Oxfordshire Highways

Cogges Link Road
Air Quality Assessment

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Jacobs, 95 Bothwell Street, Glasgow G2 7HX
Tel 0141 204 2511   Fax 0141 226 3109

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Checked by	:	R Woolley
Approved by	:	R Mansfield

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Executive Summary

Vehicular traffic is one of the principal sources of urban air pollution and therefore the road traffic associated with the construction and operation of the proposed road has been assessed as it comprises a potentially significant source of local air pollution.

Baseline Conditions

Air quality in the area of Cogges Link is largely influenced by emissions from traffic using nearby roads. Bridge Street in the centre of Witney, currently carries the majority of traffic within the local road network. Traffic flows are heaviest during both the morning and afternoon peak hours producing queues around a number of junctions in the local road network, the highest rates of emissions occur in congested, slow moving traffic. Emission rates under stop start driving conditions are much higher than those when the vehicle is driven more smoothly.

In March 2005 West Oxfordshire District Council (WODC) declared two air quality management areas in the towns of Witney and Chipping Norton. The Council's detailed investigation into the local air quality concluded that nitrogen dioxide was likely to fail the Government's annual mean objective for nitrogen dioxide in 2005. Therefore, an Air Quality Management Area (AQMA) has been declared for NO2 incorporating Bridge Street, together with its junctions with New Yatt Road, Newland, Mill Street and High Street.

Environmental Impact and Mitigation

Predicted levels of pollutants are used to compare the existing situation with the Cogges Link scenario in place. This highlights the calculated concentrations at the chosen representative locations and indicates the expect decrease in pollutant emissions over time, with pollutant concentrations in the Do Minimum 2011 decreasing significantly from the current ambient levels. The annual mean concentrations of NO2 do however remain above the objective at a number of receptors. The area of exceedences will be significantly reduced.

In the Do Minimum scenario, traffic remains congested along Bridge Street, the High Street and Newland, with properties fronting on to the road experiencing annual mean NO2 concentrations in the mid 40s to low 50s $\mu g/m^3$. With the introduction of the scheme the reassignment of traffic will lead to a significant reduction in pollutant concentrations along these roads. The annual mean NO2 concentrations will fall by up to 14 $\mu g/m^3$, to below 40 $\mu g/m^3$ within the majority of the town centre. Other properties fronting onto roads in the highway network that experience a reduction in traffic flows, such as Oxford Hill, Woodstock Road and Newland will also experience a reduction in pollutant concentrations of up to 6 $\mu g/m^3$, over the do-minimum scenario.

Properties in Eton Close and Blakes Avenue, relatively close to the proposed road will experience an increase in pollutant concentrations with the opening of the road, with the annual mean NO2 concentrations increasing from low 20s $\mu g/m^3$ by up to 6 $\mu g/m^3$ to 26 $\mu g/m^3$. Pollutant concentrations will however remain significantly within the AQOs at these properties.

Contents

1 Introduction

1.1.1 Oxfordshire Highways is proposing to build a new link road adjacent to the town of Witney known as Cogges Link Road (CLR). The 1.8km long road would be single lane two-way road with a 40 mph speed limit. It would connect Witan Way (south of Witney town centre) to the B4022 at Oxford Hill at the junction with Jubilee Way (on the eastern outskirts of the town). The road would run westwards around the southwest of Cogges and would cross the river flood plain on embankment, with two bridges over the two branches of the River Windrush. After passing beneath a new bridge carrying Stanton Hardcourt Road, the link road would climb steadily northwards, partly in cutting and incorporating extensive earth-bunding, to form a junction with the existing signal controlled junction at Oxford Hill and Jubilee Way.

1.1.2 Vehicular traffic on nearby roads is the principal source of air pollution in the vicinity of the proposed scheme. The area to the north and west of the proposed route in the Cogges estate is predominantly residential. Therefore, sensitive receptors which may be affected by air quality impacts from the proposed road are those residents living in Eton Close and Blakes Avenue to the south of the housing development.

1.1.3 The construction of the new link road would potentially benefit the residential properties fronting onto the current road network within Witney town centre, principally the High Street, Bridge Street, Witan Way, Newlands and Oxford Hill due to traffic reductions caused by the reassignment of traffic as a result of the new road development.

1.1.4 This assessment examines the effects of road traffic emissions on the local air quality in the surrounding area with respect to current standards and guidelines. The assessment identifies concentration levels of the current and future ambient air pollution in the study area; assesses the potential air pollution impacts as a result of the proposed new link road at both a local and regional scale; and considers the potential air quality effects associated with the construction phase.

Legislation and Guidance

1.1.5 The key pieces of legislation relating to air quality, in the context of the EIA, are summarised under separate headings below.

National Air Quality Strategy

1.1.6 In 1997 the United Kingdom National Air Quality Strategy (NAQS) was published. This document set out an analysis of the magnitude and potential health and environmental problems associated with air pollutant emissions, particularly those emanating from road traffic.

1.1.7 The Strategy proposed a schedule of Air Quality Objectives (AQOs), which were to be met for various pollutants in the years up to 2005. In setting these AQOs, due account was taken of health and socio-economic cost-benefit factors, together with consideration of the practical and pragmatic aspects of whether targets would be achievable. Whilst it was identified in the Strategy that the AQOs for benzene, 1,3 -butadiene, lead and carbon monoxide could be achieved as a result of improvement measures already put in place by the government, complying with targets for nitrogen dioxide (NO_2) and fine particulates (PM_{10}) would be more difficult. In considering what additional measures would have to be introduced to counter these apparent shortfalls, the Government felt: 'changes in planning and transport policies (are needed) which would reduce the need to travel and reliance on the car'. More recently, the Government has emphasised the need for the car owning population to move to more low emission vehicles.

1.1.8 The UK Strategy was revised in 2000 and updated in 2007 (The Air Quality Strategy for England, Scotland, Wales and Northern Ireland)[1]. The 2007 Strategy re-established objectives for improvements in air quality in the United Kingdom and includes new targets for ultra fine particulates ($PM_{2.5}$) utilising the exposure reduction methodology. Within the Strategy, the revised set of AQOs are presented, with some objectives being dropped (PM_{10} Objective for 2010) as well as new additions; such as objectives for $PM_{2.5}$ and ozone (O_3) concentrations together with one for the protection of vegetation and fragile ecosystems.

Part IV of the Environment Act 1995

1.1.9 The Environment Act 1995[2], specifically sections 82-84, requires Local Authorities to carry out reviews of air quality within their administrative areas and, where it is assessed that the AQOs may not be complied with by the objective dates; an Air Quality Management Area (AQMA) must be declared. The Local Authority must then formulate an Action Plan, setting out the measures that will be employed to achieve compliance with the objectives. In March 2005 West Oxfordshire District Council (WODC) declared two AQMAs in Witney and Chipping Norton. The Council's detailed investigation into the local air quality concluded that NO_2 was likely to fail the Government's annual mean objective for NO_2 in 2005 (Figure 1. Witney Air Quality Management Area).

Air Quality Regulations (England) and Amendments

1.1.10 A review of the UK Air Quality Strategy was undertaken in 1998 and a consultation document was published in January 1999, outlining proposals for amending the Strategy. The proposals, in brief, consisted of recommendations to adopt the provisions of the EU Air Quality Daughter Directives. In August 1999, in response to the consultation, the Government then published a draft Air Quality Strategy for England, Scotland, Wales and Northern Ireland. The Air Quality Regulations (England) 2000 enacted in April 2000[3], and the Air Quality (England) (Amendment) Regulations 2002[4] gives legal force to the air quality standards set out in the draft Strategy. As detailed above the 2007 Strategy re-established objectives for improvements in air quality in the United Kingdom and included new targets for $PM_{2.5}$ utilising the exposure reduction methodology; together with objectives for O_3 concentrations and for the protection of vegetation and fragile ecosystems.

1.1.11 The AQOs included in the Regulations are set out in Appendix 1.

Climate Change: The UK Programme

1.1.12 This climate change programme aims to bring about a reduction in UK emissions of various greenhouse gases, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

1.1.13 Under the Kyoto Protocol the UK has a legal obligation to reduce the emissions of greenhouse gases to 12.5% below 1990 levels by 2008-2012. The UK has gone beyond this in setting a domestic target of a 20% reduction in CO_2 emissions below 1990 levels by 2010.

Air Quality and Transport

1.1.14 Road transport is a major source of a number of air pollutants, including benzene, nitrogen oxides, carbon monoxide, carbon dioxide and fine particulate matter. Their estimated contributions to total UK emissions in 2004 were:

- Hydrocarbons Benzene 23% and 1,3-butadiene 55%
- Carbon monoxide 58%
- Carbon Dioxide 21%
- Oxides of Nitrogen 37%
- Fine Particulates (PM10) 23%

(Source: NAEI (2005) Emissions Data Spreadsheet)[5]

1.1.15 The predicted growth in traffic and distance travelled in the future could result in deterioration in local air quality, though this must be balanced against the concurrent improvements in engine technology and cleaner fuels. EU and national legislation targets drive these improvements in vehicle technology and fuels.

1.1.16 In the UK, the attainment of the AQOs is closely linked to the need for a reduction in road traffic related pollution. Regulations made under the Road Traffic Act 1988, Transport Act 1982 and Clean Air Act 1993 seek to regulate the emissions from road traffic. The legislative framework set in these Regulations, in conjunction with the Government White Paper "A New Deal for Transport" which aims to improve public transport and reduce congestion and traffic generated pollution, is intended to reduce the impact of the transport sector on air pollution, and in so doing to assist the achievement of the air quality objectives.

1.1.17 The changes due to the proposed new road scheme on the behaviour of local road traffic may have an effect on local air quality by altering vehicle emissions characteristics. Vehicles operate most efficiently and generate the least pollution in freely flowing traffic conditions and at moderate speeds rather than under congested stop start conditions. Factors affecting vehicle emissions include speed, engine temperature, acceleration rates, vehicle condition, type and size.

1.2 Methodology

1.2.1 In the UK, the attainment of the NAQS objectives is closely linked to the need for a reduction in road traffic related pollution. Regulations made under the Road Traffic Act 1988, Transport Act 1982 and Clean Air Act 1993 seek to regulate the emissions from road traffic. The legislative framework set in these Regulations, in conjunction with the Government White Paper A New Deal for Transport which aims to improve public transport and reduce congestion and traffic generated pollution, is intended to reduce the impact of the transport sector on air pollution, and in so doing to assist the achievement of the air quality objectives.

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2 Methodology

2.1.1 This section describes the approach to assessing the air quality impacts of the link road focusing on residential properties in the vicinity of the Cogges Link Road that may be subject to a change in air quality and properties in areas which may be relieved of road traffic, in particular Witney town centre. The methodology is based on the widely used and robust assessments of Design Manual for Roads and Bridges Volume 11 (DMRB)[6], Transport Analysis Guidance (TAG)[7] and Local Air Quality Management Technical Guidance (TG.03)[8].

2.1.2 The key pollutant considered in this assessment is nitrogen dioxide (NO_2), (see Appendix 2 for more detail). This pollutant is of the most concern with regard to its potential exceedence of the AQOs and its effects on human health. In particular, the previous air quality assessments carried out by WODC have shown that the current concentrations of NO_2 at certain locations are above the AQOs. Therefore, an AQMA has been declared for NO_2 incorporating Bridge Street, together with its junctions with New Yatt Road, Newland, Mill Street and High Street. The assessment therefore focuses primarily on NO_2 as previous assessments carried out on behalf of the local authority have shown that concentrations of the other air pollutants associated with road traffic emissions, such as carbon monoxide (CO), benzene (C_6H_6), particulates (PM_{10}) and 1,3-butadeine (C_4H_6) will meet the objectives in this area. As the concentrations of these pollutants will not give rise to any particular air quality problems, they have been scoped out of this assessment.

2.1.3 The basic outline methodology in the employed assessment is detailed below:

- Define Study Area;
- Identify sensitive receptors that could be impacted by the link road;
- Establish the existing ambient concentrations of the pollutants under consideration;
- Establish the future baseline on the basis of a 'Do Minimum' scenario;
- Establish the impacts of the "Do Something" scenario (2011);
- Compare the impacts of the two scenarios of 'Do Minimum' and 'Do Something' for 2011;
- Compare the future scenarios against relevant air quality standards and objectives

Assessment Methodology for the Construction Phase

2.1.4 In the absence of a detailed construction schedule and knowledge of individual construction activities and timings, the approach that has been taken is to identify the main potential sources of emissions, and to undertake a qualitative assessment of these impacts and identify potential mitigation measures.

Assessment Methodology for the Operational Phase

2.1.5 The methodologies described in DMRB, TG.03 and TAG have been used to assess the local air quality impacts of the link road. Appendix 2 details the basic outline of the properties and the potential impacts on humans of some of the key pollutants released by road vehicles.

2.1.6 Detailed air dispersion modelling based upon the declared AQMA, in particular around Bridge Street, Mill Street and the High Street has been undertaken utilising the AAQuIRE© air dispersion model, following guidance given in TG.03 predicting concentrations of NO_2. All modelling was performed on a two-dimensional receptor grid, with a grid spacing of 10 metres to ensure that a high level of spatial resolution was obtained as recommended by TG.03. The results allowed the generation of a number of contour plots of the concentrations of NO_2. Concentrations were also predicted at a number of specific representative receptor locations that are most likely to be effected by the link road. TG.03 provides government guidance for local authorities on the review and assessment of air quality, and the selection and use of dispersion models, with AAQuIRE© being one of the preferred models. AAQuIRE© is a programme based around the algorithms of the internationally validated United States Environmental Protection Agency's CALINE and AERMOD air dispersion programs.

Detailed Air Quality Dispersion Modelling

2.1.7 The methodology adopted enables quantitative predictions of ambient pollution levels to be made for the three scenarios (Current ambient 2005, Do Minimum 2011 and Do Something 2011). The existing and proposed road networks were divided into sections where traffic flows and average speeds were considered to be homogeneous. For each appropriate section, speeds and flows of light duty vehicles (LDVs) and heavy good vehicles (HGVs) are detailed for the AM period, inter-peak (IP) period and PM period traffic. The traffic details are highlighted in the Traffic Assessment of this Environmental Statement.

2.1.8 The pollutant concentrations have been modelled using a single year of neutral meteorological data from RAF Brize Norton meteorological station (2005). Since both Do Minimum and Do Something scenarios utilise the same data set, it is considered that the inter-annual variability in meteorological data is unlikely to impact on the results and conclusions.

2.1.9 The predicted levels of pollutants for the baseline and Do Minimum scenario are compared against levels for the future Do Something scenario at all sensitive receptor locations. The receptor locations are taken at property facades of sensitive receptors in the proximity of the link road and also at monitoring locations and sensitive receptors within the AQMA. The results from the baseline modelling have been verified by comparing levels against data from the diffusion tube surveys carried out by WODC.

2.1.10 Diffusion tubes are useful as screening tools, and can provide additional information on the spatial distribution of NO_2 concentrations. The output of verified model predictions can be usefully compared to suitably validated diffusion tube results, and this can provide an additional level of confidence in the results. During the verification process it is aimed to show that all final modelled NO_2 concentrations are within 20% of the monitored NO_2 concentrations.

2.1.11 Model verification refers to checks that are carried out on model performance at a local level. This involves the comparison of predicted values versus measured values, where there is a disparity between the predicted and measured concentrations, the first step should always be to check the input data and model parameters in order to minimise the errors. If required, the second step will be to determine an appropriate adjustment factor that can be applied. The verification procedure is detailed in Appendix 3.

2.1.12 Modelled results may not compare well with monitoring data for a number of reasons including:

- The model setup (including road widths, discrepancies in modelled and monitored receptor locations);
- Errors in traffic flow and speed data estimates, localised traffic effects from the local network, the localised NO_2 / NO_x relationship;
- Model limitations (treatment of surface roughness and meteorological data); and
- Uncertainty in monitoring data (notably diffusion tubes e.g. bias adjustment factors and the annualisation of short-term data, or interference with the diffusion tubes).

2.1.13 The assessment has been undertaken for the Do Minimum and Do Something 2011 year of opening scenarios to derive predicted annual mean concentrations of NO_2.

2.1.14 The assessment of air quality impacts arising from the link road is made by the addition of background concentrations of pollutants to the predicted emissions from the road vehicles. This background data has been obtained from the database available on the National Air Quality Archive website, which provides concentrations for a number of reference years and from the local monitored data. These background data have been adjusted where necessary to the specific year of assessment using the year adjustment factors available on the same website. The values used are for the relevant background Ordnance Survey grid squares in the vicinity of Witney.

2.1.15 For the Local Air Quality Assessment of air quality effects resulting from the Cogges Link Road a total of 11 specific receptors have been considered. The representative receptor locations chosen include the diffusion tube locations within the AQMA and also those located in the Cogges residential estate closest to the Cogges Link Road to determine the extent of any impacts at these properties. The modelling locations were chosen to duplicate actual baseline monitoring locations or be the nearest relevant property to the diffusion tube employed in the baseline monitoring survey, such that the results of the monitoring period could be used in the validation of the model. The locations chosen are presented in the Table 1 below.

Table 1: Representative Receptor Locations

	Receptor Number	Location	OS Grid Reference
In the proximity of Cogges Link Road	1	104 Eton Close	436705, 208962
	2	95 Blakes Avenue	436734, 209368
	3	1 Blakes Avenue	436717, 209534
	4	24 Wadard's Meadow	436717, 209787
	5	9 Oxford Hill	436572, 209912
	6	80 Newland	436266, 210143
	7	10 Bridge Street	435822, 210240
	8	62 High Street	435697, 209980
Monitoring Locations within the AQMA	9	Newland's Continuous Analyser	435938, 210334
	10	Bridge Street	435825, 210240
	11	Mill Street	435665, 210199

Impact Criteria

2.1.16 In many areas of Environmental Impact Assessment (EIA), criteria e.g. Minor Adverse or Major Beneficial are applied to assess the significance of an impact. However, in the context of air quality, significance criteria are not used and instead comparison is made with environmental quality standards (e.g. AQOs).

2.1.17 The impact assessment criteria are based on the AQOs as shown in Appendix 1. Where there is an exceedence of the AQOs and an increase in pollutant concentrations as a result of the proposed development, then this will be deemed to be a significant impact.

2.1.18 The AQOs form an integral part of the air quality reviews being undertaken by Local Authorities. The AQOs are regarded as the most appropriate standard for comparing current and predicted air quality. They represent the most stringent values applicable in the UK and are the ambient concentrations that Local Authorities use as a comparative measure of local air quality.

2.1.19 The following is provided as an extract from TAG Unit 3.3.3, paragraph 1.4.10:

2.1.20 "A qualitative comment may be provided to support the above assessments. If any properties are demolished or constructed as part of the Scheme, then this should be noted [here]. If the Air Quality Strategy Objective is predicted to be exceeded or an exceedence is removed due to the option, then this should be noted [here] also. In particular, a qualitative comment must be provided if the *proposals affect air quality within an Air Quality Management Area and state what the effect is, or if either of the following situations applies:*

- *The proposal leads to an increase in annual mean PM_{10} levels at 20m from the road centre of at least 1 µg/m³;*
- *The proposal leads to an increase in annual mean NO_2 levels at 20m from the road centre of at least 2 µg/m³ and where concentrations are above the AQS NO_2 objective of 40 µg/m³."*

2.1.21 The above provides a frame of reference for defining the comments on the air quality impacts associated with the proposed Cogges Link Road.

Consultation

2.1.22 WODC together with OCC and the Oxfordshire Highways Department were consulted during the development of the scope and methodology of the air quality assessment. Furthermore, consultees' views on traffic and air quality issues in the local areas were valuable in developing the scope and methodology of the model, and providing background air quality information pertaining to the study area. Monitoring data was sourced from WODC.

3 Baseline Conditions

3.1.1 This section of the report describes the current condition of those aspects of the environment that are likely to be significantly affected by the link road. Establishing the current pollutant concentrations puts the effect of the link road into context, and provides a standard against which Do Minimum and Do Something scenarios can be evaluated.

3.1.2 The current ambient air quality data relates to sites which are either roadside, where measured pollution levels reflect the immediate presence of the road carriageway, or background sites, which are some distance away from the current road network and other main roads.

Baseline Background Pollutant Concentrations

3.1.3 The assumed baseline background concentration of NO_2 has been obtained from The National UK Air Quality Archive maps for the appropriate 1x1km grid squares and from background diffusion tube data from WODC.

Local Authority Air Quality Assessment

3.1.4 On 1 March 2005 WODC declared an AQMA in Witney town centre. This action was taken because after detailed investigation it was concluded this area would fail the Government's objective for the NO_2 annual mean concentration. Figure 1 shows the location of the AQMA in the centre of Witney. The declared AQMA encompasses Bridge Street in Witney and part of High Street and Mill Street. Road traffic is considered to be the principal source of NO_2 pollution. Bridge Street is a main route for traffic travelling along the A4095 from East to West. Bridge Street is fronted mainly by residential apartments and terraced housing with some additional commercial properties.

3.1.5 The detailed dispersion modelling study carried out by Faber Maunsell 2006 predicted that the NO_2 concentration at the façade of buildings in Bridge Street is between 48 µg/m^3 and 52 µg/m^3; and that the peak concentration at the façade of properties facing the junction of High Street and Witan Way is approximately 42 µg/m^3.

3.1.6 WODC has undertaken an extensive NO_2 diffusion tube survey at sites located in the AQMA. The survey has been undertaken with passive diffusion tubes with the aim of producing representative baseline concentrations of NO_2. A continuous NO_2 analyser operated at the junction of Newlands and Bridge Street provided useful information about the baseline distribution of the pollutant and of the local NO_X/NO_2 relationship.

Detailed Modelling of Baseline Scenario

3.1.7 The AAQuIRE© air dispersion model used to predict pollutant levels at the sensitive receptor locations has been based on modelled traffic data for a baseline year of 2005 supplied by Oxfordshire Highways in June 2007. The results of modelling for the Baseline Scenario 2005 are detailed in Table 2 below. This table also gives a comparison of the modelled results with data from the monitoring survey carried out by the Council.

Table 2: Detailed Modelling of Ambient 2005 Scenario

	Receptor Number	Location	Modelled NO_2 annual mean (µg/m^3)	NO_2 annual mean diffusion tube monitoring (seasonally & bias adjusted) (µg/m^3)
In the proximity of Cogges Link	1	104 Eton Close	23.8	
	2	95 Blakes venue	24.5	
	3	1 Blakes Avenue	25.6	
	4	24 Wadard's Meadow	29.7	
	5	9 Oxford Hill	35.3	
	6	80 Newland	42.8	
	7	10 Bridge Street	61.5	
	8	62 High Street	49.6	
Monitoring Locations within the AQMA	9	Newland's Continuous Analyser	54.9	
	10	Bridge Street	59.6	53.0
	11	Mill Street	41.5	44.0
AQO			**40**	**40**

3.1.8 The baseline results from the modelling study will be subject to error due to uncertainties in modelling dispersion algorithms and particularly the input data. Therefore, it is imperative that the performance of any modelling study is verified by comparison with data from nearby diffusion tube sites.

3.1.9 The calculated levels of pollutants at the specific receptor locations within Witney town centre highlight the current exceedences of the annual NO_2 objective and reinforce the decision by WODC to declare an AQMA through the High Street, Bridge Street and Newland. The baseline contour plot reproduced in Figure 2 demonstrates the extent of the predicted area of exceedences.

3.1.10 Pollutant concentrations at properties in the Cogges residential estate to the east of Witney currently experience relatively low levels of NO_2, with concentrations tending towards background levels.

4 Construction Design and Mitigation

4.1.1 Fugitive dust is the most likely pollutant to impact on air quality during the construction phase. Such dust emissions can be effectively controlled at source and can generally be avoided by good site practice. A range of mitigation measures would be included in the Construction Environmental Management Plan to minimise the effects of airborne dust.

4.1.2 Liaison with the WODC prior to the start of construction would be undertaken to agree proposed working practices and environmental controls. This would be a key element in ensuring suitable and effective mitigation.

4.1.3 Based on these discussions, the Site Contractor would be required to work to a Code of Practice, which could include measures to minimise fugitive dust emissions, especially in the vicinity of potential receptors. As appropriate, the Code of Practice may include the measures detailed below.

4.1.4 Minimisation of fugitive dust emissions from construction activities, including material storage and concrete batching:

- Adhering to relevant legislation and guidance;
- Avoiding the use of plant or machinery that would create dust wherever reasonably possible;
- Dampening down areas at risk of creating fugitive dust as appropriate;
- Controlling construction activities as appropriate to minimise dust release;
- Utilising water suppression where appropriate for material cutting such as the use of abrasive disc cutters;
- Enclosing significant material stockpiles as far as is practicable;
- Carrying out the mixing of large quantities of concrete only in enclosed or shielded areas where possible;
- Maintaining all material handling areas in a dust free state as far as is practicable;
- Establishing procedures to ensure that the site is regularly inspected for spillage of dusty or potentially dusty materials and any such spillage would be dealt with promptly

4.1.5 Minimisation of dust from vehicle movements within the site through:

- Giving attention to maintaining medium and heavily used routes in as dust free state as is reasonably possible;
- Regularly dampening down of any unsurfaced routes using water bowsers during periods of dry weather where they have the potential to cause nuisance;
- Establishing and enforcing appropriate speed limits, as necessary;
- Installing wheel washing facilities if appropriate and heavy vehicles leaving the site would be required to use the installation as necessary

4.1.6 Implement a public relations service through:

- The Site Contractor providing advertising and maintaining a telephone number via which public dust complaints can be received and appropriate action taken; notifying the environmental health departments of West Oxfordshire District Council and Oxfordshire County Council of details of all such complaints for verification purposes;
- Notifying the environmental health department of activities with the potential for causing major dust problems so that appropriate safeguards can be adopted

4.1.7 Monitor compliance with this Code of Practice through:

- Requiring the contractor to set up their own monitoring programme to evaluate compliance with this code (Construction Environmental Management Plan)

4.1.8 All policies, practices and procedures would be periodically reviewed to ensure their appropriateness as part of the environmental audit of the Co-ordinated Environmental Monitoring Programme (CEMP) by the Environmental Clerk of Works appointed for the construction phase of the development.

Assessment of Construction Impacts

4.1.9 Construction of the Cogges Link Road is planned to commence in Autumn 2009 with completion in Winter 2011-2012. Construction may therefore cover a period of just over two years. Potential disruption due to construction may occur during this period to residents in close proximity to the proposed route and to vehicle travellers on the existing road network.

4.1.10 From an air quality perspective, the key activities, related to the construction of the Cogges Link Road likely to create the greatest impact are as follows:

- Fugitive dust emissions from a variety of construction activities including re-profiling of cuttings and embankments;
- Off-site disposal of excavated material during construction;
- HDV haulage of material to and from the construction site

4.1.11 A detailed construction schedule is yet to be established and without detailed knowledge of individual construction activities and timings, the following should be regarded as a preliminary assessment of the potential impacts.

Construction Activities

4.1.12 Construction of the Cogges Link Road would involve the digging of foundations, excavation, and construction of embankments and localised vehicle movements.

4.1.13 The main potential air quality impacts arising from such construction activities are likely to be associated with fugitive dust emissions. However, these are generally variable in nature and can be dependent on the type of constructional activity, ground conditions and the prevailing meteorological conditions at that time. A large proportion of dust from construction activities is usually caused by entrainment of dust disturbed by vehicle movements on unsurfaced haul roads. Similarly, dust can also be entrained from uncovered stockpiles and surplus spoil materials. The majority of access routes to construction areas would be via surfaced roads minimising the potential for dust entrainment.

4.1.14 For fugitive dust from such works, a high proportion of any entrained dust is likely to be deposited within a few hundred metres of the site; the specific distance of dust deposited from the site is relative to the strength and location of prevailing winds, particle size and local topography. Consequently because of the temporary nature of the construction activities, it is likely that the potential impacts would be in relation to dust deposition and potential nuisance in the immediate vicinity of the site rather than long term air quality concerns. Appropriate mitigation measures would, however, enable these potential impacts to be reduced to acceptable levels. These mitigation methods are discussed in Section 5 of this report.

Off-site disposal of excavated material

4.1.15 During construction, surplus material from excavations would be re-utilised within the construction area wherever possible minimising the off-site removal of material.

HGV haulage of material to and from site

4.1.16 There is the potential for wind blown dust and spillage from vehicles (e.g. mud on public roads) during the import or export of aggregate, rubble or soil materials. Vehicle exhaust emissions associated with construction traffic would also be released in the vicinity of the site although these are unlikely to have a significant impact on local air quality.

4.1.17 Disruption caused by vehicle movements bringing material to and from the construction site would be minimised by the provision of dedicated access routes to the areas being worked. This would be achieved by imposing appropriate working conditions on the Contractor, as part of the Contract. Maintenance of these dedicated routes would also be required to ensure minimal nuisance and disruption from fugitive dust emissions i.e. ensuring bowsers and sprays are available and used appropriately, particularly during the summer months.

Health Impacts

4.1.18 The duration of significant activities associated with the generation of fine dust particles such as PM_{10} will be limited to those periods when there is significant earthwork and earthmoving activities. The likelihood of local residents experiencing a detriment to their health due to the proposed construction activities is therefore considered to be very low due to the relativity large distances between the area of construction activity and residential property. In summary the scheme's Environmental Management Plan (EMP) would address the potential for dust nuisance and associated health impacts at the nearest properties.

5 Operational Impacts

Local Air Quality Assessment

5.1.1 In order to quantify the air quality impact of the proposed development, the predicted air quality concentrations resulting from road traffic on the existing road network have been compared to that resulting from traffic flows on the proposed road network. A three-way comparison has been made between the current air quality (Current Ambient 2005) and the expected concentrations in the Year of Opening (2011) without the Cogges Link Road (Do Minimum Scenario) and those predicted if the Cogges Link Road is built (Do Something Scenario).

5.1.2 The annual mean concentrations of NO_2 have been predicted at the selected representative receptors for the Do Minimum and Do Something Scenarios for 2011. The corresponding AQO is also listed to enable direct comparison with the predicted concentrations.

5.1.3 A summary of the predicted annual mean NO_2 concentrations at the receptors locations is provided in Table 3 and contour plots of the annual mean NO_2 concentrations are provided in Figures 2, 3 & 4.

Table 3: Predicted Annual Mean NO_2 Concentrations

	Receptor Number	Location	Current Ambient 2005 (µg/m^3)	Do Minimum 2011 (µg/m^3)	Do Something 2011 (µg/m^3)
In the proximity of Cogges Link Road	1	104 Eton Close	23.8	20.4	25.8
	2	95 Blakes venue	24.5	20.9	22.3
	3	1 Blakes Avenue	25.6	21.9	23.4
	4	24 Wadard's Meadow	29.7	25.2	24.1
	5	9 Oxford Hill	35.3	29.8	26.3
	6	80 Newland	42.8	35.4	29.7
	7	10 Bridge Street	61.5	54.6	40.8
	8	62 High Street	49.6	45.6	31.7
Monitoring Locations within the AQMA	9	Newland's Continuous Analyser	54.9	46.1	35.8
	10	Bridge Street	59.6	51.3	38.2
	11	Mill Street	41.5	36.8	29.5
AQO for NO_2			40		

5.1.4 The principal findings from the modelling of the Do Minimum 2011 and Do Something 2011 Scenarios, when the predicted levels of pollutants are compared with the existing situation at representative locations, are shown in Table 3. This shows the calculated concentrations at the chosen representative locations and indicates the expect decrease in pollutant emissions over time, with pollutant concentrations in the Do Minimum 2011 decreasing significantly from the current ambient levels. The annual mean concentrations of NO_2 do however remain above the objective at a number of receptors (as highlighted above). The contour plot of NO_2 concentrations does, however, indicate that the area of exceedences will be reduced.

5.1.5 In the Do Minimum scenario, traffic remains congested along Bridge Street, the High Street and Newland, with properties fronting on to the road experiencing annual mean NO_2 concentrations in the mid 40s to low 50s $\mu g/m^3$. With the introduction of the scheme the reassignment of traffic will lead to a significant reduction in pollutant concentrations along these roads. The annual mean NO_2 concentrations will fall by up to 14 $\mu g/m^3$, to below 40 $\mu g/m^3$ within the majority of the town centre. Other properties fronting onto roads in the highway network experiencing a reduction in traffic flows, such as Oxford Hill, Woodstock Road and Newland will also experience a reduction in pollutant concentrations of up to 6 $\mu g/m^3$, over the Do-minimum scenario. The contour plot of the proposed scheme's impact upon the pollutant concentrations within Witney town centre would indicate that the town centre AQMA could be redrawn and reduced in area or could be un-declared as an AQMA as a result of the introduction of the proposed Cogges Link Road.

5.1.6 Properties in Eton Close and Blakes Avenue, relatively close to the proposed road will experience an increase in pollutant concentrations with the opening of the road, with the annual mean NO_2 concentrations increasing from low 20s $\mu g/m^3$ by up to 6 $\mu g/m^3$ to 26 $\mu g/m^3$. Pollutant concentrations will however remain significantly within the AQOs.

5.1.7 With both the Do Minimum and Do Something scenarios, at all properties considered in the assessment the pollutant concentrations will reduce from the current ambient levels for the year of opening, 2011. It is concluded that the proposed road scheme would result in no residential properties experiencing an adverse impact in terms of local air quality, with the introduction of the proposed road scheme and that there are a substantial number of properties within the centre of Witney that would experience an improvement in local air quality.

6 Regional Air Quality Assessment

6.1.1 Pollutants from traffic can also contribute to more widespread impacts such as the formation of photochemical oxidants, enhanced acid deposition and an increased greenhouse effect. Phenomena of these types depend more on the total amount of pollution in the atmosphere and the prevailing atmospheric / climatic conditions than on concentrations in a particular locality.

6.1.2 DMRB provides a methodology for estimating the total pollutant emissions resulting from the scheme's implementation and to calculate a scheme's net contribution to overall air quality. Total emissions have been predicted for carbon monoxide (CO), nitrogen oxides (NOx), total hydrocarbons (THC), particulate matter (PM_{10}) and carbon (C) for the traffic baseline year (2005) and the proposed opening year (2011) for the Do Minimum and With Scheme scenarios.

Table 4: Regional Assessment Results

Scenario	CO (kg/year)	THC (kg/year)	NO_X (kg/year)	PM_{10} (kg/year)	C (tonnes/year)
Baseline 2005	33,024	4,167	13,526	526	1,418
Do Minimum 2011	27,986	3,321	10,388	374	1,538
Do Something 2011	26,114	3,058	11,233	386	1,591
% Change (2011)	- 6.7	- 7.9	+ 8.1	+ 3.3	+ 3.4

6.1.3 Table 4 shows the total annual mass emission of five pollutants generated by traffic on roads affected by the proposed road scheme. The table considers the percentage change in total emission from the Do Minimum and Do Something options for the year of opening. The table demonstrates the expected general decline in pollutant emissions over time (2005 - 2011) as a result in improvements in vehicle and fuel technology.

6.1.4 The table shows that there is a general increase in the emissions of pollutants, particularly in the levels of NO_X emissions with Do Something, compared to the Do Minimum. This is mainly due to the predicted increase in traffic in the area as a result of the new Cogges Link Road and a predicted increase in vehicle speeds as a result of traffic using the Cogges Link Road.

6.1.5 The additional vehicle emissions as a result of the scheme's additional length of carriageway, increase in vehicle speeds of vehicles on the Cogges Link Road and associated increases in vehicle kilometers travelled on the local road network outweigh the reduction in emissions in the centre of Witney, that would result from the reduced congestion as a result of the proposed scheme. The introduction of the proposed scheme leads to an increase in the emissions of greenhouse gases in particular nitrous oxides and carbon dioxide (as carbon).

6.1.6 There are no standards against which to evaluate the results of the regional assessment, however when compared to the national road transport emissions as provided in Table 5, the mass of emissions produced by the proposed road is an extremely small percentage of the total.

Table 5: Emissions from UK Road Transport Sources

Pollutant	Total UK Road Transport Emissions (KT)
Carbon monoxide (CO)	1140
Total oxides of nitrogen ($N0_X$)(1)	395
Volatile organic compounds (VOC)(2)	121
Particulates (PM_{10})	34
Carbon dioxide (CO_2)	122,724

KT = 1000 tonnes; kg*10^6
(1) $N0_2$ equivalents
(2) Excludes methane and therefore equivalent to 'non-methane hydrocarbons'

National Atmospheric Emissions Inventory (NAEI)

7 Conclusions

Assessment of Construction Impacts

7.1.1 During construction, the main air quality impacts are expected from the following key activities:

- Fugitive dust emissions from a variety of construction activities;
- HGV haulage of material to and from the construction site

7.1.2 With appropriate mitigation, the significance of the overall air quality impact on the majority of local residential properties during construction is likely to be of minor impact. There is the potential for some properties located within 200 metres of the construction site to be impacted to a higher degree.

Assessment of Operational Assessment

7.1.3 Table 4 shows the calculated existing concentrations at the chosen representative locations. It indicates that the objectives adopted in the Air Quality Strategy 2007 for NO_2 are currently not met in the town centre and will not be met in the year of opening 2011 reinforcing WODC decision to declare an AQMA within this area.

7.1.4 In the Do Minimum scenario, traffic remains congested along Bridge Street, the High Street and Newland with properties fronting on to these roads experiencing annual mean NO_2 concentrations in the low 40s $\mu g/m^3$, exceeding the AQO.

7.1.5 With the introduction of the scheme, the reassignment of traffic within the town centre will lead to a reduction in pollutant concentrations along these roads. The annual mean NO_2 concentrations will fall by up to 14 $\mu g/m^3$ to be significantly below 40 $\mu g/m^3$ at the majority of properties in the town centre. Other properties fronting onto roads in the highway network experiencing a reduction in traffic flows such as Oxford Hill, Woodstock Road and Newland will experience a reduction in pollutant concentrations of up to 6 $\mu g/m^3$. This would indicate that the town centre area AQMA could be redrawn and reduced in size or possibly un-declared.

7.1.6 Properties in Eton Close and Blakes Avenue relatively close to the proposed road will experience an increase in pollutant concentrations with the opening of the road, with the annual mean NO_2 concentrations increasing from the low 20s $\mu g/m^3$ by up to 5 $\mu g/m^3$ to 26 $\mu g/m^3$, the pollutant concentrations will remain significantly below the AQOs.

7.1.7 It is concluded that the proposed road scheme would result in no residential properties experiencing an adverse impact in terms of local air quality and that there are a substantial number of properties within the centre of Witney that would experience a major improvement in local air quality.

7.1.8 The regional greenhouse gas assessment shows that there is an increase in gaseous emissions of the majority of pollutants with the scheme, compared to the Do Minimum scenario. This is mainly due to the predicted increase in traffic in the area as a result of the new Cogges Link Road. The additional vehicle emissions are principally as a result of the scheme's additional lengths of carriageway and relatively high vehicle speeds along Cogges Link Road together with the associated increases in vehicle kilometers travelled, which outweighs the reduction in emissions in the town centre of Witney that would result from the proposed scheme reliving the town centre congestion.

7.1.9 There are no standards against which to evaluate the results of the regional assessment, the scheme implementation does lead to an increase in the emissions of carbon and nitrous oxides however when compared to the total national road transport emissions the mass of emissions produced by the proposed road scheme this is an extremely small percentage of the total.

8 References

1 The Air Quality Strategy for Scotland, Wales and Northern Ireland (2007)

2 The Environment Act 1995

3 Air Quality (England) Regulations SI 2000 No.928

4 Air Quality (England) (Amendment) Regulations SI 2002 No.3043

5 National Atmospheric Emissions Inventory 2005

6 Design Manual for Road and Bridges Volume 11 (2007)

7 Transport Analysis Guidance (www.webtag.org.uk)

8 Local Air Quality Management Technical Guidance (03)

Appendix 1
The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007)

The Environment Act 1995 introduced the legislative framework for local air quality management in the United Kingdom. It required the Secretary of State to produce a national air quality strategy. This was originally produced in 1997 and established the Government's agenda for air quality management in the future. The UK Strategy was revised in 2000 and updated in 2007 (The Air Quality Strategy for England, Scotland, Wales and Northern Ireland). The 2007 Strategy re-established objectives for improvements in air quality in the United Kingdom and includes new targets for $PM_{2.5}$ utilising the exposure reduction methodology. Within the Strategy, the revised set of Air Quality Objectives is presented, with some objectives being dropped (PM_{10} Objective for 2010) as well as new additions, such as objectives for $PM_{2.5}$ and O_3 concentrations together with one for the protection of vegetation and fragile ecosystems.

The Air Quality Human Health Objectives (for England & Wales) 2007 are shown below :

Pollutant	Objective	Measured as	To be achieved by
Benzene (C_6H_6)	16.25 µ g /m³ (5 ppb)	Running annual mean	31 December 2003
	5 µ g /m³ (1.5 ppb)	Annual mean	31 December 2010
1-3 Butadiene ($CH_2CHCHCH_2$)	2.25 µ g /m³ (1 ppb)	Running annual mean	31 December 2003
Carbon Monoxide (CO)	10 µ g /m³ (8.6 ppm)	Maximum daily running 8 hr mean	31 December 2003
Lead (Pb)	0.5 µ g /m³	Annual mean	31 December 2004
	0.25 µ g /m³	Annual mean	31 December 2008
Nitrogen Dioxide (NO_2)	200 µ g /m³ (105 ppb) not to be exceeded more than 18 times a year	1 hour mean	31 December 2005
and	40 µ g /m³ (21 ppb)	Annual mean	31 December 2005
Particles (PM_{10})	50 µ g /m³ not to be exceeded more than 35 times a year	24 hour mean	31 December 2004
and	40 µ g /m³	Annual mean	31 December 2004
Particles ($PM_{2.5}$)	25 µ g /m³ (target)	Annual mean (Exposure reduction - urban background)	2020
with	15% cut target		2010 - 2020
Sulphur Dioxide (SO_2)	350 µ g /m³ (132 ppb) not to be exceeded more than 24 times a year	1 hour mean	31 December 2004
and	125 µ g /m³ (47 ppb) not to be exceeded more than 3 times a year	24 hour mean	31 December 2004
and	266 µ g /m³ (100 ppb) not to be exceeded more than 35 times a year	15 minute mean	31 December 2005

$\mu g/m^3$ means micrograms per cubic metre; mg/m^3 means milligrams per cubic metre; ppb means parts per billion; ppm means parts per million; gravimetric means measured using the European gravimetric transfer sampler or equivalent.

In addition to these objectives, the strategy also included objectives for ozone, although these are to be addressed at the national level rather than by individual local authorities. Due to the nature of ozone pollution, action by one authority would be ineffective in controlling ozone concentrations.

The Ozone Air Quality Objective 2007 is shown in the table below

Pollutant	Objective	Measured as	To be achieved by
Ozone (O_3)	100 $\mu g/m^3$ (50 ppb) not to be exceeded more than 10 times a year	Daily maximum of running 8 hour mean	31 December 2005

The Air Quality Vegetation and Ecosystems Objectives (for England & Wales) 2007 are shown below

Pollutant	Objective	Measured as	To be achieved by
Oxides of nitrogen (NO_X)	30 $\mu g/m^3$	Annual mean	31 December 2000
Sulphur Dioxide (SO_2)	20 $\mu g/m^3$	Annual mean	31 December 2000
and	20 $\mu g/m^3$	Winter average	31 December 2000
Ozone (O_3)	18,000 $\mu g/m^3$	5yr average of summer 1hr values AOT40*	1 Jan 2010

*AOT40 - Accumulated Exposure over a Threshold Concentration of 40 ppb

Appendix 2

Basic Principles of Air Quality

Pollution from transport is one of the key determinants of air quality. This Appendix provides a basic outline of the properties and potential impacts on humans of some of the key pollutants released by vehicles.

Key Pollutants

The UK Air Quality Strategy (AQS) published by the Department of Environment Transport and the Regions (DETR) in January 2000 and since updated recognises oxides of nitrogen (NO_x) and emissions of particulate matter, less than 10 microns in diameter (known as PM_{10}) as being the pollutants of greatest concern from road traffic emissions. Hydrocarbon emissions (particularly in the form of benzene and 1,3-butadiene), lead, carbon monoxide and $PM_{2.5}$, (particulate matter less than 2.5 microns in diameter) have also been identified as key transport related pollutants. However, within the UK, most areas are unlikely to experience excessive levels of the lead and hydrocarbons, due to increasingly stringent controls on fuel emissions from the overall vehicle fleet in the UK.

This is reflected in the DETR methodology used to assess the potential air quality impact of road transportation schemes, the Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Part 1 (Air Quality) 2007, which primarily considers the following pollutants:

- Carbon monoxide (CO);
- Oxides of nitrogen (NO_x);
- Particulate matter, less than 10 microns in diameter (PM_{10}) and 2.5 microns ($PM_{2.5}$);
- Hydrocarbons (HC);
- Benzene (C_6H_6) and
- 1,3-butadiene (C_4H_6)

Each of the above air pollutants is considered in more detail below.

Carbon Monoxide (CO)

CO is produced by the incomplete combustion of fossil fuels. It is a colourless, odourless and toxic gas that combines with haemoglobin in the blood much more readily than oxygen. If inhaled it reduces the amount of oxygen that can be taken into the blood stream. CO is often used to predict the amount of road traffic pollution as it is produced in high concentrations in exhaust gases.
The National Atmospheric Emissions Inventory (NAEI) states that road traffic emissions accounted for approximately 50% of the total UK emissions of CO in 2005.

Oxides of Nitrogen (NO_x)

Motor vehicles produce NO_x when nitrogen in the fuel or air combines with atmospheric oxygen during the combustion process. The NO_x tends to be emitted predominantly as the less harmful nitric oxide (NO) and then converted into nitrogen dioxide (NO_2) in the atmosphere.

Since it is a gas NO_2 penetrates deep into the lungs causing damage to lung tissue and increased airway resistance and respiratory illness. Short-term exposure to NO_2 has been shown to increase lung reactivity to other pollutants. NO_2 is also involved in the formation of acid rain, photochemical smog and ozone.

The NAEI states that road traffic emissions accounted for approximately 37% of the total UK emissions of NO_x in 2005.

Fine Particulate Matter (PM_{10} and $PM_{2.5}$)

Fine particulate matter (PM_{10} and $PM_{2.5}$) are fine solids or liquid droplets suspended in the air. PM may be generated from a number of sources, for example, as a combustion product from fuel burning, by re-suspension of surface borne road dust and as an abrasion product from tyres and brakes. Both diesel and petrol vehicles emit particulate matter and contribute to the ambient concentrations of PM in the vicinity of roads. Diesel vehicles emit considerably higher levels of particulate matter compared to their petrol equivalents.

PM can aggravate diseases such as bronchitis, asthma and cardiovascular problems. Other symptoms include headaches, eye irritation, nausea and wheezing. PM also causes problems with visibility and soiling.

The NAEI states that road traffic emissions accounted for approximately 23% of the total UK emissions of PM_{10} in 2005.

Hydrocarbons (HC)

HC occur in vehicle exhaust emissions from un-combusted and incompletely combusted fuel. They are largely responsible for the odour of exhaust fumes. HC emissions also occur through fuel evaporation. Benzene and 1,3-butadiene, derived predominantly from vehicle emissions, are highlighted in the AQS as toxic carcinogens.

The NAEI states that road traffic emissions accounted for approximately 23% of the total UK emissions of benzene and 55% of the total UK emissions of 1,3 -butadiene in 2005.

Carbon Dioxide (CO_2)

CO_2 formed during the combustion of fossil fuels is recognised as being of concern on a global rather than local scale because of its contribution to global warming via the greenhouse effect. As such, it is not considered in the Localised Air Quality Impact Assessment but is included in the Regional Impact Assessment.

The NAEI states that road traffic emissions accounted for approximately 21% of the total UK emissions of CO_2 (as carbon) in 2005.

Factors affecting Pollutant Concentrations

A number of factors influence how road transport sources contribute to overall air quality emissions. These include a number of general factors that influence the emission characteristics from road vehicles, although, emissions from a particular vehicle operated under specific circumstances may deviate considerably from the average pattern. The general factors include:

- Traffic composition - the greater the percentage of Heavy Duty Vehicles (HDVs) the greater the total emission. This is predominantly because larger vehicles usually have large capacity engines and predominantly burn diesel fuel.
- Average speed - the highest emission rates are encountered in congested, slow moving traffic. Emission rates under stop start driving conditions are much higher than those when vehicles are driven more smoothly. Accordingly, queue lengths are an important consideration. There is also a tendency for emission rates to increase at high speeds, particularly those of NO_x.

- Fuel used - for engines of a similar age and technological standing, diesel fuels are generally considered to produce elevated concentrations of some pollutants, especially particulate matter, in comparison to petrol engine equivalents.
- Vehicle related - the engine size, vehicle age, maintenance and fitting of a catalyst all influence the emissions from a particular vehicle. In general, the smaller the engine size, the newer the car and the better the maintenance, the lower the emissions. Also, catalyst equipped cars will have fewer emissions than equivalent non-catalyst cars, once engines are at operating temperatures.
- Driving Style - emission rates under stop-start driving conditions are much higher than those when vehicles are driven more smoothly.
- Distance from the source - as the distance increases from the emission point, natural dispersion of the pollutants will occur resulting in a reduced pollutant concentration.
- Although road projects may often be perceived as only having negative impacts, for a development such as Cogges Link Road, the overall environmental effect is likely to be beneficial. This is due to a number of factors, in particular:
- The Cogges Link Road would relieve congestion on Bridge Street;
- Average traffic speeds on much of the Bridge Street would increase as a result of the link road, most notably during peak and congested periods; and traffic queues at main junctions may be relieved by the link road.

Appendix 3

Modelling and Model Verification

The pollutant concentrations have been modelled using a single year of neutral meteorological data from RAF Brize Norton meteorological station (2005) which is considered to be the most suitable data set for this study area. Since both Do Minimum and Do Something scenarios utilise the same data set, it is considered that the inter-annual variability in meteorological data is unlikely to impact on the results and conclusions.

Background Concentrations

The background concentrations used in the study was determined using the NO_2 diffusion tube located in Early Road, Witney, which is representative of the urban background concentrations. The diffusion tube established an annual background concentration of NO_2 of 21 $\mu g/m^3$ when bias adjusted.

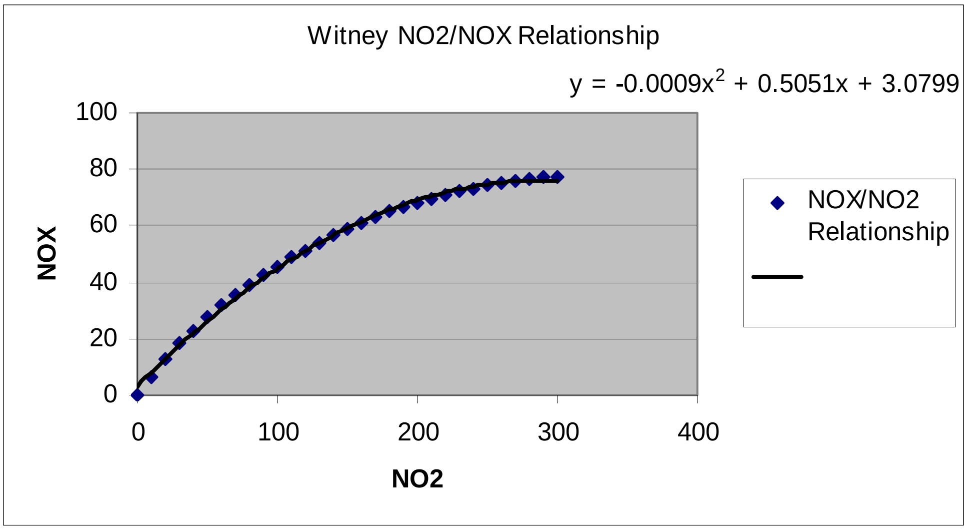
Conversion of NO_X to NO_2

The proportion of NO_2 in NO_X varies greatly with time and space according to a number of variable factors including the distance from the emission source and the amount of low level ozone available. Recent data reported in "Deriving NO_2 from NO_X for Air Quality Assessments of Roads – Updated to 2006" (Laxen & Marner March 2007) highlighted the changing profile of vehicle emissions with the level of primary NO_2 increasing in the total NO_X emitted. The increases in the % of NO_2 are thought to be due primarily to the increased penetration of Euro III diesel vehicles fitted with oxidation catalyst and the fitting of catalytic regenerative traps to the vehicles exhaust system. The report highlighted the fact that the previous DMRB methodology significantly underestimated the nearside road concentrations of NO_2 by over 20%.

This change in the NO_2 / NO_X relationship has been reflected in advice from the Highways Agency that the methodology of TG(03) and DMRB should be updated to include the DEFRA issued NO_X to NO_2 calculator or where available local monitored data (since 2003) should be used in the verification of the model.

Data from the continuous analyser located at the junction of Bridge Street and Newland was used to produce a localised NO_2 / NO_X relationship. A polynomial equation based upon the monitored NO_X / NO_2 curve was developed and this has been used to convert the annual average NO_X concentrations generated by the model to annual average NO_2 concentrations.

Newland Continuous Analyser NO_X / NO_2 Curve



Data Verification

As previously discussed it is important to make a comparison between the modelling results and actual monitoring data, to ensure that the model is reproducing actually reproducing observed data sets. Greater confidence in the accuracy of the future years modelling results and their robustness if good agreement is found between the monitored and modelled baseline conditions.

Data from the two diffusion tubes have been used to adjust the modelled results, their high exposure in the AQMA being particular relevant. The modelled results were adjusted using a calibration factor derived from the results of the monitored and modelled specific receiver locations. The verification methodology follows the procedure in TG.03.

The polynomial equation describing the localised NO_2 / NO_X relationship, from the Bridge Street / Newland analyser is used to determine the proportion of NO_X converted to NO_2 at each site. The monitored roadside NO_2 is derived by subtracting the background NO_2 from the total monitored NO_2 concentration at each site. The modelled and monitored roadside NO_2 contributions are then compared in a scatter graph and a trend line developed. An equation describing this relationship is derived, fitting it through zero. The equation of the trend line is then used to correct the modelled roadside NO_2 concentrations further.

The corrected modelled roadside NO_2 is then added to background NO_2 to derive the total modelled NO_2 concentrations at each site. Another scatter graph was then drawn to compare the total modelled NO_2 against total monitored NO_2, the equation of this trend line is then used to further adjust the total modelled NO_2.

Diffusion Tube Site	Annual Mean NO_2 µg/m³ (2005)		
	Modelled	Monitored (adjusted)	Difference
Bridge Street	59.7	53.0	12.6
Mill Street	41.5	44.0	- 5.7

Uncertainty Estimates

In addition to systematic errors in the model, such as variations in the traffic information or meteorological data, the model is likely to predict concentrations slightly different from the actual monitored ambient levels. These random errors are useful in assisting in the declaration of an AQMA and in particular the extent of its boundary. Guidance from National Society for Clean Air (NSCA) "Air Quality Management Areas: Turning Reviews into Action" identifies a number of ranges of uncertainty (based upon the relevant objective) that may be used when there are only a few locations suitable for verification.

'Stock U Values', figures provided by the NSCA allow the standard deviation of the model (SDM) to be calculated. The Stoke U Value for NO_2 is between 0.1 and 0.2 for an annual mean. The SDM can be calculated from the air quality objective (Co) and the U value.

Co for NO_2 = 40

SDM = 0.1 * 40 = 4 µg/m³

The calculation quantifies the uncertainty in the model in the identification of areas where exceedences of the AQO may be considered possible. This gives a band that, therefore extends between 36 µg/m³ and 44 µg/m³ at one standard deviation where the possibilities of exceedences of the objective may exist. The extent of AQMA should therefore consider the possibility of exceedences based upon the 36 µg/m³ annual mean NO_2 contour. The contour plots of the annual mean concentration of NO_2 highlight this area.

Figure 1

Witney Air Quality Management Area

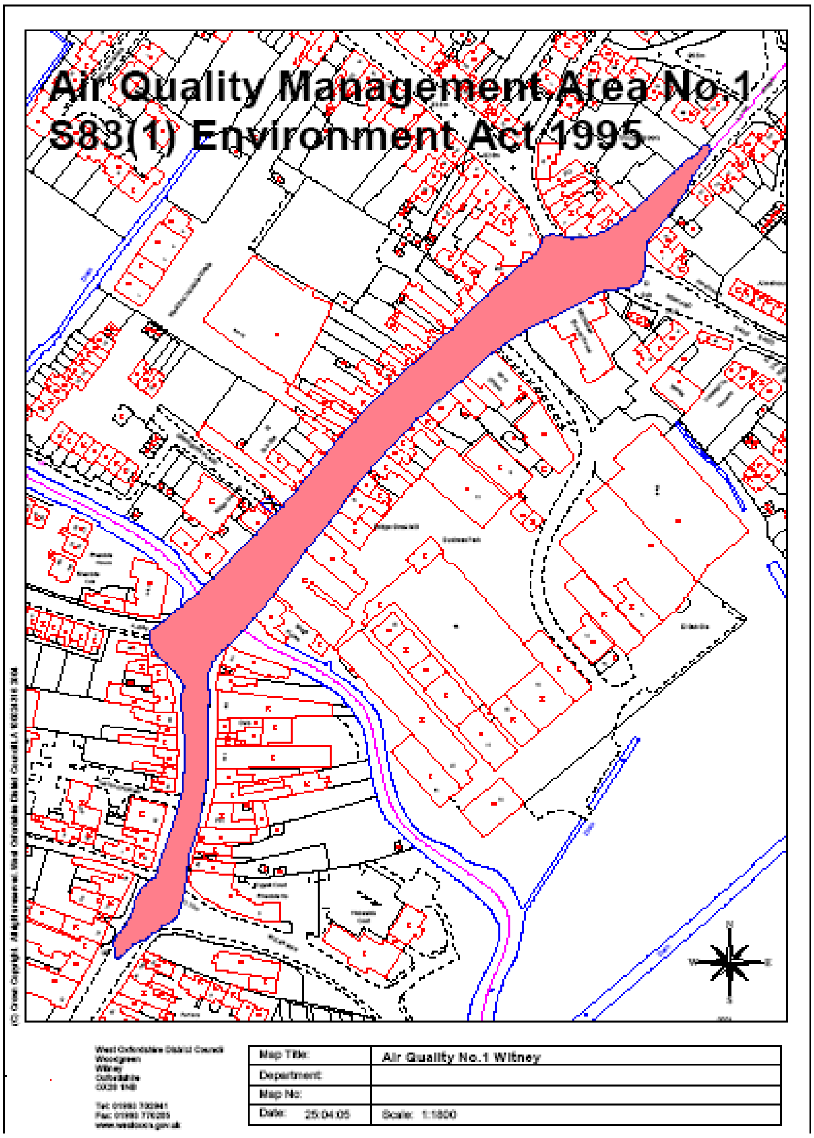


Figure 2

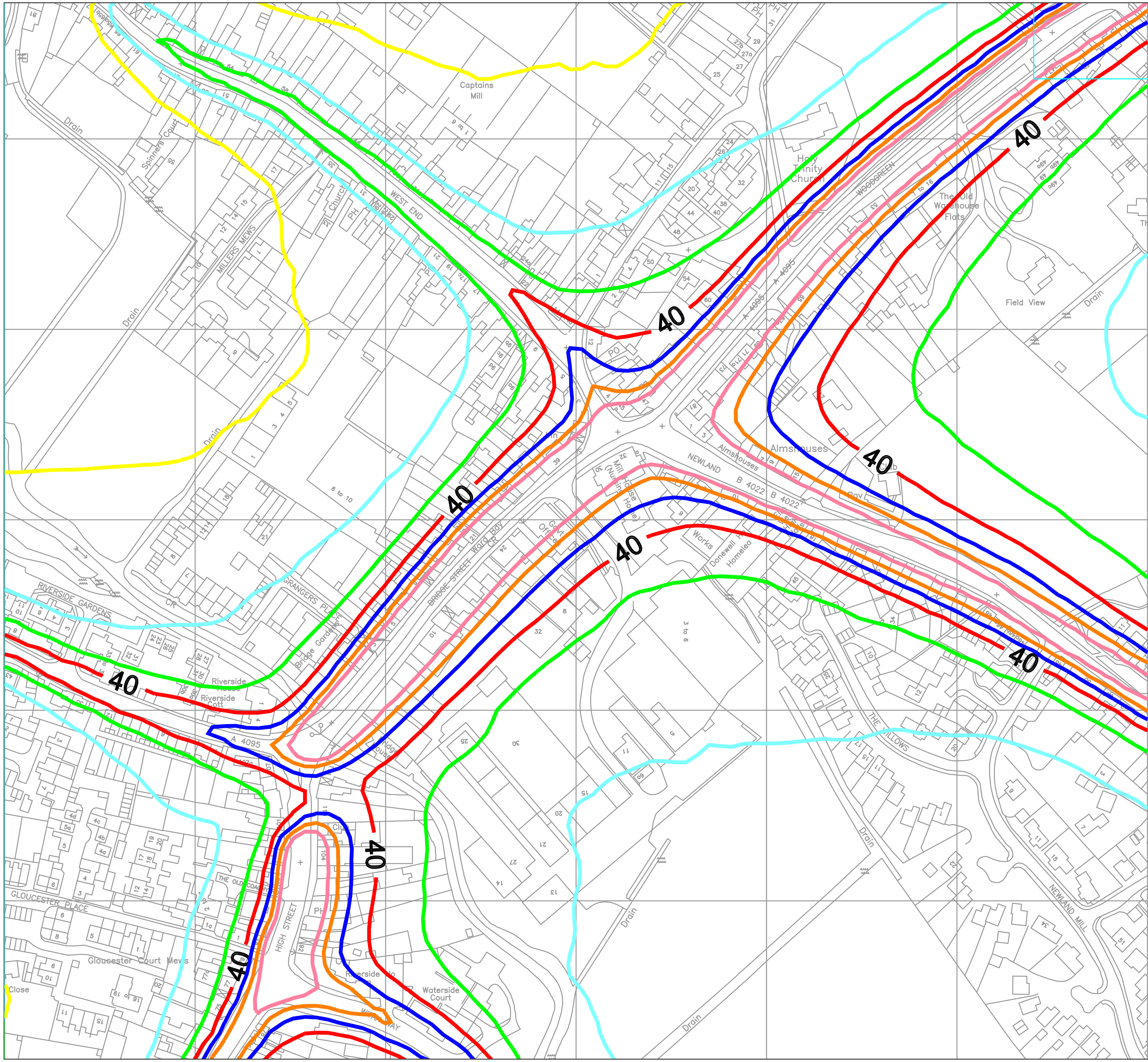
Baseline : Annual Mean Nitrogen Dioxide Concentrations 2005

Figure 3

Do Minimum : Annual Mean Nitrogen Dioxide Concentrations 2011

Figure 4

Do Something : Annual Mean Nitrogen Dioxide Concentrations 2011



Annual Mean µg/m³

Yellow	28
Light blue	32
Green	36
Red	40
Blue	44
Orange	48
Pink	52

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Oxfordshire Highways
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Project: Cogges Link Road

Title: Base Year: Annual Mean Nitrogen Dioxide Concentrations µg/m³
Year 2005
Figure 2

Scale	Drawn By	Checked By	Approved By
NOT TO SCALE DO NOT SCALE	S.O. Date 20.11.07	R.W. Date 20.11.07	J.R. Date 20.11.07

Clients Ref

Drawing Number: B0834600/Fig 2 | Rev: 1

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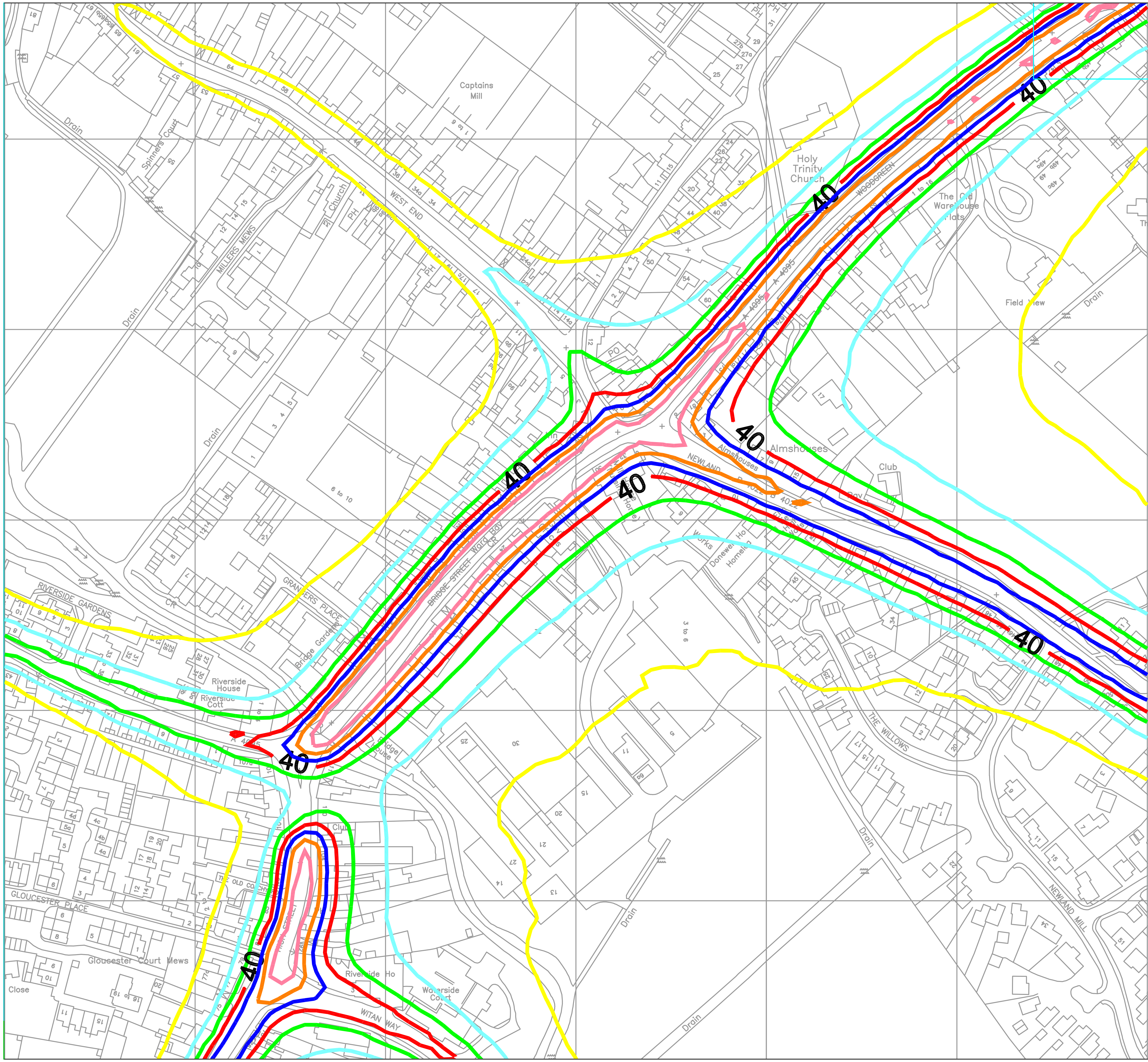

Annual Mean µg/m³

	Annual Mean µg/m³
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Telephone (01844) 296200
FAX (01844) 296201

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Project: Cogges Link Road

Title: Do Minimum: Annual Mean Nitrogen Dioxide Concentrations µg/m³
Year 2011
Figure 3

Scale	Drawn By	Checked By	Approved By
NOT TO SCALE DO NOT SCALE	S.O. Date 20.11.07	R.W. Date 20.11.07	J.R. Date 20.11.07

Clients Ref

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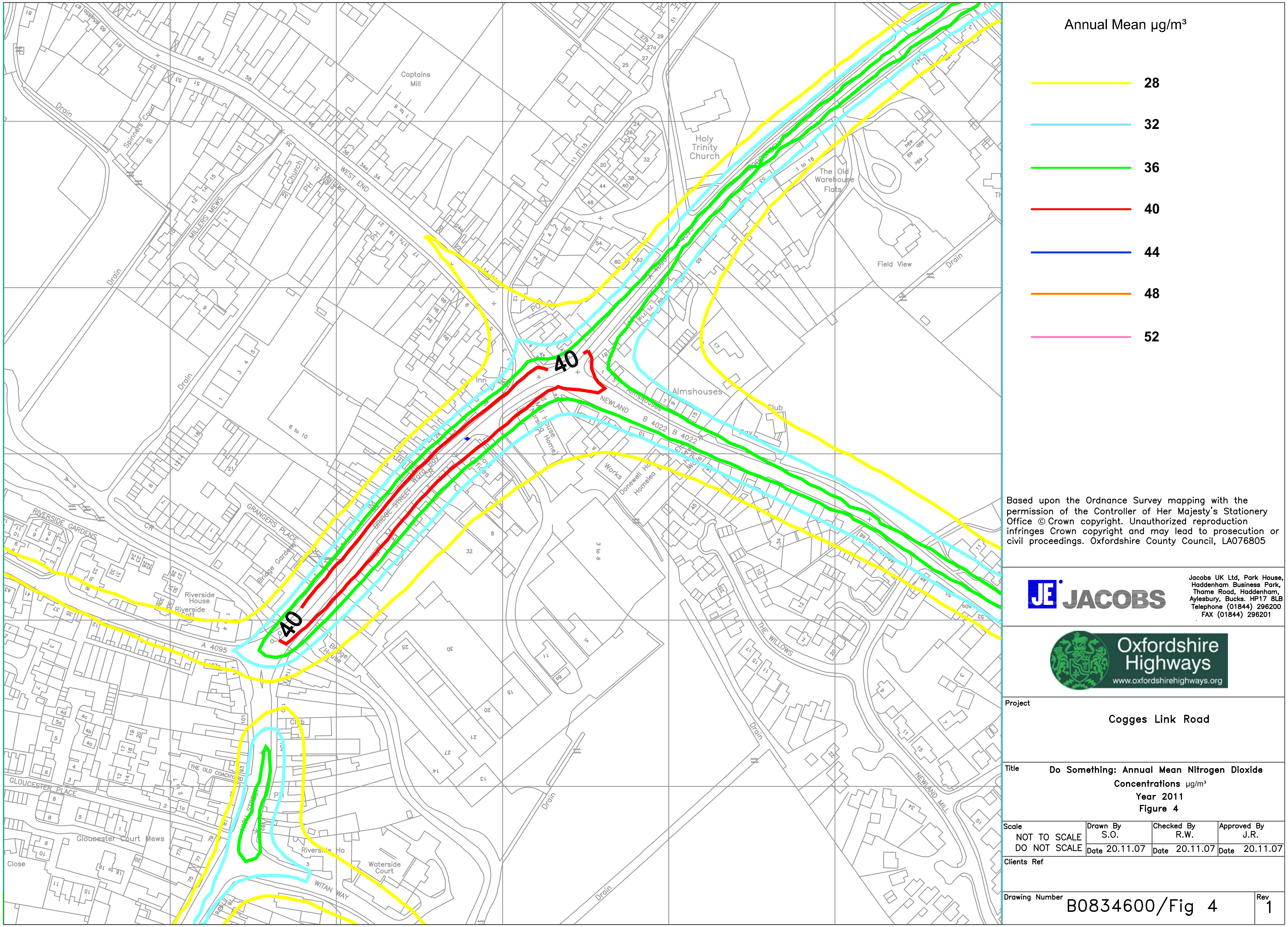

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Jacobs UK Ltd, Park House, Haddenham Business Park, Thame Road, Haddenham, Aylesbury, Bucks. HP17 8LB
Telephone (01844) 296200
FAX (01844) 296201

Oxfordshire Highways
www.oxfordshirehighways.org

Project: Cogges Link Road

Title: Do Something: Annual Mean Nitrogen Dioxide Concentrations µg/m³
Year 2011
Figure 4

Scale	Drawn By	Checked By	Approved By
NOT TO SCALE DO NOT SCALE	S.O. Date 20.11.07	R.W. Date 20.11.07	J.R. Date 20.11.07

Clients Ref

Drawing Number: B0834600/Fig 4 — Rev 1

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