



**Detailed Assessment of Air Quality
within Six Areas**

of

The Borough of Reigate and Banstead

April 2004.

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Abbreviations and Definitions

| | |
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| AADT | Annual Average Daily Traffic Flow. |
| AQMA | Air Quality Management Area. |
| DEFRA | Department of the Environment, Food and Rural Affairs (formerly DETR). |
| DMRB | Design Manual for Roads and Bridges. |
| EPAQS | Expert Panel on Air Quality Standards. |
| EU | European Union. |
| HA | The Highways Agency. |
| HGV | Heavy Goods Vehicle. |
| m ³ | cubic metre. |
| NETCEN | National Environmental Technology Centre, UK. |
| NO ₂ | Nitrogen Dioxide. |
| NO _x | Oxides of Nitrogen (mainly NO and NO ₂ expressed as NO ₂ equivalent). |
| PM | Particulate Matter. |
| PM ₁₀ | Essentially particles under 10 µm in diameter. Officially defined as the size fraction below 10µm in aerodynamic diameter, which has a cut off point at 50% of the particles which are 10µm in aerodynamic diameter. |
| ppb | part(s) per billion. |
| µg | microgram (1 millionth of a gram). |
| µg m ⁻³ (µg/m ³) | microgram(s) per cubic metre. |
| USA | Updating and Screening Assessment. |

Executive Summary

Part IV of the Environment Act 1995 requires local authorities to periodically review air quality in their area against current and future air quality objectives as set out in the Air Quality Strategy (2000), the Air Quality Regulations (England) 2000, the Air Quality (Amendment) Regulations 2002, and the Air Quality Strategy Addendum document (2003).

As part of the above Act the council completed an updating and screening assessment in April 2003, which identified one new area on the SE corner of the junction of the A217 and Rushworth Road as in need of a detailed assessment, with a view to declaring an air quality management area (AQMA), as the concentrations of nitrogen dioxide (NO₂) and PM₁₀ were predicted to exceed the UK government objectives for these pollutants.

The updating and screening assessment also recommended a detailed assessment of the existing air quality management areas:

- i) on the M25
- ii) on the M23
- iii) the two individual properties on the A23 (not the A217 as in the 2003 updating and screening assessment)
- iv) the Horley AQMA

with a view to either revoking or better defining the extent of these AQMAs.

The existing AQMAs were subsequently examined in two reports (stage 4 assessments) completed as part of the councils obligations under the first round of the review and assessment process, and the findings of these reports have been considered in view of additional monitoring data from 2003.

The detailed assessment of these sites indicates that:

- i) the property on the SE corner of the junction of the A217 and Rushworth Road will not breach the 2004 objective for PM₁₀, but is predicted to breach the 2005 annual average NO₂ objective. Therefore an air quality management area will need to be declared for this property with respect to the 2005 annual average NO₂ objective.
- ii) the AQMA declared on the property on the SE corner of the junction of the A23 and Dean Lane, and subsequently revoked following the stage 4 assessment, is predicted to breach the 2005 annual average NO₂ objective based on monitoring data from 2003. Therefore this site will need to be re

declared as an air quality management area with respect to the 2005 annual average NO₂ objective.

- iii) the AQMA surrounding the M23 to the north of the M25, and the AQMA at the Flying Scud Public House on the A23, which were revoked following the stage 4 assessment, will still meet the 2005 annual average objective for NO₂ based on the 2003 data and so remain revoked.
- iv) the AQMA on the M23 to the south of the M25 is to remain in its current form due to the uncertainty in the modelling results, but a diffusion tube monitoring site needs to be established at the affected property.
- v) The AQMA on the M25 is to remain in its original form.
- vi) The Horley AQMA near to Gatwick airport is to remain in its original form, due primarily to the uncertainty over the impact of the predicted growth at the airport beyond 2005. However, at present only properties closest to both the airport and the A23 are predicted to exceed the 2005 objective in 2005.

1.0 Introduction

Part IV of the Environment Act 1995 requires local authorities to periodically review air quality in their area against current and future air quality objectives as set out in the Air Quality Strategy for England, Scotland, Wales and N. Ireland (The Air Quality Strategy, January 2000), the Air Quality Regulations (England) 2000, the Air Quality (Amendment) Regulations 2002, and the Air Quality Strategy Addendum document (2003). The air quality objectives set out in these documents are derived from health based standards recommended by the Government's Expert Panel on Air Quality Standards (EPAQS), but the objectives also take into account the costs, benefits, feasibility, and practicality of reaching such standards. The relevant objectives to this detailed assessment are set out in Table 1.1.

| | Annual Mean Limit | Daily Limit (24 hrs) | UK Objective to be met by | EU Limit Value to be met by * |
|------------------|-----------------------|---|---------------------------|-------------------------------|
| NO ₂ | 40 µg m ⁻³ | – | 31/12/05 | 31/12/10 |
| PM ₁₀ | 40 µg m ⁻³ | 50 µg m ⁻³ to be exceeded no more than 35 times per year | 31/12/04 | 31/12/04 |

*EU limit values are the same as UK Objective values.

Table 1.1: Air Quality Objectives relevant to this Detailed Assessment.

Under these regulations the council is required to undertake an updating and screening assessment of air quality within the Borough, and where this assessment identifies areas which might breach the air quality objective values, then a detailed assessment is required by April 2004.

The updating and screening assessment of air quality within the Borough was completed in April 2003 (RB, 2003), and this identified that the following areas of the Borough were in need of a detailed assessment with respect to the 2005 annual average nitrogen dioxide (NO₂) objective:

- i) the property at the SE corner of the junction of Rushworth Road and the A217, as this was predicted to breach the 2005 objective for NO₂.
- ii) the M25 air quality management area (AQMA) with a view to narrowing the extent of the AQMA.
- iii) the M23 and individual properties on the A23 (not A217 as in the updating and screening assessment) with a view to narrowing and / or revoking the AQMAs.

- iv) the southern area of Horley near to Gatwick airport to better define the extent of the AQMA.

The updating and screening assessment also identified that the number of potential exceedences of the *daily* PM₁₀ objective (Table 1.1) at the property on the SE corner of the junction of Rushworth Road and the A217 might be greater than the number permitted, and so this would also need to be examined as part of the detailed assessment.

With the exception of the property at the SE corner of the junction of Rushworth Road and the A217, the other areas requiring a detailed assessment had already been identified as likely to breach the 2005 annual average NO₂ objective in the first round of the review and assessment process (AQC, 2001).

Due to delays in the first round of review and assessment, the Stage 4 (further) assessments of air quality within the air quality management areas (AQMA) were completed after the updating and screening assessment in 2003. The further assessment work on the M25 AQMA, the AQMA declared on individual properties on the A23, and the M23 AQMA to the north of the M25, was completed in May 2003 (AQC, 2003). This examined in detail whether the AQMA for these areas should be retained, and if retained the spatial extent of the AQMA. Similar work was completed for the AQMA on the M23 to the south of the M25, and the southern area of Horley near to Gatwick Airport, in April 2004 (AQC, 2004).

Consequently only a detailed assessment of the property on the SE corner of the junction of the A217 and Rushworth Road will be presented in this report, although the main findings of the Stage 4 assessments will be summarised and presented along with any new monitoring data for these sites.

2.0 Methodology

The methodologies used throughout this work are drawn primarily from DEFRA's technical guidance - LAQM TG(03) (DEFRA, 2003), and the frequently asked questions on the DEFRA website (DEFRA, 2003a). The monitoring data used throughout the report comes primarily from diffusion tube surveys of the affected areas.

The diffusion tubes used throughout this study were supplied by Lambeth Scientific (50 % triethanolamine in acetone), and the reported diffusion tube values have had a correction factor applied. The correction factor is calculated from tubes co-located in triplicate with the council's suburban real time monitoring site in Horley near to Gatwick Airport. The specific correction factor applied is stated in the relevant section, as the length of the monitoring period varied from 8 months at Rushworth Road, to 11 to 12 months at all of the other sites. However, the methodology used is as set out by DEFRA (2003 / AQC, 2004b).

The diffusion tube network in the Borough operates in accordance with the practices and exposure periods of the UK diffusion tube network, and the real time monitoring equipment is operated in accordance with the manufacturers operating instructions, national and European best practice, and calibrated to national and international standards.

The data from the real time site in Horley, Surrey, is ratified and verified by ERG (Kings College, London), with bi-annual site audits by the National Physical Laboratory. It is important to note that the real time data set used to calculate the diffusion tube correction factors is only fully ratified and verified to 29th August 2003, and provisional from this date onwards. However, no changes are expected to be made to the data set that would significantly impact on the tube correction factors (Fuller, 2004).

The traffic data used in this report for 2003 to 2011 was obtained from the Surrey Road Traffic Model. This is based on the JAM model, and is updated annually with the aid of 118 automatic traffic counters around the county. There has been no independent examination of the accuracy / precision of the traffic model, that this author is aware of, although a comparison of three sample points where traffic counts were made by the Highways Agency on the M25 and M23, while hardly conclusive, demonstrated a good agreement between the predicted and measured data (RB, 2003). Although there is a lack of data to examine the accuracy / precision of the model on the A and B road network, there is no reason to believe that the model is any better (or worse) than any other county wide road transport model in operation around the UK.

The regional background pollutant concentrations were obtained from the local air quality management (LAQM) website (DEFRA, 2003b), and were projected forward using the method set out by Brown (2003).

Distance measurements throughout the report were determined from the council's GIS system (ArcView 3.1 / 8) from 1:10 000 base maps supplied by Ordnance Survey.

2.1 Changes since the Updating and Screening Assessment (USA)

Six months after the submission of the updating and screening assessment (USA) it was noted that the background NO_x and NO₂ projections for 2005 and 2010 had been made using the NETCEN mapped 2001 concentrations and the relevant correction factors for 2005 and 2010, rather than by applying the mapped 2005 and 2010 NO_x and NO₂ concentrations. The consequence of this error is that the predicted NO₂ concentrations in the original USA are slightly more pessimistic than they might otherwise had been, although the differences are very small as detailed in Table 2.1 for the grid square centred on Rushworth Road, and consequently have no effect on the main findings of the original updating and screening assessment.

| | NO _x | | NO ₂ | |
|-----------------------|-----------------|------|-----------------|------|
| | 2005 | 2010 | 2005 | 2010 |
| Values used in USA | 45.3 | 36.2 | 26.7 | 22.9 |
| Mapped Values | 44.2 | 34.7 | 26.2 | 22.2 |
| Change (Mapped - USA) | -1.1 | -1.5 | -0.5 | -0.7 |

Table 2.1: Differences between the NO_x and NO₂ background concentrations used in the USA, and the 'correct' mapped values (based on 1 km x 1km Grid Square containing Rushworth Road).

The updating and screening assessment for 2003 used the Design Manual for Roads and Bridges (DMRB) spreadsheet version 1.01 (February 2003). However, subsequently the Highways Agency became aware of problems with this version of the model. The problems arise where two roads with very different traffic flows are considered, and the road with the lighter traffic flow is closer to the receptor than the more heavily trafficked road. In this situation the predicted concentrations are often an over estimate of the 'true' pollutant concentrations at the receptor (AQC, 2003b; Stanger, 2003).

This problem has no major bearing on any of the receptors considered in the updating and screening assessment, with the possible exception of the receptor at the junction of the A217 and Rushworth Road where the road closest to the receptor carries around one third the traffic on the major road. Consequently the pollutant concentrations were recalculated using the new

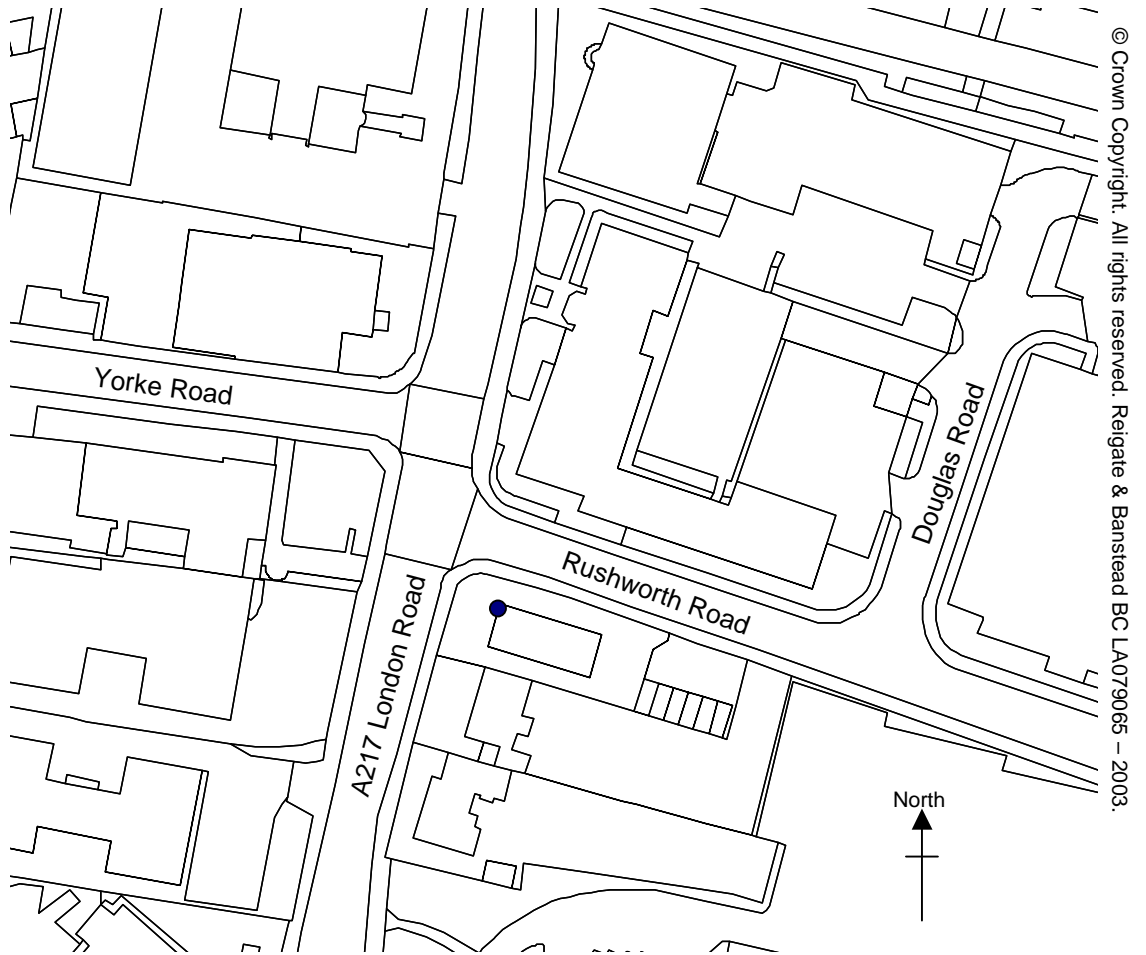
version of the DMRB model (v.1.02 - November 2003), to determine the effect of the changes on the predicted pollutant concentrations at the Rushworth Road receptor. The results of this exercise are discussed in Section 3.

3.0 Assessment of the Junction of Rushworth Road (Reigate) and the A217

As part of the updating and screening assessment of air quality within the Borough in early 2003, all roads and junctions within the Borough handling over 10 000 vehicles (AADT - annual average daily traffic) were assessed using the DMRB spreadsheet (v1.01 - February 2003). This work indicated that a single receptor at the SE corner of the junction of the A217 and Rushworth Road (Figure 3.1) would be likely to breach the UK Government's 2005 annual average objective value for nitrogen dioxide (NO₂) of 40 µg m⁻³. The modelling also predicted a breach of the 2004 PM₁₀ objective of no more than 35 days per year over 50 µg m⁻³, although the site was predicted to meet the 2004 annual average PM₁₀ objective of 40µg m⁻³.

The receptor predicted to breach these objectives consists of a small block of six residential flats arranged over three floors, with all the remaining buildings immediately surrounding the junction used as offices. At its closest point the affected property is 16 m from the centre of the A217 (predicted to carry 26 100 vehicles (AADT) in 2005), and 11 m from the centre of Rushworth Road which is predicted to carry 10 100 vehicles (AADT) in 2005.

The exceedence of the 2004/5 objectives arises from the proximity of the building to *both* roads at the junction. Properties located at the eastern end of Rushworth Road at the junction with the A242 (Croydon Road), which is predicted to carry 14 100 cars in 2005, are predicted not to exceed the 2005 objective for NO₂ with a concentration of 31.4 µg m⁻³, and to also have only seven days over the 50 µg m⁻³ PM₁₀ objective.



Key:

● Location of Diffusion Tubes (Ground Floor).

0 Scale 60 m

Figure 3.1: Location of the affected Property and Diffusion Tubes at the Junction of Rushworth Road and London Road (A217).

As discussed in Section 2.1 due to the slight over estimation of the background concentrations for NO₂ and NO_x in the original modelling, and more importantly due to the problems that were subsequently identified with version 1.01 of the DMRB model, the predicted concentrations for NO₂ and PM₁₀ were recalculated for the Rushworth Road site using version 1.02 of the DMRB to confirm the original findings of the updating and screening assessment (Figures 3.2, 3.3, and 3.4). The results of this work are summarised in Table 3.1.

| | Annual Average NO ₂ Concentration (µg m ⁻³) in 2005 | Annual Average PM ₁₀ Concentration (µg m ⁻³) in 2004 | PM ₁₀ : Number of days over 50 µg m ⁻³ in 2004 |
|----------------------|--|---|--|
| UK Objectives | 40 | 40 | 35 |
| EU Limit Values | 40* | 40 | 35 |
| DMRB v.1.01 (Feb 03) | 42.6 | 33.3 | 41 |
| DMRB v.1.02 (Nov 03) | 40.1 | 30.6 | 30 |

*EU limit value for NO₂ to be met by 2010.

Table 3.1: Predicted PM₁₀ and NO₂ Concentrations (2004 and 2005 respectively) at the Receptor on the SE corner of the Junction of the A217 and Rushworth Road.

The results using the new model (version 1.02 November 2003) indicate that there is no need to proceed to a detailed assessment for PM₁₀, as the number of exceedences of the 50 µg m⁻³ daily limit value are predicted to be below the number permitted, although a detailed assessment is still required with respect to the annual average NO₂ concentration.

3.1 Nitrogen Dioxide Concentrations at Rushworth Road

3.1.1 Monitoring Results for 2003

Two diffusion tubes are located at the Rushworth Road site (Figure 3.1), and the monthly mean of these two tubes is taken as the monthly concentration. As monitoring at the site began at the start of May 2003, only 8 months of data was available at the time of writing this report.

Therefore to 'convert' the data to an annual average for 2003, first a bias correction factor was calculated for the 8 month data set (Equation 3.1), to correct for differences between the diffusion tubes and the real time monitor.

$$\frac{\text{Mean of 8 monthly periods of real time data (30/4/03 to 30/12/03 : 99.5 \% data capture)}}{\text{Mean of 8 months of tube data * (30/4/03 to 30/12/03)}} = \frac{29.08}{23.58} = 1.23$$

*The monthly data is a mean of three co-located diffusion tubes.

(Equation 3.1)

Figure 3.2: DMRB Modelled Annual Mean NO₂ Concentrations at the Junction of the A217 and Rushworth Road ($\mu\text{g m}^{-3}$).

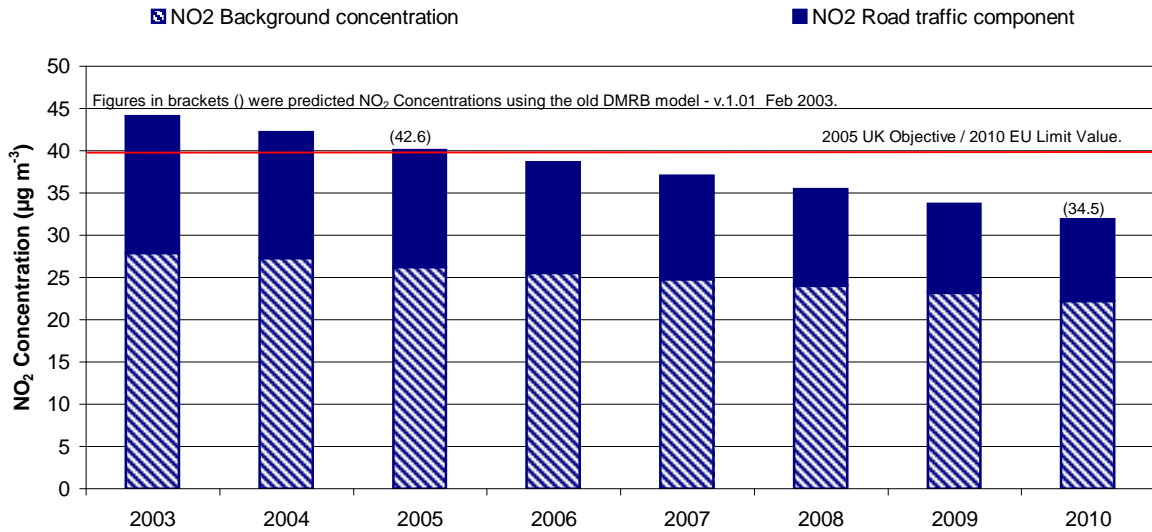


Figure 3.3: Predicted number of Daily mean PM₁₀ Concentrations > 50 $\mu\text{g m}^{-3}$ at the Junction of the A217 and Rushworth Road.

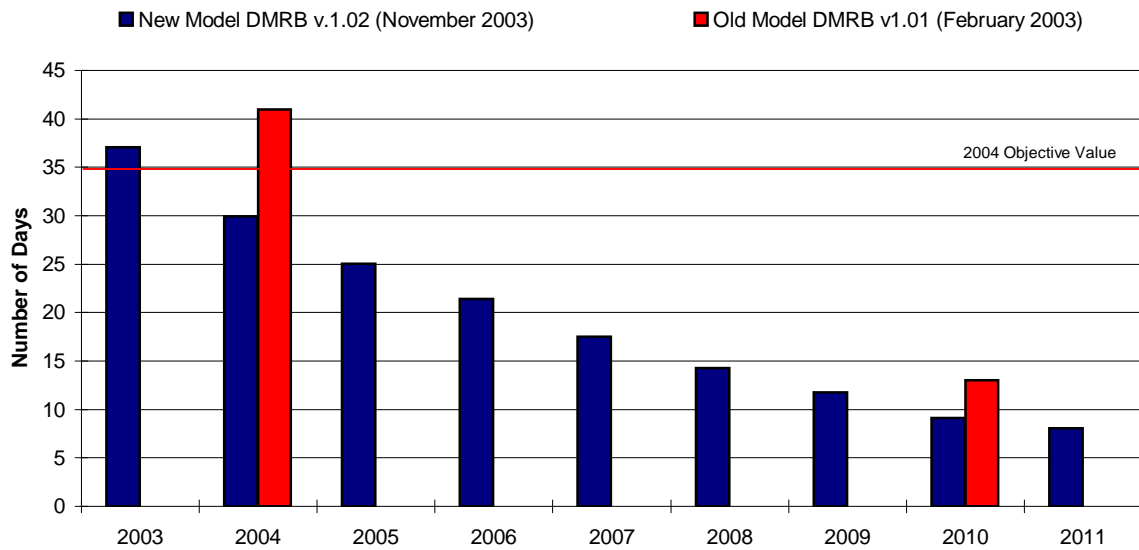
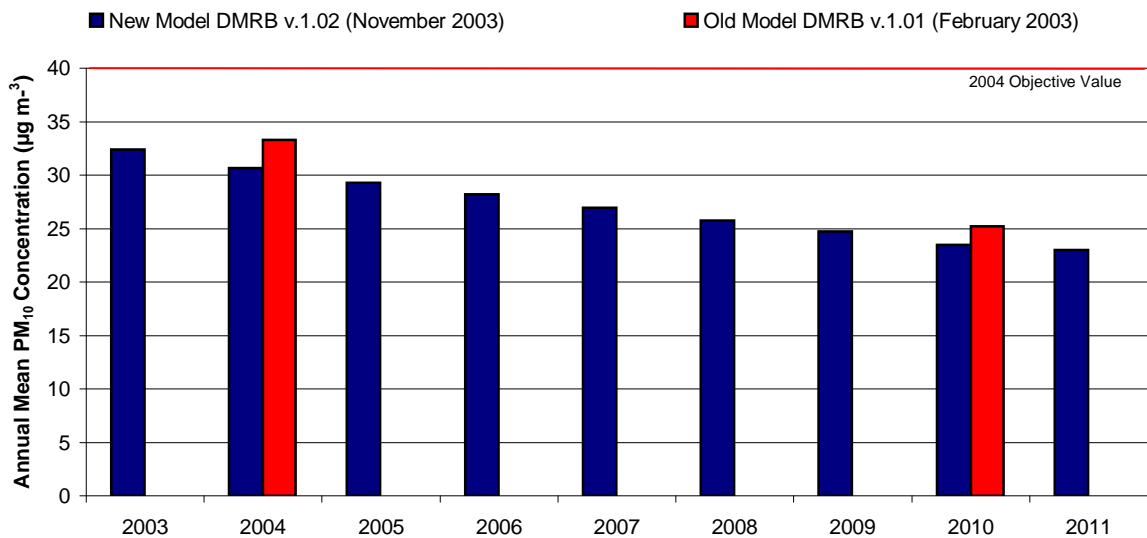


Figure 3.4: Predicted Annual Mean PM₁₀ Concentrations 2003 - 2011 at the Junction of the A217 and Rushworth Road ($\mu\text{g m}^{-3}$).



The 8 month bias correction factor was then applied to the 8 month mean NO₂ concentration measured at Rushworth Road:

Mean NO₂ conc. (8 months) at Rushworth Road = 33.06 µg m⁻³

Mean NO₂ conc. (8 months) at Rushworth Road bias adjusted = 33.06 x 1.23 = 40.66 µg m⁻³

To convert the 8 month (May to December 2003) mean to an annual mean for 2003, four long term real time background monitoring sites within 80 km of Reigate and Banstead were selected in addition to the council's own site in Horley. The annual mean NO₂ concentration for 2003 for each of these sites was then calculated, together with the period mean for the 8 months for which the diffusion tube data was available at Rushworth Road. A ratio of the annual mean to the period mean was then calculated, and the mean of these five ratios taken (Table 3.2).

| | May to Dec. Mean (µg m ⁻³) | Data Capture (%) | Annual Mean (µg m ⁻³) | Data Capture (%) | Annual / period ratio* |
|--|--|------------------|-----------------------------------|------------------|------------------------|
| Reigate & Banstead (Horley) | 29.1 | 99.5 | 31.4 | 99.7 | 1.08 |
| Mole Valley (Lower Ashstead) | 24.3 | 99.6 | 27.2 | 96.6 | 1.12 |
| Mole Valley (Dorking) | 26.6 | 99.0 | 30.0 | 98.2 | 1.13 |
| Tunbridge Wells (Town Hall) | 25.6 | 88.9 | 28.7 | 91.5 | 1.12 |
| Sevenoaks (Greatness) | 22.3 | 94.3 | 24.6 | 95.9 | 1.10 |
| Mean of the five annual : period ratios | | | | | 1.11 |
| *based on unrounded data. Note: the data from sites outside of Reigate and Banstead is ratified and verified until 31/3/03. Data after this date has been provisionally checked. However, the generally good agreement between sites for the annual : period ratio suggests that the lack of ratified and verified data in this situation does not have a significant impact on the final ratio used. | | | | | |

Table 3.2: Ratio of annual to period mean concentrations at selected background monitoring sites within 80 km of Reigate and Banstead.

Using the annual to period mean ratio from Table 3.2, this gives a final annual mean NO₂ concentration at Rushworth Road in 2003 of:

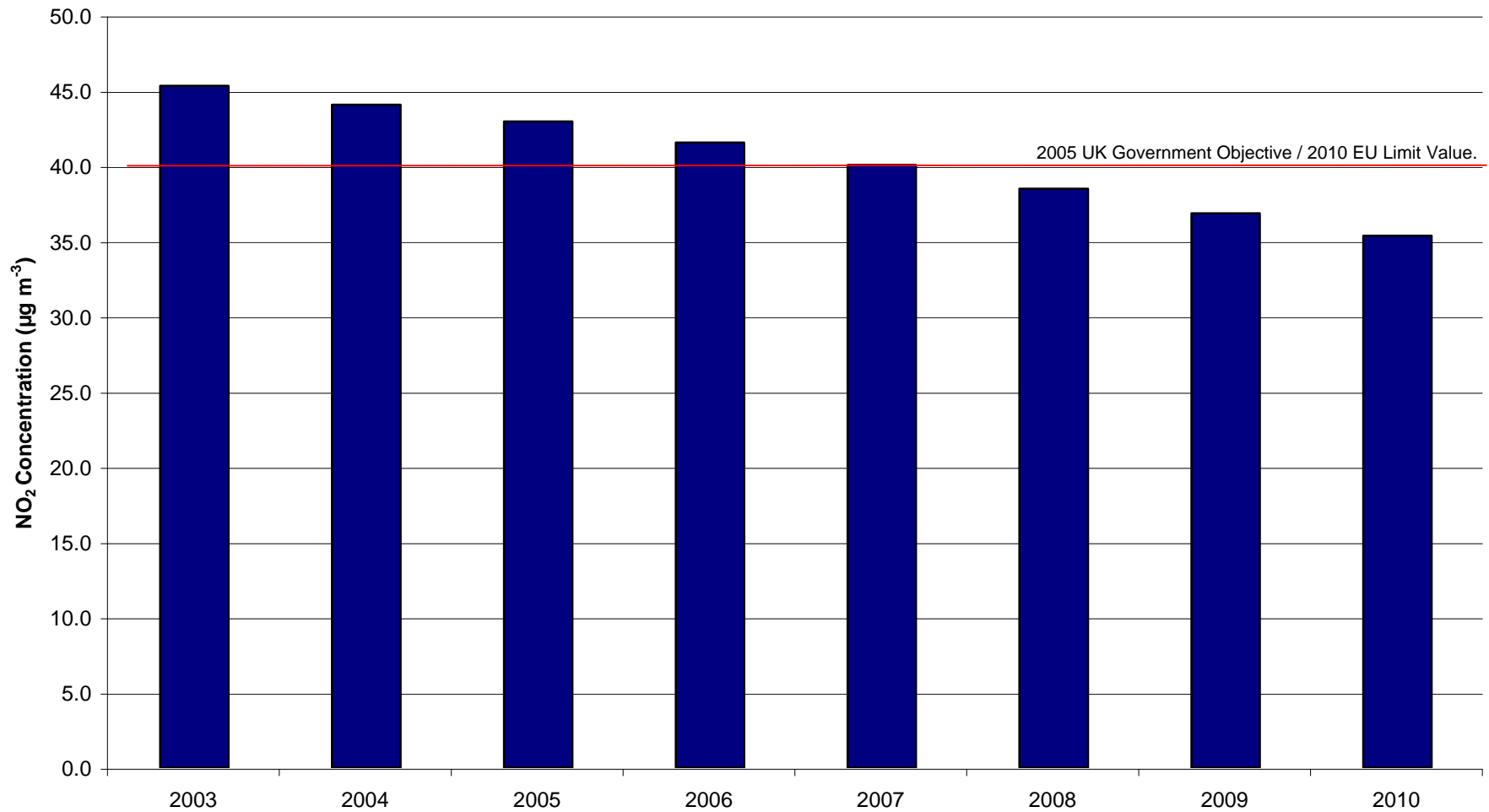
$$(40.66 \times 1.11) = 45 \mu\text{g m}^{-3} \quad (\text{Equation 3.2})$$

Thus the NO₂ concentrations at the receptor shown in Figure 3.1 currently do not meet the 2005 annual average objective for NO₂ of 40 µg m⁻³.

3.1.2 Nitrogen Dioxide Concentrations beyond 2003

To examine if the 2005 objective of 40 µg m⁻³ will be met by 2005, and also if the 2010 EU limit value (also 40 µg m⁻³) will be met by 2010, the 2003 data was extrapolated forward (Figure 3.5) using adjustment factors supplied by DEFRA (DEFRA, 2003).

Figure 3.5: Predicted* Annual Mean NO₂ Concentrations 2004 to 2010 at the Junction of the A217 and Rushworth Road (µg m⁻³).



* Concentrations based on measured and corrected 2003 diffusion tube data (May to Dec 2003) extrapolated to 2003 as per DEFRA (2003). Forward projections (2004 to 2010) based on the extrapolated 2003 values corrected using factors for Roadside sites (DEFRA, 2003).

The kerbside site adjustment factors were used for this work, as these can be applied to receptors up to 15 m from the kerbside depending on the road configuration and the traffic flow, and in this situation the receptor is within 8 m and 13 m of the kerb of Rushworth Road and the A217 respectively.

Figure 3.5 indicates that the NO₂ concentrations at the Rushworth Road receptor will fail to meet the 2005 UK Government annual average objective for NO₂, with concentrations of 43 µg m⁻³ predicted for 2005 i.e. 3 µg m⁻³ higher than the objective value. However, concentrations are predicted to meet the objective by 2007/8, and are predicted to continue to fall until at least 2010, when the concentration is predicted to be around 35 µg m⁻³. Consequently the annual average NO₂ concentration at the site will be below the 2010 EU limit value, even allowing for a 10 % error in the projected 2010 concentration.

However, it is important to bear in mind that the data in Figure 3.5 is derived from an eight month diffusion tube survey in 2003, and therefore monitoring will need to continue to confirm these predictions. Generally nitrogen dioxide concentrations in 2003 were considered close to or slightly above the long term average, based on data from the London area network (ERG, 2004), and thus the predictions based on the monitoring data in Figure 3.5 are neither overly optimistic nor pessimistic.

Although the concentration of nitrogen dioxide is predicted to meet the UK Government objective by 2007/8, and meet the 2010 EU limit value, under section 83(1) of the 1995 Environment Act local authorities have a duty to designate areas where the air quality objectives are *unlikely* to be met on time as air quality management areas (AQMA). As the annual average nitrogen dioxide concentration will not meet the 2005 objective in 2005 at the receptor on the SE corner of the junction of the A217 and Rushworth Road, this receptor will have to be designated an air quality management area.

As there is only one relevant receptor at the junction of the A217 and Rushworth Road - a single residential property consisting of six flats over three floors, it is proposed that the area of the AQMA is confined to this single receptor.

3.2 PM₁₀ Concentrations at Rushworth Road

The DMRB model used in the updating and screening assessment (v.1.01), predicted that there would be 41 days on which PM₁₀ concentrations exceeded 50 µg m⁻³, which would breach the 2004 objective of no more than 35 days per year over 50 µg m⁻³.

It was not possible to install any PM₁₀ monitoring equipment at the Rushworth Road site, as there were large trees close to the building façade on both sides of the building facing the road junction. The layout of the other buildings around the junction also meant that monitoring equipment could not be located at an alternative site at a suitable distance from the junction to be representative of the exposure at the façade of the residential property.

However, following the release of the new DMRB model (v.1.02 - November 2003) it was clear that there was in fact no need to proceed to a detailed assessment for PM₁₀, as the concentration of PM₁₀ was predicted to exceed 50 µg m⁻³ on no more than 30 days in 2004 i.e. below the permitted 35 days per year of the objective (Figure 3.3), and that the number of days over 50 µg m⁻³ was predicted to continue to fall until at least 2010.

The *annual average* PM₁₀ concentration at Rushworth Road had already been predicted to meet the 2004 objective of 40 µg m⁻³ using version 1.01 of the DMRB in the updating and screening assessment, and so a detailed assessment was not required in respect of this objective. Modelling of this objective with the later version of the DMRB indicates that that this remains the case (Figure 3.4).

Thus in summary, the PM₁₀ concentrations at the receptor on the SE corner of the junction of the A217 and Rushworth Road, are predicted to meet both objectives for PM₁₀ when screened using the 'new' DMRB model. Therefore there is no need for the declaration of an air quality management area with respect to PM₁₀.

3.3 Summary and Conclusions

Nitrogen dioxide concentrations at the Rushworth Road site are predicted to exceed the 2005 annual average objective of 40 µg m⁻³, based on the results of monitoring data at the site.

However, concentrations are predicted to fall to 40 µg m⁻³ by 2007/8 and will meet the 2010 EU limit value for NO₂. Nevertheless, an air quality management area (AQMA) will need to be declared for the junction of the A217 and Rushworth Road as the 2005 objective will not be met in 2005. As there is only a single receptor at the junction where relevant exposure can occur, it is proposed that the AQMA be confined to a single building on the SE corner of the junction, which consists of a block of six flats arranged over three floors.

The AQMA order is required with respect to nitrogen dioxide only, as there are predicted to be no breaches of the 2004 PM₁₀ objectives.

4.0 Assessment of Existing AQMAs within Reigate and Banstead

As a consequence of delays in the first round of the review and assessment procedure, the stage 4 (further) assessments of the AQMAs within the Borough were completed after the updating and screening assessment of April / May 2003. Therefore this section of the report will not go into detail on the approach / modelling used when examining the existing AQMAs, as this can be obtained from the stage 4 reports (AQC, 2003 and 2004). The aim of this section is to summarise the main findings of these reports, and to present the data collected from these sites during 2003.

4.1 M25 Air Quality Management Area

The AQMA declared for the M25 within the Borough extends 30 m either side of the edge of the carriageway. The stage 4 assessment of the AQMA (AQC, 2003) confirmed that the AQMA should remain in its original form, as the NO₂ concentration at the receptor nearest the motorway (16 m from the edge of the carriageway) on Ashcombe Road near to junction 7, and properties on the same road up to 23 m from the carriageway, would breach the 2005 annual average NO₂ objective.

The report noted that NO₂ concentrations on Ashcombe Road were slightly elevated compared to other sites along the motorway, and that this was thought due in part to the proximity of the site to junction 7 of the M25 (the interchange with the M23), and also in part due to flow breakdown occurring on the M25 at this point as vehicles attempt to leave the M25 for the M23.

Subsequent work on the air quality action plan for the M25 (RB, 2004), suggests that the 2005 objective should be met in 2008, and that all properties within the M25 AQMA will meet the 2010 EU limit value for nitrogen dioxide.

The monitoring data for 2003 is shown in Figure 4.1 together with data from 2002. A correction factor of 1.17 has been applied to the 2002 data (see AQC, 2003 for full details), while a factor of 1.29 has been applied to the 2003 data (Equation 4.1). The tube data for 2003 covers an eleven month period, and all tubes are located on the façade of residential properties.

$$\frac{\text{Mean of 11 monthly periods of real time data (04/02/03 to 30/12/03 : 99.7 \% data capture)}}{\text{Mean of 11 months of tube data *(04/02/03 to 30/12/03)}} = \frac{31.18}{24.15} = 1.29$$

*The monthly data is a mean of three co-located diffusion tubes.

(Equation 4.1)

Figure 4.1: Annual mean NO₂ Concentrations along the M25 - Corrected Diffusion Tube Data (2002 n = 9, 2003 n=11).

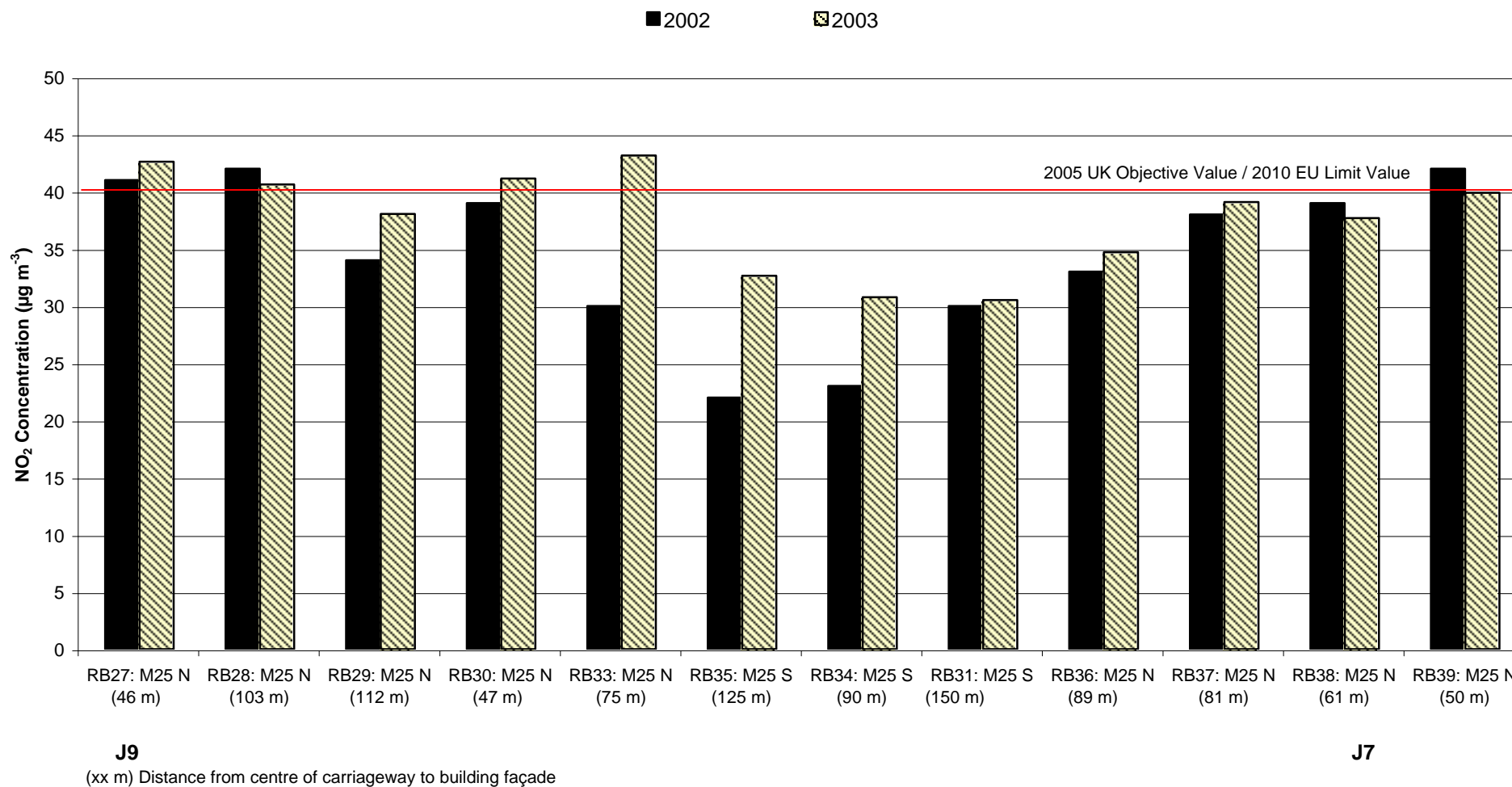


Figure 4.1 demonstrates that at most sites NO₂ concentrations have gone up slightly, but down slightly at three sites. However, a large increase (7 to 13 µg m⁻³) has occurred at sites RB33, 34, and 35. Sites RB34 and 35 are neighbouring houses around 40 m apart to the south of the M25 between junctions 8 and 9, while RB33 is located to the north of the M25 almost opposite RB34 and 35. Throughout 2003 there have been roadworks on the anticlockwise carriageway near to these properties, and thus this is the most likely explanation for the considerable increase in NO₂ concentrations i.e. flow breakdown, traffic jams, and stop start driving due to the roadworks. Thus the 2003 concentrations at these three sites can be considered 'one offs', but it very clearly demonstrates the magnitude of the impact that motorway roadworks can have on the surrounding air quality.

The 2003 data was projected forward to 2005 (Table 4.1) using the background correction factors supplied by DEFRA (DEFRA, 2003). This confirms that there will still be breaches of the 2005 objective for nitrogen dioxide at RB27, which is approximately 16 m from the edge of the carriageway, and also at properties along Ashcombe Road which are closer to the motorway than the tube site at RB39. Site RB33 is likely to be below the 2005 objective, assuming that the roadworks do not continue until 2005.

| | RB27 | RB28 | RB29 | RB30 | RB33 ^c | RB35 ^c | RB34 ^c | RB31 | RB36 | RB37 | RB38 | RB39 |
|-------------------|------|------|------|------|-------------------|-------------------|-------------------|------|------|------|------|------|
| 2003 ^a | 43 | 41 | 38 | 41 | 43 | 33 | 31 | 31 | 35 | 39 | 38 | 40 |
| 2005 ^b | 41 | 39 | 36 | 39 | 41 | 31 | 29 | 29 | 33 | 37 | 36 | 38 |

^a Corrected Data (Correction factor = 1.29, n = 11 for each site).
^b Projected values based on background factors supplied by DEFRA (DEFRA, 2003).
^c 2005 actual values likely to be 7 - 10 µg m⁻³ lower, as 2003 data increased due to roadworks.

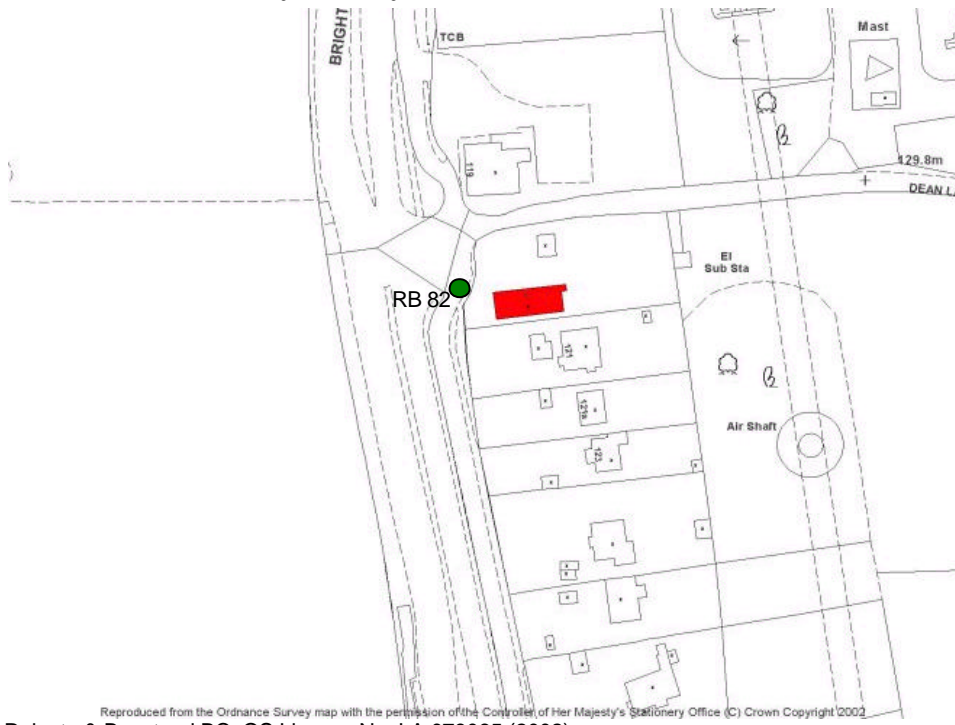
Table 4.1: Corrected 2003 Annual Average NO₂ Concentrations and Projected 2005 Concentrations (µg m⁻³) along the M25.

Thus overall the projected 2003 data is in general agreement with the findings of the stage 4 assessment.

4.2 The Two Individual AQMAs on the A23

The A23 originally had two locations where NO₂ concentrations were predicted to breach the 2005 annual average objective. Each location consisted of a single property, and consequently AQMAs were declared at each of these properties (Figure 4.2)

1, Dean Lane, Hooley, Surrey.

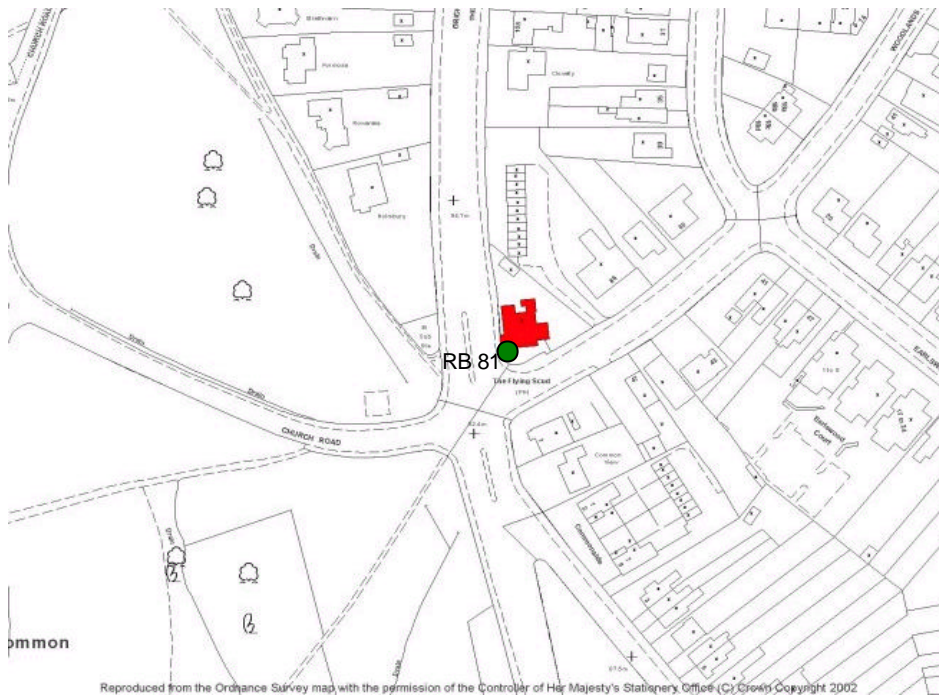


Reigate & Banstead BC: OS Licence No. LA 079065 (2002)

Key:

- AQMA
- Diffusion Tube & Number
- North
↑

Flying Scud Public House, Brighton Road, Redhill, Surrey.



Reigate & Banstead BC: OS Licence No. LA 079065 (2002)

Key:

- AQMA
- Diffusion Tube & Number
- North
↑

Figure 4.2: Location of Individual AQMAs on the A23 within Reigate and Banstead. (after AQC, 2003).

The stage 4 assessment of these properties (AQC, 2003), completed after the updating and screening assessment, concluded that NO₂ concentrations were unlikely to breach the 2005 objective values based on the 2002 data, and so the AQMAs could be revoked.

However, monitoring data from 2003 (Figure 4.3) suggests that while the Flying Scud Public house is still likely to meet the 2005 objective for NO₂, confirming the decision to revoke the AQMA, the relevant receptor at 1, Dean Lane Hooley is predicted not to meet the objective based on the 2003 data. Although the relevant receptor at Dean Lane is 5 m further from the road than the RB82 tube site, the receptor is still predicted to be over the 2005 objective for NO₂ with a projected concentration of 43 µg m⁻³ (Table 4.2).

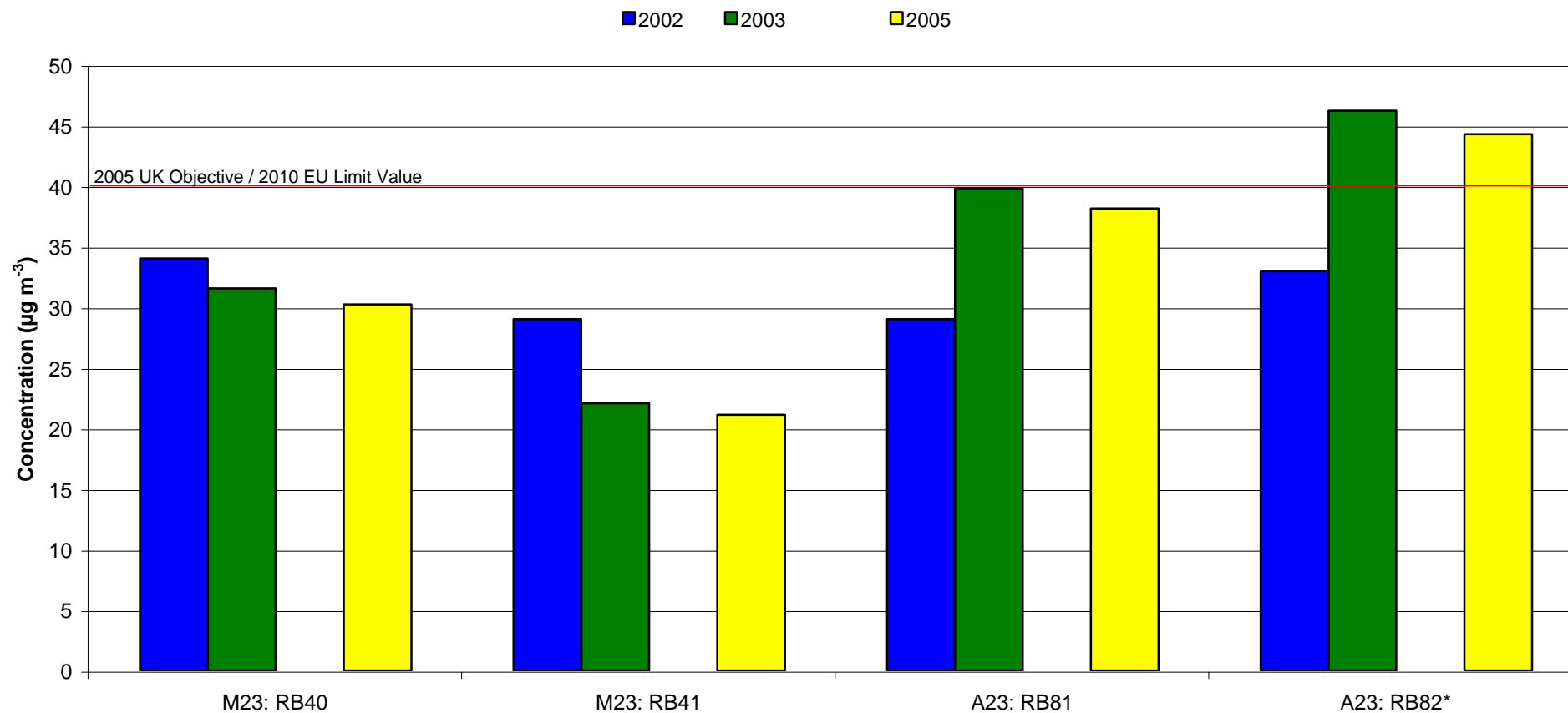
| | Predicted DMRB ^a Concentration (2003) | Measured Concentration (2003) | Measured : Predicted Ratio | Adjusted ^b Concentration (2003) | Projected ^c Concentration (2005) |
|---|--|-------------------------------|----------------------------|--|---|
| RB82 | 38.2 | 46.2 | 1.21 | - | - |
| Relevant Receptor | 37.3 | - | - | 45.1 | 43.2 |
| <small>All values except ratio µg m⁻³. ^a Version 1.02 November 2003. Traffic data for Dean Lane estimated (5000 AADT, 1% HGV, 5 kph). ^b Adjusted conc. derived from predicted DMRB conc. multiplied by the measured : predicted ratio calculated for RB82. ^c Projection based on background correction factors by DEFRA (DEFRA, 2003).</small> | | | | | |

Table 4.2: Extrapolated Annual Average NO₂ Concentration in 2003 at the Relevant Receptor on the A23 / Dean Lane and Projected 2005 Concentration.

Dispersion modelling undertaken as part of the stage 3 assessment predicted annual average NO₂ concentrations at 1, Dean Lane of 42 to 46 µg m⁻³ in 2005 (AQC, 2001), which agrees well with the above figure from the adjusted and projected DMRB value. The dispersion modelling also predicted that the annual average NO₂ concentration at the neighbouring property to the south (15 m further back from the A23) would be 34 to 38 µg m⁻³, while the property on the north side of Dean Lane is a commercial premises.

Therefore it is proposed that the AQMA at 1, Dean Lane, Hooley be 're-declared' for this individual property only, as in the original AQMA declaration.

Figure 4.3: Measured (2002 and 2003) and Projected (2005) Annual Mean NO₂ Concentrations (µg m⁻³) near the M23 and A23.



Notes:

* Building Façade is approximately 5 m further from the road than this tube site.

2002 Data from Stage 4 Assessment (AQC, 2003), correction factor applied = 1.17.

2003 Data - Corrected Diffusion Tube data (n=11, correction factor = 1.29).

2005 Data - Projected 2003 data using background correction factors supplied by DEFRA (DEFRA, 2003).

4.3 The M23 AQMA

The original M23 AQMA consisted of two sections, one to the north of the M25, and one to the south of the M25, each extending to a distance of 30 m from either edge of the carriageway.

The AQMA to the north of the M25 was reviewed in the first of the stage 4 assessments (AQC, 2003) undertaken after the updating and screening assessment. This concluded that based on the 2002 data and the projected 2005 concentrations that the AQMA to the north of the M25 could be revoked, as concentrations at the affected properties would be below the 2005 objective. Monitoring at relevant receptors within the AQMA (RB40 and 41 - Figure 4.3) during 2003, shows a further fall in the NO₂ concentrations in 2003 compared to 2002, and that both sites are still projected to meet the 2005 NO₂ objective based on the 2003 data. Thus this confirms the original decision to revoke the M23 AQMA to the north of the M25.

The second part of the M23 AQMA is the section of the M23 to the south of the M25 that is within the Borough boundary. There is only one relevant receptor within this AQMA, which is 25 m from the edge of the western side of the motorway, but it has not been possible to date to install any form of monitoring at this property.

This section of the M23 AQMA was examined in the second stage 4 report (AQC, 2004), completed after the updating and screening assessment, which also examined the NO₂ concentrations in Horley near to Gatwick Airport. This report predicted NO₂ concentrations at the relevant receptor of 43.6 µg m⁻³ in 2005, based on dispersion modelling.

However, the dispersion model had only been verified using monitoring data immediately in the vicinity of the airport, whereas the relevant receptor on the M23 is around 2.5 km from where the model was validated. Thus the degree of uncertainty associated with the modelled 2005 value for the M23 receptor is likely to be higher than in the vicinity of the airport.

It is also important to examine the predicted concentration at the receptor on the M23 in the context of the traffic flow. The M23 next to the relevant receptor is predicted to carry around 105,000 vehicles (AADT) in 2005, compared to around 160,000 (AADT) between junction 7 and 8 on the M25. The stage 4 assessment of the M25 (AQC, 2003) found that concentrations were likely to exceed 40 µg m⁻³ in 2005 only at properties closer than 23 m to the edge of the carriageway i.e. on a road carrying 50,000 more vehicles (AADT) at comparable speeds to the M23. Therefore, this suggests that the NO₂ concentration of 43.6 µg m⁻³ predicted for the receptor within the southern M23 AQMA may be an overestimate of the 'true' value.

This fact was acknowledged in the stage 4 assessment (AQC, 2004) and modelling of the M23 receptor with the DMRB screening tool, which had shown very good agreement with the monitoring data from the M25 (AQC, 2003), predicted that concentrations at this receptor would be $36.5 \mu\text{g m}^{-3}$. However, given the uncertainty associated with the results from this site the stage 4 assessment concluded that the AQMA should remain in place, but that monitoring should be undertaken to confirm these findings.

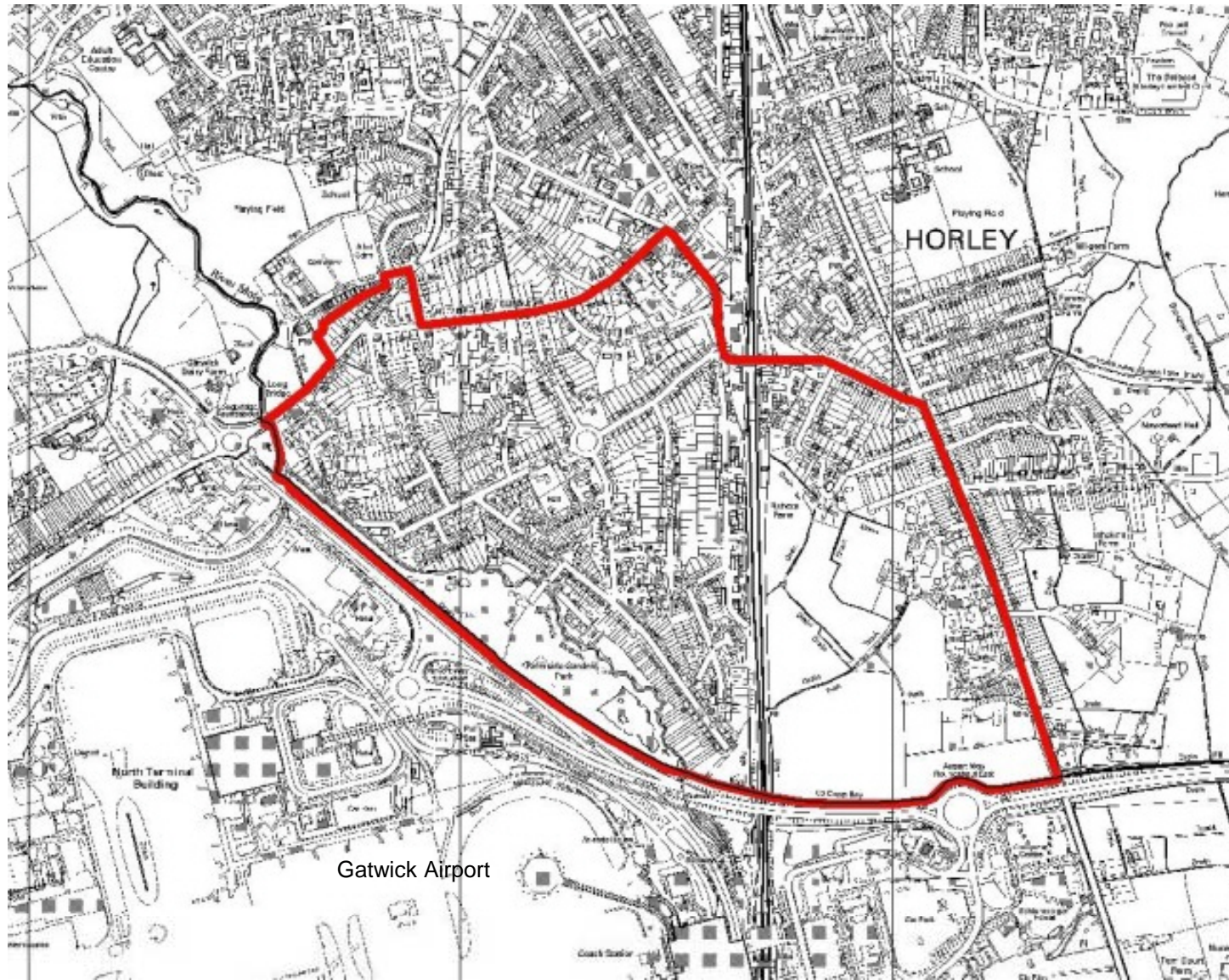
So in summary, the 2003 data indicates that the decision to revoke the M23 AQMA to the north of the M25 was appropriate. However, the stage 4 assessment of the M23 AQMA to the south of the M25 indicates that in the absence of monitoring data, and with the uncertainty associated with the modelling data, that the AQMA should remain in place and that some form of monitoring is now required in this area.

4.4 The Horley AQMA near to Gatwick Airport

The stage 4 (further) assessment of the Horley AQMA was completed in March 2004 (AQC, 2004), and so only the main findings of this report and the complete monitoring data set for 2003 will be presented in this section.

The Horley AQMA is located to the NE of Gatwick Airport and covers approximately 1 km^2 (Figure 4.4). Monitoring takes place at 27 different locations within the AQMA using diffusion tubes, with real time monitors also present at two of the sites.

Dispersion modelling of the AQMA (bespoke ADMS v.3 operated by AEA) for the period May 2002 to April 2003 (Underwood *et al.*, 2003) based on an emission inventory matched to the same period (Underwood *et al.*, 2003b), was completed in late 2003 and validated against monitoring data for the same period. The modelling data was then projected forward to 2005 (Figure 4.5) for use in the stage 4 assessment of the AQMA (for full details of the modelling see AQC, 2004).



Key:

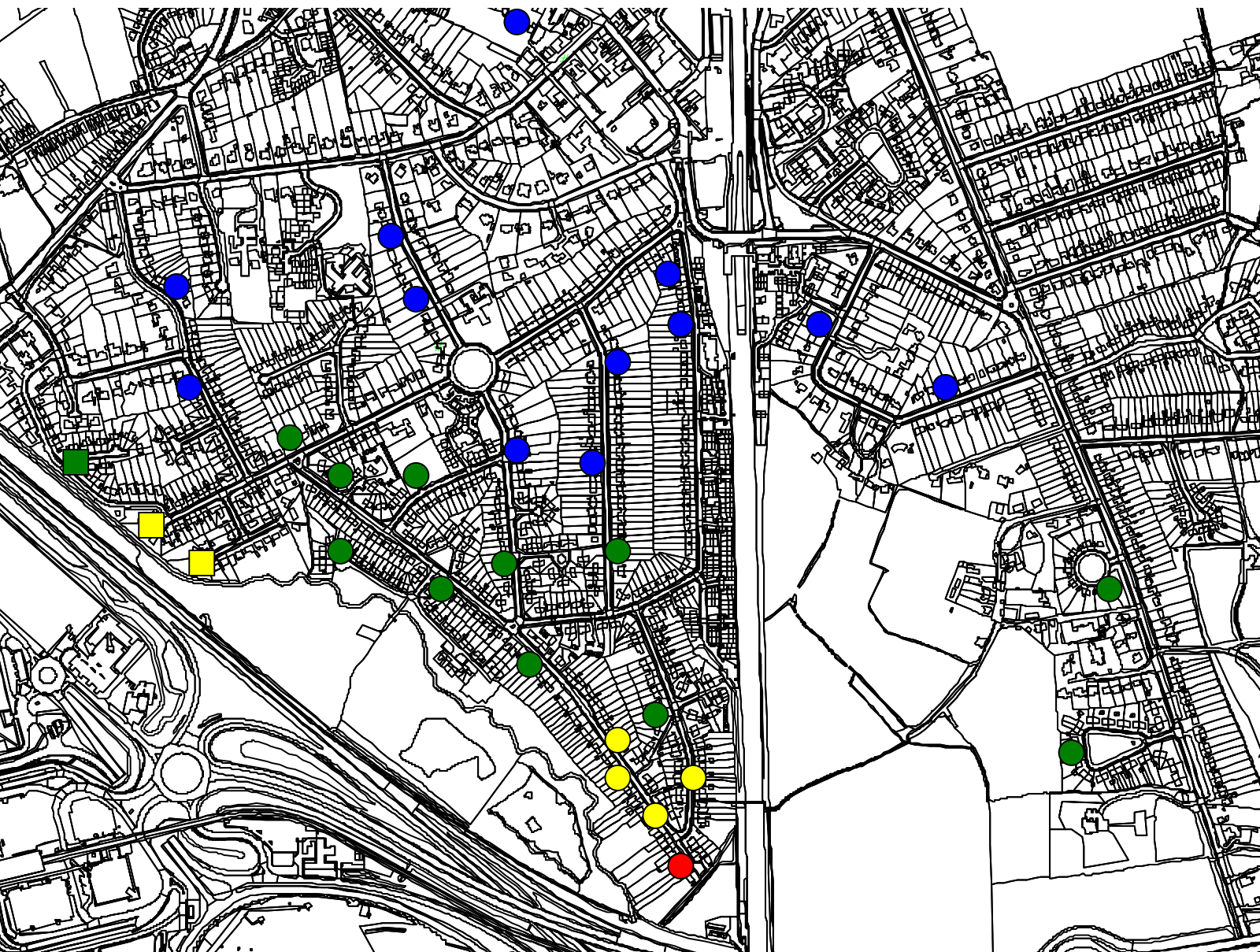
— Boundary of AQMA

North



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Figure 4.4: Horley Air Quality Management Area near to Gatwick Airport.



Key:

- 20.1 to 25 $\mu\text{g m}^{-3}$
- 25.1 to 30 $\mu\text{g m}^{-3}$
- 30.1 to 35 $\mu\text{g m}^{-3}$
- 35.1 to 40 $\mu\text{g m}^{-3}$
- 40.1 to 44 $\mu\text{g m}^{-3}$

North



0 250 m

Modelled Sites only.
(3 in total).
No monitoring at this point.

Figure 4.5: 2005 Annual Average NO₂ Concentrations in Horley near to Gatwick Airport.

Values based on dispersion modelling. For full methodology see AQC, 2004.

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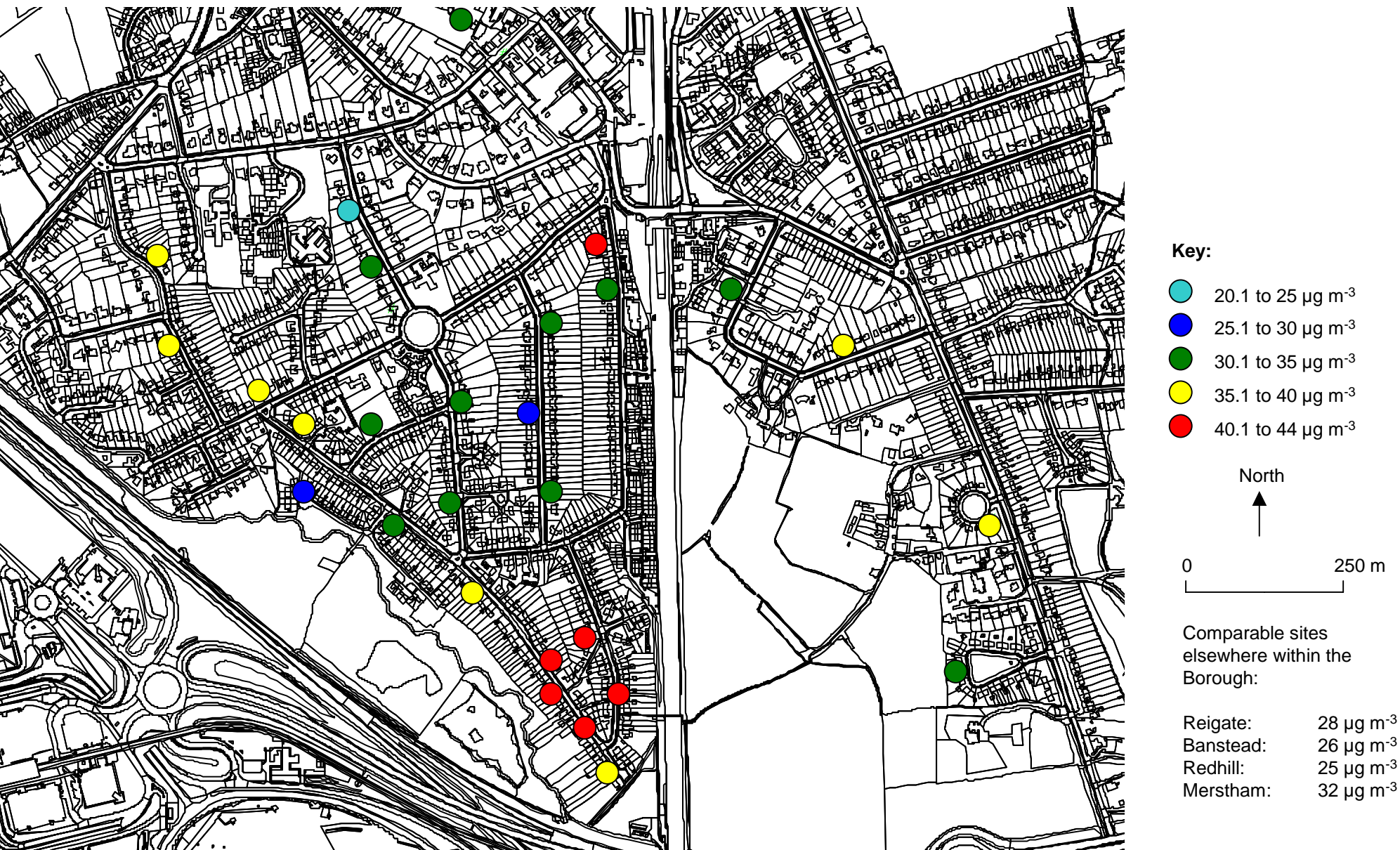


Figure 4.6: 2003 Annual Average NO_2 Concentrations in Horley near to Gatwick Airport (n = 11, correction factor =1.29).

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The further assessment concluded that while the 2005 data (Figure 4.5) indicates that only one site is likely to breach the 2005 objective, the AQMA should remain in place in its original form as:

- i) airport passenger numbers are projected to increase from around 35 million passengers per annum in 2005, to 40 million passengers per annum by 2008.
- ii) the uncertainty associated with the modelled data.

While it is not possible to quantify the uncertainty associated with the 2005 data, the calculated uncertainty for the 2002/3 data set was $5 \mu\text{g m}^{-3}$ and there is no reason to suggest that the uncertainty should be significantly higher or lower than this value for the 2005 data.

The monitoring results for 2003 are shown in Figure 4.6. A total of five sites close to the airport have NO_2 concentrations over $40 \mu\text{g m}^{-3}$, and this will be due to a combination of the airport and road traffic on the A23 (Airport Way). A further site to the north within the AQMA was also over $40 \mu\text{g m}^{-3}$, although this is likely to be primarily due to road traffic.

A comparison between the 2003 monitored values and the predicted 2005 values (Figures 4.5 and 4.6) suggests that the concentrations of NO_2 will fall. However, it is important to remember that the NO_2 concentrations in the Horley AQMA consist of three main components:

- i) the background NO_2 concentration, which will be broadly similar across all of the sites.
- ii) a traffic derived component dependant on the proximity of the monitoring sites to the roads.
- iii) an airport / aircraft derived component, which will decrease in influence moving away from the airport.

As has been seen in the previous AQMAs examined in this report, and at the Rushworth Road site, the general trend in traffic derived NO_2 concentrations is downwards, as improvements in vehicle emissions more than off set the 'business as usual' increase in road traffic. The trend in the background NO_2 concentrations is also downwards. However, the emissions from the aircraft fleet over the next 5 to 10 years are likely to only improve marginally while passenger numbers are likely to increase from around 35 million per annum in 2005 to 40 million in 2008 (AQC, 2004), and so consequently the NO_2 emissions derived from aircraft are likely to increase.

Passenger numbers are predicted to increase from 32 million per annum to 35 million per annum between 2003 and 2005, and from figures 4.5 and 4.6 it would appear that the reductions in the traffic derived and background NO₂ concentrations are likely to off set the effect of any increase in emissions from aircraft within the AQMA, especially at properties closest to the airport where the aircraft emissions will make the biggest contribution to NO₂ concentrations.

However, if passenger numbers increase from 35 million per annum in 2005 to 40 million in 2008, whether the improvements in the background and traffic emissions will continue to outstrip or at least match the increased emissions from the aircraft is unknown at this time. Hence the uncertainty over the spatial extent of the AQMA beyond 2005.

So in summary, the monitoring data for 2003 indicates that the south east tip of the Horley AQMA is currently over 40 µg m⁻³. Modelling undertaken as part of the stage 4 assessment suggests that concentrations will exceed the 2005 objective at the south east tip of the AQMA, and therefore the AQMA is to be retained. The uncertainty associated with the predicted 2005 concentrations, and also the impact of the expansion of the airport beyond 2005, means that the AQMA is retained in its current form.

5.0 Summary and Conclusions

5.1 Junction of the A217 and Rushworth Road

The property on the SE corner of the junction of the A217 and Rushworth Road is predicted:

- i) *not to breach* the permitted number of exceedences of the 50 µg m⁻³ 2004 PM₁₀ objective;
- ii) *to breach* the 2005 annual average objective for NO₂ of 40 µg m⁻³;

and therefore will need to be declared an air quality management area with respect to nitrogen dioxide only.

Nevertheless, projection of the 2003 data beyond 2005 for the affected property at Rushworth Road suggests that the 2005 annual average NO₂ objective will be met around 2007/8, and that the site would meet the 2010 EU limit value for NO₂.

5.2 Junction of the A23 and Dean Lane

The property at 1, Dean Lane (SE corner of the junction between the A23 and Dean Lane) is predicted to breach the 2005 annual average objective for NO₂, based on the 2003 monitoring data, and so will need to be re declared as an air quality management area with respect to the 2005 annual average NO₂ objective. This follows the revocation of the order in 2003, based on the findings of the stage 4 report using the 2002 data.

5.3 A23 Flying Scud Public House and the M23

The decision to revoke the air quality management area on the M23 to the north of the M25, and at the Flying Scud public house on the A23, based on the projected 2002 data in the stage 4 assessment, is confirmed by the projected 2003 data also indicating no breaches of the 2005 annual average NO₂ objective.

However, the M23 AQMA to the south of the M25 is to be retained in its current form due to the lack of monitoring data at the affected property, and the uncertainty associated with the modelled values. A diffusion tube monitoring site will therefore need to be established in the area to measure the NO₂ concentrations.

5.4 The M25 AQMA

The stage 4 assessment of the M25 AQMA concluded that it should be retained in its original form, and projection of the 2003 data to 2005 confirms that there are still likely to be breaches of the 2005 annual average NO₂ objective.

5.5 The Horley AQMA

The stage 4 assessment of this AQMA concluded that only the SE tip of the AQMA (nearest the A23 and the airport) was predicted to breach the 2005 objective. However, the 'uncertainty' associated with the modelled data, and also the expansion of the airport beyond 2005 meant that the AQMA should be retained in its current form.

References

- AQC (2001) *Stage 3 Local Air Quality Review and Assessment - NO₂ and PM₁₀*. Report No. A35870100/yb/1743/final. Air Quality Consultants / Stanger Science and Environment, Bristol, UK, July 2001.
- AQC (2003) *Further Assessment (Stage 4) of Air Quality within Four Air Quality Management Areas in Reigate and Banstead*. Air Quality Consultants, Bristol, UK, May 2003.
- AQC (2003b) *Revised Procedure for Application of the DMRB Air Quality Model to Locations with more than one Road Link*. Air Quality Consultants, Bristol, UK, J369, October 2003.
- AQC (2004) *Further Assessment (Stage 4) of Air Quality within Two Air Quality Management Areas in Reigate and Banstead*. Air Quality Consultants, Bristol, UK, April 2004.
- AQC (2004b) *Methodology used in the Survey of Diffusion Tube Co-Location Studies*. Air Quality Consultants, Bristol, UK, J211, February 2004.
- Brown, Y. (2003) *Guidance note for use of projection factors for background and roadside pollutant concentrations*. (13/02/03) Casella Stanger, London, UK.
- DEFRA (2003) *Local Air Quality Management - Technical Guidance*. Report No. LAQM. TG (03). HMSO, London.
- DEFRA (2003a) *Local Air Quality Management Tools*. www.airquality.co.uk.
- ERG (2004) London Air Quality Network Meeting - 16th February 2004, King's College, London.
- Fuller, G.W. (2004) Personal Communication. Air Quality Analyst, Environment Research Group (ERG), King's College, London.
- RB (2003) *Updating and Screening Assessment of Air Quality in the Borough of Reigate and Banstead*. Reigate and Banstead BC, Surrey, UK, May 2003.
- RB (2004) *Air Quality Action Plan for the M25 within the Borough of Reigate and Banstead*. Reigate and Banstead BC, Surrey, UK, February 2004.
- Stanger (2003) *Projects and Helpdesks - November 2003 Revised DMRB*. www.stanger.co.uk/jointprojects/detail.asp?id=102&jointprojectid=7
- Underwood, B.Y., Peirce, M.J., Walker, C.T. (2003) *Air Quality Modelling for Gatwick Airport 2002/3. A Report Produced for BAA Gatwick*. netcen/AEAT/ENV/R/1625/Issue 1. (December 2003). AEA Technology, Warrington, UK. (Restricted Commercial).
- Underwood, B.Y., Walker, C.T., Peirce, M.J. (2003b) *Gatwick Emission Inventory 2002/3. A Report Produced for BAA Gatwick*. netcen/AEAT/ENV/R/1569/Issue 1. (December 2003). AEA Technology, Warrington, UK. (Restricted Commercial).