, with NO_2 predicted to be in the range of 28µg/m^3 to 33µg/m^3 in this area.

Predicted results for year 2010 show an average decrease of about 3µg/m^3 to 4µg/m^3 at most receptors. They show that the AQS objective is still predicted to be exceeded by this date on Glendermott Road and Ebrington Terrace.

Based on these results, it is therefore recommended to declare an AQMA in Dale's Corner. The extent of the area of exceedence and the location of properties in the vicinity of the junction suggest that the AQMA could encompass properties on Glendermott Road up to number 19 past Bond's Street (as there are no other adjacent properties further East and concentrations are likely to drop further back from the junction) and on Limavady Road, including properties on Ebrington Terrace and Columba Terrace up to the junction with May Street. Modelled results suggest that properties along Clooney Terrace would not need to be included in the AQMA, although it may be conservative to include properties within the 36µg/m^3 contour (i.e. properties below but within 10% of the AQS objective of 40µg/m^3) to account for uncertainties linked to the diffusion tube monitoring (bias factor) and the modelling.

Table 7 - Predicted NO_2 annual mean concentrations – Specific receptors

Receptor ID	X(m)	Y(m)	Z(m)	NO_2 2008 ($\mu g/m^3$)	NO_2 2010 ($\mu g/m^3$)
Diffusion Tube D4	244210	416714	2.0	31.2	28.4
Diffusion Tube D5	244238	416753	2.0	**52.8**	**49.3**
Diffusion Tube F1,3,4	244219	416794	1.5	**47.2**	**43.8**
MelroseTerrace1	244190	416755	1.5	37.9	34.8
MelroseTerrace2	244181	416727	1.5	28.4	25.8
AlfredStreet1	244161	416756	1.5	31.5	28.8
AlfredStreet2	244102	416744	1.5	29.1	26.6
GlendermottRd1	244244	416749	1.5	**54.4**	**50.8**
GlendermottRd2	244275	416725	1.5	**52.6**	**49.0**
CarlinTerrace1	244421	416557	1.5	27.0	24.6
ColumbaTerrace1	244255	416888	1.5	37.2	34.2
EbringtonTerrace1_4m	244212	416772	4.0 (1)	**45.7**	**42.3**
LimavadyRd1	244383	417078	1.5	31.7	29.0
ClooneyTerrace1	244210	416719	1.5	32.2	29.4
ClooneyTerrace2	244207	416661	1.5	28.8	26.3
ClooneyTerrace3	244207	416485	1.5	25.0	22.8
ClooneyTerrace4	244186	416600	1.5	26.5	24.2
ClooneyTerrace5	244183	416532	1.5	25.7	23.4
BondsHill1	244094	416506	1.5	33.4	30.6

In bold, exceedence of the NO_2 annual mean AQS objective ($40\mu g/m^3$)
(1) Receptor set at 4m as ground floor occupied by business but first floor is a flat

NO2 Concentration Contours
Annual Mean 2008 - ug/m3

- < 24
- 24 to 28
- 28 to 32
- 32 to 36
- 36 to 40
- 40 to 45
- 45 to 50
- > 50

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Location	**Derry - Dale's Corner Junction**
Title	**NO2 Concentration Contours - 2008**

By	Checked	Approved
EC	**AG**	**AG**

Scale	Date
N.T.S.	**April 2009**

Job No.	Fig. No.
1400079	**Figure 5**

5 Conclusions

As part of the Local Air Quality Management (LAQM) regime a Detailed Assessment of air quality at Dale's Corner Junction, Derry, was carried out following monitored exceedences of the NO_2 annual mean objective in 2007.

The Detailed Assessment is required as part of the Second round of Review and Assessment for local authorities that have identified potential exceedences of the AQS objectives.

The Detailed Assessment was based on advanced atmospheric dispersion modelling of NO_x traffic emissions using ADMS-Roads and with consideration to updated background pollutant concentrations, monitoring and traffic data for year 2008. The assessment followed the recommendations and methodology for Detailed Assessments described in the new Technical Guidance LAQM.TG(09) released by Defra in February 2009.

The findings of this report are the following:

- Updated monitoring results for year 2008 confirmed that exceedences of the NO_2 annual mean AQS objective were likely near properties along Glendermott Road and Limavady Road, close to the junction.
- The dispersion modelling results are consistent with monitoring data, and confirm that an Air Quality Management Area (AQMA) should be declared at Dale's Corner for the NO_2 annual mean.
- Concentration contours allowed determining the extent of the area of exceedence, which includes properties on Glendermott Road close to the junction, and on Limavady Road along Ebrington Terrace and Columba Terrace, up to the junction with May Street. Consequently, an AQMA should encompass those properties.
- Both monitored and modelled results show that properties along Clooney Terrace are below the NO_2 AQS objective and therefore may not be included in the AQMA. However, it may be justified to include those properties on Clooney Terrace close to the junction to be conservative and account for uncertainties in both monitoring data and modelling results.

Appendix 1

Traffic Data

Table A 1 – Traffic data used for dispersion modelling

Road Link	Speed (km/hr)	AADT 2008	AADT 2010	% HDVs
KingSt1_W	30	13335	13847	3.9%
KingSt2_W_J	15	13335	13847	3.9%
KingSt1_E	30	15544	16140	5.1%
KingSt2_E_J	15	10481	10883	4.7%
Limavady1_S_J	15	9800	10175	3.5%
Limavady1_N_J	15	7348	7630	5.3%
Glendermott1_W_J	15	6376	6620	3.8%
Glendermott2	30	18110	18805	4.8%
Clooney1_J	15	6778	7038	5.0%
Clooney2	30	6778	7038	5.0%
KingStLimavady_J	15	5063	5257	6.0%
GlendermottClooney_J	15	634	658	16.9%
Glendermott1_E_J	15	11100	11526	4.6%
Clooney2_J	15	6145	6380	3.7%
Limavady0_N_J	15	2285	2373	3.8%
Limavady2	30	17147	17805	4.3%
Limavady3	30	17147	17805	4.3%

Appendix 2

Diffusion Tube Bias Adjustment Factor

The Air Quality Review and Assessment Helpdesk[16] provide yearly bias adjustment factors based on data from a number of co-located sites collated from local authorities. The average bias factor for Derry CC' supplier (Bureau Veritas Laboratories) and the relevant preparation method (10% TEA in water) was 0.83 in 2008[17].

NO_2 triplicate diffusion tubes installed at the continuous monitoring site in Dale's Corner also allow the calculation of a local bias adjustment factor for NO_2 diffusion tube results. The local bias adjustment factor derived from these triplicates was 1.00 for 2008. The calculation was carried out using the local bias factor calculation spreadsheet available on the Air Quality Archive website[18] (see details in Table A 2 below).

Table A 2 – Calculation of Local Bias Adjustment Factor 2008 – Dale's Corner Air Quality CM station

Month	Diffusion Tubes Measurements							Automatic Monitoring Site		Data Quality Check	
	Tube D1 (NO2 - ug/m3)	Tube D2 (NO_2 – µg/m^3)	Tube D3 (NO_2 - µg/m^3)	Triplicate Mean (NO_2 - µg/m^3)	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean (NO_2 - µg/m^3)	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data Capture Check
January	43.0	46.0	43.0	44.0	1.7	3.9	4.3	49	100	Good	Good
February	47.0	47.0	43.0	45.7	2.3	5.1	5.7	55	99	Good	Good
March	42.0	41.0	42.0	41.7	0.6	1.4	1.4	36	94	Good	Good
April	40.0	40.0	36.0	38.7	2.3	6.0	5.7	38	100	Good	Good
May	32.0	42.0	40.0	38.0	5.3	13.9	13.1	39	100	Good	Good
June	35.0	28.0	34.0	32.3	3.8	11.7	9.4	24	87	Good	Good
July	27.0	26.0	35.0	29.3	4.9	16.8	12.3	28	89	Good	Good
August	29.0	30.0	31.0	30.0	1.0	3.3	2.5	31	97	Good	Good
September	40.0	38.0	37.0	38.3	1.5	4.0	3.8	36	98	Good	Good
October	49.0	32.0	38.0	39.7	8.6	21.7	21.4	37	100	Poor Precision	Good
November	30.0	48.0	44.0	40.7	9.5	23.2	23.5	44	100	Poor Precision	Good
December	59.0	58.0	56.0	57.7	1.5	2.6	3.8	60	100	Good	Good
									Overall survey -->	Good precision	Good Overall DC
									Overall Bias Adjustment Factor	1.00	

As the difference between the local and national bias factor is significant, this was further investigated. New Technical Guidance LAQM.TG(09)[19], released in February 2009 by Defra, provides recommendations in relation to the correction of NO_2 diffusion tubes, and the choice between a local and the national bias factor[20]. Based on these recommendations, the national bias of 0.83 has been used in this Detailed Assessment. NO_2 results obtained with this correction factor are consistent with the trend observed over the past years (see Table 3).

[16] www.uwe.ac.uk/aqm/review/

[17] Based on the latest available spreadsheet of Bias Adjustment Factors available on the Review and Assessment Helpdesk website - www.uwe.ac.uk/aqm/review/R&Asupport/diffusiontube310309.xls

[18] www.airquality.co.uk/laqm/tools.php

[19] Local Air Quality Management Technical Guidance LAQM.TG(09), Defra, February 2009

[20] LAQM.TG(09) – Box 3.3 – Choice of bias adjustment factors : locally-derived or from the national database

Appendix 3

Model verification

Predicted NO_x concentrations based on ADMS-Roads (v2.2) were verified by comparison against available monitoring data and an adjustment (or correction) factor was calculated. All predicted results (at sensitive receptors) were then adjusted based on this factor.

NO_2 predicted results have then been derived from NO_x results based on the new NO_x/NO_2 calculator spreadsheet available on the UK Air Quality Archive website[21]

The methodology recommended in the new Technical Guidance LAQM.TG(09) was used as follows:

1. Both monitored and predicted road-NO_x concentrations (i.e. the contribution of traffic road sources to the total NO_x) were calculated by subtracting the background NO_x concentration as provided in Section 2.2.3. NO_x concentrations at diffusion tubes were estimated based on the new NO_x/NO_2 calculator[21]. The average ratio between monitored road-NO_x and modelled road-NO_x was calculated (2.48).

2. Predicted road-NO_x was adjusted based on this factor, and the total predicted NO_x was obtained by adding the background NO_x concentration.

3. Predicted road-NO_2 was calculated based on the new NO_x/NO_2 calculator. The background NO_2 concentration (as provided in Section 2.2.3) was added to obtain the total predicted NO_2 annual mean.

Table A 3 shows the data used to calculate the adjustment factor. The graph of modelled NO_2 versus monitored NO_2 provided in Figure A1 shows that the adjusted modelled results are in good agreement with the monitoring data.

Table A 3 - Model verification – Dale's Corner Junction – Based on 2008 data

ID	Background NO_x (µg/m^3)	Monitored total NO_x (µg/m^3)	Monitored Road-NO_x - (µg/m^3)	Modelled Road-NO_x (µg/m^3)	Adjustment Factor (based on linear regression)
CM Dales Corner	28.0	88.7	60.7	19.3	2.48
D4		44.0	16.0	13.3	
D5		145.6	117.6	47.4	
F1,3,4		117.4	89.4	36.4	

For NO_2 diffusion tubes, this was estimated with the new NO_x/NO_2 converter available on the Air Quality Archive website

[21] www.airquality.co.uk/archive/laqm/tools.php

Figure A1 - Adjusted Modelled NO_2 vs. Monitored NO_2