

**DOVER DISTRICT COUNCIL**

**LAQM FURTHER ASSESSMENT 2009**

**BV/AQ/ADIX0552**

**APRIL 2009**



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## 1 Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government guidance when undertaking such work.

Dover District Council (DDC) completed the third round Updating and Screening Assessment (USA) in June 2006, with the conclusion that a detailed assessment was required for NO<sub>2</sub> due to emissions from road traffic on the A20 Limekiln Street, south of the York Street roundabout, and once again at the junction of High Street and Ladywell. The Detailed Assessment 2007 concluded that both areas assessed would exceed the annual mean nitrogen dioxide (NO<sub>2</sub>) objective. In December 2007, DDC declared a new AQMA at the junction of High Street and Ladywell, in addition to extending the A20 Trunk Road AQMA to incorporate Limekiln Street.

Bureau Veritas has been commissioned by Dover District Council to provide a Further Assessment of air quality within the A20 Trunk Road, Dover (Amended) AQMA and High Street/Ladywell, Dover AQMA which will provide technical input to their Air Quality Action Plan.

The Further Assessment has been undertaken in accordance with DEFRA LAQM.TG(09)<sup>1</sup> Guidance methodologies. The Further Assessment aims, through assessment of monitoring data and modelled predictions,

- to confirm the original assessment of air quality in the AQMAs against the prescribed objectives;
- to calculate more accurately how much of an improvement in air quality would be needed to deliver the air quality objectives within the AQMAs;
- to refine knowledge of the sources of pollution so that air quality action plan measures can be properly targeted.

The information from the further assessment is required to assist the preparation of the Action Plan measures for the AQMA in order that the measures may be targeted and focused, thereby prioritising the most cost-effective approach to reducing air pollutant concentrations in the AQMAs.

The findings of this report are the following:

- Updated monitoring data indicate that exceedences of the annual mean objective continue to be measured within the AQMAs and confirm the need for the declarations.
- Updated monitoring and modelled results suggest that there is a risk of exceedences of the annual mean objective outside of the A20 Trunk Road AQMA in Bench Street where there are a small number of residential properties at 1<sup>st</sup> floor locations. It is recommended that the A20 Trunk Road AQMA be extended to incorporate the area of public exposure in Bench Street.
- The source apportionment shows that, while background pollution levels contribute significantly, road traffic is the main contributors of the overall NO<sub>x</sub> levels in the AQMAs. Of the road traffic emissions, in the A20 Trunk Road AQMA in particular, heavy duty vehicles are the main contributors.
- The maximum predicted NO<sub>x</sub> reduction required within the A20 Trunk Road AQMA to comply with the NO<sub>2</sub> AQS objective is 39.0µg/m<sup>3</sup> (equivalent to a 33% improvement in NO<sub>x</sub>). This equates to a 10.9µg/m<sup>3</sup> reduction in NO<sub>2</sub> (equivalent to 21% improvement in NO<sub>2</sub>). Consequently, measures formulated in the Local Action Plan should aim to reduce the levels of NO<sub>x</sub> / NO<sub>2</sub> within the AQMA by these amounts.
- The maximum reduction in NO<sub>x</sub> concentrations in the AQMA required to comply with the AQS objectives in the High Street/Ladywell AQMA is about 11µg/m<sup>3</sup> (equivalent to a 12.5% reduction in NO<sub>x</sub> levels). This equates to about 3µg/m<sup>3</sup> reduction in NO<sub>2</sub> (8% reduction).

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<sup>1</sup> Defra (2009), Local Air Quality Management Technical Guidance LAQM.TG(09)

Consequently, measures formulated in the Local Action Plan should aim to reduce the levels of  $\text{NO}_x$  /  $\text{NO}_2$  within the AQMA by these amounts.

- Predicted model results for the year 2010 indicate the annual mean objective is still likely to be exceeded at several locations within the AQMAs. Monitoring data suggests that the predicted drop off rate is not occurring in these AQMAs and therefore it is likely that exceedences will still be widespread in 2010 and the EU Limit Value will not be achieved by this date. Using roadside nitrogen dioxide projection factors from the Technical Guidance LAQM.TG(09), it is predicted that the annual mean objective would be met at all locations by 2015.

## 2 Introduction

### 2.1 Project Background

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government guidance when undertaking such work. The Further Assessment is a requirement of the Third Round of Review and Assessment for Local Authorities that have declared an Air Quality Management Area (AQMA). It is intended to supplement information in the AQMA gathered in the Detailed Assessment. Bureau Veritas was commissioned by Dover District Council (DDC) to undertake the Further Assessment of the AQMA declared for nitrogen dioxide (NO<sub>2</sub>) in December 2007, at the junction of High Street and Ladywell, in addition to the extension of the A20 Trunk Road AQMA to incorporate Limekiln Street.

### 2.2 Legislative Background

The significance of existing and future pollutant levels are assessed in relation to the national air quality standards and objectives, established by Government. The revised Air Quality Strategy (AQS)<sup>2</sup> for the UK (released in July 2007) provides the over-arching strategic framework for air quality in the UK and contains national air quality standards and objectives established by the UK Government and devolved administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from the Limit Values prescribed in the EU Directives transposed into national legislation by member states.

The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The Directive 2008/50/EC<sup>3</sup> introduces new obligatory standards for PM<sub>2.5</sub> for Government but places no statutory duty on local Government to work towards achievement.

The Air Quality Standards (England) Regulations 2007<sup>4</sup> came into force on 15<sup>th</sup> February 2007 in order to align and bring together in one statutory instrument the Governments obligations to fulfil the requirements of the CAFE Directive.

The objectives for ten pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide particulates - PM<sub>10</sub> and PM<sub>2.5</sub>, ozone and PAHs - Polycyclic Aromatic Hydrocarbons) have been prescribed within the Air Quality Strategy<sup>2</sup> based on The Air Quality Standards (England) Regulations 2007.

This assessment focuses on those pollutants included in Air Quality Regulations for the purpose of Local Air Quality Management, in respect of pollutant sources affecting air quality within the Council's administrative area. The objectives set out in the AQS for these pollutants are presented in the table below.

The UK Government and the Devolved Administrations have also set new national air quality objectives for PM<sub>2.5</sub>. These objectives have not been incorporated into LAQM Regulations, and authorities have no statutory obligation to review and assess air quality against them.

The locations where the AQS objectives apply are defined in the AQS as locations outside buildings or other natural or man-made structures above or below ground where members of the public are regularly present and might reasonably be expected to be exposed [to pollutant concentrations] over the relevant averaging period of the AQS objective. Typically these include residential properties and schools/care homes for longer period (i.e. annual mean) pollutant objectives and high streets for short-term (i.e. 1-hour) pollutant objectives.

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<sup>2</sup> The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007), Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland

<sup>3</sup> Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe

<sup>4</sup> The Air Quality Standards Regulations 2007, Statutory Instrument No 64, The Stationary Office Limited

**Table 2.1 – Air Quality Objectives included in the Air Quality Regulations for the purpose of Local Air Quality Management**

Pollutant	Objective	Concentration measured as	Date to be achieved by and maintained thereafter
<b>Benzene</b> All authorities	16.25 µg/m <sup>3</sup>	running annual mean	31.12.2003
Authorities in England and Wales only	5.00 µg/m <sup>3</sup>	annual mean	31.12.2010
Authorities in Scotland and Northern Ireland only	3.25 µg/m <sup>3</sup>	running annual mean	31.12.2010
<b>1,3 Butadiene</b> All authorities	2.25 µg/m <sup>3</sup>	running annual mean	31.12.2003
<b>Carbon monoxide</b> Authorities in England, Wales and Northern Ireland only	10.0 µg/m <sup>3</sup>	maximum daily running 8-hour mean	31.12.2003
Authorities in Scotland only	10.0 µg/m <sup>3</sup>	running 8-hour mean	31.12.2003
<b>Lead</b> All authorities	0.5 µg/m <sup>3</sup>	annual mean	31.12.2004
	0.25 µg/m <sup>3</sup>	annual mean	31.12.2008
<b>Nitrogen dioxide</b> <sup>a</sup> All authorities	200 µg/m <sup>3</sup> , not to be exceeded more than 18 times a year	hourly mean	31.12.2005
	40 µg/m <sup>3</sup>	annual mean	31.12.2005
<b>Particles (PM<sub>10</sub>) (gravimetric)</b> <sup>b</sup> All authorities	50 µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	24 hour mean	31.12.2004
	40 µg/m <sup>3</sup>	annual mean	31.12.2004
Authorities in Scotland only <sup>c</sup>	50 µg/m <sup>3</sup> not to be exceeded more than 7 times a year	24 hour mean	31.12.2010
	18 µg/m <sup>3</sup>	annual mean	31.12.2010
<b>Sulphur dioxide</b> All authorities	350 µg/m <sup>3</sup> not to be exceeded more than 24 times a year	1 hour mean	31.12.2004
	125 µg/m <sup>3</sup> not to be exceeded more than 3 times a year	24 hour mean	31.12.2004
	266 µg/m <sup>3</sup> not to be exceeded more than 35 times a year	15 minute mean	31.12.2005

<sup>a</sup> EU Limit values in respect of nitrogen dioxide to be achieved by 1st January 2010. There are, in addition, separate EU limit values for carbon monoxide, sulphur dioxide, lead and PM<sub>10</sub>, to be achieved by 2005, and benzene by 2010.

<sup>b</sup> Measured using the European gravimetric transfer sampler or equivalent.

<sup>c</sup> These 2010 air quality objectives for PM<sub>10</sub> apply in Scotland only, as set out in the Air Quality (Scotland) Amendment Regulations 2002.

## 2.3 Local Air Quality Management (LAQM) Review and Assessment

As established by the Environment Act 1995 Part IV, all local authorities in the UK are under a statutory duty to undertake an air quality assessment within their area and determine whether they are likely to meet the air quality objectives set down by Government for a number of pollutants. The process of review and assessment of air quality undertaken by local authorities is set out under the Local Air Quality Management (LAQM) regime and involves a phased three yearly assessment of local air quality. Where the results of the review and assessment process highlight that problems in the attainment of health-based objectives for air quality will arise, the authority is required to declare an Air Quality Management Area (AQMA) – a geographic area defined by high levels of pollution and exceedences of AQS objectives.

The LAQM regime was first set down in the 1997 National Air Quality Strategy (NAQS)<sup>5</sup> and introduced the idea of local authority 'Review and Assessment'. The Government subsequently published policy and technical guidance related to the review and assessment processes in 1998. This guidance has since been reviewed and the latest documents include Policy Guidance (LAQM.PG (09))<sup>6</sup> and Technical Guidance (LAQM.TG (09))<sup>7</sup>. The guidance lays down a progressive, but continuous, framework for the local authorities to carry out their statutory duties to monitor, assess and review air quality in their area and produce action plans to meet the air quality objectives.

Defra and the Devolved Administrations released the latest Policy and Technical Guidance in February 2009, in anticipation of the fourth round of review and assessment. The fourth round begins with the Updating and Screening Assessment, required to be completed by local authorities by the end of April 2009, and builds upon the Council's previous work in the first three rounds.

## 2.4 Summary of Review and Assessment in Dover

Dover District Council (DDC) undertook the first round of review and assessment between 1998 and 2001. The first round concluded that it was necessary to declare an Air Quality Management Area (AQMA) for sulphur dioxide due to shipping that incorporates Marine Parade, Athol Terrace, East Cliff and part of Langdon Cliffs and Jubilee Way. The AQMA came into force on 20<sup>th</sup> June 2002. All other air quality objectives were predicted to be met.

The Updating and Screening Assessment (USA) was the first phase of the second round which commenced in 2003. DDC completed this in July 2003, with the conclusion that a Detailed Assessment was required for nitrogen dioxide (NO<sub>2</sub>) and fine particulates (PM<sub>10</sub>) due to emissions from road traffic at the junctions of Townwall Street/Woolcomber Street and High Street/Ladywell. All other Air Quality Objectives were expected to be met.

The Detailed Assessment (2004) and subsequent Addendum Report considered the nitrogen dioxide (NO<sub>2</sub>) annual mean objective at the two locations identified in the USA, through dispersion modelling using ADMS-Roads and additional monitoring undertaken at relevant receptor locations. The results showed that there were predicted exceedences of the NO<sub>2</sub> annual mean objective identified at the nearest receptors to the A20 Townwall Street/Woolcomber Street junction. DDC declared this area an AQMA in October 2004.

The Annual Progress Report (APR) for 2005 considered monitoring data for 2004, and concluded that there were no exceedences of air quality objectives outside the designated AQMA areas, except

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<sup>5</sup> DoE, 1997, 'The United Kingdom National Air Quality Strategy', The Stationery Office

<sup>6</sup> Policy Guidance LAQM.PG(09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

<sup>7</sup> Technical Guidance LAQM.TG (09) (2009), Part IV of the Environment Act 1995, Local Air Quality Management, Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland, The Stationery Office

for NO<sub>2</sub> annual mean at kerbside sites at the High Street/Ladywell Junction and PM<sub>10</sub> 24-hour mean Objective at the roadside site at the A20 Townwall

Street/Woolcomber Street Junction. It was recommended that NO<sub>2</sub> monitoring be undertaken at a relevant receptor location at the High Street/Ladywell Junction to demonstrate compliance with the objective.

The third round of review and assessment, following the same stages as the second round, began with the USA. DDC completed this in June 2006, with the conclusion that a Detailed Assessment was required for NO<sub>2</sub> due to emissions from road traffic on the A20 Limekiln Street, south of the York Street roundabout, and once again at the junction of High Street and Ladywell. The Detailed Assessment 2007 concluded that both areas assessed would exceed the annual mean NO<sub>2</sub> objective. In December 2007, DDC declared a new AQMA at the junction of High Street and Ladywell, in addition to extending the A20 AQMA to incorporate Limekiln Street.

A Detailed Assessment was also undertaken in 2007 for hourly and annual NO<sub>2</sub> at Dover Eastern Docks to assess the combined impact of shipping and traffic emissions. This concluded that although exceedences of the hourly and annual objective were predicted in the port area, the area of exceedence did not represent relevant exposure.

## 2.5 Scope and Methodology of the Further Assessment

The approach of the Further Assessment is to provide the Local Authority with an opportunity to supplement the information gathered in the previous LAQM reports and confirm whether the AQMA is still required or if it needs to be amended (increased or reduced).

The methodology is based on dispersion modelling and includes the following:

- Review of additional monitoring since the Detailed Assessment – including continuous monitoring and diffusion tubes,
- Assessment of reduction in pollutant concentrations that is required to meet the AQS objectives in the AQMAs,
- Source apportionment of pollutants including relevance of background contributions and different vehicle classification on the roads of concern.

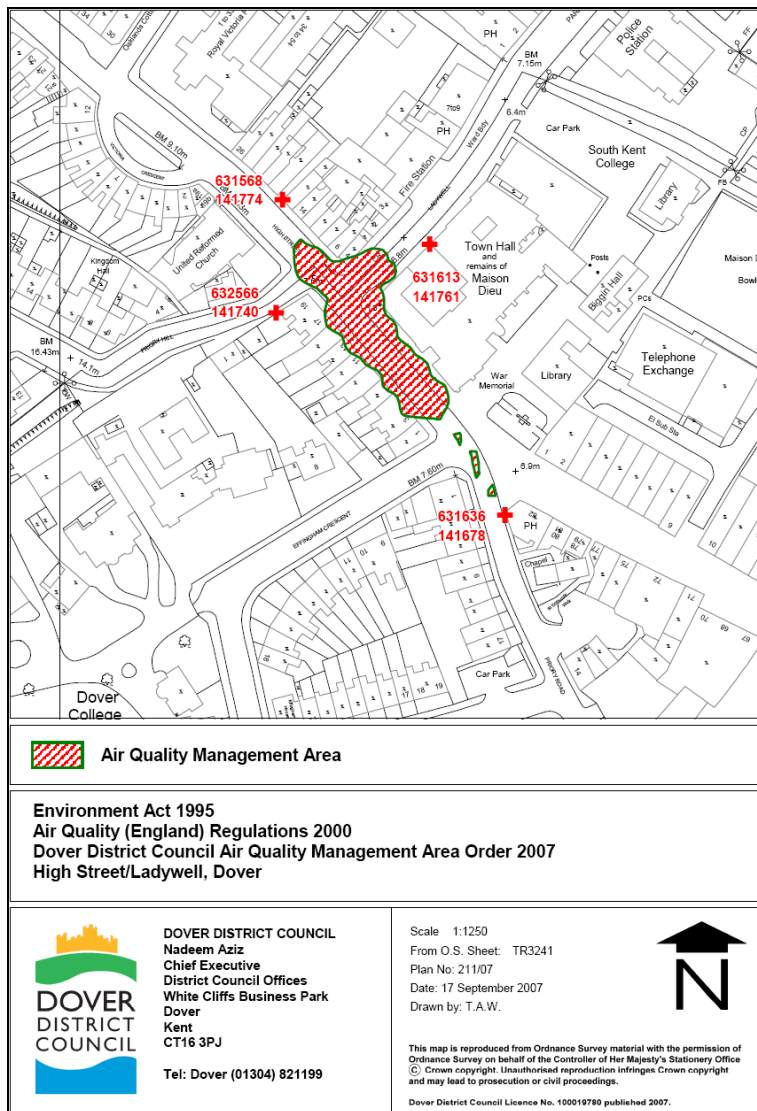
Detailed dispersion modelling was carried out as part of the Further Assessment based on the ADMS-Roads (v2.3) atmospheric dispersion model. Monitoring results from the Town Hall automatic analyser and nitrogen dioxide diffusion tubes installed in the assessment areas were used to verify the modelled results. NO<sub>x</sub> and NO<sub>2</sub> concentrations were predicted for the baseline (verification) year, 2008, and future year 2010. The dispersion modelling was undertaken in accordance with the methodologies provided in the Technical Guidance (LAQM.TG(09)) Guidance for Detailed and Further Assessments.

### 3 Baseline Information

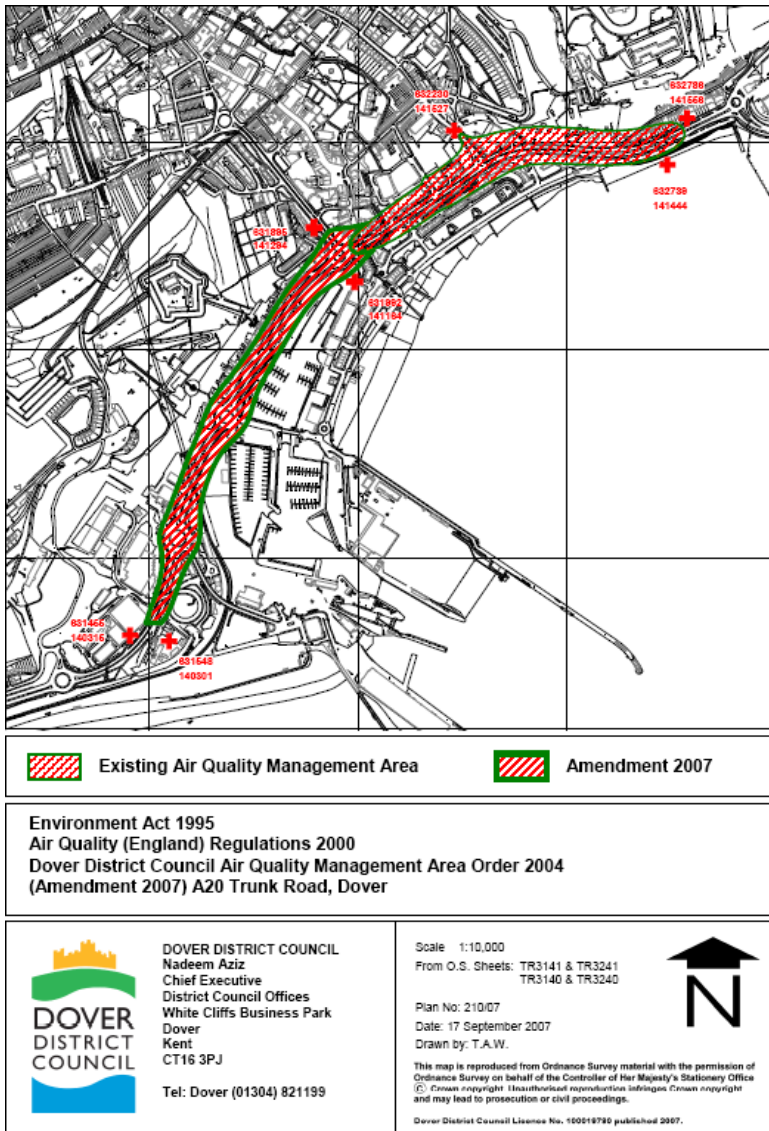
#### 3.1 Air Quality Management Areas (2007)

In December 2007, DDC declared an AQMA at the junction of High Street and Ladywell in Dover town centre for NO<sub>2</sub>, in an area encompassing roads and properties between the junction of Effingham Crescent/High Street, and Priory Hill/High Street. At the same time, DDC extended the A20 AQMA declared in 2004 to encompass an area following the A20 from just west of the Limekiln Roundabout at the western end to a point approximately 140m from the Eastern Docks in Dover. The designated AQMAs are shown in Figure 3.1 and 3.2.

**Figure 3.1 – High Street/Ladywell Air Quality Management Area**



**Figure 3.2 – A20 Trunk Road Air Quality Management Area 2004 (amended 2007)**



## 3.2 Traffic Data

Updated traffic counts for the roads in the AQMAs were provided by Kent County Council, via their consultants Jacobs, where available. Data included the annual average daily traffic (AADT) and breakdown of traffic flows into vehicle categories.

Traffic data were projected to 2007, 2008 and 2010 using growth factors from Tempro<sup>8</sup> and NRTF<sup>9</sup> (National Road Traffic Forecasts) adjusted for the Dover area.

In the absence of speed data, free flowing vehicle speed was assumed to be the speed limit. Speed was reduced near junctions to 20kph and along congested sections of the road by 10kph to account for stop/ start emissions. The traffic data used in this assessment are summarised in Appendix 1.

## 3.3 Air Quality Monitoring Data

### 3.3.1 Continuous Monitoring data

Dover District Council currently has a roadside site within the High Street/Ladywell AQMA in Dover town centre (grid reference x = 631645, y =141770) monitoring NO<sub>2</sub>, which was installed in May 1997. Within the A20 Trunk Road AQMA, at the junction of Townwall Street and Woolcomber Street (grid reference x=632277, y=141513), there is a roadside site which was installed in December 2000, but this monitors PM<sub>10</sub> only.

NO<sub>2</sub> concentrations are measured using a chemiluminescent analyser and PM<sub>10</sub> concentrations are monitored using a Tapered Element Oscillating Microbalance (TEOM). Kent and Medway Air Quality Monitoring Network (KMAQMN) managers, AEA ratify the data. The Quality Assurance/Quality Control (QA/QC) procedures for the KMAQMN are equivalent to the UK Automatic Urban and Rural Network (AURN) procedures. The manufacturer of the equipment, Enviro Technology Services plc, services the station on a six monthly routine basis. It should be noted that the network managers have subjected the 2008 data to preliminary ratification, and there may be a slight change once final ratification has been completed.

The results from the NO<sub>2</sub> continuous monitoring in the High Street/Ladywell AQMA, relevant to this assessment, for the period 1997 – 2008 are shown in Table 3.1. This site was used for model verification.

**Table 3.1: Dover NO<sub>2</sub> continuous analyser concentrations (µg/m<sup>3</sup>) in 1997 - 2008**

Location	Description	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dover Old Town Hall Roadside (AQMA)	Annual Mean NO <sub>2</sub> > 40 µg/m <sup>3</sup>	<b>52</b>	<b>50</b>	<b>49</b>	<b>42</b>	39	<b>41</b>	<b>44</b>	40	40	40	38	40
	NO <sub>2</sub> Hourly Mean > 200 µg/m <sup>3</sup> for more than 18 times per year	0	1	5	1	0	0	0	1	0	3	0	0
	% Data Capture	(57)	98	92	94	95	97	(73)	99	99	99	99	99

\*NB data for 2008 has yet to undergo final ratification. Exceedences are highlighted in bold. Data capture below the recommended 90% is shown in brackets.

<sup>8</sup> Tempro (Trip End Model Presentation Program) version 6.0, Department for Transport

<sup>9</sup> DETR, National Road Traffic Forecasts (Great Britain) 1997

### 3.3.2 Nitrogen Dioxide Diffusion Tube data

In addition to the continuous monitoring network, Dover District Council operates 16 NO<sub>2</sub> diffusion tubes sites within the District. The tubes are prepared and analysed by Harwell Scientific using the 50% TEA in acetone method. The laboratory method is currently UKAS accredited.

To take account of the bias in the diffusion tubes analysed by Harwell Scientific, an assessment has been made of data from the NO<sub>2</sub> continuous analyser at Dover Town Hall, on the junction of High Street and Ladywell (AQMA) which has co-located triplicate diffusion tubes and 12 months of data capture. The diffusion tube results tend to over read the continuous analysers, with a bias adjustment factor of 0.85 for 2007 0.86 for 2008. The methodology outlined in the Technical Guidance LAQM.TG (09) has been used in the calculation of the bias adjustment factor. This calculation is shown in Appendix 2. Table 3.1 shows bias corrected diffusion tube results for Dover. Results have been taken from the previous review and assessment reports to put the most recent year's results into context and consider trends over time. Of the 16 sites in the Table, 11 are within the declared AQMAs and are showing exceedences of the annual mean NO<sub>2</sub> objective. The Townwall 1 kerbside site near the junction of A20 Townwall Street and Woolcomber Street is indicating continued high levels at this location. This site is within the A20 Townwall Street AQMA and is located where there is significant queuing of traffic, but no relevant exposure. The Bench Street site where exceedences have also been predicted is on the outer edge of the declared A20 Trunk Road AQMA – there is potential relevant exposure at 1<sup>st</sup> floor locations in Bench Street. The Council should consider amending the boundary of the A20 Trunk Road AQMA to incorporate this area of exceedence (and relevant exposure) in Bench Street.

**Table 3.1 - Diffusion Tube Results in Dover**



Code	Location	x	y	Site Type	AQMA?	Location used for verification	2001	2002	2003	2004	2005	2006	2007	2008	Data capture 2008 (No. months)
							Bias= 0.92	Bias= 0.84	Bias= 0.92	Bias= 1.03	Bias= 0.86	Bias= 0.798	Bias= 0.847	Bias= 0.86	
<b>DV01</b>	High Street Dover Site 6	631376	141949	R	No	No	<b>42.3</b>	36.8	<b>48.7</b>	<b>44.8</b>	37.5	38.9	36.5	36.1	11
<b>DV04</b>	Green Lane Dover Site 8	630905	143362	B	No	No	22.7	21.8	28.6	18.9	22.6	20.4	22.2	23.0	10
<b>DV05</b>	Bench Street Dover	631997	141296	I	No	No	<b>45.5</b>	38.9	<b>48.4</b>	36.8	36.9	<b>40.6</b>	<b>42.2</b>	<b>41.1</b>	11
<b>DV06/07/08</b>	Town Hall Dover ZD1 (triplicate)	631597	141748	R	Yes - HL	Yes	<b>48.3</b>	<b>49.6</b>	<b>64.4</b>	<b>43.9</b>	38.0	<b>40.6</b>	39.0	<b>40.5</b>	11
<b>DV10</b>	Townwall Street Dover ZD2	632302	141465	R	Yes – A20	Yes	<b>56.6</b>	<b>51.8</b>	<b>58.9</b>	<b>49.8</b>	<b>56.3</b>	<b>51.0</b>	<b>52.9</b>	<b>55.0</b>	12
<b>DV11/16/17</b>	The Gateway (triplicate)	632318	141422	F	Yes – A20	Yes	-	-	<b>44.6</b>	39.9	35.4	<b>42.3</b>	<b>43.4</b>	<b>44.0</b>	11
<b>DV12/18/19</b>	St Martins (triplicate)	631577	140468	F	Yes – A20	Yes	-	-	-	-	<b>45.0</b>	<b>49.5</b>	<b>49.1</b>	<b>50.1</b>	12
<b>DV13</b>	Town Hall 2	631579	141760	R	Yes - HL	Yes	-	-	-	<b>47.4</b>	<b>47.4</b>	<b>48.4</b>	<b>52.3</b>	<b>55.4</b>	9
<b>DV14</b>	Town Hall 3	631587	141736	R	Yes - HL	Yes	-	-	-	<b>53.6</b>	<b>51.7</b>	<b>50.5</b>	<b>53.0</b>	<b>51.8</b>	12
<b>DV15</b>	Townwall 1	632248	141422	K	Yes – A20	Yes	-	-	-	<b>55.5</b>	<b>73.2</b>	<b>70.4</b>	<b>88.7</b>	<b>79.4</b>	12
<b>DV20/21/22</b>	Town Hall A (triplicate)	631597	141748	F	Yes - HL	Yes	-	-	-	-	-	<b>51.0</b>	<b>53.4</b>	<b>58.5</b>	12
<b>DV23</b>	Snargate A	631727	140966	F	Yes – A20	Yes	-	-	-	-	-	-	-	<b>59.0</b>	10
<b>DV24</b>	Snargate B	631802	141079	F	Yes – A20	Yes	-	-	-	-	-	-	-	<b>55.5</b>	12
<b>DV25</b>	Snargate C	631854	141164	F	Yes – A20	Yes	-	-	-	-	-	-	-	<b>54.0</b>	12
<b>DV26</b>	1 King Lea	630902	140095	R	No	No	-	-	-	-	-	-	-	24.7*	3*
<b>DV27</b>	Castle Comm School	636984	151752	R	No	No	-	-	-	-	-	-	-	22.7*	2*

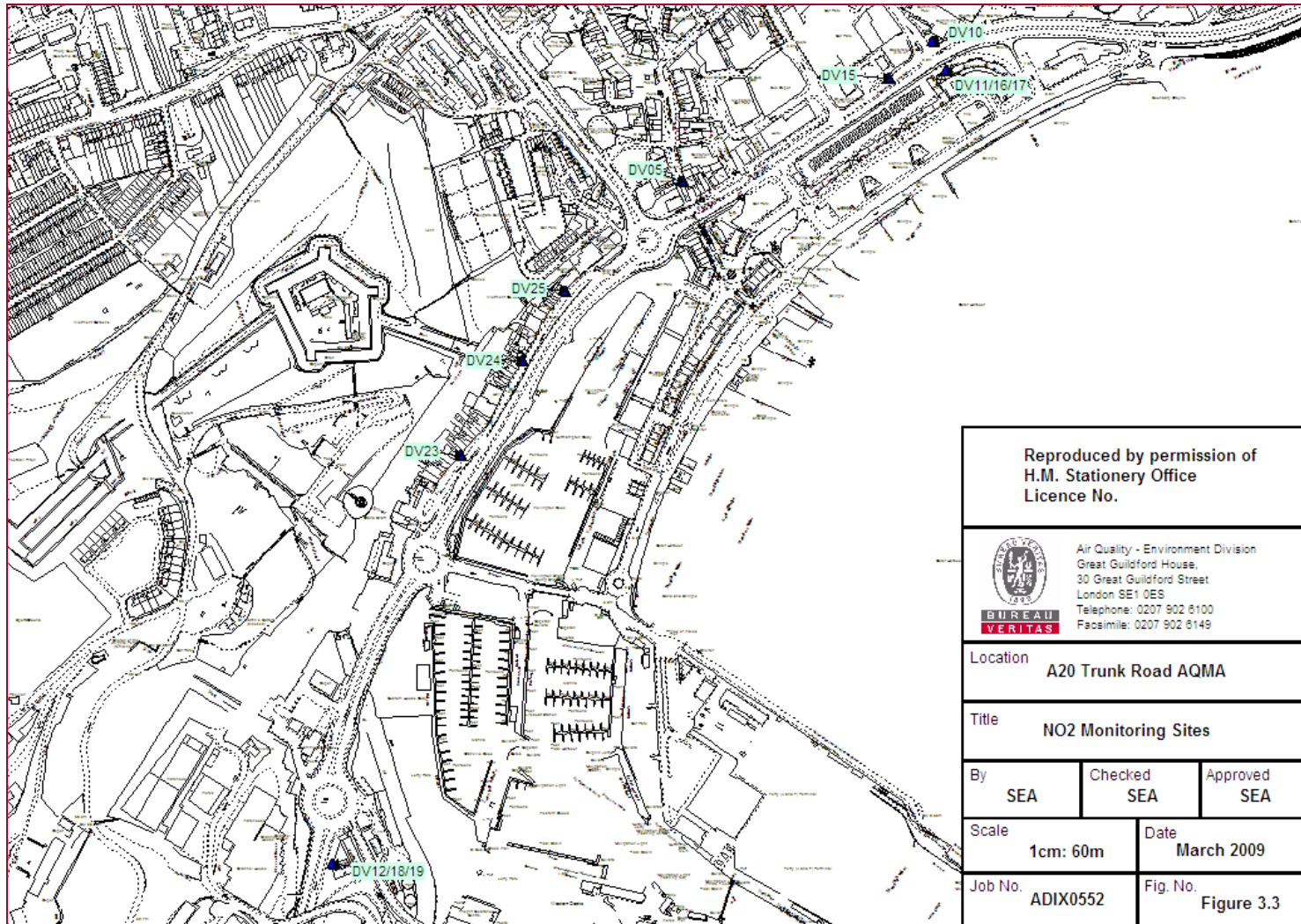
\* Annualised results based on Kent and Medway Air Quality Monitoring Network background sites with >90% data capture

In bold, exceedence of the NO<sub>2</sub> annual mean AQS objective (40 µg/m<sup>3</sup>)

B=Background, R= Roadside, k=Kerbside, I=Intermediate, F=façade, HL=High Street/Ladywell AQMA, A20 – A20 Trunk Road AQMA.



Figure 3.3 – Dover Monitoring Sites A20 Trunk Road AQMA





### 3.3.3 Background Concentrations

Local monitoring data and LAQM.TG (09) updated background maps were considered to determine appropriate background for this assessment. NO<sub>2</sub> concentrations from the background maps for year 2007 are approximately 16 - 20µg/m<sup>3</sup> within the Dover urban area. However, this is likely to be under estimated, as the NO<sub>2</sub> annual mean at the nearest continuous monitoring background site in the Kent and Medway Monitoring Network (Folkestone suburban) was 24µg/m<sup>3</sup> in 2007. Similarly, the background nitrogen diffusion tube site in Dover concentration was 22µg/m<sup>3</sup> in 2007. To avoid underestimations in background, the results from the nearest continuous monitoring site were therefore used in the model assessment to derive background NO<sub>2</sub> and NO<sub>x</sub>. Background NO<sub>x</sub> and NO<sub>2</sub> concentrations for future years were derived from the projection factors from the background maps provided through the Air Quality Archive website<sup>10</sup>

**Table 3.2 - Background Concentrations for Dover (µg/m<sup>3</sup>)**

Pollutant	2007 Background (µg/m <sup>3</sup> )	2008 Background (µg/m <sup>3</sup> )	2010 Background (µg/m <sup>3</sup> )
NO <sub>x</sub>	37	34	32
NO <sub>2</sub>	24	23	22

<sup>10</sup> <http://www.airquality.co.uk/archive/index.php>

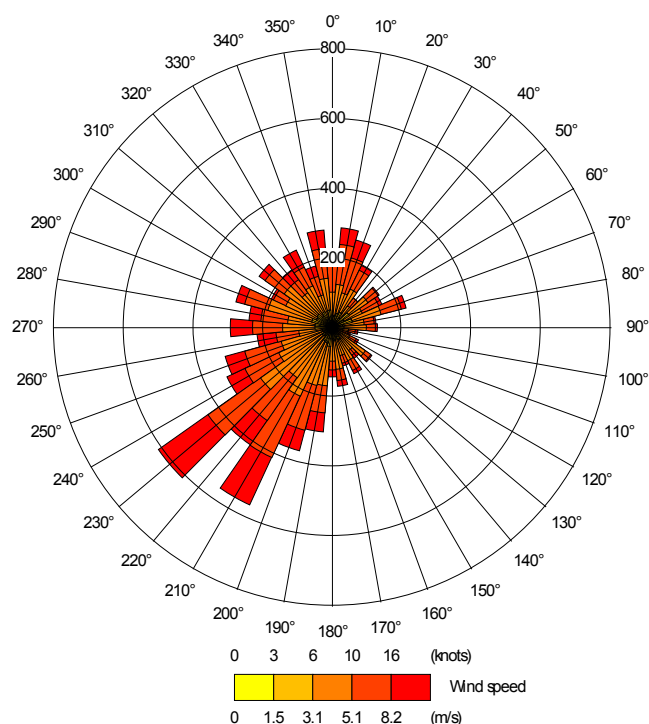
## 4 Dispersion Modelling Methodology

Detailed dispersion modelling of  $\text{NO}_x$  was undertaken based on ADMS-Roads (version 2.3) atmospheric dispersion model from Cambridge Environmental Research Consultants (CERC). Conversion to  $\text{NO}_2$  was based on the updated  $\text{NO}_x/\text{NO}_2$  conversion model released by Defra in February 2009 as part of LAQM.TG(09) tools.

ADMS-Roads is an advanced Gaussian dispersion model, which has been extensively used in local air quality management and has formed the basis for many AQMA declarations. A number of validation studies have been completed, showing overall good agreement between model outputs and observations at continuous monitoring sites. The street canyon option was activated for sections of High Street and Ladywell where properties on both side are close to the road.

Dispersal of pollutant emissions is dependent (amongst other factors like topography and street canyon effects) upon the prevailing meteorological conditions at the time of emissions release. Hourly sequential meteorological data from the closest Met Office station (Manston) was used in this assessment, based on year 2007. The wind rose for meteorological data is shown in Figure 4.2.

**Figure 4.2 – Manston 2007 Hourly Sequential Meteorological Data**



## 5 Results

### 5.1 Model Verification and adjustment

Model verification at specific locations was carried out prior to predicting concentrations within the AQMA through contour mapping. The objectives of the model verification are:

- to evaluate model performance,
- to show that the baseline is well established, and
- to provide confidence in the assessment

Comparison of the modelled and monitored results was carried out based on local NO<sub>2</sub> monitoring data from roadside automatic analyser and diffusion tubes in Dover. Predicted NO<sub>2</sub> was derived based on the latest NO<sub>x</sub>/NO<sub>2</sub> conversion model released by Defra in February 2009<sup>11</sup>.

During the verification process, Bureau Veritas aim to ascertain whether all final modelled NO<sub>2</sub> concentrations are within 25% of the monitored NO<sub>2</sub> concentrations. Modelled results may not compare as well at some locations for a number of reasons including:

- Errors in traffic flow and speed data estimates,
- Model setup (including street canyons, road widths, receptor locations),
- Model limitations (treatment of roughness and meteorological data),
- Uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors and annualisation of short-term data).

The above factors were all investigated as part of the model verification process to minimise the uncertainties as far as practicable. Street canyon width was adjusted to make sure that the diffusion tubes at façade of properties were effectively within street canyons.

The model verification results are provided in Table 5.1.

Overall, predicted concentrations are in reasonably good agreement with monitoring data, as all adjusted modelled NO<sub>2</sub> results are within ±25% of monitored concentrations, except Snargate Street A. Six out of ten sites are within ±10%. The continuous monitoring site and triplicate diffusion tube sites show the closest agreement (all within ±10%). The model correctly predicts an exceedence of the objective at all the sites located within the AQMA.

The full verification methodology is shown in Appendix 3.

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<sup>11</sup> <http://www.airquality.co.uk/archive/laqm/tools.php>

**Table 5.1 – Model verification results at monitoring sites in Dover**

Site	Within AQMA (yes/no)	Monitored NO <sub>2</sub> 2007 (µg/m <sup>3</sup> )	Predicted Total NO <sub>2</sub> 2007(µg/m <sup>3</sup> )	Difference predicted / monitored 2007 (µg/m <sup>3</sup> )	Difference predicted / monitored 2007 (%)
Town Hall ZD1 (Continuous analyser)	Yes -HL	38.0	<b>41.2</b>	3.2	8.5
Town Hall 2 (DT)	Yes -HL	<b>52.0</b>	<b>41.8</b>	-10.2	-19.6
Town Hall 3 (DT)	Yes -HL	<b>53.0</b>	<b>51.2</b>	-1.8	-3.4
Town Hall A (Triplicate DT)	Yes -HL	<b>53.0</b>	<b>49.1</b>	-3.9	-7.3
Townwall St ZD2 (DT)	Yes -A20	<b>53.0</b>	<b>50.4</b>	-2.6	-4.9
The Gateway (Triplicate DT)	Yes -A20	<b>43.0</b>	<b>45.6</b>	2.6	6.1
St Martins (Triplicate DT)	Yes -A20	<b>49.0</b>	<b>53.5</b>	4.5	9.1
Snargate St A (DT)*	Yes -A20	<b>57.5</b>	<b>42.5</b>	-15.0	-26.0
Snargate St B (DT)*	Yes -A20	<b>53.6</b>	<b>46.3</b>	-7.4	-13.7
Snargate St C (DT)*	Yes -A20	<b>52.2</b>	<b>44.0</b>	-8.2	-15.7
Summary					
Number of sites	Within ±10%			6	
	Between ± 10-25%			3	
	Exceeds ±25%			1	
	Total			10	
In bold: exceedence of NO <sub>2</sub> annual mean AQS objective HL=High Street/Ladywell AQMA, A20=A20 Trunk Road AQMA * New DT sites in 2008 – data has been projected to 2007 to include in verification.					

## 5.2 Modelled NO<sub>2</sub> concentrations

Annual average NO<sub>2</sub> concentrations were predicted for the baseline year 2007, 2008 and 2010 at a number of specific receptors representing relevant public exposure, located at the facade of properties. Additionally, predictions were made to a 5m-grid spacing across the assessment areas to produce NO<sub>2</sub> concentration contour maps for year 2008. Contour results were predicted at 1.5m from the ground, while specific receptors were adjusted to location of relevant exposure.

Appendix 4 summarises predicted NO<sub>2</sub> results for years 2007, 2008 and 2010 at specific receptor locations in the AQMA. NO<sub>2</sub> concentration contours for year 2008 are also illustrated in Appendix 5.

The model predicted exceedences of the AQS objective in 2007 and 2008 at most receptors relevant of public exposure (facade of properties), within the AQMAs. Concentrations are not predicted to exceed the objective at receptors outside the AQMA, although results at a few receptors are close to 40µg/m<sup>3</sup>, notably in Bench Street. Comparison with monitoring results in Bench Street shows that the model under predicts concentrations in this area. Therefore, there is a risk that exceedences occur outside the A20 Trunk Road AQMA in Bench Street as suggested by the latest monitoring data, and it is recommended that the A20 Trunk Road AQMA be extended. The extension should encompass properties along Bench Street.

Predicted results for year 2010 show a slight decrease at most of the receptors. This is due to predicted decrease in background pollution and road emissions that compensate expected traffic growth. Nevertheless, the objective is still likely to be exceeded by this date at several locations within the AQMAs. Also, monitoring data does not suggest that this predicted drop off is occurring in these AQMAs. It is likely that widespread exceedences will continue to occur in the AQMAs beyond 2010. Using roadside nitrogen dioxide projection factors from the Technical Guidance TG(09), it is predicted that the annual mean objective would be met at all locations by 2015.

## 5.3 Source Apportionment

The breakdown of vehicle classification was taken into account in the model set-up. This allowed determining NO<sub>x</sub> source apportionment at specific (worst case) receptors in the AQMAs. The source apportionment was carried out for the following vehicle classes: Light duty vehicles (LDVs) and Heavy duty vehicles (HDVs). To enable source apportionment of the background contribution, the modelled maps from the air quality archive have been utilised, as these incorporate a break down of background concentrations of NO<sub>x</sub> by source. Proportions of each background source category have been used to categorise the total background NO<sub>x</sub> and NO<sub>2</sub> in the assessment areas. The 1 x 1km grid squares relevant to the AQMAs were x=631500, y=141500 for the High Street/Ladywell AQMA and x=632500, y=141500 and x=631500, y=140500 for the A20 Trunk Road AQMA. In the latter case, the grid squares were averaged.

Table 5.2 and Table 5.3 summarises the results at (worst case) receptors representing public exposure in the AQMAs. The source apportionment indicates that:

- Heavy duty vehicles (HDVs) are the main contributors, as they account for 31 - 63% of the total NO<sub>x</sub> concentrations at receptors. In particular, in the A20 Trunk Road AQMA the HDV emissions are contributing significantly to exceedences of the AQS objectives.
- Light duty vehicles (LDVs) contribute around 8 - 31% to the total NO<sub>x</sub> concentrations at receptors
- Road traffic overall contribute 62% to 71% of the total NO<sub>x</sub> concentration at receptors
- Background concentrations account for 28% to 39% of the total NO<sub>x</sub> concentration at receptors, with approximately 15% due to regional background concentrations outside the local authority's influence.

The contribution of HDVs to the total NO<sub>x</sub> concentrations is quite significant especially if compared to the proportion of the vehicle fleet they represent (4% High Street; 12-14% A20 Townwall Street; 23% A20 Archcliffe Road).

**Table 5.2 - Source apportionment of NO<sub>x</sub> concentrations at specific receptors**

AQMA	High Street/ Ladywell	A20 Trunk Road	
	15 High Street x=631585, y=141735	St Martins x=631573, y=140471	Gateway x=632296, y=141420
<b>Receptor (Maximum modelled concentration)</b>			
<b>Total NO<sub>x</sub> 2008 µg/m<sup>3</sup> (Total Background + Local Road Source)</b>	89.6	117.4	104.2
<b>NO<sub>x</sub> Total Background (Local + Regional)</b>	33.8	33.8	33.8
<b>NO<sub>x</sub> Local Background</b>	18.6	18.4	18.4
▪ <i>Includes: Road sources</i>	8.6	8.7	8.7
▪ <i>Industry (combustion in industry, energy production, extraction of fossil fuel, and waste)</i>	0.4	0.4	0.4
▪ <i>Domestic</i>	4.0	1.7	1.7
▪ <i>Aircraft</i>	0.0	0.0	0.0
▪ <i>Rail</i>	0.0	0.0	0.0
▪ <i>Other (ships, offroad and other emissions)</i>	5.5	7.6	7.6
▪ <i>Point sources</i>	0.1	0.1	0.1
<b>NO<sub>x</sub> Regional Background</b>	15.2	15.4	15.4
<b>Local Road Source Contributions (LDV + HDV)</b>	55.8	83.6	70.4
▪ <b>NO<sub>x</sub> LDV</b>	27.6	9.6	13.8
▪ <b>NO<sub>x</sub> HDV</b>	28.1	74.0	56.6
<b>% Local background</b>	20.8	15.7	17.7
<b>% Regional background</b>	17.0	13.1	14.7
<b>% Road traffic</b>	62.3	71.2	67.6
▪ <b>% due to LDV traffic</b>	30.9	8.2	13.3
▪ <b>% due to HDV traffic</b>	31.4	63.0	54.3
▪ <b>% LDV contribution of total road traffic</b>	49.6	11.5	19.7
▪ <b>% HDV contribution of total road traffic</b>	50.4	88.5	80.3

**Table 5.3 - Source apportionment of NO<sub>2</sub> concentrations at specific receptors**

AQMA	High Street/ Ladywell	A20 Trunk Road	
	15 High Street x=631585, y=141735	St Martins x=631573, y=140471	128 - 149 Gateway x=632296, y=141420
<b>Receptor (Maximum modelled concentration)</b>			
<b>Total NO<sub>2</sub> 2008 µg/m<sup>3</sup> (Total Background + Local Road Source Contributions)</b>	43.4	50.9	47.5
<b>NO<sub>2</sub> Total Background (Local + Regional)</b>	23.3	23.3	23.3
▪ <b>NO<sub>2</sub> Local Background</b>	12.8	12.7	12.7
▪ <b>NO<sub>2</sub> Regional Background</b>	10.4	10.6	10.6
<b>Local Road Source Contributions (LDV + HDV)</b>	20.2	27.7	24.3
▪ <b>NO<sub>2</sub> LDV</b>	10.0	3.2	4.8
▪ <b>NO<sub>2</sub> HDV</b>	10.2	24.5	19.5
<b>% Local background</b>	29.5	24.9	26.7
<b>% Regional background</b>	24.0	20.8	22.2
<b>% Road traffic</b>	46.5	54.3	51.1
▪ <b>% due to LDV traffic</b>	23.0	6.3	10.0
▪ <b>% due to HDV traffic</b>	23.4	48.1	41.0
▪ <b>% LDV contribution of total road traffic</b>	49.6	11.5	19.7
▪ <b>% HDV contribution of total road traffic</b>	50.4	88.5	80.3

## 5.4 NO<sub>x</sub> reduction

A requirement of the Further Assessment is to determine the amount of NO<sub>2</sub> reduction required at the worst-case receptors within an AQMA. This approach highlights the maximum reduction in NO<sub>2</sub> required (as NO<sub>x</sub>, in µg/m<sup>3</sup>) to comply with the AQS objective, and assumes that other receptors will require less of a reduction. For the current assessment, the approach to estimate the required NO<sub>2</sub> reduction was to determine the levels of NO<sub>x</sub> for the highest concentrations predicted at sensitive receptors relevant of public exposure. The results are shown in Table 5.4.

In order to determine the required reduction in NO<sub>x</sub>, the NO<sub>2</sub> annual mean AQS objective of 40µg/m<sup>3</sup> was calculated to be equivalent to a 78.4µg/m<sup>3</sup> NO<sub>x</sub> concentration (based on local background monitored NO<sub>x</sub> at and the latest NO<sub>x</sub>/NO<sub>2</sub> conversion model).

The maximum predicted NO<sub>x</sub> reduction required within the High Street/Ladywell AQMA to comply with the NO<sub>2</sub> AQS objective is 11.2µg/m<sup>3</sup> (equivalent to a 13% improvement in NO<sub>x</sub>). This equates to a 3.4µg/m<sup>3</sup> reduction in NO<sub>2</sub> (equivalent to 8% improvement in NO<sub>2</sub>).

The maximum predicted NO<sub>x</sub> reduction required within the A20 Trunk Road AQMA to comply with the NO<sub>2</sub> AQS objective is 39.0µg/m<sup>3</sup> (equivalent to a 33% improvement in NO<sub>x</sub>). This equates to a 10.9µg/m<sup>3</sup> reduction in NO<sub>2</sub> (equivalent to 21% improvement in NO<sub>2</sub>).

Consequently, the formulation of the Action Plan should aim to reduce the levels of NO<sub>x</sub> / NO<sub>2</sub> within the AQMAs by these amounts.

**Table 5.4 – Required NO<sub>x</sub> and NO<sub>2</sub> reduction**

AQMA	Year	Receptor location	Modelled NO <sub>x</sub> (µg/m <sup>3</sup> )	NO <sub>x</sub> (equivalent to 40µg/m <sup>3</sup> NO <sub>2</sub> ) µg/m <sup>3</sup>	Reduction NO <sub>x</sub> required (µg/m <sup>3</sup> )	% Reduction NO <sub>x</sub>	Modelled NO <sub>2</sub> (µg/m <sup>3</sup> )	NO <sub>2</sub> AQS objective (µg/m <sup>3</sup> )	Reduction NO <sub>2</sub> required (µg/m <sup>3</sup> )	% Reduction NO <sub>2</sub>
High Street/ Ladywell	2008	15 High Street X=631585, y=141735	89.6	78.4	11.2	12.5	43.4	40	3.4	7.9
A20 Trunk Road	2008	St Martins X=631573 Y=140471	117.4		39.0	33.2	50.9		10.9	21.4
	2008	128 - 149 Gateway X= 632296 Y=141420	104.2		25.8	24.8	47.5		7.5	15.9

## 6 Conclusions and Recommendations

As part of the Local Air Quality Management (LAQM) regime, a Further Assessment based on detailed dispersion modelling was carried out for the High Street/Ladywell and A20 Trunk Road Air Quality Management Areas (AQMA) in Dover. The AQMAs were declared for nitrogen dioxide (NO<sub>2</sub>) in December 2007 due to exceedences of the NO<sub>2</sub> annual mean Air Quality Strategy objective.

The Further Assessment is required as part of the Review and Assessment of air quality for local authorities that have declared or amended an AQMA, with the objective to supplement information gathered in the previous assessments.

This assessment was based on advanced atmospheric dispersion modelling of NO<sub>2</sub> traffic emissions, relying on updated background pollutant concentrations, monitoring, traffic and meteorological data for the year 2007.

Source apportionment of pollutant contribution was carried out to determine contributions of vehicle emissions and other sources to NO<sub>x</sub>/NO<sub>2</sub> concentrations in the AQMAs. The NO<sub>x</sub> reduction to comply with the NO<sub>2</sub> annual mean AQS objective was calculated based on the highest concentration results at sensitive receptors relevant of public exposure (facades of properties).

The findings of this report are the following:

- Updated monitoring and modelled results confirm that the High Street/Ladywell and A20 Trunk Road AQMAs are still required in Dover, as the AQS objective is still likely to be exceeded at relevant receptor locations.
- Updated monitoring and modelled results suggest that there is a risk of exceedences of the annual mean objective outside of the A20 Trunk Road AQMA in Bench Street where there are a small number of residential properties at 1<sup>st</sup> floor locations. It is recommended that the A20 Trunk Road AQMA be extended to incorporate the area of public exposure in Bench Street. Modelled contour results also indicate slight boundary changes to other parts of the A20 AQMA and these changes will also be incorporated when amending the AQMA.
- The source apportionment shows that, while background pollution levels contribute significantly, road traffic is the main contributors of the overall NO<sub>x</sub> levels in the AQMAs. Of the road traffic emissions, in the A20 Trunk Road AQMA in particular, heavy-duty vehicles are clearly the most significant contributors.
- The maximum predicted NO<sub>x</sub> reduction required within the A20 Trunk Road AQMA to comply with the NO<sub>2</sub> AQS objective is 39.0µg/m<sup>3</sup> (equivalent to a 33% improvement in NO<sub>x</sub>). This equates to a 10.9µg/m<sup>3</sup> reduction in NO<sub>2</sub> (equivalent to 21% improvement in NO<sub>2</sub>). Consequently, measures formulated in the Local Action Plan should aim to reduce the levels of NO<sub>x</sub> / NO<sub>2</sub> within the AQMA by these amounts.
- The maximum reduction in NO<sub>x</sub> concentrations required to comply with the AQS objectives in the High Street/Ladywell AQMA is about 11µg/m<sup>3</sup> (equivalent to a 12.5% reduction in NO<sub>x</sub> levels). This equates to about 3µg/m<sup>3</sup> reduction in NO<sub>2</sub> (8% reduction). Consequently, measures formulated in the Local Action Plan should aim to reduce the levels of NO<sub>x</sub> / NO<sub>2</sub> within the AQMA by these amounts.
- Predicted model results for the year 2010 indicate the annual mean objective is still likely to be exceeded at several locations within the AQMAs. Monitoring data suggests that the predicted drop off rate is not occurring in these AQMAs and therefore it is likely that exceedences will still be widespread in 2010 and the EU Limit Value will not be achieved by this date. Using roadside nitrogen dioxide projection factors from the Technical Guidance LAQM.TG(09), it is predicted that the annual mean objective would be met at all locations by 2015.

## Appendix 1 – Traffic Data

**Table A1-1 – Dover traffic data**

Road No.	Road Name	X	Y	Year	%HDV	AADT 2007	AADT 2008	AADT 2010
A20	Townwall Street	632500	141480	2007	13.6	22983	23011	23073
A256	York Street	631800	141420	2007	3.4	14684	14702	14741
A256	Woolcomber Street	632260	141500	2007	3.8	6217	6224	6241
A20	Townwall Street	632230	141400	2007	11.7	25525	25556	25625
A20	The Viaduct	631670	140400	2007	24.7	2482	2485	2492
A20	Limekiln Street	631750	140950	2007	10.9	21323	21349	21406
A20	Archcliffe Road	631500	140330	2007	22.5	29479	29514	29594
A256	London Road	631330	142000	2007	3.6	13041	13057	13092
u/c	Russell Street*	632197	141370	2001	8.9	1364	1366	1369
u/c	Ladywell*	631642	141814	2003	5	6220	6228	6245
u/c	Priory Hill*	631577	141753	2003	5	5194	5200	5214

\* New counts were unavailable for these road links. Data was taken from previous Detailed Assessment undertaken.

## Appendix 2 – Bias Adjustment Calculation

**Table A2-1 – Bias Adjustment Calculation (2007)**

Dover Town Hall Roadside Site	
Bias factor A	0.85 (0.79 - 0.91)
Bias B	18% (10% - 26%)
Diffusion Tubes Mean:	46 $\mu\text{gm}^{-3}$
Mean CV (Precision):	6
Automatic Mean:	39 $\mu\text{gm}^{-3}$
Data Capture for periods used:	99%
Adjusted Tubes Mean:	39 (36 - 42) $\mu\text{gm}^{-3}$

**Table A2-2 – Bias Adjustment Calculation (2008)**

Dover Town Hall Roadside Site	
Bias factor A	0.86 (0.82 - 0.91)
Bias B	16% (10% - 21%)
Diffusion Tubes Mean:	47 $\mu\text{gm}^{-3}$
Mean CV (Precision):	4
Automatic Mean:	41 $\mu\text{gm}^{-3}$
Data Capture for periods used:	97%
Adjusted Tubes Mean:	41 (39 - 43) $\mu\text{gm}^{-3}$

## Appendix 3 – Model Verification

Table A3-1 – Model verification – A20 Trunk Road AQMA

Site	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Ratio of Monitored Road NO <sub>x</sub> /Modelled Road NO <sub>x</sub>	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Adjusted Modelled Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Total NO <sub>2</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>2</sub> (µg/m <sup>3</sup> )	% Difference NO <sub>2</sub> [(Modelled - Monitored)/ Monitored]
Townwall Street ZD2	24	37	113.8	76.8	29.3	2.6	2.69	79.0	116.0	50.4	53.0	-4.9
The Gateway			75.7	38.7	22.6	1.7		60.9	97.9	45.6	43.0	6.1
St Martins			97.5	60.5	34.1	1.8		91.8	128.8	53.5	49.0	9.1
Snargate Street A			134.0	97.0	18.6	5.2		50.1	87.1	42.5	57.5	-26.0
Snargate Street B			116.5	79.5	23.4	3.4		63.1	100.1	46.3	53.6	-13.7
Snargate Street C			110.6	73.6	20.5	3.6		55.2	92.2	44.0	52.2	-15.7

Table A3-2 – Model verification – High Street/Ladywell AQMA

Site	Background NO <sub>2</sub> (µg/m <sup>3</sup> )	Background NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Monitored Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Ratio of Monitored Road NO <sub>x</sub> /Modelled Road NO <sub>x</sub>	Adjustment Factor (Regression) for Modelled Road Contribution	Adjusted Modelled Road Contribution NO <sub>x</sub> (µg/m <sup>3</sup> )	Adjusted Modelled Total NO <sub>x</sub> (µg/m <sup>3</sup> )	Modelled Total NO <sub>2</sub> (µg/m <sup>3</sup> )	Monitored Total NO <sub>2</sub> (µg/m <sup>3</sup> )	% Difference NO <sub>2</sub> [(Modelled - Monitored)/ Monitored]
Town Hall Continuous monitor ZD1	24	37	83.0	46.0	13.8	3.33	3.3*	46.0	83.0	41.2	38.0	8.5
Town Hall 2			109.6	72.6	14.3	5.06		47.8	84.8	41.8	52.0	-19.6
Town Hall 3			113.8	76.8	24.7	3.11		82.3	119.3	51.2	53.0	-3.4
Town Hall A			113.8	76.8	22.2	3.46		73.9	110.9	49.1	53.0	-7.3

\* Continuous roadside monitor at the Town Hall used for model verification of the High Street/Ladywell AQMA.

## Appendix 4 – Modelled Specific Receptor Results A20 Trunk Road AQMA

Figure A4-1a –A20 Trunk Road AQMA 2007

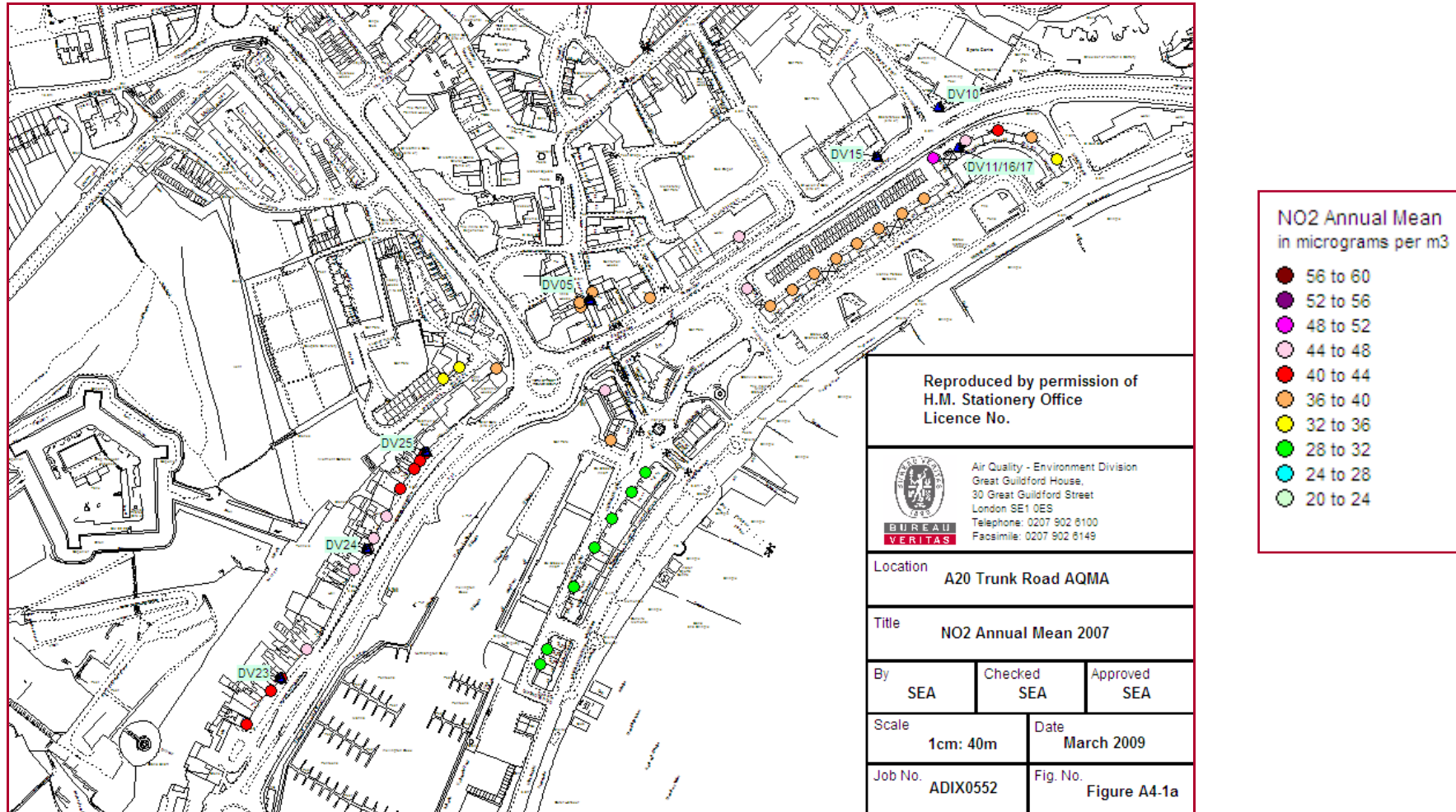
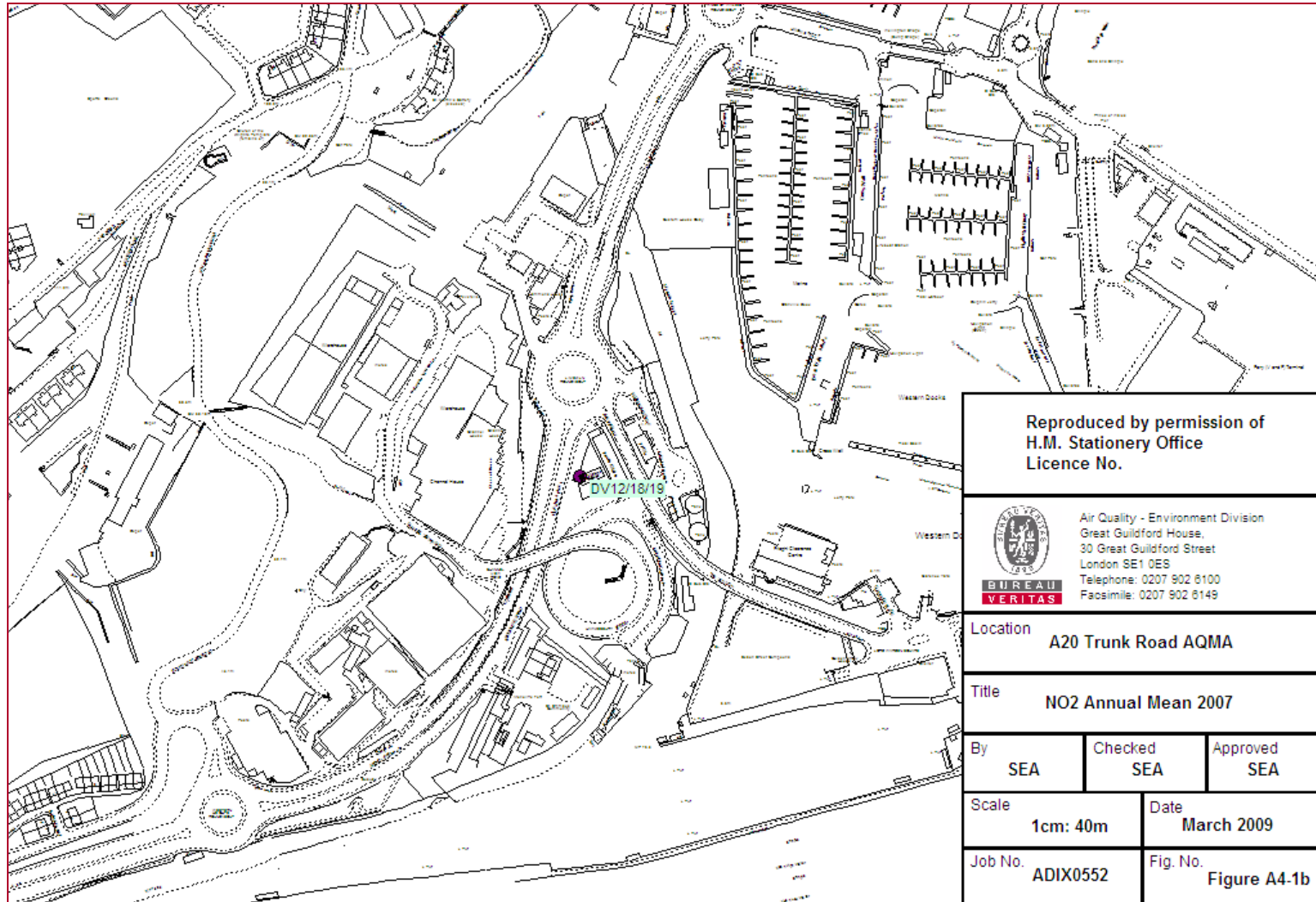


Figure A4-1b –A20 Trunk Road AQMA 2007



**NO2 Annual Mean**  
 in micrograms per m3

- 56 to 60
- 52 to 56
- 48 to 52
- 44 to 48
- 40 to 44
- 36 to 40
- 32 to 36
- 28 to 32
- 24 to 28
- 20 to 24


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 Air Quality - Environment Division Great Guildford House, 30 Great Guildford Street London SE1 0ES Telephone: 0207 902 6100 Facsimile: 0207 902 6149		
Location <b>A20 Trunk Road AQMA</b>		
Title <b>NO2 Annual Mean 2007</b>		
By	Checked	Approved
SEA	SEA	SEA
Scale	Date	
1cm: 40m	March 2009	
Job No.	Fig. No.	
ADIX0552	Figure A4-1b	

Figure A4-2a –A20 Trunk Road AQMA 2008

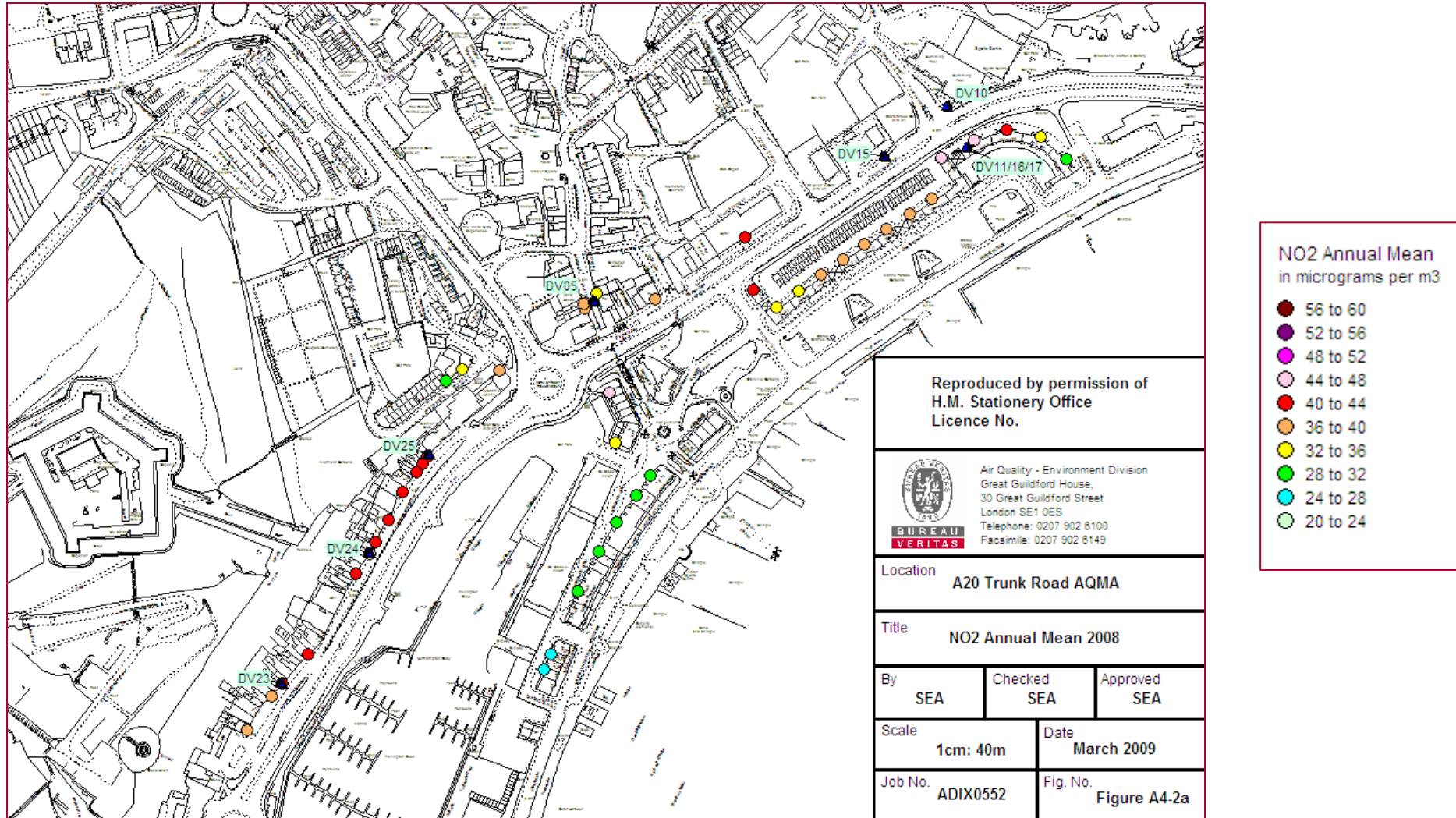


Figure A4-2b –A20 Trunk Road AQMA 2008

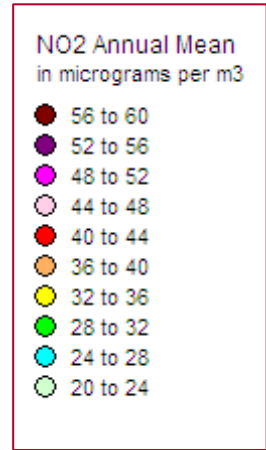
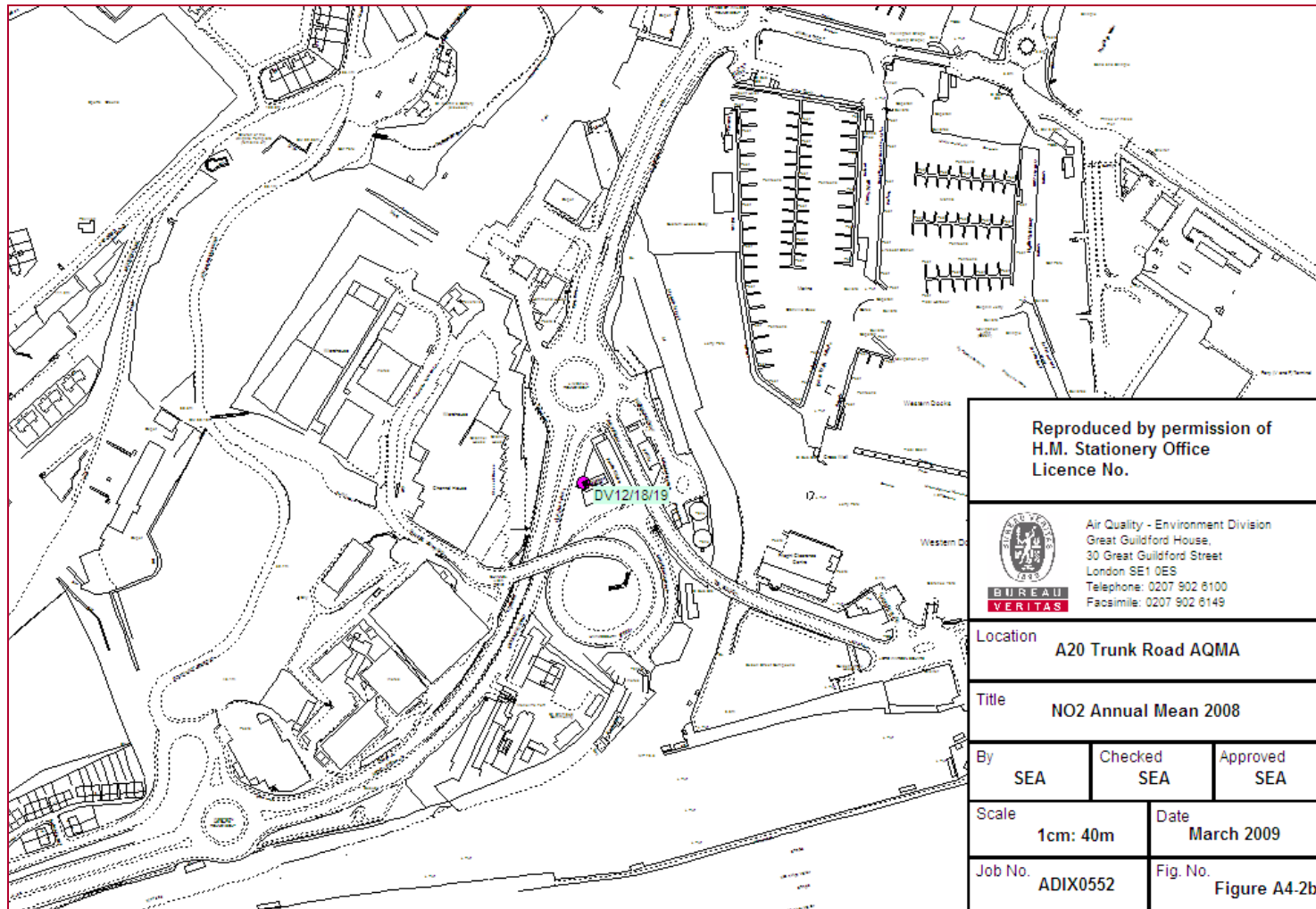


Figure A4-3a – A20 Trunk Road AQMA 2010

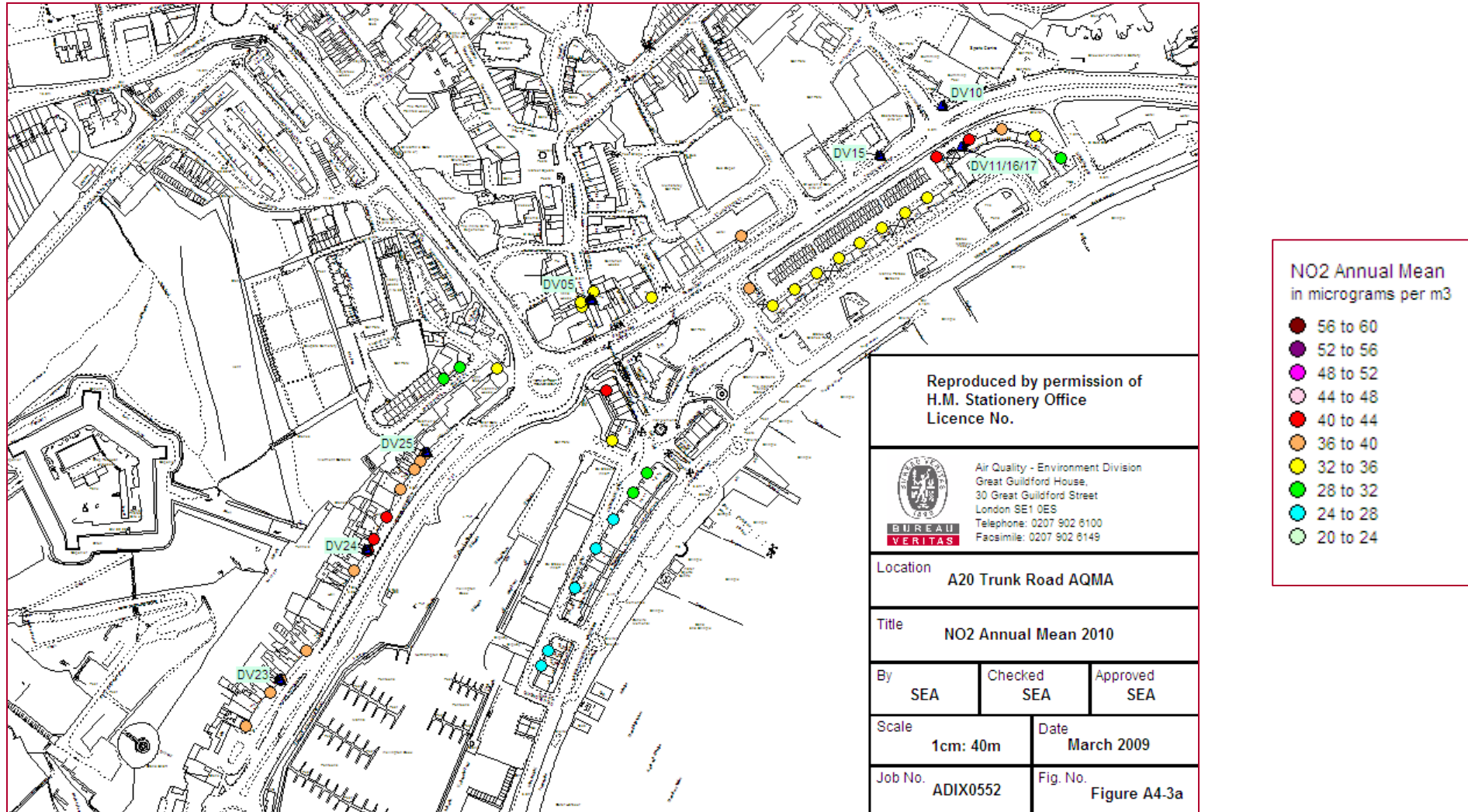
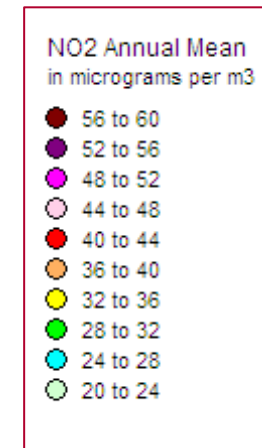
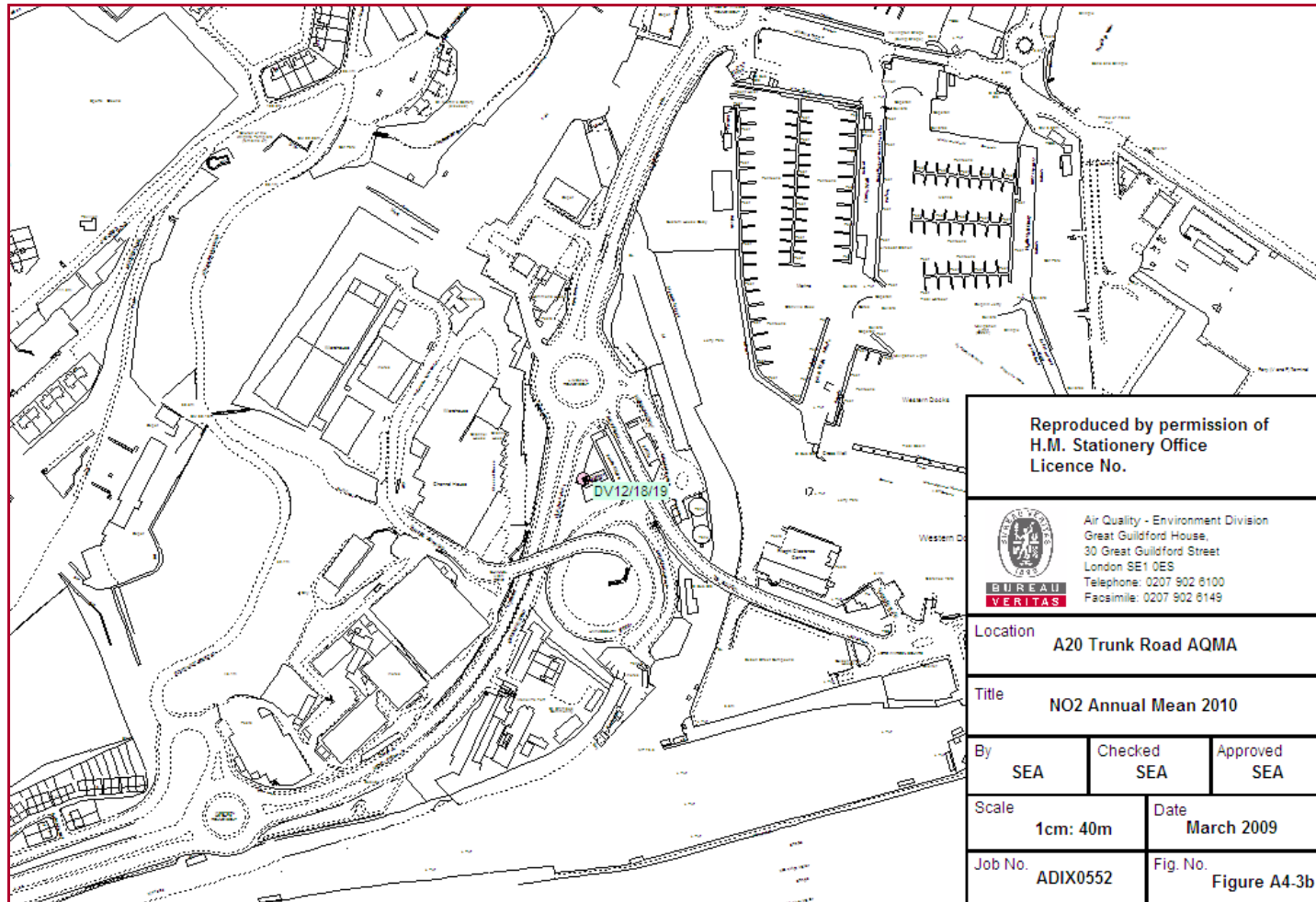


Figure A4-3b – A20 Trunk Road AQMA 2010



## Appendix 5 – Modelled Specific Receptor Results High Street/Ladywell AQMA

Figure A5-1 –High Street Ladywell AQMA 2007

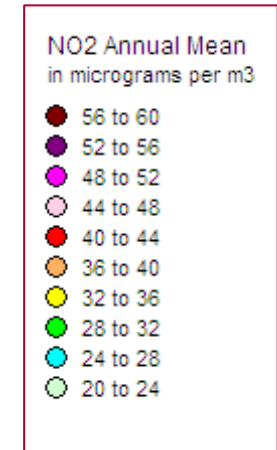
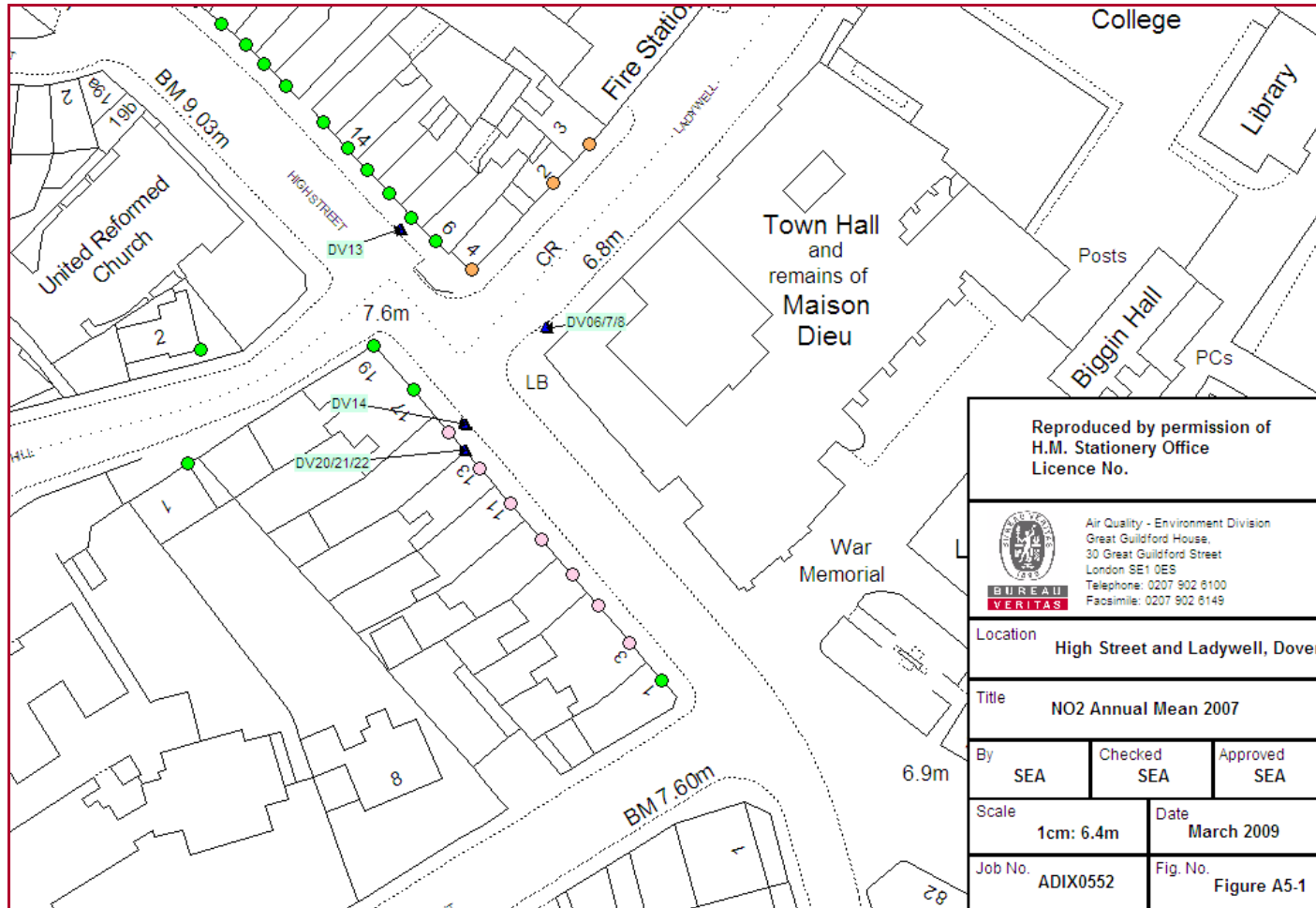


Figure A5- 2 –High Street Ladywell AQMA 2008

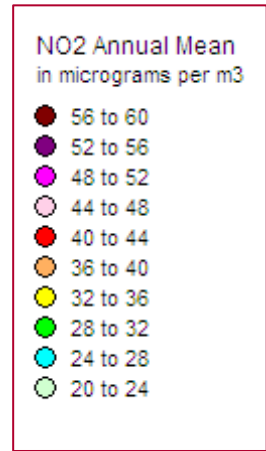
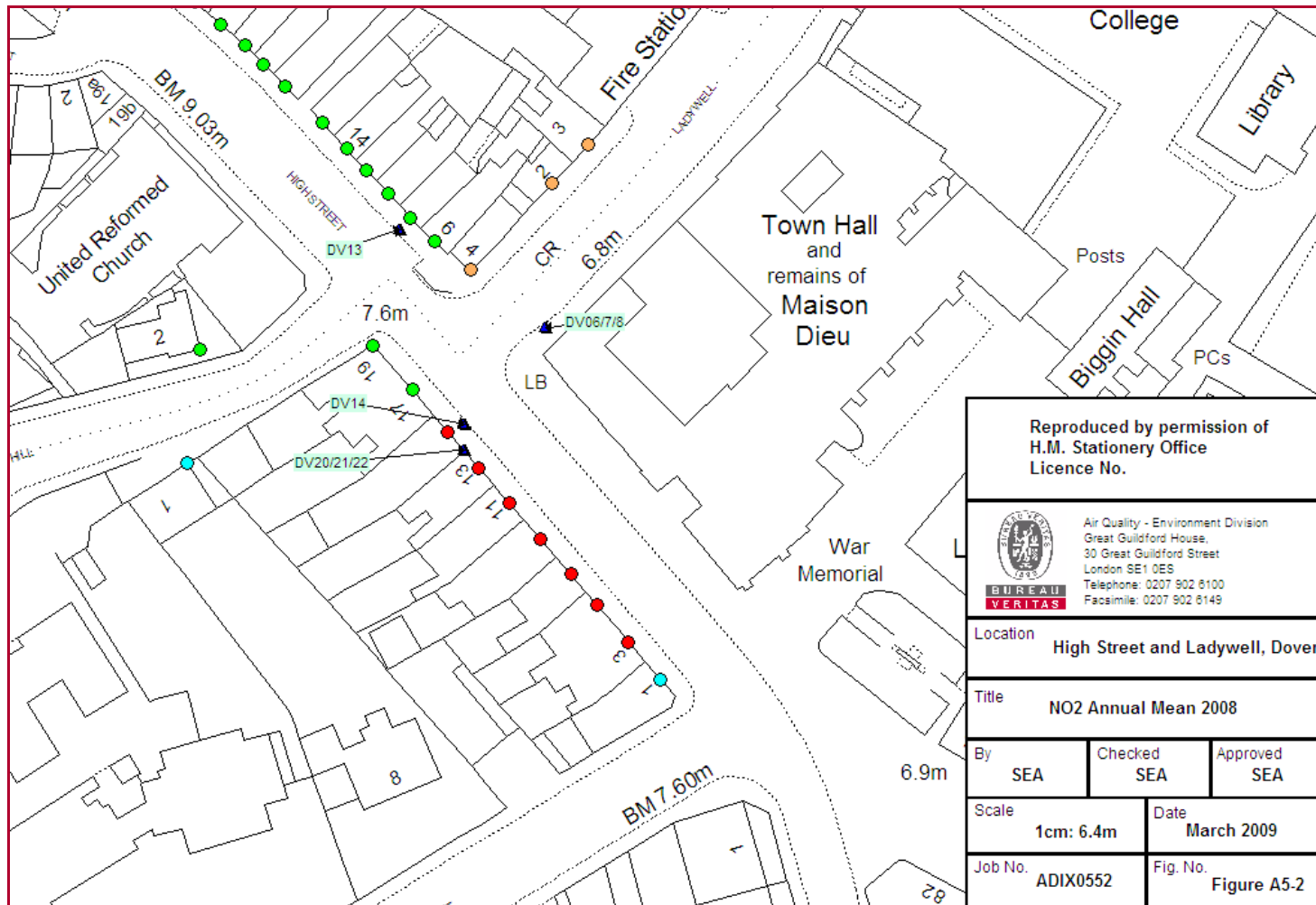
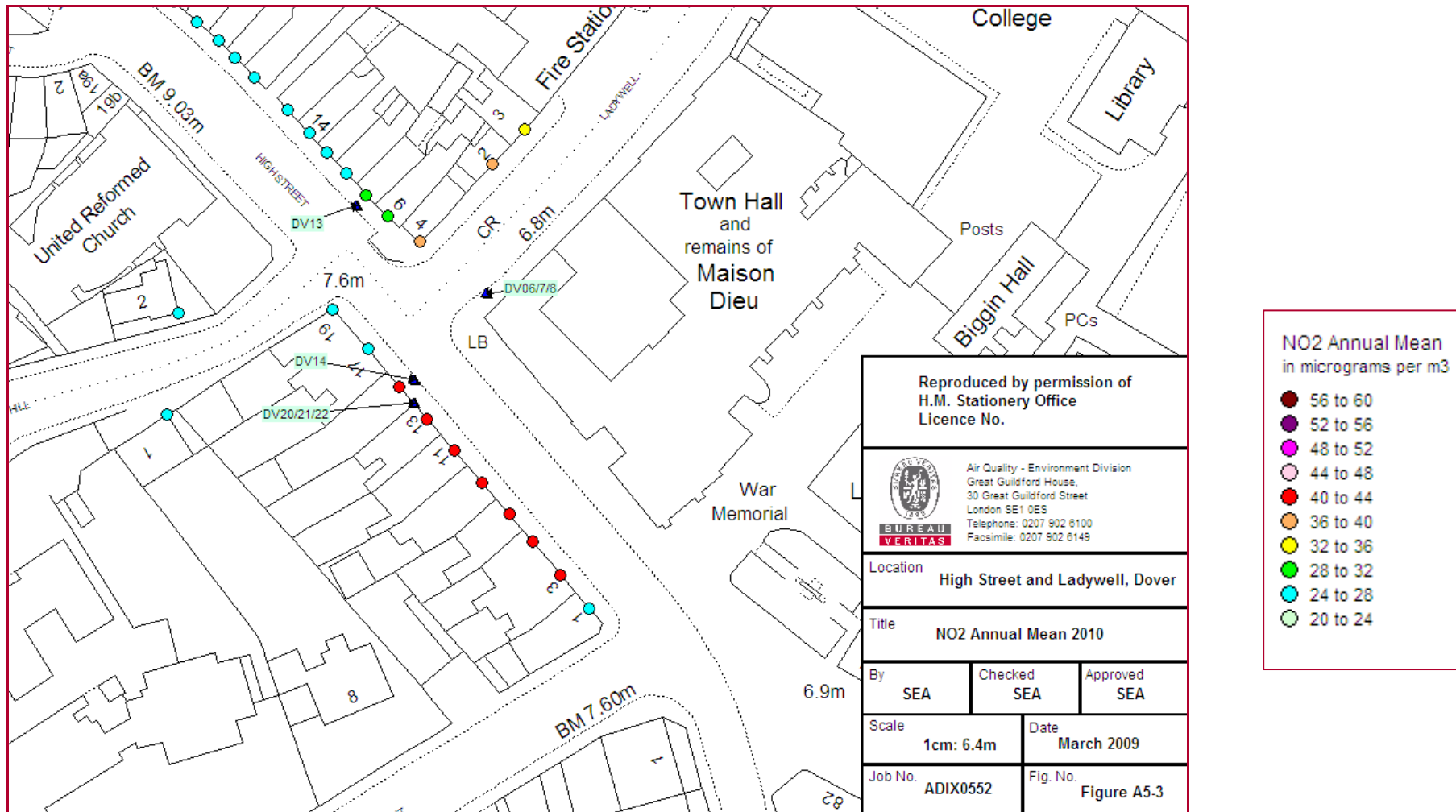
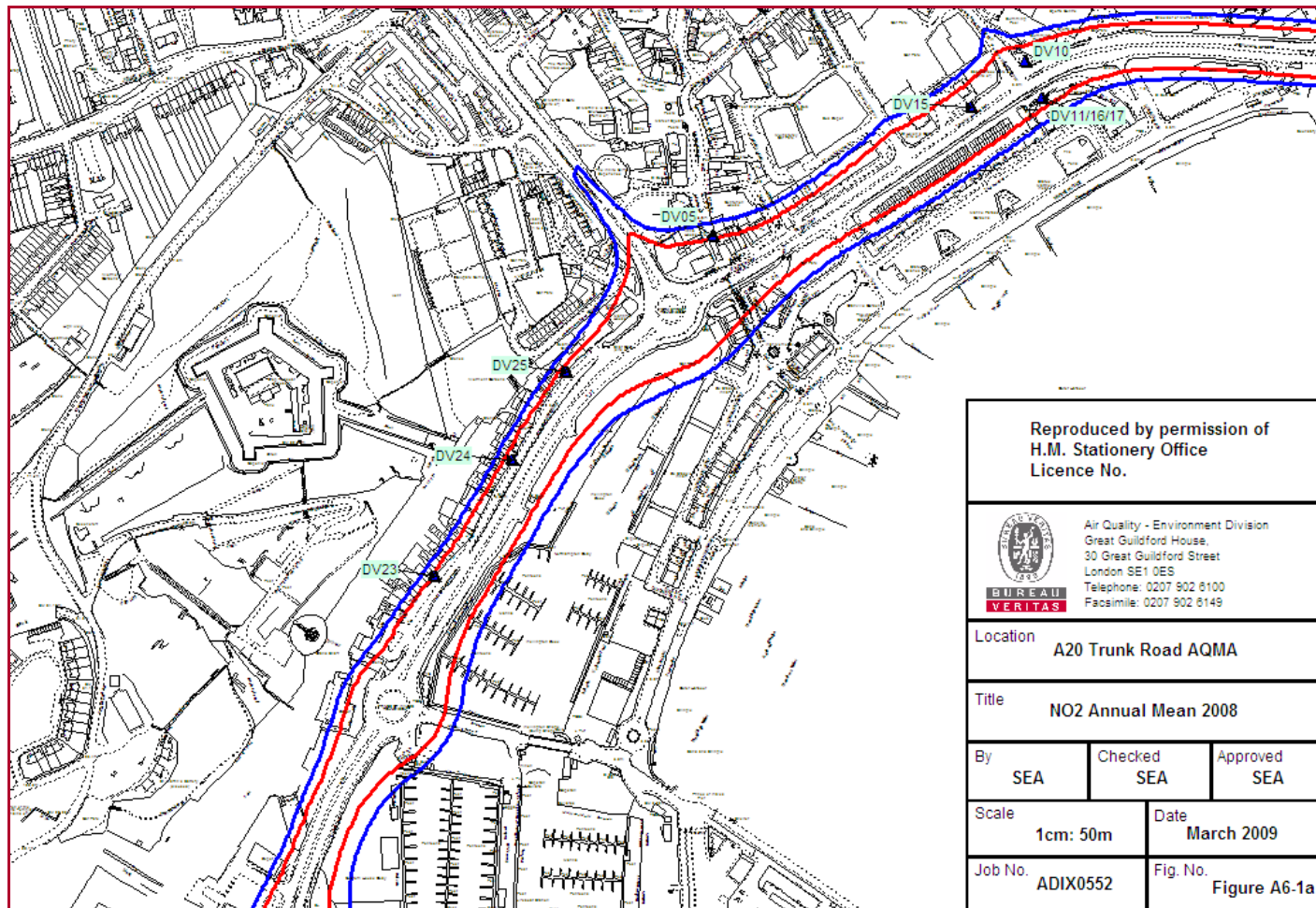


Figure A5-3 –High Street Ladywell AQMA 2010



## Appendix 6 – Modelled Contour Results

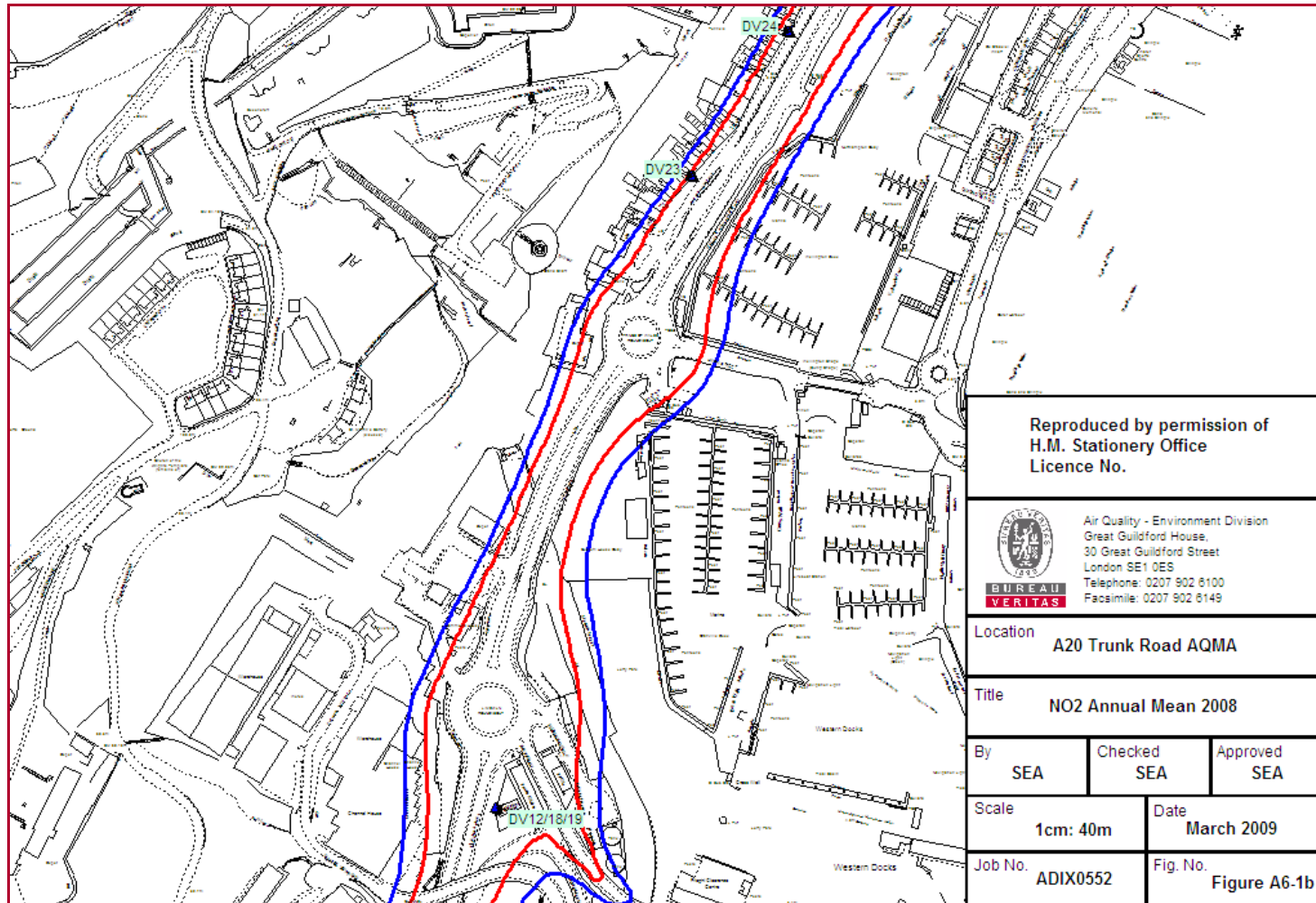
Figure A6-1a – A20 Trunk Road AQMA 2008



**NO2 Annual Mean**

— 36 micrograms per m<sup>3</sup>  
 — 40 micrograms per m<sup>3</sup>

Figure A6-1b –A20 Trunk Road AQMA 2008





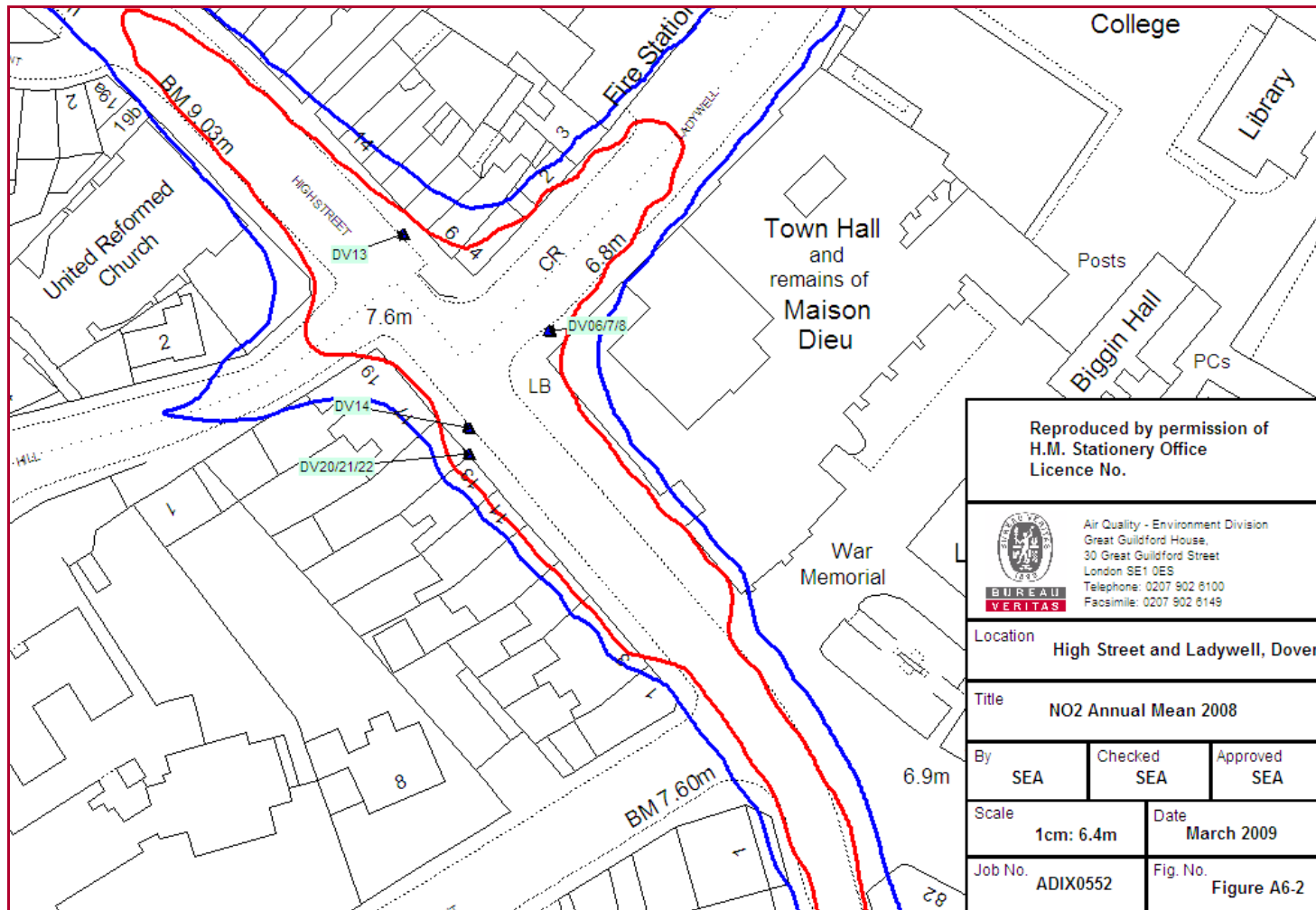
NO2 Annual Mean	
	36 micrograms per m3
	40 micrograms per m3

Figure A6-2 –High Street Ladywell AQMA 2008



NO2 Annual Mean

- 36 micrograms per m3
- 40 micrograms per m3