2012 Air Quality Detailed Assessment for South Gloucestershire Council

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

July 2012

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Report Reference number	SGC_DA_2012
Date	July 2012

Executive Summary

This report summarises the outcome of the detailed assessment for nitrogen dioxide from moving railway locomotives on the London Paddington to Swansea railway line within South Gloucestershire. The need for this detailed assessment was identified through the assessment of pollutant sources in South Gloucestershire Council's 2009 Updating and Screening Assessment (USA).

The detailed assessment investigated potential relevant exposure to nitrogen dioxide emissions from moving locomotives at a small number of properties within 30 metres of the railway line in Little Stoke, Patchway, Stoke Gifford and Winterbourne by monitoring with diffusion tubes during 2011.

The assessment concludes that moving railway locomotives on the London Paddington to Swansea railway line do not lead to any exceedences or likely exceedences of the annual mean nitrogen dioxide objective at the locations assessed. The monitoring undertaken showed the measured nitrogen dioxide concentrations to be well below the annual mean objective.

No further action is required in respect of the air quality impacts from moving locomotives on the London Paddington to Swansea railway line within South Gloucestershire. The residents of the properties where monitoring was undertaken and other relevant statutory consultees will be advised of the assessment outcome.

Monitoring at the detailed assessment sites will continue until the end of 2012 so that a full calendar year of results can be obtained. These results will be reported in the 2013 Annual Progress Report due in April 2013.

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1 Introduction

1.1 Purpose of Report

This report is the Detailed Assessment of nitrogen dioxide (NO_2) concentrations from moving locomotives on the London Paddington to Swansea railway line at locations in Little Stoke, Patchway, Stoke Gifford and Winterbourne. The report is one of a series produced by South Gloucestershire Council, which periodically review and assess air quality within the district and fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 (Defra, 2007) and the relevant Policy and Technical Guidance documents (Defra, 2009).

The purpose of this Detailed Assessment is to determine, with reasonable certainty, whether there is a likelihood of the air quality objective for nitrogen dioxide not being achieved at locations with relevant exposure (i.e. places where people will be exposed to the pollutant). Where exceedences are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

1.2 Description of Local Authority Area

South Gloucestershire lies to the north and east of the city of Bristol with the River Severn forming the western boundary. The area is a diverse mix of urban and rural areas, including major residential, industrial and commercial developments. The road network within the district contains the major junction of the M4 & M5 motorways. Main line intercity passenger rail services are available from Bristol Parkway Station in Stoke Gifford. This station is on the London Paddington to Swansea mainline. The mainline north from Bristol Temple Meads also goes via Bristol Parkway.

The population of South Gloucestershire is 262,800 (ONS 2011 Census estimate). 60% of the population live in the urban areas immediately adjoining Bristol, namely Filton, Patchway, Bradley Stoke, Kingswood, Downend, Staple Hill and Hanham; 19% live in the towns of Yate, Chipping Sodbury and Thornbury and the remaining 20% live in the more rural areas of South Gloucestershire. The population has grown by 7% on the number recorded in the 2001 Census (245,600) and the population is projected to continue to rise, meaning that managing future development and providing vital transport infrastructure is a key challenge. A map of the South Gloucestershire area is provided in Appendix A (Figure 1).

1.3 Air Quality Objectives

The Government has established a set of air quality standards and objectives to protect human health. The standards are set out as concentrations below which effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based upon scientific and medical evidence of the effects of an individual pollutant. The objectives set out the extent to which the Government expects the standards to be achieved by a specific date.

The air quality objectives applicable to local air quality management (LAQM) are set out in the Air Quality (England) Regulations 2000 (SI 928) (Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (SI 3043) (Stationery Office, 2002). The relevant objectives for this assessment are shown in Table 1. This table shows the objectives in units of micrograms per cubic metre ($\mu g/m^3$) with the number of exceedences in each year that are permitted (where applicable).

Table 1 Relevant Air Quality Objectives

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005

The air quality objectives only apply where members of the public are likely to be present for the averaging period of the objective. For the annual mean objective, relevant exposure is mainly limited to residential properties, schools and hospitals. The 1-hour objective applies at these locations as well as any outdoor locations where a member of the public might reasonably be expected to stay for one hour or more.

Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 µg/m^3 (Defra, 2009b). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level.

1.4 Summary of Previous Review and Assessments

The previous and current review and assessment work is summarised in Table 2.

Table 2 Summary of LAQM Review and Assessment Work

Stage/Report	Summary of work undertaken	Date Completed
Round 1		
Stage 1	Identification of main sources of pollution which may have a significant impact on air quality	February 1999
Stage 2	Additional screening of pollutant concentrations	November 2000
Stage 3	Detailed appraisal of potential impacts of significant sources of pollution and predictions of levels to future dates	
Declaration of Air Quality Management Area	Area declared where predictions indicate NO_2 objectives will not be met (110m either side of the M4, M5, M32 and M49 motorways within South Gloucestershire).	November 2001
Stage 4	More detailed assessment work inside the declared area to provide confidence in the original decision to declare the area	July 2003
Round 2		
Updating and Screening Assessment 2003	Identification of relevant changes since first round	May 2003
Revocation of AQMA	AQMA 110m either side of the M4. M5, M32 and M49 motorways revoked following further work.	March 2004
Annual Progress Report 2004	Report on progress over the previous year. Report identified potential future non-compliance with 24-hour PM10 objective at Yate.	May 2004
Annual Progress Report 2005	Report on progress over the previous year.	April 2005

Stage/Report	Summary of work undertaken	Date Completed
Round 3		
Updating and Screening Assessment 2006	Identification of relevant changes since previous round. Report shows compliance with all objectives, including 24-hour PM_{10} objective at Yate, concluding that a Detailed Assessment previously identified in the 2004 Progress Report was no longer required.	May 2006
Annual Progress Report 2007	Report on progress over the previous year. Identified the need for a detailed assessment for potential exceedences of the annual mean NO_2 objective in Staple Hill, Kingswood and at Cribbs Causeway M5 (Junction 17).	May 2007
Detailed Assessment 2008	Assessment of potential NO_2 exceedence locations identified in 2007 Progress Report (Cribbs Causeway, Kingswood and Staple Hill). Concluded AQMAs required in all three locations.	September 2008
Round 4		
Updating and Screening Assessment 2009	Identification of relevant changes since previous round. Need for detailed assessment of NO_2 from moving trains identified at relevant locations along London Paddington to Swansea railway line.	April 2010
Declaration of AQMAs (Cribbs Causeway, Kingswood & Staple Hill)	Air Quality Management Areas declared in Cribbs Causeway, Kingswood and Staple Hill following outcome of Detailed Assessment	April 2010
Progress Report (Combined 2010 & 2011)	Report on progress over the previous two years. No exceedences of NO_2 objectives outside the AQMAs and compliance with all other objectives.	August 2011
Further Assessment 2011	Further assessment of Cribbs Causeway, Kingswood and Staple Hill AQMAs. Extensions to Kingswood and Staple Hill AQMAs recommended along with the possible revocation of Cribbs Causeway AQMA, depending on 2011 results	September 2011
Air Quality Action Plan - Kingswood & Staple Hill	Identifies measures aimed at improving air quality in the Kingswood and Staple Hill AQMAs	March 2012
Round 5		
Kingswood and Staple Hill AQMAs amended	Kingswood and Staple Hill AQMAs extended following outcomes of the Further Assessment	May 2012
Detailed Assessment 2012	Assessment of NO_2 from moving trains at relevant locations along London Paddington to Swansea railway line as identified in USA 2009	July 2012 (this report)
Updating and Screening Assessment 2012	Identify relevant changes since previous round. Also to include review of 2011 monitoring results for Cribbs Causeway AQMA to determine whether AQMA can be revoked.	In progress

The need for this Detailed Assessment was identified by the 2009 Updating and Screening Assessment (USA) (South Gloucestershire Council, 2010). Defra LAQM Technical Guidance 2009 (LAQM.TG(09)) (Defra, 2009b) introduced a new requirement to assess the potential for exposure to nitrogen dioxide from moving railway locomotives in the USA. This requirement arose from evidence that nitrogen dioxide concentrations can be elevated alongside railway lines with a large number of diesel locomotives movements. The London Paddington to Swansea railway line in South Gloucestershire was identified as such a line.

Following the new screening criteria in LAQM.TG(09), the USA identified that there were locations with a large number of diesel locomotive movements, elevated background concentrations of nitrogen dioxide above 25 $\mu g/m^3$ and potential relevant exposure within 30 metres of the railway line. The USA concluded that a detailed assessment was required for nitrogen dioxide from moving locomotives at a small number of properties (ten in total) in Little Stoke, Patchway, Stoke Gifford and Winterbourne.

Maps of the locations identified for detailed assessment are shown in Appendix A (Figure 5 - Figure 7).

Maps of the currently declared AQMAs are shown in Appendix A (Figure 2 - Figure 4). None of the AQMAs are in close proximity to the detailed assessment locations. The Cribbs Causeway AQMA is the closest AQMA at approximately 2.9 kilometres from the detailed assessment location in Patchway (204 Gloucester Road).

2 Summary of Monitoring Undertaken

2.1 New Monitoring Sites

Diffusion tube monitoring was established at seven of the ten properties identified as having potential relevant exposure to elevated nitrogen dioxide concentrations along the London Paddington to Swansea railway line in Little Stoke, Patchway, Stoke Gifford and Winterbourne. This was considered to be representative of the properties potentially at risk and took into account the suitability of the properties for monitoring, for example, the practicalities of accessing the sites for monthly tube changeovers and a suitable structure, such as a downpipe, onto which a diffusion tube could be mounted.

Diffusion tubes were sited to represent relevant exposure and, at all but one of the sites (Site 109), were located at the facades of the properties. At site 109, the tube was located on a lamppost on a minor road to the rear of the property closer to the railway line. The tubes at the other sites (apart from Site 106) were sited on the façade closest to the railway line to measure worst- case conditions in terms of rail emissions, while minimising the pollution signal from other sources i.e. major roads. At Site 106, it was only possible to locate the tube on the front of the property.

In the vicinity of the Winterbourne monitoring sites, the railway line goes into a deep cutting so there is a considerable difference in height between the monitoring sites and the track.

Monitoring commenced in April 2011 following some delays in setting up the monitoring sites.

Maps of the monitoring locations are provided in Appendix A (Figure 8 - Figure 10) and details of the diffusion tube monitoring sites are provided in Table 3.

Table 3 Details of Nitrogen Dioxide Diffusion Tube Monitoring Sites

Site Ref.	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Is monitoring collocated with a Continuous Analyser (Y/N)	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road (m) *(N/A if not applicable)*	Does this location represent worst-case exposure?
106	Stoke Gifford 73 Hambrook Lane (Façade)	Other[a]	363112	179559	NO_2	N	N	Y (0)	10	Y
107	Stoke Gifford 77 Hambrook Lane (Rear façade)	Other	363148	179555	NO_2	N	N	Y (0)	20	Y
108	Patchway 204 Gloucester Road (Rear façade)	Other	360613	181680	NO_2	N	N	Y (0)	12	Y
109	Little Stoke Clay Lane lp8 (rear of Gallivan Close)	Other	360895	181410	NO_2	N	N	Y (13)	2	Y
110	Winterbourne 2 Sandstone Rise (Rear façade)	Other	364992	179895	NO_2	N	N	Y (0)	13	Y
111	Winterbourne 2 Down Road (Façade)	Other	364930	179842	NO_2	N	N	Y (0)	59	Y
112	Winterbourne 106 Dragon Road (Façade)	Other	364930	179886	NO_2	N	N	Y (0)	31	Y

[a] Monitoring locations where any special source-orientated monitoring is undertaken in relation to specific emission sources; in this case, railway lines.

2.2 Monitoring Results

As monitoring commenced in April 2011, a full calendar year of data was not obtained. Nine months of data (75%) was obtained at all sites apart from Site 112 where the first diffusion tube deployed went missing, resulting in a data capture of 67%. Data capture for the monitoring period was 100% for all sites apart from Site 112 where data capture was 88%.

The LAQM Review and Assessment Helpdesk were contacted about the approach to reporting monitoring data on 18 June 2012. The response given was that, as sufficient data capture (75%) had been achieved for 2011 at all but one of the monitoring sites, and because the monitoring showed concentrations well below the objective at all sites, it was permissible to report the findings even though a full calendar year of results had not been obtained. However, as a precaution, the monitoring will remain in place until the end of 2012 so that results for a full calendar year can be obtained. These results will be reported in the 2013 Annual Progress Report.

The diffusion tube monitoring results are presented in Table 4. The results are bias adjusted using the 2011 national bias adjustment factor (0.83) as per spreadsheet 03/12 (see Appendix B: Diffusion Tube Bias Adjustment Factors).

The result for Site 112 was annualised (adjusted to an annual mean equivalent to allow comparison with the annual mean objective) as data capture was below 75% (see Appendix B: Short-Term to Long-Term Data Adjustment).

The result for Site 109 was not distance adjusted to estimate the concentration at the façade as it was well below the objective.

Table 4 2011 Results of Detailed Assessment Nitrogen Dioxide Diffusion Tube Monitoring

Site Ref.	Site Name	Site Type	Within AQMA?	Triplicate or Collocated Tube	Data Capture 2011 (Number of Months or %)	Data with less than 9 months has been annualised (Y/N)	Confirm if data has been distance corrected (Y/N)	Annual mean concentration (Bias Adjustment Factor = 0.83) 2011 (μg/m^3)
106	Stoke Gifford 73 Hambrook Lane (Façade)	Other	N	N	75%	N	N	21.1
107	Stoke Gifford 77 Hambrook Lane (Rear façade)	Other	N	N	75%	N	N	18.6
108	Patchway 204 Gloucester Road (Rear façade)	Other	N	N	75%	N	N	26.7
109	Little Stoke Clay Lane lp8 (rear of Gallivan Close)	Other	N	N	75%	N	N	24.3
110	Winterbourne 2 Sandstone Rise (Rear façade)	Other	N	N	75%	N	N	18.9
111	Winterbourne 2 Down Road (Façade)	Other	N	N	75%	N	N	19.5
112	Winterbourne 106 Dragon Road (Façade)	Other	N	N	67%	N	N	23.0 [a]

[a] Annualised mean where data capture below 75%

2.2.1 Comparison of Monitoring Results with Nitrogen Dioxide Objective

The monitoring shows the annual mean nitrogen dioxide concentrations at all seven sites, which represent worst-case residential exposure, are well below the annual mean objective of 40 µg/ m^3. The 1-hour nitrogen dioxide objective does not require further consideration as it is only likely to be exceeded where the annual mean concentration is above 60 µg/m^3.

In Winterbourne, there is a considerable difference in height between the monitoring sites and the track as the railway line goes into a deep cutting. This is very likely to have reduced any potential impact of nitrogen dioxide emissions on receptors and contributed to achieving compliance at these sites.

3 Conclusions and Proposed Actions

3.1 Conclusions

This assessment shows that moving locomotives on the London Paddington to Swansea railway line within South Gloucestershire do not lead to any exceedences or likely exceedences of the annual mean nitrogen dioxide objective at the locations assessed. It can be concluded that for this section of railway, emissions from moving locomotives are not significant.

3.2 Proposed Actions

No further action is required in respect of the air quality impacts of the London Paddington to Swansea railway line within South Gloucestershire. The residents of the properties where monitoring was undertaken and other relevant statutory consultees will be advised of the assessment outcome.

Monitoring at the detailed assessment sites will continue until the end of 2012 so that a full calendar year of results can be obtained. These results will be reported in the 2013 Annual Progress Report due in April 2013.

4 References

Defra, 2007. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland.

Defra, 2009a. Local Air Quality Management Policy Guidance (LAQM.PG(09))

Defra, 2009b. Local Air Quality Management Technical Guidance (LAQM.TG(09))

Defra, 2012. National Diffusion Tube Bias Spreadsheet for 2011 (03/12) [Online] Defra Website, LAQM Support.

South Gloucestershire Council, 2010. 2009 Air Quality Updating and Screening Assessment for South Gloucestershire Council

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

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

5 Glossary

AQMA	Air Quality Management Area
AQAP	Air Quality Action Plan
AURN	Automatic Urban and Rural Network
BCCSS	Bristol City Council Scientific Services
Exceedence	A period of time where the concentration of a pollutant is greater than the appropriate air quality objective
LAQM	Local Air Quality Management
LAQM.TG(09)	Defra Local Air Quality Management Technical Guidance 2009
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides
QA/QC	Quality Assurance/ Quality Control
USA	Updating and Screening Assessment. An air quality assessment that is undertaken every 3 years in the LAQM process
WASP	Workplace Analysis Scheme for Proficiency (assesses laboratory proficiency in diffusion tube analysis)
$\mu g/m^3$	Microgrammes per cubic metre

Appendices

Appendix A: Maps

Appendix B: Quality Assurance/ Quality Control (QA/QC) Data

Appendix C: Monthly Diffusion Tube Data

Appendix A: Maps

District Map

Figure 1 Map of South Gloucestershire Area

Air Quality Management Areas Maps

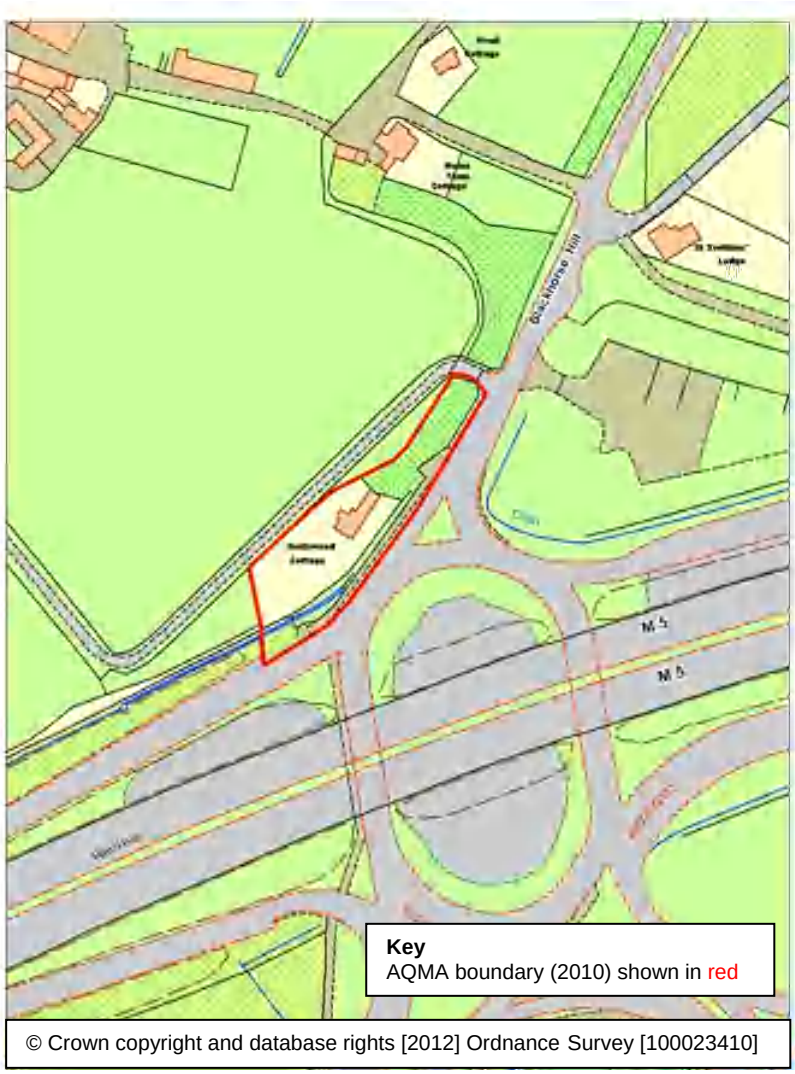


Figure 2 Cribbs Causeway AQMA

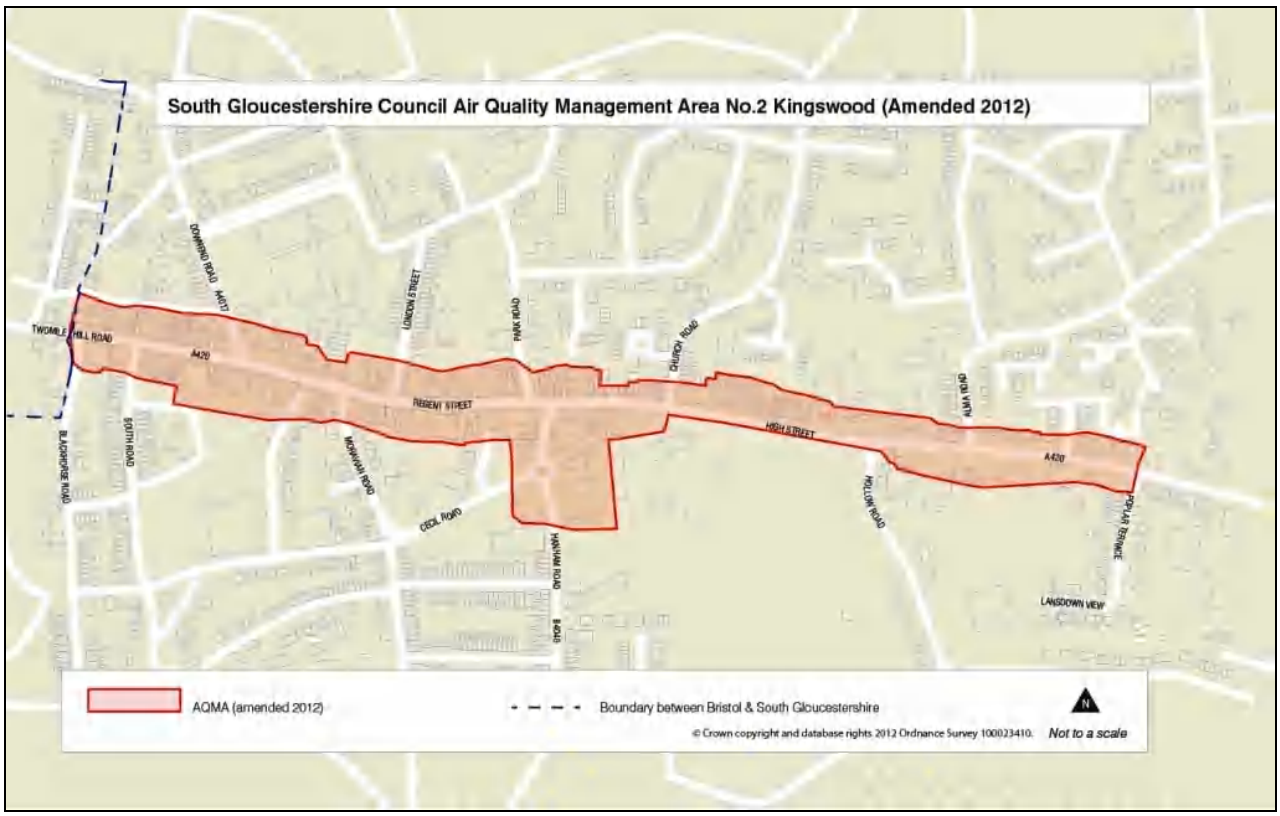


Figure 3 Kingswood AQMA (Amended 2012)

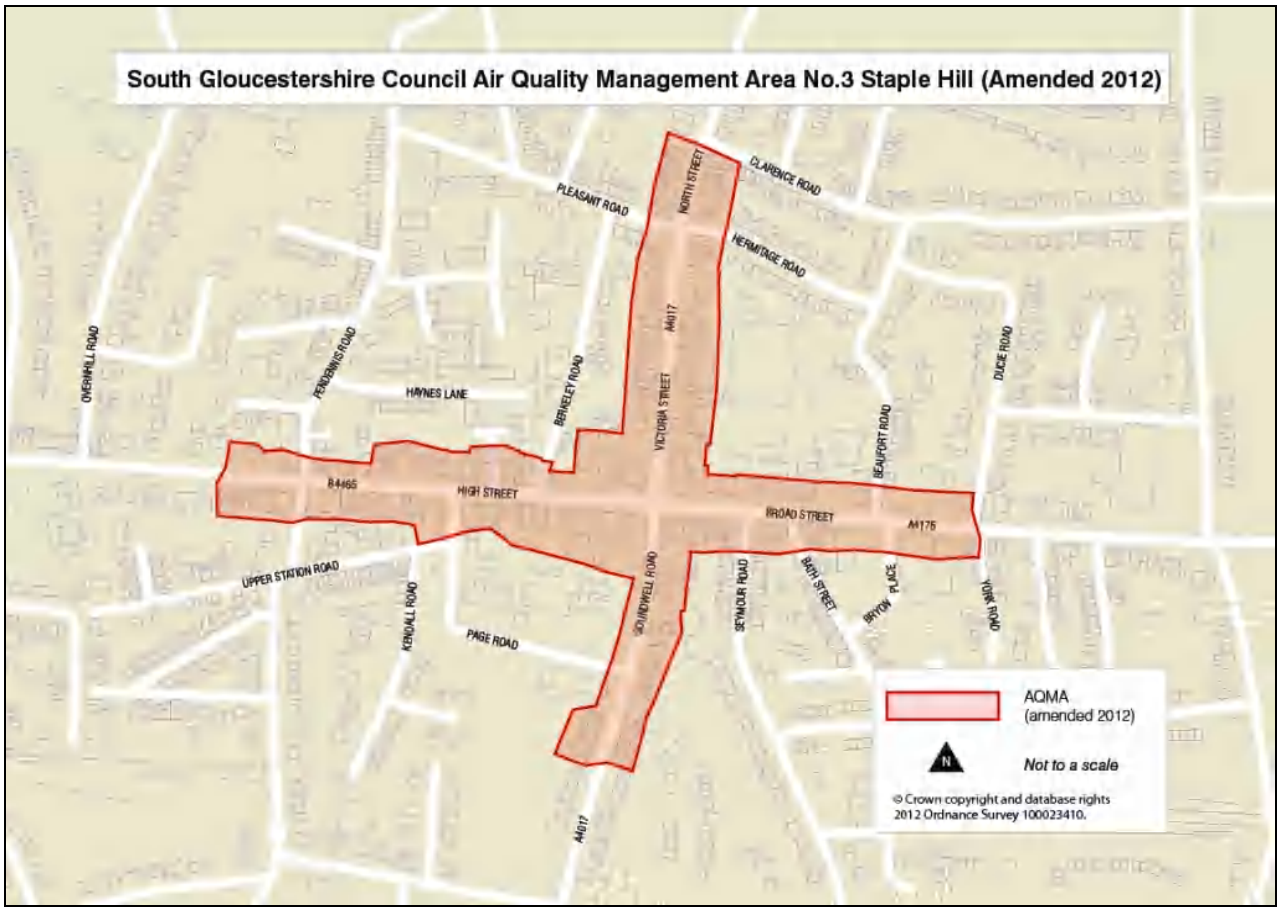


Figure 4 Staple Hill AQMA (Amended 2012)

Moving Locomotives Maps

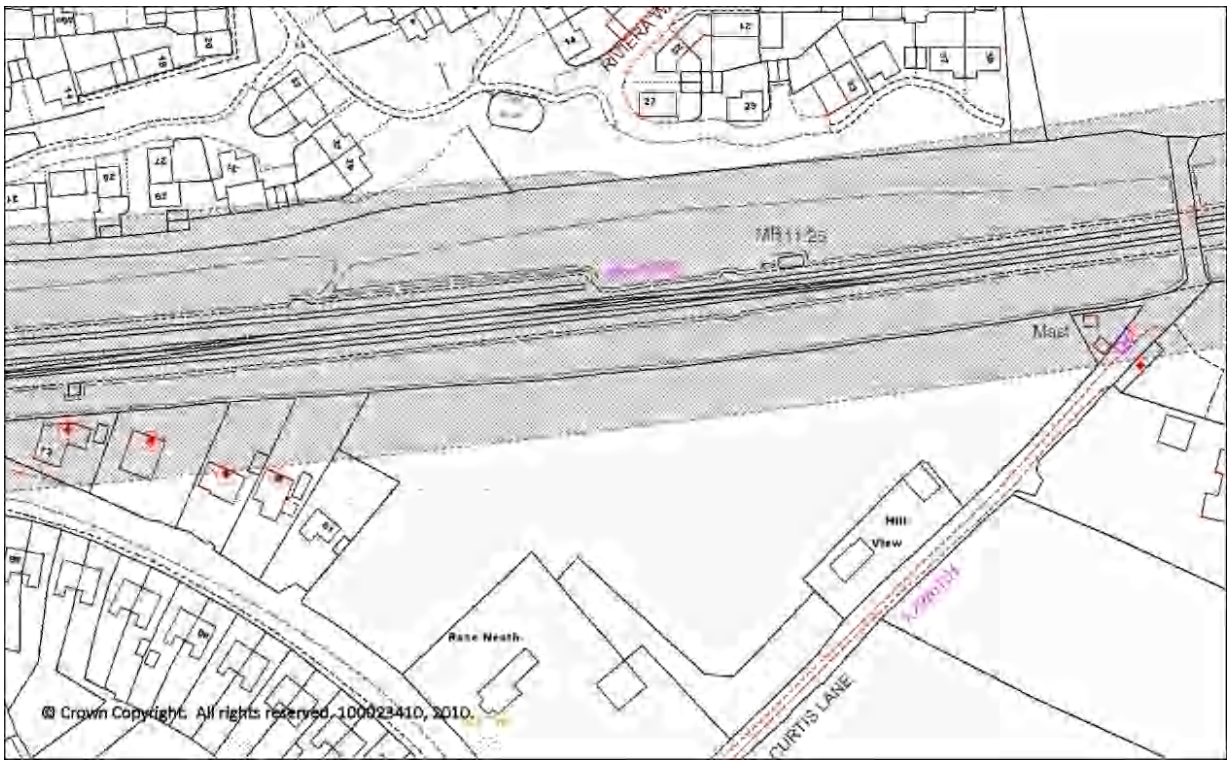


Figure 5 Stoke Gifford 30m buffer and relevant exposure

Key: Buffer (shaded grey) • Relevant exposure (red dots)

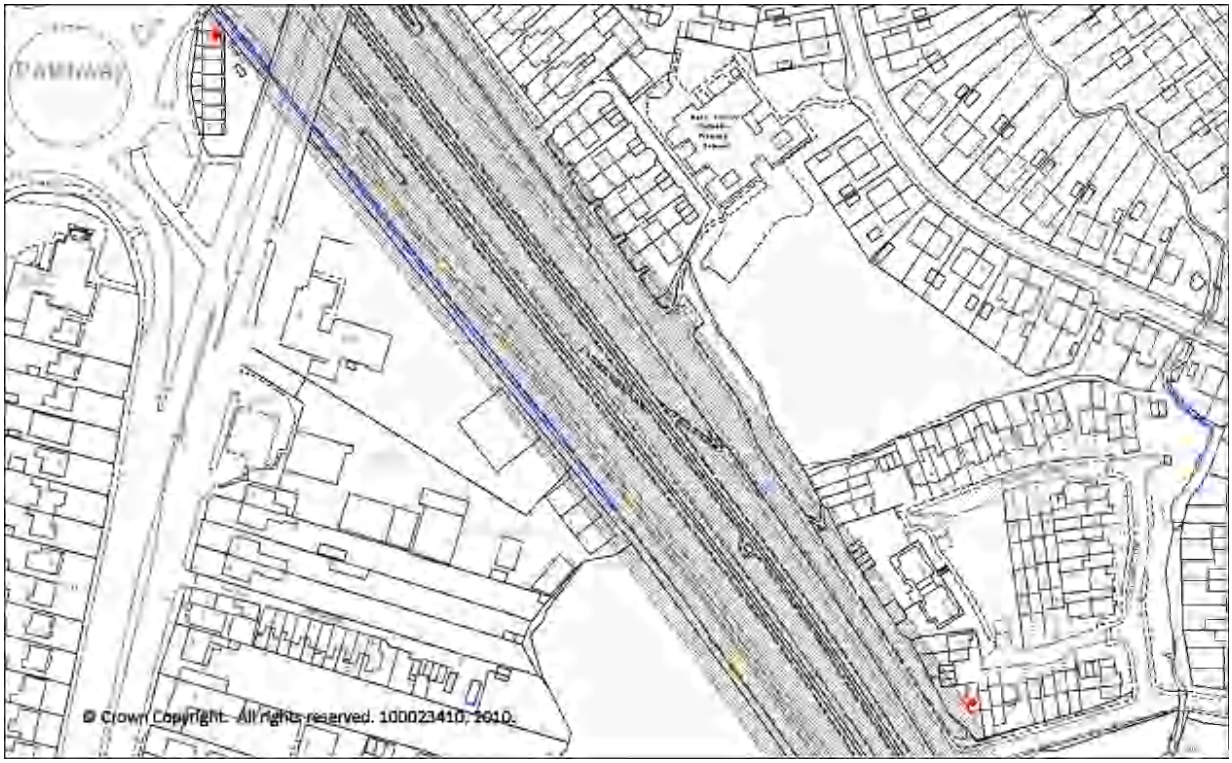


Figure 6 Patchway & Little Stoke 30m buffer and relevant exposure

Key: Buffer • Relevant exposure

Figure 7 Winterbourne 30m buffer and relevant exposure

Key: Buffer • Relevant exposure

Monitoring Site Locations

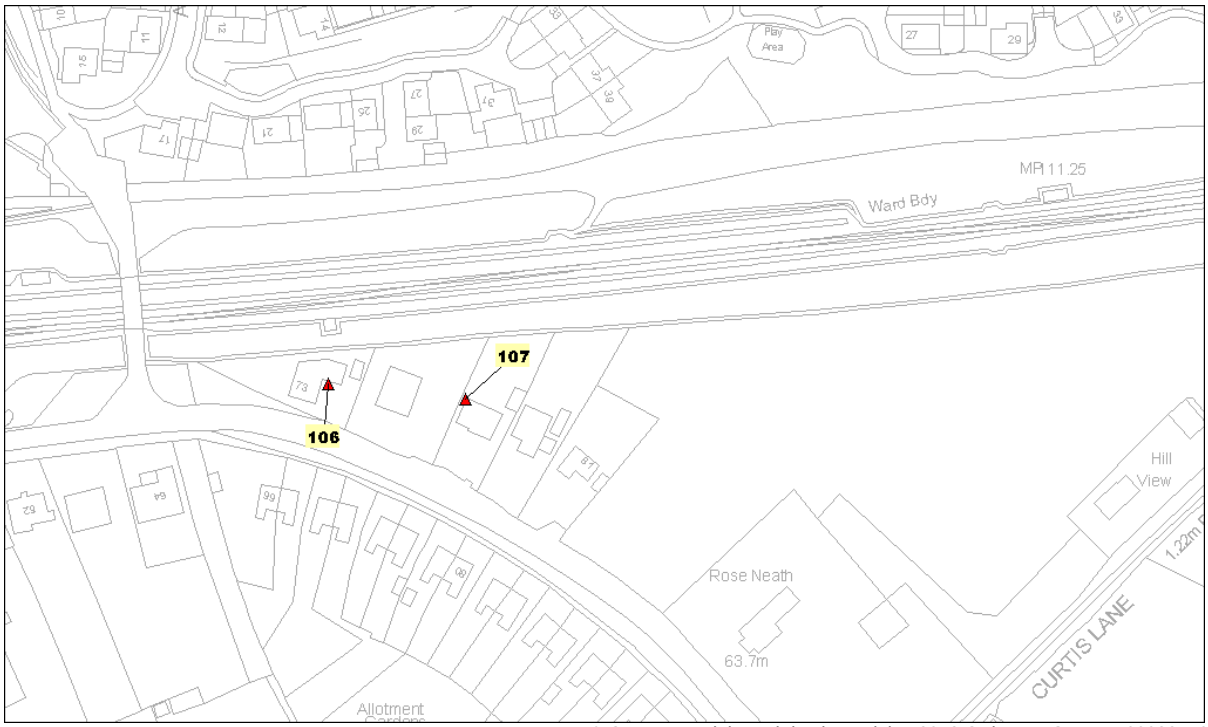


Figure 8 Stoke Gifford (Hambrook Lane) Diffusion Tube Sites

Figure 9 Patchway and Little Stoke Diffusion Tube Sites

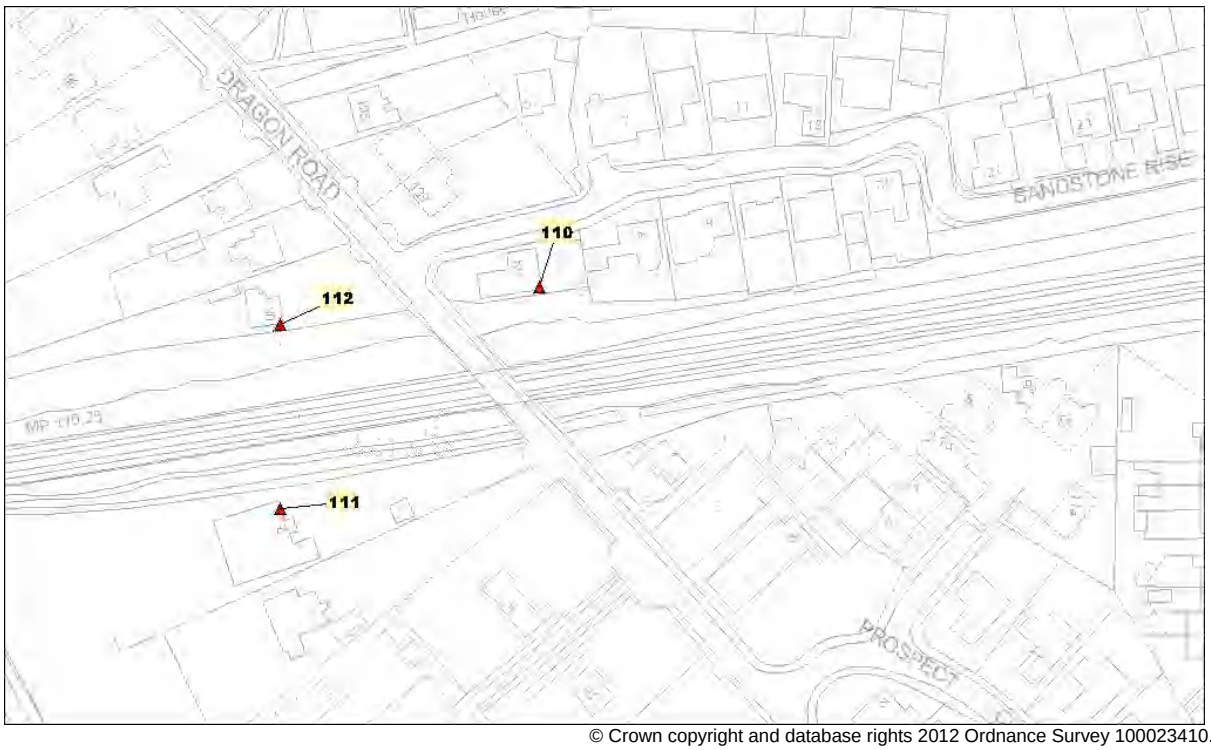


Figure 10 Winterbourne Diffusion Tube Sites

Appendix B: QA/QC Data

Diffusion Tube Bias Adjustment Factors

South Gloucestershire Council use diffusion tubes prepared and analysed by Bristol Scientific Services (20% triethanolamine (TEA) in water). In 2011, the Council operated a co-location study at the Yate real-time monitoring site. The national bias-adjustment factor for 2011 for Bristol Scientific Services is 0.83 (spreadsheet version 03/12) (Defra, 2012) compared to the local factor for South Gloucestershire of 0.86.

Discussion of Choice of Factor to use

In 2011, there were 8 studies available in the national database, including the South Gloucestershire study. For this reason, and in order to be consistent with previous reports, it was considered to be more robust to use the national factor.

Short-Term to Long-Term Data Adjustment

One of the monitoring sites in the detailed assessment study (Site 112) had less than 75% data capture. This was due to the first tube deployed going missing. Long-term data from five monitoring sites from the national Automatic Urban and Rural Network (AURN) was used to generate adjustment factors to annualise the short term data as described in LAQM.TG(09) Box 3.2. This is shown in Table 5.

Table 5 Nitrogen dioxide data used to adjust short-term monitoring data to annual mean for Site 112

Site	Site Type	Annual Mean	Period Mean 1/5/11- 31/12/11	Ratio
Bristol St Paul's	Urban Background	27.2	23.2	1.17
Cardiff Centre	Urban Background	27.2	22.9	1.19
Charlton Mackrell	Rural Background	7.6	6.8	1.13
Cwmbran	Urban Background	13.1	10.6	1.24
Newport	Urban Background	22.0	18.8	1.17
			Average	**1.18**

QA/QC of Diffusion Tube Monitoring

Bristol City Council Scientific Services (BCCSS) carries out the placement and analysis of the diffusion tubes. The laboratory is not UKAS accredited for the analysis of the diffusion tubes but does participate in the Workplace Analysis Scheme for Proficiency (WASP). For nitrogen dioxide diffusion tubes, this involves the analysis of four diffusion tubes spiked with a known amount of sodium nitrite every four months and comparison of participating laboratories results. The results from the WASP scheme for rounds 112 to 115 during 2011 show good performance for BCCSS.

BCCSS also participate in the field inter-comparison study at Marylebone Road, London run by AEA Energy and Environment. The summary report for this study indicates a good precision rating for BCCSS and is shown in Figure 11.

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
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	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	05/01/2011	02/02/2011	101.1	104.9	116.9	108	8.2	8	20.5	91.2	93.3	Good	Good
2	02/02/2011	02/03/2011	132.9	133.2	129.7	132	1.9	1	4.8	111.7	93.3	Good	Good
3	02/03/2011	30/03/2011	92.7	91.7	89.3	91	1.7	2	4.3	95.7	96.8	Good	Good
4	30/03/2011	27/04/2011	135.5	124.1	122.5	127	7.1	6	17.6	106.4	97.5	Good	Good
5	27/04/2011	01/06/2011	105.6	105.7	100.9	104	2.7	3	6.8	99.9	97.4	Good	Good
6	01/06/2011	29/06/2011	116.6	107.7	112.2	112	4.5	4	11.1	93.1	90.8	Good	Good
7	29/06/2011	03/08/2011	124.0	117.7	114.7	119	4.7	4	11.8	86.1	91.1	Good	Good
8	03/08/2011	31/08/2011	97.0	100.1	97.5	98	1.7	2	4.1	82.2	97.7	Good	Good
9	31/08/2011	28/09/2011	125.8	159.5	143.1	143	16.9	12	41.9	108.5	96.1	Good	Good
10	28/09/2011	31/10/2011	108.0	104.5	97.1	103	5.6	5	13.8	108.2	96.5	Good	Good
11	18/11/2011	14/12/2011	159.9	159.4	148.4	156	6.5	4	16.1	110.2	97.4	Good	Good
12	30/11/2011	04/01/2012	130.5	125.6	142.8	133	8.9	7	22.0	105.4	96.6	Good	Good
13													

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

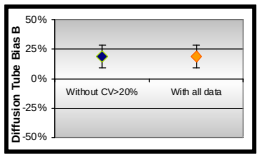
Overall survey --> Good precision | Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:

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

Accuracy (with 95% confidence interval) without periods with CV larger than 20%		Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 12 periods of data		Bias calculated using 12 periods of data	
Bias factor A	0.84 (0.78 - 0.91)	Bias factor A	0.84 (0.78 - 0.91)
Bias B	19% (10% - 28%)	Bias B	19% (10% - 28%)
Diffusion Tubes Mean:	119 μgm^{-3}	Diffusion Tubes Mean:	119 μgm^{-3}
Mean CV (Precision):	5	Mean CV (Precision):	5
Automatic Mean:	100 μgm^{-3}	Automatic Mean:	100 μgm^{-3}
Data Capture for periods used:	95%	Data Capture for periods used:	95%
Adjusted Tubes Mean:	100 (93 - 108) μgm^{-3}	Adjusted Tubes Mean:	100 (93 - 108) μgm^{-3}



Jaume Targa, for AEA
Version 04 - February 2011

Figure 11 Summary Report for Field Intercomparison Study 2011

Reference materials and equipment are obtained by BCCSS from suppliers who are approved to BS EN 9001. All reference materials are of at least analytical grade or equivalent. Standards are prepared using equipment that is all within BCCSS normal quality system.

Diffusion tubes are supplied by Gradko and are recycled by Bristol Scientific Services. Each nitrogen dioxide diffusion tube is prepared by pipetting a solution of 20% triethanolamine in water onto the metal grids in the end cap, then assembling the tube components. A fresh batch of tubes is prepared each month ready to dispatch in time for the required exposure date. A "blank" tube that has not been exposed is analysed with each batch of exposed tubes to determine if there has been any inadvertent contamination of the tubes.

Data Ratification and Bias Adjustment

The diffusion tube results are examined on a monthly basis to identify any spurious data and any suspect data is investigated further. Trends in monitored levels across the diffusion tube sites are compared to take into account seasonal factors, such as changing weather patterns and increased traffic flows, and to detect any local changes at the sites, such as road works. The monthly raw data is then averaged over the monitoring period to give a mean result. The monitoring period is usually a calendar year so the calculated average is therefore the annual mean.

While diffusion tubes provide a simple, cost-effective way of monitoring a wide range of locations, the accuracy of the tubes can be variable depending on the laboratory preparation, handling and analysis. To overcome this, a Bias Adjustment Factor, is applied to the raw mean for the relevant monitoring period to ratify the dataset. This factor can be calculated from monitoring sites where triplicate diffusion tubes are collocated with a continuous NOx analyser by comparing results of the two measurement methods. The ratified data from the continuous NOx analyser at Yate is used to obtain a local bias adjustment factor (BAF) through comparison with results obtained for triplicate NO_2 diffusion tubes collocated at this analyser site. The South Gloucestershire collocation study is added to the national collocation study.

Appendix C: Monthly Diffusion Tube Data

Table 6 2011 Monthly Nitrogen Dioxide Diffusion Tube Results

Site No.	Site Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Mean	Bias Adj Mean	Annual-ised Mean
106	Stoke Gifford 73 Hambrook Lane façade	N/O	N/O	N/O	28.5	21.1	17.8	25.4	22.5	25.0	29.7	32.8	26.0	25.4	21.1	-
107	Stoke Gifford 77 Hambrook Lane façade	N/O	N/O	N/O	28.0	16.8	16.8	21.2	19.1	21.5	26.8	29.5	22.1	22.4	18.6	-
108	Patchway 204 Gloucester Road rear façade	N/O	N/O	N/O	38.1	25.5	28.1	32.3	29.4	31.4	36.0	37.0	32.2	32.2	26.7	-
109	Little Stoke Clay Lane lp8 (rear of Gallivan Close)	N/O	N/O	N/O	31.6	25.4	24.2	30.0	25.4	30.1	33.3	31.6	32.1	29.3	24.3	-
110	Winterbourne 2 Sandstone Rise rear façade	N/O	N/O	N/O	22.4	18.1	16.7	19.3	21.5	23.9	26.9	28.7	26.8	22.7	18.9	-
111	Winterbourne 2 Down Road facade	N/O	N/O	N/O	25.8	20.9	16.8	21.6	21.4	23.2	25.7	30.4	25.6	23.5	19.5	-
112	Winterbourne 106 Dragon Road façade	N/O	N/O	N/O	Missing	20.3	17.6	20.1	22.8	28.1	28.3	19.5	30.9	23.4	19.5	23.0

N/O Site not operational