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HIGHWAYS AGENCY

M1 Junction 19 Improvement

Environmental Statement

Volume 2

Chapter 1 Air Quality and Climate Change

Final

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1.1 INTRODUCTION

1.1.1 This chapter assesses the potential impacts to Air Quality of the improvement proposed for the M1 Junction 19 both operationally due to changes in the road network layout and traffic flows, and during construction. The assessment has focused on nitrogen dioxide (NO_2) and particulate matter (PM_{10}) (including construction dust) as well as the effects of the proposed junction on carbon dioxide (CO_2) emissions which are recognised as being important to climate change.

1.1.2 The local air quality impacts on NO_2 and PM_{10} concentrations have been assessed at receptors around the M1 Junction 19, including properties in the surrounding villages Lilbourne, Catthorpe, Shawell and Swinford. Pollutant concentrations due to road traffic emissions have been predicted at these receptors, using the ADMS (Atmospheric Dispersion Modelling Software) Roads advanced dispersion model, whilst the impacts of the construction phase of the junction improvements have been assessed qualitatively.

1.1.3 The operational impacts of the proposed junction on changes in overall emissions due to road traffic have been assessed using the Environmental Assessment Techniques described within Volume 11, Section 3 of the Highways Agency's Design Manual for Roads and Bridges (DMRB)[1] and DfT's Transport Analysis Guidance (TAG)[2] to determine overall changes in air quality based on exposure.

1.1.4 The methodology used for this assessment is described in Section 1.2, while a review of relevant legislation and planning policy with regards to air quality is provided in Section 1.3. The existing air quality in the vicinity of the proposed junction is presented in Section 1.4. Existing air quality has been established through a review of the local authorities Local Air Quality Management (LAQM) reports and available monitoring data undertaken as part of the air quality assessment for the proposed junction improvements. Existing pollutant concentrations have been discussed in relation to the air quality criteria, whilst the potential impacts and associated mitigation measures are discussed in Section 1.5. Finally, the residual air quality impacts and their significance are presented respectively in Sections 1.6 and conclusions are provided in Section 1.8. Section 1.7 provides an indication of any difficulties encountered in the assessment.

1.1.5 In common with other Chapters the Air Quality and Climate Change assessment recognises that the Catthorpe Viaduct, which carries the M6 to M1 Southbound link over the M1, is being replaced as a maintenance project. The scope of this work includes the replacement of the bridge on a new alignment immediately to the south west of the existing. It also requires the creation of new approach embankments either side of the M1. The work is programmed to begin in June 2010, for completion in November 2011.

1.1.6 The bridge and earthworks either side of the M1 would be retained in the proposed layout for the M1 Junction 19 Improvement, as would the alignment of the M6 to M1 Southbound link east of the M1. To the west of M1 this link would have to be amended to accommodate the proposed M6 to A14 link.

1.1.7 A separate environmental assessment[3] has been carried out for the bridge replacement as a standalone maintenance project.

1.1.8 This EIA for the M1 Junction 19 Improvement takes into account the new bridge both:-

- As part of the existing junction assuming the M1 Junction 19 Improvement is not built, the 'Do Minimum' scenario
- As part of the completed M1 Junction 19 Improvement, the 'Do Something' scenario

1.1.9 In terms of this assessment replacement of the Catthorpe Viaduct will result in some impacts for nearby properties during its construction in advance of the junction improvement. In operational terms, replacement of the viaduct would not result in any traffic changes and has no effect on the assessment for air quality and climate change presented in this chapter.

1.1.10 These issues are discussed at Section 1.6 Environmental Impacts.

Objectives

1.1.11 The project objectives for the assessment in relation to Air Quality and Climate Change are:-

- To improve local air quality in line with National Air Quality Objectives
- To reduce emissions of Carbon Dioxide

Interactions

1.1.12 There are interactions between this chapter and other chapters as follows:-

- Noise effects which would also affect receptors identified in this chapter are described in Chapter 6 Noise and Vibration
- Visual impacts for local residents are covered in Chapter 4 Landscape
- Chapter 3 Ecology and Nature Conservation identifies designated ecological sites which have to be assessed for air quality impacts

Potential Impacts During the Operational Phase

1.1.13 Emissions from traffic resulting from changes to road infrastructure and new highways have a potential impact on air quality.

1.1.14 The main constituents of vehicle exhaust emissions, produced by the combustion of hydrocarbon fuel in the presence of air, are carbon dioxide (CO_2) and water vapour (H_2O). However, combustion engines are not perfectly efficient and partial combustion of fuel results in emissions of carbon monoxide (CO), particulates, hydrocarbons and Volatile Organic Compounds (VOCs). In addition, some of the nitrogen in the air is oxidised under the high temperature and pressure during combustion. This results in emissions of nitrogen oxides (NO_x). NO_x emissions from vehicles predominately consist of nitric oxide (NO), but also contain nitrogen dioxide (NO_2). Once emitted, NO can be oxidised in the atmosphere to produce further NO_2.

1.1.15 The quantities of each pollutant emitted depend upon the type and quantity of fuel used, engine size, speed of the vehicle, driving conditions, and the type of emissions abatement equipment fitted. Once emitted these pollutants disperse in the air with the effect that pollutant concentrations generally decrease further from the road until concentrations reach background levels. The pollutants commonly associated with road traffic emissions are nitrogen dioxide (NO_2), fine particulates (PM_{10}), carbon monoxide (CO), hydrocarbons, 1,3-butadiene and benzene, as well as carbon dioxide (CO_2).

1.1.16 The air quality assessment will focus on the pollutants NO_2 and PM_{10} which are the least likely to meet their Air Quality Strategy (AQS) objectives in the vicinity of roads. This approach was also adopted in the Environmental Impact Assessment Scoping Report[4]. This approach is demonstrated by the LAQM review and assessment process which shows that around 90% of Air Quality Management Areas (AQMAs) declared by Local Authorities in the UK are for these pollutants in relation to road traffic emissions. The data for these AQMAs for various pollutants is provided in Table 1.1.

Table 1.1: Number of Local Authorities Declaring AQMAs Based on Pollutant

Pollutant	No. of Local Authorities declaring AQMA
235 AQMA across UK	
Nitrogen Dioxide (NO_2)	213
Particulates (PM_{10})	74
Sulphur Dioxide (SO_2)	11
Benzene (C_6H_6)	1
Source: Air Quality Archive website [5]	

1.1.17 It is evident from Table 1.1 that NO_2 accounts for the majority of AQMAs, followed by PM_{10}. Further details of the pollutants associated with road traffic emissions are provided in the following sections.

Nitrogen Oxides

1.1.18 Nitric oxide (NO) and nitrogen dioxide (NO_2) are collectively known as nitrogen oxides (NO_x). Nitrogen oxides are produced during the high temperature combustion processes involving the oxidation of nitrogen. Nitrogen oxides are initially emitted mainly as nitric oxide. This nitric oxide then undergoes further oxidation in the atmosphere, particularly with ozone, to produce secondary NO_2. The production of secondary NO_2 could also be favoured due to a class of compounds, VOCs, typically present in urban environments, and under certain meteorological conditions such as hot sunny days and stagnant anti-cyclonic winter conditions.

1.1.19 Of nitrogen oxides it is NO_2 that is associated with the health impacts[6]. Exposure to NO_2 can bring about reversible effects on lung function and airway responsiveness. It may also increase reactivity to natural allergens and exposure to NO_2 puts children at increased risk of respiratory infection and may lead to poorer lung function in later life.

1.1.20 National emissions for NO_x have decreased by 46% in 2007 compared with 1990. For 2007, NO_x (as NO_2) emissions are estimated to be 1486 kilo tonnes[7] The transport sector remained the largest source of NO_x emissions with road transport contribution 30% to NO_x emissions in 2007. Power and energy industries and manufacturing industries and construction sectors are the next large contributors to NO_x emissions with respective estimated contribution of 29% and 17%.

Particulate Matter

1.1.21 Particulate matter also called particulate pollutants is a mixture of solid and liquid particles suspended in the air. There are a number of ways the airborne particulate matter may be categorised. The most widely used categorisation is based on the size of particles such as $PM_{2.5}$, particles of diameter less than 2.5 µm, PM_{10}, particles of diameter less than 10 µm.

1.1.22 Particulate matter is composed of a wide range of materials arising from a variety of sources. Examples of man-made sources are carbon particles from incomplete combustion, ash, re-condensed metallic vapours and so-called secondary particles (or aerosols) formed by chemical reactions in the atmosphere. As well as being emitted directly from combustion sources, man-made particles can arise from mining, quarrying, and construction operations, from brake and tyre wear in motor vehicles and from road dust re-suspension from moving traffic or strong winds. Natural sources of particles included wind-blown dust, sea salt and biological particles such as pollen and fungal spores.

1.1.23 The health impacts from particulate matter depend upon size and chemical composition of particles. For the purposes of AQS objectives (provided in Section 1.3), the particulate matter, PM_{10} and $PM_{2.5}$, is solely defined on size rather than chemical composition. This enables a uniform method of measurement and comparison. The short and long-term exposure to particulate matter has been associated with increased risk of lung and heart diseases. Particles may also carry surface-absorbed carcinogenic compounds. Smaller particles have a greater likelihood of reaching the lungs which may cause adverse health effects[6].

1.1.24 Particles between $PM_{2.5}$ and PM_{10} are termed the coarse fraction and are normally deposited in the upper airway. Generally, particles generated from combustion processes and the condensation of vapours fall within the fine fraction ($PM_{2.5}$) whereas those particles generated from mechanical break down of solids (such as during quarrying and construction activities) are within the coarse fraction ($PM_{2.5}$ and above)[8].

1.1.25 The emissions of PM_{10} have declined significantly since 1970, particularly due to reduction in coal use. More recently, in the UK the emissions of PM_{10} are estimated to be 125 kilo tonnes in 2007[7]. Road transport and industrial processes remain the largest sources of PM_{10} emissions, but residential emissions, those due to commercial activities, and manufacturing are also significant. Road transport is estimated to have contributed 21% to PM_{10} emissions in 2007[7]. The main source within road transport is exhaust emissions from diesel vehicles, but tyre and brake wear are also significant.

1.1.26 It is important to note that theses estimates only refer to primary emissions, that is, the emissions directly resulting from sources and processes and do not include the secondary particles. These are the particles resulting from the interaction of various gaseous components in the air, such as ammonia, sulphur dioxide and nitrogen oxides. These secondary particles can come from further a field and impact on the air quality in the UK and vice versa.

1.1.27 Similar to PM_{10}, emissions of $PM_{2.5}$ have declined since 1970 and more recently. In 2007 emissions of $PM_{2.5}$ are estimated to be 82 ktonnes[7] which is approximately 60% of PM_{10} emissions.

Construction (Nuisance) Dust

1.1.28 Airborne particles cover a wide range of particle sizes and types (e.g. wind blown dust, sea salt aerosols, biological material and secondary particles). In the UK and Europe, air quality standards and guidelines are currently related to particles of less than 10µm in aerodynamic diameter, referred to as PM_{10}. These particles are representative of the large proportion of airborne particulate matter, which may have a potential impact on health. Particles of less than $PM_{2.5}$ are referred to as the fine fraction and are capable of reaching the deepest part of the lung.

1.1.29 The nuisance effects of dust emissions are related to both emissions of large and fine particles. Deposition of these particles onto surfaces, such as windows and cars, causes soiling that, if sufficiently great, can be perceived as a nuisance. In addition, occasional clouds of dust can cause a visual and sensory nuisance. It is important to note that the PM_{10} fraction of fugitive particulate emissions has a far smaller deposition rate than larger size fractions, and can travel up to 1km from source[9].

1.1.30 There are no nationally adopted UK, European, or World Health Organisation (WHO) assessment criteria for nuisance arising from the deposition of dust. Custom and practice criteria are applied in accordance with the monitoring methods used, which vary according to the specific requirements of any monitoring strategy put in place.

1.1.31 Table 1.2 provides a summary of the monitoring methods typically used for the determination of nuisance occurrence and the criteria applied to establish the likelihood of nuisance occurrence. It is worth noting that exceedence of these criteria does not automatically infer that nuisance has taken place – this is entirely dependent upon the perception of nuisance, which in itself is subject to considerable variation due to differing attitudes to 'what is nuisance'. Generally, nuisance dust in the community is perceived as an accumulated deposit on surfaces such as window ledges, paintwork and other light coloured horizontal surfaces. When the rate of accumulation is sufficiently rapid to cause noticeable fouling, discolouration or staining then the dust is generally considered to be a nuisance. However, the point at which an individual makes a complaint regarding dust is highly subjective.

Table 1.2: Typical Approaches to Dust Deposition Monitoring

Method	Monitoring Technique	Units	Typical Criteria
Deposition Gauges	Frisbee / Directional Dust Gauges	Deposition of mass per unit area per day	200 mg/m^2/day (averaged over a month)[10]
Reflectance Techniques	Sticky Pads / Strips [11]	% Effective Area Coverage (EAC) per day	0.2 % = Noticeable 0.5 % = Possible complaints 0.7 % = Objectionable 2.0 % = Probable complaints 5.0 % = Serious complaints[11]
	Dust Slides [12]	Soiling Units (SU)	>25 SU per week is likely to cause complaint [13]

Carbon Dioxide

1.1.32 Carbon dioxide (CO_2) is a major product of the combustion of carbon containing materials such as fossil fuels and organic matter, and is produced by many other chemical processes. CO_2 is also emitted from natural processes such as geothermal sources and evaporation from the oceans. CO_2 is a greenhouse gas which can trap heat from the Earth and increase atmospheric temperatures. Emissions of CO_2 are important on a global and national scale due to the global warming potential of CO_2 and its resulting role in climate change. The Climate Change Bill was introduced into Parliament in November 2007 and became law on 26 November 2008. The Climate Change Act 2008[14] provides a new approach to managing and responding to climate change in the UK.

1.1.33 Recent emissions estimates show that CO_2 emissions (as CO_2 equivalent) have decreased by about 8% in 2007 compared with 1990. This suggests a further reduction of about 12% by 2010, is required if the short-term domestic goal to reduce CO_2 emissions is to be achieved. For 2007 the CO_2 emissions in the UK are estimated to be 543 Mtonnes[7]. Energy supply is the largest contributor to these emissions with a percentage share of 40% in 2007. The other important sectors include transport (25%), businesses (16%) and residential sectors (14%).

1.2 METHODOLOGY

1.2.1 The impacts on air quality of the proposed improvement for the M1 Junction 19 have been assessed in two parts:-

- Local Air Quality Impact; and
- Regional Air Quality Impact

1.2.2 The impacts of the proposed junction on air quality during construction are also considered in Section 1.6. The assessment of construction traffic emissions has been undertaken by way of a qualitative assessment which includes review of best practice measures for minimising release of dust and particulates from construction traffic and construction related processes.

Local Air Quality Impact Assessment Methodology

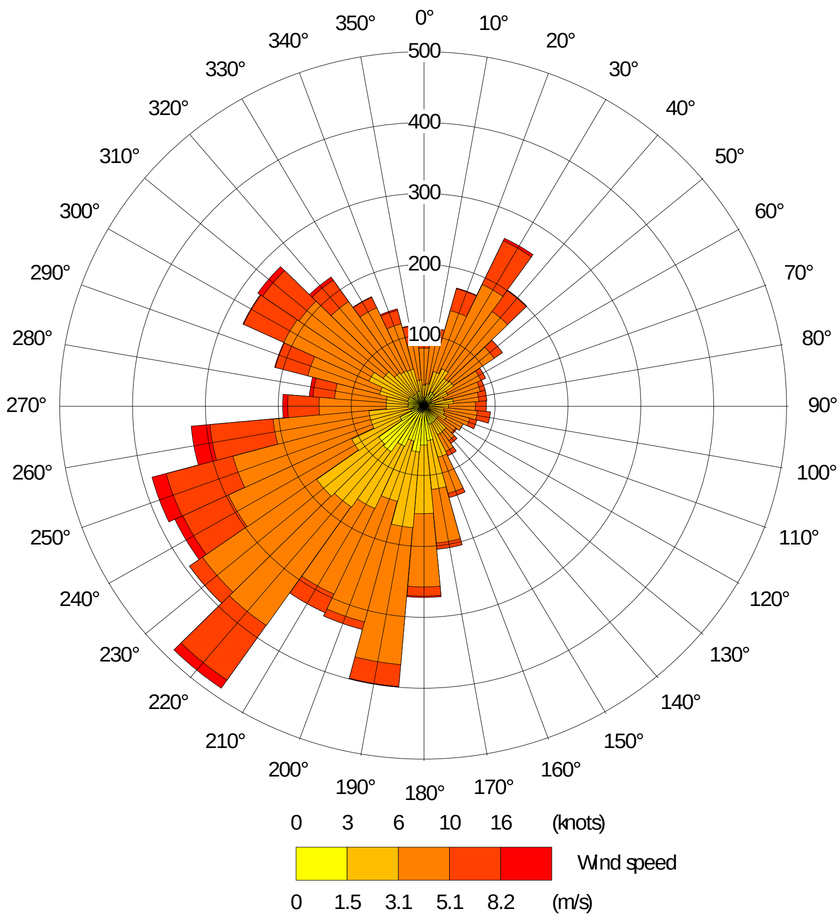
1.2.3 The impact of the proposed junction on local air quality has been assessed using the framework of the methodologies outlined in DMRB[1]. However, rather than employing the DMRB local air quality assessment screening model to predict pollutant concentrations, detailed dispersion modelling has been undertaken using the Cambridge Environmental Research Consultants (CERC) Ltd ADMS-Roads advanced Gaussian air dispersion model. Details of the model inputs are provided below. The ADMS roads model has been used for the prediction of the local air quality impacts because it allows for the consideration of complex layout of multiple road links which are important considerations when predicting pollutant concentrations.

1.2.4 ADMS-Roads (v2.3) is the latest model in the ADMS family from CERC. Based on the ADMS-Urban system, it can model up to 600 road sources and seven industrial sources at any one time. The model has been extensively used in local air quality management, and has formed the basis for many AQMA declarations. Whilst a considerable number of validation studies have been completed for the model, a specific verification of the model outputs based on monitoring data in the vicinity of the junction have been undertaken in order to ensure that the results of the local air quality assessment are consistent with observations at monitoring sites.

Meteorological Data

1.2.5 Meteorological data for 2007 has been used from Church Lawford meteorological station situated les than 15km west-south-west of M1 Junction 19. Figure 1.1 presents the wind rose for the Church Lawford meteorological data and illustrates the dominant southerly wind direction.

Figure 1.1: Church Lawford Wind Rose (2007)



Road Sources

1.2.6 Modelled traffic data validated against observed flows has been provided by Jacobs for those links associated with the M1 Junction 19 and local road network, and incorporated into the air quality model. The traffic data is provided in Appendix A.

1.2.7 Using the criteria provided by the DMRB[1] for local assessments, road links have been screened out of the assessment, where they do not match any of the following criteria, based on change between the Do Minimum (2014) and Do Something (2014). However, in some cases, roads below the criteria have been included in order to complete gaps on the modelled road network:-

- Road alignment will change by 5m or more; or
- Traffic flows will change by 1000 vehicles per day or more; or
- Heavy-duty vehicle (HDV) flows will change by 200 vehicles per day or more; or
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr or more

1.2.8 The modelled road links are illustrated in Figure 1.2 for the base year 2007, Do Minimum 2014 (including Catthorpe Viaduct), and Do Something 2014.

1.2.9 The local and regional air quality assessments have been carried out using the validated traffic model. A wider-scale traffic network has also been developed using the Simulation and Assignment of Traffic to Urban Road Networks (SATURN) network analysis program. In addition to the full validated links that are used within the air quality assessment, the wider network from SATURN also includes simulated links (e.g. Rugby) and key links in buffer areas, such as the M69, which may also be affected by the proposed junction. This wider network has been used as part of the TAG[2] Unit 3.3.5 assessment of greenhouse gases as described in paragraph 1.2.44 below.

1.2.10 Sections of the wider network including parts of Rugby within a declared Air Quality Management Area (AQMA) (see Section 1.4 Baseline Conditions below) are not included in the area validated for the traffic model, so the full extent of the AQMA has not been included in the air quality modelling. Some individual receptors within the Rugby AQMA have been assessed and these are indicated on Figure 1.3 along with the extent of the AQMA within the study area.

1.2.11 It is considered that the urban area of Rugby (including within the AQMA) would be unlikely to experience significant impacts from strategic traffic changes resulting from the implementation of the proposed junction.

1.2.12 Modelled roads were assumed to be at ground level apart from bridges or roads on embankments, which have been elevated in the air quality model. Where sections of the M1 or other roads are in a cutting, as the air quality model does not allow roads to be set below 0m, this was accounted for locally in the model by estimating the difference in elevation between the road and the receptors and adjusting the receptor height accordingly.

Emissions Factors

1.2.13 The emissions factors incorporated into ADMS-Roads (v2.3), which were used to calculate the NO_x and PM_{10} emissions for each road link in the assessment are the most up-to-date emission factors available. These factors, released in 2003 by Department for Environment Food and Rural Affairs (Defra) and Department for Transport (DfT), are the same as those calculated with the Emission Factors Toolkit[15] and the DMRB[1] widely used throughout the UK. The emissions factors are available for three different road types which act as a proxy for the differences in fleet composition of traffic in different conditions; urban, rural and motorway.

1.2.14 Emission factors for brake and tyre wear were not part of the emission factors database released in 2003 due to the lack of available data and high uncertainties. However, it is acknowledged that brake and tyre wear emissions make a substantial contribution to road traffic particulate emissions, and, unlike exhaust emissions, these are unlikely to reduce in future years. Therefore, their contribution to the overall road traffic PM_{10} emissions is likely to increase in the future.

1.2.15 However, the National Atmospheric Emissions Inventory (NAEI)[16] released national emission factors for road traffic brake and tyre wear, by vehicle and road type. Although these are still subject to great uncertainty, Technical Guidance LAQM.TG(09)[17] recommends that PM_{10} modelling now includes these emission factors. Therefore, brake and tyre wear emission factors have been included in the air quality model.

1.2.16 It is acknowledged that updated road traffic emissions factors are due to be released by Defra but these are not available for use in this assessment.

Background Concentrations

1.2.17 It is important to consider the ‘background’ component of each pollutant when undertaking an air quality assessment of this type. That is, the general level of pollutants that occur as a result of natural and/or other activities which are not associated with any direct emission. Often, the background concentrations are associated with trans-boundary transportation of aerosols (in the case of PM_{10}) and/or emissions from some distance away (e.g. power stations).

1.2.18 Background concentrations can be derived from local monitoring data where available, or from Defra’s estimated background air pollution maps available on the UK Air Quality Archive website[5] in $1km^2$ grid squares. Although there are a few NO_2 diffusion tube monitoring sites classified as “background sites”, concentration at these sites is still likely to be influenced by the motorway traffic on the M1 and the M6. Therefore, background data for both NO_2 and PM_{10} for the baseline year 2007 and future year 2014 have been derived from the national background maps.

1.2.19 Moreover, as the air quality assessment area covers a wide area, it was deemed more realistic to consider variable backgrounds for the assessment, to take into account regional variations in the background levels. This provides a more accurate picture of air quality and improves the overall accuracy of the modelled results. Each monitoring site or sensitive receptor used in the assessment has therefore been assigned a specific background based on the Defra background maps.

1.2.20 The background maps for NO_x and PM_{10} now include the contribution from individual emission sectors, such as motorways, A-roads, industrial, domestic emissions and brake and tyre wear. Background NO_2 contribution from individual emission sectors can also be derived from NO_x based on the methodology available on the UK Air Quality Archive website[5].

1.2.21 As the motorways and main roads have been included in the model set-up, these were removed from the NO_x, NO_2 and PM_{10} background maps, to avoid double counting. For PM_{10}, as the brake and tyre wear emissions were also taken into account in the model, their contribution to PM_{10} concentrations was also removed from the Defra background maps.

1.2.22 Background concentrations, as described in Section 1.4, have been incorporated into the model.

Model Input Parameters

1.2.23 A minimum Monin-Obukhov length of 10m has been selected to represent the stability of the atmosphere due to the characteristics of the local area. The model will consider this to be the minimum height above ground level above which vertical turbulence is inhibited. A surface roughness length of 0.3m has been assigned in the model. These are typical values representative of the local air quality assessment area.

Traffic Data

1.2.24 Modelled traffic flows on the M1 and the surrounding road network have been provided. The following traffic data was supplied for road links affected by the improvements:-

- Annual Average Daily Traffic (AADT) flows
- Average vehicle speed
- Proportion of Heavy Duty Vehicles (HDVs)

1.2.25 The traffic data used in the assessment is shown in Appendix A. Modelled traffic data was provided for 2007 (Baseline) and 2014 (Do Minimum and Do Something).

Model Output

1.2.26 The ADMS-Roads dispersion model produces modelled concentrations of PM_{10} and NO_x at specific receptors, identified for the prediction of air quality impacts. Receptors have been set at a range of heights relative to the M1 Junction 19 and local road network.

Model Verification

1.2.27 Model verification involves the comparison of modelled concentrations to monitored concentrations. The objectives of the model verification are:-

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

1.2.28 The model has been used to predict concentrations of NO_x (nitric oxide and nitrogen dioxide combined) at 20 diffusion tube monitoring locations, in order to verify the model against monitored concentrations. These diffusion tubes have been used as part of the model verification due to their proximity to modelled road sources and are shown on Figure 1.3.

1.2.29 Model verification could not be carried out for predicted PM_{10} concentrations, as there is no PM_{10} monitoring station available in the modelled area.

1.2.30 Modelled NO_2 concentrations have not been used, as recent studies have suggested that due to emissions of primary NO_2 from road traffic, models such as ADMS-Roads may under predict the contribution of NO_2 at relevant receptors. As such, using the updated method recommended in Technical Guidance LAQM.TG(09)[17] provided on behalf of Defra, modelled and monitored road contribution of NO_x have been compared in order to determine an appropriate adjustment factor for the modelled road contribution of NO_x. The adjusted contribution of NO_x is then combined with background NO_2 and the latest Defra conversion method is used to estimate total NO_2 concentrations. These NO_2 concentrations for 2007 have been compared with the bias corrected annual average NO_2 diffusion tube results (see Section 1.4).

1.2.31 The base year for the traffic model is 2007 whilst NO_2 concentration measurements in the area have been undertaken in 2003 and 2009. Defra Technical Guidance (LAQM.TG09) has been used to project monitored NO_2 concentrations to the year 2007 in order to allow comparison with the base traffic year. This approach is commonly used where base traffic year is not necessarily the most recent year of monitoring.

1.2.32 During the verification process, it is common practice to show that all final modelled NO_2 concentrations are within 25% of the monitored NO_2 concentrations. Modelled results may not compare well at some locations for a number of reasons including:-

- Discrepancies in traffic data (flows, speeds or fleet composition),
- Model set up (i.e. road widths, elevations and receptor locations/heights),
- Model limitations (treatment of roughness and meteorological data),
- Local wind flow patterns due to local terrain and land use that cannot be accounted for in dispersion models
- Uncertainty in monitoring data (notably diffusion tubes, e.g. bias adjustment factors and annualisation of short-term data),
- Background concentrations, and
- Uncertainty in emissions data.

1.2.33 The above factors were all considered as part of the model verification process to minimise the uncertainties as much as practicable.

1.2.34 The results of the model verification are provided in Section 1.4, while a complete summary of the verification process is provided Appendix B.

TAG Local Air Quality Sub-Objective

1.2.35 The DMRB[1] methodology and TAG[2] require an assessment of the overall change in exposure at properties to pollutant concentrations. TAG Unit 3.3.3 Local Air Quality Sub-Objective provides details of the methodology for this assessment.

1.2.36 The methodology recommends that roads showing less than 10% change in traffic flows can be scoped out of the assessment, unless the road is a motorway or there are particular sensitivities such as the presence of an AQMA. Therefore, the study area for the TAG local air quality assessment was determined based on the following criteria:

- Traffic flows in AADT (between the Do Something and Do Minimum 2014) will change by 10% or more; or
- The road is part of the motorway network; or
- The road is of particular sensitivity (e.g. due to traffic congestion, change to the speed limit or the presence of an Air Quality Management Area).

1.2.37 Therefore, all roads within the Rugby AQMA have been included in the assessment area. Both the A14 and A5 have also been included due to their sensitivity.

1.2.38 In order to assess exposure to pollutant concentrations near the roads affected by the proposed junction, the number of properties within 200m of the centre of each road has been determined, in 50m bands, with and without the proposed junction in place. Concentrations of NO_2 and PM_{10} at distances of 20m, 70m, 115m and 175m from the centre of each road have been predicted using the DMRB methodology to represent the average pollutant concentration in each of the 50m bands. Concentrations are calculated with and without the proposed junction in the proposed opening year (2014).

1.2.39 Although a variable background for NO_x, NO_2 and PM_{10} was used in the local air quality assessment based on ADMS-Road modelling, this approach was not retained for the TAG appraisal. An average concentration derived from the Defra background maps for the assessed area was deemed suitable, given the lower accuracy of the TAG methodology compared to the detailed modelling approach combined with the low variation in background concentrations, as presented further below in Table 1.9.

1.2.40 The TAG methodology assesses the change in the representative pollutant concentrations combined with the number of properties in each band. This is aggregated over each of the sections of road affected by the proposed junction to give an Overall Assessment Score. This represents the change in overall exposure to pollution concentrations with the proposed junction in place.

1.2.41 TAG also requires that the effect of the proposed junction on air quality within any potential or existing AQMAs be considered. The validated traffic model upon which the local air quality TAG assessment is carried out includes those roads within the Rugby AQMA (excluding Rugby Centre). There are no roads affected by the proposed junction within the Lutterworth AQMA.

Regional Air Quality Impact Assessment Methodology

TAG Regional Air Pollution Sub-Objective

1.2.42 In accordance with TAG[2] Unit 3.3.4, the DMRB regional air quality assessment method has been used to predict annual emissions of NO_x and PM_{10}. Using the criteria provided by the DMRB[1] for regional assessments, road links have been screened out of the assessment where they do not match any of the following criteria, based on change between the Do Minimum (2014) and Do Something (2014):

- Traffic flows in AADT will change by 10% or more; or
- Heavy-duty vehicle (HDV) flows will change by 10% or more; or
- Daily average speed will change by 20 km/hr or more.

1.2.43 Total NO_x and PM_{10} emissions have been estimated using the DMRB methodology for the existing road network in 2007 and with and without the proposed junction in the opening year, 2014, and the “design” year 2029. This method is similar to the local assessment (as such AADT, average vehicle speeds and the proportion of heavy duty vehicles are still required), except that the evaluation is not made in respect to any individual receptor, but rather calculated total annual emissions.

Greenhouse Gases. DMRB Assessment and TAG Sub-Objective

1.2.44 Both the DMRB[1] and TAG[2] Unit 3.3.5, The Greenhouse Gases Sub-Objective, require an assessment of impact of the proposed junction improvement on emissions of the greenhouse gas CO_2. The proposed junction may affect emissions of CO_2 through changes fuel use as a result of changes to traffic flow characteristics on the M1, M6, and surrounding local road network.

1.2.45 Total CO_2 emissions, based on the road network identified in Section 1.2.42, have been estimated using the DMRB regional air quality assessment methodology for the existing road network in 2007, and with and the proposed junction in the opening year, 2014, and the “design” year 2029. This method is similar to the local assessment (as such AADT, average vehicle speeds and the proportion of heavy duty vehicles are still required), except that the evaluation is not made in respect to any individual receptor, but rather calculated total annual emissions.

1.2.46 In addition, and in accordance with TAG Unit 3.3.5, total carbon emissions for the 60 year appraisal period (2014 to 2073) have also been calculated for the entire traffic model network (an area much larger than that assessed in the air quality assessment) using the carbon emissions output from TUBA (Transport Users Benefit Appraisal) as provided by Jacobs.

Assessment of Significance

1.2.47 This air quality assessment considers the impact of the proposed junction in terms of its impact on pollutant concentrations at nearby properties. Predicted concentrations at sensitive receptors with the proposed junction are compared to the AQS objectives in the first instance in order to determine if compliance with these is met.

1.2.48 The significance of the changes in concentrations due to the proposed junction are further described based on the changes in:-

- The annual average NO2 concentrations;
- The annual average PM10 concentrations; and
- The change in the number of daily mean PM10 exceedences.

1.2.49 As commonly used by air quality professionals, the impact magnitude is a range between extremely small and very large, when describing magnitude of changes in air pollutant concentrations. In order to use the descriptors required by Section 2 of DMRB, these have been revised as shown in Table 1.3 below.

Table 1.3: Assignment of Impact Magnitude

Change Between Do Minimum and Do Something Scenarios			
Magnitude of Impact		Air Quality Descriptor	DMRB Descriptor
Annual Mean (NO_2 and PM_{10})	Daily Mean (PM_{10})		
>25%	>15 Days	Very Large	Major
15 - 25%	10 - 15 Day	Large	Moderate
10-15%	5 - 10 Days	Medium	
5-10%	3 - 5 Days	Small	Minor
1-5%	1-3 Days	Very Small	
<1%	1 Day	Extremely Small	Negligible
0%	0 Day	No Change	No Change

1.2.50 If predicted concentrations approach or exceed the AQS objectives, this may increase the effect significance of the proposed junction on pollutant concentrations. For example, a predicted increase of 1µg/m^3 annual mean NO_2 in an area where the baseline annual mean NO_2 concentration is over or approaching 40µg/m^3 may result in the worsening of air quality in an AQMA or the declaration of a new or larger AQMA. The predicted increase in NO_2 concentrations is therefore likely to be considered significant, whereas a 1µg/m^3 increase in annual mean NO_2 in an area of good air quality is likely to be considered less significant. Thus, the significance of effect of the proposed junction on air quality cannot be directly related to the change in pollutant concentrations alone.

1.2.51 The NSCA (now Environmental Protection UK) guidance document on planning for air quality[18] has been used as a framework to determine the significance of the effects, which takes into account the following:-

- The concentration relative to the air quality objective both with and without the proposed junction (above or below the relevant AQS objective);
- The direction of change (adverse or beneficial); and
- The magnitude of change (based on the percentage change for annual means, number of days for daily mean), as described in Table 1.3.

1.2.52 Significance assessment is assigned at each receptor where impacts are quantified, based on predicted changes in air quality between the Do Minimum and Do Something (2014) scenarios. Taking account of the change in concentrations at each receptor, and the position relative to the objective, the assessment of effect is described as required by DMRB using the terms Neutral, Slight, Moderate, Large or Very Large, and whether the change is Adverse or Beneficial. The relationship between the impact magnitude of changes in concentration and the effect significance descriptors is provided in Table 1.4. However, the approach to assignment of significance is based on reasoned and professional judgement, which takes account of the NSCA guidance[18] commonly used in the assessment of air quality.

Table 1.4: Assignment of Significance Effect

DMRB Magnitude Descriptor	No Change	Negligible	Minor		Moderate		Major
Air Quality Magnitude Descriptor	**No Change**	**Extremely Small**	**Very Small**	**Small**	**Medium**	**Large**	**Very Large**
Absolute Concentration in Relation to AQS objective	**Decrease with Scheme**						
Above both with or without Scheme	Neutral	Slight Beneficial	Slight Beneficial	Moderate Beneficial	Large Beneficial	Very Large Beneficial	Very Large Beneficial
Above without Scheme - Below with Scheme	Neutral	Slight Beneficial	Moderate Beneficial	Large Beneficial	Large Beneficial	Very Large Beneficial	Very Large Beneficial
Below both with or without Scheme - But not Well Below without Scheme	Neutral	Neutral	Slight Beneficial	Slight Beneficial	Moderate Beneficial	Moderate Beneficial	Large Beneficial
Well Below both with or without Scheme	Neutral	Neutral	Neutral	Slight Beneficial	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Absolute Concentration in Relation to AQS objective	**Increase with Scheme**						
Above both with or without Scheme	Neutral	Slight Adverse	Slight Adverse	Moderate Adverse	Large Adverse	Very Large Adverse	Very Large Adverse
Below without Scheme - Above with Scheme	Neutral	Slight Adverse	Moderate Adverse	Large Adverse	Large Adverse	Very Large Adverse	Very Large Adverse
Below both with or without Scheme - But not Well Below with Scheme	Neutral	Neutral	Slight Adverse	Slight Adverse	Moderate Adverse	Moderate Adverse	Large Adverse
Well Below both with or without Scheme	Neutral	Neutral	Neutral	Neutral	Slight Adverse	Slight Adverse	Moderate Adverse
"Well Below" is defined as <75% of the AQS objective							

1.2.53 The focus of the assessment of the significance is on NO_2 concentrations as predictions for this pollutant have been verified, and the change in this pollutant are considered to provide a better description of significance than those for PM_{10} which are not locally verified, and tend to be extremely small.

1.2.54 For the purpose of assessing air quality effects, the sensitivity of receptors is considered at the outset, and only relevant receptors are assessed. As such, there is no further consideration of the importance of the receptor in terms of effects as all locations are considered sensitive receptors. However, where the effects of activities are not quantified, an assessment has been made on a qualitative basis. Where this is the case e.g. construction dust effects, effects from disruption to existing traffic during construction, the significance of effect descriptors have been assigned based on professional judgement, knowledge and experience. Such an approach is consistent with the NSCA guidance document[18].

1.2.55 For the regional air quality impact assessment, changes in regional emissions are calculated and aggregated. The number of properties at which air quality is expected to improve or deteriorate with the proposed junction in place is also provided. As such, the improvement or deterioration in air quality has been described in terms or beneficial or adverse impacts.

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1.3 LEGISLATION AND POLICY FRAMEWORK

UK Air Quality Strategy

1.3.1 The significance of existing and future pollutant levels can be assessed in relation to the national air quality standards and objectives, established by Government. The revised AQS[19] for the UK (released in July 2007) provides the over-arching strategic framework for air quality management in the UK and contains national air quality standards and objectives established by the UK Government and devolved administrations to protect human health. The air quality objectives incorporated in the AQS and the UK Legislation are derived from the Limit Values prescribed in the EU Directives transposed into national legislation by member states.

1.3.2 The CAFE (Clean Air for Europe) programme was initiated in the late 1990s to draw together previous directives into a single EU Directive on air quality. The Directive, 2008/50/EC[20], has recently been adopted and replaces all previous air quality Directives. The Directive introduces new obligatory standards for $PM_{2.5}$ for Government.

1.3.3 The Air Quality Standards (England) Regulations 2007[21] came into force on 15th February 2007 in order to align and bring together in one statutory instrument the Governments obligations to fulfil the requirements of the new (then proposed) CAFE Directive.

1.3.4 The objectives for ten pollutants (benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide, particulates - PM_{10} and $PM_{2.5}$, ozone and PAHs - Polycyclic Aromatic Hydrocarbons) have been prescribed within the Air Quality Strategy[19] based on The Air Quality Standards (England) Regulations 2007. As described in Section 1.1, the air quality assessment focuses on NO_2 and PM_{10} concentrations, the Objectives set out in the AQS and the EU Directive for these pollutants are shown in Table 1.5.

Table 1.5: AQS objectives and EU Limit Values set in regulations for England for NO_2 and PM_{10}

	National Air Quality Objectives (England)			**EU Directive**	
Pollutant	**Air Quality Objective**		**Date To Be Achieved And Maintained**	**Limit or Target Values**	**Date To Be Achieved And Maintained**
	Concentration	**Measured As**			
Nitrogen dioxide	200 µg/m^3 not to be exceeded more than 18 times a year	1 hour mean	31.12.2005	Limit Value as AQS Objective	01/01/2010
	40 µg/m^3	annual mean	31.12.2005		01/01/2010
Particles (PM_{10}) (gravimetric)(a)	50 µg/m^3 not to be exceeded more than 35 times a year	24 hour mean	31.12.2004	Limit Value as AQS Objective	01/01/2005
	40 µg/m^3	annual mean	31.12.2004		01/01/2005
Particles ($PM_{2.5}$)	25 µg/m^3	annual mean	2020	Target Value 25 µg/m^3	2010

	National Air Quality Objectives (England)			EU Directive	
Pollutant	Air Quality Objective		Date To Be Achieved And Maintained	Limit or Target Values	Date To Be Achieved And Maintained
	Concentration	Measured As			
(gravimetric)(a)	Target of 15% reduction concentrations at urban background (b)	annual mean	Between 2010 and 2020	Target of 20% reduction in concentrations at urban background	Between 2010 and 2020
a: Measured using the European gravimetric transfer sampler or equivalent b: (In urban areas) 25 µg/m3 is a concentration cap combined with 15% reduction					

1.3.5 The UK Government and the Devolved Administrations have also set new national air quality objectives for $PM_{2.5}$. These objectives have not been incorporated into LAQM Regulations (section 1.3.7), and authorities do not have a statutory obligation to review and assess air quality against them. Methodologies for the assessment of $PM_{2.5}$, including development of vehicle emissions factors are currently being developed but are not fully available for this assessment.

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

Local Air Quality Management (LAQM)

1.3.7 Part IV of the Environment Act[22] places a statutory duty on local authorities to periodically 'review and assess' the air quality within their area under the LAQM regime. This involves consideration of present and likely future air quality against the objectives prescribed within regulations. The air quality objectives that apply to LAQM are defined in Air Quality Regulations 2000[23] and Air Quality (Amendment) Regulations 2002[24] for seven pollutants benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, sulphur dioxide, particulates - PM_{10}. The LAQM regulations exclude $PM_{2.5}$.

1.3.8 Where the local authority concludes that pollutant concentrations are unlikely to meet the objectives by their target dates, in areas where the objectives apply, the authority is required to declare an Air Quality Management Area (AQMA) under Section 83(1) of the Act 1995.

1.3.9 Following the declaration of an AQMA, the authority is then required to prepare an Action Plan which sets out the measures it intends to put in place in pursuit of achieving the objectives. There are currently 235 authorities with declared AQMAs, the majority of which are related to exceedences of the objectives for nitrogen dioxide and PM_{10}, predominantly as a result of emissions from road traffic.

Construction Dust Policy and Guidance

1.3.10 Dust is defined as airborne or deposited particulate matter up to 75 µm in diameter (according to BS6069[25]) and constitutes one of the most common forms of nuisance alongside noise and odour.

1.3.11 The Environmental Protection Act 1990[26] and Clean Air Act 1993[27] provide the statutory basis to protect residents and the natural environment in the vicinity of development sites from pollution. Dust has been defined as a statutory nuisance under Part III of the Environmental Protection Act.

1.3.12 There are no nationally adopted UK, European, or World Health Organisation (WHO) assessment criteria for nuisance arising from the deposition of dust. Custom and practice criteria are applied in accordance with the monitoring methods used, which vary according to the specific requirements of any monitoring strategy put in place.

1.3.13 Annex F in Volume 11 Section 3 of the DMRB[1] discusses the potential harmful effects of air pollution, including the dust generated from construction related activities, upon ecosystems and provides guidance on the effects assessment. The guidance requires the locations of any designated species or habitats within 200m of the roads affected by a proposal or a construction site to be clearly identified and rigorous mitigation measures applied.

1.3.14 The other main guidance and policy documents used for the assessment of nuisance dust and PM_{10} are:-

- Planning Policy Statement (PPS) 23: Planning and Pollution Control[28], and its Annex 1: Pollution Control, Air and Water Quality. PPS 23 defines the Government's policies on planning and pollution control;
- CIRIA (Construction Industry Research and Information Association) guidance C650 – Environmental good practice on site[29]. The guidance describes the potential nuisance dust effects from developments on sensitive receptors, human and ecology, and identifies the best practice and mitigation measures to minimise the harmful effects;
- NSCA – Development Control and Planning for Air Quality[18]. The document provides the good practice guidance to minimise the environmental effects from construction and demolition activities; and
- Useful publications related to the assessment and minimising the dust effects from development related activities include the BRE (Building Research Establishment) publication 'Control of dust from construction and demolition activities' [30] and the best practice guidance produced by GLA (Greater London Authority) and London Councils titled 'the control of dust and emissions from construction and demolition'.
- Environment Agency Guidance (M17)[10] and Mineral Policy Statement 2[31] in relation to particulate matter around waste and mineral extraction sites.

Climate Change

1.3.15 The Climate Change Bill was introduced into Parliament in November 2007 and became law on 26 November 2008. The Climate Change Act 2008[14] provides a new approach to managing and responding to climate change in the UK by setting legally binding targets, taking powers to help meet targets, and establishing clear and regular accountability. The main aims of the Act are to improve carbon management, which helps to move towards a low-carbon economy, and to demonstrate international leadership in sharing responsibility for reducing global emission.

1.3.16 The Act sets a legally binding target of at least an 80% reduction in greenhouse gas emissions by 2050 (based on 1990 levels). A target to reduce emissions by at least 34% by 2020 is also in place. A carbon budgeting system has been put in place to track progress towards these targets as described in the UK Low Carbon Transition Plan[32].

1.3.17 The Climate Change Committee (CCC) has also been set up as an independent body to advice the government on carbon budgets, and to report annual on targets towards these budgets. The first CCC report on building a low carbon economy[33] identifies the different sectors and options for reducing emissions, which includes wide scale decarbonisation of the transport sector. The measures identified for the transport sector include improving fuel efficiency of conventional engines in the shorter-term and increasing the use of sustainable biofuels. Over time, progressive introduction of new technologies including electric cars, plug in hybrids, and hydrogen vehicle would be needed, and introduction of second generation biofuels.

1.3.18 Many of the options for reducing carbon emissions from the transport sector will depend upon the strength of policy levels such as strengthening legally binding fuel efficiency limits on cars and vans, and policies and fiscal measures which encourage deeper cuts in emissions through changes to driver behaviour, model shift and better journey planning.

Regional Planning Policies

West Midlands Regional Spatial Strategy (2008)

1.3.19 The Regional Spatial Strategy for the West Midlands was adopted in 2008 and includes policies covering Air Quality and Greenhouse Gases which include CC1: Climate Change, QE1: Conserving and Enhancing the Environment and QE3: Creating a High Quality Built Environment. Policy CC1 seeks to exploit opportunities to mitigate and adapt to climate change. Policies QE1 and QE3 seek to reduce air pollution.

East Midlands Regional Plan (2009)

1.3.20 The East Midlands Regional Plan was adopted in 2009 and includes the provision of up to date regional policies. There is only one policy which relates to Air Quality and Greenhouse Gases which is Policy 36: Regional Priorities for Air Quality. Policy 36 requires development to consider the impacts of development and increased traffic levels on air quality.

Local Planning Policies

Warwickshire Local Transport Plan 2006-2011 (2006)

1.3.21 The Warwickshire Local Transport Plan (LTP) was adopted in 2006 and is the second transport plan produced for Warwickshire. The LTP contains one Core Strategy relevant to Air Quality and Greenhouse Gases which is the Air Quality Strategy. These core strategies are not policies but set out the aims of Warwickshire regarding certain aspects of transport planning.

Northamptonshire Local Transport Plan 2006-2011

1.3.22 The Northamptonshire LTP was adopted in 2006 and sets out strategic aims rather than individual policies. Among these key aims is the improvement of air quality. In conjunction with the LTP Northamptonshire have also produced a sister document called *Northamptonshire Transport Strategy for Growth (2007).* This document does not contain any specific policies on Air Quality and Greenhouse Gases.

Daventry District Council Local Plan 1997

1.3.23 The Daventry District Council Local Plan was adopted in 1997. In September 2007 any policies not "saved" expired, there are no saved policies that are relevant to Air Quality and Greenhouse Gases. These policies are to be eventually replaced with emerging policies under the Local Development Framework (LDF). Daventry are producing a joint Core Strategy as part of the LDF which is the West Northamptonshire Joint Core Strategy (2007) which is currently at the issues and options stage. This means that any policies are currently only in draft form. As the Core Strategy is currently at Issues and Options Stage there are not yet any policies but the strategy does set out Strategic Objectives which will inform the basis of future policies. Strategic Objective 8 of the Core Strategy aims to ensure that development is sensitive to its environment.

Harborough District Council Local Plan 2001

1.3.24 The Harborough District Local Plan was adopted in 2001 and as mentioned above all policies that were not formally saved expired in September 2007. There is only one saved policy which is relevant to Air Quality and Greenhouse Gases which is EV23: Control of Pollution and Nuisance. The policy aims to ensure that development does not have an adverse effect on the amenity of nearby uses due to air pollution.

1.3.25 Harborough are in the process of producing their Core Strategy which is currently at alternative options stage. Within this document Core Spatial Policy 3: Promoting Sustainable Development raises greenhouse gases from road traffic as an issue which needs addressing.

Rugby Borough Council Local Plan 2006

1.3.26 The Rugby Borough Local Plan was adopted in 2006 and contains a number of saved policies. Of these saved policies GP3: Loss of Amenity, GP11: Pollution Control and GP12: Air Quality Management Areas are relevant to Air Quality and Greenhouse Gases. Policy GP3 states that planning permission would not be granted for any development that would have an adverse impact on amenity due to dust, fumes and smells. Policies GP11 and GP12 seek to protect and improve air quality.

1.3.27 In addition to the saved policies in the Local Plan Rugby are also in the process of writing their Core Strategy which is currently at the preferred options stage. Within the Core Strategy Spatial Objective 12 covers the issue of climate change.

North Northamptonshire Core Strategy (2008)

1.3.28 The North Northamptonshire Core Strategy was adopted in 2008 and is a joint Core Strategy covering the areas of Corby, Kettering, Wellingborough and East Northamptonshire. Within this document there are no policies that are relevant to Air Quality and Greenhouse Gases.

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1.4 BASELINE CONDITIONS

1.4.1 Junction 19 of the M1 and the surrounding residential properties lie within the administrative boundary of Harborough District Council (north of the River Avon and east of the A5), Daventry District Council (south of the River Avon and east of the A5) and Rugby Borough Council (west of the A5).

1.4.2 This Section presents the results of the assessment of existing air quality, based on:-

- The review of Local Air Quality Management reports from the Councils;
- The results of monitoring data undertaken as part of the assessment; and
- The background concentrations for each pollutant and each year of assessment
- The results of dispersion modelling for both the base year (2007) and the Do Minimum scenario 2014 (without the proposed junction).

Review of Local Air Quality Management

Harborough District Council Review and Assessment

1.4.3 Harborough District Council declared an AQMA in 2001 following their first round of review and assessment of air quality, which concluded that annual mean NO_2 concentrations were unlikely to meet the AQS objective in Lutterworth town centre along the A426 High Street. Concentrations of all other pollutants were expected to meet the AQS objectives. Subsequent Updating and Screening Assessment reports (USA 2003 and 2006) confirmed these results, while a Detailed Assessment of NO_2 concentrations in Lutterworth town centre in June 2004 resulted in a slight expansion of the Lutterworth AQMA.

1.4.4 An Air Quality Action Plan has been incorporated into the Leicestershire Local Transport Plan and includes details of how air quality within Lutterworth will be addressed by a series of measures and targets.

1.4.5 The latest Updating and Screening Assessment (2009) concluded that the AQMA may need to be extended further south along the High Street towards Rugby Road, and potentially northwards along Leicester Road, as highlighted by updated monitoring data. A Detailed Assessment for NO_2 will be undertaken in 2009/10 in order to determine the full extent of the revised AQMA. No further assessment of PM_{10} concentrations has been required and the AQS objectives for PM_{10} are expected to be met.

Daventry District Council Review and Assessment

1.4.6 Between 1998 and 2000, Daventry District Council undertook its first round of review and assessments of air quality. The First Round assessments concluded that air pollution monitoring throughout the district should be extended to include areas with in the proximity of the M1 motorway so that they were able confirm that they comply with the NO_2 AQS objectives. Within existing monitored areas, pollution concentrations suggested that AQS objectives were likely to be met. It was therefore not necessary to declare any AQMAs for any pollutant.

1.4.7 The second round of review and assessment began with an USA in 2003. The USA predicted that the NO_2 AQS objective would be exceeded at several residential properties located within the vicinity of the M1. However, this could not be verified as there was no monitored data available within the immediate vicinity of these residential properties.

Following discussions between Daventry District Council and Defra, a conclusion was reached that a Detailed Assessment was not necessary at that particular time pending results of monitoring.

1.4.8 The 2005 Progress Report Assessment reported that monitored NO_2 concentrations within the vicinity of the M1 were exceeding the objectives. However, these locations were not representative of relevant exposure as the monitoring locations were immediately adjacent to the motorway and likely to be worse case.

1.4.9 The third round of review and assessment started with the 2006 USA, which confirmed that the air quality objectives for benzene, 1, 3-butadiene, carbon monoxide, lead, PM_{10} and sulphur dioxide were still met. Both diffusion tube monitoring data and modelling results showed that there was a risk of exceeding the annual mean NO_2 concentration in the vicinity of the M1 at Haythog Farm, and a Detailed Assessment was recommended for this area. However, the Council did not proceed to a Detailed Assessment before evaluating the location of valid receptors close to the M1 and collating additional monitoring data.

1.4.10 The air quality Progress Report 2008-09 concluded that a Detailed Assessment was not required anymore, following the results of updated monitoring data at Haythog Farmhouse for 2006 to 2008, which showed that the NO_2 annual mean was below the AQS objective.

1.4.11 The fourth round of review and assessment started a new USA, which was completed in September 2009 and confirmed that no Detailed Assessment was required for any pollutant at the time. No further assessment of NO_2 or PM_{10} concentrations has been required and the AQS objectives are expected to be met.

Rugby Borough Council Review and Assessment

1.4.12 Between 1998 and 2001, Rugby Borough Council undertook its first round of review and assessments of air quality, which concluded that no AQS objective was at risk of being exceeded at the time.

1.4.13 Following the USA 2003, which identified a number of areas that may lead to exceedences of the NO_2 annual mean objective within the centre of Rugby, the Council carried out a Detailed Assessment of NO_2 in June 2004. The NO_2 assessment confirmed exceedences of the annual mean objective. Consequently, an AQMA was declared in 2004 covering the whole urban area of Rugby to the A5 in the east and M6 to the north. The Detailed Assessment also identified a risk of exceedence of the PM_{10} AQS objectives. A Detailed Assessment of PM_{10} was completed in 2005, which predicted that the PM_{10} objectives would be met; therefore no AQMA was declared for PM_{10}.

1.4.14 As part of the third round of review and assessment, the USA 2006 concluded that six of the seven pollutants assessed still met the AQS objectives, while diffusion tube monitoring data confirmed that the NO_2 annual mean was still exceeding the objective at several locations within the AQMA, although the general decrease was observed in NO_2 levels across the Borough.

1.4.15 Subsequent air quality Progress Reports completed in 2007 and 2008, and the latest USA 2009 confirmed that NO_2 concentrations were decreasing in the Borough, with five diffusion tubes within the AQMA being above the AQS objective for NO_2 in 2008. No further assessment of PM_{10} concentrations has been required and the AQS objectives for PM_{10} are expected to be met.

Ambient Air Quality Monitoring

2003-2004 monitoring survey near M1 Junction 19

1.4.16 A monitoring program was undertaken in 2003 / 2004 to characterise the existing air quality in the vicinity of the M1, Junction 19[34]. Diffusion tubes were exposed between July 2003 and December 2004 at nine locations surrounding the junction to evaluate baseline levels of NO_2. Each tube was exposed for 18 periods of between three and five weeks. The tubes were prepared and analysed by Gradko International Ltd using the 20% Triethanolamine (TEA) in water preparation method.

1.4.17 It is common practice throughout the UK for diffusion tube concentrations to be bias adjusted. Diffusion tubes are often co-located with continuous monitors in order to determine the bias of the diffusion tube measurements relative to the continuous monitor. Co-locating the diffusion tubes in triplicate also allows the precision and accuracy of the diffusion tube measurements to be determined. Bias of diffusion tubes generally depends upon the laboratory and preparation method used. The data from NO_2 diffusion tube co-location studies across the UK is collated and made available through the Review and Assessment Helpdesk on behalf of Defra[35]. This allows the calculation of a default bias factor to be determined based on a wide number of studies.

1.4.18 For this survey, monitoring data were adjusted based on the national bias factor for 2003 (0.96) and 2004 (0.91). The monitoring locations and results are provided in Table 1.6. The tube locations are also provided in Figure 1.3.

1.4.19 Since monitoring data for 2003 was only collected since July of that year, the 2003 data has been annualised (and is the same as reported in the Comparative Environmental Assessment[36] (CEA). As a full year of monitoring data was available for 2004, this year of data has been projected to 2007 (the base year for traffic for this assessment) based on Defra Technical Guidance (LAQM.TG09)[17].

Table 1.6: 2003-2004 NO_2 Monitoring Survey

ID	Name	X	Y	Type [(1)]	NO_2 Annual Mean 2003 ($\mu g/m^3$) - Annualised and Bias Adjusted (National Bias=0.96)	NO_2 Annual Mean 2004 ($\mu g/m^3$) - Bias Adjusted (National Bias=0.91)	NO_2 Annual Mean Estimate 2007 ($\mu g/m^3$, Projection)
A1	Stanford Mear	459430	277747	R	29.6	30.1	27.5
A2	Stonebank	455600	279578	R	32.8	31.5	28.8
A3	Old Barn Farm	455880	278612	R	37.4	34.9	31.9
A4	Westfield Lodge	456419	279174	R	28.7	34.5	31.5
A5	Swinford Cemetery	456610	279302	R	28.2	29.1	26.6
A6	Tomley Hall Farm Access Road	454896	278958	R	35.4	39.0	35.6
A7	Lilbourne 1	456337	277230	R	34.7	29.3	26.7
A8	Catthorpe	455359	278196	R	29.4	28.7	26.2
A9	Lilbourne 2	456697	277279	R	28.5	31.7	28.9

In **bold** exceedence of the NO_2 annual mean AQS objective
(1) K – Kerbside, R – Roadside, B - Background

2009 monitoring survey near M1 Junction 19

1.4.20 A new monitoring survey was undertaken in 2009 to complement the 2003 survey[37]. Diffusion tubes were exposed at 10 locations surrounding the junction to evaluate levels of NO_2. The tube locations are shown on Figure 1.3. The tubes were prepared and analysed by Gradko International Ltd using the 50% TEA in acetone preparation method.

1.4.21 The results have been adjusted based on the local bias adjustment factor derived from triplicate tubes co-located with a continuous analyser operated on behalf of Highways Agency in Shepshed, Loughborough, near junction 23 of the M1. The monitoring location and results are provided in Table 1.7

1.4.22 The monitoring results for the period from April to September (6-months) have been annualised based on the 7 closest background monitoring sites from the Automatic Urban and Rural Network (AURN), which complies with the methodology described in Technical Guidance LAQM.TG(09)[17] to estimate annual averages based on periods less than 9 months monitoring data. As the annual mean 2009 for the AURN sites was not yet available, the annualisation has been carried out based on 2008 results. Therefore, the annualised diffusion tube results are an estimate of the 2008 annual average at each location.

1.4.23 Although tubes T3 and T6 are classified as "Background", they are likely to be impacted by the heavy traffic on the M1 and/or the M6 motorways. Therefore, and as discussed in Section 1.2.18, it has not been deemed justifiable to use these sites to determine the background NO_2 concentration for the whole air quality assessment area.

1.4.24 Results have been projected from 2008 back to 2007 to provide the estimated NO_2 concentrations for the baseline year 2007. Projected concentrations were estimated based on the projection factors provided in Technical Guidance LAQM.TG(09)[17].

Table 1.7: 2009 NO_2 Monitoring Survey

ID	Name	X	Y	Type (1)	NO_2 Average (µg/m^3) April - September 2009	NO_2 Annual Mean 2008 (µg/m^3) Annualised(2) and Bias Adjusted (3)	NO_2 Annual Mean Projected 2007 (µg/m^3)
T1	Stanford Mear Farm	459390	277818	R	18.8	26.6	27.5
T2	Swinford Farm	456416	279170	R	23.4	33.2	34.3
T3	Church Lane	454153	279634	B	17.5	24.7	25.5
T4	Holywell House	453511	279442	R	32.7	**46.3**	**47.9**
T5	Old Barn Farm	455943	278548	R	21.1	29.8	30.8
T6	15 Manor End	455890	278322	B	15.9	22.5	23.3
T7	30 Station Road	456365	277114	R	20.9	29.5	30.5
T8	35 Yelvertoft Road	456532	276876	R	29.6	**41.9**	**43.3**
T9	Lilbourne Fields Farm	456768	276601	R	27.5	39.0	**40.3**
T10	Wood Farm	455098	282686	R	22.4	31.7	32.8

In **bold** exceedence of the NO_2 annual mean AQS objective
(1) K – Kerbside, R – Roadside, B - Background
(2) - Annualisation factor = 1.37 based on data from the following AURN sites :Coventry Memorial, Leamington Spa, Market Harborough, Northampton, Sandwell West Bromwich, Birmingham Tyburn, Oxford St Ebbes
(3) - Bias adjustment factor of 1.03 from local survey in Shepshed (April-September 2009)

Local Authority Monitoring Data

1.4.25 Daventry District Council also has two diffusion tube sites in the vicinity of the M1 Junction 19 in Lilbourne as shown on Figure 1.3. The information has been collated from the Council's latest Updating and Screening Assessment report[38]. The Council's diffusion tubes are prepared and analysed by Gradko using the 50% TEA in water method. Results have been bias adjusted based on the national diffusion tube co-location survey available on the Air Quality Review and Assessment website[35].

1.4.26 Tube N12 of the diffusion tube locations in Lilbourne is 2m from the hard shoulder of the M1. Concentrations monitored at this location are not relevant for comparison with the AQS objectives as there is no relevant exposure and they represent worse-case concentrations next to the motorway carriageway. 2007 and 2008 annual means are provided in Table 1.8. The results obtained from this diffusion tube are not used further within this assessment.

1.4.27 Although tube N13 is classified as "Background", it is likely to be impacted by the heavy traffic on the M1. Therefore, and as discussed in Section 1.2.18, it has not been deemed justifiable to use this site to determine background NO_2 concentration for the whole air quality assessment area.

Table 1.8: Daventry NO_2 Monitoring Results near M1

ID	Name	X	Y	Type (1)	NO_2 Annual Mean 2007 – µg/m³ - Bias Adjusted (National Bias=0.93)	NO_2 Annual Mean 2008 – µg/m³ - Bias Adjusted (National Bias=1.05)
N12	M1 Lilbourne	456572	276826	K	**84.8**	**77.1**
N13	Horsepool Lilbourne	456217	277049	B	21.7	20.2

(1) K – Kerbside, R – Roadside, B - Background
In **bold** exceedence of the NO_2 annual mean AQS objective

Summary of Monitoring Data

1.4.28 Results from M1 Junction 19 surveys show that the NO_2 annual mean at most sensitive receptors in the vicinity are well below the AQS objective, apart from sites T4, T8 and T9 showing NO_2 concentrations of 47.9µg/m³, 43.3µg/m³ and 40.3µg/m³ in 2007 respectively. These sites are described further below.

1.4.29 Site T4 is located at the façade of a property adjacent to the A5 Watling Street, 470m north of the M6 and about 2.5km northwest of the M1 junction 19. The high concentrations at this location are likely to be due to proximity to the A5 and vehicles passing within 5m of the property. An assessment of the monitoring location confirms that the property represents relevant exposure, and may represent the worse-case location on the A5 within the study area.

1.4.30 Site T8 in Lilbourne is located about 30m to the west of the carriageway of the M1, 1km south of the M1 Junction 19. This site represents the closest housing to the M1 Northbound carriageway in Lilbourne. Site T9 in Lilbourne is located about 80m east of the kerb of the M1, 1.5km south of the M1 Junction 19. The concentrations at these locations are due to emissions from high volumes of traffic on the M1. Tube N12 in Lilbourne, which is much closer to the M1, shows evidence of the high concentrations associated to the traffic on the M1. However, as discussed above, this site does not represent relevant public exposure.

1.4.31 Concentrations at all other sites are below the AQS objective for annual mean NO_2. Whilst monitoring surveys have been undertaken during different years, the 2007 projected results for all surveys are consistent at similar sites. For example, concentrations at Old Barn Farm in 2007 are estimated to be 31 - 32 µg/m³ for both surveys.

Background Pollutant Concentrations

1.4.32 The background data for each monitoring site and sensitive receptor used for this assessment for both years (2007 and 2014) are provided in Appendix D and are based on the methodology described in section 1.2. The range of background concentrations for the modelled area is also shown in Table 1.9 below.

Table 1.9: Range of Background Concentrations in Assessment Area

	Background Concentration Range (µg/m^3)		
Year	**NO_x**	**NO_2**	**PM_{10}**
2007	12.3 - 16.7	9.7 - 12.6	16.0 - 17.2
2014	10.1 - 13.3	8.1 - 10.3	15.2 - 16.3
Based on UK background air pollution maps available on the Air Quality Archive website[5]			

Sensitive Receptors

1.4.33 There are a number of sensitive receptors in proximity to the M1 Junction 19 and local road network which have been identified for the purposes of the local air quality assessment. All those receptors considered as part of the assessment are described further below.

Construction Receptors

1.4.34 Sensitive receptors in proximity of the construction areas have been considered as part of the assessment. Boundaries or “footprints” have been defined around the construction area representing the locations within 200m where increased effects of dusts may occur (without mitigation), in line with advice provided within the DMRB[1]. Construction dust footprints for 100m and 50m from the construction area were also defined to identify those receptors which are at most risk of experiencing nuisance dust. The areas within 50m and 100m construction footprints are also used as a focus for mitigation measures.

1.4.35 A qualitative assessment has been undertaken which deals with the broader issues relating to construction effects which will be relevant to all those properties defined as being within 200m of the relevant construction areas.

1.4.36 The number of residential properties within each construction footprint has been counted using maps of the area. In total, there are 18 residential properties within 200m, five within 100m, and two within 50m of the whole construction area. The number of properties within each construction footprint is detailed in Table 1.10 and their location shown in Figure 1.4. It should be mentioned that, although Stonebank is listed as one location in this assessment, there are three mobile homes on the site.

1.4.37 The activities within the construction area vary significantly, and in some locations, including Lilbourne, these activities are confined to white line rearrangements on existing carriageway.

Table 1.10: Number of Properties within Construction Footprints

Construction Buffer Area	Number of Properties
200m	18
100m	5
50m	2

Air Quality Modelling Receptors

1.4.38 There are a number of sensitive receptors within the vicinity of the junction which have been identified for the purposes of assessing the operational effects of the proposed junction on local air quality concentrations. Sensitive receptors are defined as locations where members of the public are regularly present and are likely to be exposed over the averaging period of the objective (which varies depending on the pollutant assessed). It is generally appropriate to consider the building façade to represent relevant exposure.

1.4.39 In total, 55 sensitive receptors at the façade of properties have been included in the model set-up to illustrate the effect of the proposed junction on local air quality. The selected receptors are provided Table 1.11 and Figure 1.3. Receptors have been considered to be at 1.5m height above local ground level by default, although the height of a few receptors has been adjusted to account for the difference in relative height between the roads and nearby receptors.

Table 1.11: List of Modelled Sensitive Receptors

ID	Name	X (m)	Y (m)	Z (m)
A	27 The Horsepool, Lilbourne	456304	277073	1.5
B	29 Station Road, Lilbourne	456335	277158	1.5
C	4 Braye Cottages, Lilbourne Lane, Swinford	456934	279181	1.5
D	79 Station Road, Lilbourne	456088	277369	1.5
E	8 Rugby Road, Swinford	456694	279342	1.5
F	Bird's Nest Cottage, Catthorpe	455249	278116	1.5
G	Botany Bay, North Street, Swinford	456916	279524	1.5
H	Catthorpe Manor	455854	278100	1.5
I	Cross Keys Cottage, Rugby Road, Swinford	456957	279394	1.5
J	Elm Cottage, Clay Coton	459452	276926	1.5
K	Hawthorn House, Station Road, Catthorpe	455385	278097	1.5
L	Heath House, Swinford Road, Catthorpe	455340	278198	1.5
M	Hill Top Farm	455098	279863	1.5
N	Lambcote Hill Farm	456174	279519	1.5
O	Lilbourne Fields Farmhouse	456766	276594	6.5
P	Little Grove, Chapel Street, Swinford	456892	279456	1.5
Q	Manor Cottage, Shawell	454585	280346	1.5
R	Meadowside, Rugby Road, Swinford	456797	279292	1.5
S	Old Barn Farm A	455933	278571	12.5
T	Pendale, Main Street, Shawell	454445	280335	1.5
U	Roman Cottage, Catthorpe Road, Shawell	454528	280248	1.5
V	Selby House, Stanford-on-Avon	458899	278786	1.5
W	Stonebank	455903	279216	4.5
X	The Elms, Station Road, Lilbourne	456289	277265	1.5
Y	Tomley Hall Farm	455206	279295	1.5
Z	Westfield Lodge, Rugby Road, Swinford	456431	279166	1.5
AA	Catthorpe Road	454597	279121	1.5
AB	51, Avocet Close	451352	278328	1.5
AC	Keepers Cottage	451254	278137	1.5
AD	3, Coton House Cottages	451697	279363	1.5
AE	15, Shearwater Drive	451311	278129	1.5

ID	Name	X (m)	Y (m)	Z (m)
AF	Coton Meadows, Stage 5	451821	278082	1.5
AG	The Berries, Watling Street	454078	278456	1.5
AH	20 Watling Street	454060	278393	1.5
AI	19 Watling Street	454067	278373	1.5
AJ	Braywood, Watling Street	454025	278551	1.5
AK	Holywell House, Watling Street	453518	279433	1.5
AL	Coton Farm, Newton Lane	453045	279421	1.5
AM	2 The Leyes, Newton	453020	278334	1.5
AN	Newton Manor Cottage	452471	277479	1.5
AO	4 Speedwell Close, Rugby	452085	277435	1.5
AP	St Thomas' Cross (PH) Newton Manor Lane	453061	277552	1.5
AQ	37 Yelvertoft	456526	276875	6.5
AR	21 Yelvertoft	456502	276879	6.5
AS	35 Yelvertoft Road	456514	276877	6.5
AT	11 Yelvertoft	456359	276905	1.5
AU	3 Yelvertoft	456250	276910	1.5
AV	New Farmstead / Manor Farm	455520	278105	1.5
AW	Northfield House	452867	281202	1.5
AX	The Spinney	453604	282017	1.5
AY	Rose Cottage	454714	283683	1.5
AZ	Misterton Lodge	455702	283665	1.5
BA	Stanford Mear	459406	277824	1.5
BB	The Old Granary	453716	276345	1.5
BC	Gibbet House	452886	280707	1.5

Designated Sites

1.4.40 The DMRB[1] provides guidance for undertaking environmental assessment of air quality for sensitive ecosystems (vegetation) in internationally designated nature conservation sites and Sites of Special Scientific Interest (SSSI). Air pollution can damage vegetation, affect plant health and productivity and species composition. The pollutant that is of most concern for sensitive vegetation is generally NO_x.

1.4.41 There are two SSSI near the M1 Junction 19: Cave’s Inn Pit to the south of Shawell and Stanford Park between Swinford and Stanford-on-Avon.

1.4.42 Cave’s Inn Pit SSSI is characterised as a neutral marsh (within a former quarry) and is located approximately 110m east of the A5. Traffic flows along the A5 are about 14,000 vehicles per day in the baseline (2007) scenario, and are expected to be about 23,800 vehicles per day in the Do Minimum (2014) scenario, and 24,400 vehicles per day with in the Do Something (2014) scenario. This represents a change of less than 1000 AADT in traffic flows along the A5 as a result of the proposed junction, when compared with the Do Minimum (2014). Therefore the potential significance of effect on the SSSI is considered to be *Neutral*.

1.4.43 Stanford Park SSSI is characterised as a broadleaved, mixed and yew woodland located adjacent to Stanford Road. However, traffic flows along these roads do not exceed 600 vehicles per day and are not expected to increase in 2014, either with or without the proposed junction. As such, any potential significance of effect on this SSSI as a result of the proposed junction would be *Neutral*.

1.4.44 There are no Ramsar, Special Protection Areas (SPAs) or Special Areas of Conservation (SAC) within 200m of the construction site boundaries.

1.4.45 Given the above no further assessment of air pollution to sensitive ecosystems has been carried out.

Model Verification

1.4.46 As described in Section 1.2, NO_x modelled results have been verified against monitoring data. Due to the wide area covered by the assessment, predicted results are likely to depend on the type of environment. For example, the model is likely to perform differently for receptors very close to the kerb (such as these along the A5 Watling Street) compared to locations further away but impacted by the motorways. Cuttings and embankments also have an impact on dispersion, and although the relative height between the roads and nearby receptors has been taken into account, these are simplifications that may not fully represent the complexity of the actual terrain and environment due to local wind flow effects.

1.4.47 To account for the variability in the type of environment within the air quality assessment area, four separate adjustment factors have been used to correct the modelled NO_x contribution due to road traffic, as follows:-

- An adjustment factor of 2.48 for those receptors (receptors O, AQ, AR and AS) in Lilbourne closest to the M1 south of Junction 19 (near Yelvertoft Road bridge) where M1 is in a cutting;
- An adjustment factor of 2.09 for the receptors located at roadside sites along the A5 (receptors AG, AH, AI, AJ and AK);
- An adjustment factor of 2.01 for the receptors near Old Barn Farm (receptors H and S) which are located southwest of the M1 Junction 19 where local terrain tends to rise above the junction; and
- An adjustment factor of 1.28 for all other receptors.

1.4.48 NO_2 predicted results have then been derived based on the methodology described in Technical Guidance LAQM.TG(09)[17]. The verified model results at the monitoring locations are provided in Table 1.12 along with the difference between monitored and modelled results. Further details of the model verification methodology are shown in Appendix B.

Table 1.12: Verified NO_2 Results at Monitoring Locations

Area	Site ID	Site Location	Monitored NO_2 2007 ($\mu g/m^3$)	Predicted NO_2 2007 ($\mu g/m^3$)	Difference Predicted / Monitored ($\mu g/m^3$)	Difference Predicted / Monitored (%)
Lilbourne near M1	T8	35 Yelvertoft Road	**43.3**	38.2	-5.1	-11.8%
	T9	Lilbourne Fields Farm	**40.3**	**44.2**	3.8	9.5%
Along A5	T4	Holywell House	**47.9**	**47.9**	0.0	0.0%
Southwest of M1 Junction 19 (Old Barn Farm)	T5	Old Barn Farm	30.8	29.9	-1.0	-3.1%
	T6	15 Manor End	23.3	26.7	3.4	14.7%
	A3	Old Barn Farm	31.9	30.4	-1.5	-4.7%
All Others	DAV_N13	Horsepool Lilbourne	21.7	21.8	0.1	0.3%
	T1	Stanford Mear Farm	27.5	28.9	1.4	5.1%
	T2	Swinford Farm	34.3	33.2	-1.1	-3.3%
	T3	Church Road	25.5	20.6	-5.0	-19.4%
	T7	30 Station Road	30.5	27.0	-3.5	-11.6%
	T10	Wood Farm	32.8	29.4	-3.4	-10.3%
	A1	Stanford Mear	27.5	26.3	-1.2	-4.2%
	A2	Stonebank	28.8	29.3	0.6	2.1%
	A4	Westfield Lodge	31.5	33.1	1.6	5.1%
	A5	Swinford Cemetery	26.6	27.0	0.4	1.6%
	A6	Tomley Hall Farm Access Road	35.6	39.1	3.5	9.9%
	A7	Lilbourne 1	26.7	26.3	-0.4	-1.7%
	A8	Catthorpe	26.2	22.1	-4.1	-15.7%
	A9	Lilbourne 2	28.9	31.0	2.1	7.3%
Summary						
Number of sites			Within ±10%		14	
			Between ± 10-25%		6	
			Exceeds ±25%		0	
			Total		20	

In **bold**: exceedence of NO_2 annual mean AQS objective

1.4.49 Whilst predicted and monitored results will never exactly agree, the general aim is for predicted results to be representative of monitored concentrations. Overall, predicted concentrations are in good agreement with measurements, with no sites over or under predicting by more than 25%. Predicted results are within ±10% of the monitored NO_2 concentrations at 14 out of 20 sites, while 6 sites are between ± 10-25%.

1.4.50 The greatest discrepancies between the modelled and monitored concentrations occur at sites T8 in Lilbourne (-5.1µg/m^3), T3 on Church Lane (-5.0µg/m^3) and A8 in Catthorpe (-4.1µg/m^3).

1.4.51 The model under predicted by 12% at monitoring site T8 in Lilbourne, west of the M1, where monitoring shows that the AQS objective was exceeded (43.3µg/m^3). Predicted concentration at this site is below although very close the AQS objective (38.2µg/m^3). However, at receptor T9 nearby, predictions compare well with both monitoring and predicted concentrations being above the AQS objective (44.2 µg/m^3 modelled against 40.3µg/m^3 monitored).

1.4.52 Site T3 on Church Lane is about 700m north of the M6 near Shawell. The model under predicted by 20%, with a predicted concentration of 20.6µg/m^3. However, the monitored concentration (25.5µg/m^3) at this location is also well below the AQS objective.

1.4.53 The model under predicted by 16% at site A8 in Catthorpe, 800m southwest of the M1 Junction 19. However, both predicted and monitored concentrations (respectively 22.1µg/m^3 and 26.2µg/m^3) are well below the AQS objective.

Predicted Baseline 2007

1.4.54 This Section presents the predicted results for the base year 2007. Predicted annual mean concentrations of NO_2 and PM_{10} for the baseline and for all sensitive receptors identified in Table 1.11 are shown in Table 1.13 and compared against the annual mean AQS objective of 40µg/m^3. Comparison with the PM_{10} short-term AQS objective (35 daily means exceeding 50µg/m^3 per year) is also provided. The number of PM_{10} daily mean exceedences was derived from the PM_{10} annual mean, based on the relationship provided in Technical Guidance LAQM.TG(09)[17].

1.4.55 Analysis of UK continuous NO_2 monitoring data has shown that it is unlikely that the hourly mean NO_2 objective, of 18 hourly means over 200µg/m^3, would be exceeded where the annual mean objective is below 60µg/m^3 [39]. The maximum predicted annual average for NO_2 is below 60µg/m^3; therefore the NO_2 hourly mean AQS objective is expected to be met at all relevant locations. Consequently, where mentioned below, the NO_2 AQS objective refers to the annual mean AQS objective of 40µg/m^3.

Table 1.13: Predicted Annual Mean Concentrations – Baseline 2007

Receptor Name	Modelled Annual Average NO_2 – µg/m^3	Modelled Annual Average PM_{10} – µg/m^3	Number of Daily PM_{10} > 50µg/m^3
A	24.0	17.6	1
B	25.8	17.8	1
C	23.6	17.5	1
D	21.3	17.4	1
E	25.2	17.7	1
F	20.7	17.4	1

Receptor Name	Modelled Annual Average NO_2 – µg/m^3	Modelled Annual Average PM_{10} – µg/m^3	Number of Daily PM_{10} > 50µg/m^3
G	22.7	17.5	1
H	27.9	17.5	1
I	23.8	17.6	1
J	16.8	16.4	0
K	20.5	17.4	1
L	21.7	17.5	1
M	22.0	17.5	1
N	32.2	18.3	2
O	**48.8**	18.6	2
P	23.5	17.6	1
Q	19.2	17.9	1
R	24.6	17.6	1
S	31.3	17.7	1
T	18.4	17.8	1
U	19.6	17.9	1
V	17.5	16.5	1
W	**40.7**	19.5	3
X	24.8	17.7	1
Y	25.1	17.7	1
Z	32.9	18.4	2
AA	28.6	18.0	1
AB	29.7	19.0	2
AC	32.9	19.5	3
AD	27.0	18.0	1
AE	30.8	19.2	2
AF	16.9	17.6	1
AG	37.4	18.0	1
AH	31.3	17.6	1
AI	30.6	17.5	1
AJ	**40.7**	18.3	2
AK	**47.9**	18.7	2
AL	27.3	18.1	1
AM	23.0	17.7	1
AN	20.3	17.8	1
AO	21.7	18.0	1
AP	25.2	18.1	1
AQ	**42.6**	18.1	1
AR	**40.5**	17.9	1
AS	**41.5**	18.0	1
AT	25.4	17.7	1
AU	24.3	17.6	1
AV	20.7	17.4	1
AW	20.6	17.2	1
AX	23.5	17.7	1

Receptor Name	Modelled Annual Average NO_2 – µg/m³	Modelled Annual Average PM_{10} – µg/m³	Number of Daily PM_{10} > 50µg/m³
AY	32.2	18.8	2
AZ	21.2	17.6	1
BA	27.7	17.1	1
BB	17.0	16.9	1
BC	28.6	18.0	1

In **bold**, exceedence of the NO_2 or PM_{10} annual mean AQS objective (40µg/m³)

NO_2 Concentrations

1.4.56 The annual mean NO_2 concentration is predicted to exceed the AQS objective at 7 sites for the baseline 2007, including receptors O, AQ, AS and AR in Lilbourne, receptors AK and AJ along the A5 Watling Street and receptor W near the M1 north of Junction 19.

1.4.57 Receptors AQ, AS and AR marginally exceeded the objective (respectively 42.6µg/m³, 41.5µg/m³ and 40.5µg/m³. However, as these are close to diffusion tube T8, which under predicted by 12% (5µg/m³), modelled concentrations at these receptors may be under predicted as well. These receptors are located in Lilbourne south of the M1 Junction 19, on Yelvertoft Road close to the bridge over the M1. Receptor AQ is the closest to the M1 (about 35m from the carriageway), while AS and AR are respectively 45m and 55m from the carriageway..

1.4.58 Receptor O is located in Lilbourne Fields Farm about 70m east of the M1, south of Junction 19. The NO_2 concentration was predicted to be 48.8µg/m³, which is the maximum predicted NO_2 annual mean. However, this receptor is close to diffusion tube T9, where the model over predicted by 9.5% (see model verification results, Table 1.12), although the monitoring also showed a marginal exceedence of the objective.

1.4.59 Receptor AK is located about 450m north of the M6, 5m from the kerb of the A5 and close to monitoring site T4. The NO_2 concentration was predicted to be 47.9µg/m³, which is the concentration monitored at that diffusion tube. Receptor AG, also located along the A5 (about 500m south of the M6) was also predicted to be close to (although below) the objective (37.4µg/m³).

1.4.60 Receptor W is located at Stonebank 300m northwest of the M1 Junction 19, about 40m from the kerb of the M1. The NO_2 concentration was predicted to be marginally above the AQS objective (40.7µg/m³).

1.4.61 All other sensitive receptors showed predicted concentrations below the AQS objective, with most of them below 30µg/m³.

PM_{10} Concentrations

1.4.62 There were no predicted exceedences of the PM_{10} annual mean AQS objective. The maximum predicted annual mean was 19.5µg/m³ at receptor W at Stonebank and receptor AC at Keepers Cottage. A maximum of three daily means exceeding 50µg/m³ was predicted at these two receptors. This is well below the AQS objective, which allows 35 exceedences per year.

1.4.63 It should be noted that PM_{10} results could not be verified, as no suitable monitoring site was available. Although additional emissions such as brake and tyre wear were included in the model, it is likely that the PM_{10} road contribution is underestimated by the model.

1.4.64 However, the LAQM process has shown that, in areas where the main source of pollution is traffic-related, it is unlikely that the PM_{10} AQS objectives would be breached if there is no exceedence of the NO_2 AQS objectives. Analysis of all AQMAs declared in the UK have also shown that where an AQMAs has been declared for NO_2 due to road traffic, PM_{10} exceedences are generally contained within a smaller area or do not occur. Therefore, it is considered unlikely that PM_{10} levels would exceed the AQS objectives at any of the sensitive receptors assessed.

Modelled Do Minimum 2014

1.4.65 This Section presents the predicted results for the Do Minimum scenario (without the proposed junction in 2014). Predicted annual mean concentrations of NO_2 and PM_{10} for all sensitive receptors are shown in Table 1.14 and compared against the annual mean AQS objective of 40µg/m^3. Comparison with the PM_{10} short-term AQS objective (35 daily means exceeding 50µg/m^3 per year) is also provided.

Table 1.14: Predicted Annual Mean Concentrations – Do Minimum 2014

Receptor Name	Modelled Annual Average NO_2 – µg/m^3	Modelled Annual Average PM_{10} – µg/m^3	Number of Daily PM_{10} > 50µg/m^3
A	19.4	16.7	1
B	20.9	16.9	1
C	18.8	16.6	1
D	17.2	16.5	0
E	20.3	16.7	1
F	17.1	16.6	1
G	18.5	16.6	1
H	22.6	16.6	1
I	19.5	16.8	1
J	13.2	15.6	0
K	16.5	16.5	1
L	17.5	16.6	1
M	18.1	16.6	1
N	26.5	17.3	1
O	**41.8**	17.7	1
P	19.3	16.7	1
Q	15.4	16.9	1
R	19.8	16.7	1
S	25.5	16.8	1
T	14.6	16.8	1
U	16.4	17.1	1
V	13.8	15.7	0
W	34.2	18.2	2
X	20.1	16.8	1

Receptor Name	Modelled Annual Average NO_2 – µg/m^3	Modelled Annual Average PM_{10} – µg/m^3	Number of Daily PM_{10} > 50µg/m^3
Y	20.1	16.8	1
Z	26.8	17.3	1
AA	22.7	17.0	1
AB	22.6	17.9	1
AC	25.1	18.3	2
AD	21.0	17.0	1
AE	23.4	18.0	1
AF	13.4	16.7	1
AG	32.3	17.3	1
AH	26.3	16.8	1
AI	25.7	16.7	1
AJ	35.4	17.6	1
AK	39.3	17.7	1
AL	21.8	17.0	1
AM	18.3	16.7	1
AN	17.3	17.0	1
AO	19.0	17.3	1
AP	21.7	17.3	1
AQ	35.8	17.2	1
AR	33.9	17.0	1
AS	34.8	17.1	1
AT	20.5	16.7	1
AU	19.3	16.6	1
AV	16.7	16.5	0
AW	16.6	16.4	0
AX	19.1	17.1	1
AY	26.2	18.2	2
AZ	19.0	17.2	1
BA	21.3	16.1	0
BB	13.3	16.0	0
BC	22.2	17.1	1

In **bold**, exceedence of the NO_2 or PM_{10} annual mean AQS objective (40µg/m^3)

NO_2 Concentrations

1.4.66 The maximum predicted NO_2 annual mean concentration is 41.8µg/m^3 at receptor O in Lilbourne Fields Farm, which is above the AQS objective. However, as discussed previously, this receptor is close to diffusion tube T9, where the model over predicted. Therefore, the predicted concentration at this receptor may be over estimated.

1.4.67 This is the only predicted exceedence, although receptor AK along the A5 Watling Street north of the M6, is also close (but below) the objective, with 39.3µg/m^3 predicted. All other receptors are predicted to be below 40µg/m^3, with most of the receptors being well below the objective.

1.4.68 As discussed previously, concentrations at receptors AQ, AR and AS in Lilbourne are close to diffusion tube T8, where the model under predicted. Predicted concentrations are within 33.9µg/m^3 and 35.8µg/m^{3}at these receptors, and therefore they may be close to exceeding the AQS objective in the Do Minimum 2014 scenario.

1.4.69 Overall, concentrations predicted for the 2014 Do Minimum scenario are lower compared to the 2007 baseline. Whilst there are increased traffic flows due to expected traffic growth (even without the proposed junction) the levels are expected to reduce significantly due to the implementation of more stringent emissions controls for vehicles in future years. In addition, national measures are aimed to reduce the emissions from other sources which contribute to general background levels of pollutants across the UK and these reductions also lead to predictions of lower concentrations in future years.

PM_{10} Concentrations

1.4.70 There are no predicted exceedences of the PM_{10} annual mean AQS objective. The maximum predicted annual mean is 18.3µg/m^3 at receptor AC at Keepers Cottage. A maximum of two daily means exceeding 50µg/m^3 is predicted at that same receptor, as well as at receptors W (Stonebank) and AY (Rose Cottage). This is well below the AQS objective, which allows 35 exceedences per year.

1.4.71 However, as mentioned above, PM_{10} results could not be verified and it is likely that the PM_{10} road contribution has been underestimated.

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1.5 MITIGATION

Proposed Mitigation Measures – Impacts from Construction

1.5.1 The proposed mitigation measures as described in Section 1.6 below with good on-site management practices would be implemented to reduce the short-term impacts.

1.5.2 It is also recommended that a programme of monitoring nuisance dust and PM_{10} be considered in consultation with local authority Environmental Health Officers to review and assess the effectiveness of adopted mitigation measures during construction. This would be considered within the Construction Environmental Management Plan (CEMP) that would set out the details of pollution controls, as part of a strategy to minimise the effects of construction on adjacent land users. The CEMP would identify all potential impacts of activities and operations. It would also include a framework and timetable for implementing work practices, procedures and management controls to eliminate potential negative impacts on local air quality.

Proposed Mitigation Measures – Operational Impacts (Traffic)

1.5.3 The predictions of traffic impacts in the current assessment have taken account of the improvements in technology and tighter emissions controls through the future pollutant emission rates. The design of the proposed junction provides for free flowing links and improved passage of traffic using Junction 19. Complete separation of the local road network from much more significant motorway flows all contribute towards relieving congestion in the area which would reduce emissions during peak times as start-stop traffic conditions would be avoided.

1.5.4 There are a number of traffic management actions that could also reduce emissions from traffic during operation of the junction. These actions are detailed in the report "The Role of the Highways Agency in Local Air Quality Management" [40], and a summary of these actions is provided in Table 1.15 below.

Table 1.15: Traffic Management Measures

Primary Control Area	Action
Speed	Enforcement of existing limits
	Permanent speed limit reduction
	Vehicle class specific speed limits
	Improved signing
	Controlled motorways (variable speed limit depending on traffic flow with lower speed limits during busy periods)
	Traffic calming (rumble strips, colour bands, road surface changes etc.)
Access Control	Ramp metering (restricting access from the slip road onto the motorway)
	Zone restriction e.g. clear zone, low-emission zone, home zone, no stopping / parking zones etc
	Width restrictions
	Park and ride encouragement
Information Provision	Variable Message Signs (VMS)
	Driver training improvements
	Route/diversion information
	Alternative route provision
	Radio/Internet/TV traffic announcements

Primary Control Area	Action
	Advanced warning of road repairs and closures, bad weather, major events etc
	Improved public transport information
	Use of motorway service areas as an interchange for park and ride
Segregation of traffic	Dedicated lanes for specific vehicle groups, single occupancy etc
	Tidal lanes (varying number of lanes depending on time of day)
	Climbing lanes
	Signal priority
	HDV or LDV dedicated routes

1.5.5 However, no traffic management measures have been proposed for the junction when operational and none are taken into account in the assessment.

1.6 ENVIRONMENTAL IMPACTS

Impacts during Construction

1.6.1 The construction of the proposed junction is expected to last just under three years in total with the main phase of construction estimated to be from late 2011 until Autumn 2014. Whilst the scale and duration of the works would involve many activities over a number of months, there are very few properties (less than 20) within 200m of the main construction areas, as identified in Table 1.10 in Section 1.4. Properties within 100m of construction works are considered to be at greater risk of experiencing nuisance dust due to closer proximity to activities, whilst pollutants and dust will disperse with greater distances.

1.6.2 Here it should also be noted that the replacement of Catthorpe Viaduct as a separate maintenance project would also affect some of the receptors detailed below as set out in a separate environmental assessment[3]. Those affected by Catthorpe Viaduct Replacement would be Old Barn Farm (receptor S), Westfield Lodge (Z), and two properties on Station Road in Lilbourne (receptors B and X). The description that follows relates to the Junction Improvement.

1.6.3 The pollutants associated with the construction phase are: airborne particulate matter (associated with health impacts as they are inhalable), dust (which is associated with nuisance and amenity impacts due to soiling/visibility) and gaseous pollutants such as NO_x, SO_2, CO and benzene from the exhaust of construction site vehicles, plant and machinery.

1.6.4 The potential impacts on air quality during the construction phase fall into three main categories:-

- Fugitive emissions of particles and dust due to construction activities including during site clearance and demolition;
- Tailpipe emissions of PM_{10} and gaseous pollutants from construction vehicles, plant and machinery; and
- Additional emissions of pollutants from vehicle exhausts due to potential disruption to existing traffic on the road network.

1.6.5 Further details of these potential impacts are provided below.

Construction Area

1.6.6 The proposed construction area will include working areas on and around sections of the M1, M6, and A14 and within the main junction. There is also works associated with the improvements to the local road network, mainly minor realignments (apart from new sections of the local road network between Catthorpe Road/Swinford Road/Rugby Road. A temporary site compound will also be located about 100m northeast of junction 19 off Rugby Road, covering an area of about 15,400m^2.

1.6.7 Specific receptors within 100m of the construction works have been identified in Section 1.4. Properties closest to the main construction areas at the junction include:-

- Lambcote Hill Farm (Receptor N) within 90m;
- Westfield Lodge and Brookside (Receptor Z) within 90m;
- Old Barn Farm (Receptor S) within 100m;
- Stonebank (Receptor W) within 15m; and
- Catthorpe Road (Receptor AA) within 10m

1.6.8 There are a few properties along Station Road in Lilbourne, although the latter are between 150m to 200m from minor works areas which will incorporate white line rearrangements as opposed to earthworks and demolition.

1.6.9 The closest property to the main construction works area is the property in Stonebank (Receptor W), which lies 15m west of the proposed construction boundary near the M1 north of Junction 19. Another property on Catthorpe Road (Receptor AA) north of the M6 is within 10m from the construction boundary associated with improvements to Shawell Lane and Catthorpe Road near the A5.

1.6.10 As such, without controlled operational procedures and good site practices (discussed below), construction dust impacts could occur at these properties.

Fugitive Emissions of Particles and Dust Due to Construction Activities

1.6.11 Airborne particulate matter is a very diverse material in terms of its physical and chemical properties, and particle size. Smaller particles remain airborne longer, dispersing widely and deposit more slowly over a wider area. Research has shown that large dust particles (greater than 30 µm), that make up the greatest proportion of dust emitted from construction sites, will largely deposit within 100 m from source[10].

1.6.12 Intermediate size particles (between 10 – 30 µm) may travel up to 200 – 500 m. The smallest particles (PM_{10}, of aerodynamic diameter less than 10µm) can travel up to 1 km, though very small particles can travel much further[10].

1.6.13 Site clearance/demolition and construction activities such as earth-moving works and the storage of aggregates can generate fugitive emissions of PM_{10} (those particles which are smaller than 10µm in diameter) and dust (particles between 10µm and 75µm) and thus lead to poor air quality on a temporary basis.

1.6.14 The PM_{10} fraction of dust can worsen pre-existing respiratory diseases, enhance sensitivity to allergens and may also have implications for cardiovascular health. Construction dust particles are generally larger in size and are therefore not as harmful as smaller particles, which can penetrate further into the lung. According to the Air Quality Expert Group (AQEG)[41], typically 15 – 45% of construction dust is emitted as PM_{10} (less than 10µm diameter), with construction activities estimated to account for approximately 2% of the total PM_{10} emissions.

1.6.15 Particles generated from some construction activities, such as tail-pipe emissions from construction traffic and onsite construction machinery can be much smaller in size than those particles (fugitive) associated with the mechanical break up of material.

1.6.16 Mechanical processes result in a particle size distribution that is heavily weighted towards the larger particle sizes (> 75µm), and are consequently regarded as more of a nuisance than a health issue.

1.6.17 Airborne dust can be deposited through gravitational settling, and known as “wash-out” during rainfall. Deposition of construction dust has the potential to cause nuisance and inconvenience through the soiling of sensitive surfaces such as windows, painted surfaces and cars. Dust deposition can also damage vegetation by affecting photosynthesis, respiration and transpiration thereby reducing the overall productivity of plants.

1.6.18 Particulate emissions from construction activities are very difficult to quantify, due to the numerous and varied sources. Few representative empirical data are available which can be directly related to construction anticipated for the proposed junction. An investigation of the potential effects of fugitive particulate emissions from demolition/site clearance and construction is best approached by way of a semi-quantitative assessment of those receptors which may be affected during the construction programme.

1.6.19 The construction phase is likely to involve the following series of distinct operations, some of which may have an impact on air quality:-

- Land clearing, ground excavation, site preparation and laying of road foundations and temporary routes;
- Material handling e.g. cut and fill, earth moving using bulldozers and scrapers, compacting;
- Vehicle movements on unpaved surfaces. This is usually the greatest source of dust at construction sites;
- Bund creation using topsoil and subsoil. Proximity to off-site sensitive locations can be significant;
- Demolition of existing structures (bridges)
- Creation of new highway, bridges and embankments;
- Storage of aggregate materials in open stockpiles and resulting wind blow, with re-entrainment of settled particles (secondary emissions, often off-site due to dust exported on vehicle wheels). Proximity to off-site sensitive locations can be significant; and
- Direct emissions from cutting, drilling, mixing etc.

1.6.20 At construction sites, it is generally acknowledged that the most significant dust emission sources are mechanical handling operations and haulage of material on un-surfaced site roads. However, wind blow from stockpiles can also generate significant levels of dust, because this can occur on a 24-hour basis whereas mechanical handling and vehicular haulage take place only during the working day.

1.6.21 In practice, activities with the potential to generate dust and PM_{10} emissions are controlled by sensible operational procedures, a high level of housekeeping and good site practices, therefore minimising the likelihood of a negative impact on the local air quality.

1.6.22 Temporary activities such as demolition of existing structures have the potential to generate significant levels of dust and PM_{10} due to the nature of these of works but these are scheduled to take place over 1-2 days and direct impacts on air quality would therefore only occur over a very short timescale and are not considered to be significant.

1.6.23 With regard to earthworks and the movement of material on site, first estimates show that about 390,000 m^3 of fill material would be required over the whole construction phase, including 20,000 m^3 of imported fill material for Catthorpe Viaduct (representing less than 10% of required material). An estimated 39,500 on-site vehicle movements (over the three years of the construction period) would be necessary to achieve this, including about 10,000 vehicle movements for the imported fill material.

1.6.24 The vast majority would be excavated from within the site from various locations to create the new embankments required along the A14, M1 and M6. Therefore, most of the vehicles movements would be localised around the junction interchange itself. For on-site excavation, haul routes would need to include the existing "dumbbells" and also the new A14 / M6 link. The only receptors within 200m of these construction activities are the mobile homes at Stonebank. However, with controlled operational procedures and good site practices the impact of construction dust on these receptors would be minimised.

1.6.25 For the imported fill material, although it is not possible to identify all properties within 200m of the delivery routes, these routes would be restricted to the main road network to a local quarry, thus reducing the potential for dust nuisance. A local quarry about 4 miles from the site would be used for the fill material. In addition, delivery routes would avoid the use of the local road network, and would have to avoid routes through Swinford in order to access the temporary construction compound on land at Lambcote Hill Farm. Contractors vehicles would not be permitted to use roads through the villages. Where possible, deliveries would avoid the use of the A5 as baseline predictions for some receptors suggest concentrations are close to or above the AQS objective for NO_2.

1.6.26 Other major construction activities with the potential for dust nuisance would include the strip and store of topsoil and the removal of material from foundation excavations, pile arisings, trenches and small excavation. However, these would be localised on-site movements, thus keeping the likelihood of dust to a minimum with appropriate site practices. Moreover, the removed material would be intended to be reused to form environmental bunds, thus removing the need for additional vehicle movements for off site haulage.

1.6.27 Appropriate regard to the control of dust during all construction works would form part of the CEMP, which would involve liaison with the local planning authority. Rigorous implementation of the appropriate mitigation methods can ensure that fugitive dust and PM_{10} emissions can be significantly reduced. The following are examples of the mitigation measures that would be incorporated into the CEMP in respect of air quality matters:-

- The damping down of exposed soils, loose materials or unmade surfaces close to sensitive locations during dry weather;
- Early paving of permanent roads;
- Haul routes to be located away from off-site sensitive properties and to be watered regularly (wet suppression of dust); Watering of haul road surfaces and restricting haulage vehicle speeds are recognised to reduce dust emission rates by about 70-80%;
- The sheeting of vehicles transporting earthworks materials to or from site;
- Limiting vehicle speeds over unmade surfaces;
- Controls applied to the cutting and grinding of materials;
- Restrictions on the burning of materials;
- The use of cleanable hard standings and the provision of wheel washing facilities where appropriate;
- Regular use of sweepers on local roads if visible amounts of soil material from the works are carried onto the public highway;

- All site vehicles and plant to have upward-facing exhausts to minimise surface dust re-suspension;
- Bunds or screens may be constructed as wind breaks, to reduce wind speeds. Earth bunds would be seeded as soon as possible, prior to which they are to be maintained damp where necessary;
- The aggregate stocking area is to be located away from sensitive areas and residential properties;
- Stockpiles should also be watered; where necessary they should be covered or enclosed to reduce effects of windblown dust where necessary;
- Off-site vehicles to be sheeted, their wheels and bodies to be cleaned and the access road to be hard-surfaced and maintained damp;
- Minimisation of drop heights to discharge material close to where it is required.
- Consolidation and bulking of wastes to minimise transportation and handling requirements
- Operation of a complaint and investigative response procedure;
- Compliance with relevant legislation and British Standards;

1.6.28 Without implementation of these mitigation measures and best practice procedures on site, the effects of construction on air quality at receptors within 100m of the construction area may be of *Adverse* significance due to the duration of the works, although the effects would be temporary and only occur during construction. However, provided suitable mitigation measures are in place before and during construction, the impacts on air quality would be reduced considerably and the significance of effects considered to be *Neutral* given the distance of most sensitive receptors to construction works and effective mitigation measures.

Tailpipe Emissions From Construction Vehicles and Machinery

1.6.29 Tailpipe emissions from construction vehicles, although temporary, can be significant and would add to the pollutants emitted from road traffic vehicle exhaust. It is arguable that construction site vehicles, plant and machinery are more likely to be diesel-fuelled, operate less efficiently and/or at lower speeds, and therefore have higher emission of air pollutants.

1.6.30 However, it is important to note that the emissions from construction site vehicles, plant and machinery are regulated and controlled, and subjected to emissions testing by manufacturers. Construction site vehicles, plant and machinery operate intermittently and for short durations of activity, and are relocated regularly according to the construction programme needs.

1.6.31 The distance travelled by the haulage vehicles has been significantly minimised by the proposed Junction as only a small amount of material is required to be brought to and removed from the site by reusing materials within the construction areas where practicable. Therefore, the proposed junction design inherently reduces the potential impacts due to use of off-site haulage routes, as it does for fugitive emissions associated with otherwise large amounts of off-site movement of materials (as discussed in section 1.6.23).

1.6.32 Temporary haul routes to be used for movement of materials and equipments during the construction are mainly located within the construction areas of the junction and follow the line of existing trunk roads (M1, M6, A14), therefore reducing the risk of additional exposure to emissions from the construction vehicles. The construction activity estimated to result in the largest number of vehicle movements (on-site) is anticipated to be the earthworks with about 17,000 vehicle movements estimated to be necessary, most of them being on-site movements. An estimated additional 15,000 vehicle movements would be required for topsoil strip and store and removal from foundation excavations and pile arisings.

1.6.33 Other imported material such as concrete and reinforcement, structural steel, pavement sub base and blacktop, barriers and lighting, etc, would require an estimated 23,000 vehicle movements. All these movements would be spread over the three-years period required for the construction phase. Although more detailed information is not available at this stage, as a broad estimate this would be equivalent to an additional 50 HDV movements per day, which is well below the DMRB criteria for traffic flow changes (AADT) of 200 HDVs per day. In addition, delivery routes would avoid the use of the local road network, and would have to avoid routes through Swinford in order to access the temporary construction compound on land at Lambcote Hill Farm. Routes through the local villages of Shawell, Swinford and Catthorpe would not be permitted, but some minor movements may be required along Shawell Road between Swinford and Shawell in order to undertake works at the M1 overbridge in order to improve local links.

1.6.34 Where possible, deliveries would avoid the use of the A5 (as baseline predictions for some receptors suggest concentrations are close to or above the AQS objective for NO_2) and would mainly be during off-peak hours in order to reduce impacts during congested times. Routes through Rugby Centre AQMA would be avoided in order to reduce potential impacts within the AQMA.

1.6.35 Appropriate regard to the exhaust emissions of all construction vehicles would form part of the CEMP, which would involve liaison with the local planning authority. The following mitigation measures would be incorporated into the CEMP:-

- Where possible, all non-road mobile machinery (NRMM) should use fuel equivalent to ultra low sulphur diesel (ULSD);
- The machinery with exhaust emissions should be placed as far from sensitive properties as practicable
- No vehicles or plant should be left idling unnecessarily;
- All vehicles and plant should be well maintained and regularly serviced according to the manufacturers recommendations;
- Haul routes to be located away from off-site sensitive properties; and
- Construction affecting traffic flows should be scheduled for off-peak hours when possible.
- Off-site haulage and deliveries will avoid the use of the A5 and the Rugby Centre AQMA would be avoided where possible, and off-peak hours would be used.

1.6.36 To conclude, the effects of construction vehicle tailpipe emissions on annual average air quality concentrations are generally of *Slight Adverse* significance as vehicles movements overall are small compared to existing volumes of traffic on the road network. Mitigation measures, in particular those which are aimed at routes used by deliveries and vehicles will be most effective in reducing the impacts at sensitive receptors in the area and on the local road network.

Additional Emissions Due To Potential Disruption to Traffic During Construction

1.6.37 Some impacts on existing traffic flows can occur during long term construction programmes. Without proper planning and traffic management, increased congestion may occur on roads surrounding the main construction areas which may lead to an increase in vehicle emissions.

1.6.38 The effects of additional traffic emissions can lead to increased concentrations of NO_2 and PM_{10}. However, pollutants generally disperse rapidly with distance from the road so that they tend to approach background concentrations further away[17] as shown by monitoring undertaken at the majority of receptors in the general vicinity of the junction.

1.6.39 The M1 Junction 19 already suffers from traffic delays and queuing due to the junction configuration, mainly due to high volumes of traffic regularly causing long queues on the A14 and on exit slip roads from the M1 and M6.

1.6.40 However, the construction sequence for the road works has been designed to minimise further disruption to traffic, and traffic management measures would be implemented in order to maintain the flow of existing traffic on the M1, M6 and surrounding local road network. This would minimise the risk of increased vehicle emissions due to congested traffic. Typical measures would include:-

- Scheduling operations affecting traffic for off-peak hours whenever possible;
- Minimising obstructions to through traffic lanes; and
- Developing a traffic plan to minimise traffic flow interference from construction activities.

1.6.41 Planned road closures would be necessary to demolish existing structures and erect new structures. These would involve temporary closure (generally less than 24-hours at time) of the M1 northbound to M6 link, the M1 southbound between junctions 20 and 19, the M6 to M1 southbound link, or the M1 northbound between junctions 19 and 20, at certain stage of the construction phase.

1.6.42 Diversion routes during these temporary road closures would use the A5 Watling Street and the A426 Rugby Road between the M6 and Lutterworth. However, road closure would be short-term, between 10 to 24 hours and are planned to also avoid peak-hour traffic. Any such closure will be planned for periods of minimum potential disruption such as at weekends. Temporary lane closures on the M1 would be planned for periods of minimum potential disruption in accordance with Highways Agency Public Service Agreement (PSA) requirements. Therefore, traffic disruption would be minimised and any temporary road closure would have no significant long term impact on local air quality levels. As such, the significance of effect of potential disruption to traffic due to construction is considered to be *Neutral*.

Local Air Quality Impacts

Predicted Concentrations

1.6.43 Predicted annual mean concentrations of NO_2 and PM_{10} for the Do Something scenario (with the proposed junction in operation) are shown in Table 1.16 and Table 1.17, respectively, and compared against the annual mean AQS objective of 40µg/m^3. The percentage change in predicted concentrations between the Do Minimum (2014) and baseline (2007) scenarios and between the Do Something (2014) and Do Minimum (2014) scenarios is also provided *for comparison.* As before predicted exceedances are shown in bold type. There are no predicted exceedances for PM_{10} in the Do Something scenario.

Do Something 2014 NO_2 Annual Means

1.6.44 The highest NO_2 concentration predicted for the Do Something (2014) scenario is 41.2µg/m^3 at receptor O in Fields Farm, Lilbourne, which is above the AQS objective. However, as discussed previously, this receptor is close to diffusion tube T9, where the model over predicted. Therefore, the predicted concentration at this receptor may be over estimated.

1.6.45 This is the only predicted exceedence in the Do Something scenario, although two other receptors, AK and AJ along the A5 Watling Street, are predicted to be below but close to the objective (respectively 39.1µg/m^3 and 36.9µg/m^3).

1.6.46 As discussed previously, concentrations at receptors AQ, AR and AS in Lilbourne are close to diffusion tube T8, where the model under predicted. Predicted concentrations in the Do Something 2014 scenario are within 33.4µg/m^3 and 35.4µg/m^{3}at these receptors, and therefore they may be close to exceeding the AQS objective in the Do Minimum 2014 scenario.

1.6.47 All other receptors are below the AQS objective, most of them predicted to be below 30µg/m^3.

Change in NO_2 Annual Means between the Do Something and Do Minimum Scenarios

1.6.48 Although receptor O is predicted to be above the AQS objective in 2014 for the Do Something scenario, it represents a slight decrease (-0.6µg/m^3) when compared to the Do Minimum scenario, for which an NO_2 annual mean of 41.8µg/m^3 was predicted. Similarly, for receptor AK along the A5 north of the M6, which is close to the objective both with and without the proposed junction, there is a slight decrease in the Do Something scenario (from 39.3µg/m^3 to 39.1µg/m^3).

1.6.49 However, for receptor AJ along the A5 south of the M6, the model predicts an increase of 1.5µg/m^3 in NO_2 between the Do Something and the Do Minimum scenarios, from 35.4µg/m^3 to 36.9µg/m^3. Although overall traffic flows are predicted to decrease slightly along the A5 near receptor AJ (from about 15,900 vehicles per day in the Do Minimum scenario to 15,600 vehicles per day in the Do Something scenario), this increase in NO_2 is due to the predicted increase in relative numbers of Heavy-Duty Vehicles (HDVs) (from 3.8% to 4.2% of the overall traffic, representing an increase from 600 to 650 vehicles per day), which contribute higher pollutant emissions than cars.

1.6.50 The highest increase in NO_2 concentrations between the Do Something and the Do Minimum scenarios is predicted at receptor BA (+1.9µg/m^3), which is located off Stanford Road, about 100m north of the A14, 3.5km east of the M1 Junction 19. The increase here is due to the predicted increase in traffic on the A14, from about 55,800 vehicles per day to about 78,000 vehicles per day with the proposed junction in place. However, the overall NO_2 concentration (23.2µg/m^3) would still be well below the AQS objective of 40µg/m^3 due to the distance of the receptor to the A14.

1.6.51 The largest decrease (e.g. improvement) in NO_2 concentrations between the Do Something and the Do Minimum scenarios is predicted at receptor W (-1.5µg/m^3), located in Stonebank, 300m northwest of the M1 Junction 19, about 40m from the kerb of the M1, where the concentration in NO_2 is predicted to be 32.7µg/m^3 with the proposed junction in place. The decrease at this receptor is due to the predicted decrease in HDV traffic flows on the M1 by about 700 vehicles per day between the Do Minimum and the Do Something scenarios, despite the overall increase in traffic forecast on the M1 (from 92,000 to 108,000 vehicles per day).

1.6.52 All other sensitive receptors are predicted to experience marginal changes in NO_2 concentrations (generally within ±1µg/m^3) between the Do Minimum and Do Something scenarios.

Table 1.16: Comparison of Predicted NO_2 Concentrations

Receptor Name	NO_2 Baseline 2007 – µg/m^3	NO_2 Do Minimum 2014 – µg/m^3	Change (Do Minimum - Baseline - %)	NO_2 Do Something 2014 – µg/m^3	Change (Do Something - Do Minimum - %)
A	24.0	19.4	-18.9%	19.2	-1.5%
B	25.8	20.9	-18.8%	20.5	-2.2%
C	23.6	18.8	-20.3%	19.2	1.9%
D	21.3	17.2	-19.5%	16.9	-1.4%
E	25.2	20.3	-19.6%	20.6	1.4%
F	20.7	17.1	-17.1%	16.2	-5.2%
G	22.7	18.5	-18.5%	18.4	-0.9%
H	27.9	22.6	-19.1%	22.8	0.8%
I	23.8	19.5	-18.1%	19.5	0.0%
J	16.8	13.2	-21.3%	13.8	4.4%
K	20.5	16.5	-19.4%	16.4	-0.7%
L	21.7	17.5	-19.0%	17.0	-3.4%
M	22.0	18.1	-17.6%	17.7	-2.2%
N	32.2	26.5	-17.6%	25.6	-3.3%
O	**48.8**	**41.8**	-14.4%	**41.2**	-1.6%
P	23.5	19.3	-18.0%	19.1	-0.9%
Q	19.2	15.4	-20.0%	15.3	-0.4%
R	24.6	19.8	-19.4%	20.4	2.6%
S	31.3	25.5	-18.6%	25.5	0.0%
T	18.4	14.6	-20.8%	14.8	1.5%
U	19.6	16.4	-16.1%	15.3	-6.9%
V	17.5	13.8	-21.3%	14.2	3.3%
W	**40.7**	34.2	-16.1%	32.7	-4.5%
X	24.8	20.1	-19.1%	19.5	-2.8%
Y	25.1	20.1	-19.9%	20.6	2.2%
Z	32.9	26.8	-18.5%	26.2	-2.5%
AA	28.6	22.7	-20.7%	24.0	5.7%
AB	29.7	22.6	-24.0%	23.0	1.7%
AC	32.9	25.1	-23.7%	25.4	1.2%
AD	27.0	21.0	-22.0%	21.7	3.4%
AE	30.8	23.4	-24.1%	23.7	1.4%
AF	16.9	13.4	-20.5%	13.7	1.6%
AG	37.4	32.3	-13.8%	33.5	3.7%
AH	31.3	26.3	-15.9%	27.7	5.0%
AI	30.6	25.7	-16.2%	27.0	5.2%

Receptor Name	NO_2 Baseline 2007 – µg/m^3	NO_2 Do Minimum 2014 – µg/m^3	Change (Do Minimum - Baseline - %)	NO_2 Do Something 2014 – µg/m^3	Change (Do Something - Do Minimum - %)
AJ	**40.7**	35.4	-13.0%	36.9	4.1%
AK	**47.9**	39.3	-17.9%	39.1	-0.5%
AL	27.3	21.8	-20.4%	22.1	1.5%
AM	23.0	18.3	-20.3%	18.4	0.3%
AN	20.3	17.3	-14.7%	17.5	1.0%
AO	21.7	19.0	-12.6%	19.1	0.9%
AP	25.2	21.7	-14.0%	21.7	0.0%
AQ	**42.6**	35.8	-15.9%	35.4	-1.1%
AR	**40.5**	33.9	-16.4%	33.4	-1.3%
AS	**41.5**	34.8	-16.2%	34.4	-1.2%
AT	25.4	20.5	-19.3%	20.4	-0.5%
AU	24.3	19.3	-20.5%	19.5	1.2%
AV	20.7	16.7	-19.6%	16.7	0.0%
AW	20.6	16.6	-19.2%	16.0	-4.0%
AX	23.5	19.1	-18.6%	18.1	-5.4%
AY	32.2	26.2	-18.7%	25.1	-4.4%
AZ	21.2	19.0	-10.6%	17.7	-6.7%
BA	27.7	21.3	-22.9%	23.2	8.7%
BB	17.0	13.3	-21.8%	13.5	1.2%
BC	28.6	22.2	-22.4%	22.0	-0.7%

In **bold**, exceedence of the NO_2 annual mean AQS objective (40µg/m^3)

Do Something PM_{10} Annual Means

1.6.53 Predicted annual mean PM_{10} concentrations are below the AQS objectives at all receptors in the Do Something scenario. The highest predicted PM_{10} concentration is 18.4µg/m^3 at receptor AC at Keepers Cottage.

1.6.54 As previously described, PM_{10} results are not verified as no suitable monitoring site was available. Although additional emissions such as brake and tyre wear were included in the model, it is likely that the PM_{10} road contribution is underestimated by the model. Changes in PM_{10} concentrations tend to be smaller than those for NO_2, and it is considered that predictions for NO_2 (which have been compared against local monitoring), provide a better description of the changes in air quality due to the proposed junction.

Change in PM_{10} Annual Means between the Do Something and Do Minimum Scenarios

1.6.55 The highest increase in PM_{10} annual mean concentrations between the Do Something and the Do Minimum scenarios is predicted at receptors BA (+0.3µg/m^3) and AA (+0.2µg/m^3).

1.6.56 The highest decrease in PM_{10} annual mean concentrations between the Do Something and the Do Minimum scenarios is predicted at receptors AZ (-0.3µg/m^3) and AY (-0.2µg/m^3).

1.6.57 PM_{10} annual mean concentrations at all other sensitive receptors are mostly unchanged (within ±0.1µg/m^3).

Table 1.17: Comparison of Predicted PM_{10} Concentrations

Receptor Name	PM_{10} Baseline 2007 – µg/m^3	PM_{10} Do Minimum 2014 – µg/m^3	Change (Do Minimum - Baseline - %)	PM_{10} Do Something 2014 – µg/m^3	Change (Do Something - Do Minimum - %)
A	17.6	16.7	-5.0%	16.7	-0.1%
B	17.8	16.9	-5.0%	16.9	-0.2%
C	17.5	16.6	-5.3%	16.7	0.7%
D	17.4	16.5	-5.0%	16.5	0.0%
E	17.7	16.7	-5.3%	16.8	0.8%
F	17.4	16.6	-4.6%	16.5	-0.7%
G	17.5	16.6	-4.9%	16.6	0.1%
H	17.5	16.6	-5.1%	16.7	0.4%
I	17.6	16.8	-4.8%	16.8	0.2%
J	16.4	15.6	-5.2%	15.7	0.6%
K	17.4	16.5	-5.1%	16.5	0.1%
L	17.5	16.6	-5.0%	16.6	-0.3%
M	17.5	16.6	-5.2%	16.6	0.3%
N	18.3	17.3	-5.6%	17.4	0.5%
O	18.6	17.7	-4.9%	17.6	-0.5%
P	17.6	16.7	-4.8%	16.7	0.0%
Q	17.9	16.9	-5.4%	16.9	0.1%
R	17.6	16.7	-5.3%	16.8	0.9%
S	17.7	16.8	-5.3%	16.8	0.5%
T	17.8	16.8	-5.4%	16.9	0.2%
U	17.9	17.1	-4.6%	16.9	-1.0%
V	16.5	15.7	-5.2%	15.8	0.5%
W	19.4	18.2	-5.9%	18.3	0.6%
X	17.7	16.8	-5.0%	16.8	-0.2%
Y	17.7	16.8	-5.4%	16.9	0.8%
Z	18.4	17.3	-5.6%	17.5	0.8%
AA	18.0	17.0	-5.5%	17.3	1.4%
AB	19.0	17.9	-6.1%	17.9	0.5%
AC	19.5	18.3	-6.0%	18.4	0.5%
AD	18.0	17.0	-5.5%	17.1	0.5%
AE	19.2	18.0	-6.3%	18.1	0.5%
AF	17.6	16.7	-5.1%	16.7	0.2%
AG	18.0	17.3	-4.1%	17.4	0.5%
AH	17.6	16.8	-4.5%	16.9	0.6%
AI	17.5	16.7	-4.5%	16.8	0.6%
AJ	18.3	17.6	-4.0%	17.7	0.7%
AK	18.7	17.7	-5.6%	17.7	0.2%
AL	18.1	17.0	-5.9%	17.1	0.2%

Receptor Name	PM_{10} Baseline 2007 – µg/m^3	PM_{10} Do Minimum 2014 – µg/m^3	Change (Do Minimum - Baseline - %)	PM_{10} Do Something 2014 – µg/m^3	Change (Do Something - Do Minimum - %)
AM	17.7	16.7	-5.7%	16.7	0.0%
AN	17.8	17.0	-4.5%	17.1	0.1%
AO	18.0	17.3	-4.1%	17.3	0.1%
AP	18.1	17.3	-4.3%	17.3	-0.1%
AQ	18.1	17.2	-5.0%	17.1	-0.3%
AR	17.9	17.0	-5.0%	17.0	-0.2%
AS	18.0	17.1	-5.0%	17.0	-0.3%
AT	17.7	16.7	-5.2%	16.7	-0.1%
AU	17.6	16.6	-5.6%	16.7	0.4%
AV	17.4	16.5	-5.1%	16.5	0.3%
AW	17.2	16.4	-4.3%	16.3	-0.7%
AX	17.7	17.1	-3.7%	16.9	-1.1%
AY	18.8	18.2	-3.5%	17.9	-1.2%
AZ	17.6	17.2	-2.2%	16.9	-1.8%
BA	17.1	16.1	-6.0%	16.4	2.0%
BB	16.9	16.0	-5.4%	16.1	0.2%
BC	18.0	17.1	-5.3%	17.0	-0.5%

Magnitude of Impact and Significance of Effect

1.6.58 This Section presents the magnitude of impact and significance of effect of the proposed junction on air quality, based on the change in NO_2 and PM_{10} annual mean concentrations between the Do Something and Do Minimum scenarios. Results of the comparison are provided in Table 1.18 and 1.19, which provide the description of the impact magnitude and significance of effect for each sensitive receptor.

1.6.59 The method for assigning the impact magnitude and significance of effect is provided in Section 1.2.

1.6.60 The impact magnitude associated to the change in NO_2 concentrations is *Minor* at most of the receptors. There are a few receptors where the Do Something scenario shows *Adverse* effects along the A5. Conversely, the impact at some receptors is *Beneficial*, especially at receptors near the M1 in Lilbourne.

1.6.61 The significance of effect at receptor AJ on the A5, 380m south of the M6 is predicted to be *Slight Adverse*. As discussed before, the change in NO_2 concentrations at this receptor is +1.5µg/m^3, from 35.4µg/m^3 to 36.9µg/m^3. Although the magnitude associated to this change is considered to be *Minor* (4.1%), the resulting NO_2 annual mean concentration is close to the AQS objective, although still below.

1.6.62 Similarly, the significance of effect at receptor AG, located 110m further south on the A5, is predicted to be *Slight Adverse* due to the predicted increase in NO_2 (+1.2µg/m^3 or 3.7%); although it does not lead to an exceedence of the objective (from 32.3µg/m^3 to 33.5µg/m^3). The significance is predicted to be *Neutral* at other nearby receptors on the A5 (receptors AI and AH), where a *Minor* increase in NO_2 is also predicted. This is because the overall concentration is well below the objective (respectively 27.0µg/m^3 and 27.7µg/m^3).

1.6.63 The significance of effect at receptor AK further north on the A5 is considered to be *Slight Beneficial* as, although the decrease in NO_2 is *Negligible* (-0.2µg/m^3), the concentration is very close to the AQS objective in both the Do Minimum (39.3µg/m^3) and Do Something (39.1µg/m^3).

1.6.64 The significance of effect at receptor W in Stonebank is also predicted to be *Slight Beneficial*, with a decrease of 1.5µg/m^3 in NO_2 due to the decrease in HDVs predicted on the M1.

1.6.65 *Beneficial* effects are also predicted at properties in Lilbourne, close to the M1 (receptors AQ, AR, AS on Yelvertoft Road). Although the impact magnitude is *Minor* (-0.4µg/m^3), the significance is considered to be *Slight Beneficial* as concentrations are further reduced and remain below the AQS objective for NO_2. Whilst concentrations at Receptor O (Lilbourne Fields Farm to the east of the M1) remain above the objective in both scenarios, there is also a *Slight Beneficial* significance of effect predicted although the magnitude is *Minor* (-0.7µg/m^3).

Table 1.18: Impact significance – NO_2 Annual Mean

Receptor Name	Annual Average NO_2 (Do Minimum 2014 – µg/m^3)	Annual Average NO_2 (Do Something 2014 – µg/m^3)	NO_2 Change (Do Something - Do Minimum – µg/m^3)	NO_2 Change (Do Something - Do Minimum - %)	Magnitude of Change	Significance of Change
A	19.4	19.2	-0.3	-1.5%	Minor	Neutral
B	20.9	20.5	-0.4	-2.2%	Minor	Neutral
C	18.8	19.2	0.4	1.9%	Minor	Neutral
D	17.2	16.9	-0.2	-1.4%	Minor	Neutral
E	20.3	20.6	0.3	1.4%	Minor	Neutral
F	17.1	16.2	-0.9	-5.2%	Minor	Neutral
G	18.5	18.4	-0.2	-0.9%	Negligible	Neutral
H	22.6	22.8	0.2	0.8%	Negligible	Neutral
I	19.5	19.5	0.0	0.0%	Negligible	Neutral
J	13.2	13.8	0.6	4.4%	Minor	Neutral
K	16.5	16.4	-0.1	-0.7%	Negligible	Neutral
L	17.5	17.0	-0.6	-3.4%	Minor	Neutral
M	18.1	17.7	-0.4	-2.2%	Minor	Neutral
N	26.5	25.6	-0.9	-3.3%	Minor	Neutral
O	**41.8**	**41.2**	-0.7	-1.6%	Minor	Slight Beneficial
P	19.3	19.1	-0.2	-0.9%	Negligible	Neutral
Q	15.4	15.3	-0.1	-0.4%	Negligible	Neutral
R	19.8	20.4	0.5	2.6%	Minor	Neutral
S	25.5	25.5	0.0	0.0%	Negligible	Neutral
T	14.6	14.8	0.2	1.5%	Minor	Neutral
U	16.4	15.3	-1.1	-6.9%	Minor	Neutral
V	13.8	14.2	0.5	3.3%	Minor	Neutral

W	34.2	32.7	-1.5	-4.5%	Minor	Slight Beneficial
X	20.1	19.5	-0.6	-2.8%	Minor	Neutral
Y	20.1	20.6	0.4	2.2%	Minor	Neutral
Z	26.8	26.2	-0.7	-2.5%	Minor	Neutral
AA	22.7	24.0	1.3	5.7%	Minor	Neutral
AB	22.6	23.0	0.4	1.7%	Minor	Neutral
AC	25.1	25.4	0.3	1.2%	Minor	Neutral
AD	21.0	21.7	0.7	3.4%	Minor	Neutral
AE	23.4	23.7	0.3	1.4%	Minor	Neutral
AF	13.4	13.7	0.2	1.6%	Minor	Neutral
AG	32.3	33.5	1.2	3.7%	Minor	Slight Adverse
AH	26.3	27.7	1.3	5.0%	Minor	Neutral
AI	25.7	27.0	1.3	5.2%	Minor	Neutral
AJ	35.4	36.9	1.5	4.1%	Minor	Slight Adverse
AK	39.3	39.1	-0.2	-0.5%	Negligible	Slight Beneficial
AL	21.8	22.1	0.3	1.5%	Minor	Neutral
AM	18.3	18.4	0.1	0.3%	Negligible	Neutral
AN	17.3	17.5	0.2	1.0%	Minor	Neutral
AO	19.0	19.1	0.2	0.9%	Negligible	Neutral
AP	21.7	21.7	0.0	0.0%	Negligible	Neutral
AQ	35.8	35.4	-0.4	-1.1%	Minor	Slight Beneficial
AR	33.9	33.4	-0.4	-1.3%	Minor	Slight Beneficial
AS	34.8	34.4	-0.4	-1.2%	Minor	Slight Beneficial
AT	20.5	20.4	-0.1	-0.5%	Negligible	Neutral
AU	19.3	19.5	0.2	1.2%	Minor	Neutral
AV	16.7	16.7	0.0	0.0%	Negligible	Neutral
AW	16.6	16.0	-0.7	-4.0%	Minor	Neutral
AX	19.1	18.1	-1.0	-5.4%	Minor	Neutral
AY	26.2	25.1	-1.1	-4.4%	Minor	Neutral
AZ	19.0	17.7	-1.3	-6.7%	Minor	Neutral
BA	21.3	23.2	1.9	8.7%	Minor	Neutral
BB	13.3	13.5	0.2	1.2%	Minor	Neutral
BC	22.2	22.0	-0.2	-0.7%	Negligible	Neutral
Summary						
Number of Sites			Very Large Beneficial		0	
			Large Beneficial		0	
			Moderate Beneficial		1	
			Slight Beneficial		5	
			Neutral		47	
			Slight Adverse		2	
			Moderate Adverse		0	
			Large Adverse		0	
			Very Large Adverse		0	
			Total		55	

1.6.66 Overall, for PM_{10} the impact magnitude associated with the change in PM_{10} concentrations is considered either *Negligible* or *Minor*. The associated significance for PM_{10} is *Neutral* at all receptors.

Table 1.19: Impact significance – PM_{10} Annual Mean

Receptor Name	Annual Average PM_{10} (Do Minimum 2014 – μg/m^3)	Annual Average PM_{10} (Do Something 2014 – μg/m^3)	PM_{10} Change (Do Something - Do Minimum – μg/m^3)	PM_{10} Change (Do Something - Do Minimum - %)	Magnitude of Change	Significance of Change
A	16.7	16.7	0.0	-0.1%	Negligible	Neutral
B	16.9	16.9	0.0	-0.2%	Negligible	Neutral
C	16.6	16.7	0.1	0.7%	Negligible	Neutral
D	16.5	16.5	0.0	0.0%	Negligible	Neutral
E	16.7	16.8	0.1	0.8%	Negligible	Neutral
F	16.6	16.5	-0.1	-0.7%	Negligible	Neutral
G	16.6	16.6	0.0	0.1%	Negligible	Neutral
H	16.6	16.7	0.1	0.4%	Negligible	Neutral
I	16.8	16.8	0.0	0.2%	Negligible	Neutral
J	15.6	15.7	0.1	0.6%	Negligible	Neutral
K	16.5	16.5	0.0	0.1%	Negligible	Neutral
L	16.6	16.6	-0.1	-0.3%	Negligible	Neutral
M	16.6	16.6	0.1	0.3%	Negligible	Neutral
N	17.3	17.4	0.1	0.5%	Negligible	Neutral
O	17.7	17.6	-0.1	-0.5%	Negligible	Neutral
P	16.7	16.7	0.0	0.0%	Negligible	Neutral
Q	16.9	16.9	0.0	0.1%	Negligible	Neutral
R	16.7	16.8	0.2	0.9%	Negligible	Neutral
S	16.8	16.8	0.1	0.5%	Negligible	Neutral
T	16.8	16.9	0.0	0.2%	Negligible	Neutral
U	17.1	16.9	-0.2	-1.0%	Negligible	Neutral
V	15.7	15.8	0.1	0.5%	Negligible	Neutral
W	18.2	18.3	0.1	0.6%	Negligible	Neutral
X	16.8	16.8	0.0	-0.2%	Negligible	Neutral
Y	16.8	16.9	0.1	0.8%	Negligible	Neutral
Z	17.3	17.5	0.1	0.8%	Negligible	Neutral
AA	17.0	17.3	0.2	1.4%	Minor	Neutral
AB	17.9	17.9	0.1	0.5%	Negligible	Neutral
AC	18.3	18.4	0.1	0.5%	Negligible	Neutral
AD	17.0	17.1	0.1	0.5%	Negligible	Neutral
AE	18.0	18.1	0.1	0.5%	Negligible	Neutral
AF	16.7	16.7	0.0	0.2%	Negligible	Neutral
AG	17.3	17.4	0.1	0.5%	Negligible	Neutral
AH	16.8	16.9	0.1	0.6%	Negligible	Neutral

AI	16.7	16.8	0.1	0.6%	Negligible	Neutral
AJ	17.6	17.7	0.1	0.7%	Negligible	Neutral
AK	17.7	17.7	0.0	0.2%	Negligible	Neutral
AL	17.0	17.1	0.0	0.2%	Negligible	Neutral
AM	16.7	16.7	0.0	0.0%	Negligible	Neutral
AN	17.0	17.1	0.0	0.1%	Negligible	Neutral
AO	17.3	17.3	0.0	0.1%	Negligible	Neutral
AP	17.3	17.3	0.0	-0.1%	Negligible	Neutral
AQ	17.2	17.1	0.0	-0.3%	Negligible	Neutral
AR	17.0	17.0	0.0	-0.2%	Negligible	Neutral
AS	17.1	17.0	0.0	-0.3%	Negligible	Neutral
AT	16.7	16.7	0.0	-0.1%	Negligible	Neutral
AU	16.6	16.7	0.1	0.4%	Negligible	Neutral
AV	16.5	16.5	0.0	0.3%	Negligible	Neutral
AW	16.4	16.3	-0.1	-0.7%	Negligible	Neutral
AX	17.1	16.9	-0.2	-1.1%	Minor	Neutral
AY	18.2	17.9	-0.2	-1.2%	Minor	Neutral
AZ	17.2	16.9	-0.3	-1.8%	Minor	Neutral
BA	16.1	16.4	0.3	2.0%	Minor	Neutral
BB	16.0	16.1	0.0	0.2%	Negligible	Neutral
BC	17.1	17.0	-0.1	-0.5%	Negligible	Neutral
Summary						
Number of Sites			Very Large Beneficial		0	
			Large Beneficial		0	
			Moderate Beneficial		0	
			Slight Beneficial		0	
			Neutral		55	
			Slight Adverse		0	
			Moderate Adverse		0	
			Large Adverse		0	
			Very Large Adverse		0	
			Total		55	

Predicted Change in Overall Exposure

1.6.67 TAG local air quality sub-objective aggregated worksheets, on which the following tables are based, are provided in Appendix E.

1.6.68 The results of this Local Air Quality Assessment are shown in Table 1.20. The assessment score represents the overall change in exposure between the Do Something and the Do Minimum (2014) scenarios. It should be noted that the TAG local air quality sub-objective worksheets only generate an approximation of the change in overall exposure at those properties identified within 200m of each of the modelled roads. This is mainly due to the fact that individual properties are counted within one of the four distance bands and the impact at each property is determined based on the predicted average concentrations within each band (see Section 1.2).

1.6.69 As shown in Table 1.20, there would be a *Very Small* decrease in exposure for both PM_{10} and NO_2, with the proposed junction in place.

Table 1.20: Overall Change in Exposure to Pollutants with the proposed junction

Pollutant	Aggregated TAG Score		
	Do Minimum 2014	**Do Something 2014**	**Overall Assessment**
NO_2	15053.9	14998.3	-55.5
PM_{10}	25511.0	25502.4	-8.6

Properties Showing Improvement, Deterioration or No Change in Exposure to Air Quality

1.6.70 Table 1.21 provides the number of properties at which air quality (NO_2 and PM_{10}) is expected to improve, deteriorate or not change as a result of the proposed junction. For both NO_2 and PM_{10}, there are more properties where the air quality is predicted to improve rather than deteriorate. This is consistent with the pollutant concentrations predicted at individual properties, presented under Local Air Quality Impacts, which show that concentrations tend to increase or decrease mostly by less than 1µg/m^3 for NO_2 and even lower for PM_{10}.

Table 1.21: Number of Properties at which Air Quality is Expected to Improve Deteriorate Or Remain the Same, with the proposed Junction

Pollutant	Number of Properties			
	With an Improvement	**With No Changes**	**With a Deterioration**	**Total**
NO_2	685	546	379	1610
PM_{10}	420	994	196	1610

Regional Impacts

1.6.71 Table 1.22 shows the estimated NO_x, PM_{10}, carbon and CO_2 emissions from the M1 Junction 19 and surrounding road network in 2007, and with and without the proposed junction in 2014 and the "design" year 2029. Carbon emissions have been derived from the DMRB Regional Spreadsheet for the road network defined in Section 1.2.42. CO_2 emissions have been calculated by multiplying the carbon emissions by 44 ÷ 12. The full regional worksheet (TAG 3.3.4) s provided in Appendix F.

1.6.72 A significant reduction in annual NO_x and PM_{10} emissions occurs between 2007 and 2014, with or without the proposed junction. This is due to improvements in vehicle emissions technology and stricter emissions standards, which offset the increases in traffic flows between 2007 and 2014.

1.6.73 When compared to the Do Minimum scenario, calculations show that NO_x and PM_{10} emissions would increase by respectively 7% and 21% overall, with the proposed junction in place. However, this would still represent a decrease of 24% in NO_x emissions and 16% in PM_{10} emissions when compared to the baseline 2007.

1.6.74 The DMRB regional assessment shows that carbon and CO_2 emissions increase between the baseline 2007 and 2014, with or without the proposed junction in place. This increase is due to the growth in traffic flows on most roads which leads to an overall increase in Carbon and CO_2 emissions due to increased fuel use. Unlike NO_x and PM_{10}, emissions of carbon and CO_2 are directly linked to fuel use. As such, while advances in vehicle emissions technology results in an improvement in NO_x and PM_{10} emissions, overall fuel use will increase across the network due to the additional vehicles between 2007 and 2014.

1.6.75 When compared to the Do Minimum scenario, calculations show that carbon and CO_2 emissions would increase by 12% with the proposed junction in place. The significance of changes in CO_2 emissions for any single project is difficult to determine due to the national and global importance of the emissions to climate change.

Table 1.22: Annual NO_x, PM_{10} and Carbon Emissions (in Tonnes)

				Do Something 2014 compared with		Design Year	
Pollutant	**Base Year 2007**	**Do Minimum 2014**	**Do Something 2014**	**Base Year 2007**	**Do Minimum 2014**	**Do Minimum 2029**	**Do Something 2029**
NO_x	757	536	575	-181 (-24%)	39 (7%)	538	627
PM_{10}	24	16	20	-4 (-16%)	3 (21%)	19	24
C	46,357	53,336	59,849	13,491 (29%)	6,513 (12%)	62,713	74,263
CO_2	169,977	195,566	219,446	49,469 (29%)	23,880 (12%)	229,947	272,297

1.6.76 Based on the methodology described in Section 1.2, the change in carbon emissions between the Do Minimum and Do Something scenarios over the 60 year appraisal period (2014 to 2073) has also been calculated using TUBA. Results are provided in Table 1.23. The full greenhouse gases worksheets (TAG 3.3.5) are provided in Appendix G.

1.6.77 Total carbon emissions increase with the scheme for the 60 year appraisal period and the opening year (2014) although the increase in carbon emissions between the Do Minimum and Do Something scenarios only represents 0.7% of the total carbon emissions over 60 years.

Table 1.23: Carbon Emissions over 60 Year Appraisal Period

Total Carbon Emissions (tonnes)						Change in Carbon Emissions (tonnes) between Do Something and Do Minimum Scenarios		
in Opening Year (2014)		in Design Year (2029)		Over 60 Year Appraisal Period				
Do-Minimum Scenario	Do-Something Scenario	Do-Minimum Scenario	Do-Something Scenario	Do-Minimum Scenario	Do-Something Scenario	in Opening Year (2014)	in Design Year (2029)	Over 60 Year Appraisal Period
663,142	671,222	796,910	801,854	46,473,701	46,794,771	+8,080 (1.2%)	+4,944 (0.6%)	+321,070 (0.7%)

1.6.78 The increased carbon emissions in both the DMRB regional assessment and 60 year appraisal are due to increased fuel use across each road network. The overall emissions for the road network included assessed by TUBA is significantly greater than that represented within the DMRB regional assessment because the TUBA network is much bigger and hence the carbon emissions annual totals (e.g. opening year 2014) are significantly higher.

1.6.79 The increase in carbon emissions in the opening year (2014) is calculated to be greater for the TUBA network than for the DMRB regional assessment. It is likely that, due to the size of the TUBA network, changes in other parts of the road network outside the area included in the DMRB regional assessment result in further increase in carbon emissions elsewhere, which result in overall higher greater increase in annual carbon emissions.

Implications for Planning Policies

Regional Policy

1.6.80 Policies CC1 and QE1 from the Regional Spatial Strategy for the West Midlands refer to the protection of air quality, mitigating climate change through the lowering of greenhouse gases. Policy QE3 also seeks to assess and minimise the amount of air pollution as a result of development. The proposed development would have a *Slight Adverse* impact on these policies.

1.6.81 Regional policy 36 from the East Midlands Regional Plan states that the potential for adverse effects to air quality as a result of new development should be mitigated where possible, to contribute to an overall reduction in air pollution within the region. The proposed junction improvements would have a *Slight Adverse* impact on air quality within the region and therefore this policy.

Local Planning Policies

1.6.82 There are no saved policies relevant to air quality within the Daventry District Council Local Plan. Daventry are however producing a joint Core Strategy (West Northamptonshire Joint Core Strategy) as part of the LDF process and although this document is currently at the draft issues and options stage, it does set out Strategic Objectives which will inform the basis of future policies. Strategic Objective 8 of the Core Strategy aims to ensure that development is sensitive to its environment. The proposed development would have a *Neutral* impact on this policy through the use of sensitive design and mitigation measures to be used during the construction phase in order to minimise the potential for adverse impacts on the environment.

1.6.83 Saved policy EV23 from the Harborough District Local Plan aims to control pollution and minimise the potential for adverse impact on the environment, ensuring that development does not have an adverse effect on the amenity of nearby uses due to air pollution. Harborough are also in the process of producing their Core Strategy; Core Spatial Policy 3: Promoting Sustainable Development states that greenhouse gases as a result of increased road traffic is an issue that needs to be addressed and a reduction in traffic movements should be sought where possible. The proposed junction improvements will have a *Slight Adverse* impact on the above policies.

1.6.84 The Rugby Borough Local Plan contains a number of saved policies that relate to air quality, including GP3, GP11 and GP12. These policies seek to ensure that planning permission is not granted for any development that would result in an adverse impact on amenity due to dust, fumes or smells and also that air quality is generally protected and improved where possible. Core Strategy Spatial Objective 12 from the emerging Rugby Borough Core Strategy Preferred Options Document states that new development should mitigate against climate change.

1.6.85 Overall, it is considered that the proposed improvement to Junction 19 would have a *Slight Adverse* impact on Regional or Local policy principles and objectives in relation to air quality given its proposed use. However, the implementation of mitigation measures to minimise air pollution during both the construction and operational phases of development would help the development to greater accord with both Regional and Local policy.

1.7 INDICATION OF DIFFICULTIES ENCOUNTERED

1.7.1 No specific difficulties were encountered in the air quality assessment, although particular attention was given to:

- The analysis of air quality monitoring data, especially the bias correction factor and annualisation methodology. Although there are uncertainties inherent to the monitoring method (diffusion tubes) and the calculation of bias, annualisation and projection factors, data on which they rely have been carefully selected and checked to ensure monitoring results are consistent and robust.

- The model verification, for which sensitivity analysis has been carried out, to make sure the adjustment of modelled results was the most suitable.

- Other key input data such as the background concentrations, which were subject to a thorough analysis to make sure they were representative of the area

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1.8 SUMMARY AND CONCLUSIONS

1.8.1 The impact on air quality and climate change of the proposed junction has been assessed.

1.8.2 The assessment of the impact on air quality of each of the operational phases of the proposed options has followed the DMRB and TAG methodologies. The assessment considered the impacts and effects on local and regional air quality. The impacts of the scheme on air quality during construction have also been considered.

Effects During Construction

1.8.3 The potential impacts on air quality during the construction phase fall into three main categories:-

- Fugitive emissions of particles and dust due to construction activities including during site clearance and demolition;
- Tailpipe emissions of PM_{10} and gaseous pollutants from construction vehicles, plant and machinery; and
- Additional emissions of pollutants from vehicle exhausts due to potential disruption to existing traffic on the road network.

1.8.4 Whilst the scale and duration of the works would involve many activities over a number of months, there are very few properties (less than 20) within 200m of the main construction areas. Properties within 100m of construction works are considered to be at greater risk of experiencing nuisance dust due to closer proximity to activities, whilst pollutants and dust will disperse with greater distances.

1.8.5 The closest of these include Stonebank, Old Barn Farm, Lambcote Hill Farm, Westfield Lodge and Brookside. For these few properties within 100m of the proposed construction activities, the likelihood of an impact occurring as a result of the construction phase would be increased and a wide range of mitigation measures are proposed in order to reduce the potential impacts on local air quality and dust.

1.8.6 Emissions related to construction traffic and machinery could have an impact on local air quality adjacent to those routes where HGV traffic is expected to increase for the duration of the construction periods. However, best practice measures to reduce emissions from these sources would be implemented throughout the construction programme.

1.8.7 The construction sequence for the road works has been designed to minimise disruption to traffic using the junctions undergoing improvements. The aim of these traffic management measures is to reduce any increases in traffic congestion and resulting emissions that may occur as a result of the construction programme as much as possible. The necessary road closures and diversions would be temporary and short-term, not exceeding 24 hours. Moreover, they would be planned to minimise disruption, i.e. during nighttimes or weekends. Therefore, it is not expected that diversion routes on the A5 and A426 would have a significant impact on air quality levels.

1.8.8 A CEMP would be prepared in order to set out the proposed measures and subsequent actions regarding control of dust and emissions during construction. Provided that suitable mitigation measures described in this assessment and further detailed in the CEMP are in place during the construction works, the effect of the construction phase on air quality would be of *Neutral* significance.

Local Air Quality Impacts

1.8.9 The local air quality assessment predicted pollutant concentrations at residential properties with and without the proposed junction in 2014. Pollutant concentrations are predicted to meet the relevant AQS objectives for PM_{10} both with and without the junction improvements in 2014.

1.8.10 For NO_2, one property is predicted to exceed the annual mean AQS objective in 2014, both with and without the proposed junction, at Fields Farm in Lilbourne, although there is a slight decrease predicted at the property with the proposed junction in place. However the model over predicted concentrations in this area compared to the monitoring results and predicted concentrations at this receptor may therefore be over estimated. 2014 concentrations are however predicted to decrease in both the Do Something and Do Minimum scenarios at this property compared to the baseline scenario, which shows that concentrations are well above the NO_2 AQS objective in 2007.

1.8.11 Although no exceedence was predicted at nearby properties west of the M1 in Lilbourne on Yelvertoft Road with or without the proposed junction in place in 2014, the model under predicted in that area. Therefore, these properties may also be at risk of exceeding the AQS objective in 2014. However, modelled results show a slight decrease in predicted NO_2 concentrations at these receptors with the proposed junction in place.

1.8.12 Overall, the significance of difference in concentrations between the Do Something and Do Minimum scenarios is considered to be *Neutral*. The significance of changes in concentrations is *Neutral* at most of the properties identified in the assessment. There are a few receptors where the Do Something scenario shows *Adverse* effects along A5 Watling Street, where NO_2 concentrations slightly increase (considered as a *Minor* impact magnitude) due to a slight increase in HDVs daily flows along the A5. However, NO_2 concentration is predicted to remain below the AQS objective at these locations with the proposed junction in place.

1.8.13 Conversely, the impact at some receptors is *Beneficial*, especially at properties close to the M1 in Lilbourne, due to a slight decrease predicted in daily HDVs on the motorway.

1.8.14 On a property by property basis, the number of properties where air quality is expected to improve, due to a decrease in NO_2 or PM_{10} concentrations, is greater than the number where air quality is expected to deteriorate with the proposed junction. The AQS is predicted to be met at most sensitive receptors in the area, with concentrations generally predicted to be well below 30µg/m^3 compared to an AQS objective of 40µg/m^3.

Regional Air Quality Impacts

1.8.15 The regional assessment of air quality impacts considers annual NO_x and PM_{10} emissions, as well as estimated carbon and CO_2 emissions both with and without the proposed junction in place. A reduction in annual NO_x and PM_{10} emissions is predicted to occur between 2007 and 2014 as a result of improvements in vehicle emissions technology and stricter emissions standards, which offsets the increases in traffic flows in future years. However, the annual emissions in 2014 are estimated to increase with the proposed junction compared to without due to increased traffic flows on the road network.

1.8.16 Similarly, emissions of carbon and CO_2 calculated from the DMRB methodology for the Do Something scenario in 2014 increase by 12% ,compared to the Do Minimum scenario, although it is difficult to determine significance due to the importance of national and global emissions overall. However, carbon and carbon dioxide emissions also increase with and without the proposed junction in place between 2007 and 2014 due to the predicted growth in traffic flows over the years which results in greater fuel use and increased carbon emissions.

1.8.17 TUBA output for the 60 year appraisal period (2014 to 2073) indicates that there would be increases in carbon emissions from the appraisal network with the proposed junction in place compared to the Do Minimum scenario. However, the increase in carbon emissions only represents 0.7% of the total carbon emissions over 60 years.

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