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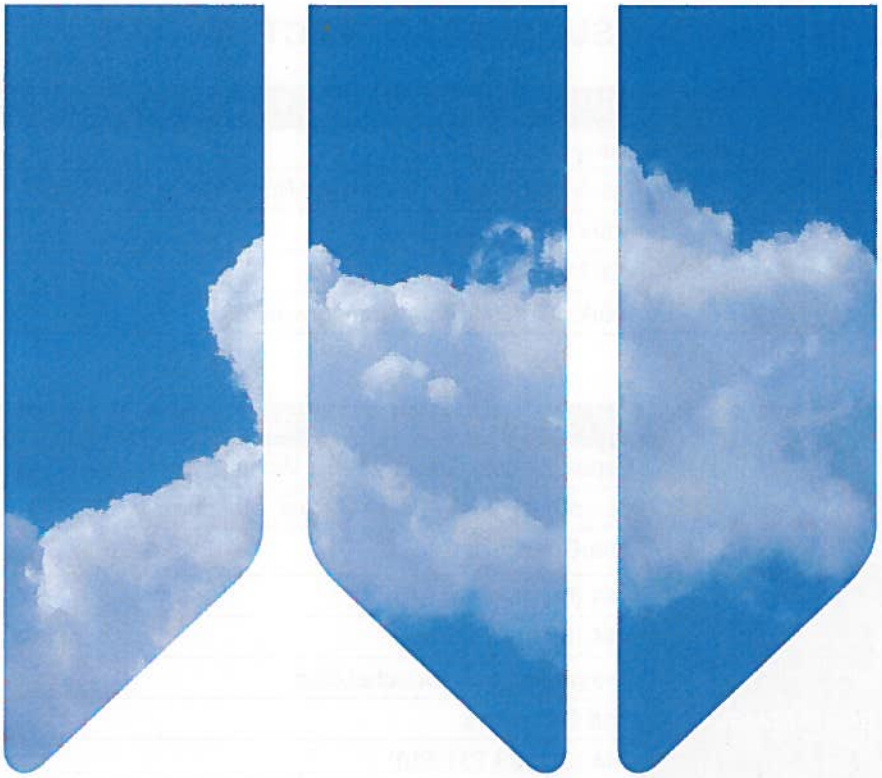

Local Air Quality Management

Strand Road, Abercorn Road, John Street, and Spencer Road

Detailed Assessment

E&E3/AQ/PR00050

Produced for:

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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 and take account of Government Guidance when undertaking such work.

The 2011 Updating and Screening Assessment for Derry concluded that a Detailed Assessment was required at Strand Road, Abercorn Road, John Street and Spencer Road, due to 2010 measured exceedences of the annual mean nitrogen dioxide (NO_2) objective (DCC, 2011). Mouchel has been commissioned by Derry City Council to assess air quality at these locations.

The aim of this Detailed Assessment was to determine whether the Air Quality Strategy objectives were being exceeded at locations with relevant exposure and if so, the extent of the Air Quality Management Area(s) required. The Detailed Assessment has been undertaken in accordance with Department for Environment, Food and Rural Affairs' Local Air Quality Management (LAQM.TG09) methodologies and amended tools released in August 2012.

The findings of the Detailed Assessment are as follows:

1. NO_2 diffusion tube data from 2011 indicates no exceedence of the NO_2 annual mean objective at Strand Road. One of the monitoring sites is however within 10% of the air quality objective for this pollutant ($37\mu g/m^3$).

2. Exceedences of the NO_2 annual mean objective were predicted through dispersion modelling along Strand Road. The contour map confirms exceedence at the façade of a number of properties.

3. NO_2 diffusion tube data from 2011 indicates an exceedence of the NO_2 annual mean objective at Lower Spencer Road.

4. Exceedences of the NO_2 annual mean objective were also predicted through dispersion modelling at Lower Spencer Road. The contour map confirms exceedence at the façade of a number of properties.

5. With respect to the hourly NO_2 objective, there are no monitoring sites or modelled results showing annual mean NO_2 concentrations in excess of 60 $\mu g/m^3$ at any of the locations modelled and therefore it is unlikely that there will be any exceedences of the hourly NO_2 objective;

6. As a result of these findings it is recommended that the Council declare an AQMA for the NO_2 annual mean objective encompassing properties listed in the report at Strand Road and Spencer Road locations.

1 Introduction

Mouchel Ltd has been commissioned by Derry City Council (DCC) to undertake a Detailed Assessment (DA) of air quality at Strand Road, Abercorn Road, John Street, and Spencer Road. The various study areas are shown in Figure 1.

In 2011 the Council completed a Progress Report which concluded that a DA was required due to measured exceedences of the annual mean nitrogen dioxide (NO_2) objective (DCC, 2011) at these locations, as prescribed in the Air Quality Strategy (AQS). The aim of this DA is to determine if an Air Quality Management Area (AQMA) is needed and to define the extent of exceedence of the NO_2 objective. It will be undertaken in accordance with current Technical Guidance of the Department for Environment, Food and Rural Affairs' (Defra) on Local Air Quality Management (LAQM) (LAQM.TG09) using updated data and tools.

1.1 Background

The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007) sets out a framework for air quality management, which includes a number of air quality objectives. National and international measures are expected to achieve these objectives in most locations, but where areas of poor air quality remain, air quality management at a local scale has a particularly important role to play.

The Environment (Northern Ireland) Order 2002 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government Guidance when undertaking such work. The role of this process is to identify areas where it is unlikely that the air quality objectives will be achieved. These locations must be designated as AQMAs and a subsequent Air Quality Action Plan (AQAP) developed in order to reduce pollutant emissions in pursuit of the objectives.

Technical Guidance for Local Air Quality Management (LAQM.TG09) (Defra, 2009) sets out a phased approach to the Review and Assessment process. This prescribes an initial Updating and Screening Assessment (USA), which all local authorities must undertake. It is based on a checklist to identify any matters that have changed since the previous round. If the USA identifies any areas where there is a risk that the objectives may be exceeded, which were not identified in the previous round, then the Local Authority should progress to a DA.

The purpose of the DA is to determine whether an exceedence of an air quality objective is likely and the geographical extent of that exceedence. If the outcome of the DA is that one or more of the air quality objectives are likely to be exceeded, then an AQMA must be declared. Subsequent to the declaration of an AQMA, a Further Assessment (FA) should be carried out to confirm that the AQMA declaration is justified; and that the appropriate area has been declared; to ascertain the sources contributing to the exceedence; and to calculate the magnitude of reduction in emissions required to achieve the objective. This information can be used to inform an AQAP, which will identify measures to improve local air quality.

1.2 Air Quality Objectives

The Government's Air Quality Strategy (Defra, 2007) provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. The 'standards' are set as concentrations below which health effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of a particular pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of the costs, benefits, feasibility and practicality of achieving the standards. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives.

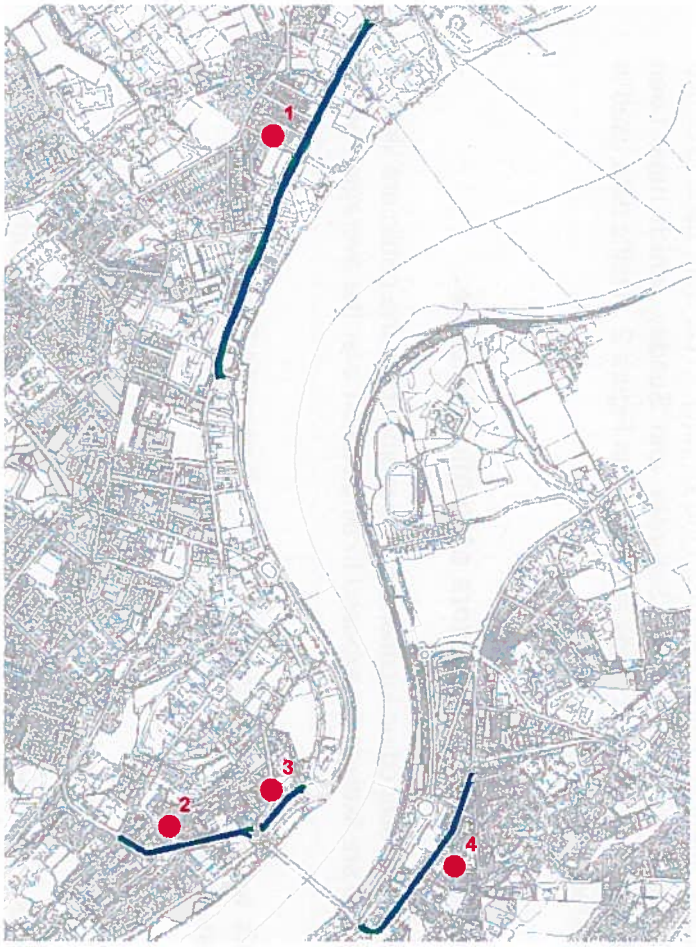
The air quality objectives applicable to LAQM in Northern Ireland are set out in the Air Quality Regulations (Northern Ireland) 2003, Statutory Rules of Northern Ireland 2003 (No. 342). Table 1 summarises the objectives which are relevant to this report. Appendix A provides a brief summary of the health effects of NO_2.

The air quality objectives only apply where members of the public are likely to be regularly present for the averaging time of the objective (i.e. where people will be exposed to pollutants). For annual mean objectives, relevant exposure is limited to residential properties, schools, hospitals and care homes. The 1-hour objective applies at these locations as well as at any outdoor location where a member of the public might reasonably be expected to stay for 1 hour or more, such as shopping streets, parks and sports grounds, as well as some bus stations and railway stations that are not fully enclosed.

Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded unless the annual mean concentration is greater than 60 $\mu g/m^3$ (Defra, 2009). Thus, exceedences of 60 $\mu g/m^3$ as an annual mean nitrogen dioxide concentration are used as an indicator of potential exceedences of the 1-hour objective.

Table 1 - Air Quality Objectives included in the Regulations for the purpose of Local Air Quality Management in Northern Ireland for NO_2

Pollutant	Time Period	Objective	Date to be achieved by and maintained thereafter
Nitrogen Dioxide	1-hour Mean	200 $\mu g/m^3$, not to be exceeded more than 18 times a year	31 December 2005
	Annual Mean	40 $\mu g/m^3$	31 December 2005



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1 Strand Road at Rockmills

2 Abercorn Road/Bishop Street

3 John Street

4 Spencer Road/Fountain Hill

Modelled Queue

Modelled Network

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Client: Derry City Council		Description: Location of study areas	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright OSNI Licence LA 41 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	20/09/2012
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				Approved	AG	22/09/2012

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Figure 1

Scale: Not to Scale

Figure 1 - Location of Study Areas

2 Assessment Methodology

2.1 Analysis and Processing of Traffic Data

Traffic data were provided by Derry City Council from a manual turning count survey carried out by the Council in March 2012. The data, covering AM (08:00-09:00) and PM (17:00-18:00) 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 within the study area. Locations of the ATCs used are presented in Figure 2. The turning count data were deemed representative of 2011 traffic conditions, baseline year of the current assessment. Data used were:

i. Annual Average Daily Traffic flows (ADDT 24h);
ii. the percentage of HDVs (vehicles > 3.5t gross vehicle weight); and
iii. the average daily speed (kph).

Vehicle speeds were decreased at the approach of junctions and roundabouts to account for traffic congestion and queuing. Traffic data from the 24-hour ATCs were used to derive diurnal profiles of traffic flows for weekday, Saturday and Sunday, which have been applied to all modelled roads. Modelled roads are shown on Figure 2 . Traffic data used in the assessment are provided in Appendix B.

2.2 Identification of Relevant Receptors of Public Exposure

The current assessment is focused on locations where members of the public are likely to be regularly present and are likely to be exposed to air pollution over the averaging period of the objectives.

A total of 2765 public exposure receptors were identified using NI Pointer data and then modelled to ascertain annual mean concentrations of NO_2 within the study areas.

2.3 Analysis and Processing of Continuous Monitoring (CM) Data

Derry City Council has two automatic monitoring sites measuring NO_2, both outside the areas considered in this detailed assessment. Therefore, these sites have not been used for model verification. However, the Automatic Urban and Rural Network (AURN) automatic monitoring site at Brooke Park has been used for analysis of local background pollution data. Details of Brooke Park are shown in Table 2.

Table 2 - Brooke Park Continuous Monitoring Results (2007-2011)

Location	X, Y	Year	NO_x Annual Mean ($\mu g/m^3$)	NO_2 Annual Mean ($\mu g/m^3$)	No. of NO_2 hourly mean >200$\mu g/m^3$	% Data Capture
Brooke Park	242962, 417217	2007	18.0	12.6	0	89
		2008	28.4	18.5	0	96
		2009	23.5	15.8	0	97
		2010	39.6	19.2	0	99
		2011	20.7	16.0	0	100

2.4 Analysis and Processing of Passive Monitoring Data

Derry City Council manages a network of diffusion tubes measuring NO_2 concentrations across their area of jurisdiction.

Seven monitoring locations were within close proximity to the relevant exposure locations and the modelled road network. These were evaluated in terms of distance to the road sources modelled, site type, data quality, and data capture.

The diffusion tubes were prepared and analysed by Gradko in early 2010 and by Environmental Scientifics Group from April 2010 who used the 20% TEA in water preparation. It was necessary to adjust diffusion tube data to account for laboratory bias. DCC has co-located triplicate diffusion tubes with two of its automatic monitoring sites: Dale's Corner and Brooke Park. Results from 2011 have been bias adjusted using a local factor of 0.91 derived from the two co-located studies.

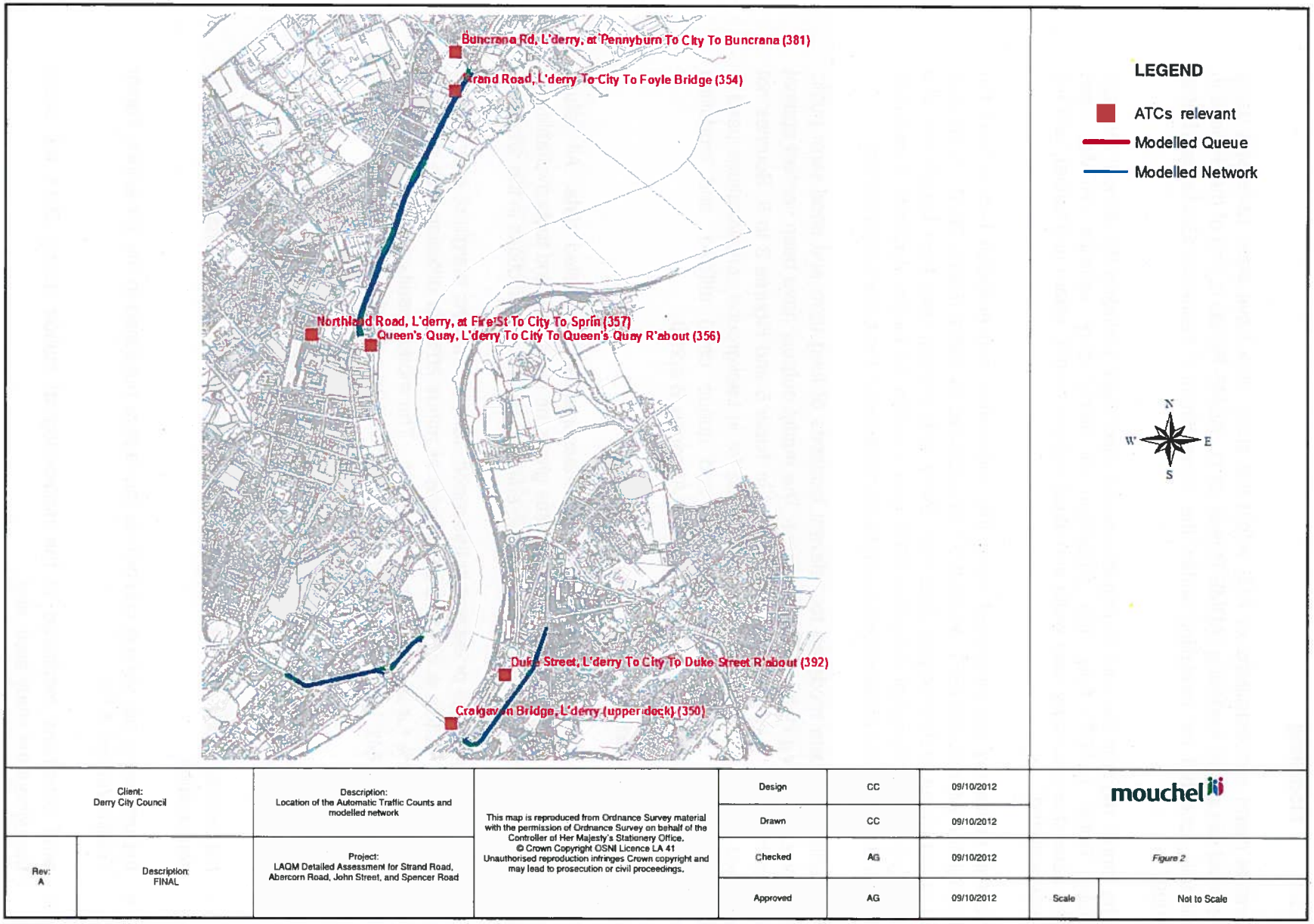
2.5 Processing of Background Concentrations

Local monitoring data and Defra's updated background pollutant maps were considered to determine appropriate NO_x and NO_2 background concentrations for this assessment. Table 3 shows the comparison of background concentrations from Brooke Park AURN continuous monitoring site and the average of background levels in nearest 1km × 1km grid squares in 2011, as per national estimates. Backgrounds were adjusted following the latest Defra's guidance and tools.

National background levels varied from 22.3 to 9.7 $\mu g/m^3$ for NO_x and from 15.6 to 7.5 $\mu g/m^3$ for NO_2. For this assessment the background concentrations from Brooke Park have been used to better represent local conditions. This is considered to be a conservative approach.

Table 3 - Background Concentrations within the study area

Source	Location (NI OS Grid Coordinates)	Pollutant	2011 Background Value ($\mu g/m^3$)
Brooke Park AURN Site	X 242962, Y 417217	NO_x	20.7
		NO_2	16.0
Defra Background Maps	8 tiles (average value)	NO_x	18.1
		NO_2	13.1



Client: Derry City Council		Description: Location of the Automatic Traffic Counts and modelled network	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright OSNI Licence LA 41 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012	mouchel
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				Approved	AG	09/10/2012	Scale: Not to Scale

Figure 2 - Location of the Automatic Traffic Counts and modelled network

2.5.1 Modelling

Annual mean concentrations of NO_2 within the study area have been assessed using detailed dispersion modelling (ADMS-Roads v3.1). ADMS-Roads is one of the dispersion models accepted for modelling within the Government's Technical Guidance (Defra, 2009).

The model requires the user to provide various input data, including the Annual Average Daily Traffic (AADT) flow, the proportion of heavy duty vehicles (HDVs), road characteristics (including road width and street canyon height, where applicable), and the vehicle speed.

Vehicle emissions are calculated using this information and emission factors from the Emission Factor Toolkit (EFT, Version 5.1.3) published by Defra (Defra, 2012). A full year of hour-by-hour meteorological data from Derry with missing data from Lough Fea and Aldergrove Meteorological stations in 2011 were used in the model. Appendix C presents the wind rose for the meteorological conditions modelled in the current assessment.

Concentrations were modelled for relevant locations of long term and short term public exposure (including local monitoring sites). The model outputs have been verified against local diffusion tube measurements described in Table 5 and Figures 3 to 5. Sources not included explicitly in the model were accounted for in background concentrations used in the assessment. The input data (traffic and queue data) utilised, and modelling methodology are described in further detail in Appendix B and D.

2.5.2 Data Uncertainty

There is an element of uncertainty in all measured and modelled data. All values presented in this report are the best estimates given the input data and tools available, but uncertainties in the data might cause over-predictions or under-predictions in the results.

All of the measurements presented in this report have an intrinsic margin of error. Defra (2009) suggest that this is of the order of plus or minus 20% for diffusion tube data and plus or minus 10% for automatic measurements. The model results rely on traffic count data, and thus any uncertainties inherent in this data set will carry through to this assessment.

There will be additional uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example, it has been assumed that:

i. the vehicle fleet within the study area will conform to the national (UK) average composition;

ii. the emissions per vehicle conform to the factors published in the Emissions Factor Toolkit Version 5.1.3;

iii. wind conditions measured at the meteorological station during 2011 will occur throughout the study area; and

iv. the subsequent dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain.

An important step in the assessment is verifying the dispersion model against the measured data. By comparing the model results with actual measurements, data will be adjusted for any under or over-prediction.

The UK Government's Air Quality Expert Group (AQEG) has published a report on trends in primary NO_2 in the UK (AQEG, 2007). This examines evidence that shows that while NO_x emissions have fallen in line with predictions made a decade previously, the composition of NO_x has, in some urban environments, changed. This may have caused NO_2 concentrations at some locations to fall less rapidly than was expected.

The latest guidance from Defra has been followed regarding NO_x to NO_2 relationships.

These limitations to the assessment are considered when reviewing the results set out in the following Sections. The results are 'best estimates' and have been treated as such in the discussion.

3 Results

3.1 Monitored NO_2 Concentrations

Details of the diffusion tube data used in the current assessment are presented in Table 4. Annual mean NO_2 concentrations measured at Strand Road, Abercorn Road, John Street, and Spencer Road for 2009, 2010 and 2011 are presented in Table 5. Concentrations measured for 2011 at these locations are shown in Figures 3 to 5.

Table 4 - Diffusion tube site information for Spencer Road, John Street, Strand Road and Abercorn Road locations

Site Name	Site Type	OS Grid Ref X	OS Grid Ref Y	Pollutants Monitored	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road (N/A if not applicable)	Does this location represent worst-case exposure?
63 Abercorn Road	Roadside	243166	416211	NO_2	N	Y (0m)	1.5	Y
8 Abercorn Road	Roadside	243422	416230	NO_2	N	Y (0m)	1.5	Y
10 John St	Roadside	243627	416308	NO_2	N	Y (0m)	2	Y
12 John St	Roadside	243602	416279	NO_2	N	Y (0m)	2	Y
99 Strand Road	Roadside	243522	417894	NO_2	N	Y (0m)	3	Y
Rockmills	Roadside	243607	418037	NO_2	N	Y (0m)	4	Y
70 Spencer Road	Roadside	244011	416068	NO_2	N	Y (0m)	2	Y

The annual mean NO_2 objective is exceeded at one location, 70 Spencer Road, being within 10% of the objective at the remaining sites with the exception of Rockmills site which registered the lowest concentration across the four study areas (33.5 $\mu g/m^3$).

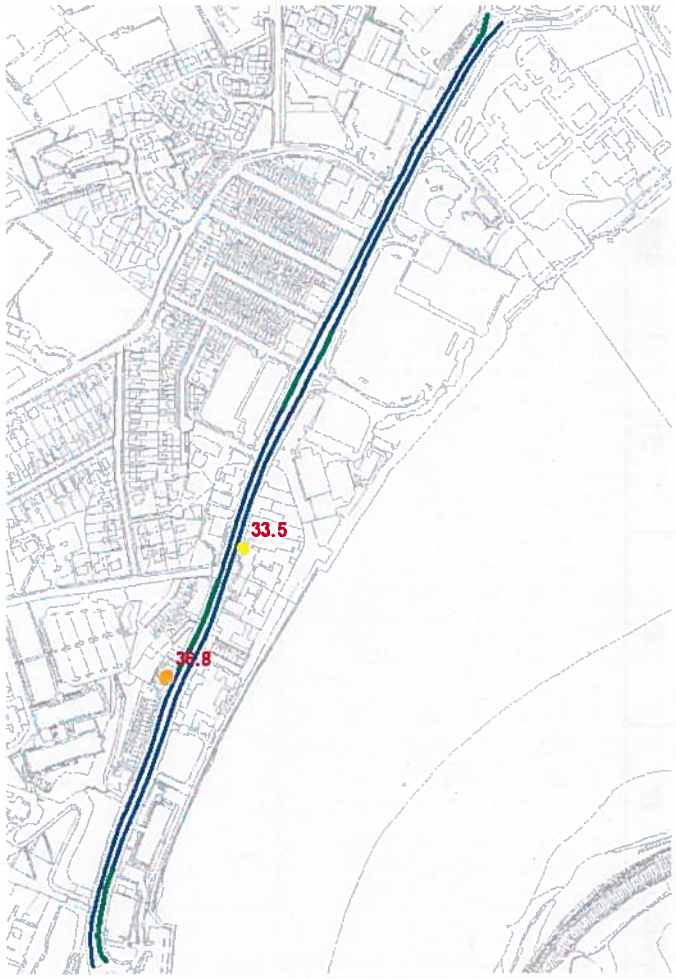
2010 was considered a particularly bad pollution year and a significant increase is registered in relation to 2009 at all locations.

Comparing annual mean concentration values of 2009 against 2011, it is observed that concentrations increase in 2011 by 2 $\mu g/m^3$ at Abercorn Road and by 3 $\mu g/m^3$ at Spencer Road, with imperceptible changes at John Street and Strand Road. Rockmills registers a decrease of 3.5 $\mu g/m^3$.

The annual mean concentrations do not exceed 60 $\mu g/m^3$ indicating no likely exceedences of the hourly mean objective for NO_2 within the four study areas.

Table 5 - Annual Mean NO_2 concentrations measured at the diffusion tube sites across the four study areas

Location	Data Capture 2011 (%)	Annual Mean NO_2 ($\mu g/m^3$ Bias Adjusted)		
		2009 (Bias Factor 0.93, Local)	2010 (Bias Factor 0.99, Local)	2011 (Bias Factor 0.91, Local)
63 Abercorn Road	83	36	47	37.7
8 Abercorn Road	25	31	40	-
10 John St	100	37	47	36.2
12 John St	100	37	48	36.7
99 Strand Road	75	37	52	36.8
Rockmills	83	37	48	33.5
70 Spencer Road	92	40	51	**42.8**



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Monitoring Sites at Strand Road at Rockmills

Annual Mean NO_2 Concentrations (μgm^{-3})

- <20
- 20 - 30
- 30 - 36
- 36 - 40
- >40
- Modelled Queue
- Modelled Network

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Client: Derry City Council		Description: Location of Diffusion Tube Monitoring Sites - Strand Road at Rockmills	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright OSNI Licence LA 41 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings	Design	CC	09/10/2012	mouchel
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				Approved	AG	09/10/2012	Scale: Not to Scale

Figure 3 - Location of Diffusion Tube Monitoring Sites - Strand Road at Rockmills

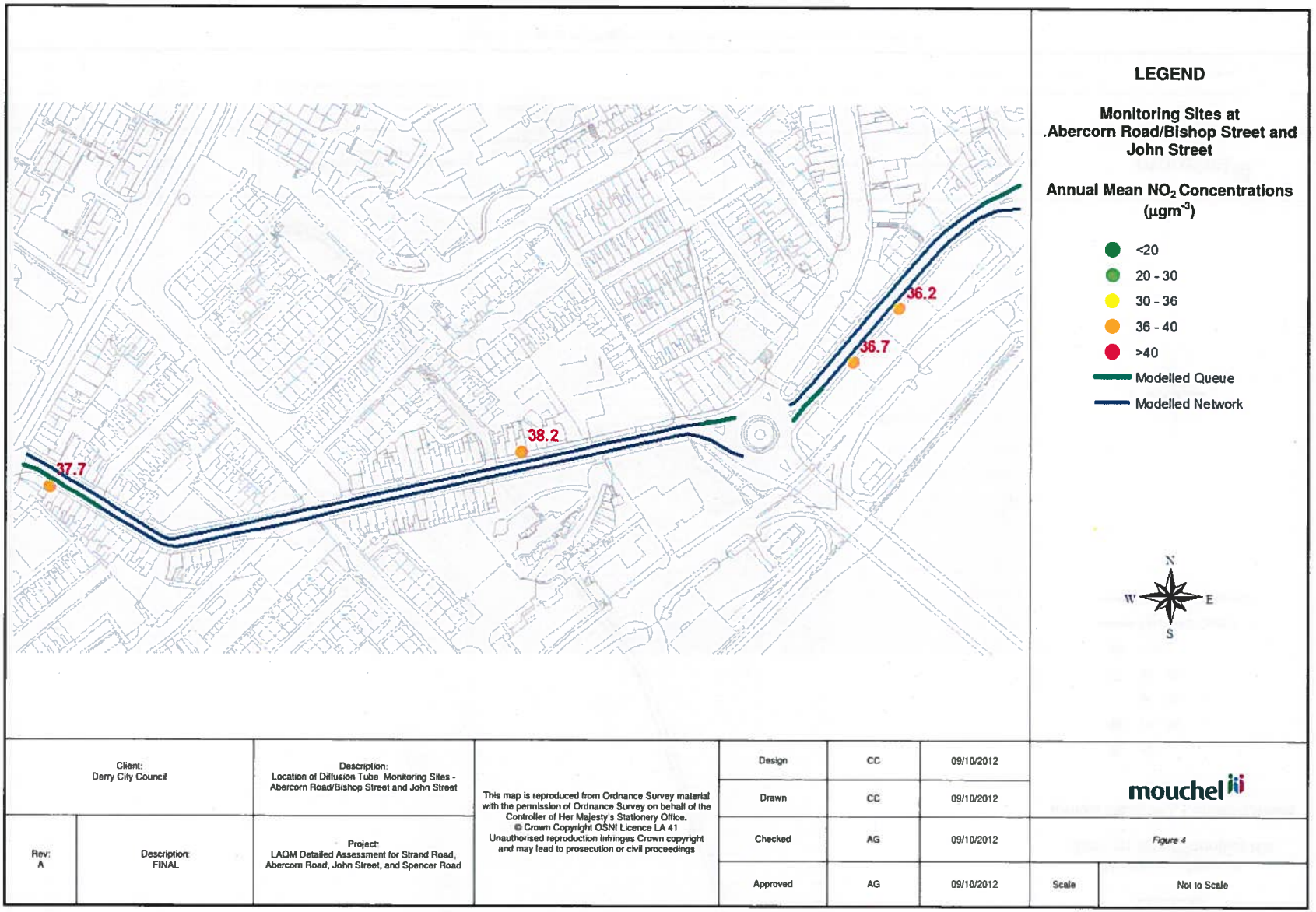
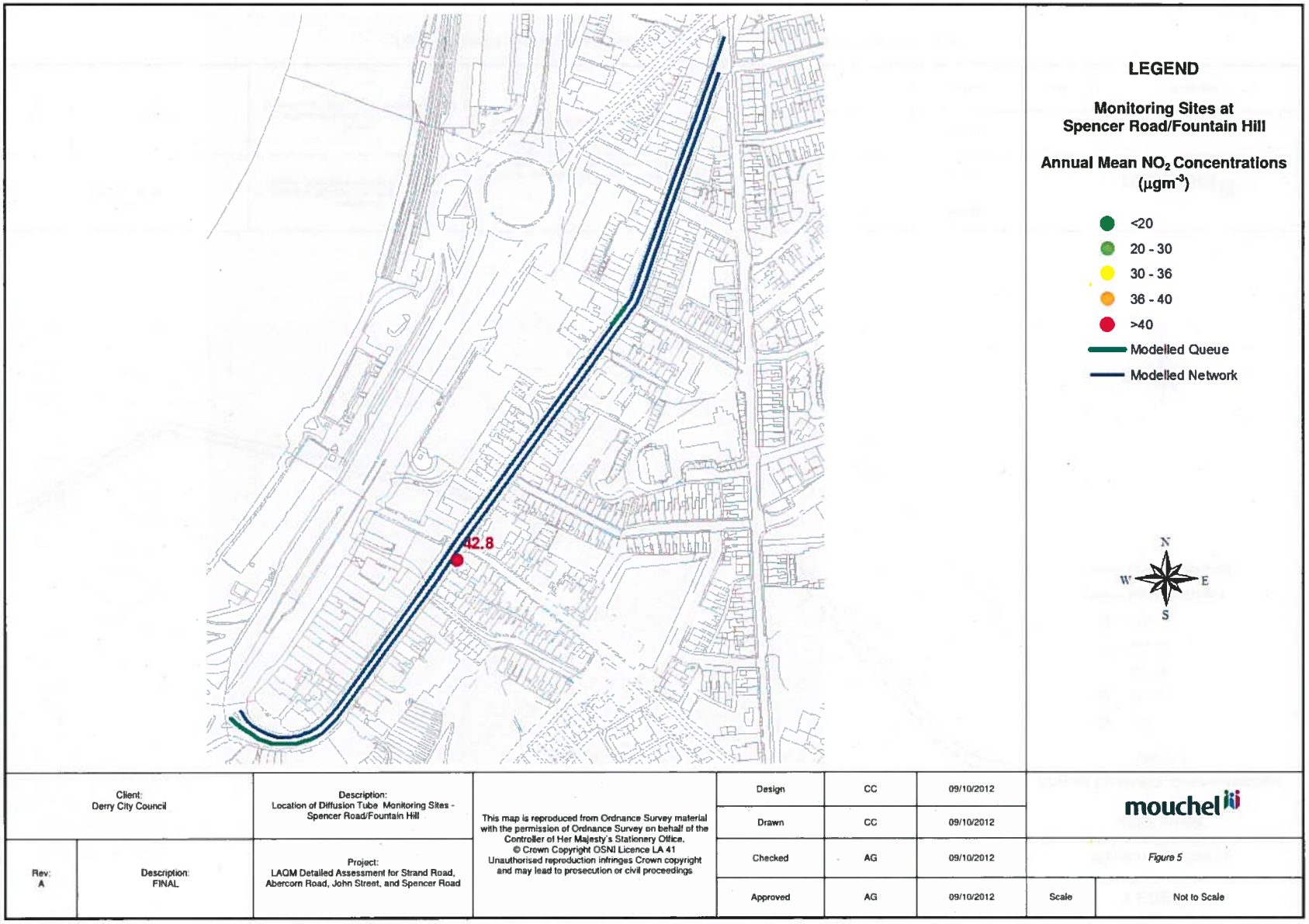


Figure 4 - Location of Diffusion Tube Monitoring Sites - Abercorn Road/Bishop Street and John Street



Client: Derry City Council		Description: Location of Diffusion Tube Monitoring Sites - Spencer Road/Fountain Hill	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright OSNI Licence LA 41 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings	Design	CC	09/10/2012	mouchel
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				Approved	AG	09/10/2012	Scale: Not to Scale

Figure 5 - Location of Diffusion Tube Monitoring Sites - Spencer Road/Fountain Hill

3.2 Modelled NO_2 Concentrations

Annual average NO_2 concentrations were predicted for 2011 at a number of receptors representing relevant public exposure, located at the façade of properties. Additionally, predictions were made to a 3m-grid spacing across the assessment areas to produce NO_2 concentration contours.

Predicted annual mean NO_2 concentrations in 2011 at each of the receptor locations of Strand Road, Abercorn Road, John Street, and Spencer Road, are shown in Figures 6, 7, and 8.

In 2011, the annual mean objective is predicted to be exceeded at 21 receptors along Strand Road and one receptor along Spencer Road (Lower region). None of these receptors are predicted to experience concentrations exceeding 60 $\mu g/m^3$, therefore the hourly mean NO_2 objective is not at risk of being exceeded at these locations.

Figures 9 to 14 show concentration isopleths along Spencer Road, John Street, Strand Road and Abercorn Road in 2011.

3.2.1 Strand Road

The model predicted exceedences of the AQS objective for NO_2 annual mean in 2011 at a number of properties along Strand Road.

Table 6 presents the receptors along Strand Road the annual mean objective is predicted to be exceeded in 2011. The maximum concentration value estimated is 51$\mu g/m^3$, registered at receptor with Unique Property Reference Number (UPRN) 187143118 which is located at the middle section of Strand Road.

Other properties along Strand Road are also very close to the AQS NO_2 annual mean objective. The model is slightly under predicting NO_2 in this area as seen in the verification results (Appendix D), suggesting that other façades along this Road would be within 10% or above the objective (i.e. 36$\mu g/m^3$ or above). Figures 9 and 10 confirm that the area of exceedence would encompass the properties highlighted below.

Table 6 - Modelled Annual Mean NO_2 Concentrations ($\mu g/m^3$) at locations exceeding the Air Quality Objective

Postcode	UPRN	X	Y	NO_2 $\mu g/m^3$
BT48 7PB	**187143118**	**243626**	**418105**	**51**
BT48 7NN	**185950092**	**243454**	**417636**	**48**
BT48 7NN	**185950090**	**243452**	**417621**	**47**
BT48 7PA	**185950053**	**243554**	**417957**	**44**
BT48 7PA	**185949801**	**243555**	**417960**	**44**
BT48 7PW	**185816304**	**243677**	**418266**	**43**
BT48 7PW	**185816307**	**243677**	**418266**	**43**
BT48 7PW	**185816301**	**243677**	**418266**	**43**
BT48 7PW	**185816308**	**243677**	**418266**	**43**
BT48 7PW	**185816302**	**243677**	**418266**	**43**
BT48 7PW	**185816303**	**243677**	**418266**	**43**
BT48 7PW	**185816306**	**243677**	**418266**	**43**
BT48 7PW	**187140442**	**243677**	**418266**	**43**
BT48 7PW	**185816305**	**243677**	**418266**	**43**
BT48 7PA	**185949800**	**243541**	**417933**	**42**
BT48 7PL	**185849370**	**243719**	**418348**	**42**
BT48 7NU	**187131010**	**243532**	**417915**	**42**
BT48 7NU	**185983649**	**243527**	**417904**	**42**
BT48 7NU	**185950046**	**243527**	**417904**	**42**
BT48 7PL	**185512357**	**243719**	**418348**	**42**
BT48 7NU	**185949791**	**243519**	**417888**	**41**
BT48 7NU	185949790	243516	417883	40*
BT48 7NN	185950089	243466	417661	40*
BT48 7NT	185512070	243571	417929	40*
BT48 7NP	185512055	243501	417847	36*

* likely to be exceeding as well due to model uncertainty

3.2.2 Abercorn Road

No exceedences of the NO_2 annual mean objective are predicted at Abercorn Road in 2011. Figures 7 and 11 indicate that all receptors are below $40\mu g/m^3$ with values predicted to be within the 30-40 $\mu g/m^3$ range.

3.2.3 John Street

No exceedences of the NO_2 annual mean objective are predicted at John Street in 2011. Figures 7 and 12 indicate that all receptors are below $40\mu g/m^3$ with values predicted to be within the 30-40 $\mu g/m^3$ range.

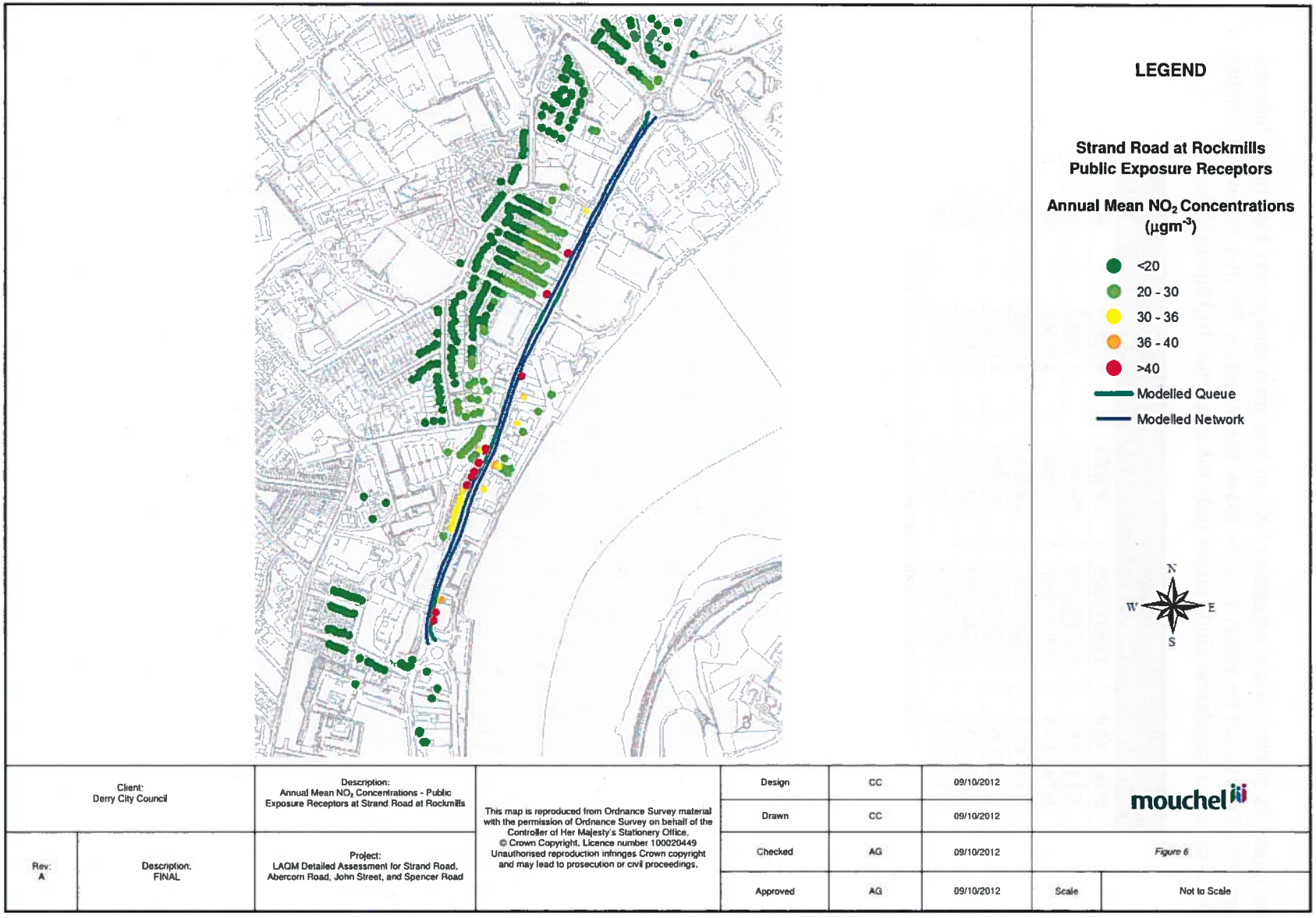
3.2.4 Spencer Road

Exceedences of the NO_2 annual mean objective are predicted at Spencer Road in 2011. Figures 8, and 13 and 14 indicate location of receptors above $40\mu g/m^3$ with the highest value predicted to be 41 $\mu g/m^3$ at receptor UPRN 185817506, located at the lower end of the road.

The model is slightly under predicting NO_2 in this area suggesting that other façades along this Road would be within 10% or above the objective. Figures 13 and 14 confirm that the area of exceedence would encompass the properties highlighted below.

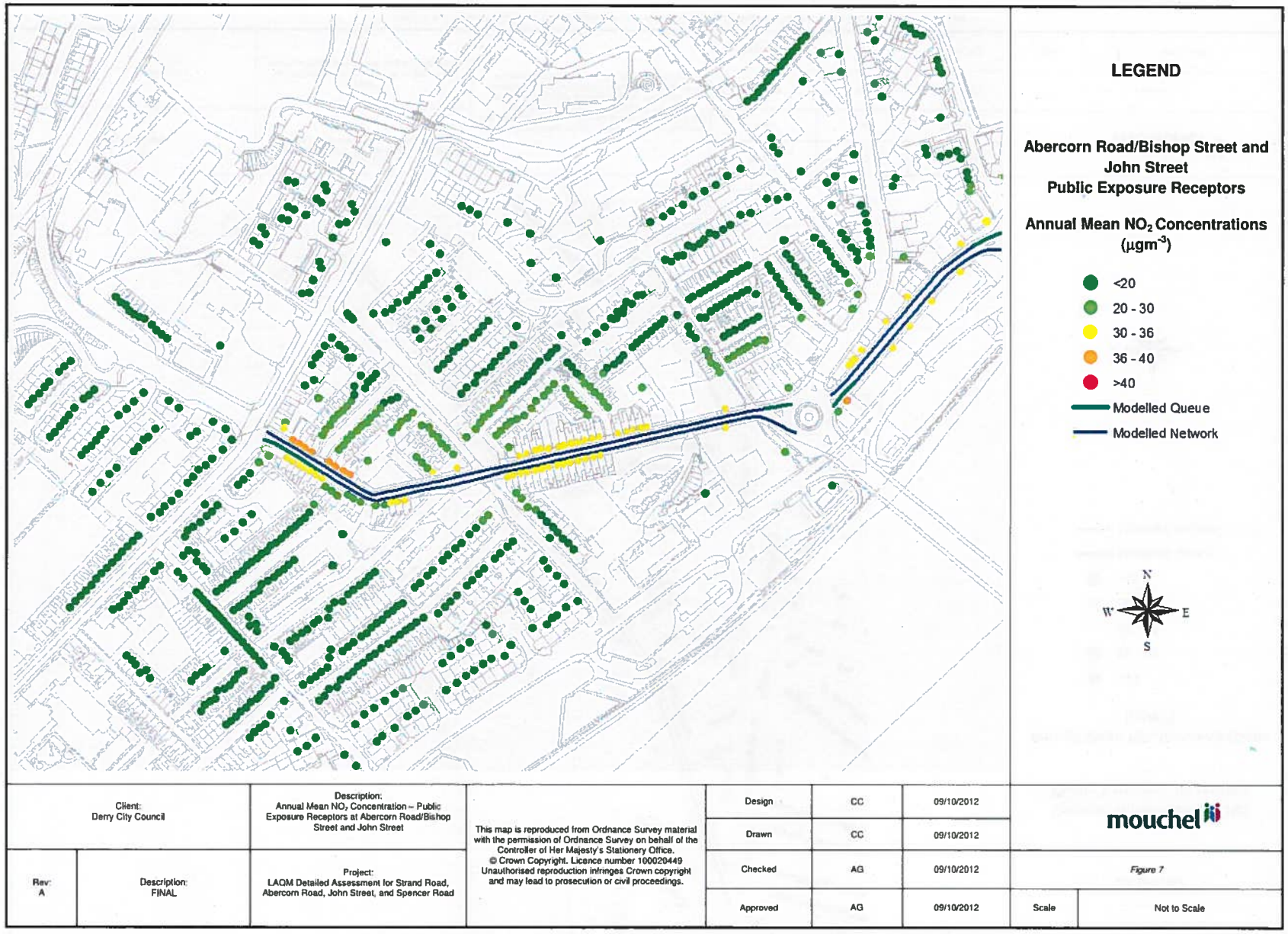
Postcode	UPRN	X	Y	NO_2 $\mu g/m^3$
BT47 4AA	**185817506**	**243902**	**415954**	**41**
BT47 6AA	185497060	243915	415960	39*
BT47 6AA	185497069	243967	416007	39*
BT47 6AA	185817515	243940	415969	38*
BT47 6AA	185497096	243940	415969	38*
BT47 6AA	185497097	243940	415969	38*
BT47 6AA	185497052	243940	415969	38*

* likely to be exceeding as well due to model uncertainty



Client: Derry City Council		Description: Annual Mean NO_2 Concentrations - Public Exposure Receptors at Strand Road at Rockmills	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright. Licence number 100020449 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012	mouchel
				Drawn	CC	09/10/2012	
Rev: A	Description: FINAL	Project: LAQM Detailed Assessment for Strand Road, Abercorn Road, John Street, and Spencer Road		Checked	AG	09/10/2012	*Figure 6*
				Approved	AG	09/10/2012	Scale: Not to Scale

Figure 6 - Annual Mean NO_2 Concentration – Public Exposure Receptors at Strand Road at Rockmills



Client: Derry City Council		Description: Annual Mean NO_2 Concentration – Public Exposure Receptors at Abercorn Road/Bishop Street and John Street	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright. Licence number 100020449 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012
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				Approved	AG	09/10/2012

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Figure 7

Scale: Not to Scale

Figure 7 - Annual Mean NO_2 Concentration – Public Exposure Receptors at Abercorn Road/Bishop Street and John Street

LEGEND

Spencer Road/Fountain Hill Public Exposure Receptors

Annual Mean NO_2 Concentrations (μgm^{-3})

- <20
- 20 - 30
- 30 - 36
- 36 - 40
- >40
- Modelled Queue
- Modelled Network

N
W E
S

Client: Derry City Council		Description: Annual Mean NO_2 Concentration – Public Exposure Receptors at Spencer Road/Fountain Hill	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright. Licence number 100020449 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012	mouchel
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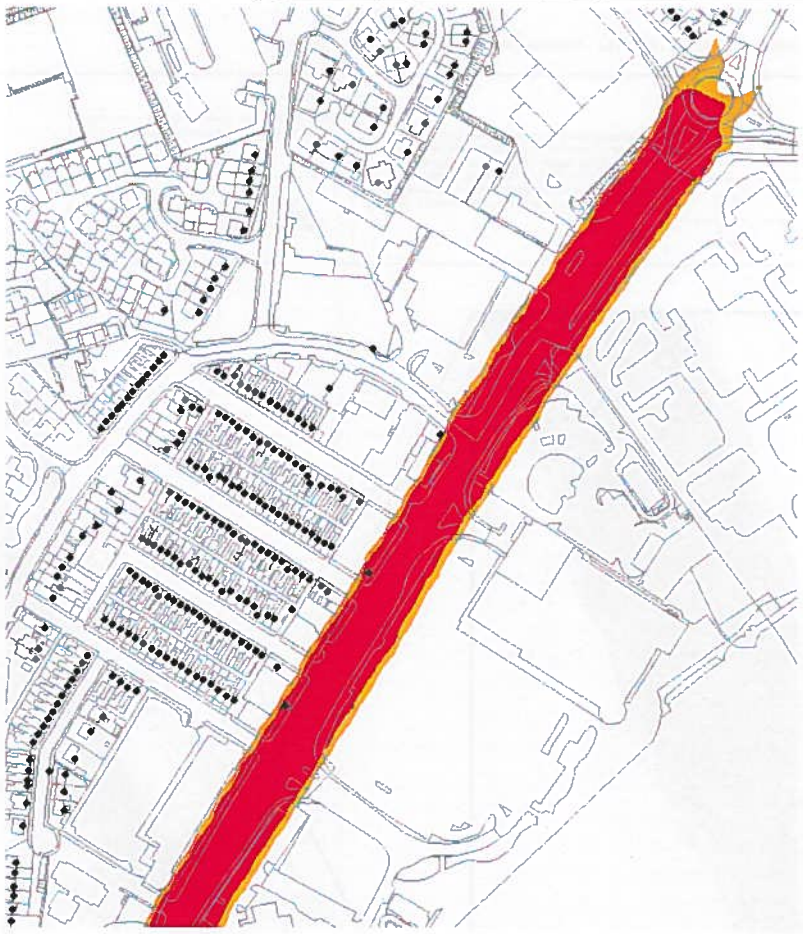
Rev: A	Description: FINAL	Project: LAQM Detailed Assessment for Strand Road, Abercorn Road, John Street, and Spencer Road		Checked	AG	09/10/2012	*Figure 8*
				Approved	AG	09/10/2012	Scale: Not to Scale

Figure 8 - Annual Mean NO_2 Concentration – Public Exposure Receptors at Spencer Road/Fountain Hill



LEGEND

Strand Road at Rockmills (Upper Area) Modelled Contours

Annual Mean NO_2 Concentrations (μgm^{-3})

- > 40
- 36-40

N
W E
S

Client: Derry City Council		Description: Annual Mean NO_2 Concentration - Modelled Contours – Strand Road at Rockmills	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright. Licence number 100020449 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012
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				Approved	AG	09/10/2012

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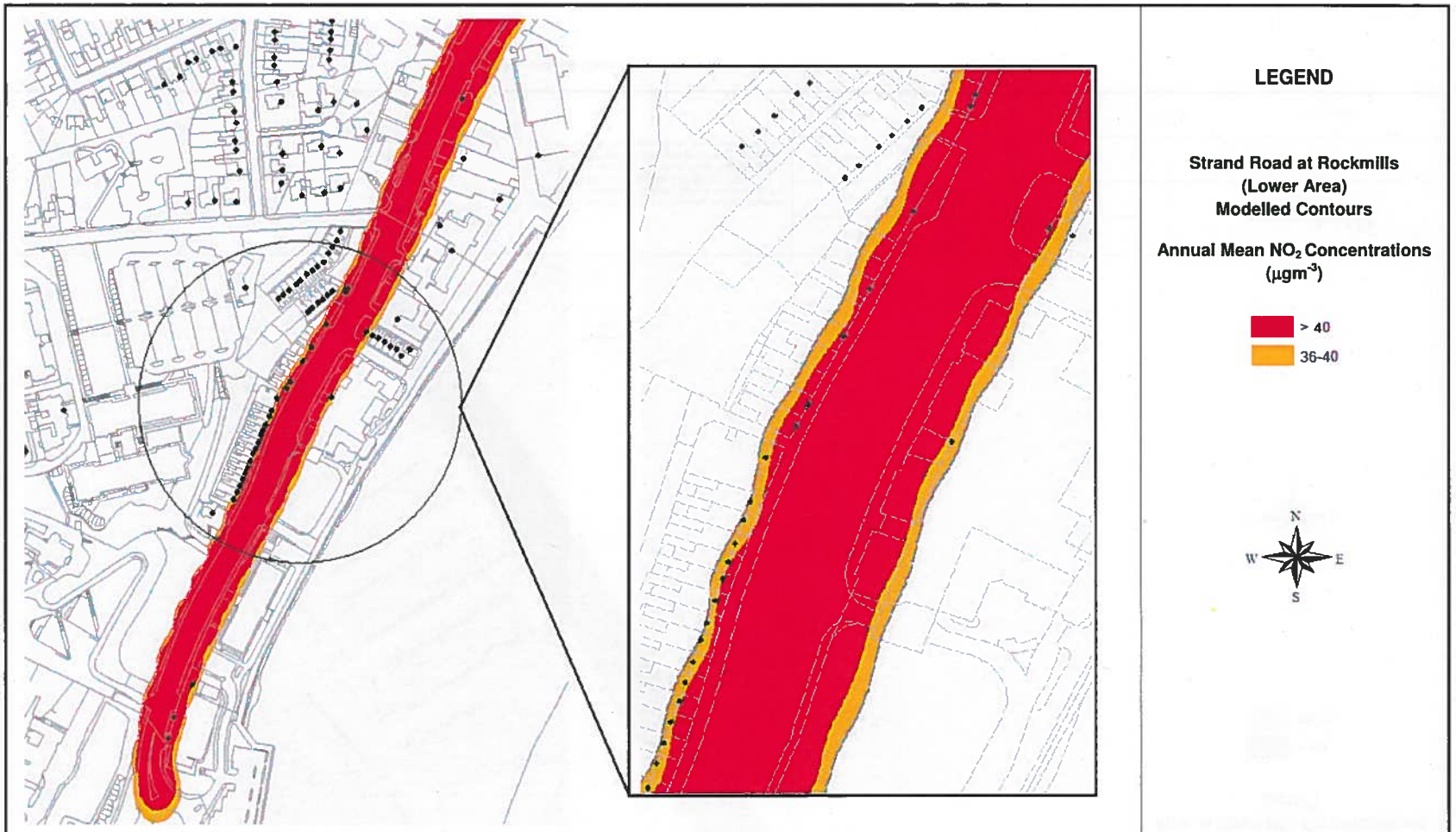
Figure 9

Scale: Not to Scale

Figure 9 - Annual Mean NO_2 Concentration - Modelled Contours – Strand Road at Rockmills



Client: Derry City Council		Description: Annual Mean NO_2 Concentration - Modelled Contours – Strand Road at Rockmills	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright. Licence number 100020449 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012
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Rev: A	Description: FINAL	Project: LAQM Detailed Assessment for Strand Road, Abercorn Road, John Street, and Spencer Road		Checked	AG	09/10/2012
				Approved	AG	09/10/2012

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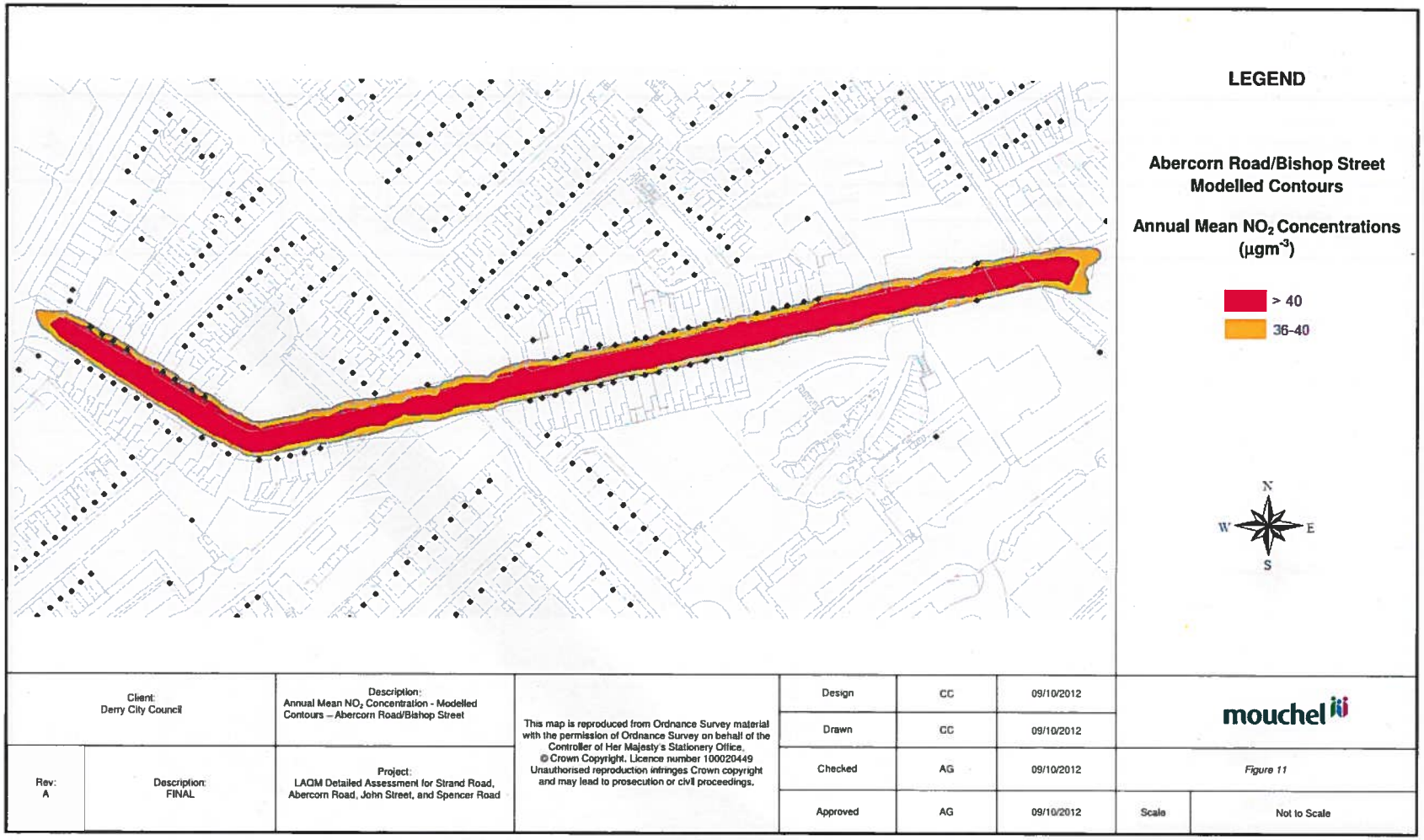
Figure 10

Scale: Not to Scale

Figure 10 - Annual Mean NO_2 Concentration - Modelled Contours – Strand Road at Rockmills (cont.)



Client: Derry City Council		Description: Annual Mean NO_2 Concentration - Modelled Contours – Abercorn Road/Bishop Street	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright. Licence number 100020449 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012	mouchel
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				Approved	AG	09/10/2012	Scale: Not to Scale

Figure 11 - Annual Mean NO_2 Concentration - Modelled Contours – Abercorn Road/Bishop Street

LEGEND

John Street
Modelled Contours

Annual Mean NO_2 Concentrations (μgm^{-3})

- > 40
- 36-40

N
W E
S

Client: Derry City Council		Description: Annual Mean NO_2 Concentration - Modelled Contours – John Street	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office, © Crown Copyright. Licence number 100020449 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012
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Rev: A	Description: FINAL	Project: LAQM Detailed Assessment for Strand Road, Abercorn Road, John Street, and Spencer Road		Checked	AG	09/10/2012
				Approved	AG	09/10/2012

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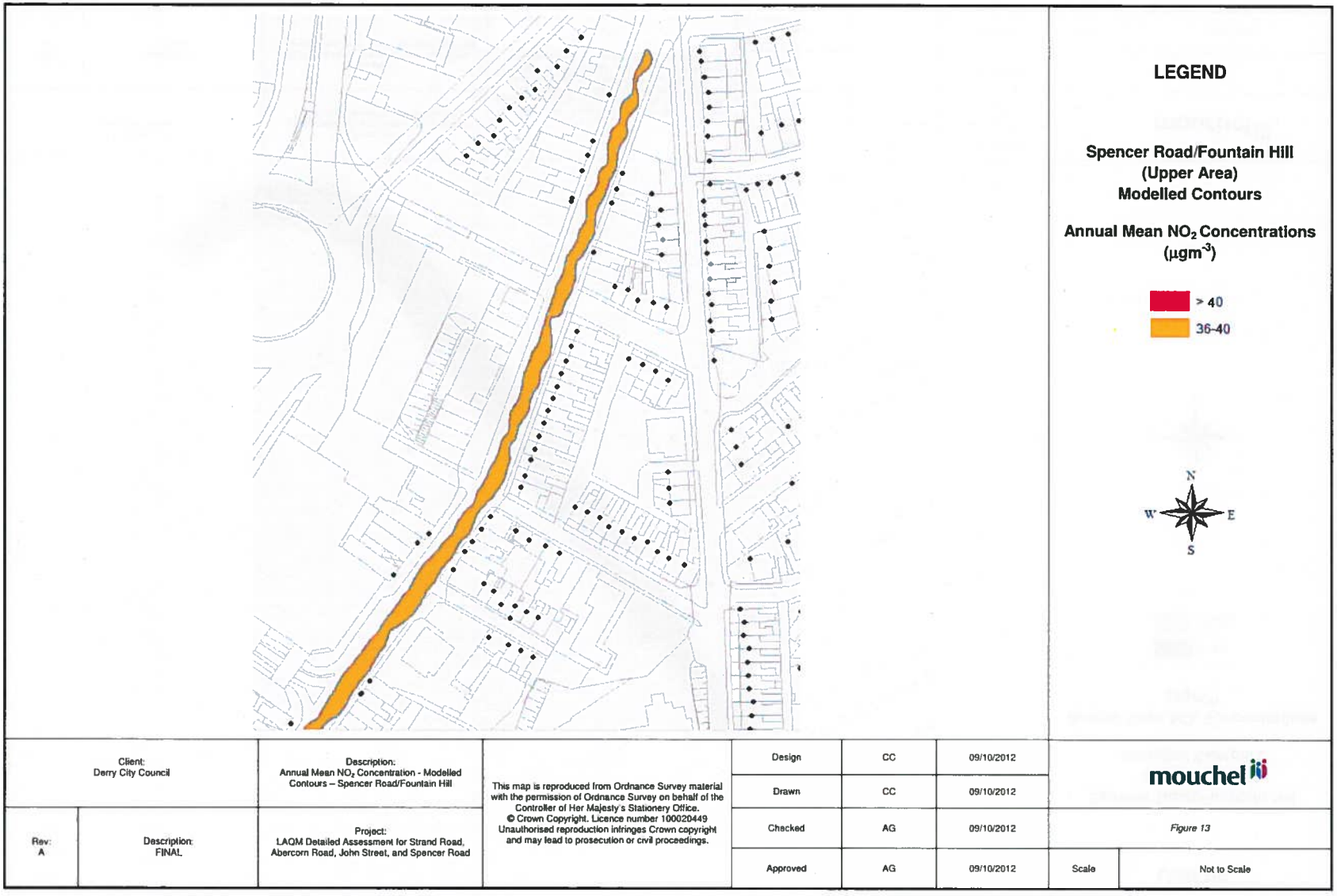
Figure 12

Scale: Not to Scale

Figure 12 - Annual Mean NO_2 Concentration - Modelled Contours – John Street



Client: Derry City Council		Description: Annual Mean NO_2 Concentration - Modelled Contours – Spencer Road/Fountain Hill	This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office. © Crown Copyright. Licence number 100020449 Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.	Design	CC	09/10/2012
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Rev: A	Description: FINAL	Project: LAQM Detailed Assessment for Strand Road, Abercorn Road, John Street, and Spencer Road		Checked	AG	09/10/2012
				Approved	AG	09/10/2012

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Figure 13

Scale: Not to Scale

Figure 13 - Annual Mean NO_2 Concentration - Modelled Contours – Spencer Road/Fountain Hill

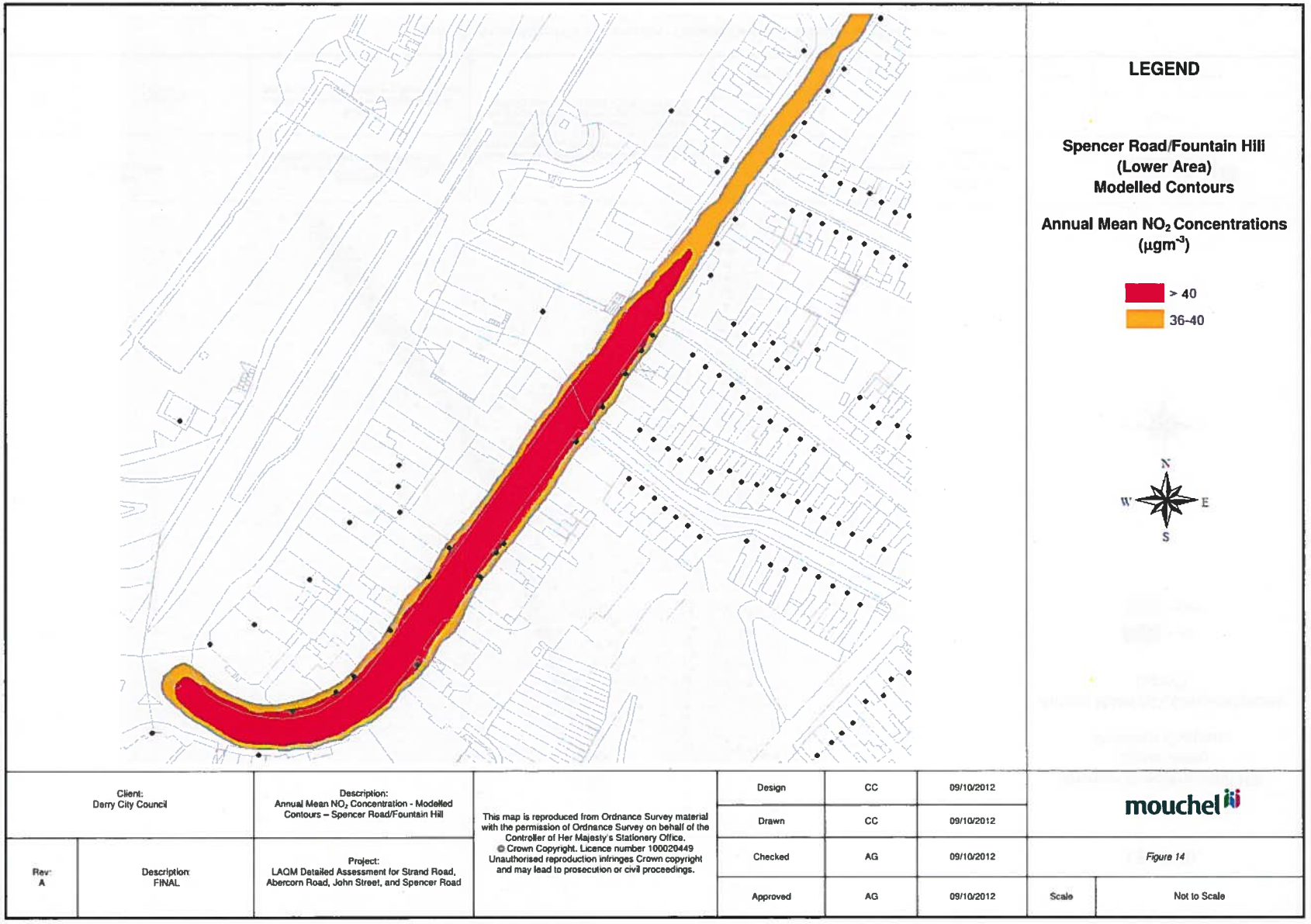

Figure 14 - Annual Mean NO_2 Concentration - Modelled Contours – Spencer Road/Fountain Hill (cont.)

4 Conclusions and Recommendations

A Detailed Assessment of NO_2 concentrations along Strand Road, Abercorn Road, John Street, and Spencer Road has been carried out.

These areas were identified as being at risk of exceeding the annual mean NO_2 objectives in the Council's 2011 Progress Report. The Detailed Assessment has been carried out using a combination of measurements and detailed dispersion modelling, with the model results verified against the measurements.

The assessment has identified locations where the annual mean NO_2 objective is being exceeded at locations of relevant exposure along Strand Road and Spencer Road.

None of these receptors modelled are predicted to experience concentrations exceeding 60 $\mu g/m^3$, therefore the hourly mean NO_2 objective is not at risk of being exceeded.

It is therefore recommended that the Council declares an AQMA for the NO_2 annual mean objective for these two locations.

This should cover, as a minimum, the area shown in Figures 9, 10 and 14 where locations with relevant exposure lie within the 40 $\mu g/m^3$ contour for Strand Road and Spencer Road.

5 References

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Derry City Council, 2011. 2011 Air Quality Progress Report.

Stationery Office, 2000. Air Quality Regulations, 2000, Statutory Instrument 928.

Stationery Office, 2002. The Air Quality (England) (Amendment) Regulations 2002. Statutory Instrument 3043.

6 Appendices

6.1 Appendix A - Summary of Health Effects of NO_2

Pollutant	Main Health Effects
Nitrogen Dioxide	Short-term exposure to high concentrations may cause inflammation of respiratory airways. Long-term exposure may affect lung function and enhance responses to allergens in sensitised individuals. Asthmatics will be particularly at risk (Defra, 2007a).

6.2 Appendix B - Traffic Data

6.2.1 Horizontal Road Alignment

Road alignment was based around Ordnance Survey data. Those roads explicitly included in the modelling have been realigned to reflect the precise location of emission.

6.2.2 Traffic Data

Traffic data for the study area have been produced Derry City Council. These traffic data have been used to calculate vehicle emission rates using the emission factor toolkit (EFT version 5.1.3) available online in the 'tools' section of Defra's LAQM support website (Defta, 2009b).

The traffic links, associated composition, flows and speeds in each assessment year are presented in Table 7 below. The traffic diurnal pattern derived for the four study areas is presented in Figure 15. The numbers represent the identification of the traffic count site and the text the direction each diurnal pattern corresponds to.

Table 7 - Summary of Traffic Characteristics Data – DCC Survey Data

1 UPPER ABERCORN ROAD Traffic Census Derry C C March 2012															Queues		Length		Time		Freq	
	Link			Cars	Vans	Buses	HGV's	Total	Total HGV	Total Vehicles	HGV/Total Veh	Total % HGV	Ave Speed(mph)	Total Ave Speed(mph)		No. Vehicles	Aver	(m)	Aver	(sec)	Aver	(Sec)	Aver
RD1a_AM	a	Weekday	a.m. peak	529	32	5	8	574	34	2699	0.012597258		15		RD1aQ_AM	5		20		20		120	
RD1a_AMOP			a.m. off-peak	361	57	0	12	430					18		RD1aQ_AMOP	5		20		30		30	
RD1a_PM			p.m. peak	495	42	1	1	539					15		RD1aQ_PM	12		48		60		120	
RD1a_PMOP			p.m. off-peak	322	47	1	5	375					19		RD1aQ_PMOP	-	-	-	-	-	-	-	
RD1a_SatAM		Saturday	a.m.	300	34	0	0	334					18		RD1aQ_SatAM	4		16		30		30	
RD1a_SunPM		Sun	p.m.	437	9	0	1	447					20		RD1aQ_SunPM	-	-	-	-	-	-	-	
RD1b_AM	b	Weekday	a.m. peak	326	27	1	3	357	17	2727	0.006233957	0.941560749	15		RD1bQ_AM	-	-	-	-	-	-	-	
RD1b_AMOP			a.m. off-peak	385	55	0	5	445					18		RD1bQ_AMOP	-	-	-	-	-	-	-	
RD1b_PM			p.m. peak	735	42	0	0	777					15		RD1bQ_PM	-	-	-	-	-	-	-	
RD1b_PMOP			p.m. off-peak	415	48	2	4	469					19		RD1bQ_PMOP	-	-	-	-	-	-	-	
RD1b_SatAM		Saturday	a.m.	260	19	2	0	281					18		RD1bQ_SatAM	-	-	-	-	-	-	-	
RD1b_SunPM		Sun	p.m.	381	17	0	0	398					20		RD1bQ_SunPM	4	-	-	-	-	-	-	
														18			6		26		35		75

2 LOWER ABERCORN ROAD Traffic Census Derry C C March 2012															Queues		Length		Time		Freq	
	Link			Cars	Vans	Buses	HGV's	Total	Total HGV	Total Vehicles	HGV/Total Veh	Total % HGV	Ave Speed(mph)	Total Ave Speed(mph)		No. Vehicles	Aver	(m)	Aver	(sec)	Aver	(Sec)	Aver
RD2a_AM	a	Weekday	a.m. peak	531	54	4	6	595	28	2883	0.009712105		20		RD2aQ_AM	-	-	-	-	-	-	-	
RD2a_AMOP			a.m. off-peak	337	53	1	7	398					20		RD2aQ_AMOP	5		20		20		600	
RD2a_PM			p.m. peak	685	38	0	4	727					24		RD2aQ_PM	-	-	-	-	-	-	-	
RD2a_PMOP			p.m. off-peak	483	32	0	3	518					22		RD2aQ_PMOP	-	-	-	-	-	-	-	
RD2a_SatAM		Saturday	a.m.	270	27	1	0	298					20		RD2aQ_SatAM	5		20		5		600	
RD2a_SunPM		Sun	p.m.	331	14	0	2	347					25		RD2aQ_SunPM	4		16		5		1200	
RD2b_AM	b	Weekday	a.m. peak	321	51	2	2	376	30	2216	0.013537906	1.162500579	20		RD2bQ_AM	-	-	-	-	-	-	-	
RD2b_AMOP			a.m. off-peak	332	44	0	18	394					20		RD2bQ_AMOP	-	-	-	-	-	-	-	
RD2b_PM			p.m. peak	423	41	0	2	466					18		RD2bQ_PM	-	-	-	-	-	-	-	
RD2b_PMOP			p.m. off-peak	372	38	0	3	413					22		RD2bQ_PMOP	-	-	-	-	-	-	-	
RD2b_SatAM		Saturday	a.m.	255	6	2	0	263					24		RD2bQ_SatAM	-	-	-	-	-	-	-	
RD2b_SunPM		Sun	p.m.	290	13	0	1	304					28		RD2bQ_SunPM	-	-	-	-	-	-	-	
														22			5		19		10		800

3 JOHN STREET Traffic Census Derry C C March 2012															Queues		Length		Time		Freq	
			Vehicle Class	Cars	Vans	Buses	HGV's	total	Total HGV	Total Vehicles	HGV/Total Veh	Total % HGV	Ave Speed(mph)	Total Ave Speed(mph)		No. Vehicles	Aver (m)		Aver (sec)		Aver (Sec)	Aver
	Link																					
RD3a_AM	a	Weekday	a.m. peak	589	29	22	14	654	126	2469	0.051032807		25		RD3aQ_AM	6	24		10		1200	
RD3a_AMOP			a.m. off-peak	262	36	11	9	318					25		RD3aQ_AMOP	6	24		10		1200	
RD3a_PM			p.m. peak	319	13	14	2	348					25		RD3aQ_PM	6	24		10		1200	
RD3a_PMOP			p.m. off-peak	425	38	22	6	491					25		RD3aQ_PMOP	6	24		10		1200	
RD3a_SatAM		Saturday	a.m.	267	10	10	11	298					25		RD3aQ_SatAM	6	24		10		1200	
RD3a_SunPM		Sun	p.m.	345	10	3	2	360					25		RD3aQ_SunPM	6	24		10		1200	
RD3b_AM	b	Weekday	a.m. peak	231	17	14	14	276	101	2372	0.042580101	4.680645399	25		RD3bQ_AM	6	24		10		1200	
RD3b_AMOP			a.m. off-peak	372	48	7	10	437					25		RD3bQ_AMOP	6	24		10		1200	
RD3b_PM			p.m. peak	471	20	16	5	512					25		RD3bQ_PM	6	24		10		1200	
RD3b_PMOP			p.m. off-peak	354	26	14	6	400					25		RD3bQ_PMOP	6	24		10		1200	
RD3b_SatAM		Saturday	a.m.	365	26	6	2	399					25		RD3bQ_SatAM	6	24		10		1200	
RD3b_SunPM		Sun	p.m.	336	5	6	1	348					25		RD3bQ_SunPM	6	24		10		1200	
														25			6		24		10	1200

4 LOWER SPENCER ROAD Traffic Census Derry C C March 2012															Queues		Length		Time		Freq	
	Link		Vehicle Class	Cars	Vans	Buses	HGV's	Total	Total HGV	Total Vehicles	HGV/Total Veh	Total % HGV	Ave Speed(mph)	Total Ave Speed(mph)		No. Vehicles	Aver (m)		Aver (sec)		Aver (Sec)	Aver
RD4a_AM	a	Weekday	a.m. peak	497	51	0	1	549	14	3306	0.004234725		16		RD4aQ_AM	10	40		120		60	
RD4a_AMOP			a.m. off-peak	505	52	1	8	566					16		RD4aQ_AMOP	6	24		60		60	
RD4a_PM			p.m. peak	607	64	0	0	671					14		RD4aQ_PM	14	64		60		90	
RD4a_PMOP			p.m. off-peak	540	65	0	1	606					16		RD4aQ_PMOP	8	32		30		90	
RD4a_SatAM		Saturday	a.m.	469	39	0	1	509					16		RD4aQ_SatAM	10	40		60		90	
RD4a_SunPM		Sun	p.m.	388	15	0	2	405					18		RD4aQ_SunPM	4	16		45		60	
RD4b_AM	b	Weekday	a.m. peak	410	16	2	1	429	9	2490	0.003614458	0.392459129	20		RD4bQ_AM	-	-	-	-	-	-	-
RD4b_AMOP			a.m. off-peak	366	39	0	2	407					20		RD4bQ_AMOP	-	-	-	-	-	-	-
RD4b_PM			p.m. peak	501	47	0	1	549					20		RD4bQ_PM	-	-	-	-	-	-	-
RD4b_PMOP			p.m. off-peak	449	37	0	1	487					20		RD4bQ_PMOP	-	-	-	-	-	-	-
RD4b_SatAM		Saturday	a.m.	306	23	0	2	331					20		RD4bQ_SatAM	-	-	-	-	-	-	-
RD4b_SunPM		Sun	p.m.	280	7	0	0	287					22		RD4bQ_SunPM	-	-	-	-	-	-	-
														18			9		36		63	75

5 UPPER SPENCER ROAD Traffic Census Derry C C March 2012															Queues		Length		Time		Freq	
	Link		Vehicle Class	Cars	Vans	Buses	HGV's		Total HGV	Total Vehicles	HGV/Total Veh	Total % HGV	Ave Speed(mph)	Total Ave Speed(mph)		No. Vehicles	Aver (m)		Aver (sec)		Aver (Sec)	Aver
RD5a_AM	a	Weekday	a.m. peak	570	69	0	3	642	11	1956	0.005623722		20		RD5aQ_AM	4		16		60		240	
RD5a_AMOP			a.m. off-peak	315	27	0	0	342					20		RD5aQ_AMOP	2		8		30		600	
RD5a_PM			p.m. peak	235	18	0	1	254					20		RD5aQ_PM	4		16		60		240	
RD5a_PMOP			p.m. off-peak	273	27	0	1	301					20		RD5aQ_PMOP	2		8		30		600	
RD5a_SatAM		Saturday	a.m.	210	12	0	6	228					20		RD5aQ_SatAM	2		8		30		600	
RD5a_SunPM		Sun	p.m.	181	8	0	0	189					20		RD5aQ_SunPM	-	-	-	-	-	-	-	
RD5b_AM	b	Weekday	a.m. peak	333	34	1	6	374	15	2275	0.006593407	0.610856424	20		RD5bQ_AM	-	-	-	-	-	-	-	
RD5b_AMOP			a.m. off-peak	424	24	0	0	448					20		RD5bQ_AMOP	-	-	-	-	-	-	-	
RD5b_PM			p.m. peak	390	21	2	1	414					20		RD5bQ_PM	-	-	-	-	-	-	-	
RD5b_PMOP			p.m. off-peak	264	32	0	5	301					20		RD5bQ_PMOP	-	-	-	-	-	-	-	
RD5b_SatAM		Saturday	a.m.	334	23	0	0	357					20		RD5bQ_SatAM	-	-	-	-	-	-	-	
RD5b_SunPM		Sun	p.m.	370	11	0	0	381					20		RD5bQ_SunPM	-	-	-	-	-	-	-	
														20			3		11		42		456

6 STRAND ROAD AT FLETCHER AVENUE Traffic Census Derry C C May 2012															Queues		Length		Time		Freq	
	Link			Cars	Vans	Buses	HGV's	Total	Total HGV	Total Vehicles	HGV/Total Veh	Total % HGV	Ave Speed(mph)	Total Ave Speed(mph)		No. Vehicles	Aver (m)		Aver (sec)		Aver (Sec)	Aver
RD6a_AM	a	Weekday	a.m. peak	713	87	22	28	850	189	6356	0.029735683		30		RD6aQ_AM	-	-	-	-	-	-	-	
RD6a_AMOP			a.m. off-peak	853	86	20	18	977					30		RD6aQ_AMOP	-	-	-	-	-	-	-	
RD6a_PM			p.m. peak	1391	105	26	5	1527					30		RD6aQ_PM	24		110		180		180	
RD6a_PMOP			p.m. off-peak	990	91	28	19	1128					30		RD6aQ_PMOP	-	-	-	-	-	-	-	
RD6a_SatAM		Saturday	a.m.	848	74	7	6	935					30		RD6aQ_SatAM	-	-	-	-	-	-	-	
RD6a_SunPM		Sun	p.m.	894	35	7	3	939					30		RD6aQ_SunPM	-	-	-	-	-	-	-	
RD6b_AM	b	Weekday	a.m. peak	1269	117	21	16	1423	157	6317	0.02485357	2.72946263	30		RD6bQ_AM	-	-	-	-	-	-	-	
RD6b_AMOP			a.m. off-peak	857	111	18	20	1006					30		RD6bQ_AMOP	-	-	-	-	-	-	-	
RD6b_PM			p.m. peak	982	65	17	4	1068					30		RD6bQ_PM	24		110		180		180	
RD6b_PMOP			p.m. off-peak	888	95	28	10	1021					30		RD6bQ_PMOP	-	-	-	-	-	-	-	
RD6b_SatAM		Saturday	a.m.	789	73	9	7	878					30		RD6bQ_SatAM	-	-	-	-	-	-	-	
RD6b_SunPM		Sun	p.m.	905	9	6	1	921					30		RD6bQ_SunPM	-	-	-	-	-	-	-	
														30			24		110		180		180

7 STRAND ROAD AT MEADOWBANK AVENUE Traffic Census Derry C C May 2012															Queues		Length		Time		Freq	
	Link			Cars	Vans	Buses	HGV's	Total	Total HGV	Total Vehicles	HGV/Total Veh	Total % HGV	Ave Speed(mph)	Total Ave Speed(mph)		No. Vehicles	Aver	(m)	Aver	(sec)	Aver	(Sec)	Aver
RD7a_AM	a	Weekday	a.m. peak	736	74	19	13	842	148	5897	0.025097507		18		RD7aQ_AM	8		32		60		180	
RD7a_AMOP			a.m. off-peak	851	83	16	8	958					16		RD7aQ_AMOP	8		32		60		180	
RD7a_PM			p.m. peak	1302	65	24	3	1394					15		RD7aQ_PM	12		48		60		120	
RD7a_PMOP			p.m. off-peak	994	56	42	13	1105					18		RD7aQ_PMOP	8		32		60		180	
RD7a_SatAM		Saturday	a.m.	649	38	2	1	690					15		RD7aQ_SatAM	7		28		30		45	
RD7a_SunPM		Sun	p.m.	866	35	6	1	908					18		RD7aQ_SunPM	8		32		30		180	
RD7b_AM	b	Weekday	a.m. peak	1301	92	24	27	1444	188	5945	0.031623213	2.836036	16		RD7bQ_AM	10		40		50		120	
RD7b_AMOP			a.m. off-peak	840	86	17	17	960					18		RD7bQ_AMOP	8		32		60		180	
RD7b_PM			p.m. peak	724	66	22	7	819					18		RD7bQ_PM	8		32		60		180	
RD7b_PMOP			p.m. off-peak	793	71	27	14	905					18		RD7bQ_PMOP	8		32		60		180	
RD7b_SatAM		Saturday	a.m.	863	50	20	5	938					18		RD7bQ_SatAM	8		32		30		180	
RD7b_SunPM		Sun	p.m.	841	30	6	2	879					18		RD7bQ_SunPM	8		32		30		180	
													17				8		34		49	159

8 STRAND ROAD AT PENNYBURN ROUNDABOUT Traffic Census Derry C C May 2012															Queues		Length		Time		Freq	
	Link			Cars	Vans	Buses	HGV's	Total	Total HGV	Total Vehicles	HGV/Total Veh	Total % HGV	Ave Speed(mph)	Total Ave Speed(mph)		No. Vehicles	Aver	(m)	Aver	(sec)	Aver	(Sec)	Aver
RD8a_AM	a	Weekday	a.m. peak	869	118	23	13	1023	202	7563	0.026708978		20		RD8aQ_AM	-	-	-	-	-	-	-	
RD8a_AMOP			a.m. off-peak	795	103	28	32	958					25		RD8aQ_AMOP	8		32		10		180	
RD8a_PM			p.m. peak	1644	124	31	2	1801					25		RD8aQ_PM	6		24		5		60	
RD8a_PMOP			p.m. off-peak	1506	88	30	23	1647					25		RD8aQ_PMOP	6		24		5		240	
RD8a_SatAM		Saturday	a.m.	883	63	7	7	960					22		RD8aQ_SatAM	5		24		5		240	
RD8a_SunPM		Sun	p.m.	1138	30	3	3	1174					18		RD8aQ_SunPM	10		40		5		120	
RD8b_AM	b	Weekday	a.m. peak	1538	212	29	31	1810	181	8856	0.020438121	2.35735495	30		RD8bQ_AM	-	-	-	-	-	-	-	
RD8b_AMOP			a.m. off-peak	935	113	17	19	1084					30		RD8bQ_AMOP	-	-	-	-	-	-	-	
RD8b_PM			p.m. peak	1580	88	29	3	1700					30		RD8bQ_PM	-	-	-	-	-	-	-	
RD8b_PMOP			p.m. off-peak	1245	96	22	7	1370					30		RD8bQ_PMOP	-	-	-	-	-	-	-	
RD8b_SatAM		Saturday	a.m.	1555	47	9	5	1616					30		RD8bQ_SatAM	-	-	-	-	-	-	-	
RD8b_SunPM		Sun	p.m.	1236	30	8	2	1276					30		RD8bQ_SunPM	-	-	-	-	-	-	-	
													26				7		29		6	168

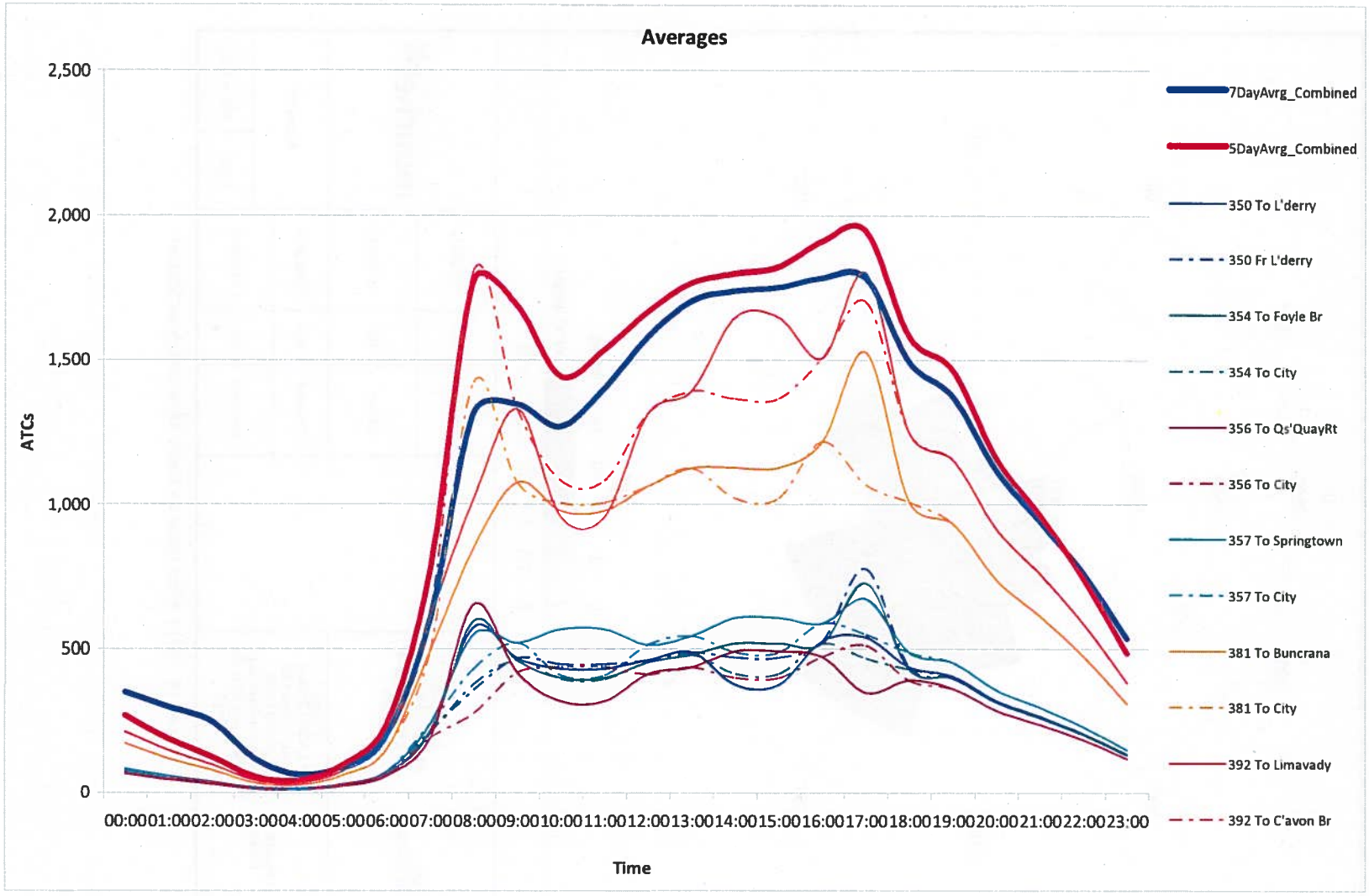
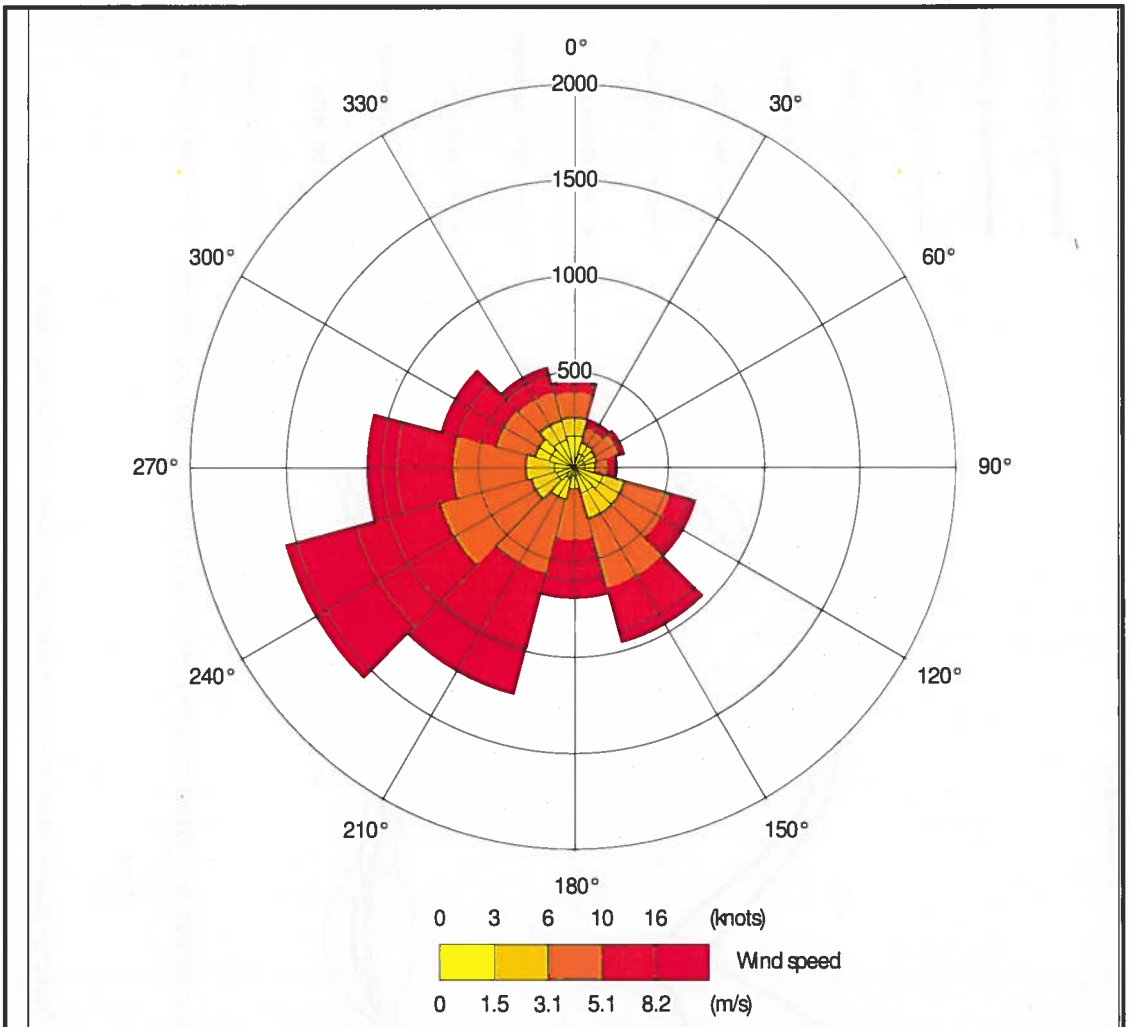


Figure 15 - Diurnal Pattern of Traffic for Strand Road, Abercorn Road, John Street, and Spencer Road

6.3 Appendix C - Meteorological Data



Client: Derry City COuncil		Description: 2011 Wind Rose for Derry Meteorological Station		Design	CC	11/10/2012
				Drawn	CC	11/10/2012
Rev: A	Description: FINAL	Project: LAQM Detailed Assessment for Strand Road, Abercorn Road, John Street, and Spencer Road		Checked	AG	11/10/2012
				Approved	AG	11/10/2012

mouchel

Figure 15

Scale: Not to Scale

Figure 16 - 2011 Wind Rose for Derry Meteorological Station

6.4 Appendix D - Model Verification and Adjustment

The comparison of modelled concentrations with local monitored concentrations is a process termed 'verification'. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and/or uncertainties in model input data, modelling and monitoring data assumptions. The following are examples of potential causes of such discrepancy:

- estimates of background pollutant concentrations;
- meteorological data uncertainties;
- traffic data uncertainties;
- model input parameters, such as 'roughness length'; and
- overall limitations of the dispersion model.

6.4.1 Model Precision

Residual uncertainty may remain after systematic error or 'model accuracy' has been accounted for in the final predictions. Residual uncertainty may be considered synonymous with the 'precision' of the model predictions, i.e. how wide the scatter or residual variability of the predicted values compare with the monitored true value, once systematic error has been allowed for. The quantification of model precision provides an estimate of how the final predictions may deviate from true (monitored) values at the same location over the same period.

Suitable local monitoring data for the purpose of verification are available for concentrations of NO_2 at the locations shown in section 3.1. These monitoring data have been used to validate the dispersion model prediction and obtain adjustment factors which can be applied to predictions of pollutant concentrations.

6.4.2 Model Performance

An evaluation of model performance has been undertaken to establish confidence in model results. LAQM.TG(09) (Defra, 2009) identifies a number of statistical procedures that are appropriate to evaluate model performance and assess the uncertainty. The statistical parameters used in this assessment are:

- root mean square error (RMSE);
- fractional bias (FB); and
- correlation coefficient (CC).

A brief for explanation of each statistic is provided in Table 8, and further details can be found in LAQM.TG(09) Box A3.7.

Table 8 - Model Performance Statistics

Statistical Parameter	Comments	Ideal value
RMSE	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared. If the RMSE values are higher than 25% of the objective being assessed, it is recommended that the model inputs and verification should be revisited in order to make improvements. For example, if the model predictions are for the annual mean NO_2 objective of 40 $\mu g/m^3$, if an RMSE of 10 $\mu g/m^3$ or above is determined for a model it is advised to revisit the model parameters and model verification. Ideally an RMSE within 10% of the air quality objective would be derived, which equates to 4 $\mu g/m^3$ for the annual mean NO_2 objective.	0.01
FB	It is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.	0.00
CC	It is used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship. This statistic can be particularly useful when comparing a large number of model and observed data points.	1.00

These parameters estimate how the model results agree or diverge from the observations. These calculations have been carried out prior to, and after, adjustment and provide information on the improvement of the model predictions as a result of the application of the verification adjustment factors.

6.4.3 Assessment Verification Methodology

The model outputs of road-NO_x (i.e. the component of total NO_x coming from road traffic) were compared with the measured road-NO_x at the diffusion tube locations. Mouchel have then applied a two stage model Verification process in order to suitably correct any under or over estimations in the model, developing the method set out by Defra (2009) and taking into account the most recent guidance.

Total measured NO_x was calculated from the measured NO_2 concentrations at the monitoring locations using the recently updated NO_x from NO_2 calculator available on

the Defra's LAQM website. The measured road-NO_x contribution was then calculated as the difference between the total and the background value. The NO_x roads adjustment factor was determined as the multiplier between the calculated (measured) road contribution and the model derived road contribution.

Detail of the verification process data is presented in Table 9.

Table 10 presents the model performance.

Figure 17 summarises the Modelled versus Monitored data used in this assessment.

Table 9 - Verification Summary Data

Site ID	X	Y	Modelled Road NO_x	Monitored NOx (Roads) - NAQIA NO_x from NO2 Calculator TG(09)	Modelled Vs. Monitored NO_x (Roads) %	Adjusted modelled NO_x Roads	Background NO_x	Background NO_2	Monitored NO_2	Monitored Road NO_2	Modelled Road NO_2	Modelled Vs. Monitored NO_2 (Roads) %	Adjusted modelled NO_2 Roads	Modelled Vs. Monitored NO_2 (Roads) %	Modelled tot NO_2	% Difference	Adjusted Total NO_2	%Difference
AB1	243166	416211	19	47	-61%	77	21	16	38	22	32	0.50	34	59%	50	34%	54	44
JS1	243627	416308	5	44	-88%	22	21	16	36	20	11	-0.46	12	-43%	28	-24%	30	-18
JS2	243602	416279	11	45	-77%	43	21	16	37	21	20	-0.04	21	2%	37	1%	40	8
S1	243522	417894	5	45	-90%	19	21	16	37	21	9	-0.56	10	-53%	26	-30%	28	-25
S2	243607	418037	5	37	-87%	20	21	16	34	18	10	-0.44	10	-41%	26	-21%	28	-16
SP1	244011	416068	5	61	-92%	20	21	16	43	27	10	-0.64	10	-62%	26	-39%	28	-34
				Factor A	**4.09**						**Factor B**	**1.06**			**Factor C**	**1.07**		

Table 10 - Model Performance

	No Adjustment	NO_x Roads Adjustment	NO_2 Roads Adjustment	NO_2 Total Adjustment
Adjustment Factor A		**4.09**		
Adjustment Factor B			**1.06**	
Adjustment Factor C				**1.07**
Correlation Co-efficient	0.0	0.0	0.0	0.0
RMSE	10.8	8.9	-	-
Fractional Bias	0.2	0.0	0.1	0.1
Within +-10%	1	1	1	1
Within +-10 to 25%	1	1	2	2
Within +- 25%	2	2	3	3
Greater +- 25%	4	4	3	3

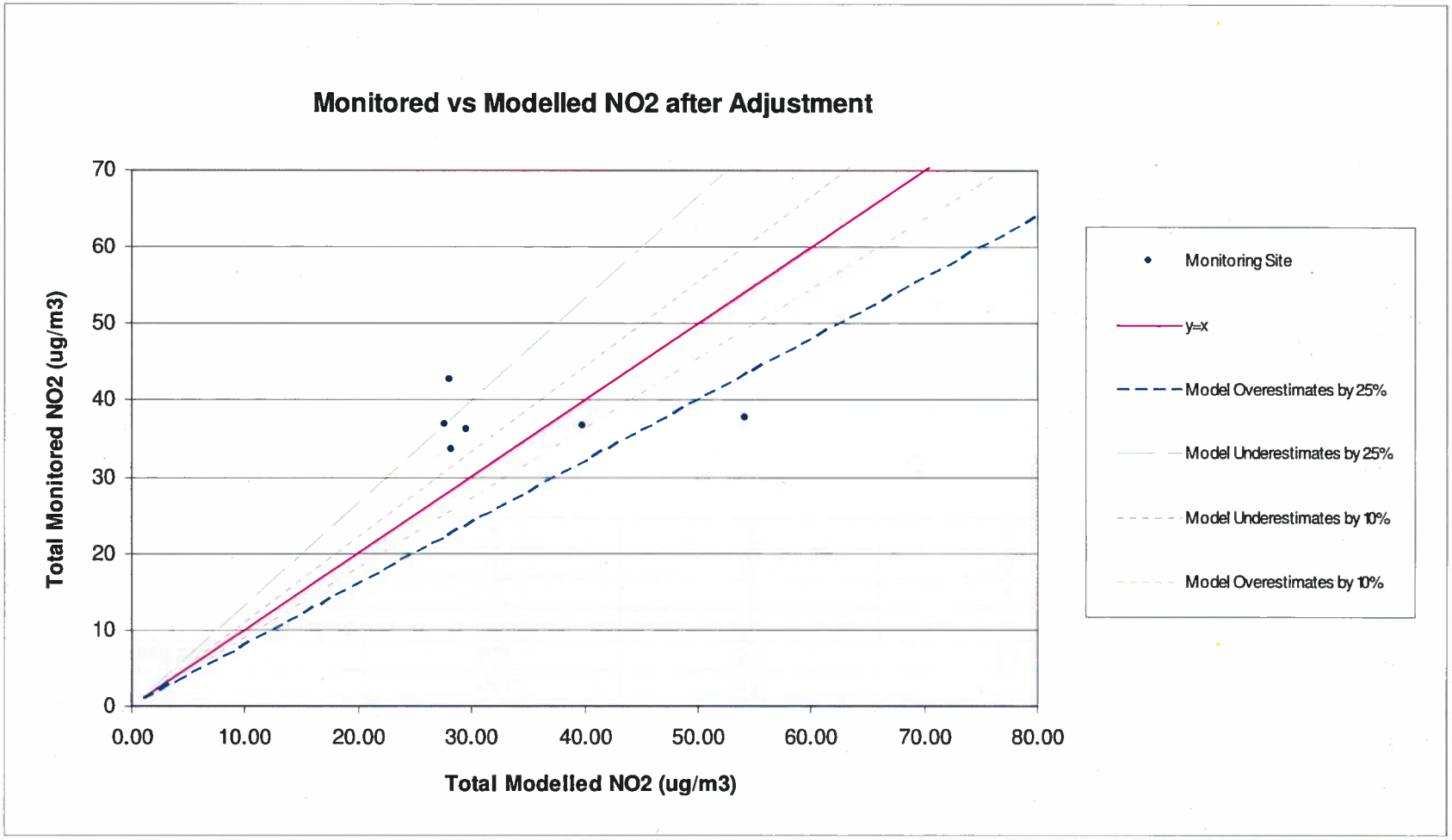


Figure 17 - Monitored versus Modelled after adjustment