



2009 Air quality update:
Shortened detailed assessment
of nitrogen dioxide in Bordon,
Hampshire

East Hampshire District Council

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

September 2009

Local Authority Officer	Gemma Richards
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Department	Environmental Health
Address	East Hampshire District Council Penns Place Petersfield Hampshire GU31 4EX
Telephone	01730 234322
e-mail	gemma.richards@easthants.gov.uk

Report Reference number	EHDC 2009 Short DA Bordon
Date	10/09/09

Executive Summary

This report reviews nitrogen dioxide data that East Hampshire District Council has collected in Bordon between 2000 and July 2009. The purpose of the report is to determine whether or not it is likely that the annual mean air quality objective for nitrogen dioxide will be achieved in Bordon at the A325/Chalet Hill junction.

The 2008 Detailed Assessment¹ predicted that exceedences of the annual mean objective for nitrogen dioxide at relevant receptors in Bordon were unlikely and therefore concluded that an Air Quality Management Area (AQMA) was not necessary at this location. Modelling predicted significantly lower concentrations at relevant receptors located at first floor level than ground floor level with no relevant exposure.

Following communication with DEFRA regarding concentrations of nitrogen dioxide measured with diffusion tubes along the A325/Bordon, it was agreed that the results of the 2008 Detailed Assessment may be optimistic due to increases in the bias adjustment factors used to correct the 2007 data.

The information that is provided in this report is intended to supplement and update that given in the 2008 Detailed Assessment, to enable East Hampshire District Council sufficient data to determine whether declaring an Air Quality Management Area (AQMA) is justified.

In January 2009 additional monitoring tubes were placed at first floor level to investigate whether ground floor concentrations measured at commercial premises are representative of higher floors with residential use. Initial results of the 2009 survey suggest that ground floor concentrations of nitrogen dioxide are not representative of higher floors. However despite reductions in concentrations at first floor level, it appears likely that an exceedence of the $40\mu\text{g}/\text{m}^3$ objective exists at the façade of the residential properties adjacent to tube BR7 located above Corals, High Street, Bordon.

In light of the review of monitoring data for Bordon and the initial results for the 2009 survey at height which suggest a likely exceedence of the annual mean objective for nitrogen dioxide at one location, East Hampshire District Council will need to declare an AQMA in Bordon which includes the residential properties above Corals, High Street, Bordon.

At this time it appears likely that the boundary of the AQMA will cover the residential properties above the Corals building only (1 - 5 High Street, Bordon). Provisional 2009 results for another first floor level monitoring tube BR8 indicate that although concentrations of nitrogen dioxide exceed the $40\mu\text{g}/\text{m}^3$ air quality objective at ground floor level, concentrations of nitrogen dioxide at first floor level are likely to fall below the air quality objective.

East Hampshire District Council recognises the results for 2009 are indicative only and therefore proposes to review this position and determine the extent of the AQMA in January 2010 when a complete dataset for 2009 is available.

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1 Introduction

1.1 Description of Local Authority Area

East Hampshire is a rural District which borders West Sussex and Surrey and lies to the north of the urban areas of Portsmouth and Havant. The District covers an area of approximately 200 square miles and has a population of approximately 110,000 people. It is renowned for its attractive countryside, much of which is of an exceptionally high quality. Approximately 40% of the District lies within the East Hampshire Area of Outstanding Natural Beauty.

The District is based around the two market towns of Petersfield and Alton with other major centres at Whitehill, Bordon and Horndean. The rest of the District is characterised by many attractive villages, the largest of which are Liphook and Liss. The towns and villages contain many buildings and areas of architectural, archaeological and historic interest, which contribute greatly to the attractive appearance and character of the District's built environment.

The District is bisected by the A3 (Motorway and Trunk Road), which is a major transport link between London and Portsmouth. Other roads of local importance include the A31 (Farnham to Winchester), the A32 (Alton to Fareham), the A272 (Winchester to Petersfield), the A325 (A3 to Farnham via Bordon) and the A339 (Alton to Basingstoke). Rail services to London and the South coast stop at Liphook, Liss, Petersfield and Rowlands Castle. There are also stations at Alton and Bentley. The Mid Hants Watercress Line operates steam trains between Alton and Ropley.

East Hampshire has a buoyant local economy. There is a range of manufacturing and service industries, mainly in small to medium sized firms, and a significant public sector presence. The Ministry of Defence is also a major employer. In the countryside, agriculture remains an important sector of the local economy.

A map of East Hampshire is shown in Appendix 1.

1.2 Purpose of Report

During the third review and assessment of air quality in East Hampshire potential exceedences of the air quality objective for nitrogen dioxide were identified along the A325/Chalet Hill in Bordon. The 2008 Detailed Assessment¹ produced by Faber Maunsell on behalf of the Council (amended in 2009) predicted that exceedences of the annual mean nitrogen dioxide at relevant receptors were unlikely and therefore concluded that an Air Quality Management Area was not necessary at this location.

In February 2009 after communication with DEFRA regarding concentrations of nitrogen dioxide measured with diffusion tubes along the A325/Bordon, it was agreed that the results of the 2008 Detailed Assessment¹ may be optimistic in light of increases in the bias adjustment factors used to correct the 2007 data. Therefore East Hampshire District Council proposed:

- To submit a shortened Detailed Assessment for the A325/Bordon at the end of August 2009 that focuses on monitoring results only and takes into account new monitoring sites located at high level. The shortened Detailed Assessment is to be based upon the latest adjustment figures present at the time the data is analysed, but will not feature any modelling. Previous years' data will also be revisited taking into account the most recent bias adjustment factors available. This will give the Council sufficient data to determine whether an Air Quality Management Area is justified.

DEFRA have agreed to this approach.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. 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.

The purpose of this report is to address the issues agreed with DEFRA in February 2009. This report represents the Council's official submission to DEFRA under the requirements of the Environment Act 1995. All existing nitrogen dioxide monitoring results for Bordon have been reviewed using the latest available bias adjustment factors.

This Detailed Assessment intends to determine with reasonable certainty whether or not there is a likelihood of the objectives not being achieved in Bordon. It provides East Hampshire District Council an opportunity to supplement the information gathered in earlier review and assessment work. Typically Detailed Assessments assess the impact of pollution sources on local receptors at identified hotspots through dispersion modelling. No modelling has been carried out in the production of this report. The information that is provided is intended to supplement and update that given in the 2008 Detailed Assessment, to enable East Hampshire District Council sufficient data to determine whether declaring an AQMA is justified.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM in **England** are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table 1.1. This table shows the objectives in units of microgrammes per cubic metre $\mu\text{g}/\text{m}^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

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Table 1.1 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
	5.00 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	0.25 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2005
Particles (PM₁₀) (gravimetric)	50 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.4 Summary of Previous Review and Assessments

The First Review and Assessment of Air Quality

East Hampshire District Council completed the first review and assessment of air quality in December 2000². This assessment concluded that the air quality objectives contained in the Air Quality Regulations 1997 would be achieved throughout the District.

The Second Review and Assessment of Air Quality

East Hampshire District Council completed the second review and assessment of air quality in July 2005. This comprised of the following elements:

- Updating and Screening Assessment – August 2003³
- Progress Report – September 2004⁴
- Detailed Assessment – July 2005⁵

The Council carried out the Updating and Screening Assessment of air quality in August 2003. The results of this assessment showed that no pollutants were expected to exceed the air quality objectives and therefore there was no requirement to proceed to a Detailed Assessment. However the assessment highlighted several areas which the Council needed to investigate further. These included:

- Monitoring of nitrogen dioxide levels adjacent to the A3 Bramshott Chase
- Monitoring PM₁₀ at the Bordon Sandpit in Sleaford
- Discussion with the Mid Hants Watercross Line regarding public exposure to sulphur dioxide.

In 2004 the Council produced a Progress Report which investigated the issues raised in the 2003 Updating and Screening Assessment. The report also provided the latest nitrogen dioxide and PM₁₀ monitoring results from the air quality monitoring station at Horndean and from the nitrogen dioxide diffusion tube monitoring carried out across the District.

The results from the air quality monitoring station showed that the nitrogen dioxide and PM₁₀ concentrations were likely to meet the air quality objectives in 2004/05. The diffusion tube monitoring showed possible exceedences of the annual mean concentration of nitrogen dioxide in 2005 at the A3 Bramshott Chase and A325 Chalet Hill, Bordon. This meant that a Detailed Assessment of nitrogen dioxide was required for these locations.

In 2005 the Council commissioned Casella Stanger to undertake a Detailed Assessment of air quality adjacent to the A3 Bramshott Chase and A325 Chalet Hill, Bordon. Using dispersion modelling, it was predicted that the annual mean nitrogen dioxide concentrations would be below the annual mean objective and the EU limit value in all years at Bordon and Bramshott Chase. However, monitoring along the A3 at Bramshott Chase suggested a potential exceedence of the annual mean objective for nitrogen dioxide. Casella Stanger recommended that the air quality monitoring was continued in order to provide an annual average estimate for 2005. No AQMA was required at this time.

This Detailed Assessment was based on a worst case scenario as it ignored the Highways Agency's future development of a tunnel at Hindhead in Surrey which will improve traffic flow along the A3.

The Third Review and Assessment of Air Quality

East Hampshire District Council completed the third review and assessment of air quality in April 2009. This comprised of the following elements:

- Updating and Screening Assessment – June 2006⁶
- Detailed Assessment – August 2008 – amended August 2009⁷
- Progress Report – August 2009⁸

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The Council carried out the Updating and Screening Assessment of air quality in June 2006. For nitrogen dioxide, the results from diffusion tube monitoring highlighted that the 2005 and 2010 annual mean objective for nitrogen dioxide may be exceeded at several monitoring locations in the District including:

- A3 Bramshott/Grayshott
- A3 Horndean/ Portsmouth Rd
- A325 Bordon

This meant that a Detailed Assessment of nitrogen dioxide was required for these locations.

In 2007 the Council experienced a significant turnover of staff within the Environmental Protection team including the loss of the air quality officer. This resulted in some loss of continuity with the review and assessment process and a loss of expertise in air quality.

At the end of 2007 the Council commissioned Faber Maunsell to undertake a Detailed Assessment of air quality adjacent to the A325 Bordon and A3 Horndean/Portsmouth Rd, but not the A3 Bramshott/Grayshott.

The reasons for excluding the A3 Bramshott/Grayshott relate to the construction of the A3 Hindhead tunnel, a major project being carried out by the Highways Agency to deliver quicker and more reliable journeys on a safer road between London and Portsmouth.

The majority of the tunnel construction work is located outside of East Hampshire within Waverley Borough Council's area. An Environmental Assessment of this scheme carried out for the Highways Agency in 2004 predicted that the alterations to the A3 will result in improvements to air quality within East Hampshire District Council's area⁷. The development was predicted to result in a lower exposure of traffic pollutants at residential properties at Bramshott Chase due to the realignment of the A3. Predictions demonstrated that annual mean nitrogen dioxide concentrations at locations with relevant public exposure will remain below the annual mean objective when the road works have been completed⁷. With this in mind the Council concluded to continue monitoring nitrogen dioxide in this area, but to not proceed to a Detailed Assessment at this time.

Further reasons why a Detailed Assessment of the A3 Bramshott/Grayshott was not carried out include:

- a. Conditions in Bramshott Chase are currently temporary and so monitoring results will only present a transient set of circumstances during the construction phase for the new A3.
- b. The current phase of the construction project has temporarily relocated the A3 at greater distance from the receptors that were of concern in the 2006 USA.
- c. Not all monitoring locations reported in the 2006 USA are at representative locations (i.e. residential facades), but either on commercial sites or much closer to the roadway than the nearest relevant exposure.
- d. The road works within East Hampshire are expected to be completed in December 2010 with the tunnel due to open mid 2011.
- e. The new road will be located at greater distance from existing sensitive receptors.

Using the AAQULRE regional air quality dispersion model and reviewing monitoring data, the 2008 Detailed Assessment concluded that no Air Quality Management Area was required at either the A325/Bordon or A3 Horndean/Portsmouth Rd. The report predicted that the annual mean nitrogen dioxide concentrations would be below the annual mean objective and the EU limit value in all years at all locations.

The 2008 Detailed Assessment was submitted to DEFRA for consultation in August 2008. Further information was submitted to DEFRA in October 2008 to address points raised during the appraisal process which included the proposal to submit a Progress Report as an appendix in the 2008 Detailed Assessment.

In February 2009 after further communication with DEFRA regarding concentrations of nitrogen dioxide along the A325/Bordon the following course of action was agreed:

- To submit the 2009 USA by the end of April 2009 in accordance with the national timetable.
- To submit a shortened Detailed Assessment for the A325/Bordon at the end of August 2009 that focuses on monitoring results only and takes into account new monitoring sites located at high level. The shortened Detailed Assessment is to be based upon the latest adjustment figures present at the time the data is analysed, but will not feature any modelling. Previous years' data will also be revisited taking into account the most recent bias adjustment factors available. This will give the Council sufficient data to determine whether an Air Quality Management Area is justified.
- To make amendments to the 2008 Detailed Assessment detailed in the Council's letter to DEFRA dated 27/10/08.

An amended 2008 Detailed Assessment¹ including the 2008 Progress Report as an appendix was submitted to DEFRA on 04 August 2009.

The 2008 Progress Report¹ showed that air quality objectives would be achieved for all pollutants except nitrogen dioxide. For nitrogen dioxide the results from diffusion tube monitoring showed that the 2005 annual mean objective may be exceeded along the A3/Bramshott Chase at the following monitoring position:

- Bramshott, Mercedes Garage

This location is not considered representative of relevant public exposure. The nearest relevant exposure to this monitoring position are properties set back 9m and 48m from the A3. Concentrations measured at the façade of the residential properties (Bramshott, Chase Villas) which are the closest to the A3 in this area fall below the annual objective limit.

In view of the construction of the A3 Hindhead tunnel and the absence of relevant public exposure at the Mercedes Garage, the 2008 Progress Report concluded that a Detailed Assessment for this location is currently not required.

Concentrations of nitrogen dioxide continue to be monitored at Bramshott Chase during the construction of the A3 Hindhead Tunnel and will be reported again in the 2010 Progress Report.

The Fourth Review and Assessment of Air Quality

The fourth review and assessment of air quality in East Hampshire began in 2009. The Council carried out the Updating and Screening Assessment of air quality in April 2009⁸. The report showed that air quality objectives would be achieved for all pollutants except nitrogen dioxide in Bordon at two monitoring locations:

- Bordon, Corals (1) Chalet Hill (BR4)
- Bordon, High Street (1) (BR5)

These locations are not considered representative of relevant public exposure. Additional monitoring tubes were placed at a higher level closer to the facades of the nearest relevant exposure at first floor level in January 2009. The results of this survey are provided in this report.

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Previous report	Date produced	Brief outcome
LAQM Review & Assessment Report	December 2000	Air quality objectives achieved
Updating and Screening Assessment	August 2003	Air quality objectives achieved, but identified that several areas require further investigation.
Progress Report	September 2004	Addressed areas raised in 2003 USA. Identified that a Detailed Assessment was required for nitrogen dioxide at A3 Bramshott Chase and A325 Chalet Hill/ Bordon.
Detailed Assessment	July 2005	Air quality objectives achieved
Updating and Screening Assessment	June 2006	Identified that a Detailed Assessment was required for nitrogen dioxide at A3 Bramshott/Grayshott, A325 Chalet Hill/Bordon and A3 Horndean/Portsmouth Road.
Amended 2008 Detailed Assessment and 2008 Progress Report	August 2009 (first submitted August 2008)	Detailed Assessment: predicted that air quality objectives achieved at A3 Horndean/Portsmouth Road and A325 Chalet Hill/Bordon, but some concern that results in the report may be optimistic. Progress Report: Air quality objectives achieved with the exception of diffusion tube at Bramshott, Mercedes Garage. No relevant exposure and local conditions transient due to construction of Hindhead Tunnel.
Updating and Screening Assessment	April 2009	Air quality objectives achieved with the exception of two monitoring positions in Bordon. No relevant exposure at these positions. Further information to be submitted in August 2009.

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Table 2.1 Details of Automatic Monitoring Sites

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	In AQMA ?	Relevant Exposure?	Distance to kerb of nearest road	Worst-case Location ?
Bordon	Urban background	479646, 135341	NO ₂ PM ₁₀	No	No	4m	N

The data from the station is collected via a GSM modem. Data management is carried out by Casella ETi who screen and validate the raw data and provide the Council with written reports of the results on a quarterly basis.

2.1.2 Non-Automatic Monitoring

Nitrogen dioxide is also measured in East Hampshire using diffusion tubes. The tubes are supplied and analysed by Gradko International Ltd and prepared by using 50% v/v TEA in acetone methodology. Gradko International Ltd is a UKAS accredited laboratory. Further details on the QA/QC of the diffusion tubes can be seen in Appendix 2. Appendix 2 also summarises the bias adjustment factors used in this report. Maps showing the locations of the diffusion tube monitoring sites can be seen in Appendix 3.

Table 2.2 Details of Non- Automatic Monitoring Sites – Nitrogen dioxide

Site Name	Site Type ^a	OS Grid Ref	In AQMA	Relevant Exposure?	Tube height (m)	Distance from kerb (m)	Worst-case Location
Bordon, Corals (1) Chalet Hill BR4	RS	479666, 135354	No	No Relevant exposure at 1 st /2 nd level	2.56	2.9	Yes
Bordon, Corals (2) Chalet Hill BR7	RS	479666, 135354	No	Representative of relevant exposure	3.31	2.9	Yes
Bordon, Ashmead BR1	RS	479707, 135438	No	Yes	2	10	No
Bordon, Chalet Court BR2	RS	479695, 135356	No	Yes	1.5	6	No
Bordon, 10 Chalet Hill BR3	RS	479711, 135321	No	No	2	3	Yes
Bordon, High Street (1) BR5	RS	479654, 135312	No	No Relevant exposure at 1 st floor level	2.26	1.9	Yes
Bordon, High Street (2) BR8	RS	479654, 135312	No	Representative of relevant exposure	3.17	1.9	Yes
Bordon, Air Quality Cabin (3 tubes co-located) BR6	RS	479646, 135341	No	No Representative of relevant exposure	2	4.8	No
Bordon, 11 High Street (1) BR9	RS	479642, 135278	No	No	2.6	1.4	Yes
Bordon, 11 High Street (2) BR10	RS	479642, 135278	No	Representative of relevant exposure	3.25	1.4	No
Bordon, Bassenthwaite Gdns BU1	UB	479795, 136267	No	Yes	1.7	N/A	No
Whitehill, Petersfield Rd WR1	RS	479314, 134307	No	No Residential façade is approx 18m from road	2	1	Yes

a RS = roadside
UB = urban background

2.2 Comparison of Monitoring Results with Air Quality Objectives

2.2.1 Nitrogen Dioxide

The Government and the Devolved Administrations have adopted two air quality objectives for nitrogen dioxide (NO₂); an annual mean concentration of 40 µg/m³, and a 1-hour mean concentration of 200 µg/m³ not to be exceeded more than 18 times per year.

Automatic Monitoring Data

The measured annual mean concentrations of nitrogen dioxide at the Bordon air quality station for the years 2005 to 2008 fall below the air quality objective of 40 µg/m³ and there were no exceedances of the hourly mean objective of 200 µg/m³. This is shown in tables 2.3a and 2.3b. Data for 2009 will be reported in further detail in the 2010 Progress Report.

Table 2.3a Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective

Site ID	Within AQMA?	2005 ^a		2006		2007 ^c		2008		2009 ^e	
		Proportion of yr with valid data %	Annual mean (µg/m ³)	Proportion of yr with valid data %	Annual Mean (µg/m ³)	Proportion of yr with valid data %	Annual Mean (µg/m ³)	Proportion of yr with valid data %	Annual Mean (µg/m ³)	Proportion of yr with valid data %	Annual Mean (µg/m ³)
Bordon	No	83.1% (99%) ^b	30.2	99%	27.8	58%	30.4 (40) ^d	98%	27.6	99%	26.3

^a Monitoring commenced March 2005

^b % valid data from March to December 2005

^c Bordon station was switched off 25/05/07 – 11/10/07 due to the failure of the air conditioning unit. Data capture during this year was 58%. Results shown for 2007 have been seasonally adjusted. See 2008 Detailed Assessment¹ Appendix H for details.

^d Annualised NO₂ concentration for 2007

^e Provisional results for 2009 for period Jan-Jun. Full results will be reported in 2010 Progress Report. Not annualised.

Table 2.3b Results of Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective

Site ID	Within AQMA?	Proportion of years with valid data %	Number of Exceedences of hourly mean (200 µg/m ³)				
			2005	2006	2007*	2008	2009
Bordon	No	As above in 2.3a for all years	0	0	0 (117 µg/m ³)	0	0

(99.8th %ile of hourly means in brackets)

* Bordon station was switched off 25/05/07 – 11/10/07 due to the failure of the air conditioning unit. Data capture during this year was 58%

The results for 2007 are discussed in more detail in the 2008 Detailed Assessment¹. The annual concentration of nitrogen dioxide shown in table 2.3a for 2007 has been annualised following the guidance contained in Box 3.2 of TG(09)⁹. Further information on how this was calculated is provided in Appendix H of the 2008 Detailed Assessment and a summary showing how the adjustment factor was produced is shown in table 2.4. The annualising factor of 1.32 had the effect of increasing the raw

data in 2007. Whilst providing the best estimate of the annual mean concentration for the Bordon air quality station during 2007, the adjusted data is likely to be less reliable than data for other years.

The 99.8th percentile for 2007 was calculated for comparison against the hourly mean objective due to poor data capture. This was calculated using the guidance contained in paragraph A1.218, Annex 1 of TG(09)⁹.

Table 2.4 2007 Calculation of adjustment factor calculated from the three nearest AURN sites

Long-term AURN continuous monitors	Type	Data capture %	Annual mean NO ₂ /µg/m ³	Period mean NO ₂ /µg/m ³	Ratio
Reading New Town	Urban Background	95.8	22.9	17.9	1.28
Portsmouth	Urban Background	99.0	22.8	17.7	1.29
Brighton Preston Park	Urban Background	96.7	21.8	15.7	1.38
Average Ratio					1.32

Diffusion Tube Monitoring Data

Annual mean concentrations of nitrogen dioxide measured using diffusion tubes in Bordon are shown in table 2.5a. This table includes the annual mean concentrations for all the diffusion tube data available for Bordon from 2000 to July 2009. Where less than 9 months data is available for a monitoring location, the results have been annualised following the guidance contained in Box 3.2 of TG(09)⁹. Further information on the estimation of annual mean concentrations from short-term monitoring data is provided in Appendix 2. Results in bold indicate an exceedence of the annual mean objective for nitrogen dioxide of 40µgm³.

All data has been reviewed and the most suitable bias-adjustment factor available has been applied. In deciding which bias adjustment factor to apply consideration has been given to guidance in Box 3.3 of TG(09)⁹ and the air quality helpdesks' websites. Further information on the choice of the bias adjustment factor used for each year is provided in Appendix 2.

A summary of locally derived and national bias adjustment factors for all years is provided in table 2.5c. For the years 2003 and 2004 the co-location study was located at the air quality monitoring station's previous location in Horndean. Further information on this location is given in EHDC's 2004 Progress Report⁴. Local bias adjustment factors have been calculated using the AEA Group's spreadsheet "Checking Precision and Accuracy of Triplicate Tubes"¹². Copies of the completed spreadsheets are available in Appendix 4 for all years where a co-location study was carried out. National bias adjustment factors were obtained from the Review and Assessment Helpdesk's database (v05/09)¹¹.

Raw data for all years is provided in Appendix 5.

Most of the nitrogen dioxide concentrations are measured at roadside locations. Concentrations of nitrogen dioxide at the location of nearest relevant exposure may be lower as they are further away from the road.

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Table 2.4a Adjusted results of Nitrogen Dioxide Diffusion Tubes

Site ID	Site name	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$) Adjusted for bias									
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
BR4	Corals (1) Chalet Hill	No	51.9	43.6	23.6	39.3	49.6	46.9	49.4	48.3	48.3	46.9
BR7	Corals (2) Chalet Hill	No										44.9
BR1	Ashmead	No						26.0	26.1	26.3	25.4	22.2
BR2	Chalet Court	No						32.8	30.5	28.8	25.8	25.4
BR3	10 Chalet Hill	No							28.2	31.4	29.8	30.9
BR5	High Street (1)	No						41.6	44.0	47.8	42.8	42.2
BR8	High Street (2)	No										38.3
BR6	Air Quality Cabin 1	No						28.6	28.6	29.0	27.2	24.9
BR6	Air Quality Cabin 2	No						28.3	27.8	28.8	26.7	25.6
BR6	Air Quality Cabin 3	No						27.5	27.9	30.8	26.6	25.2
BR9	11 High Street (1)	No										34.0
BR10	11 High Street (2)	No										33.8
BU1	Bassenthwaite Gdns	No									14.5	13.8
WR1	Whitehill, Petersfield Rd	No							42.0	40.7	35.3	34.6

Blue cells indicate data has been annualised. Further information on the estimation of annual mean concentrations from short-term monitoring data is provided in Appendix 2

Green cells indicate new monitoring positions for 2009 which have been placed at height

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Table 2.4b Results of Nitrogen Dioxide Diffusion Tubes in Bordon (raw data)

Site ID	Site ID	Within AQMA?	Annual mean concentrations ($\mu\text{g}/\text{m}^3$) Not adjusted for bias and or annualised									
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
BR4	Corals (1) Chalet Hill	No	43.23	30.08	18.89	41.47	41.64	42.66	44.89	47.85	51.40	49.20
BR7	Corals (2) Chalet Hill	No										47.10
BR1	Ashmead	No						23.68	23.71	26.04	27.05	23.30
BR2	Chalet Court	No						29.84	27.75	28.47	27.50	26.70
BR3	10 Chalet Hill	No							29.81	35.59	31.66	32.50
BR5	High Street (1)	No						40.12	39.98	47.34	45.52	46.70
BR8	High Street (2)	No										40.20
BR6	Air Quality Cabin 1	No						25.98	25.97	28.74	28.91	26.20
BR6	Air Quality Cabin 2	No						27.32	25.30	28.48	28.44	26.90
BR6	Air Quality Cabin 3	No						26.58	25.34	30.47	28.26	26.40
BR9	11 High Street (1)	No										37.90
BR10	11 High Street (2)	No										35.50
BU1	Bassenthwaite Gdns	No									16.21	14.40
WR1	Whitehill, Petersfield Rd	No							38.15	40.27	37.56	36.30

Blue cells indicate less than 9 months data

Green cells indicate new monitoring positions for 2009 which have been placed at height

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Table 2.4c Summary of locally derived and national bias adjustment factors for all years

Year	Local bias adjustment factor	National bias adjustment factor	Number of studies national factor based on	Choice of bias adjustment factor	Reason	Other comments
2000	none available	1.2	2	National	Local factor not available	Apply with caution as only based on 2 studies
2001	none available	1.45	9	National	Local factor not available	
2002	none available	1.27	12	National	Local factor not available	
2003	0.91	1.11	19	National	Diffusion tube survey shows poor precision and local factor decreases the raw data	
2004	1.19	1.1	27	Local	Co-location site shows good precision and reflects local conditions	
2005	1.14	1.1	14	National	Co-location study is for less than 9 months	
2006	1.1	1.01	18	Local	Co-location site shows good precision and reflects local conditions	
2007	none available	0.98	15	National	Local factor not available	
2008	0.94	0.93	16	Local	Co-location site shows good precision and reflects local conditions	
2009	2008 - 0.94	2008 - 0.93	As above	As above	Full data set for 2009 not available	Results indicative only

Table 2.4a shows exceedences of the annual air quality objective $40 \mu\text{g m}^{-3}$ at the following monitoring locations:

- **BR4** - Corals (1) Chalet Hill;
- **BR7** - Corals (2) Chalet Hill;
- **BR5** - High Street (1); and
- **WR1** - Whitehill, Petersfield Road.

The above monitoring positions, with the exception of tube BR7, are not considered to be representative of relevant public exposure.

Tube WR1 showed exceedences of the annual objective in 2006 and 2007 only, and the closest relevant public exposure is approximately 18m from the road, therefore it is considered likely that there are currently no exceedences at the facades of residential properties close to this location.

Tubes BR4 and BR5 are located at ground floor level outside commercial premises. The closest relevant public exposures are residential premises located at first floor height. Tube BR4 is attached to a lamp post in front of a commercial façade and BR5 is located on rain water goods in front of a commercial façade. The Corals building is one of the tallest buildings in this area and is three storeys high. The majority of the other buildings in this commercial parade are two storeys high. Photographs showing the layout of the High Street in Bordon are provided in Appendix 6.

Additional diffusion tubes have been located at the same location as BR4 (Corals (1) Chalet Hill) and BR5 (High Street (1)), but closer to first floor level to investigate whether ground floor concentrations are representative of higher floors. The survey of nitrogen dioxide concentrations at height commenced in January 2009. The new higher sites are known as BR7 (Corals (2) Chalet Hill) and BR8 (High Street (2)). A further monitoring position which measures concentrations both at ground floor and first floor level has also been introduced at 11 High Street, Bordon; known as BR9 (11 High Street (1)) and BR10 (11 High Street (2)).

Figure 2.2.1 Photographs of BR4 Corals (1) (lower tube) and BR7 Corals (2) (higher tube)



Red circles mark position of diffusion tubes

Figure 2.2.2 Photograph of BR5 High Street (1) (lower tube) and BR8 High Street (2) (higher tube)



Red circles mark position of diffusion tubes

Initial results of the 2009 survey indicate that ground floor concentrations of nitrogen dioxide are not representative of higher floors. This is highlighted in table 2.5 below. The extent of the reduction in concentrations appears to fall off with distance from the A325/Chalet Hill junction as lower concentrations of nitrogen dioxide were measured at 11 High Street which is approximately 70m south west of the junction.

Table 2.5 Summary of initial results of 2009 diffusion tube survey at height, Bordon

Site ID	Site name	Height of tube from ground (m)	Annual mean concentrations ($\mu\text{g}/\text{m}^3$)	Reduction in concentration
BR4	Corals (1) Chalet Hill	2.56	46.9	Increase in height of 0.75m achieves reduction in concentration of 2 $\mu\text{g}/\text{m}^3$
BR7	Corals (2) Chalet Hill	3.31	44.9	
BR5	High Street (1)	2.26	42.2	Increase in height of 0.91m achieves reduction in concentration of 3.9 $\mu\text{g}/\text{m}^3$
BR8	High Street (2)	3.17	38.3	
BR9	11 High Street (1)	2.6	34.0	Increase in height of 0.65m achieves reduction in concentration of 0.2 $\mu\text{g}/\text{m}^3$
BR10	High Street (2)	3.25	33.8	

The data in table 2.5 has been adjusted for tube bias and annualised in accordance with guidance in TG(09)⁹ using 2008 data from long term AURN continuous monitors as agreed with the Review and Assessment helpdesk on 18/08/09. A full year of data is not yet available for 2009, which means the results above are indicative only. 2009 data will be reported in full in the 2010 Progress Report.

East Hampshire District Council

Table 2.5 indicates that although concentrations of nitrogen dioxide exceed the $40\mu\text{g}/\text{m}^3$ air quality objective at BR5 (ground floor level), concentrations of nitrogen dioxide at BR8 (first floor level), are likely to fall below the air quality objective of $40\mu\text{g}/\text{m}^3$. BR8 is considered representative of relevant public exposure at this location.

The provisional 2009 results for tubes BR4 and BR7 also show that concentrations of nitrogen dioxide decrease with height, however an exceedence of the $40\mu\text{g}/\text{m}^3$ objective still exists at the higher position of BR7. It should be noted that tube BR7 is located a small distance away from the façade of the first floor flat. It was not safe to position the tube any higher, or closer to the window of the relevant receptor. It is likely that concentrations at the relevant receptor are lower than the predicted $44.9\mu\text{g}/\text{m}^3$, however on the balance of probabilities it appears likely that an exceedence of the objective will still exist at the building façade of the residential premises.

The new sites at BR9 and BR10 fall below the annual air quality objective of $40\mu\text{g}/\text{m}^3$.

In light of the review of diffusion tube data for Bordon and the initial results for the 2009 survey at height which suggest likely exceedences of the annual mean objective for nitrogen dioxide at one location, on this basis East Hampshire District Council consider that it is necessary to declare an Air Quality Management Area in Bordon which includes the residential properties above Corals, High Street, Bordon.

Provisional 2009 data for tube BR8 suggests there is not a strong case for declaring an AQMA which includes the first floor flat at 9 High Street, Bordon. At this time it appears likely that the boundary of the AQMA will cover the residential properties above the Corals building only (1 - 5 High Street, Bordon).

The results for 2009 are indicative only and have been adjusted using 2008 data. East Hampshire District Council therefore proposes to review this position and determine the extent of the AQMA in January 2010 when a complete dataset for 2009 is available.

3 Conclusions and Proposed Actions

Exceedences of the annual mean NO₂ objective have been identified at four locations in Bordon over the period 2000 to mid 2009:

- **BR4** - Corals (1) Chalet Hill;
- **BR7** - Corals (2) Chalet Hill;
- **BR5** - High Street (1); and
- **WR1** - Whitehill, Petersfield Road.

With the exception of tube BR7, these locations are not considered representative of relevant public exposure. Tube BR7 is part of a new diffusion tube survey in Bordon which commenced in January 2009 to investigate whether ground floor concentrations of nitrogen dioxide are representative of higher floors.

Initial results of the 2009 survey indicate that ground floor concentrations of nitrogen dioxide are not representative of concentrations at higher floors. The extent of the reduction in concentrations varies at each position monitored. Concentrations measured close to first floor level at tube BR7 are lower than those measured at BR4 (ground floor level), however an exceedence of the 40µg/m³ objective still exists at the higher position of BR7.

Provisional 2009 results for tube BR8 (High Street (2)) suggest there is not a strong case for declaring an AQMA which includes the first floor flat at this location. East Hampshire District Council recognises that this conclusion is based on an incomplete data set for 2009 which has been bias adjusted and annualised using 2008 data.

As the provisional results for the 2009 survey suggest a likely exceedence of the annual mean objective for nitrogen dioxide at tube BR7, East Hampshire District Council wconsider that it is appropriate that an Air Quality Management Area is created in Bordon which includes the residential properties at this location. Current evidence suggests that an exceedence of the annual mean objective for NO₂ is only likely at this location; therefore at this time it appears likely that the boundary of the AQMA will cover the residential properties above Corals, 1-5 High Street, Bordon only.

Proposed further action:

- 1) East Hampshire District Council proposes to review data for 2009 in January 2010 when a complete dataset for the diffusion tubes located at first floor level is available and base the boundary of the AQMA on its findings.
- 2) East Hampshire District Council shall declare an AQMA in Bordon at the junction of the A325 with Chalet Hill.
- 3) East Hampshire District Council will submit the 2010 Progress Report by the end of April 2010 in accordance with the national timetable and produce a Further Assessment in accordance with the legislative requirements of the Environment Act 1995.

4 References

- 1 East Hampshire District Council (2009). 2008 Detailed Assessment of Nitrogen Dioxide for East Hampshire including 2008 Progress Report. East Hampshire District Council
- 2 East Hampshire District Council. (1999). First Stage Air Quality Review & Assessment. East Hampshire District Council
- 3 East Hampshire District Council (2003). Updating and Screening Assessment of Air Quality in East Hampshire. East Hampshire District Council
- 4 East Hampshire District Council (2004). Air Quality Progress Report for East Hampshire. East Hampshire District Council
- 5 Casella Stanger (2005). East Hampshire District Council Local Air Quality Management – Detailed Assessment Report. Casella Stanger
- 6 East Hampshire District Council (2006) Updating Screening and Assessment of Air Quality in East Hampshire. East Hampshire District Council
- 7 Highways Agency (2004) A3 Hindhead Environmental Statement. Highways Agency
- 8 East Hampshire District Council (2009) Updating Screening and Assessment of Air Quality in East Hampshire. East Hampshire District Council
- 9 DEFRA (2009) Local Air Quality Management LAQM.TG(09). Department for Environment, Food and Rural Affairs
- 10 AEA Energy & Environment (2006) AEA_DifTPAB_V02.xls Checking Precision and Accuracy of Triplicate Tubes. AEA
- 11 Air Quality Review & Assessment Helpdesk (2009) Spreadsheet of Bias Adjustment Factors (v.05/09). Accessed 01/09/09 at: <http://www.uwe.ac.uk/aqm/review/R&Asupport/diffusiantube050509.xls>
- 12 AEA (2009) WASP – Annual Performance Criteria for NO₂ Diffusion Tubes used in Local Air Quality Management (LAQM), 2008 onwards, and Summary of Laboratory Performance in Rounds 100-104. Accessed on 08/09/09 at: http://www.laqmsupport.org.uk/Summary_of_Laboratory_Performance_in_WASP_R100-104.pdf

Appendices

Appendix 1	Map of East Hampshire
Appendix 2	QA/QC data
Appendix 3	Maps showing the location of nitrogen dioxide diffusion tubes in East Hampshire
Appendix 4	Precision and Accuracy of Triplicate Tubes for years 2003 to 2008 (including provision results for 2009)
Appendix 5	Raw diffusion tube data for all years
Appendix 6	Photographs of Bordon A325/High street and surrounding area

Appendix 1: Map of East Hampshire

Appendix 2: QA:QC Data

Diffusion Tube Bias Adjustment Factors

The diffusion tubes used by East Hampshire District Council are supplied and analysed by Gradko International Ltd and prepared by using 50% v/v TEA in acetone methodology. Gradko International Ltd is a UKAS accredited laboratory.

National bias adjustment factors have been obtained for the years 2000 to 2008 using the national database which is run by the R&A Helpdesk (version 05/09)¹¹. A summary of these is given below:

Year	Bias adjustment factor from national database (05/09)	Number of studies based on
2000	1.2	2
2001	1.45	9
2002	1.27	12
2003	1.11	19
2004	1.1	27
2005	1.1	14
2006	1.01	18
2007	0.98	15
2008	0.93	16

Factor from Local Co-location Study

East Hampshire District Council has carried out its own investigation of diffusion tube accuracy by carrying out co-location studies of nitrogen dioxide since 2002. The 2003 and 2004 studies were carried out in Horndean. The co-location studies since 2005 have been carried out at the air quality station's current location in Bordon.

Local bias adjustment factors for all years have been calculated using the "Checking Precision and Accuracy of Triplicate Tubes" spreadsheet available on the "LAQM tools" section of the Air Quality Archive at www.airquality.co.uk/archive/laqm/laqm.php¹⁰. The spreadsheet provided the following local bias adjustment factors:

Year	Local bias adjustment factor
2003	0.91
2004	1.19
2005	1.14
2006	1.1
2007	None available due to poor data capture of AQMS
2008	0.94

Copies of the spreadsheets used to calculate the local bias adjustment factors can be seen in Appendix 4.

The annual means and bias for each site can be seen in table 2.4a of the report.

Discussion of Choice of Factor to Use

Where only one factor was available for the year being reviewed, that factor was applied.

Table 2.4c on page 17 details which factors were chosen for the remaining years and provides the reason why that factor was applied in each case.

East Hampshire District Council

For 2009 the 2008 local bias adjustment factor of 0.94 was applied as a full dataset is not yet available for 2009. Data collected to date for 2009 has been entered into an AEA precision and accuracy spreadsheet which for the months January to July 2009 shows the local bias adjustment factor to be 0.96.

Data sets where less than 9 months data is available have been annualised using the guidance set out in Box 3.2 of TG(09)⁹ before being bias adjusted.

Short-term to long-term data adjustment

Where less than 9 months data was available for a monitoring location, the results have been annualised following the guidance contained in Box 3.2 of TG(09)⁹.

The long term sites originally chosen for these calculations were Reading New Town and Portsmouth however years with less than 90% data capture were rejected and replaced with data from another nearby AURN site. Data from the original choice of Reading New Town was not available for 2002 and 2003 as monitoring in this location did not begin until October 2003.

All data used has been ratified.

Year 2002

BR4 - Corals (1) Chalet Hill

Long term site	Site Type	Annual Mean	Period Mean	Ratio
Portsmouth	Background	25.6	27.47	0.93
Reading	Background	33.0	31.87	1.04
			Average (Ra)	0.98

Year 2003

BR4 - Corals (1) Chalet Hill

Long term site	Site Type	Annual Mean	Period Mean	Ratio
Portsmouth	Background	26.3	31.13	0.84
Bournemouth	Background	22.2	25.70	0.86
			Average (Ra)	0.85

Year 2005

BR5 - High Street

Long term site	Site Type	Annual Mean	Period Mean	Ratio
Portsmouth	Background	23.1	24.44	0.94
Reading New Town	Background	22.9	24.81	0.92
			Average (Ra)	0.93

BR6 - Air quality cabin

Long term site	Site Type	Annual Mean	Period Mean	Ratio
Portsmouth	Background	23.1	24.61	0.94
Reading New Town	Background	22.9	24.63	0.93
			Average (Ra)	0.93

Year 2006

BR3 – 10 Chalet Hill

Long term site	Site Type	Annual Mean	Period Mean	Ratio
Portsmouth	Background	22.3	25.90	0.86
Brighton Preston Park	Background	20.9	24.30	0.86
			Average (Ra)	0.86

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Year 2007

BR3 – 10 Chalet Hill

Long term site	Site Type	Annual Mean	Period Mean	Ratio
Portsmouth	Background	22.8	25.83	0.88
Reading New Town	Background	22.9	25.97	0.88
			Average (Ra)	0.88

Year 2008

Calculations from 2009 USA

BU1 - Bassenthwaite Gardens

Long term site	Site Type	Annual Mean	Period Mean	Ratio
Portsmouth	Background	23.3	24.6	0.947
Reading	Background	22.1	23.0	0.961
Bordon	Roadside	27.6	29.0	0.952
			Average	0.953

WR1 - Whitehill, Petersfield Road

Long term site	Site Type	Annual Mean	Period Mean	Ratio
Portsmouth	Background	23.3	25.4	0.917
Reading	Background	22.1	23.8	0.929
Bordon	Roadside	27.6	28.8	0.958
			Average	0.935

QA/QC of automatic monitoring

The Bordon air quality station is serviced every 6 months by Casella ETi. QA/QC audits are also carried by AEA through its calibration club. These audits involve checking the analyser linearity, NO_x converter efficiency and comparing the site cylinders with audit cylinders. AEA follow procedures adopted within the quality programme of the UK national Automatic Urban and Rural Monitoring Network (AURN).

The analysers are also checked and calibrated using gases by the Council every 2 weeks in accordance with the Council's written procedure and the results are recorded in the site log.

Using the spreadsheets available on the "LAQM tools" section of the Air Quality Archive at www.airquality.co.uk/archive/laqm/laqm.php automatic monitoring was found to show overall good precision. These spreadsheets can be seen in Appendix 4.

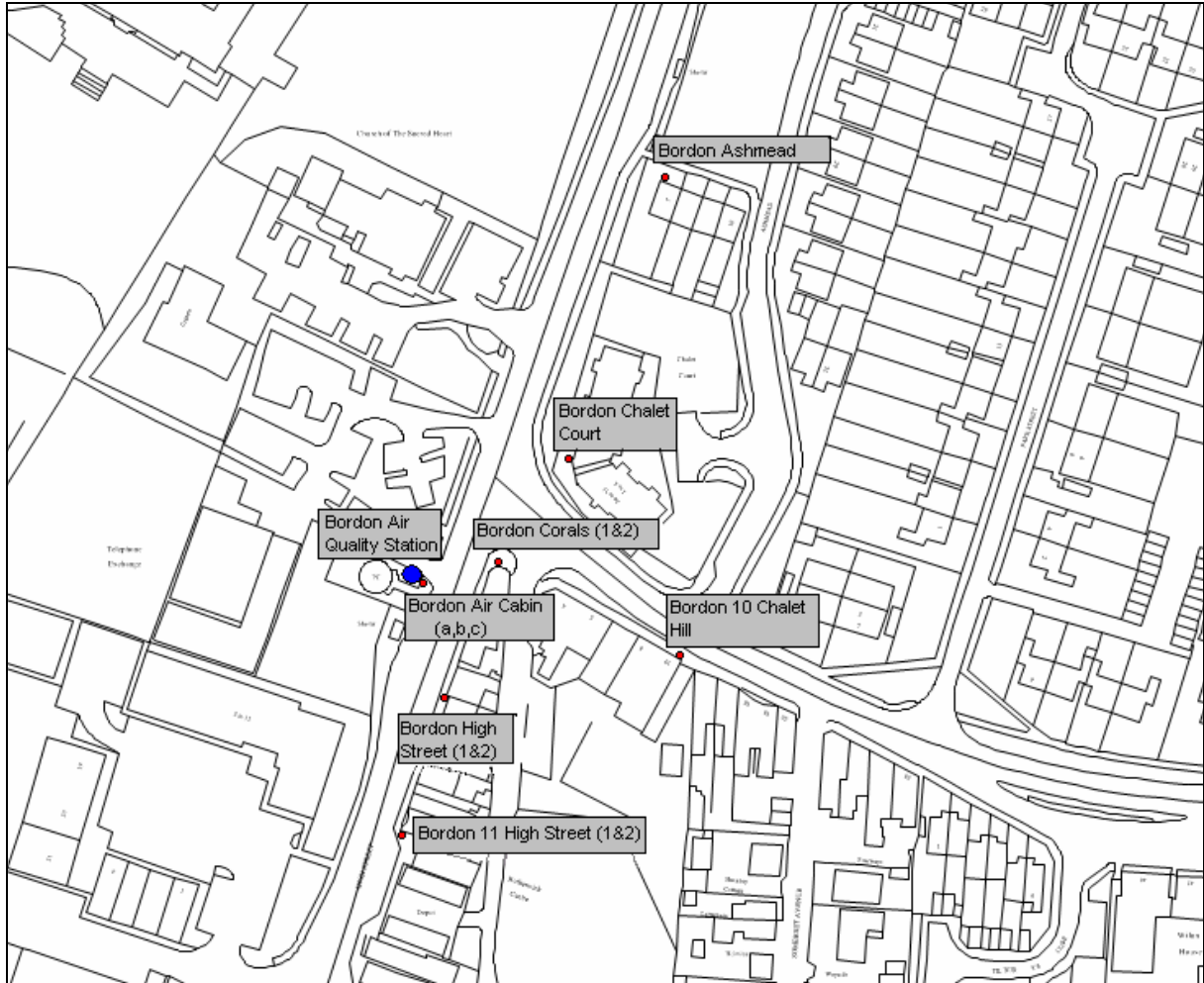
QA/QC of diffusion tube monitoring

The most recent summary of laboratories' performance in the Workplace Analysis Scheme for Proficiency (WASP)¹² prepared by AEA on behalf of Defra and the Devolved Administrations published in May 2009 shows that Gradko have demonstrated good performance in the analysis of NO₂ diffusion tubes.

Using the spreadsheet available on the "LAQM tools" section of the Air Quality Archive at www.airquality.co.uk/archive/laqm/laqm.php diffusion tube monitoring was found to show overall good precision for all years except 2003. These spreadsheets can be seen in Appendix 4.

Appendix 3: Maps showing the locations of nitrogen dioxide diffusion tubes in Bordon

Bordon A325/Chalet Hill



Bordon, Bassenthwaite Gardens



Appendix 4: Precision and Accuracy of Triplicate Tubes years 2003 to 2008 (including provisional results for 2009)

2003

Checking Precision and Accuracy of Triplicate Tubes

Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{g m}^{-3}$	Tube 2 $\mu\text{g m}^{-3}$	Tube 3 $\mu\text{g m}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	01/01/2003	31/01/2003	20.1	40.7	28.3	30	10.4	35	25.8
2	01/02/2003	31/02/2003	41.5	35.0	34.4	37	3.9	11	9.8
3	01/03/2003	31/03/2003	21.2	27.7	33.6	27	6.2	23	15.5
4	01/04/2003	30/04/2003	28.8		30.5	30	1.2	4	10.9
5	01/05/2003	31/05/2003	31.1	30.5	33.4	32	1.5	5	3.8
6	01/06/2003	30/06/2003	30.5	30.0	31.1	31	0.6	2	1.4
7	01/07/2003	31/07/2003	34.7	40.7	36.5	37	3.1	8	7.6
8	01/08/2003	31/08/2003	32.2	36.8	23.9	31	6.5	21	16.2
9	01/09/2003	30/09/2003	39.2	44.0	42.8	42	2.5	6	6.2
10	01/10/2003	31/10/2003	34.6	32.3	34.1	34	1.2	4	3.0
11	01/11/2003	30/11/2003	38.9	41.2	36.7	39	2.2	6	5.5
12	01/12/2003	31/12/2003	29.1	28.6		29	0.4	1	3.2
13									

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

AEA Energy & Environment
From the AEA group

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
36	99.9	Poor Precision	Good
38	100	Good	Good
33	100	Poor Precision	Good
26	99.4	Good	Good
28	100	Good	Good
25	99.9	Good	Good
34	98.3	Good	Good
34	100	Poor Precision	Good
43	100	Good	Good
27	99.5	Good	Good
33.1	100	Good	Good
28.3	100	Good	Good

Overall survey --> **Poor precision** **Good Overall DC**
(Check average CV & DC from Accuracy calculations)

Site Name/ID: **Horndean 2003 data**

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%

Bias calculated using 9 periods of data

Bias factor A **0.91 (0.85 - 0.98)**
Bias B **10% (2% - 18%)**

Diffusion Tubes Mean: **34 $\mu\text{g m}^{-3}$**
Mean CV (Precision): **5**

Automatic Mean: **31 $\mu\text{g m}^{-3}$**
Data Capture for periods used: **100%**

Adjusted Tubes Mean: **31 (29 - 34) $\mu\text{g m}^{-3}$**

Precision **9 out of 12 periods have a CV smaller than 20%**

Accuracy (with 95% confidence interval)
WITH ALL DATA

Bias calculated using 12 periods of data

Bias factor A **0.97 (0.89 - 1.07)**
Bias B **3% (-6% - 13%)**

Diffusion Tubes Mean: **33 $\mu\text{g m}^{-3}$**
Mean CV (Precision): **10** caution

Automatic Mean: **32 $\mu\text{g m}^{-3}$**
Data Capture for periods used: **100%**

Adjusted Tubes Mean: **32 (29 - 35) $\mu\text{g m}^{-3}$**

Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

2004

Checking Precision and Accuracy of Triplicate Tubes

Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{g m}^{-3}$	Tube 2 $\mu\text{g m}^{-3}$	Tube 3 $\mu\text{g m}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	01/01/2004	31/01/2004	37.2	36.1	35.0	36	1.1	3	2.8
2	01/02/2004	28/02/2004	28.2	34.0	33.4	32	3.2	10	7.9
3	01/03/2004	31/03/2004	35.6	30.8	33.8	33	2.4	7	6.0
4	01/04/2004	30/04/2004	21.7	30.9	27.9	27	4.7	18	11.7
5	01/05/2004	31/05/2004	22.6	26.3	31.2	27	4.3	16	10.7
6	01/06/2004	30/06/2004	20.6	21.7	25.6	23	2.6	12	6.5
7	01/07/2004	31/07/2004	25.3	24.8	19.6	23	3.2	14	7.9
8	01/08/2004	31/08/2004	25.6	28.2	25.4	26	1.6	6	4.0
9	01/09/2004	30/09/2004	22.9	25.7		24	2.0	8	17.7
10	01/10/2004	31/10/2004	31.5	31.1	50.9	38	11.4	30	28.2
11	01/11/2004	30/11/2004	31.4	34.8	32.5	33	1.7	5	4.3
12	01/12/2004	31/12/2004							
13									

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

AEA Energy & Environment
From the AEA group

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
36.2	99.5	Good	Good
37.3	100	Good	Good
42.6	100	Good	Good
36.1	100	Good	Good
34	100	Good	Good
28	100	Good	Good
27	100	Good	Good
30	99.9	Good	Good
28	100	Good	Good
32	98.3	Poor Precision	Good
38.4	100	Good	Good
43.2	100	Good	Good

Overall survey --> **Good precision** **Good Overall DC**
(Check average CV & DC from Accuracy calculations)

Site Name/ID: **Horndean 2004 data**

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%

Bias calculated using 10 periods of data

Bias factor A **1.19 (1.12 - 1.26)**
Bias B **-16% (-21% - -11%)**

Diffusion Tubes Mean: **28 $\mu\text{g m}^{-3}$**
Mean CV (Precision): **10**

Automatic Mean: **34 $\mu\text{g m}^{-3}$**
Data Capture for periods used: **100%**

Adjusted Tubes Mean: **34 (32 - 36) $\mu\text{g m}^{-3}$**

Precision **10 out of 11 periods have a CV smaller than 20%**

Accuracy (with 95% confidence interval)
WITH ALL DATA

Bias calculated using 11 periods of data

Bias factor A **1.15 (1.05 - 1.27)**
Bias B **-13% (-21% - -5%)**

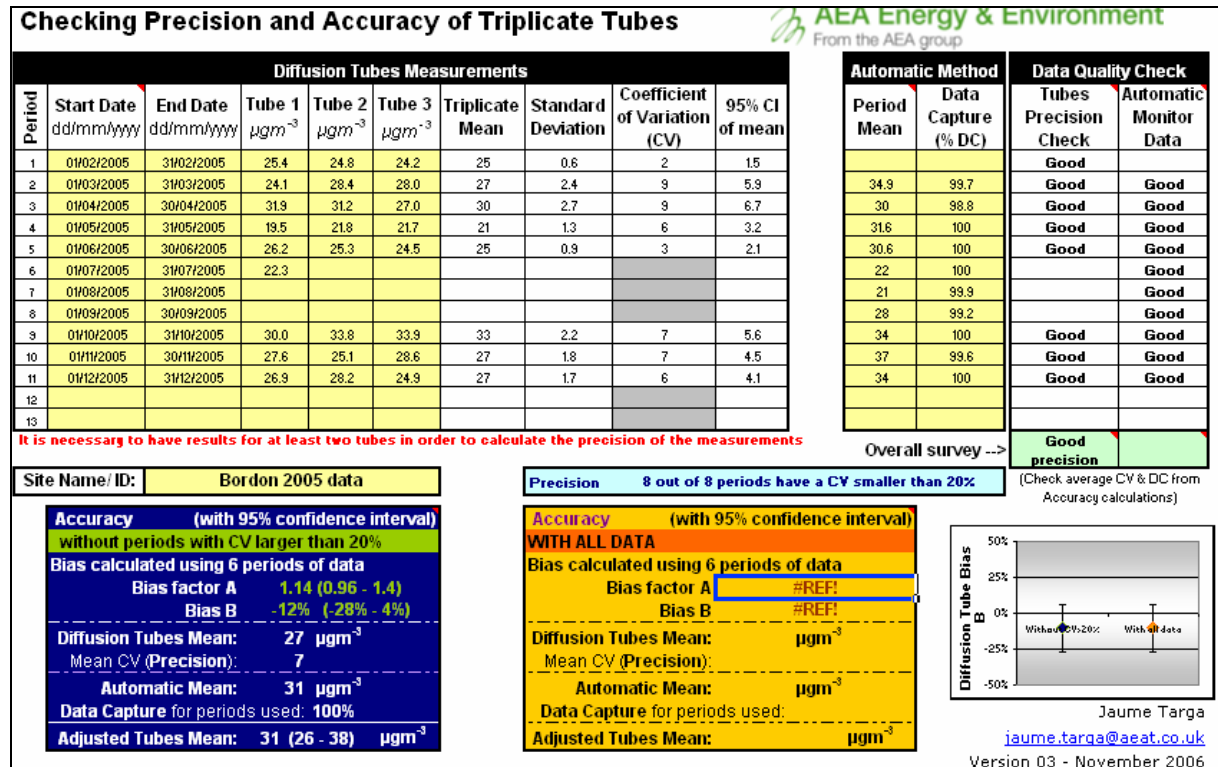
Diffusion Tubes Mean: **29 $\mu\text{g m}^{-3}$**
Mean CV (Precision): **12** caution

Automatic Mean: **34 $\mu\text{g m}^{-3}$**
Data Capture for periods used: **100%**

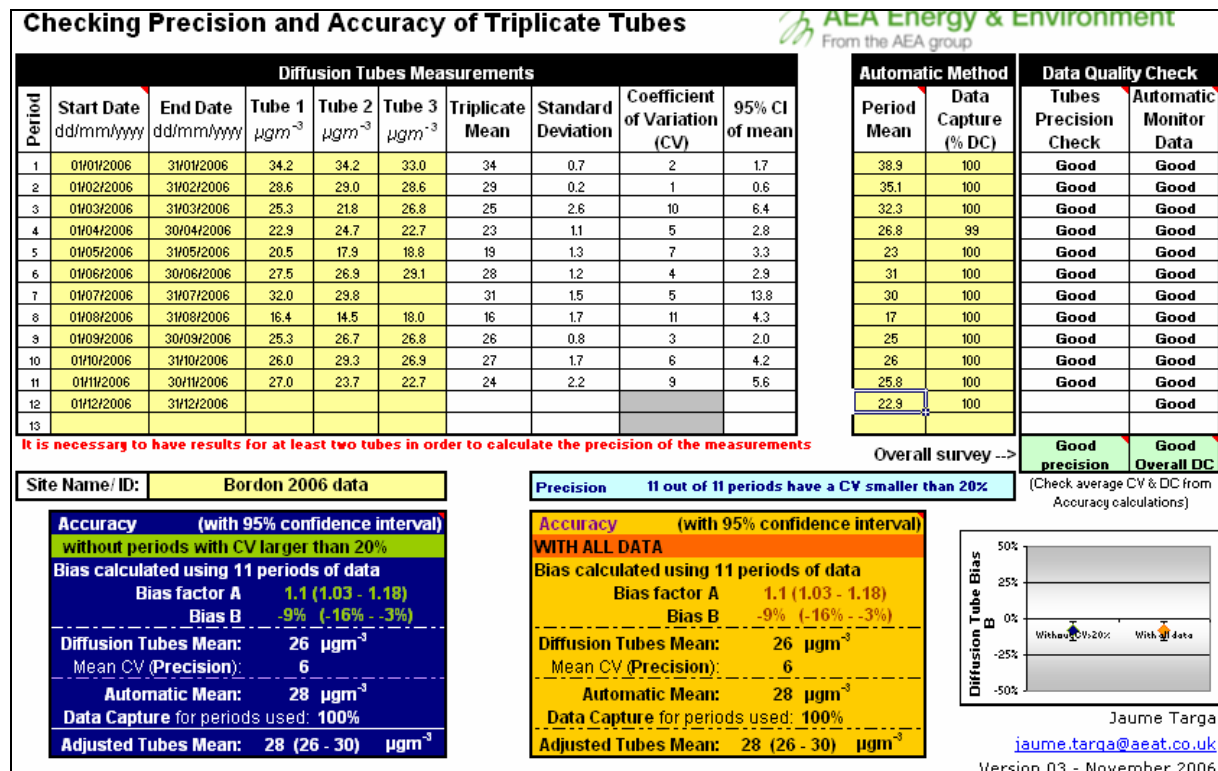
Adjusted Tubes Mean: **34 (31 - 37) $\mu\text{g m}^{-3}$**

Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

2005



2006



East Hampshire District Council

2007 - Local bias adjustment not calculated due to poor data capture of Bordon air quality station (58%).

2008

Checking Precision and Accuracy of Triplicate Tubes

Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{g m}^{-3}$	Tube 2 $\mu\text{g m}^{-3}$	Tube 3 $\mu\text{g m}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	01/01/2008	31/01/2008	26.2	23.7	29.0	26	2.6	10	6.6
2	01/02/2008	28/02/2008	35.5						
3	01/03/2008	31/03/2008	20.4	20.2	21.3	21	0.6	3	1.5
4	01/04/2008	30/04/2008	27.4	27.0	28.5	28	0.8	3	1.9
5	01/05/2008	31/05/2008	41.5	44.3	40.9	42	1.8	4	4.4
6	01/06/2008	30/06/2008	25.2	26.1	24.2	25	1.0	4	2.4
7	01/07/2008	31/07/2008	21.1	22.0	22.5	22	0.7	3	1.7
8	01/08/2008	31/08/2008		21.5	20.0	21	1.1	5	9.8
9	01/09/2008	30/09/2008	27.3	34.0	28.2	30	3.6	12	8.9
10	01/10/2008	31/10/2008	27.1	28.8	27.2	28	1.0	4	2.5
11	01/11/2008	31/11/2008	31.1	29.8	30.1	30	0.7	2	1.7
12	01/12/2008	31/12/2008	34.2	35.6	39.0	36	2.5	7	6.2
13									

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

From the AEA group

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
23.8	99.9	Good	Good
42.4	99.4	Good	Good
18.5	99.2	Good	Good
28.2	99.7	Good	Good
38	100	Good	Good
21	77.1	Good	Good
20	99.5	Good	Good
14	100	Good	Good
29	99.6	Good	Good
28	99.9	Good	Good
30.6	100	Good	Good
37.6	99.3	Good	Good

Overall survey --> **Good precision** **Good Overall DC**

(Check average CV & DC from Accuracy calculations)

Site Name/ID: **Bordon 2008**

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 11 periods of data
Bias factor A **0.94 (0.86 - 1.03)**
Bias B **7% (-2% - 16%)**

Diffusion Tubes Mean: **28 $\mu\text{g m}^{-3}$**
Mean CV (Precision): **5**

Automatic Mean: **26 $\mu\text{g m}^{-3}$**
Data Capture for periods used: **98%**

Adjusted Tubes Mean: **26 (24 - 29) $\mu\text{g m}^{-3}$**

Precision **11 out of 11 periods have a CV smaller than 20%**

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 11 periods of data
Bias factor A **0.94 (0.86 - 1.03)**
Bias B **7% (-2% - 16%)**

Diffusion Tubes Mean: **28 $\mu\text{g m}^{-3}$**
Mean CV (Precision): **5**

Automatic Mean: **26 $\mu\text{g m}^{-3}$**
Data Capture for periods used: **98%**

Adjusted Tubes Mean: **26 (24 - 29) $\mu\text{g m}^{-3}$**

Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

2009

Checking Precision and Accuracy of Triplicate Tubes

Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 $\mu\text{g m}^{-3}$	Tube 2 $\mu\text{g m}^{-3}$	Tube 3 $\mu\text{g m}^{-3}$	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	01/01/2009	31/01/2009	33.5	33.5	30.0	32	2.1	6	5.1
2	01/02/2009	31/02/2009	22.2	23.2	22.1	22	0.6	3	1.6
3	01/03/2009	31/03/2009	20.5	23.4	25.9	23	2.7	11	6.6
4	01/04/2009	30/04/2009	30.3	29.4	28.8	30	0.7	3	1.9
5	01/05/2009	31/05/2009	26.9	25.8	26.3	26	0.6	2	1.4
6	01/06/2009	30/06/2009	29.5	31.3	29.9	30	0.9	3	2.3
7	01/07/2009	31/07/2009	20.2	21.5	22.0	21	0.9	4	2.3
8									
9									
10									
11									
12									
13									

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

From the AEA group

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
33.8	100	Good	Good
23.5	100	Good	Good
22.2	100	Good	Good
31.1	100	Good	Good
22	100	Good	Good
25	100	Good	Good

Overall survey --> **Good precision** **Good Overall DC**

(Check average CV & DC from Accuracy calculations)

Site Name/ID: **Bordon 2009 data**

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 6 periods of data
Bias factor A **0.96 (0.86 - 1.09)**
Bias B **4% (-8% - 16%)**

Diffusion Tubes Mean: **27 $\mu\text{g m}^{-3}$**
Mean CV (Precision): **5**

Automatic Mean: **26 $\mu\text{g m}^{-3}$**
Data Capture for periods used: **100%**

Adjusted Tubes Mean: **26 (24 - 30) $\mu\text{g m}^{-3}$**

Precision **7 out of 7 periods have a CV smaller than 20%**

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 6 periods of data
Bias factor A **0.96 (0.86 - 1.09)**
Bias B **4% (-8% - 16%)**

Diffusion Tubes Mean: **27 $\mu\text{g m}^{-3}$**
Mean CV (Precision): **5**

Automatic Mean: **26 $\mu\text{g m}^{-3}$**
Data Capture for periods used: **100%**

Adjusted Tubes Mean: **26 (24 - 30) $\mu\text{g m}^{-3}$**

Jaume Targa
jaume.targa@aeat.co.uk
Version 03 - November 2006

Appendix 5: Raw data for all years, Bordon

2000

Site Name	Jan-00	Feb-00	Mar-00	Apr-00	May-00	Jun-00	Jul-00	Aug-00	Sep-00	Oct-00	Nov-00	Dec-00
Bordon, o/s Corals (1), Chalet Hill	70	57.5	51	40.7	35.9	34.6	39.2	34.5	29.5	40.4	43.7	41.7

National bias adjustment factor	1.2
Based on 2 studies	

No local co-location study

2001

Site Name	Jan-01	Feb-01	Mar-01	Apr-01	May-01	Jun-01	Jul-01	Aug-01	Sep-01	Oct-01	Nov-01	Dec-01
Bordon, o/s Corals (1), Chalet Hill	49.8	47.1	47.2	23.51	31.17	22.55	25.74	16.13		21.82		15.73

National bias adjustment factor	1.45
Based on 9 studies	

No local co-location study

East Hampshire District Council

2002

Site Name	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug-02	Sep-02	Oct-02	Nov-02	Dec-02
Bordon, o/s Corals (1), Chalet Hill		5.58	20.77	12.1				16.63	28.86			29.41

National bias adjustment factor 1.27
Based on 12 studies

No local co-location study

2003

Site Name	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03	Oct-03	Nov-03	Dec-03
Bordon, o/s Corals (1), Chalet Hill										38.20	51.97	34.23

National bias adjustment factor 1.11
Based on 19 studies

Local bias adjustment factor (Horndean) 0.91 (excluding periods with CV larger than 20%)
0.97

2004

Site Name	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04
Bordon, o/s Corals (1), Chalet Hill	43.35	41.02	45.04	41.47	29.86	38.03	38.47	48.96	35.71	42.25	45.76	49.80

National bias adjustment factor 1.1
Based on 27 studies

Local bias adjustment factor (Horndean) 1.19 (excluding periods with CV larger than 20%)

2005

Site Name	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05
Bordon, o/s Corals (1), Chalet Hill	36.52	43.20	45.45	52.89	39.33	39.32	40.95	40.56	30.22	47.75	51.14	44.59
Bordon, Ashmead	24.82	26.76	24.42	25.87	18.61	20.19	20.94	21.52	23.65	22.44	26.49	28.42
Bordon, Chalet Court	22.48	27.71	31.34		15.23	27.77	29.63	27.11	48.19	37.4	31.59	29.75
Bordon, High Street (1)	29.34	41.36	45.79	47.7	32.18					48.63		35.86
Bordon, Air Quality Cabin (1)		25.40	24.12	31.93	19.47	26.16	22.30			29.95	27.56	26.9
Bordon, Air Quality Cabin (2)		24.84	28.43	31.21	21.76	25.26				33.78	25.07	28.18
Bordon, Air Quality Cabin (3)		24.17	28.03	26.97	21.70	24.45				33.89	28.57	24.89

National bias adjustment factor 1.1
Based on 14 studies

Local bias adjustment factor (Bordon) 1.14
Not reliable due to poor capture rate

East Hampshire District Council

2006

Site Name	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06
Bordon, o/s Corals (1), Chalet Hill	45.35	44.19	41.76	37.46	42.47	46.08	53.07	38.6	47.32	54.35	46.42	41.66
Bordon, Ashmead	28.57	31.05	25.58	23.66	18.82	19.58	19.91	19.65	20.9	23.59	26.47	26.78
Bordon, Chalet Court	31.01	30.46	24.97	26.57	23.8	30.11	34.3	22.44	26.79	28.26	26.98	27.35
Bordon, o/s 10 Chalet Hill											26.66	32.96
Bordon, High Street (1)	44.1	42.77	37.73	37.83	39.89	50.09	54.11	17.44	39.66	40.19	35.92	
Bordon, Air Quality Cabin (1)	34.2	28.58	25.34	22.88	20.49	27.53	31.99	16.39	25.34	25.98	26.98	
Bordon, Air Quality Cabin (2)	34.15	28.99	21.84	24.7	17.85	26.9	29.82	14.47	26.65	29.26	23.67	
Bordon, Air Quality Cabin (3)	32.96	28.63	26.84	22.68	18.77	29.14		17.96	26.79	26.87	22.72	

National bias adjustment factor 1.01
Based on 18 studies

Local bias adjustment factor (Bordon) 1.1

2007

Site Name	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07
Bordon, o/s Corals (1), Chalet Hill	41.61	49.44		51.07	46.49	50.92	49.28	45.53	41.45	50.89	53.33	46.34
Bordon, Ashmead	25.97	29.58	28.37	25.45	29.34	20.71	22.85	20.09	21.08	26.88	32.44	29.67
Bordon, Chalet Court	24.17	30.1	28.02	30.99	22.32	26.05	24.84	27.86		34.47	34.33	30.07
Bordon, o/s 10 Chalet Hill	31.9	36.16	33.35	32.63					31.66	42.56	40.85	
Bordon, High Street (1)			43.5	55.54	43.32	46.02	37.74	47.76	44.91	55.66	52.86	46.08
Bordon, Air Quality Cabin (1)	20.27	30.58	26.94	31.5	25.9	29.35	22.36		25.87	37.84	32.64	32.85
Bordon, Air Quality Cabin (2)	18.18	30.87	25.57	34.61	26.36	31.02	19.95		28.34	36.13	27.26	35.04
Bordon, Air Quality Cabin (3)	19.2	31.5	22.64	35.86	28.55	31.91	20.66	31.31	23.84	37.72	50.2	32.2
Whitehill, Petersfield Road	32.89	41.71	35.57	46.83	41.12	39.48	36.45	42.1	40.7	49.52	36.6	

National bias adjustment factor 0.98
Based on 15 studies

No local bias adjustment factor due to poor data capture of Bordon AQMS

East Hampshire District Council

2008

Site Name	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08
Alton, Orchard House	18.89	26.61	15.91	18.34	16.82	13.41	11.84	13.29	17.35	17.16	21.32	29.12
Bordon, o/s Corals (1), Chalet Hill	62.39	51.92	47.47	44.25	46.23	50.05	43.79	45.17	69.41	49.63	50.8	55.63
Bordon, Ashmead	28.35	33.45	25.34	29.02	17.56	21.13	27.68	20.81	29.56	27.13	30.76	33.81
Bordon, Chalet Court	23.87		26.42	29.53	32.32	27.72	19.21	24.4	20.62	30.25	29.26	38.88
Bordon, o/s 10 Chalet Hill	28.75	41.5	34.04	34.39	31.1	29.84	24.44	24.64	32.13	31.47	36.01	
Bordon, High Street (1)	36.91	50.58	35.61		62.56	49.03	41.21	36.67	52.52	44.31	45.75	
Bordon, Air Quality Cabin (1)	26.22	35.5	20.42	27.38	41.45	25.24	22.1		27.31	27.05	31.14	34.17
Bordon, Air Quality Cabin (2)	23.72		20.15	26.98	44.25	26.09	21.98	21.53	33.95	28.84	29.83	35.57
Bordon, Air Quality Cabin (3)	29.01		21.32	28.47	40.93	24.16	22.49	19.98	28.23	27.19	30.11	39.01
Bordon, o/s Bassenthwaite Gdns							8.11		15.67	12.94	18.68	25.63
Whitehill, Petersfield Road		29.39					32.31	30.4	40.17	33.43	42.21	55

National bias adjustment factor	0.93
Based on 16 studies	

Local bias adjustment factor (Bordon)	0.94
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2009

Site ID	Site Name	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09
BR4	Bordon, o/s Corals (1), Chalet Hill	53.39	41.62	54.06	54.13	44.24	50.45	46.66
BR7	Bordon, o/s Corals (2), Chalet Hill	52.69	44.92	47.76	45.87	40.49	45.68	52.41
BR1	Bordon, Ashmead	29.29	29.23	28.07	22.66	16.94	18.47	18.17
BR2	Bordon, Chalet Court	35.0	19.12	30.77	27.89	23.93	27.15	23.07
BR3	Bordon, o/s 10 Chalet Hill	53.69	25.66	32.08	33.86	26.63	31.14	24.14
BR5	Bordon, High Street (1)	57.91	26.34	46.31	58.76	40.97	50.18	
BR8	Bordon, High Street (2)	47.78	24.29	38.36	51.5	37.17	48.4	34.22
BR6	Bordon, Air Quality Cabin (1)	33.53	22.16	20.54	30.32	26.91	29.54	20.16
BR6	Bordon, Air Quality Cabin (2)	33.51	23.2	23.41	29.41	25.75	31.33	21.45
BR6	Bordon, Air Quality Cabin (3)	29.95	22.06	25.87	28.84	26.34	29.93	21.99
BR9	Bordon, 11 High Street (1)	49.89	34.15	38.81	38.94	31.15		34.2
BR10	Bordon, 11 High Street (2)	40.81	33.33	39.07	36.97	30.89	34.58	32.91
BU1	Bordon, o/s Bassenthwaite Gdns	22.6	12.66	15.36	15.95	11.16	15.68	7.66
WR1	Whitehill, Petersfield Road	44.87	27.47	41.55	41.44	32.96	36.57	29.22

National bias adjustment factor (2008) Based on 16 studies	0.93
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Local bias adjustment factor (2008)	0.94
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Appendix 6: Photographs of Bordon A325 High Street and surrounding area



