Detailed Assessment of Air Quality 2013

Hafodyrynys, Caerphilly

Report for Caerphilly County Borough Council

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Contact:

David Hector
Ricardo-AEA Ltd
Lochshore Business Park, Glengarnock, KA14 3DD
t: 0123575 3523
e: david.hector@ricardo-aea.com
Ricardo-AEA is certificated to ISO9001 and ISO14001

Author:

David Hector

Approved By:

Dr Scott Hamilton

Date:

15 May 2013

Signed:

Executive summary

RICARDO-AEA were commissioned to undertake this Detailed Assessment of Air Quality for Woodside Terrace (A472), Hafodyrynys by Caerphilly County Borough Council. The assessment has been undertaken to investigate the potential scale and extent of exceedances of Air Quality Objectives in the study area. This Detailed Assessment will allow Caerphilly County Borough Council to decide whether or not an Air Quality Management Area is required at the location.

This modelling study, which covered the period 1st January to 31st December 2012 and used the most recent traffic, monitoring and meteorological data for Woodside Terrace, Hafodyrynys indicates that there are exceedances of the NO_2 annual mean and hourly mean objective at locations with relevant exposure.

The exceedance area encompasses;

- All houses on the South side of the A472 at Woodside Terrace
- All houses on the North side of the A472 directly opposite Woodside Terrace

We estimate that a population of about 78 people are exposed to the annual mean exceedance, based on average house occupancy data for Caerphilly.

Automatic monitoring for 2012 has also shown that the NO_2 hourly mean objective was also breached. It is likely that the hourly exceedance is localised spatially and does not appear to affect any of the residential properties. That said, as the pavement is affected this does constitute a measured exceedance of the hourly objective and any proposed AQMA declaration should reflect this.

In light of this Detailed Assessment of Air quality, CCBC should consider declaring an Air Quality Management Area encompassing all receptors with an exceedance of the NO_2 objective predicted in this study.

A Further Assessment should be completed within 12 months of the AQMA's declaration. All monitoring should be at locations of relevant exposure as described in Defra Technical Guidance LAQM.TG(09)

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1 Introduction

RICARDO-AEA was commissioned to undertake this Detailed Assessment of Air Quality for Woodside Terrace (A472), Hafodyrynys by Caerphilly County Borough Council (CCBC). The assessment has been undertaken to investigate the potential scale and extent of exceedances of Air Quality Objectives for NO_2 in the study area. This Detailed Assessment will allow CCBC to decide whether or not an Air Quality Management Area is required at the location.

1.1 Policy background

The Environment Act 1995 placed a responsibility on UK Government to prepare an Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland. The most recent version of the strategy (2007) sets out the current UK framework for air quality management and includes a number of air quality objectives for specific pollutants.

The 1995 Act also requires that Local Authorities "Review and Assess" air quality in their areas following a prescribed timetable. The Review and Assessment process is intended to locate and spatially define areas where the AQS objectives are not being met. In such instances the Local Authority is required to declare an Air Quality Management Area (AQMA), carry out a Further Assessment of Air Quality, and develop an Air Quality Action Plan (AQAP) which should include measures to improve air quality so that the objectives may be achieved in the future. The timetables and methodologies for carrying out Review and Assessment studies are prescribed in Defra's Technical Guidance- LAQM.TG(09).

Table 1 lists the objectives pertinent to this assessment that are included in the Air Quality Regulations 2000 and (Amendment) Regulations 2002 for the purposes of Local Air Quality Management (LAQM).

Table 1 NO2 Objectives included in the Air Quality Regulations and subsequent Amendments for the purpose of Local Air Quality Management

Pollutant	Air Quality Objective	
	Concentration	Measured as
Nitrogen dioxide	200 µg m-3 not to be exceeded more than 18 times a year	1 hour mean
	40 $\mu g.m^{-3}$	annual mean

1.2 Locations where the objectives apply

When carrying out the review and assessment of air quality it is only necessary to focus on areas where the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Table 2 summarises examples of where air quality objectives for NO_2 should and should not apply.

Table 2 NO2 Objectives included in the Air Quality Regulations and subsequent Amendments for the purpose of Local Air Quality Management

Averaging Period	Pollutants	Objectives *should* apply at …	Objectives should *not* generally apply at …
Annual mean	NO_2	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.	Building facades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short term
1-hour mean	NO_2	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks and railway stations etc. which are not fully enclosed. Any outdoor locations to which the public might reasonably be expected to have access.	Kerbside sites where the public would not be expected to have regular access.

1.3 Purpose of this Detailed Assessment

This study is a Detailed Assessment, which aims to assess the magnitude and spatial extent of any exceedances of the NO_2 objective at locations with relevant exposure in Woodside Terrace (A472), Hafodyrynys, Caerphilly.

1.4 Overview of the Detailed Assessment

The general approach taken to this Detailed Assessment was:

- Collect and interpret data from previous Review and Assessment reports;
- Collect and analyse recent traffic, monitoring, meteorological and background concentration data before use in the dispersion model;
- Use dispersion modelling to produce numerical predictions of NO_2 concentrations at points of relevant exposure;
- Recommend whether CCBC should declare an AQMA at Woodside Terrace, Hafodyrynys Road and suggest its spatial extent.

The modelling methodologies provided for Detailed Assessments outlined in Defra Technical Guidance LAQM.TG(09)[1] were used throughout this study.

1.5 Previous Review and Assessments

The following is summary of the information extracted from recent review and assessment reports relevant to air quality within the town of Hafodyrynys. This summary aims to provide the background history relevant to the Detailed Assessment currently being conducted for Hafodyrynys Road (A472), Caerphilly.

2003 Updating and Screening assessment (USA): The 2003 Updating and Screening Assessment concluded that all the air quality objectives would be met by the relevant deadlines, but that further monitoring was required at a number of locations where road traffic emissions were highest.

2004 Progress Report: The 2004 Progress report did not predict any exceedances of the objectives but recommended continued diffusion tube monitoring and the instigation of automatic monitoring in Caerphilly town centre

2005 Progress Report: The 2005 Progress report indicated possible exceedances of the annual mean for NO_2 objective at two locations in the County Borough, Blackwood High Street and Caerphilly Town Centre.

2006 Updating and Screening assessment: The 2006 USA confirmed the exceedances in Caerphilly Town Centre.

2007 and 2008 Progress Reports: The 2007 and 2008 Progress Reports corroborated the finding of the 2006 Updating and Screening Assessment.

2009 Updating and Screening Assessment: The 2009 USA concluded several areas within Caerphilly Town Centre were exceeding the annual mean objective for NO_2 however the majority of these locations were already contained within the AQMA and were the focus of a Further Assessment. Areas outside the AQMA, Ton-Y-Felin Street and Nantgarw Road were also included within the Further Assessment. CCBC was not required to proceed to a Detailed Assessment for any other areas within the County Borough.

2010 Progress Report: The 2010 Progress Report showed that there were exceedances of the annual mean objective for NO_2 at a number of locations in the Caerphilly Borough, the majority of which already encompassed within the existing AQMA. Two other areas namely Nantgarw Road, Caerphilly and Woodside Terrace, Hafodyrynys were identified as areas of concern in relation to the NO_2 annual mean objective. Further monitoring was to be carried out at these locations with the intention to proceed to a Detail Assessment if required.

2011 Progress Report: The 2011 Progress Report identified sites within the Caerphilly Borough where the annual mean for NO_2 objectives were being exceeded. The majority of these monitoring sites fell within the current Caerphilly Town Centre Air Quality Management Area (AQMA). However two other areas were identified which were not covered by this AQMA and as such CCBC was required to proceed to a Detailed Assessment for Nantgarw Road, Caerphilly and Woodside Terrace, Hafodyrynys.

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

2 Detailed Assessment study area

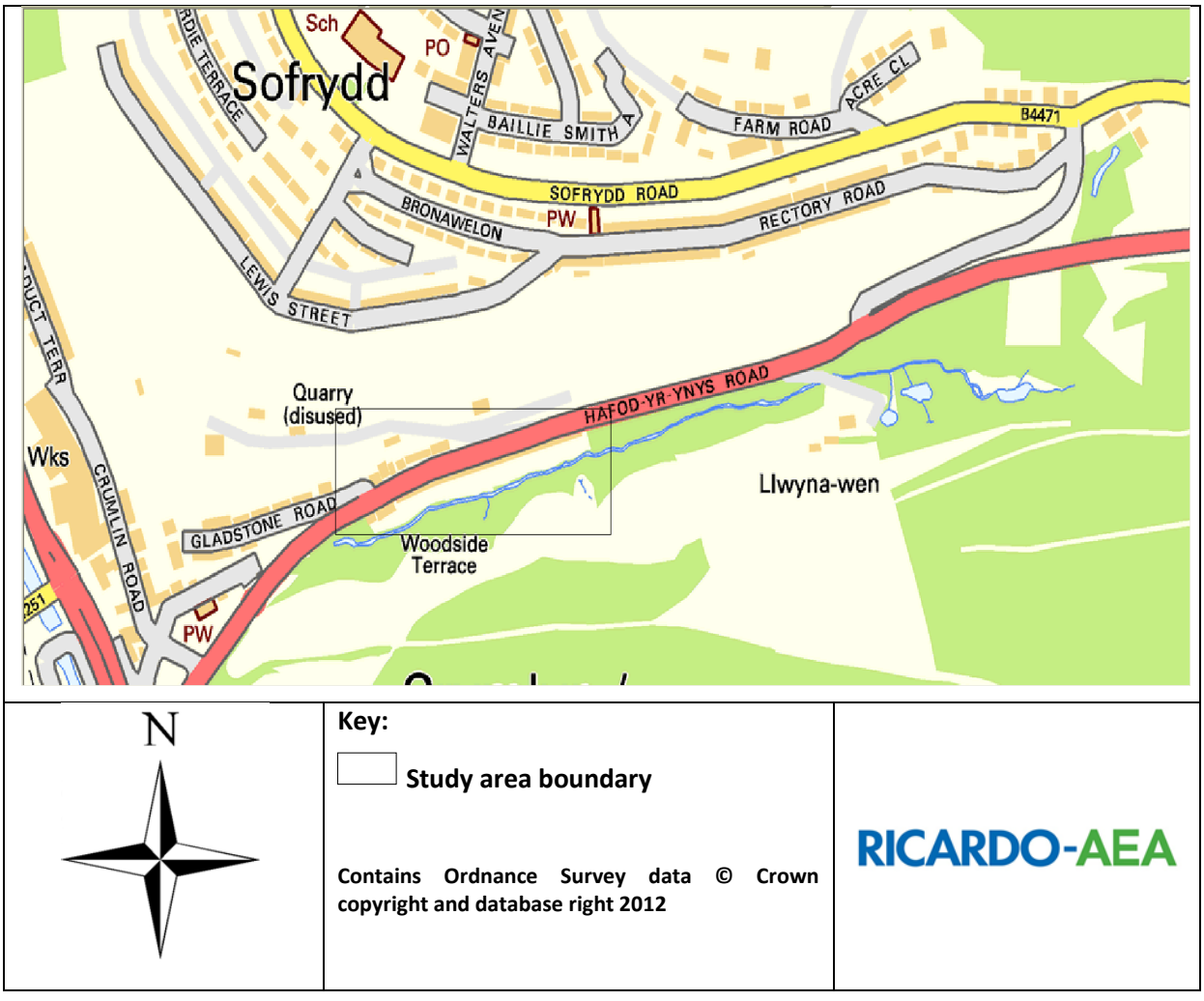
Hafodyrynys is a small village community which lies just inside the Caerphilly County Borough boundary between Crumlin and Pontypool on the A472. The village lies in a valley which offers an important East - West road connection across the South-Eastern valleys of Wales.

This Detailed Assessment specifically studies the area of Woodside Terrace located between the village of Hafodyrynys and Crumlin on the A472. Woodside terrace is situated in the foot of a high sided valley and has a row of two storey terraced houses at the south side of the road and a large supporting wall on the north side. On top of the north side supporting wall there is a mixture of two storey semi-detached and detached housing.

The A472 is a major commuter route for people travelling East to West and vice versa.

The study area is shown in Figure 1 below.

Figure 1 Detailed Assessment study area: Woodside Terrace, Hafodyrynys Road (A472)



3 Information used to support this assessment

3.1 Maps

Ordnance Survey based GIS data of the model domain and a road centreline GIS dataset were used in the assessment. This enabled accurate road widths and the distance of the housing to the kerb to be determined in ArcMap.

3.2 Road traffic data

3.2.1 Average flow, speed and fleet split

Daily traffic flow data and percentage of different vehicle classes were derived from a traffic count study carried out at Woodside Terrace in 2011 by Caerphilly County Borough Council. The traffic count point (grid ref 321700, 198580) was located near the centre of the study location providing confidence that the traffic data used are appropriate for the assessment.

Some assumptions have been made when calculating traffic flows on the roads. Appendix 1 summarises all of the traffic flow data used, the road links modelled, the data sources and any assumptions made. In addition CCBC provided information on estimated speeds, queuing length and times for the study area described.

Traffic patterns in urban locations are complex and it is not possible to fully represent these in commercial dispersion models. By attempting to describe these complex traffic patterns using quite simple metrics (AADT, average speed) a degree of uncertainty is introduced into the modelling.

3.2.2 Congestion

Traffic is known to become congested along Woodside Terrace especially during peak commuting hours in the morning and early evening. CCBC provided local knowledge of where and at what times the congestion typically occurs.

A method of modelling queuing traffic using ADMS-Roads proposed by model developers CERC has been used to represent the periodic congestion3. The method assumes that the vehicles are travelling at the lowest speed that can be modelled using ADMS-Roads (5 km/hr), with an average vehicle length of 4 m, and are positioned close to each other during congested periods. The annual average hourly traffic (AAHT) flow is calculated by dividing the speed of the vehicles by the average vehicle length, which gives a representative AAHT of 1250 vehicles per hour during congested periods.

3.2.3 Emissions factors

The most recent version of the Emissions Factors Toolkit[2] (EfT V5.2) was used in this assessment and the factors derived were input into the ADMS-Roads model. Parameters such as traffic volume, speed and fleet composition are entered into the EfT, and an emissions factor in grams of NOx/kilometre/second is generated for input into the dispersion model. The version of the EfT used incorporates the latest COPERT emission factors published in 2012 by Defra.

3.3 Ambient monitoring

NO_2 concentrations are monitored by diffusion tube at locations throughout CCBC. Three of these Diffusion tubes (Tubes CCBC48, CCBC50 and CCBC60) are located within the area being modelled in this assessment. Details of the type, locations, and concentrations recorded by the diffusion tubes are given in section 4 of this report.

An automatic monitoring site (NOx only) was installed at Woodside Terrace (Grid Ref: 321727, 198589) on the 29th November 2011. Details of the type, location, and concentrations measured by this site are given in section 4 of this report.

3.4 Meteorological data

Hourly sequential meteorological data for 2011 from St Athans was obtained from a third party supplier and used in this assessment. The chosen site is located approximately 22 km south west of the study area and has good data quality for the period of interest. A wind rose for the meteorological dataset is presented in Appendix 2.

It should be noted that meteorological measurements are subject to their own uncertainty which will unavoidably carry forward into this assessment.

3.5 Background concentrations

Background concentrations of NOx were derived from the Defra background maps[3]. A CSV file containing concentrations across Caerphilly Borough Council was obtained and the grid square was selected with the appropriate concentration for the assessment. A mapped NOx background concentration of 19 µg m^{-3} was used in this assessment.

The Defra maps are the outputs of a national scale dispersion model and will therefore be subject to a degree of uncertainty, which will be carried forward into this assessment.

[2] http://laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#eft
[3] http://laqm1.defra.gov.uk/review/tools/background.php

4 Monitoring- NO_2

4.1 2012 Diffusion monitoring data

Caerphilly County Borough Council currently monitors NO_2 on Woodside Terrace using a network of diffusion tubes. A map showing the location of the diffusion tube sites is presented in Figure 2.

Table 3 lists the 2012 NO_2 diffusion tube monitoring sites in Woodside Terrace, all of which are relevant to this assessment. A bias adjustment factor of 0.88 was applied to all of the reported 2012 diffusion tube results. This factor was derived from both co-location studies at the Council's Blackwood High Street and White Street automatic monitoring sites. Bias Adjustment factors were worked out for each site using the local bias adjustment spreadsheet supplied by Defra[4] and an average was taken. All workings are given in Appendix 4 of the report.

A summary of the diffusion tube measurements at the Woodside Terrace sites in 2012 is presented in Table 3. Annual mean NO_2 concentrations in excess of the 40 µg m^{-3} objective were measured at all sites during 2012.

Whilst reviewing the diffusion tube data the decision was made to disregard the month of January's data for both tubes CCBC50 and CCBC60. The reason for this decision was that the concentrations were found to be outliers from the rest of the data (both across the year for those locations and across the network for that specific month). If these data had been used the annual mean for those sites would be skewed by a significant amount.

It should be noted that Tube CCBC48 data capture was below 75% for 2012. This data was not annualised due to the individual missing months of data being spread out across the year rather than over a specific period.

Table 3 Diffusion tube locations in Woodside Terrace, with bias corrected data for 2012

Tube Ref	Site Description	Type	OS Grid Ref.		Data Capture 2012 (%)	Bias corrected annual mean (µg.m^{-3})
			Easting	Northing		
CCBC48	1 Woodside Tce,Hafodrynys	F	321647	198557	67	**45.3**
CCBC50	Just past Woodside Tce, on hill	R	321829	198615	92	**46.6**
CCBC60	3 New Houses, opp. 5 Woodside Terrace	F	321682	198590	100	**42.1**

Exceedances of the annual mean objective are shown in bold
F – Façade of building, and location of relevant exposure to the public
R - Roadside
CCBC48 and CCBC60 are at sites of relevant exposure

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

4.2 2012 Automatic Monitoring Data

The automatic monitoring site at Woodside Terrace (NO_2 only) was installed (Grid Ref: 321727, 198589) on the 29th November 2011. The sample inlet in situated approximately 1.6 metres from the kerbside and 2.7 metres from the nearest receptor point. Monitoring data for 2012 is given in table 4 and table 5 below. All data has been fully ratified by Ricardo-AEA to the UK national network standard. As shown below both annual and hourly mean objectives were exceeded at Woodside Terrace in 2012.

It should be noted that the automatic site is not located at a site of relevant exposure for the annual mean objective and it is likely the hourly exceedance is quite localised spatially, and may not affect any of the properties. That said the number of hourly exceedances is much greater than the 18 allowed by the objective (see Table 1). However with the pavement being affected this does constitute a measured exceedance of the hourly objective and any AQMA declaration should reflect this.

Table 4 Automatic Monitoring Data 2012: Woodside Terrace, Hafodyrynys

Pollutant	NO_2 ($\mu g\ m^{-3}$)
Maximum hourly mean	311 $\mu g\ m^{-3}$
Maximum daily mean	136 $\mu g\ m^{-3}$
Annual Average	71 $\mu g\ m^{-3}$
Data capture	98.2%

Table 5 Automatic Monitoring Data 2012: Woodside Terrace, Hafodyrynys continued..

Pollutant	Air Quality Objective	Exceedances	Days
NO_2	Annual mean > 40 $\mu g\ m^{-3}$	1	-
NO_2	Hourly mean > 200 $\mu g\ m^{-3}$	137	87

Figure 2: Woodside Terrace, Hafodyrynys Road, diffusion tube locations

N

Key:

Diffusion tube site

Automatic Monitor

RICARDO-AEA

5 Modelling- NO_2

5.1 Modelling methodology

Annual mean NO_2 concentrations for the study period have been modelled using the atmospheric dispersion model ADMS Roads (version 3.1).

The model was verified by comparing the modelled predictions of road NOx with local monitoring results. The available diffusion tube and automatic measurements (described in Section 4 above) were used to verify the annual mean road NOx model predictions. Following initial comparison of the modelled concentrations with the available monitoring data, refinements were made to the model input to achieve the best possible agreement with the monitoring results. Further information on model verification is provided in Section 5.1.3 and Appendix 1.

A surface roughness of 0.5 m was used in the modelling to represent the open suburbia land-use present across the modelled domain. A limit for the Monin-Obukhov length of 10 m was applied to represent a small town.

It has not been possible in this instance to produce dispersion plots and we rely instead on numerical predictions at residential receptors to characterise NO_2 concentrations. The domain is reasonably complex with the North side properties being at greater height in relation to the road than the South side properties. The North side also has a wall and a steep slope up to the properties which cannot be represented in the ADMS-Roads model. Dispersion plots require selection of a representative height- there is no such value that covers both sides of the road. In any case, there is only a single row of properties on each side of the road, and so any AQMA declaration would include only these properties.

Queuing traffic was treated in the model using the methodology described in Section 3.2.2 above as provided by the model developers. Queuing was assigned to specific road sections based on local knowledge following consultation with CCBC. A time varying emissions file was used in the model to account for daily variations in queuing traffic. Further information on the queues modelled is presented in Appendix 1.

It should be noted that any dispersion modelling study has a degree of uncertainty associated with it; all reasonable steps have been taken to reduce this where possible.

5.1.1 Treatment of modelled NOx road contribution

It is necessary to convert the modelled NOx concentrations to NO_2 for comparison with the relevant objectives. The Defra NOx/NO_2 model[5] was used to calculate NO_2 concentrations from the NOx concentrations predicted by ADMS-Roads. The model requires input of the background NOx, the modelled road contribution and the proportion of NOx released as primary NO_2. For the purposes of this assessment we have assumed that 22% of NOx is released as primary NO_2- the value associated with the "All other UK urban traffic" option in the model.

5.1.2 Validation of ADMS-Roads

In simple terms, validation of the model is the process by which the model outputs are tested against monitoring results at a range of locations and the model is judged to be suitable for use in specific applications.

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

CERC have carried out extensive validation of ADMS applications by comparing modelled results with standard field, laboratory and numerical data sets, participating in EU workshops on short range dispersion models, comparing data between UK M4 and M25 motorway field monitoring data, carrying out inter-comparison studies alongside other modelling solutions such as DMRB and CALINE4, and carrying out comparison studies with monitoring data collected in cities throughout the UK using the extensive number of studies carried out on behalf of local authorities and DEFRA.

5.1.3 Verification of the model

Verification of the model involves comparison of the modelled results with any local monitoring data at relevant locations. This helps to identify how the model is performing at the various monitoring locations. The verification process involves checking and refining the model input data to try and reduce uncertainties and produce model outputs that are in better agreement with the monitoring results. This can be followed by adjustment of the modelled results if required.

LAQM.TG(09) recommends making the adjustment to the road contribution only and not the background concentration these are combined with. The approach outlined in Example 2 of LAQM.TG(09) has been used in this case.

The modelled concentrations in this study were verified using the four available monitoring sites, two of which were located on the façade of buildings with relevant public exposure, and two in roadside locations. The comparison of monitored against modelled NOx revealed that the model was under-predicting the Road NOx component when compared with the measurements. It was also found that the model was under predicting significantly more on the north side of Hafodyrynys Road than the south side.

Following various refinements to the model inputs, the model continued to under predict by significantly more on the north side of Hafodyrynys Road. This under prediction was attributed to the model coping poorly with the topography of the north side of the road.

Due to this, separate adjustment factors were used for each side of the road to correct the modelled road NOx contribution. To bring the predicted NO_2 concentrations within good agreement an average adjustment factor of 2.2 was used for the south side of the road and 4.6 was used for the north side. The adjusted total NO_2 concentrations were then calculated using the Defra NOx/NO_2 calculator. All reasonable steps were taken to improve model agreement prior to the model adjustment step.

After the NOx/NO_2 model was run no further adjustments were made to the data. Tables 6 and 7 show how the adjustment factors were derived using modelled and measured road NOx.

Verifying modelling data with automatic and diffusion tube data will always be subject to uncertainty due to the inherent limitations in such monitoring data. The adjusted model agrees well with available local monitoring and has therefore been assessed to perform sufficiently well for use within this Detailed Assessment without further adjustment.

It is normally best practise to calculate the root mean square error (RMSE) for the modelling results as it provides an estimate of model uncertainty. In this case the RMSE was not calculated due to the lack of monitoring sites and data. The inclusion of more monitoring sites in the area will assist in characterising model uncertainty in future reports.

Table 6 Comparison of modelled/measured Road NOx concentrations to derived adjustment factor for south side of Hafodyrynys Road

Site	NO_x annual mean concentration ($\mu g.m^{-3}$)		
	Modelled NO_x	Measured	Factor
CCBC 48 (1 Woodside Terrace, Hafodyrynys)	32.8	72.07	2.2
CCBC 50 (Just past Woodside Terrace, on hill)	38.1	75.73	2.0
Automatic Monitoring site	60.8	155.75	2.6
Derived mean adjustment factor =			**2.2**

Table 7 Comparison of modelled/measured Road NOx concentrations to derived adjustment factor for north side of Hafodyrynys Road

Site	NO_x annual mean concentration ($\mu g.m^{-3}$)		
	Modelled NO_x	Measured	Factor
CCBC 60, **(3 New Houses, opp. 5, Woodside Terrace)**	13.8	63.23	4.6
Derived mean adjustment factor =			**4.6**

5.1.4 Receptor locations

The adjusted model has been used to predict NO_2 concentrations for discrete receptors within the study area. The receptors are located at the facade of buildings in the model domain where CCBC have indicated that relevant exposure exists. The receptors have been modelled using varying heights depending on which side of the street they are on and where on the street they are located (i.e. receptors located on the north side are higher in relation to the road surface than on the south side due to the supporting wall and sloped gardens). All receptor locations coordinates and heights are given and illustrated in Appendix 3 of this report.

5.2 Modelling results

Table 6 shows the predicted annual mean concentrations for 2012 at the modelled receptors. As shown all modelled receptor points, except HN10, have predicted NO_2 concentrations above or around the annual mean objective of $40\mu gm^{-3}$. Highest of these concentrations are located at receptor points on the south side of Hafodyrynys Road (Woodside Terrace) as illustrated in Figures 3 and 4.

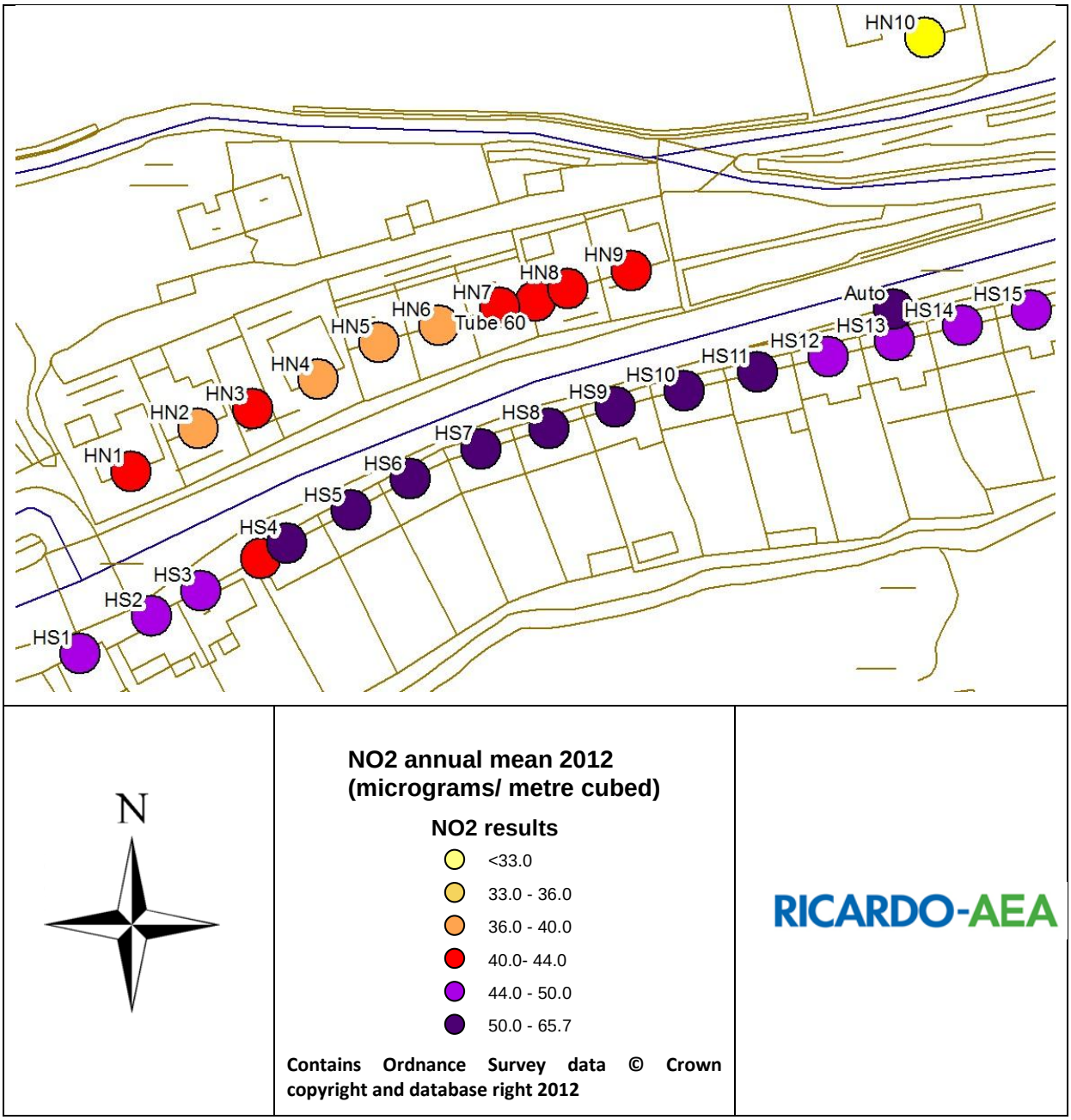
Table 8 Modelled annual mean NO2 concentrations at discrete receptors ($\mu g\ m^{-3}$)

Receptor Name	NO_2 ($\mu g\ m^{-3}$)
Diffusion tube CCBC48	**43.6 (45.3)**
Diffusion tube CCBC50	**47.4 (46.6)**
Diffusion tube CCBC60	**40.6 (42.1)**
Automatic Monitoring Site	**64.7 (71.0)**
HS1	**47.3**
HS2	**47.9**
HS3	**48.1**

Receptor Name	NO_2 (μg m^{-3})
HS4	**50.7**
HS5	**52.1**
HS6	**54.3**
HS7	**54.9**
HS8	**52.9**
HS9	**52.7**
HS10	**51.7**
HS11	**51.2**
HS12	**49.6**
HS13	**48.8**
HS14	**47.7**
HS15	**46.7**
HS16	**46.3**
HS17	**47.0**
HS18	**47.6**
HS19	**48.2**
HS20	**48.6**
HS21	**49.4**
HS22	**50.0**
HS23	**52.0**
HN1	**40.7**
HN2	**39.7**
HN3	**40.1**
HN4	**40.0**
HN5	**39.2**
HN6	**39.7**
HN7	**40.1**
HN8	**40.5**
HN9	**40.8**
HN10	32.3
Note: values in brackets are measured for easy comparison with modelled values	

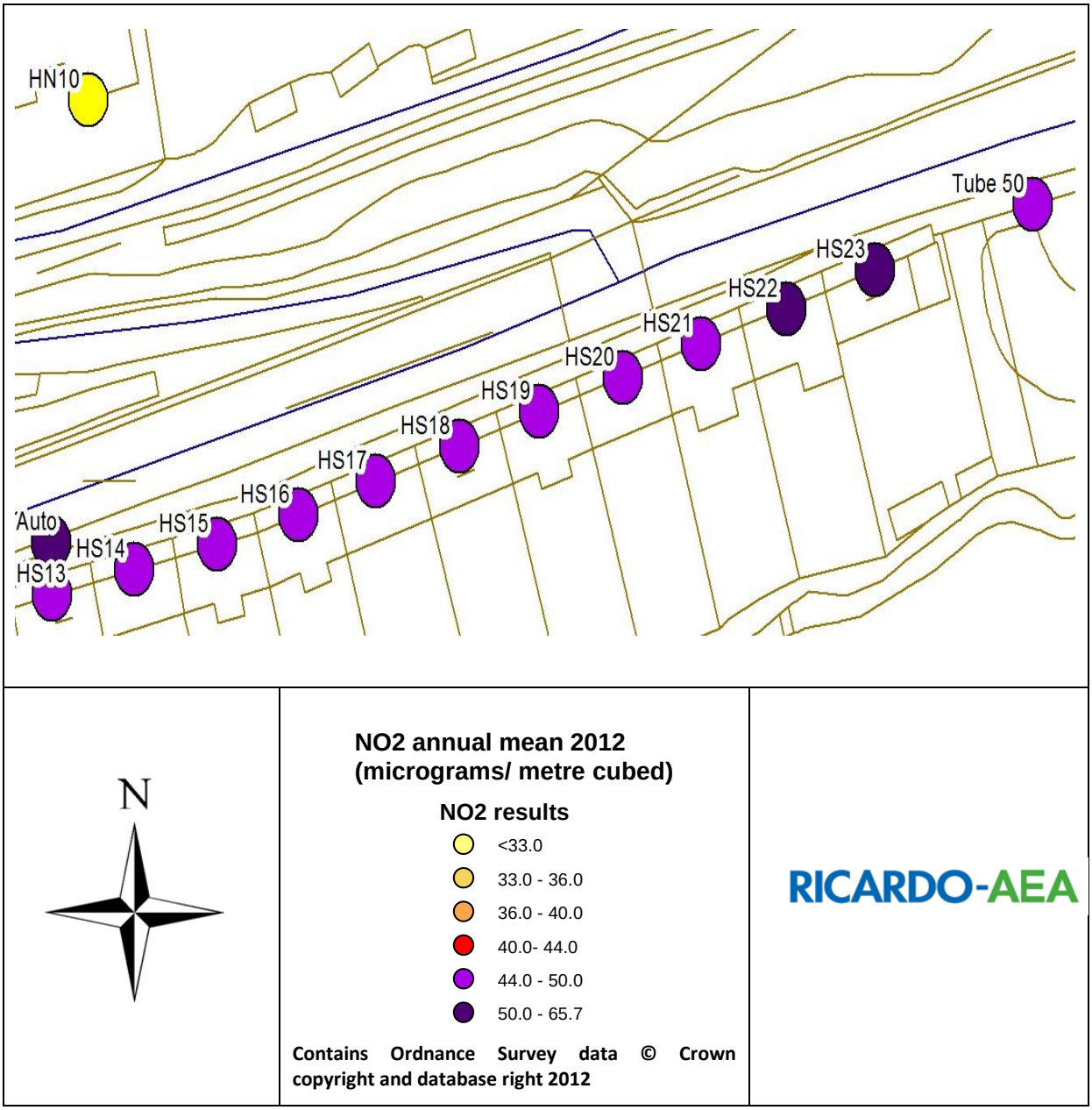
Of the properties modelled, 32 are predicted to experience exceedances of the NO_2 annual mean objective. The 2001 Census data[6] was used to derive an average household occupancy - 2.43 for Caerphilly. This allows us to estimate the population exposed to the NO_2 exceedance, which is **78** in this instance.

Figure 3 Modelled annual mean NO_2 concentrations at discrete receptors at Woodside Terrace Hafodyrynys Road (µg m^{-3})



[6] http://www.ons.gov.uk/ons/rel/census/census-2001-summary-theme-figures-and-rankings/summary-theme-figures-and-rankings/housing---census-2001-summary-theme-figures-and-rankings.xls

Figure 4 Modelled annual mean NO_2 concentrations at discrete receptors at Woodside Terrace Hafodyrynys Road (µg m^{-3})



6 Conclusion

This modelling study, which has used the most recent traffic, monitoring and meteorological data for Woodside Terrace, Hafodyrynys indicates that there are exceedances of the NO_2 annual mean and hourly mean objective at locations with relevant exposure.

The annual mean exceedance area encompasses;

- All houses on the South side of the A472, Hafodyrynys Road at Woodside Terrace
- All houses on the North side of the A472, Hafodyrynys Road directly opposite Woodside Terrace

We estimate that a population of about 78 people are exposed to the exceedance, based on average house occupancy data for Caerphilly.

Automatic monitoring for 2012 has also shown that the NO_2 hourly mean objective was also breached. It is likely that the hourly exceedance is localised spatially and does not appear to affect any of the residential properties. That said, as the pavement is affected this does constitute a measured exceedance of the hourly objective and any proposed AQMA declaration should reflect this.

In light of this Detailed Assessment of Air quality, CCBC should consider declaring an Air Quality Management Area encompassing all receptors with an exceedance of the NO_2 objective predicted in this study. A Further Assessment should be completed within 12 months of the AQMA's declaration. All monitoring should be at locations of relevant exposure as described in Defra Technical Guidance LAQM.TG(09)

7 Acknowledgements

RICARDO-AEA gratefully acknowledges the support received from Maria Godfrey and Sian E Hobson of Caerphilly County Borough Council when completing this assessment.

Appendix 1 – Traffic Data

Table A1.1 summarises the Annual Average Daily Flows (AADF) of traffic and fleet compositions used within the model.

Table A1.1: Annual Average Daily Flows

Street	Data source	%Cars	%LGV	%HGV	%Bus	%2WM	AADF
Hafodyrynys Road (A472)	Caerphilly County Borough Council	81.9	13.0	3.7%	0.4	1..0%	16111

LGV – Light Goods Vehicles
HGV – Heavy Goods Vehicles (Articulate and Rigid)
2WM - Motorcycles

Queuing Traffic

CERC note 60[7] was used for estimating emissions from queuing traffic, which defines a representative AADF for queuing traffic to be 30,000 at 5 km h-1, assuming an average vehicle length of 4m. The emissions from this AADF figure with the traffic composition of the corresponding road were then input into the Emission Factor Toolkit to calculate and emission rate. The emission rates were then used within the dispersion model as a separate line emissions of pre-defined length representing each queue. A time–varying file was used within the model to turn the congested road sections on during the congested periods in the morning and afternoon/evening, and off at all other times.

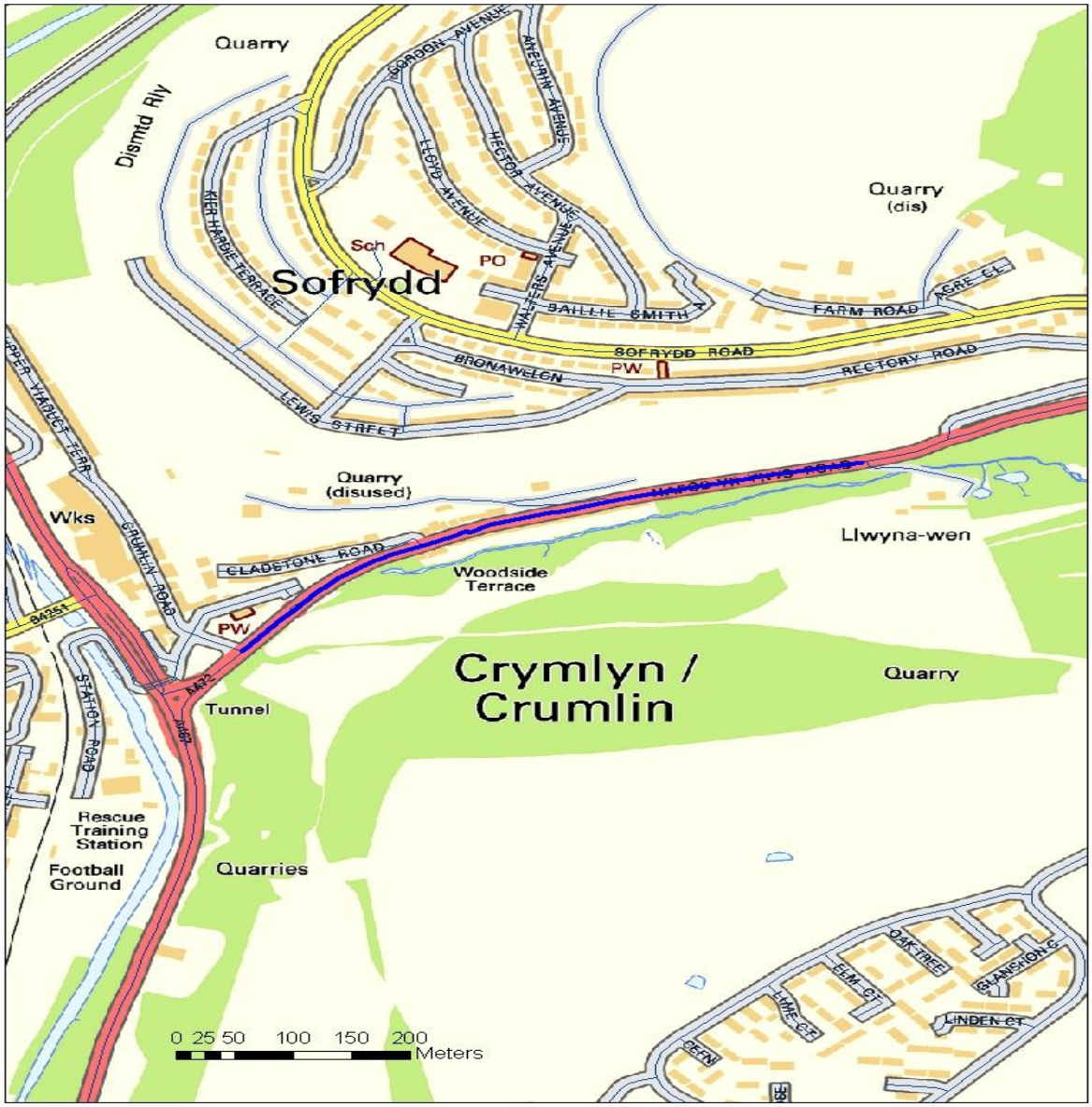
Figure A1.1 shows the locations where queuing traffic was modelled.

Traffic Speeds

As no traffic speed data were available, local speed limits were used for average “open road” speeds; with speeds through known congested/slow moving areas; and on gradients; varying from 5 km h-1 to 30 km h-1.

[7] Cambridge Environmental Research Consultants Ltd, Modelling Queuing Traffic – note 60, 20th August 2004

Figure A1.1 Modelled queue locations



N

Key

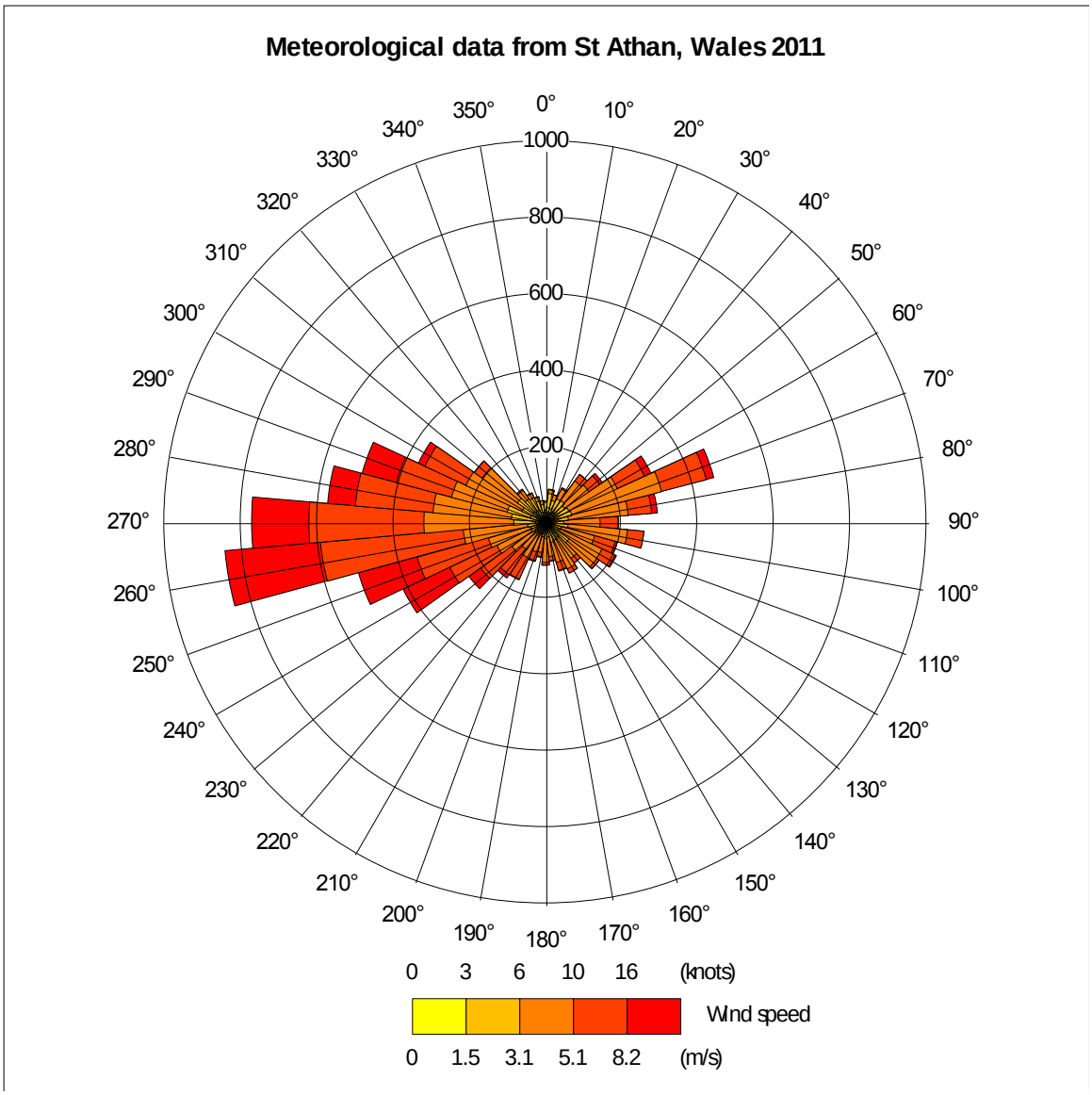
Modelled queue section

RICARDO-AEA

Appendix 2 - Wind Rose

The wind rose for the meteorological dataset covering the period 1st December to 31st January 2011 for St Athans is presented in Figure A2.1

Figure A2.1: Meteorological dataset wind rose



Appendix 3 – Receptor Locations

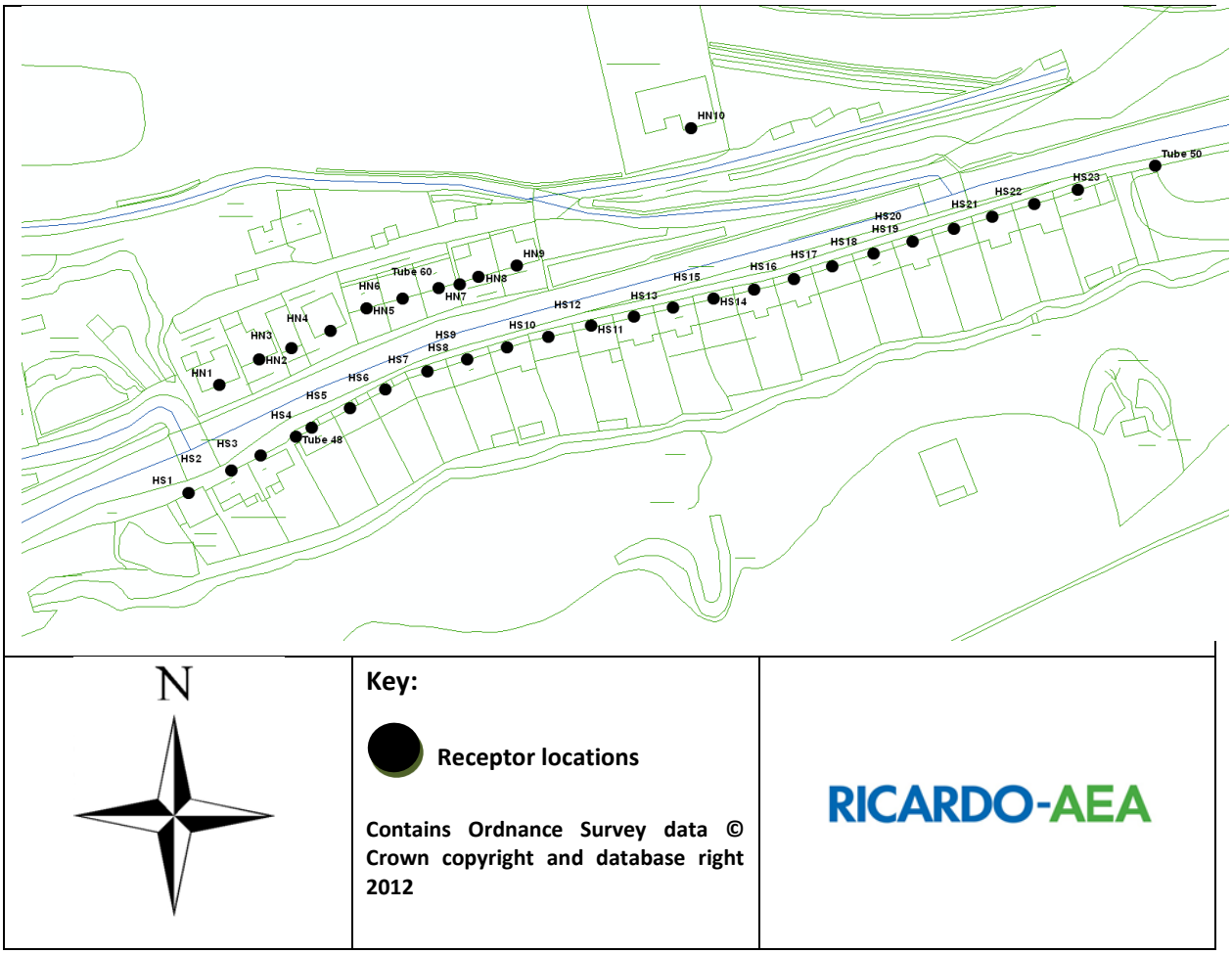
Table A3.1, provides the coordinates and heights for all receptor points used with the modelling study. All receptor points used are considered points of relevant exposure to the general public.

Table A3.1: Point source receptor coordinates and heights (in relation to road surface)

Receptor Name	X Coordinates	Y coordinates	Height (m)
CCBC48	321,647.44	198,557.73	2
CCBC50	321,829.06	198,614.97	2
CCBC60	321,682.00	198,590.00	4
Automatic site	321,727	198,589	1.5
HS1	321,647.44	198,557.73	1
HS2	321,829.06	198,614.97	1
HS3	321,682.00	198,590.00	1
HS4	321,624.72	198,545.84	1
HS5	321,633.78	198,550.55	1
HS6	321,639.91	198,553.67	1
HS7	321,650.75	198,559.66	1
HS8	321,658.84	198,563.78	1
HS9	321,666.31	198,567.69	1
HS10	321,675.19	198,571.45	1
HS11	321,683.66	198,574.05	1
HS12	321,692.03	198,576.67	1
HS13	321,700.69	198,578.77	1
HS14	321,709.84	198,581.12	1
HS15	321,718.81	198,583.03	1
HS16	321,727.06	198,585.00	1
HS17	321,735.62	198,586.91	1
HS18	321,744.25	198,588.86	1
HS19	321,752.72	198,591.08	1
HS20	321,760.75	198,593.69	1
HS21	321,769.41	198,596.41	1
HS22	321,777.75	198,599.05	1
HS23	321,786.47	198,601.69	4
HN1	321,794.56	198,604.27	4
HN2	321,803.41	198,606.92	4
HN3	321,812.62	198,609.97	4

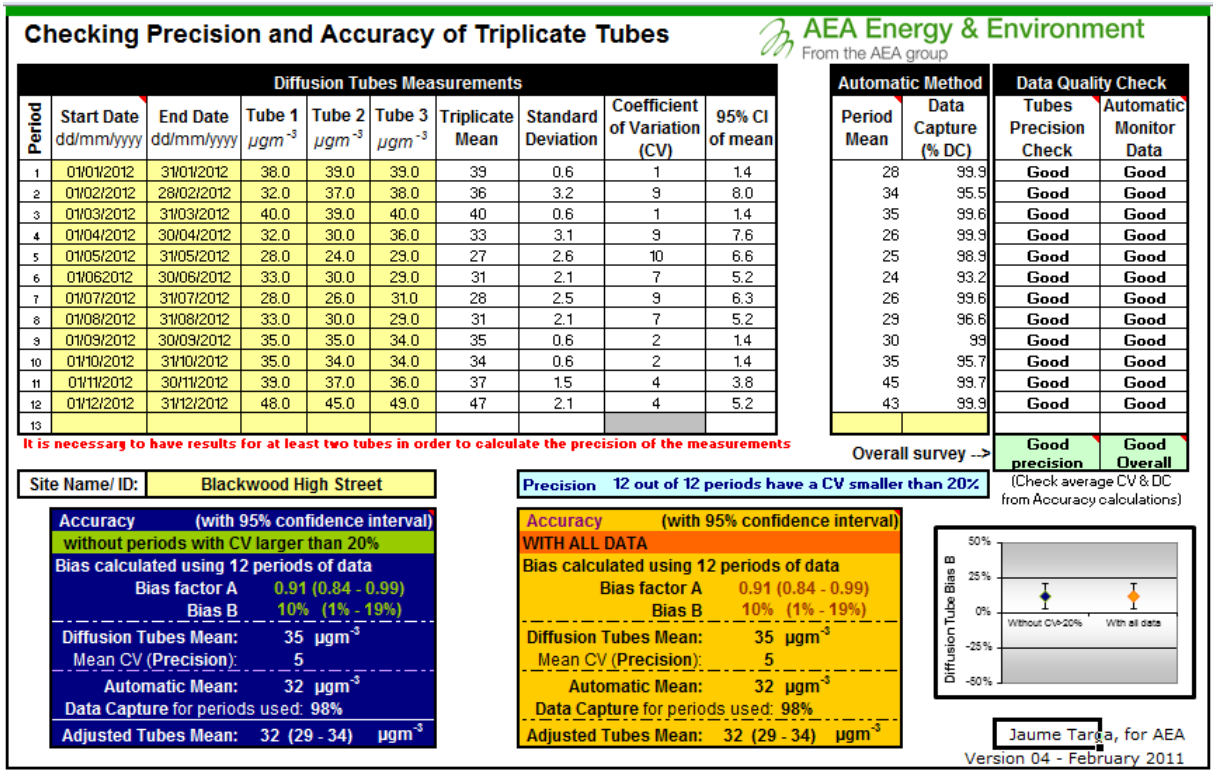
HN4	321,631.19	198,568.64	4
HN5	321,639.59	198,574.06	4
HN6	321,646.47	198,576.45	4
HN7	321,654.66	198,580.16	4
HN8	321,662.28	198,584.86	4
HN9	321,669.88	198,586.97	4
HN10	321,677.50	198,589.16	1

Figure A3.1: Receptor locations included in the model



Appendix 4 – Bias Adjustment Factor

Figure A4.1: Locally Derived Bias Adjustment Spreadsheet – Blackwood High Street



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	01/01/2012	31/01/2012	38.0	39.0	39.0	39	0.6	1	1.4
2	01/02/2012	28/02/2012	32.0	37.0	38.0	36	3.2	9	8.0
3	01/03/2012	31/03/2012	40.0	39.0	40.0	40	0.6	1	1.4
4	01/04/2012	30/04/2012	32.0	30.0	36.0	33	3.1	9	7.6
5	01/05/2012	31/05/2012	28.0	24.0	29.0	27	2.6	10	6.6
6	01/062012	30/06/2012	33.0	30.0	29.0	31	2.1	7	5.2
7	01/07/2012	31/07/2012	28.0	26.0	31.0	28	2.5	9	6.3
8	01/08/2012	31/08/2012	33.0	30.0	29.0	31	2.1	7	5.2
9	01/09/2012	30/09/2012	35.0	35.0	34.0	35	0.6	2	1.4
10	01/10/2012	31/10/2012	35.0	34.0	34.0	34	0.6	2	1.4
11	01/11/2012	30/11/2012	39.0	37.0	36.0	37	1.5	4	3.8
12	01/12/2012	31/12/2012	48.0	45.0	49.0	47	2.1	4	5.2
13									

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
28	99.9	Good	Good
34	95.5	Good	Good
35	99.6	Good	Good
26	99.9	Good	Good
25	98.9	Good	Good
24	93.2	Good	Good
26	99.6	Good	Good
29	96.6	Good	Good
30	99	Good	Good
35	95.7	Good	Good
45	99.7	Good	Good
43	99.9	Good	Good
Overall survey -->		Good precision	Good Overall

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: Blackwood High Street

Precision 12 out of 12 periods have a CV smaller than 20%

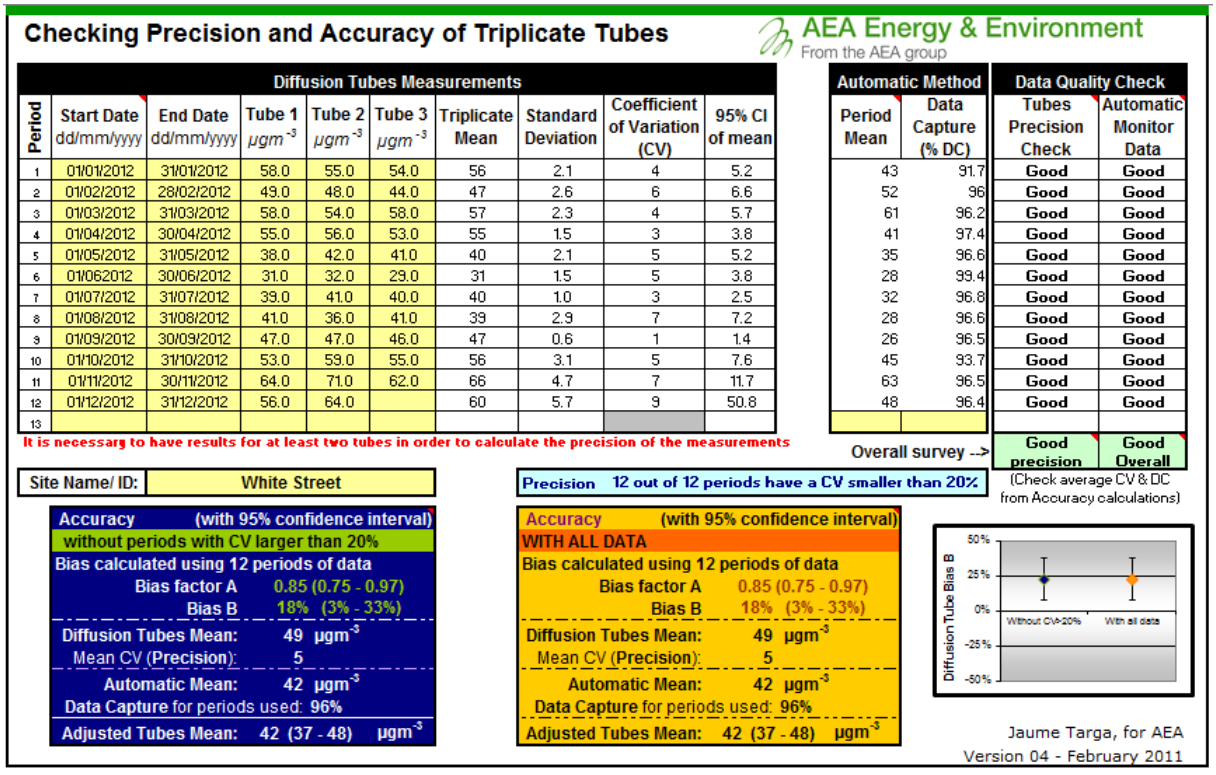
Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.91 (0.84 - 0.99)
Bias B 10% (1% - 19%)
Diffusion Tubes Mean: 35 µgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 32 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 32 (29 - 34) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.91 (0.84 - 0.99)
Bias B 10% (1% - 19%)
Diffusion Tubes Mean: 35 µgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 32 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 32 (29 - 34) µgm^{-3}

Jaume Targa, for AEA
Version 04 - February 2011

If you have any enquiries about this spreadsheet please contact the LAQM Helpdesk at: LAQMHelpdesk@uk.bureauveritas.com

Figure A4.1: Locally Derived Bias Adjustment Spreadsheet – White Street



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	01/01/2012	31/01/2012	58.0	55.0	54.0	56	2.1	4	5.2
2	01/02/2012	28/02/2012	49.0	48.0	44.0	47	2.6	6	6.6
3	01/03/2012	31/03/2012	58.0	54.0	58.0	57	2.3	4	5.7
4	01/04/2012	30/04/2012	55.0	56.0	53.0	55	1.5	3	3.8
5	01/05/2012	31/05/2012	38.0	42.0	41.0	40	2.1	5	5.2
6	01/062012	30/06/2012	31.0	32.0	29.0	31	1.5	5	3.8
7	01/07/2012	31/07/2012	39.0	41.0	40.0	40	1.0	3	2.5
8	01/08/2012	31/08/2012	41.0	36.0	41.0	39	2.9	7	7.2
9	01/09/2012	30/09/2012	47.0	47.0	46.0	47	0.6	1	1.4
10	01/10/2012	31/10/2012	53.0	59.0	55.0	56	3.1	5	7.6
11	01/11/2012	30/11/2012	64.0	71.0	62.0	66	4.7	7	11.7
12	01/12/2012	31/12/2012	56.0	64.0		60	5.7	9	50.8
13									

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
43	91.7	Good	Good
52	96	Good	Good
61	96.2	Good	Good
41	97.4	Good	Good
35	96.6	Good	Good
28	99.4	Good	Good
32	96.8	Good	Good
28	96.6	Good	Good
26	96.5	Good	Good
45	93.7	Good	Good
63	96.5	Good	Good
48	96.4	Good	Good
Overall survey -->		Good precision	Good Overall

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: White Street

Precision 12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.85 (0.75 - 0.97)
Bias B 18% (3% - 33%)
Diffusion Tubes Mean: 49 µgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 42 µgm^{-3}
Data Capture for periods used: 96%
Adjusted Tubes Mean: 42 (37 - 48) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.85 (0.75 - 0.97)
Bias B 18% (3% - 33%)
Diffusion Tubes Mean: 49 µgm^{-3}
Mean CV (Precision): 5
Automatic Mean: 42 µgm^{-3}
Data Capture for periods used: 96%
Adjusted Tubes Mean: 42 (37 - 48) µgm^{-3}

Jaume Targa, for AEA
Version 04 - February 2011

If you have any enquiries about this spreadsheet please contact the LAQM Helpdesk at: LAQMHelpdesk@uk.bureauveritas.com

RICARDO-AEA

The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR

Tel: 0870 190 1900
Fax: 0870 190 6318

www.ricardo-aea.com