

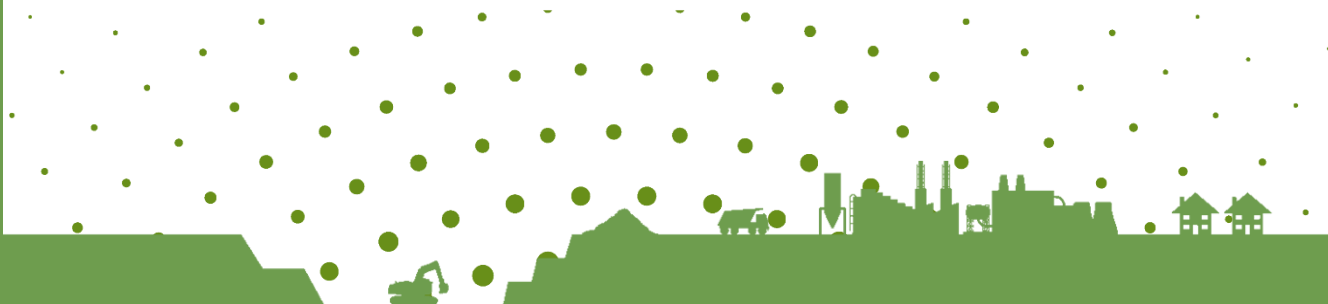


Broken Cross, Macclesfield

Air Quality Modelling Report

March, 2018

Henbury Parish Council



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Executive Summary

DustScanAQ was instructed to undertake air quality modelling for Henbury Parish Council (HPC) to assist in reviewing modelling assessments presented in planning applications 17/4277M and 17/4034M. The planning applications are both for residential developments along Cheshire Road, Macclesfield. The potential local air quality effects from the proposed developments have been assessed using guidance from Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM), and the Department for Environment, Food and Rural Affairs (Defra).

This report provides an assessment on the key impacts from changes in traffic related pollutant concentrations associated with the operational phases of the proposed developments and assesses the significance of the impacts on air quality at existing sensitive receptors.

Baseline and development traffic data was taken from the two existing assessments, and seven scenarios were modelled;

- Scenario 1: 2016 Base year;
- Scenario 2: 2022 Without development;
- Scenario 3: 2022 With development (southern development only);
- Scenario 4: 2024 Without development;
- Scenario 5: 2024 With development (northern development only);
- Scenario 6: 2024 With development (both southern and northern development)
- Scenario 7: 2024 With development (both southern and northern development) with a new Broken Cross roundabout junction upgrade plan.

Receptor locations were modelled within and close to the Broken Cross roundabout AQMA. Data was verified using a diffusion tube in the Broken Cross AQMA.

Model results showed that impacts at receptors were up to 'Substantial Adverse' for the southern development in the earliest opening year of 2022, and up to 'Moderate Adverse' for the northern development (and/or both developments together) in 2024 due to changes in the annual mean concentration for NO₂ due to the proposed developments. It is therefore recommended that further consideration should be given to both applications to allow for the following suggestions:

- Agree a joint methodological approach with the local authority;
- Agree baseline and future year traffic data with the local authority, including cumulative impacts from any other known developments;
- Justify using future year emission factors as oppose to using a worst-case assumption by using emission factors from earlier years; and
- Use diffusion tubes that are present within the AQMA for model verification.

1 Introduction

1.1 Overview

DustScanAQ has been instructed to undertake an air quality modelling report for Henbury Parish Council (HPC) to assist in reviewing modelling assessments presented in planning applications 17/4277M and 17/4034M. The air quality assessment¹ in association with 17/4277M was undertaken by BWB Consulting (BWB) on behalf of Frederic Robinson Ltd (FRL) for the proposed residential development on the land north of Chelford Road, Macclesfield (hereafter known as 'northern proposed development'). The air quality assessment² in association with 17/4034M was undertaken by Resource and Environmental Consultants Ltd (REC) on behalf of Jones Homes and Redrow Homes (JHR) for the proposed residential development on the land south of Chelford Road, Macclesfield (hereafter known as the 'southern proposed development').

The potential local air quality effects of the proposed development have been assessed using guidance from Environmental Protection UK (EPUK) and the Institute of Air Quality Management (IAQM)³, and the Department for Environment, Food and Rural Affairs (Defra)⁴.

1.2 Objective

This report provides an assessment on the following key impacts associated with the proposed developments:

- Changes in traffic related pollutant concentrations associated with the operational phases of the proposed developments; and
- Assessing the significance of the impact from the proposed developments on air quality at existing sensitive receptors.

1.3 Location

The proposed developments are in the unitary authority area of East Cheshire Borough Council ('East Cheshire') and are within close proximity to each other and to the west of central Macclesfield (Figure 1.1). Both proposed developments are adjacent to the newly designated Broken Cross AQMA, which was declared in August 2017 for annual exceedances of NO₂ due to road traffic emissions.

¹ BWB Consultancy 2017: Chelford Road, Henbury, Air Quality Assessment.

² REC 2017: Air Quality Assessment Chelford Road, Macclesfield.

³ IAQM (2017): Land Use Planning and Development Control: Planning for Air Quality'.

⁴ Defra (2016): Local Air Quality Management – Technical Guidance (TG16).

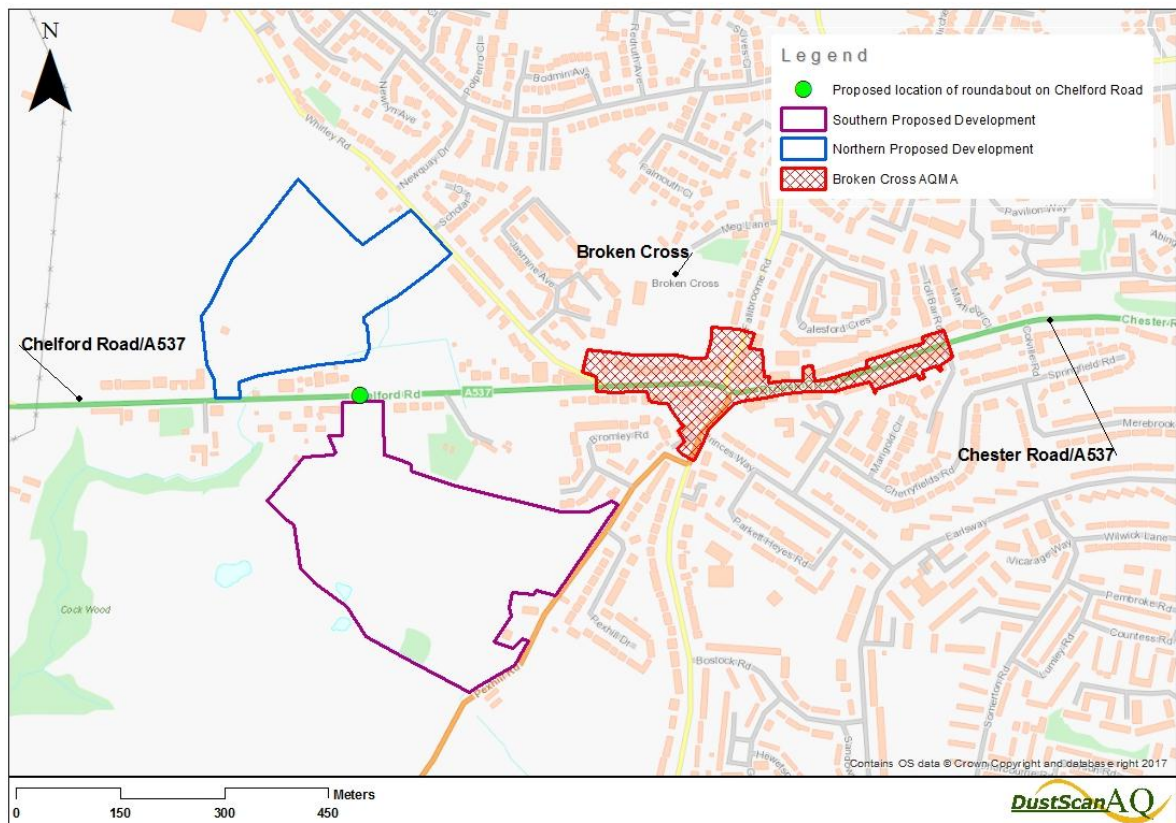


Figure 1.1: Proposed site locations and nearby AQMA

1.4 Key Pollutants

The key pollutants associated with the operational phase of the proposed development are road traffic emissions including nitrogen dioxide (NO₂) and particulate matter (PM₁₀). These pollutants are therefore considered as part of this assessment.

Further details of the key pollutants are presented below.

1.4.1 Nitrogen Dioxide (NO₂)

Nitrogen dioxide (NO₂) and nitric oxide (NO) are collectively referred as oxides of nitrogen (NO_x). During fuel combustion, atmospheric nitrogen combines with oxygen to form nitric oxide (NO), which is not considered harmful. Through a chemical reaction with ozone (O₃) however, NO can further combine with oxygen to create NO₂ which can be harmful to human health and vegetation. The foremost sources of NO₂ in the UK are from combustion sources produced mainly by road traffic and power generation.

1.4.2 Particulate Matter

Particulate matter as a term refers to a mixture of solid particles and liquid droplets suspended in the air. These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others can be so small that they

can only be detected using an electron microscope. Fine dust, essentially particles up to 10 micron (μm), is commonly referred to as PM_{10} .

PM_{10} is known to arise from a number of sources such as construction sites, road traffic movement, industrial and agricultural activities. Very fine particles ($\text{PM}_{2.5}$ – $\text{PM}_{0.1}$) are known to be associated with pollutants such as oxides of nitrogen (NO_x) and sulphur dioxide (SO_2) emitted from power plants, industrial installation and road transport sources.

1.5 Relevant Air Quality Limit Values and Standards

A summary of the relevant AQOs and the types of receptors that are relevant to this assessment are presented in Table 1.1. The AQO listed in Table 1.1 apply only at locations with relevant exposure where a member of the public could be exposed to a level of pollution concentration for the specific averaging periods for that pollutant as stated in Table 1.2.

Table 1.1: AQO Relevant to the Human Health Receptors potentially affected by the Proposed Development

Pollutant	Air Quality Objectives		Concentration measured as:
	Concentration	Allowance	
Nitrogen Dioxide (NO_2)	200 $\mu\text{g}/\text{m}^3$	18 per calendar year	1 hour mean
	40 $\mu\text{g}/\text{m}^3$	-	Annual mean

Source: Defra, 2016⁵

Table 1.2: Examples of Where the AQO Should Apply

Averaging period	Objectives should apply at	Objectives should not apply at
Annual	<i>All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.</i>	<i>Building façades of offices or other places of work where members of the public do not have regular access. Hotels, unless people live there as their permanent residence. Gardens of residential properties. Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.</i>
24 Hour	<i>All locations where the annual mean objective would apply, together with hotels. Gardens of residential properties.^(a)</i>	<i>Kerbside sites (as opposed to locations at the building façade), or any other location where public exposure is expected to be short-term.</i>

⁵ Defra (2016): Local Air Quality Management – Technical Guidance (TG16).

Averaging period	Objectives should apply at	Objectives should not apply at
1 Hour	<p><i>All locations where the annual mean and 24 and 8-hour mean objectives apply.</i></p> <p><i>Kerbside sites (for example, pavements of busy shopping streets).</i></p> <p><i>Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where members of the public might reasonably be expected to spend one hour or more.</i></p> <p><i>Any outdoor locations where members of the public might reasonably expected to spend one hour or longer.</i></p>	<p><i>Kerbside sites where the public would not be expected to have regular access.</i></p>
Note:	<p>^(a) <i>“Such locations should represent parts of the garden where relevant public exposure to pollutants is likely, for example where there is seating or play areas. It is unlikely that relevant public exposure to pollutants would occur at the extremities of the garden boundary, or in front gardens, although local judgement should always be applied.”</i></p>	

Source: Defra, 2016⁶

⁶ Defra (2016): Local Air Quality Management – Technical Guidance (TG16).

2 Methodology

2.1 Overview

This section provides the details of the methodological approach taken to assess the impacts on air quality from the proposed developments; addressing the following key elements:

- Scope of the assessment;
- Dispersion modelling approach;
- Modelled scenarios; and
- Model parameters - such as emission factors, NO_x to NO₂ conversion, estimating background concentrations, meteorology, criteria used to assess the residential suitability of the proposed development, addressing uncertainties, model assumptions and limitations.

2.2 Scope of the Assessment

The assessment is based on the following scope of work:

Table 2.1: Scope of Work

Scope	Consideration
Spatial	<p>The assessment considers roads originally identified in the two previous assessments and which have the potential to significantly change traffic around the Broken Cross AQMA as a result of the proposed developments.</p> <p>Impacts on air quality arising from traffic related emissions are considered unnoticeable above background concentrations beyond 200 m from the source⁷. Hence, this assessment only considered receptors within 200 m from a road source.</p> <p>Sensitive receptors that are likely to experience the greatest change in concentration in terms of traffic related emission as a result of the proposed development are considered within this assessment.</p>
Temporal	<p>The operational phase effects resulting from the proposed development have been considered for the earliest opening years of 2022 (for the southern development) and 2024 (for the northern development)</p>

⁷ Highways England (2007), Design Manual for Roads and Bridges (DMRB), Volume 11 Section 3 Part 1 Air Quality. Available at: <http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf>.

2.3 Modelling Assessment

2.3.1 Modelled Scenarios

The proposed developments have the earliest completion years of 2022 and 2024 for the northern and south developments respectively.

Based on this, the following scenarios have been considered:

- Scenario 1: 2016 Base year;
- Scenario 2: 2022 Without development;
- Scenario 3: 2022 With development (southern development only);
- Scenario 4: 2024 Without development;
- Scenario 5: 2024 With development (northern development only);
- Scenario 6: 2024 With development (both southern and northern development)
- Scenario 7: 2024 With development (both southern and northern development) with a new Broken Cross roundabout junction upgrade plan.

The model verification has been carried out using 2016 base year traffic data to test against the existing assessments and to verify the model against the most recent available local monitoring data that has been ratified. Further details of the model verification process are presented in Appendix B.

2.3.2 Dispersion Model Used

The assessment on identifying the impact of traffic related emissions sources in the area on the proposed development has been carried out using the latest version of 'ADMS-Roads' dispersion modelling software (version 4.1.1) developed by Cambridge Environmental Research Consultants (CERC). This model is commonly used in planning applications and regulatory assessments of traffic related emissions.

2.3.3 Road Traffic Data

Key facts for the traffic data used are:

- Traffic flow data was taken from the existing assessments with the worst-case assumptions used;
- The assessment considers 2016 base year traffic flows scaled to the 2022 and 2024 opening years with growth factors (excluding development traffic) as used in the existing assessments of 1.0707 and 1.0653 respectively;
- Measured speed data were unavailable, therefore speed data from the existing models and using professional judgement have been used for the dispersion model;

Table 2.2 shows the relevant baseline traffic data for the proposed developments and Table 2.3 shows the relevant development traffic data for 2022 and 2024. Figure 2.1 shows the extent of the 'ADMS-Roads' dispersion modelling network.

Table 2.2: Relevant Baseline Traffic Data for the Proposed Development

Road Name	All years				AADT		
	From report by	HDV (%)	Speed (kph)	Speed at junction (kph)	Base Year 2016	Opening Year 2022	Opening Year 2024
Chelford road, west of Whirley Road	BWB	6%	48	n/a	17,808	19,067	18,971
Chelford road, east of Whirley Road	BWB	6%	48	15	19,294	20,658	20,554
Whirley Road	BWB	1%	48	15	3,437	3,680	3,661
Fallibroome Road	REC	1%	48	15	9,960	10,664	10,610
Broken Cross, east of the roundabout	BWB	6%	15	15	19,759	21,156	21,049
Broken Cross, south of the roundabout	REC	1%	48	15	10,630	11,382	11,324
Gawsworth Road	REC	1%	48	n/a	5,315	5,691	5,662
Pexhill Road	REC	1%	48	15	5,315	5,691	5,662

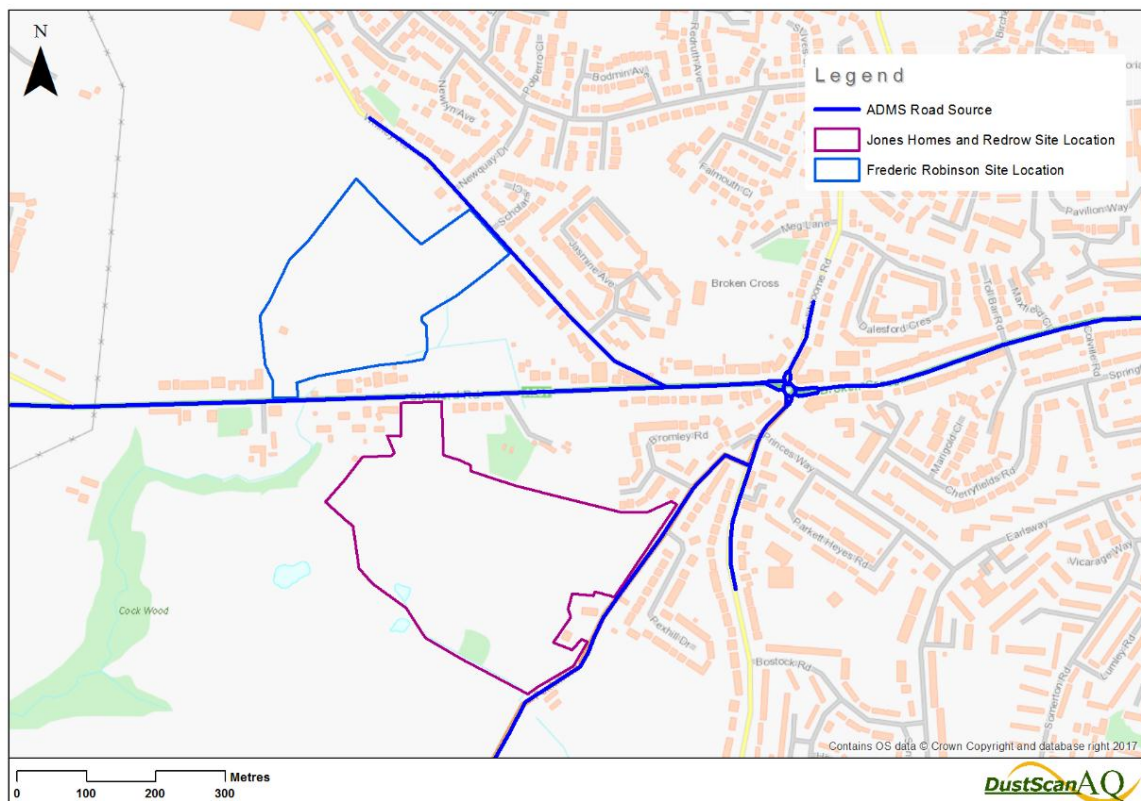


Figure 2.1: Modelled Road Network

Table 2.3: Relevant Development Traffic Data

Road Name	BWB development traffic only ^(a)	REC development traffic only ^(b)
Chelford road, west of Whirley Road	841 ^(c)	570
Chelford road, between the two site accesses	270 ^(d)	570
Chelford road, east of the southern development	270	1630
Chelford road, east of Whirley Road	259	1630
Whirley road	124	0
Fallibroome road	23	80
Broken Cross, east of the roundabout	211	820
Broken Cross, south of the roundabout	25	160
Gawsworth road	13 ^(e)	80
Pexhill road	13 ^(e)	80
Southern development site access	0	1630

Notes: ^(a) Taken from the BWB AQA, Appendix D

^(b) Taken from REC AQA, Table AII.2

^(c) This number has been used as a worst-case assumption from the BWB report, although it is suspected to be from an error in the BWB report, given that the site access onto Chelford Road is given as an AADT of 438

^(d) This assumes that the BWB AQA, Appendix D value in row 7, column 9 should read '18972' and not '18072'

^(e) Assumes a 50:50 split of traffic onto Gawsworth Road and Pexhill Road

2.3.4 Meteorological Data

The key meteorological parameters for dispersion modelling are wind speed and wind direction. Other meteorological parameters which also need to be considered include cloud cover, surface temperature, precipitation rate and relative temperature.

For dispersion modelling purposes, data are required in an hourly resolution and often it is difficult to find a local site that can provide reliable data for all the meteorological parameters on an hourly basis.

Based on the above, the most representative meteorological monitoring station identified was Manchester Airport meteorological monitoring site which is located approximately 12 km north west from the proposed development site.

In order to best replicate the existing assessments, the dispersion modelling has been carried out with meteorological data from Manchester Airport for 2016. Figure 2.2 below presents a wind rose for the modelling year.

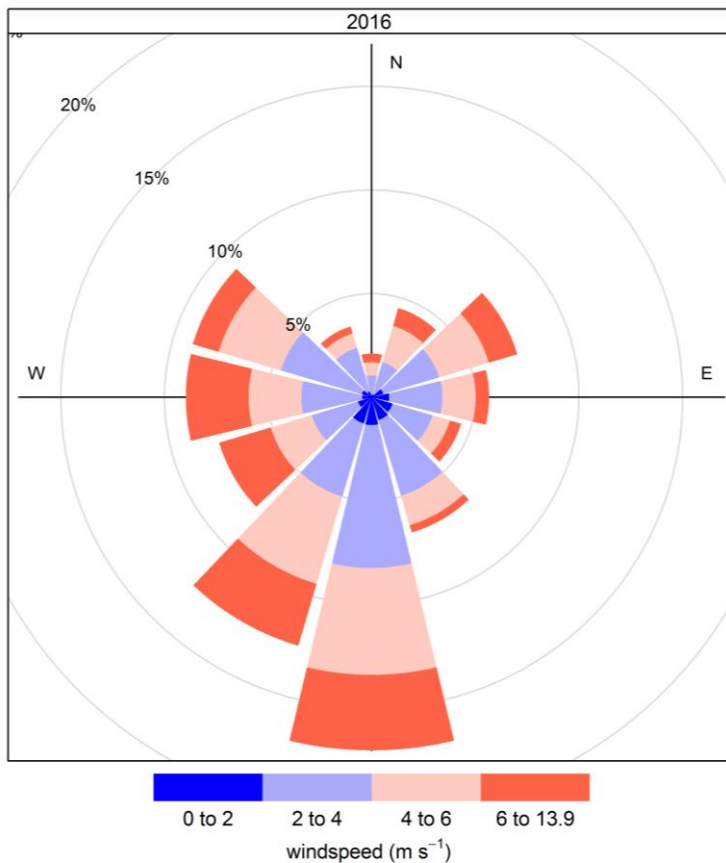


Figure 2.2: Wind rose for Manchester Airport Meteorological Station, 2016

2.3.5 Assessment of background concentrations

This assessment considers road traffic emission sources in detail and as part of the predictive process, all non-road traffic related emission sources in the Defra data set were assigned appropriate ‘background’ concentrations at the modelled receptors. Further details regarding the assignment of background pollution concentration are presented in Section 3.3.

2.3.6 Emission Factors Used

For the purpose of this assessment the latest Emission Factor Toolkit (EFT) (Version 8.0.1) has been used to estimate road link emission for all roads presented in Table 2.2. The EFT Version 8.0.1 has been developed for the UK by the National Atmospheric Emissions Inventory (NAEI) and Transport for London (TfL). The EFT is based on data collected from a number of sources including the European Environment Agency (EEA) COPERT (Computer Programme to calculate Emissions from Road Transport) emission calculator.

According to the guidance provided by Defra⁸, vehicle emissions are expected to decrease in future years as a result of advancements in emission abatement technologies.

2.3.7 NO_x to NO₂ Conversion Method

This assessment uses the latest NO_x to NO₂ conversion factor toolkit (Version 6.1), provided by Defra as a Microsoft Excel based calculation tool which is available from Defra's web-based air quality resource centre⁹. This method is considered the most appropriate technique of determining NO₂ concentrations from road NO_x contributions.

2.3.8 Estimating Hourly and Daily Mean Concentrations

The latest Local Air Quality Management (LAQM) Technical Guidance TG (16)¹⁰ has been used for predicting hourly and 24-hour pollutant concentrations.

The guidance suggests that the short term hourly NO₂ AQO of 200 µg/m³ is not likely to be exceeded at any roadside locations if the annual mean concentration is below 60 µg/m³. Based on this guidance, the hourly mean NO₂ AQO is only considered when the annual mean NO₂ concentrations are over 60 µg/m³.

In accordance with the guidance, the short term 24 hour PM₁₀ mean concentration can be calculated using the following equation as presented below:

$$\text{Number of 24 hour mean exceedences} = 18.5 + 0.00145 \times \text{annual mean}^3 + \left(\frac{206}{\text{annual mean}} \right)$$

2.3.9 Relevant Sensitive Receptors

It was found there were no nationally designated sites such as Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Sites of Special Scientific Interest (SSSI) that were identified within 200 m of the affected road network. However there is a Local Wildlife Site (LWS), Cock Wood SBI, within close proximity to both sites, although this had not been included in either of the previous reports or in this assessment.

LAQM technical guidance clarifies where likely exceedances of the objectives should be assessed and states that Review and Assessment should focus on:

“Locations where members of the public are likely to be regularly present and are likely to be exposed for a period of time appropriate to the averaging period of the relevant air quality objective”.

Table 1.2 above provides details of where the respective objectives should and should not apply and therefore the types of receptors that are relevant to the assessment. It should be noted that AQO does not apply to work-related business uses, such as factories or

⁸ Defra, 2017: Emissions Factors Toolkit v8 User Guide.

⁹ Department for Environment Food and Rural Affairs. Accessible at: <https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2015>

¹⁰ Department for Environment Food and Rural Affairs (2014): 'Local Air Quality Management Technical Guidance' (TG.16).

offices. Based on the above, the receptor locations are presented in Table 2.4 and Figure 2.3 below.

Table 2.4: Sensitive receptors identified

Receptor Number	Receptor Type	X ^(a)	Y ^(a)	Height (m)
R1	Existing Residential	388,581.5	373,608.1	1.5
R2	Existing Residential	388,604.8	373,584.8	1.5
R3	Existing Residential	388,445.0	373,582.7	1.5
R4	Existing Residential	388,701.1	373,608.1	1.5
R5	Existing Residential	388,854.5	373,590.1	1.5
R6	Existing Residential	389,131.8	373,619.7	1.5
R7	Existing Residential	389,296.9	373,609.1	1.5
R8	Existing Residential	389,341.1	373,626.7	1.5
R9	Existing Residential	389,350.2	373,617.2	1.5
R10	Existing Residential	389,364.9	373,593.8	1.5
R11	Existing Residential	389,329.1	373,589.4	1.5
R12	Existing Residential	389,379.7	373,620.1	1.5
R13	Existing Residential	389,448.2	373,620.4	1.5
R14	Existing Residential	389,580.0	373,637.8	1.5
R15	Diffusion Tube and Existing Residential	389,619.0	373,659.0	1.5
R16	Existing Residential	389,286.3	373,535.1	1.5
R17	Existing Residential	389,261.7	373,477.5	1.5
R18	Existing Residential	389,304.5	373,374.7	1.5
R19	Existing Residential	389,224.4	373,506.9	1.5
R20	Existing Residential	389,063.2	373,284.2	1.5
R21	Existing Residential	389,114.8	373,631.5	1.5
R22	Existing Residential	389,021.2	373,711.7	1.5

Note: ^(a) British National Grid

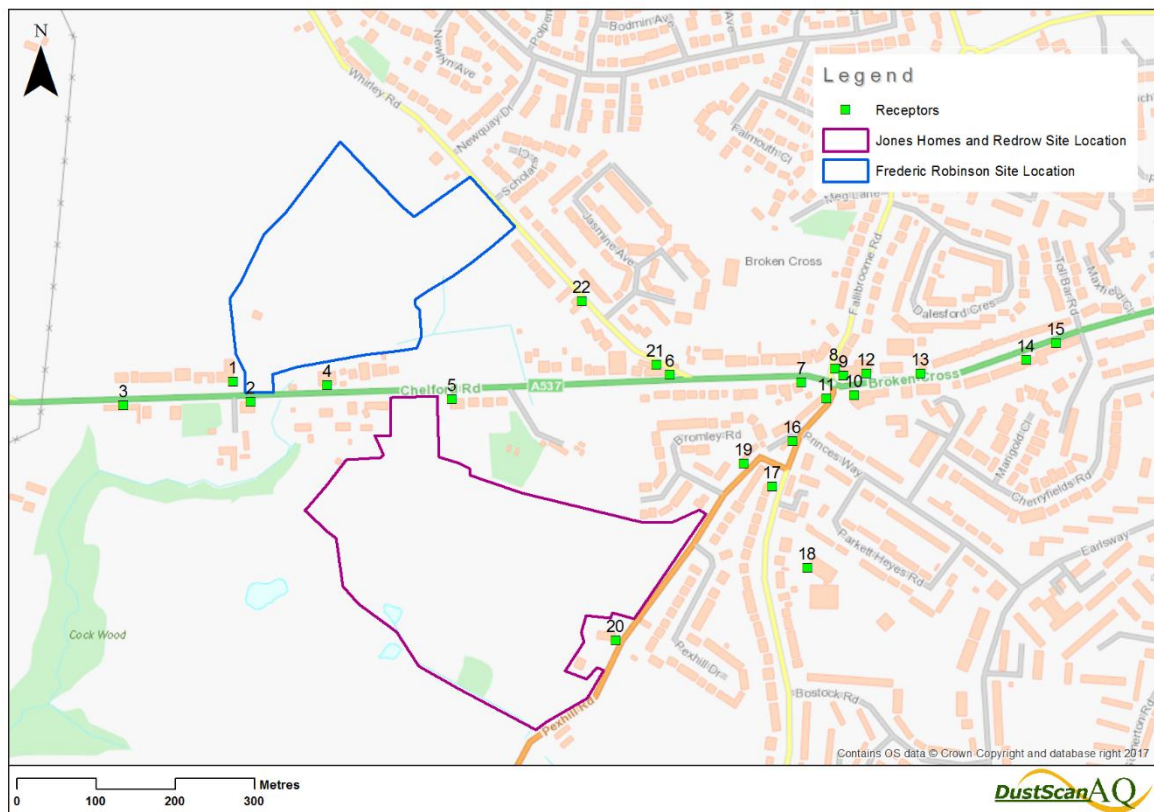


Figure 2.3: Modelled Receptor Locations

2.3.10 Criteria Used to Assess Significance

For the purposes of this assessment, the IAQM (2017) criteria have been used for calculating the magnitude descriptors for predicted change in annual mean concentrations at individual receptors (Table 2.5). The IAQM recognise that professional judgement is required in the interpretation of air quality assessment significance. Table 2.5 is intended to be used as a tool to assist with interpretation of the air quality assessment.

Table 2.5: Impact descriptors for predicted change in annual mean concentrations at individual receptors (Reproduced from EPUK and IAQM Guidance)

Long term average concentration at receptor in assessment year	% Change in concentration relative to Air Quality Assessment Level (AQAL)			
	1	2-5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

- Notes:
- ¹ AQAL = Air Quality Assessment Level, which may be an air quality objective, EU limit or target value, or an Environment Agency 'Environmental Assessment Level (EAL)'.
 - ² The Table is intended to be used by rounding the change in percentage pollutant concentration to whole numbers, which then makes it clearer which cell the impact falls within. The numbers are treated with their likely accuracy in order to avoid assumption of false level of precision. For example, Changes of 0%, i.e. less than 0.5% will be described as Negligible.
 - ³ The Table is only designed to be used with annual mean concentrations.
 - ⁴ Descriptors are used for individual receptors only; the overall significance is determined using professional judgement. For example, a 'moderate' adverse impact at one receptor may not mean that the overall impact has a significant effect. Other factors need to be considered.
 - ⁵ When defining the concentration as a percentage of the AQAL, use the 'without scheme' concentration where there is a decrease in pollutant concentration and the 'with scheme;' concentration for an increase.

2.3.11 Assumptions and Limitations

The assessment has been carried out based on the following assumptions:

- This assessment has been carried out based on our current understanding of the proposed developments;
- The assessment has used worst-case traffic data combined from the two existing assessments only;
- The assessment did not use baseline traffic data from the East Cheshire 2017 Annual Status Report (ASR), where a modelling assessment was undertaken with reference to the AQMA, as it was only available for the year 2015. However, it is recognised that traffic data from the ASR was significantly higher than that used in the two existing assessments. The robustness of the traffic data for the two existing assessments may therefore need further evaluation;
- The earliest full completion years have been assumed to be 2022 and 2024 for the southern and north developments respectively;
- The meteorological data used was taken from Manchester Airport meteorological station which is considered to be the closest, most reliable data source to the proposed development;
- Defra assumes that emissions from vehicles will decrease in the future as stated in Section 2.3.6;
- Dispersion modelling has associated uncertainties related to emission data, meteorological data and model algorithms. In order to address these uncertainties, model verification has been carried out by comparing the modelled concentrations with the monitored concentrations as described within the verification methodology presented in Appendix B.

3 Baseline Conditions

3.1 Overview

The following section sets out the baseline conditions in relation to air quality for the proposed development. Baseline air quality information is available from a number of sources including local and national monitoring data reports and websites. For the purposes of this assessment, data has been obtained from the Defra air quality resource website and from the latest East Cheshire 2017 Air Quality Progress report.

3.2 Existing Baseline Conditions

East Cheshire undertakes both automatic (continuous) and non-automatic monitoring of NO₂, although the closest automatic monitoring location to the proposed developments is at Disley, approximately 13.5 km to the north east. Thus, no local automatic monitoring data was used for this assessment. As presented in Figure 3.1 below, a non-automatic monitor was located within the Broken Cross AQMA and less than 1km to the east of both proposed developments. The monitor has subsequently been replaced with five new monitoring locations in the newly declared AQMA, although no verified or ratified data is yet available. Therefore, the most recent ratified monitoring data from this monitor has been deemed representative of the air quality at the proposed development site and has been presented in Table 3.1 below.

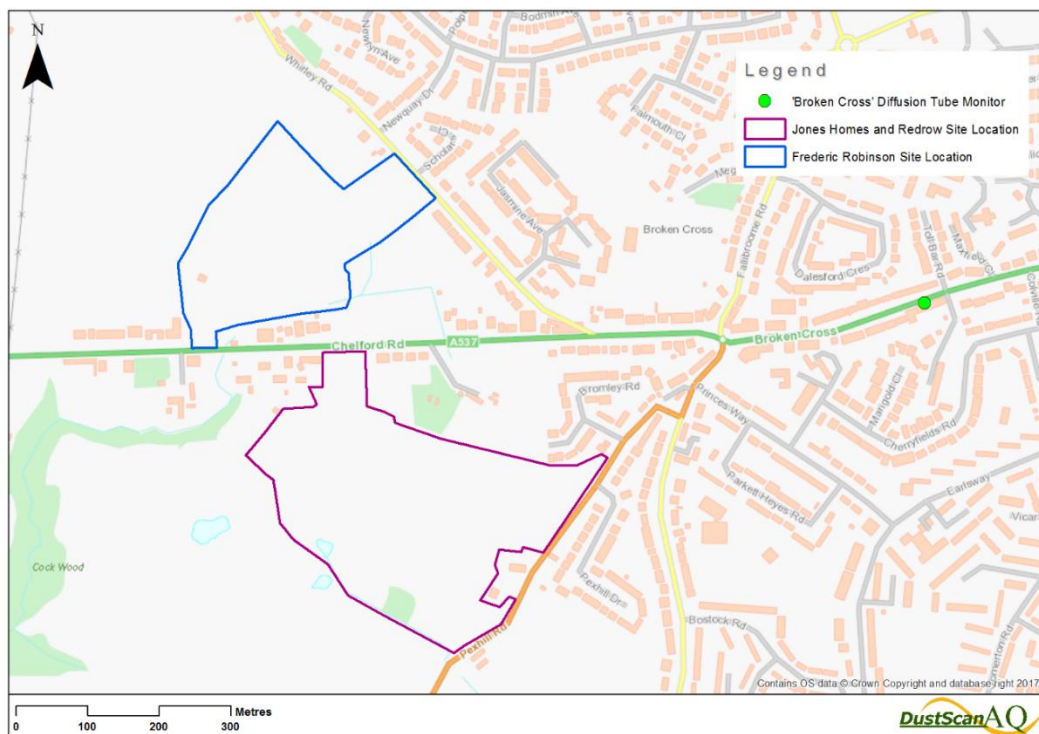


Figure 3.1: Non-automatic monitoring location

Table 3.1: NO₂ annual mean background concentration

Monitor	NO ₂ Annual Mean Concentrations (µg/m ³)
	2016 ^(a)
Broken Cross Diffusion Tube (CE91)	48.04

Note: ^(a) Bias adjustment factor of 0.92 used and data annualised

3.3 Defra Background Pollution Concentrations

Defra provides background pollution concentration estimates to assist local authorities undertake their 'Review and Assessment' work. This data is available to download from Defra air quality resource website for NO_x, NO₂, PM₁₀ and PM_{2.5} for every 1 km by 1 km grid square for all local authorities. The current dataset is based on 2015 background data and the future year projections are available for 2015 to 2030. The background dataset provides a breakdown of pollution concentrations by different sources (both road and non-road sources). Table 3.2 presents the average predicted background concentrations for the earliest assumed opening years for the relevant receptor locations.

Table 3.2: Defra Projected Background Concentrations (average for all receptors)

Pollutant	Opening year 2022	Opening year 2024
NO _x	10.72	9.94
NO ₂	8.17	7.61
PM ₁₀	11.73	11.65
PM _{2.5}	8.18	8.10

Note: Data presented within the table are derived from the following ordinance survey grid squares: 388500, 373500; 389500, 373500.

4 Potential Impacts

4.1 Operational Phase

As discussed in Section 2.2, the operational phase of the development has the potential to impact local air quality through the increased volume of local traffic movements.

4.2 Impacts of Nitrogen Dioxide (NO₂) concentrations

Table 4.1 presents predicted NO₂ pollutant concentrations for all identified sensitive receptors for Scenario 4 (without development, 2024) and Scenario 6 (with both developments, 2024) as identified within Section 2.3.9. The potential impact on air quality from the proposed development at human health receptors for Scenarios 2 and 3 (without and with the southern development only, 2022), Scenario 4 and 5 (without and with the northern development only, 2024) and Scenario 7 (with both developments and a new junction design for the Broken Cross roundabout, 2024) are set out in full in Appendix A. The potential magnitude and air quality impact has been calculated using the criteria set out in Table 2.5.

For Scenario 6 (both developments, 2024), the highest impact descriptor for the change in annual mean NO₂ pollutant concentration is predicted to be 'Moderate' at receptors R5, R8, R9 and R13. The greatest change in concentration is predicted to be an increase of 35% resulting in an annual mean NO₂ concentration of 18.40 µg/m³ at receptor point R5.

For Scenario 3 (southern development only, Table A.1) the highest impact descriptor for the change in annual mean NO₂ pollutant concentration is predicted to be 'Substantial' at R8, R9 and R13. This is due to the baseline concentrations of over 110% of the AQO and an increase relative to the AQO of 2-5%. The greatest change in concentration is predicted to be an increase of 37% resulting in an annual mean NO₂ concentration of 21.46 µg/m³ at receptor point R5.

For Scenario 5 (northern development only, Table A.4), the highest impact descriptor for the change in annual mean NO₂ pollutant concentration is predicted to be 'Slight' at R8, R9 and R13. The greatest change in concentration is predicted to be an increase of 3% resulting in an annual mean NO₂ concentration of 16.16 µg/m³ at receptor point R2.

For Scenario 7 (Table A.7), using initial plans for the new Broken Cross junction design, the highest impact descriptor for the change in annual mean NO₂ pollutant concentration is predicted to be 'Moderate' at R5 and R13. Although only initial plans for the new junction were used, the assessment shows that existing receptors surrounding the Broken Cross junction may expect improvements in NO₂ concentrations. However, it should be noted that this scenario does not include changes to vehicle speeds on Chelford Road due to new traffic signalisation (i.e. changes in queue lengths), which could significantly impact results.

In terms of short-term NO₂ concentrations, Table 4.1 shows that NO₂ annual mean concentrations at all receptor locations and for all scenarios are predicted to be less than

60 $\mu\text{g}/\text{m}^3$. Therefore, the short-term NO_2 hourly mean objective is not likely to exceed the 1 hourly NO_2 AQO. Hence, the short-term NO_2 AQO has not been considered any further.

Based on the significance criteria adopted for this assessment, it can be concluded that the air quality impacts of the proposed developments may be significant at some receptors in terms of the changes in NO_2 annual mean concentrations.

For model sensitivity, it should be noted that the 2022 model has shown greater impacts with the southern development only than the 2024 model with both developments. As highlighted in section 2.3.11, future modelling scenarios assume a significant fall-off in road traffic emissions due to predicted improvements in emissions standards and vehicle technologies. However, there is currently a lack of available justification for how realistic this approach is, and currently there is no defined method of assessing a worst-case scenario if these assumptions are not likely to be achievable.

Table 4.1: Annual mean NO_2 predicted pollutant concentrations ($\mu\text{g}/\text{m}^3$) with significance assessed for both developments in 2024 (Scenario 4 and 6)

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 6	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R1	15.43	16.06	1.58	Negligible	40
R2	15.73	16.58	2.12	Negligible	40
R3	13.50	14.00	1.25	Negligible	40
R4	20.20	21.12	2.30	Negligible	40
R5	13.60	18.40	12.00	Moderate Adverse	40
R6	23.72	24.64	2.30	Negligible	40
R7	21.14	21.79	1.63	Negligible	40
R8	38.18	39.23	2.62	Moderate Adverse	40
R9	39.68	40.87	2.97	Moderate Adverse	40
R10	21.95	22.52	1.43	Negligible	40
R11	27.55	28.17	1.55	Negligible	40
R12	30.19	31.00	2.03	Slight Adverse	40
R13	39.19	40.24	2.63	Moderate Adverse	40
R14	22.21	22.75	1.35	Negligible	40
R15	26.84	27.52	1.70	Negligible	40
R16	16.33	16.58	0.63	Negligible	40
R17	11.05	11.19	0.35	Negligible	40
R18	8.43	8.49	0.15	Negligible	40
R19	14.02	14.22	0.50	Negligible	40
R20	12.05	12.17	0.30	Negligible	40
R21	16.13	16.67	1.35	Negligible	40
R22	10.70	11.01	0.78	Negligible	40

4.3 Impacts of Particulate Matter (PM_{10}) concentrations

Table 4.2 presents predicted PM_{10} pollutant concentrations for Scenario 4 (without development, 2024) and Scenario 6 (with both developments, 2024) for the sensitive receptors as identified within Section 2.3.9. Assessments results for both developments individually are also available in Appendix A, Table A.2 and Table A.5 and for the proposed redesign of the Broken Cross junction in Appendix A, Table A.8.

The potential magnitude and air quality impact has been calculated using the criteria set out in Table 2.5. For all modelled receptors and for all scenarios, the impact of changes to the annual mean for PM₁₀ concentrations is predicted to be ‘negligible’.

Table 4.2: Annual Mean PM₁₀ Predicted Pollutant Concentrations (µg/m³) with significance assessed for both developments in 2024

Receptor number	Without Development (µg/m ³) – Scenario 4	With Development (µg/m ³) – Scenario 6	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective (µg/m ³)
R1	11.44	11.49	0.13	Negligible	40
R2	11.47	11.54	0.17	Negligible	40
R3	11.27	11.30	0.09	Negligible	40
R4	11.88	11.94	0.15	Negligible	40
R5	11.27	11.41	0.35	Negligible	40
R6	13.42	13.50	0.20	Negligible	40
R7	12.91	12.96	0.12	Negligible	40
R8	13.87	13.94	0.20	Negligible	40
R9	13.94	14.03	0.23	Negligible	40
R10	12.81	12.84	0.09	Negligible	40
R11	13.22	13.26	0.11	Negligible	40
R12	13.30	13.35	0.14	Negligible	40
R13	13.86	13.94	0.20	Negligible	40
R14	12.76	12.80	0.08	Negligible	40
R15	13.04	13.08	0.11	Negligible	40
R16	12.68	12.70	0.04	Negligible	40
R17	12.26	12.27	0.02	Negligible	40
R18	12.03	12.04	0.01	Negligible	40
R19	12.50	12.52	0.03	Negligible	40
R20	12.23	12.24	0.02	Negligible	40
R21	12.72	12.76	0.10	Negligible	40
R22	12.25	12.27	0.05	Negligible	40

4.4 Impacts of Particulate Matter (PM_{2.5}) concentrations

Table 4.3 presents predicted PM_{2.5} pollutant concentrations for Scenario 4 (without development, 2024) and Scenario 6 (with both developments, 2024) for the sensitive receptors as identified within Section 2.3.9. Assessments results for both developments individually are also available in Appendix A, Table A.3 and Table A.6 and for the proposed redesign of the Broken Cross junction in Appendix A, Table A.9.

The potential magnitude and air quality impact has been calculated using the criteria set out in Table 2.5. For all modelled receptors and for all scenarios, the impact of changes to the annual mean for PM_{2.5} concentrations are predicted to be ‘negligible’.

Table 4.3: Annual Mean PM_{2.5} Predicted Pollutant Concentrations (µg/m³) with significance assessed for both developments in 2022

Receptor number	Without Development (µg/m ³) – Scenario 4	With Development (µg/m ³) – Scenario 6	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective (µg/m ³)
R1	7.71	7.74	0.11	Negligible	25

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 6	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R2	7.72	7.76	0.15	Negligible	25
R3	7.62	7.64	0.08	Negligible	25
R4	7.95	7.98	0.14	Negligible	25
R5	7.62	7.70	0.34	Negligible	25
R6	9.15	9.19	0.18	Negligible	25
R7	8.88	8.90	0.10	Negligible	25
R8	9.42	9.46	0.18	Negligible	25
R9	9.46	9.52	0.20	Negligible	25
R10	8.82	8.84	0.08	Negligible	25
R11	9.05	9.08	0.10	Negligible	25
R12	9.10	9.13	0.13	Negligible	25
R13	9.42	9.47	0.18	Negligible	25
R14	8.80	8.82	0.08	Negligible	25
R15	8.96	8.98	0.10	Negligible	25
R16	8.74	8.75	0.04	Negligible	25
R17	8.51	8.52	0.02	Negligible	25
R18	8.39	8.39	0.01	Negligible	25
R19	8.65	8.66	0.03	Negligible	25
R20	8.50	8.51	0.01	Negligible	25
R21	8.76	8.79	0.09	Negligible	25
R22	8.51	8.52	0.04	Negligible	25

5 Conclusion

This report provides an assessment of the potential air quality impacts associated with the two proposed developments off Chelford Road, Macclesfield. The report provided an assessment of the changes in traffic related pollutant concentrations associated with the proposed developments and the significance of the impact on air quality at potential sensitive receptors.

This report used traffic data from the two existing assessments in addition to local air quality monitoring data for model validation. The proposed developments were found to have up to a 'substantial' impact on the NO₂ annual mean concentration for several receptors within the Broken Cross AQMA. The impact of changes to the annual mean for PM₁₀ and PM_{2.5} concentrations were predicted to be 'negligible'. The operational impact of the combined developments on the local air quality may therefore be considered to be significant.

It is therefore recommended that further consideration should be given to both applications to allow for the following suggestions:

- Agree a joint methodological approach with the local authority;
- Agree baseline and future year traffic data with the local authority, including cumulative impacts from any other known developments;
- Justify using future year emission factors as oppose to using a worst-case assumption by using emission factors from earlier years;
- Use diffusion tubes that are present within the AQMA for model verification; and
- Thoroughly assess the impacts of both new junctions, including new signalisation, on traffic emissions and pollutant hotspots.

Appendix A: Modelling data for Scenarios 2, 3, 5 and 7

Table A.1: Annual mean NO₂ predicted pollutant concentrations (µg/m³) with significance assessed for the southern development only in 2022

Receptor number	Without Development (µg/m ³) – Scenario 2	With Development (µg/m ³) – Scenario 3	Concentration change relative to AQO(%)	Significance descriptor	Relevant Objective (µg/m ³)
R1	17.86	18.21	0.88	Negligible	40
R2	18.22	18.95	1.83	Negligible	40
R3	15.52	15.82	0.75	Negligible	40
R4	23.63	24.53	2.25	Negligible	40
R5	15.63	21.45	14.55	Moderate Adverse	40
R6	27.80	28.65	2.12	Negligible	40
R7	24.82	25.43	1.53	Negligible	40
R8	45.14	46.09	2.38	Substantial Adverse	40
R9	47.06	48.14	2.70	Substantial Adverse	40
R10	25.87	26.41	1.35	Negligible	40
R11	32.32	32.90	1.45	Negligible	40
R12	35.80	36.55	1.88	Slight Adverse	40
R13	46.54	47.47	2.33	Substantial Adverse	40
R14	26.24	26.74	1.25	Negligible	40
R15	31.83	32.45	1.55	Slight Adverse	40
R16	18.72	18.97	0.63	Negligible	40
R17	12.39	12.54	0.37	Negligible	40
R18	9.17	9.24	0.18	Negligible	40
R19	15.92	16.12	0.50	Negligible	40
R20	13.48	13.59	0.27	Negligible	40
R21	18.63	19.09	1.15	Negligible	40
R22	12.01	12.29	0.70	Negligible	40

Table A.2: Annual Mean PM₁₀ Predicted Pollutant Concentrations (µg/m³) with significance assessed for the southern development only in 2022

Receptor number	Without Development (µg/m ³) – Scenario 2	With Development (µg/m ³) – Scenario 3	Concentration change relative to AQO(%)	Significance descriptor	Relevant Objective (µg/m ³)
R1	11.53	11.56	0.06	Negligible	40
R2	11.56	11.61	0.12	Negligible	40
R3	11.36	11.37	0.04	Negligible	40
R4	11.98	12.03	0.12	Negligible	40
R5	11.36	11.50	0.35	Negligible	40
R6	13.53	13.59	0.16	Negligible	40
R7	13.01	13.05	0.10	Negligible	40
R8	13.99	14.06	0.16	Negligible	40
R9	14.08	14.15	0.18	Negligible	40
R10	12.91	12.94	0.07	Negligible	40
R11	13.33	13.36	0.09	Negligible	40
R12	13.41	13.45	0.11	Negligible	40
R13	13.99	14.06	0.16	Negligible	40
R14	12.87	12.89	0.07	Negligible	40
R15	13.15	13.18	0.09	Negligible	40
R16	12.77	12.78	0.04	Negligible	40

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 2	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 3	Concentration change relative to AQO(%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R17	12.34	12.35	0.02	Negligible	40
R18	12.11	12.11	0.01	Negligible	40
R19	12.59	12.60	0.03	Negligible	40
R20	12.32	12.32	0.01	Negligible	40
R21	12.81	12.84	0.07	Negligible	40
R22	12.33	12.34	0.03	Negligible	40

Table A.3: Annual Mean PM_{2.5} Predicted Pollutant Concentrations ($\mu\text{g}/\text{m}^3$) with significance assessed for the southern development only in 2022

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 2	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 3	Concentration change relative to AQO(%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R1	7.79	7.81	0.05	Negligible	25
R2	7.81	7.84	0.11	Negligible	25
R3	7.70	7.71	0.04	Negligible	25
R4	8.04	8.07	0.11	Negligible	25
R5	7.70	7.79	0.34	Negligible	25
R6	9.25	9.29	0.14	Negligible	25
R7	8.97	8.99	0.09	Negligible	25
R8	9.54	9.58	0.15	Negligible	25
R9	9.59	9.63	0.17	Negligible	25
R10	8.92	8.94	0.07	Negligible	25
R11	9.16	9.18	0.08	Negligible	25
R12	9.21	9.23	0.10	Negligible	25
R13	9.55	9.58	0.14	Negligible	25
R14	8.90	8.92	0.06	Negligible	25
R15	9.07	9.09	0.08	Negligible	25
R16	8.83	8.84	0.03	Negligible	25
R17	8.59	8.60	0.02	Negligible	25
R18	8.47	8.47	0.01	Negligible	25
R19	8.73	8.74	0.03	Negligible	25
R20	8.58	8.59	0.01	Negligible	25
R21	8.85	8.87	0.07	Negligible	25
R22	8.59	8.60	0.03	Negligible	25

Table A.4: Annual mean NO₂ predicted pollutant concentrations ($\mu\text{g}/\text{m}^3$) with significance assessed for the northern development only in 2024

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 5	Concentration change relative to AQO(%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R1	15.43	15.78	0.87	Negligible	40
R2	15.73	16.19	1.15	Negligible	40
R3	13.50	13.69	0.47	Negligible	40
R4	20.20	20.37	0.43	Negligible	40
R5	13.60	13.69	0.23	Negligible	40
R6	23.72	23.91	0.48	Negligible	40
R7	21.14	21.26	0.30	Negligible	40

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 5	Concentration change relative to AQO(%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R8	38.18	38.39	0.53	Slight Adverse	40
R9	39.68	39.91	0.57	Slight Adverse	40
R10	21.95	22.06	0.27	Negligible	40
R11	27.55	27.67	0.30	Negligible	40
R12	30.19	30.35	0.40	Negligible	40
R13	39.19	39.41	0.55	Slight Adverse	40
R14	22.21	22.32	0.27	Negligible	40
R15	26.84	26.98	0.35	Negligible	40
R16	16.33	16.37	0.10	Negligible	40
R17	11.05	11.07	0.05	Negligible	40
R18	8.43	8.43	0.00	Negligible	40
R19	14.02	14.05	0.08	Negligible	40
R20	12.05	12.07	0.05	Negligible	40
R21	16.13	16.28	0.38	Negligible	40
R22	10.70	10.79	0.23	Negligible	40

Table A.5: Annual Mean PM₁₀ Predicted Pollutant Concentrations ($\mu\text{g}/\text{m}^3$) with significance assessed for the northern development only in 2024

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 5	Concentration change relative to AQO(%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R1	11.44	11.47	0.07	Negligible	40
R2	11.47	11.51	0.10	Negligible	40
R3	11.27	11.29	0.04	Negligible	40
R4	11.88	11.90	0.04	Negligible	40
R5	11.27	11.28	0.02	Negligible	40
R6	13.42	13.44	0.04	Negligible	40
R7	12.91	12.92	0.02	Negligible	40
R8	13.87	13.88	0.04	Negligible	40
R9	13.94	13.96	0.04	Negligible	40
R10	12.81	12.81	0.02	Negligible	40
R11	13.22	13.23	0.02	Negligible	40
R12	13.30	13.31	0.03	Negligible	40
R13	13.86	13.88	0.04	Negligible	40
R14	12.76	12.77	0.02	Negligible	40
R15	13.04	13.05	0.02	Negligible	40
R16	12.68	12.68	0.01	Negligible	40
R17	12.26	12.26	0.00	Negligible	40
R18	12.03	12.03	0.00	Negligible	40
R19	12.50	12.51	0.01	Negligible	40
R20	12.23	12.24	0.00	Negligible	40
R21	12.72	12.73	0.03	Negligible	40
R22	12.25	12.26	0.02	Negligible	40

Table A.6: Annual Mean PM_{2.5} Predicted Pollutant Concentrations (µg/m³) with significance assessed for the northern development only in 2024

Receptor number	Without Development (µg/m ³) – Scenario 4	With Development (µg/m ³) – Scenario 5	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective (µg/m ³)
R1	7.71	7.73	0.06	Negligible	25
R2	7.72	7.75	0.09	Negligible	25
R3	7.62	7.62	0.03	Negligible	25
R4	7.95	7.96	0.03	Negligible	25
R5	7.62	7.62	0.02	Negligible	25
R6	9.15	9.16	0.04	Negligible	25
R7	8.88	8.88	0.02	Negligible	25
R8	9.42	9.43	0.04	Negligible	25
R9	9.46	9.47	0.04	Negligible	25
R10	8.82	8.83	0.02	Negligible	25
R11	9.05	9.06	0.02	Negligible	25
R12	9.10	9.11	0.03	Negligible	25
R13	9.42	9.43	0.04	Negligible	25
R14	8.80	8.81	0.02	Negligible	25
R15	8.96	8.96	0.02	Negligible	25
R16	8.74	8.75	0.01	Negligible	25
R17	8.51	8.51	0.00	Negligible	25
R18	8.39	8.39	0.00	Negligible	25
R19	8.65	8.65	0.01	Negligible	25
R20	8.50	8.50	0.00	Negligible	25
R21	8.76	8.77	0.03	Negligible	25
R22	8.51	8.51	0.01	Negligible	25

Table A.7: Annual mean NO₂ predicted pollutant concentrations (µg/m³) with significance assessed for both developments with the redesign of the Broken Cross junction

Receptor number	Without Development (µg/m ³) – Scenario 4	With Development (µg/m ³) – Scenario 7	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective (µg/m ³)
R1	16.05	15.43	1.55	Negligible	40
R2	16.57	15.73	2.10	Negligible	40
R3	13.98	13.50	1.20	Negligible	40
R4	21.11	20.20	2.28	Negligible	40
R5	18.38	13.60	11.95	Moderate Adverse	40
R6	24.58	23.72	2.15	Negligible	40
R7	20.71	21.14	-1.08	Negligible	40
R8	31.34	38.18	-17.10	Negligible	40
R9	31.48	39.68	-20.50	Negligible	40
R10	20.26	21.95	-4.22	Negligible	40
R11	25.14	27.55	-6.03	Negligible	40
R12	29.71	30.19	-1.20	Negligible	40
R13	40.03	39.19	2.10	Moderate Adverse	40
R14	22.71	22.21	1.25	Negligible	40
R15	26.84	27.49	1.63	Negligible	40
R16	16.37	16.33	0.10	Negligible	40
R17	11.12	11.05	0.17	Negligible	40
R18	8.47	8.43	0.10	Negligible	40
R19	14.13	14.02	0.28	Negligible	40

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 7	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R20	12.16	12.05	0.27	Negligible	40
R21	16.62	16.13	1.23	Negligible	40
R22	10.99	10.70	0.73	Negligible	40

Table A.8: Annual Mean PM₁₀ Predicted Pollutant Concentrations ($\mu\text{g}/\text{m}^3$) with significance assessed for both developments with the redesign of the Broken Cross junction

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 7	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R1	11.44	11.49	0.13	Negligible	40
R2	11.47	11.54	0.17	Negligible	40
R3	11.27	11.30	0.09	Negligible	40
R4	11.88	11.94	0.15	Negligible	40
R5	11.27	11.41	0.35	Negligible	40
R6	13.42	13.50	0.19	Negligible	40
R7	12.91	12.90	-0.03	Negligible	40
R8	13.87	13.43	-1.09	Negligible	40
R9	13.94	13.41	-1.33	Negligible	40
R10	12.81	12.72	-0.23	Negligible	40
R11	13.22	13.08	-0.35	Negligible	40
R12	13.30	13.27	-0.06	Negligible	40
R13	13.86	13.93	0.17	Negligible	40
R14	12.76	12.80	0.08	Negligible	40
R15	13.04	13.08	0.11	Negligible	40
R16	12.68	12.68	0.02	Negligible	40
R17	12.26	12.26	0.01	Negligible	40
R18	12.03	12.03	0.01	Negligible	40
R19	12.50	12.51	0.02	Negligible	40
R20	12.23	12.24	0.01	Negligible	40
R21	12.72	12.75	0.10	Negligible	40
R22	12.25	12.27	0.04	Negligible	40

Table A.9: Annual Mean PM_{2.5} Predicted Pollutant Concentrations ($\mu\text{g}/\text{m}^3$) with significance assessed for both developments with the redesign of the Broken Cross junction

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 7	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R1	7.71	7.74	0.11	Negligible	25
R2	7.72	7.76	0.15	Negligible	25
R3	7.62	7.64	0.08	Negligible	25
R4	7.95	7.98	0.14	Negligible	25
R5	7.62	7.70	0.33	Negligible	25
R6	9.15	9.19	0.17	Negligible	25
R7	8.88	8.87	-0.03	Negligible	25
R8	9.42	9.17	-0.98	Negligible	25
R9	9.46	9.17	-1.20	Negligible	25
R10	8.82	8.77	-0.21	Negligible	25

Receptor number	Without Development ($\mu\text{g}/\text{m}^3$) – Scenario 4	With Development ($\mu\text{g}/\text{m}^3$) – Scenario 7	Concentration change relative to AQO (%)	Significance descriptor	Relevant Objective ($\mu\text{g}/\text{m}^3$)
R11	9.05	8.98	-0.31	Negligible	25
R12	9.10	9.09	-0.05	Negligible	25
R13	9.42	9.46	0.15	Negligible	25
R14	8.80	8.82	0.07	Negligible	25
R15	8.96	8.98	0.10	Negligible	25
R16	8.74	8.75	0.01	Negligible	25
R17	8.51	8.52	0.01	Negligible	25
R18	8.39	8.39	0.01	Negligible	25
R19	8.65	8.65	0.02	Negligible	25
R20	8.50	8.50	0.01	Negligible	25
R21	8.76	8.78	0.09	Negligible	25
R22	8.51	8.52	0.04	Negligible	25

Appendix B : Model Verification

The model verification process includes checks which are carried out to determine the performance of a dispersion model and ensure monitoring results are not bias due to any model uncertainties. Uncertainties are associated with multiple modelling inputs including:

- traffic flows,
- speeds and vehicle splits;
- emissions estimates;
- background concentrations;
- meteorological data; and
- surface roughness, length and terrain.

Model verification is mainly undertaken by comparing modelled results with monitoring data. Uncertainties and differences in data can be identified and resolved by model refinement or adjustment of the model output using a verification factor. The verification factor can be calculated in accordance with the LAQM TG (16) guidance. Model verification was only carried out for nitrogen dioxide (NO_2) as no suitable background concentrations for PM_{10} and $\text{PM}_{2.5}$ were found for the modelled road network.

B1. Methodology

For this assessment, verification of Modelled NO_2 has been carried out using data collected at a non-automatic monitoring site on Broken Cross road in 2016. Table B1 presents the local automatic monitoring data used within the model verification for NO_2 .

Table B1: Relevant NO₂ Monitoring Data Used for Model Verification

Site name	Monitor type	2016 NO _x annual mean (µg/m ³) ^(a)	2016 NO ₂ annual mean (µg/m ³)
50 Broken Cross (CE91)	Non-automatic (Diffusion Tube)	96.16	48.04

Notes: ^(a) This has been calculated using the conversion tool provided by Defra as explained in Section 3.4.7

Table B2 presents the Defra background concentrations used within the model. From the background data collected, road contributions were removed in line with Defra guidance to avoid double counting.

Table B2: Relevant background concentrations used for model verification

Verification site name	2016 NO _x background annual mean (µg/m ³)	2016 NO ₂ background annual mean (µg/m ³)
50 Broken Cross (CE91)	13.45	10.09

Table B3 presents the monitored and modelled annual mean NO₂ concentrations along with the percentage difference after verification was applied. An adjustment factor was then derived by comparing the modelled road NO_x contribution against the monitored road NO_x contribution.

Table B3: Comparison of monitored and modelled road NO₂ contribution

Site name	Monitored NO ₂ (µg/m ³)	Modelled NO ₂ (µg/m ³)	Difference in percentage
50 Broken Cross (CE91)	48.04	48.04	0%

B2. Verification Results

Based on the methodology presented above, an adjustment factor of 3.41 was estimated and applied to all road NO_x contributions to take account for systematic bias.