

**AIR QUALITY REVIEW AND  
ASSESSMENT FOR THE BOROUGH OF WOKING**



Environmental Health Service

November 2001

## SUMMARY

The 'Air Quality Strategy for England, Scotland, Wales and Northern Ireland - Working Together for Cleaner Air' was published in 2000 and is the Government's statement of its policies with respect to the assessment and management of air quality under Part IV of the Environment Act 1995. National air quality standards for eight key pollutants proposed by the Government Expert Panel on Air Quality Standards (EPAQS), have been enacted through air quality objectives in the Air Quality Regulations (England) 2000.

The Environment Act requires Local Authorities to undertake a local air quality review to assess current levels of these pollutants and to review predicted levels for the future. In areas where air quality objectives are not anticipated to be met by the year specified Local Authorities are required to establish Air Quality Management Areas.

The first stage in this process is to undertake a review of current and potential future air quality. For those pollutants where it is felt that local air quality objectives may not be achieved further investigation is required (second stage) and if necessary an even more detailed investigation (third stage). A minimum of two air quality reviews are recommended in order to assess compliance with air quality objectives before the end of 2003.

This report includes all 3 stages of air quality review for Woking Borough, investigating current and potential future air quality through an examination of the principal emission sources, reference to locally and nationally monitored air quality data, and the use of computer modelling.

The report concludes after a stage one review that for the Woking Borough area the required air quality objectives for carbon monoxide, benzene, 1,3 butadiene, and sulphur dioxide are likely to be achieved. For nitrogen dioxide and particulates (PM<sub>10</sub>) a three staged review has been carried out in the heavily trafficked areas of the Borough. The report concludes that the required air quality objectives for these pollutants are likely to be achieved. There is therefore no need at this time to declare Air Quality Management Areas in the Woking Borough area. A further air quality review will be carried out before the end of 2003 for all the pollutants to review the findings of this assessment.

Views and comments are sought from readers on the content, style and conclusions of the draft report, which will be taken into account in future reviews. Please send your comments to the address below or use the reply sheet at the back of the report.

The report has been prepared by officers of the Environmental Health Service, Woking Borough Council with assistance from colleagues in the Surrey Air Quality Group and the Sussex Air Quality Steering Group.

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## **INTRODUCTION**

This report is the review and assessment of local air quality for the Borough of Woking. It supersedes the draft Air Quality Review and Assessment report produced by Woking Borough Council in April 2001, which was put out to consultation.

The report has been produced as part of the new local air quality management (LAQM) duties placed on local authorities (LAs) under Part IV of the Environment Act 1985. (See Appendix 1) These duties required LAs to carry out periodic reviews of air quality in their areas to assess present and likely future air quality against prescribed standards, for the pollutants benzene, 1, 3 butadiene, carbon monoxide, lead, nitrogen dioxide, particulates, sulphur dioxide and ozone. The standards are contained in the 'Air Quality Strategy for England, Scotland, Wales and Northern Ireland Working Together for Cleaner Air' published by the Government in January 2000 and the Air Quality (England) Regulations 2000.

Where the standards are not likely to be achieved the Local Authority must designate an Air Quality Management Area (AQMA) and produce an action plan for improvement in air quality. It is recognised that ozone levels cannot be controlled at a local level so LAs are not required to carry out a review for this pollutant and hence it is not considered in this report.

A three staged approach to the review and assessment of air quality is recommended. All LAs should complete the first stage which involves considering all available air quality information for the local area. If from the information gathered any pollutants requiring further investigation are identified the LA will need to move on to the second stage. If having investigated further it is concluded that there is a risk of air quality objectives not being achieved then the third stage must be undertaken, which will involve an accurate and detailed review and assessment of the pollutants concerned. LAs are required to carry out a further review before the end of 2003.

The review process has been carried out in accordance with the Department of Environment Transport and Regions (DETR) Local Air Quality Management Guidance Notes and Review and Assessment Technical Guidance Series and this report drafted in light of the feedback received to the April 2001 report.

## **DESCRIPTION OF BOROUGH**

The Borough of Woking covers 6,359 hectares. It mainly comprises continuous urban area, centred on Woking Town Centre but stretching from Byfleet and West Byfleet in the east to Knaphill in the west, surrounded by open Green Belt countryside. Within the surrounding countryside there are small settlements, the largest of which are the villages of Brookwood and Mayford. The area protected by Green Belt comprises around 60% of the Borough.

The population of the Borough is estimated as 93,800 (Registrar General 2000) and has been rising steadily over the last twenty five years with the construction of major new housing estates, in particular Goldsworth Park. Further expansion of the built up area is now constrained by Green Belt designation. Only in the Knaphill/Brookwood area, and to a lesser extent in Westfield is land available on the edge of the urban area for development. At present, growth in the population of Woking continues to run at about 700 per year which represents one of the fastest rates of increase in Surrey. However, population forecasts show this growth ceasing altogether in the next few years.

The Borough is a major employment centre and Woking Town Centre a substantial shopping, commercial and entertainment centre.

The Borough is served by a variety of transport links. Train stations are located at Woking Town Centre, Worplesdon, Brookwood and West Byfleet plus just outside the borough at Byfleet and New Haw. Regular, direct services run from these stations to London and locations in the south and southwest. The Borough has road links via the A320, A3046, A322 and A247 to the M25, M3, M4 and A3. There are bus routes along most of the main and secondary roads within the Borough linking up with other towns within Surrey. The area is also well-located to international transport links with Heathrow and Gatwick airports within 45 minutes drive and Heathrow accessible by coach from Woking Town Centre.

## **SOURCES OF POLLUTION IN BOROUGH**

There are few industrial sources of pollution impacting on the Borough, the main local source of air pollution being traffic related.

### **Industrial Sources**

Under Part 1 of the Environmental Protection Act 1990 and the Pollution Prevention and Control Act 1999 a number of prescribed industrial processes are required to be authorised and to operate to a regime of emission controls set by Government. Authorisation and enforcement of the potentially most polluting processes, A (1) Processes, is by the Environment Agency and for the other processes, A (2) and B Processes, by Local Authorities. A public register of local processes authorised under this regime is held by the Council's Environmental Health Service. A summary of the local authorised processes and an indication of those most likely to release significant quantities of pollutants are shown in Table 1.

The larger petrol stations in the Borough are prescribed processes also but the Government has advised that the pollutants from these processes will not be significant and do not need to be considered for the purposes of review and assessment.

The pollutant emissions from the industries in Table 1 are strictly controlled by means of the authorisation process. Many of the authorisations issued contain improvement conditions which require reduction in emissions. Authorised industrial processes in this Borough are therefore not felt to be significant in terms of local air quality. There are no authorised processes near enough to the Borough boundary in the neighbouring local authorities to be significant.

### **Traffic Related Sources**

#### **National Perspective**

Road transport is one of the major sources of air pollution, especially in urban areas. Nitrogen Oxides (NO<sub>x</sub>) and particulates (PM<sub>10</sub>) are the most significant traffic pollutants, but other traffic pollutants include carbon monoxide (CO) and volatile organic compounds (VOCs).

Pollution from road traffic has fallen considerably in the UK since the beginning of 1990's, despite traffic growth. Between 1995 and 2005, NO<sub>x</sub> and PM<sub>10</sub> emissions are expected to drop by around 60%. This is mainly a result of tighter European vehicle emission and fuel standards. This reduction should continue, partly because older, higher polluting vehicles will be gradually phased out of the UK's vehicle fleet and partly because of even more stringent European emission standards for new vehicles.

The trend of declining emissions is expected to slow down considerably from about 2010, stop around 2020, and then slightly reverse as engine and fuel improvements are offset by continuing traffic growth. VOCs and CO emissions are expected to follow a similar pattern.

These predictions do not take into account the impact of the policies in the Government's UK integrated transport white paper 'A new deal for transport - better for everyone.' The white paper explains how the Government plans to extend choice in transport and secure mobility in a way that supports sustainable development. Key themes include: offering people viable alternatives to the car; reducing the need to travel; making better use of existing transport infrastructure and reducing the environmental impact of transport.

**Table 1: Industrial Processes in Woking Borough Authorised under Part 1 of the Environmental Protection Act 1990**

<b>PROCESS GUIDANCE NOTE</b>	<b>NAME &amp; LOCATION</b>	<b>PROCESS</b>	<b>POTENTIAL POLLUTANTS IN SIGNIFICANT QUANTITIES</b>
<b>A PROCESSES</b>			
4/5	WALKER AEC Canada Road, Byfleet	Inorganic Chemical (Cadmium Plating)	Lead, Carbon Monoxide, Sulphur Dioxide, Nitrogen Dioxide, Particulates
4/5	GBL Byfleet, Surrey	Inorganic Chemical (Coated drums for photocopiers)	Lead, Carbon Monoxide, Sulphur Dioxide, Nitrogen Dioxide, Particulates
<b>PART B PROCESSES</b>			
6/4	JEWSONS Arthurs Bridge Wharf, Horsell	Sawing and planing of softwood and hardwood timbers.	None
5/2	WOKING CREMATORIUM Hermitage Road, St Johns	The cremation of human remains.	
3/1	TARMAC TOPMIX Monument Way West, Maybury	Ready mixed concrete batching plant.	None
6/8 & 6/16	JAMES WALKER Old Woking Road, Old Woking	Coating of textile cloth.	None
6/28	JAMES WALKER Old Woking Road, Old Woking	Mixing, milling or blending of natural rubber of synthetic elastomers.	Particulates
6/34	P & T REPAIRS Dorset Way, Byfleet	Repair and Respraying of road vehicles.	None
6/34	VGL Connaught Road, Brookwood, Woking, Surrey	Repair and respraying of road vehicles.	None
6/34	STJ Goldsworth Park Industrial Estate, Goldsworth Park, Woking, Surrey	Repair and respraying of road vehicles.	None
6/16	HOUSE OF QUESTA Canada House Canada Road, Byfleet Industrial Estate Byfleet, Surrey	Repair and respraying of road vehicles.	None

## Local Perspective

There has been a marked change in travel patterns and the popularity of particular modes of travel in the last ten to fifteen years. The 1991 Census showed that 70% of journeys to and from work in Woking were made by car, 14% by public transport, 7% on foot and 3% by bicycle. The number using cars had increased by 52% in the previous ten years with the amount of commuting by private road vehicles being a significant factor in this increase. The high level of car use within the Borough can be partly explained by the level of car ownership which is 50% higher than the national average.

Surrey County Council is the highway authority for the Woking Borough area and has produced a Local Transport Plan 2001/06 for Surrey, in line with Government policy. A key objective of the plan is to protect and improve the environment of Surrey and health of its people by reducing the adverse effects of motorised transport.

In terms of the impact of vehicle emissions on local air quality, traffic congested routes which pass through residential areas or close to schools are of greatest significance. Routes with projected annual average daily traffic flows of greater than 20,000 are identified as significant sources of pollutants in the DETR guidance.

Predicted traffic information for the road network in Woking Borough in 2006 has been supplied by Surrey County Council and is based on the New Surrey County Transportation Model. The model contains information on sections of road to take account of the effect of connecting roads and the resultant effect on traffic mix, density and speeds.

Those roads meeting the DETR significant source of pollutants criteria in the Woking Borough area are shown in Table 2 and Figure 1.

**Table 2: Roads with estimated daily traffic flows > 20,000 in Woking Borough in 2006 and 1995***(Table shows traffic flows in order from the highest down for 2006 vehicle flow which was used in the DMRB)*

No.	Road Link Description	Grid Ref (See Map Figure 1)	2006 Vehicle Flow	1995 Vehicle Flow
1.	M25 from junction 11 - junction 10	L1, L2, L3	156392	130202
2.	M25 from junction 11 - junction 10	L1, L2, L3	156392	130202
3.	M25 from junction 10 - junction 11	L1, L2, L3	156392	130202
4.	M25 from junction 10 - junction 11	L1, L2, L3	156392	130202
5.	M25 from junction 10 - junction 11	L1, L2, L3	156392	130202
6.	Parvis Road (High Road - East Boundary) A245	M2, N2	47402	41929
7.	Lockfield Drive (Parley Drive - Well Lane)	F5	38241	36469
8.	Old Woking Road (Parvis Road - Rosemont Ave)	K3	34692	29851
9.	Parvis Road (Oyster Lane - Parvis /High Road East) A245	M2	33813	30148
10.	Guildford Road (Fire Station - Victoria Road) A320	G5	32776	26080
11.	Parvis Road (Caphill Road - Dartnell Park Road) A245	K2, K3	32449	28104
12.	Parvis Road (Chertsey Road - Oyster Lane) A245	M2	31152	27486
13.	Unidentified link road in Knaphill		30523	21417
14.	Monument Road (Oriental Road - Maybury Road)	H4	29713	28510
15.	Guildford Road (Victoria Road - Claremont Avenue) A320	G5, G6	28411	24135
16.	Guildford Road (North Boundary - Martyrs Lane) A320	H2	27230	28020
17.	Chertsey Road (Martyrs Lane - 6 Crossroads Roundabout) A320	H2, H3	27230	28020
18.	Lockfield Drive (Parley Drive - Amstel Way)	D5, E5, F5	27124	26462
19.	Guildford Road (Claremont Ave - Wych Hill Roundabout) A320	G6	26889	23271
20.	Lockfield Drive (Well Lane - Victoria Way)	F5, G5	26184	25782
21.	Lower Guildford Road (Hermitage Roundabout - Blackhorse Rd) A324d	C6	25547	
22.	Brookwood Lye Road A324	B6, C6	25547	
23.	Woodham Lane (6 Crossroads roundabout - Martyrs Lane) A245	H3, I3	25415	21896
24.	Wych Hill (Wych Hill Rise - Wych Hill Roundabout)	F6, G6	24721	20789
25.	Guildford Road (South Boundary - Mayford Roundabout) A320	F7, F8, F9, F10	23997	
26.	Victoria Way (Lockfield Drive - Chobham Road T Lights) A320	G4, G5	23863	24403
27.	Bagshot Road (Brookwood T Lights - Cemetery Pales) A322	B6, B7	22672	
28.	Kingfield Road (Claremont Ave - Loop Road)	G6	22644	
29.	Victoria Way (Lockfield Drive T Lights - Fire Station) A320	C5	22635	
30.	Chertsey Road (Brookhouse Roundabout - Woodham Rise) A320	G4, G5	21469	22100
31.	Chertsey Road (Woodham Rise - Carlton Road) A320	H3, H4	21469	22100
32.	Chertsey Road (Carlton Road - 6 Crossroads Roundabout) A320	H3	21469	22101
33.	Woodham Lane (Martyrs Lane - Sheerwater Road) A245	I3, I2, J2	21258	
34.	Egley Road (Almond Road - Acacia Ave) A320	F6, F7	21123	
35.	Guildford Road (Acacia Ave - Wych Hill Roundabout) A320	F6, G6	21123	
36.	Egley Road (Mayford Roundabout - Almond Road) A320	F7	21123	
37.	The Broadway and Maybury Road	G5, H5, H4	20775	
38.	Victoria Way (Chobham Rd T Lights - Brookhouse Roundabout) A320	G4	20134	21636
39.	Pyrford Common Road (Old Woking Road - Upshott Road)	K4, L4	19717	
40.	Hermitage Road (Lower Guildford Road - Amstel Way)	D5, E5	19328	
41.	Lockfield Drive (Amstel Way - Littlewick Road)	E4	19295	

## **Future Development**

As well as considering increases in emissions from existing sources of pollution in the future, proposed new sources of pollution must be considered. At the present time there are no new industrial processes or new roads planned for Woking Borough, which would have a significant impact on local air quality. New residential developments, hospitals and schools must also be considered as the siting of these near existing sources of emissions could potentially cause air quality objectives to be exceeded, although this would currently be a consideration in the development control process.

The Local Plan for Woking Borough Council has been studied with regard to the possible impact on future air quality and there were no significant findings.

## LOCAL AIR QUALITY MONITORING

Nitrogen dioxide (NO<sub>2</sub>) monitoring has been carried out at a number of sites in the Borough since 1997, with additional sites being more recently added. Four of the sites are part of the United Kingdom Nitrogen Dioxide Tube Network which has the objective of assessing the distribution of NO<sub>2</sub> concentrations in urban areas nationally. The other ten sites were chosen to give a more representative picture of NO<sub>2</sub> levels across the Borough. Monitoring for volatile organic compounds (which includes benzene) has also been carried out at one site in the Borough since 1997. The results of this monitoring provides important information for the purpose of the review and assessment of local air quality.

The monitoring method used is passive diffusion tubes. This involves the exposure of an absorbent chemical in an open ended plastic tube to atmosphere for a period of a month. The absorbent chemical takes up the specified pollutant and the concentration of that pollutant in the air at that site can be determined by laboratory analysis. The laboratory used, Lambeth Scientific Services, is subject to the Network's quality assurance/quality control requirements, which assess the data provided on the basis of field intercomparison exercises and the Workplace Analysis Scheme for Proficiency (WASP). Performance of the laboratory in this respect has been satisfactory to date. (The average bias for the laboratory's results in the 'UK NO<sub>2</sub> Network Field Intercomparison Exercise 2000' relative to an automatic chemiluminescent analyser was only 1.2%.)

There are a number of National Air Quality Monitoring Network sites which cover a comprehensive range of pollutants utilising various monitoring techniques and providing good spatial coverage across the United Kingdom. The data from these sites is available to the public via annual reports, telephone helplines and via the Internet. The National Environmental Technology Centre (NETCEN) Air Quality Pages include maps of estimated pollutant concentrations based on data from these sites and these have been used in this review to predict background concentrations of the relevant pollutants in the Woking area.

## NATIONAL AIR QUALITY STANDARDS

The standards and objectives for the pollutants of concern prescribed in the Air Quality Regulations 2000 are shown in Table 3. A summary of the main sources and health effects of these pollutants is contained in Appendix 2.

**Table 3: National Air Quality Standards**

Pollutant	Concentration Limit	Averaging Period	Date to be achieved
Benzene	16.25 µg m <sup>-3</sup> (5 ppb)	running annual mean	31 December 2003
1,3-Butadiene	2.25 µg m <sup>-3</sup> (1 ppb)	running annual mean	31 December 2003
Carbon Monoxide	116 mg m <sup>-3</sup> (10 ppm)	running 8-hour mean	31 December 2003
Lead	0.5 µg m <sup>-3</sup>	annual mean	31 December 2004
	0.25 µg m <sup>-3</sup>	annual mean	31 December 2008
Nitrogen Dioxide (NO <sub>2</sub> )	200 µg m <sup>-3</sup> (105 ppb) (not to be exceeded more than 18 times a year)	1 hour mean	31 December 2005
	40 µg m <sup>-3</sup> (21 ppb)	annual mean	31 December 2005
Particulates (PM <sub>10</sub> )	50 µg m <sup>-3</sup> (not to be exceeded more than 35 times a year)	24-hr mean	31 December 2004
	40 µg m <sup>-3</sup>	annual mean	31 December 2004
Sulphur Dioxide	350 µg m <sup>-3</sup> (132 ppb) (not to be exceeded more than 24 times a year)	1 hour mean	31 December 2004
	125 µg m <sup>-3</sup> (47 ppb) (not to be exceeded more than 3 times a year)	24 hour mean	31 December 2004
	266 µg m <sup>-3</sup> (100 ppb) (not to be exceeded more than 35 times a year)	15 minute mean	31 December 2005

ppm = parts per million, ppb = parts per billion, µg m<sup>-3</sup> = microgrammes per cubic metre

For the purposes of the review and assessment of local air quality, local authorities must have regard to locations where individuals are likely to be exposed over the averaging time of the prescribed objective. The Department of Environment, Transport and the Regions (DETR) guidance recommends that for objectives with short averaging times (SO<sub>2</sub> and NO<sub>2</sub> hourly objective) the focus should be on non-occupational, near ground level outdoor locations where exposure over short periods are likely. For objectives with longer averaging times (the objectives for benzene, 1, 3 butadiene, carbon monoxide, particulates, lead and the annual objective for NO<sub>2</sub>) the focus should be on the following near ground level outdoor locations: background locations; roadside locations; and other areas of elevated pollutants where a person might reasonably be expected to be exposed (eg. in the vicinity of housing, schools or hospitals etc.), over the relevant averaging time of the objective.

## REVIEW AND ASSESSMENT BY POLLUTANT

This section of the report considers each pollutant in turn in terms of current and predicted levels for the Woking area.

The Department of Environment, Transport and the Regions (DETR) has concluded from national analysis of air quality that existing national policies are expected to deliver the national air quality objectives for a number of pollutants, unless there are specific local circumstances. These pollutants are carbon monoxide, benzene, 1, 3 butadiene and lead.

### Carbon Monoxide (CO)

Air Quality Objective by end of 2003:  $11.6\text{mgm}^{-3}$  (10ppm) running 8 hour mean.

CO is a gas formed by the incomplete combustion of carbon containing fuels. The main source of CO in the UK is road transport in particular petrol engine vehicles. National policies are expected to achieve the air quality objective at all roadside locations with new emission limits and fuel quality standards agreed for cars, light vans and heavy-duty vehicles contributing towards reduced carbon monoxide emissions.

Significant quantities of CO are only expected where there are current or predicted daily traffic flows of greater than 80,000 for single carriageway roads, 120,000 for dual carriageways and 140,000 for motorways, in areas where there is potential for exposure of individuals in relevant locations such as housing, schools. Table 2 shows that this is not the case for roads in Woking. The only road in the Borough with daily traffic flows in excess of 80,000 currently and predicted for 2006 is the M25 where exposure of individuals is not significant as the nearest relevant locations are approximately 100m away. None of the Part A and Part B processes in Woking are significant emitters of carbon monoxide.

The estimated carbon monoxide background concentrations in this region based on national monitoring data is below  $0.75\ \mu\text{gm}^{-3}$ . It is therefore considered that the air quality objective for carbon monoxide will not be exceeded in Woking Borough in 2003 and further investigation for this pollutant is not required.

### Benzene

Air Quality Objective by end of 2003:  $16.25\ \mu\text{g m}^{-3}$  (5 ppb) running annual average.

In the UK the main atmospheric source of benzene is the combustion and distribution of petrol which it is a minor constituent, and hence motor vehicles are the most important single source on a national basis.

Estimated benzene background concentrations in this region based on available national monitoring data, shows that in the Woking area the levels are well below the air quality objective for this pollutant being  $2.5\ \mu\text{gm}^{-3}$ .

In addition the results of local monitoring for benzene show current levels below the objective (See Table 4).

**Table 4: Annual average benzene levels in parts per billion (ppb) at diffusion tube monitoring site at Sandy Lane, Woking**

Site Name	1996	1997	1998	1999	2000
Sandy Lane, Woking	5.45	2.7	1	0.9	0.5

Existing national policies are expected to deliver the prescribed air quality objective for benzene by the end of 2005 even at roadside of the most busy or congested roads. As Woking Borough and neighbouring local authorities have no major industrial processes that handle, store or emit benzene it is therefore considered that the air quality objective for benzene will not be exceeded in Woking Borough and hence further investigation for this pollutant is not required.

### **1,3 Butadiene**

Air Quality Objective by end 2003: 2.25  $\mu\text{g m}^{-3}$  (1 ppb) running annual average.

1,3 Butadiene in the atmosphere is mainly derived from the combustion of petrol and other material. It is also an important industrial chemical handled in bulk at a number of individual locations in the UK, mainly in the production of synthetic rubber for tyres.

Existing national policies are expected to deliver the prescribed air quality objective by the end of 2003, except where these are major industrial processes handling, storing or emitting 1,3 butadiene. As the latter is not the case for Woking Borough or neighbouring Boroughs, it is considered that the air quality objective for 1,3 butadiene will not be exceeded in 2003 and hence a stage two review and assessment is not required for this pollutant.

### **Lead**

Air Quality Objective by end 2004: 0.5  $\mu\text{g/m}^3$  annual average.  
by end 2008: 0.25  $\mu\text{g m}^{-3}$  annual average.

Most of the current emissions of lead in the UK have arisen from petrol-engine motor vehicles, but the growing use of unleaded petrol and the ban on the sale of leaded petrol from 1 January 2000 has led to significant reduction in urban lead levels. Lead also has a large number of industrial applications.

Existing national policies are expected to deliver the prescribed objective for lead, except where there are significant industrial sources. As the latter is not the case in Woking Borough or neighbouring Boroughs it is considered that the air quality objective for lead will not be exceeded and hence future investigation is not required for the pollutant.

For those pollutants where national policies alone are not expected to deliver the national air quality objectives a closer examination of local circumstances is required. These pollutants are sulphur dioxide, nitrogen dioxide and particulates.

### **Sulphur Dioxide (SO<sub>2</sub>)**

Air Quality Objective by end 2004: 350 µgm<sup>-3</sup> (132ppb) 1 hour mean (not to be exceeded more than 24 times a year)

by end 2004: 125 µgm<sup>-3</sup> (47 ppb) 24 hour mean (not to be exceeded more than 3 times a year)

by end 2005: 266 µgm<sup>-3</sup> (100 ppb) 15 minute mean (not to be exceeded more than 35 times a year)

SO<sub>2</sub> is emitted in the combustion of coal and oil, for example in power generation, other industry, commercial and domestic heating and road transport.

DETR guidance indicates that where there are no industrial processes which are significant SO<sub>2</sub> emitters, no solid fuel or fuel oil combustion system with thermal power greater than 5MW and domestic combustion emissions are less than 25kg per hour for 1km x 1km, grid square area (which equates to approximately 300 homes burning coal), then the risk of the objective for SO<sub>2</sub> being exceeded by the end of 2004 is negligible. As this is the case for Woking Borough further investigation is not required.

### **Nitrogen Dioxide (NO<sub>2</sub>)**

Air Quality Objective by end 2005: 200 µgm<sup>-3</sup> (105 ppb) 1 hour average  
40 µgm<sup>-3</sup> (21 ppb) annual average

Nitrogen dioxide (NO<sub>2</sub>) and nitric oxide (NO) are both oxides of nitrogen and together they are referred to as NO<sub>x</sub>. All combustion processes produce some NO<sub>x</sub> largely in the form of NO, which is then converted to NO<sub>2</sub>, mainly as a result of reaction with ozone in the atmosphere. Only NO<sub>2</sub> is associated with adverse effects on human health. The main source of NO<sub>x</sub> in the UK is road transport, which accounts for about 50% of emissions, electricity supply 20% and industrial and commercial sectors for about 17%. In urban areas, the proportion of local emissions due to road transport sources is larger.

Existing national policy measures are expected to lead to a substantial reduction in emission of NO<sub>x</sub> from road transport over the next few years, meeting the objective in many areas. However, because of the relationship between NO<sub>x</sub> and NO<sub>2</sub>, meeting the annual mean objective is expected to be more demanding than achieving the 1 hour objective. It is therefore generally considered that if the annual mean objective is achieved, it is unlikely that the 1 hour objective will be exceeded. Exceedances of the hourly air quality objective for NO<sub>2</sub> if they occur, are most likely to be associated with either winter episodes of poor dispersion or during summer oxidant episodes.

Local authorities with major roads, or highly congested roads, which have the potential to result in elevated levels of NO<sub>2</sub> in relevant locations, are expected to identify a need to progress to the second or third stage review and assessment for this pollutant.

## Stage One

There are no significant industrial sources of NO<sub>2</sub> within the Borough or neighbouring boroughs. However there are several roads with an annual average daily traffic flow of greater than 10,000 which are potentially significant sources of NO<sub>2</sub>. The potential significance of NO<sub>x</sub> emissions from road traffic is dependent upon the traffic conditions, such as flow, speed and vehicle mix. The impact of traffic emissions also falls off rapidly with increasing distance from the kerbside, and it is important to take account of where the nearest exposed population will be.

The estimated annual mean NO<sub>x</sub> background concentration in the Woking Borough area for 2005 based on available national monitoring data is below 30 µgm<sup>-3</sup>.

There are fourteen NO<sub>2</sub> diffusion tube monitoring sites in the Borough. The site locations are shown in Figure 2 and their addresses and site description are shown in Table 5.

**Table 5: Nitrogen dioxide diffusion tube monitoring sites in Woking Borough - location and description**

Site Location	Site Description
Victoria Way, Woking	Kerbside
Bittern Drive, Goldsworth Park	Background
Anchor Hill, Knaphill	Kerbside
Bagshot Road, Brookwood	Kerbside
Goldsworth Road, Woking	Kerbside
Near Litten Tree, Guildford Road, Woking	Kerbside
Near Litten Tree, Guildford Road, Woking	Kerbside
Roseberry Crescent, Old Woking	Kerbside
Lincoln Drive, Pyrford	Kerbside
Parvis Road, Byfleet	Roadside
Parvis Road Bridge, Byfleet	Above M25 Motorway
Church Road, Byfleet	Background
Woodham Lane, Woking	Kerbside
Monument Road, Old Woking	Kerbside

The site description classifications are as follows:

- . Kerbside: 0 - 1m from the kerb of a busy road.
- . Roadside: 1- 5m from the kerb of a busy road.
- . Background: >50m from any busy road and typically in a residential area

The results from these sites are shown in Table 6.

**Table 6: Annual average nitrogen dioxide levels in parts per billion (ppb) at diffusion tube monitoring sites in Woking Borough**

Site Location	Year				
	1996	1997	1998	1999	2000
Victoria Way	-	-	Site set up 1999	28	20
Bittern Drive	-	-	10	14	11
Anchor Hill	Site set up 1997	16	26	26	18
Bagshot Road	-	-	Site set up 1999	20	19
Goldsworth Road	-	-	-	Site set up 2000	16
Litten Tree (Constitution Hill)	24	18	17	17	15
Litten Tree (Guildford Road)	17	23	26	27	24
Roseberry Crescent	-	Site set up 1998	11	12	11
Lincoln Drive	Site set up 1997	8	14	16	14
Parvis Road	-	-	Site set up 1999	30	27
Parvis Bridge (M25)	32	31	31	36	28
Church Road	19	18	19	20	17
Woodham Lane	-	-	Site set up 1999	24	18
Monument Road	-	-	-	Site set up 2000	19

As the results show exceedance of the nitrogen dioxide objective currently at a number of sites in relevant locations and given the recognised inaccuracies of passive diffusion tube data a second stage review was required.

## Stage Two

In accordance with DETR guidance, the second stage review and assessment for NO<sub>2</sub> has been carried out using the screening modelling method in the Design Manual for Roads and Bridges (DMRB) which is used nationally to assess the air quality implications of new roads. The model has been used to validate local data and determine more accurately the likelihood of exceeding the air quality objective in 2005.

The DMRB model requires input data on annual average traffic flow, annual average speeds, the fraction of heavy duty vehicles and the distance from the centre of the road to the receptor. Using the traffic data from New Surrey County Transportation Model, results from the DMRB model showed predicted exceedances of the objective at 11 locations adjacent to roads with traffic flows greater than 20,000 vehicles per day and at a level just under the objective for one location. (See Table 7)

This identified the need to progress to a third stage review and assessment for NO<sub>2</sub>.

**Table 7 Predicted Exceedances In 2005 Of The No<sub>2</sub> Objective From The DMRB Model**

	<b>Link name</b>	<b>Distance from receptor to centre of road (m)</b>	<b>Distance from receptor to kerbside (m)</b>	<b>Annual average vehicle flow/hr</b>	<b>% HDV</b>	<b>Average speed km/hr</b>	<b>No<sub>x</sub> - background in ug/m<sup>3</sup></b>	<b>No<sub>2</sub> - annual mean in ug/m<sup>3</sup></b>
1	M25 junct 10 –11	115	94	6,282	13.5	120	39.9	41.96
2	M25 junct 10 – 11	115	94	6.282	13.5	112.4	37.1	40.5
3	M25 junct 10 -11	115	94	6,282	13.5	113.3	37.1	40.56
4	Parvis Rd (High Rd - East Boundary) A245	17.21	6.31	1,904	7.3	31.5	44.1	54.94
5	Lockfield Dr (Parley Dr - Well Lane)	13.1	8.8	1,536	9	43.2	28.7	48.63
6	Parvis Rd (Oyster La - Parvis/High Rd East)	18.4	14.3	1,358	6.2	48	44.1	44.46
7	Guildford Rd (Fire Statn - Victoria Rd) A320	9.5	2	1,316	4	24	29.8	38.78
8	Parvis Rd (Chertsey Rd - Oyster La) A245	18.4	14.3	1,251	5.8	44	44.1	43.03
9	Monument Rd (Oriental Rd - Maybury Rd)	8.8	5.2	1,193	9.5	11.5	28.9	63
10	Lockfield Dr (Well La - Victoria Way)	20.2	16	1,052	11.2	51	29.8	42.67
11	Wych Hill (Wych Hill Rise - Wych Hill Rndt)	5.4	1.7	993	10.6	31	28.9	44.4
12	Kingfield Rd (Claremont Ave - Loop Rd)	15.55	11.35	910	10.8	44.6	28.3	41.47

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A significant proportion of the current annual average  $PM_{10}$  is due to the secondary formation of particulate sulphates and nitrates, resulting from the oxidation of sulphur and nitrogen oxides. These are regional scale pollutants and the annual concentrations do not vary greatly over a scale of tens of kilometres. There are also natural or semi-natural sources such as wind-blown dust and sea salt particles. The impact of local urban sources is superimposed on this regional background. Such local sources are generally responsible for winter episodes of hourly mean concentrations of  $PM_{10}$  above  $100\mu g m^{-3}$  associated with poor dispersion. However, it is clear that many of the sources of  $PM_{10}$  are outside the control of individual local authorities and the estimation of future concentrations of  $PM_{10}$  are in part dependent on predictions of the secondary particle component.

## Stage One

As part of first stage review and assessment, industrial processes which emit significant quantities of PM<sub>10</sub> must be taken into consideration. In and around the Borough of Woking there are no Part A or Part B processes which are potentially significant sources of PM<sub>10</sub> or other industrial processes or landfill/quarry sites that emit significant quantities of uncontrolled and fugitive PM<sub>10</sub>.

However, in accordance with the first stage review guidance significant quantities of PM<sub>10</sub> in areas of the Borough can be predicted, as there are existing roads with projected annual average daily traffic flows of greater than 20,000. The estimated secondary particulate annual average background concentration in the Woking Borough area for 1996 is greater than 14 µg/m<sup>3</sup>. The estimated total background particulate concentration in Woking for 2004 is between 22.5-25 ug/m<sup>3</sup>. As some of the heavily trafficked roads pass through residential areas, there is a need to carry out a further stage two assessment to determine whether the air quality objective for PM<sub>10</sub> will be exceeded in areas where people are exposed.

## Stage Two

To gain a clearer indication as to the areas in the Borough where PM<sub>10</sub> exceedances are most likely, PM<sub>10</sub> emissions from roads with predicted daily flows greater than 20,000 in 2006 were calculated using the DMRB model and traffic data provided by Surrey County Council. From this data 3 locations in the Borough were identified that have predicted significant PM<sub>10</sub> levels when compared with the objective of 50 ug/m<sup>3</sup> as a running 24-hour mean by 2004 (see Table 10). This identified the need to progress to a third stage review and assessment for PM<sub>10</sub>.

## Stage Three

The stage three review and assessment for PM<sub>10</sub> was carried out using the 'Breeze Roads Model', using local traffic data and meteorological data to predict total PM<sub>10</sub> values. The results shown in Table 11 can be directly compared with the PM<sub>10</sub> air quality objective of 50 ug/m<sup>3</sup> as a running 24 hour mean to determine any exceedances.

The results show that there are no exceedances for PM<sub>10</sub>, the highest figure being 45.56 ug/m<sup>3</sup>. It is therefore concluded that it is not necessary for Woking Borough Council to declare any Air Quality Management Areas for PM<sub>10</sub>.

**Table 10 Predicted Exceedances In 2004 Of The Pm<sub>10</sub> Objective From The DMRB Model**

	<b>Link name</b>	<b>Distance from receptor to centre of road (m)</b>	<b>Distance from receptor to kerbside (m)</b>	<b>Annual average vehicle flow/hr</b>	<b>% HDV</b>	<b>Average speed (km/hr)</b>	<b>PM10 - background in ug/m<sup>3</sup></b>	<b>PM10 - 90th percentile in ug/m<sup>3</sup></b>
1	Parvis Rd (High Rd - East Boundary) A245	17.21	6.31	1,904	7.3	31.5	24.5	51.39
2	Guildford Rd (Fire Statn - Victoria Rd) A320	9.5	2	1,316	4	24	23.6	47.21
3	Monument Rd (Oriental Rd - Maybury Rd)	8.8	5.2	1,193	9.5	11.5	23.5	49.40



Table 11

### Woking Borough Council PM10 Modelling

#### 1. Parvis Road 2004

Meteorological Year	Predicted Annual Mean PM10 (ug/m3)	Background PM10* (ug/m3)	Total PM10 (ug/m3)	90 <sup>th</sup> percentile 24 Hour means	Exceedance
1998	0.83	24.5	25.33	45.34	NO
1997	0.95	24.5	25.45	45.56	NO
1996	0.82	24.5	25.32	45.32	NO
1995	0.87	24.5	25.37	45.41	NO

#### 2. Guildford Road (Fire Station – Victoria Road) A320 2004

Meteorological Year	Predicted Annual Mean PM10 (ug/m3)	Background PM10* (ug/m3)	Total PM10 (ug/m3)	90 <sup>th</sup> percentile 24 Hour means	Exceedance
1998	0.61	23.6	24.21	43.34	NO
1997	0.78	23.6	24.38	43.64	NO
1996	0.91	23.6	24.51	43.87	NO
1995	0.79	23.6	24.39	43.66	NO

#### 3. Monument Road 2004

Meteorological Year	Predicted Annual Mean PM10 (ug/m3)	Background PM10* (ug/m3)	Total PM10 (ug/m3)	90 <sup>th</sup> percentile 24 Hour means	Exceedance
1998	0.97	23.5	24.47	43.80	NO
1997	0.92	23.5	24.42	43.71	NO
1996	0.8	23.5	24.3	43.50	NO
1995	0.91	23.5	24.41	43.69	NO

\* Note. Background values taken from the AEA/NETCEN maps  
Concentrations shown above are at the nearest residential property in each case

## **CONCLUSION**

A review and assessment of local air quality has been carried out for Woking Borough, for the pollutants prescribed in the Air Quality England Regulations 2000.

For carbon monoxide, benzene, 1,3 butadiene, lead and sulphur dioxide, the result of the first stage review and assessment was that the likelihood of the air quality objectives for these pollutants being exceeded in relevant locations where people are exposed is negligible and hence a further second or third stage review was not required.

For nitrogen dioxide (NO<sub>2</sub>) and particulates (PM<sub>10</sub>) a second and third stage review was carried out, in areas with heavily trafficked roads. From the third stage review it was concluded that the air quality objectives are unlikely to be exceeded in 2005 and 2004 respectively for these pollutants.

There is therefore no need at this time to declare Air Quality Management Areas within the Borough of Woking.

## **FUTURE REVIEW AND ASSESSMENT**

The Government expects local authorities to carry out a further review and assessment for all pollutants before the end of 2003. The findings of this report will be reviewed as part of this assessment using the latest monitoring data available for the area.

This review and assessment is based on an estimation of pollutant concentrations that may occur in the future. The robustness of such estimates depends on many factors including knowledge of pollutant sources, likely changes in emissions, atmospheric dispersion processes and chemical transformation of pollutants in the air. In addition scientific understanding is developing which means that prediction methods for pollutants are subject to change. As the guidance to local authorities is revised and updated in light of these developments, this will be taken into account in the next review and assessment.

## **APPENDICES**

## Part IV of the Environment Act 1985 - Air Quality

Part IV Air	Quality	Commentary
Section 80		Obliges the Secretary of State (SoS) to publish a National Air Quality Strategy.
Section 81		Obliges the Environment Agency to take account of the strategy.
Section 82		Requires local authorities, to review air quality and to assess whether the air quality standards and objectives are being achieved. Areas where standards fall short must be identified.
Section 83		Requires a local authority, for any area where air quality standards are not being met, to issue an order designating it an air quality management area (AQMA).
Section 84		Imposes duties on a local authority with respect to AQMAs. The local authority must carry out further assessments and draw up an action plan specifying the measures to be carried out and the timescale to bring air quality in the area back within limits.
Section 85		Gives reserve powers to cause assessments to be made in any area and to give instructions to a local authority to take specified actions. Authorities have a duty to comply with these instructions.
Section 86		Provides for the role of County Councils to make recommendations to a district on the carrying out of an air quality assessment and the preparation of an action plan.
Section 87		Provides SoS with wide ranging powers to make regulations concerning air quality. These include standards and objectives, the conferring of powers and duties, the prohibition and restrictions of certain activities or vehicles, the obtaining of information, the levying of fines and penalties, the hearing of appeals and the other criteria. The regulations must be approved by affirmative resolution of both Houses of Parliament.
Section 88		Provides powers to make guidance which local authorities must have regard to.

**Summary of Source and Health Effects of Pollutants**

<b>Pollutant</b>	<b>Source</b>	<b>Health Effect</b>
Benzene	Volatile Organic Compound, emitted from vehicles and evaporation from petrol filling stations.	Has been linked to leukaemia at very high doses.
1,3-Butadiene	Volatile Organic Compound emitted by vehicles and some industrial processes.	Probable carcinogen.
Carbon Monoxide (CO)	Gas, emitted mainly by vehicles in urban areas. A product of incomplete combustion.	High doses are poisonous, low doses can cause headaches and reduce concentration.
Lead	Poisonous metal, emitted by vehicles using leaded petrol and the lead industry. Other sources include lead in paint.	Studies have shown that increased lead reduces learning ability of children, and high doses affect the nervous system.
Nitrogen Dioxide (NO <sub>2</sub> )	Gas formed principally by reaction in air involving emitted nitric oxide (NO) and oxygen.	Studies indicate that NO <sub>2</sub> may worsen asthma symptoms and reduce lung function. Long term exposure may lead to changes in lung structure.
PM <sub>10</sub>	Particulate matter may be primary (directly emitted as soot from combustion or wind-blown dust) or secondary (formed by chemical reactions involving SO <sub>2</sub> and NO <sub>x</sub> in the atmosphere).	Exposure linked to premature mortality from heart and lung conditions, increase in respiratory symptoms. Also acts as a carrier for other substances such as Polynuclear Aromatic Hydrocarbons (PAHs).
Sulphur Dioxide (SO <sub>2</sub> )	Gas generated by combustion of coal and oil, principally from power stations in the UK.	Causes lung irritation and may worsen asthma. Effects occur over short time period.

### Breeze Roads Model

Stage three of Woking Borough Council's review and assessment is based on the 'Breeze Roads Model'. The modelling was carried out by Andrew Deacon of the Sussex Air Quality Steering Group, who provided details of validation of the model against monitoring data that had been carried out when examining roads in the Crawley Borough Council area. BREEZE ROADS is designed to estimate carbon monoxide, particulate matter and nitrogen dioxide and other inert pollutant concentrations from motor vehicles. The model includes the CALINE4, CAL3QHC, and CAL3QHCR line source dispersion models. CAL3QHC and CAL3QHCR are enhanced versions of the CALINE3 model.

BREEZE ROADS incorporates three modules: two for modelling a single hour of user-defined meteorological data (CAL3QHC and CALINE4), the second for modelling historic, hourly meteorological data (CAL3QHCR). The latter module has the capability of processing a year of hourly meteorological data, carbon monoxide, particulate matter, or nitrogen dioxide emissions and traffic data. In addition, the CAL3QHCR module incorporates the Industrial Source Complex (ISC) mixing height algorithm.

When using the model for review and assessment a Tier 2 approach has been used. In this approach a full year of hourly meteorological data are entered into CAL3QHCR in place of the single hour of artificial meteorological data that are commonly entered into the CAL3QHC and CALINE4 modules. Traffic data are taken as hourly average AADT figures (i.e. AADT/24) and in the absence of local information are assumed to be constant throughout the modelling period.

For review and assessment use, the model was set to calculate annual mean NO<sub>x</sub> and PM<sub>10</sub> averages from the roads in question, with background values being taken from the AEA NETCEN maps. Four years (1995 - 1998) of Trinity Consultants meteorological data for Gatwick Airport were run for each case to allow for year to year variations in meteorology.

The emissions factors used for this modelling work are the UK fleet weighted emission factors taken from the London Research Centre UK Emission Factor Database. These break the vehicle fleet down into: petrol cars, petrol LGVs, diesel cars, diesel LGVs, rigid HGV, articulated HGV, buses and motorcycles.

Local data provided by Surrey County Council on the numbers of vehicles travelling along each road section and the percentage of Heavy Goods Vehicles were used. The data allows for traffic growth in future years, again using local estimates. Junction speeds were adjusted in accordance with paragraphs 3.7.26 to 3.7.27 of LAQM.TG2 (00), with an average speed of 30 kph being used.

Evenly spaced receptor grids were placed over the model domains, and individual discrete receptors were placed on the nearest residential properties in each case. Values given in the table of results for these model predictions are values taken at these discrete receptors.

Contour plots were also produced to show the variation in pollutant concentration over the areas.

Assessment criteria for NO<sub>x</sub> with increasing distance from the kerbside

For comparison with the annual mean objective of 40 ug/m <sup>3</sup> (21ppb) assume the following equivalent concentrations of NO <sub>x</sub> :	
Distance from kerb	NO <sub>x</sub> (ug/m <sup>3</sup> )
0 - 5 metres	108
5 - 10 metres	102
10 - 15 metres	97
15 - 20 metres	93
20 - 25 metres	90
25 - 30 metres	87
> 30 metres	85

(Source: Review and Assessment: Pollutant Specific Guidance LAQM TG4 (00) May 2000)

Calculation of calibration factor used in validation of Breeze Roads Model

	1999 (ppb)	2000 (ppb)	Measured Mean NO <sub>2</sub> (ppb)	Measured Mean NO <sub>2</sub> (ug/m3)	NO <sub>2</sub> to NOx (ug/m3)	Background NOx (mg/m3)	"Measured" Roadside Nox
Parvis Road	30	27	28.5	54.44	192.1	57.3	134.8
Victoria Way	28	20	24	45.84	138.7	45.8	92.9

	Modelled Road NOx	Ratio Measured: Modelled	Modelled Road NOx Correction	Plus Background	Conversion Back to NO <sub>2</sub>	Measured NO <sub>2</sub>
Parvis Road	24.50	5.50	134.8299899	192.1299899	54.4	50.6
Victoria Way	21.88	4.25	92.9362823	138.7362823	45.8	45.8

**Mean Correction to  
Modelled NOx**

**4.88**

Modelled Road NOx Correction	Plus Background	Conversion Back to NO <sub>2</sub>	Measured NO <sub>2</sub>	Ratio Model: Measured
119.5	176.8	52.1	50.6	1.03
106.7	152.5	48.2	45.8	1.05

**Mean Overprediction 1.040**

REPLY FORM

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**Your responses to the following will also help us with evaluation:-**

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Return to: Frances Soper  
Environmental Health Services Manager  
Woking Borough Council  
Civic Offices  
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Woking  
Surrey GU21 6YL