Aether

Air Quality Assessment for the proposed development at Jack's Green, Warish Hall Farm

Report to Weston Homes PLC

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1 Introduction

Aether has been commissioned by Weston Homes PLC to undertake an air quality assessment for the proposed development at Jack's Green, Warish Hall Farm in Takeley. The development will consist of the construction of 40 residential dwellings. Car parking spaces will be provided with the development.

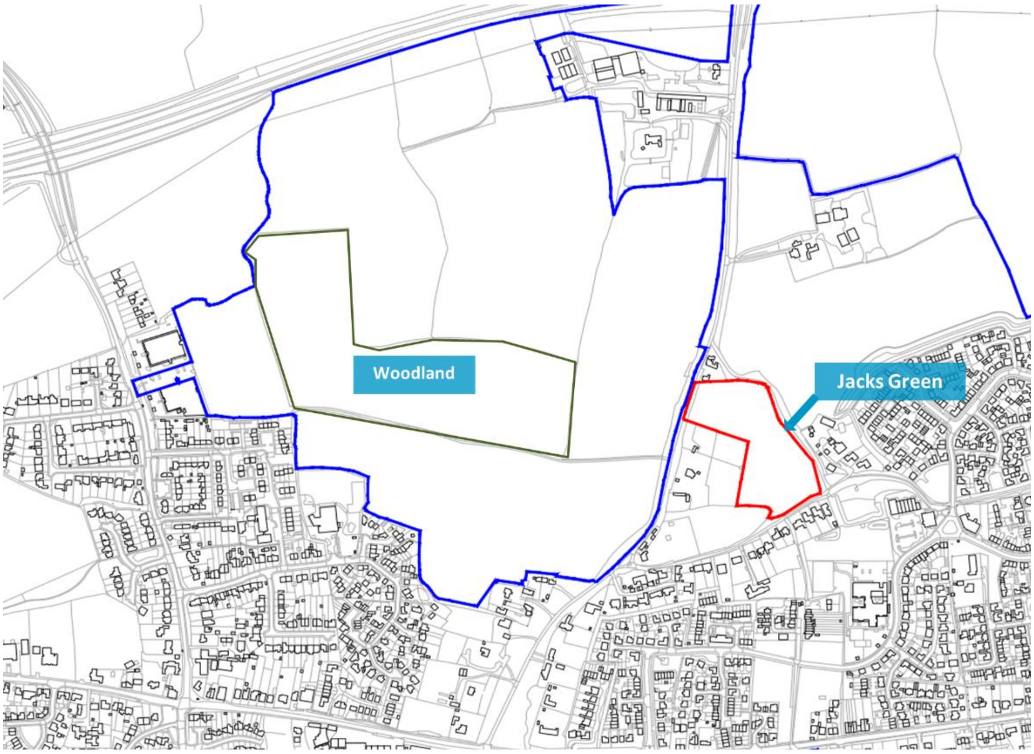
The development falls within Uttlesford District Council, which generally has good air quality, but some areas do suffer from elevated levels of air pollution, primarily due to high levels of traffic. It is therefore important to assess whether there will be an exceedance of the air quality objectives for particulate matter (PM_{10}) or nitrogen dioxide (NO_2) at the proposed site and then advise whether any action is required to reduce the residents' exposure to air pollution. In addition, it is important to establish whether the development will have a significant impact of the adjacent ancient woodland. The assessment utilises ADMS-Roads, a comprehensive dispersion modelling tool for investigating air pollution problems due to small networks of roads and industrial sources.

The expected completion date of the proposed development is 2026. The assessment has therefore been completed for 2027, the expected first full year of occupation.

1.1 The Location of the Development

The proposed development is located in Takeley, Bishop's Stortford (**Figure 1**). A new access road will be created from Smiths' Green through the Jack's Green plot.

Figure 1: Location of the development site



1.2 Assessment Criteria

1.2.1 Human receptors

A summary of the air quality objectives relevant to the Takeley development, as set out in the UK Air Quality Strategy[1], is presented in **Table 1** below. These objectives apply to human receptors.

Table 1: UK Air Quality Objectives for NO_2 and PM_{10} for the protection of human health

Pollutant	Concentration	Measured as
Nitrogen Dioxide (NO_2)	40 µg/m^3	Annual mean
	200 µg/m^3	Hourly mean not to be exceeded more than 18 times per year (99.8th percentile)
Particulate Matter (PM_{10})	40 µg/m^3	Annual mean
	50 µg/m^3	24 hour mean not to be exceeded more than 35 times a year (90.4th percentile)

The oxides of nitrogen (NO_X) comprise principally of nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is a reddish brown gas (at sufficiently high concentrations) and occurs as a result of the oxidation of NO, which in turn originates from the combination of atmospheric nitrogen and oxygen during combustion processes. NO_2 can also form in the atmosphere due to a chemical reaction between NO and ozone (O_3). Health based standards for NO_X generally relate to NO_2, where acute and long-term exposure may adversely affect the respiratory system.

Particulate matter is a term used to describe all suspended solid matter, sometimes referred to as Total Suspended Particulate matter (TSP). Sources of particles in the air include road transport, power stations, quarrying, mining and agriculture. Chemical processes in the atmosphere can also lead to the formation of particles. Particulate matter with an aerodynamic diameter of less than 10 µm is the subject of health concerns because of its ability to penetrate deep within the lungs and is known in its abbreviated form as PM_{10}.

A growing body of research has also pointed towards the smaller particles as a metric more closely associated with adverse health impacts. In particular, particulate matter with an aerodynamic diameter of less than 2.5 micrometres, known as $PM^2{}_5$. Local Authorities in England have a flexible role[2] in working towards reducing emissions and concentrations of $PM_{2.5}$ as there is no specific objective for them. However, there is a UK (excluding Scotland) annual mean objective of 25 µg/m^3.

Further information on the health effects of air pollution can be found in the reports produced by the Committee on the Medical Effects of Air Pollutants[3].

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[1] The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2007), Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland. https://uk-air.defra.gov.uk/assets/documents/Air_Quality_Objectives_Update.pdf

[2] https://laqm.defra.gov.uk/wp-content/uploads/2022/08/LAQM-TG22-August-22-v1.0.pdf LAQM TG(22) – paragraph 1.13 – 1.17

[3] https://www.gov.uk/government/collections/comeap-reports

As defined by the regulations, the air quality objectives for the protection of human health are applicable:

- Outside of buildings or other natural or man-made structures above or below ground
- Where members of the public are regularly present.

Using these definitions, the annual mean objectives will apply at locations where members of the public might be regularly exposed such as building façades of residential properties, schools and hospitals and will not apply at the building façades of offices or other places of work, where members of the public do not have regular access. The 24 hour objective will apply at all locations where the annual mean objective would apply together with hotels. Therefore, in this assessment the annual mean and 24 hour mean objectives will apply across the development site. The hourly objective will apply at all locations where members of the public could reasonably be expected to spend that amount of time. Therefore, in this assessment the hourly objective will also apply across the development site.

1.2.2 Ecological receptors

In addition to assessing the impact of air pollution on residents, separate assessment criteria need to be considered for ecological receptors. A methodology for assessing the impact of air quality on ecological sites is set out by the Institute of Air Quality Management (IAQM)[4]. For some air pollutants, critical levels have been widely adopted, below which significant harmful effects are not thought to occur. A summary of the air quality pollutant relevant to the Takeley development with their critical loads is presented in **Table 2** below.

Table 2: Critical ecological levels

Pollutant	Concentration	Measured as
Oxides of nitrogen (NO_x)	30 µg/m^3	Annual mean
	75/ 200 µg/m^3 *	24 hour mean

*Note: * A critical level of 75 µg/m^3 is not considered to be applicable to the UK where concentrations of SO_2 and ozone are low.*

Concerning the 24 hour mean NO_x objective, several studies have shown that the long term effects of NO_x are thought to be more significant than the short term effects'[5] [6]. The IAQM guidance, therefore, recommends that only the annual mean NO_x concentration is used in assessments unless specifically required by a regulator; for instance, as part of an industrial permit application where high, short term peaks in emissions, and consequent ambient concentrations, may occur. On this basis only the long term mean objective is discussed further. Together with a comparison of overall annual NO_x concentrations at ecological receptors to the critical levels, the change in pollutant concentrations due to the development, referred to as the process

[4] A guide to the assessment of air quality impacts on designated nature conservation sites, May 2020, Version 1.1. Available at: [redacted]

[5] 2 Sutton MA, Howard CM, Erisman JW, Billen G, Bleeker A, Grennfelt P, van Grinsven H, Grizzetti B. 2013. The European Nitrogen Assessment: Sources, Effects and Policy Perspectives. Page 414. Cambridge University Press. 664pp. ISBN 10: 1107006120

[6] 3 June 2011. Manual on Methodologies and Criteria for Modelling and Mapping Critical Loads & Levels and Air Pollution Effects, Risks and Trends. Chapter 3: Mapping Critical Levels for Vegetation.

contribution (PC), is also considered. The relevant criteria for assessing the significant of the proposed development are discussed in **Section 3.2.**

In addition, it is recommended that this assessment is done in collaboration with an ecologist in order to ensure that the proposed critical levels are applicable, in this case to the ancient woodland. This assessment has been done in collaboration with the project ecologist from Ecology Solutions.

1.3 Local Air Quality Management

Local authorities are required to periodically review and assess the current and future quality of air in their areas. Where it is determined that an air quality objective is not likely to be met, the authority must designate an Air Quality Management Area (AQMA) and produce an Air Quality Action Plan (AQAP).

Uttlesford District Council has one active AQMA which covers Saffron Walden's town centre[7]. The AQMA was declared due to exceedances of the annual mean NO_2 objective. In addition, there is an AQMA west of the development in East Hertfordshire District Council at the Hockerill crossroads in Bishop's Stortford[8]. An AQAP was published in 2017[9], which includes measures to reduce emissions within the AQMA.

1.4 The ADMS-Roads Method

Local air quality has been assessed using ADMS-Roads, a comprehensive dispersion model that can be used to predict concentrations of pollutants in the vicinity of roads and small industrial sources. The model has been used for many years in support of planning applications for new residential/commercial developments.

ADMS-Roads is able to provide an estimate of air quality both before and after development, taking into account important input data such as background pollutant concentrations, meteorological data, traffic flows and on-site energy generation (if applicable). The model output can be verified against local monitoring data to increase the accuracy of the predicted pollutant concentrations and this approach has been followed in this assessment.

The use of dispersion modelling enables estimates of concentrations to be made at varying heights. As a result, suggestions for appropriate mitigation measures can be made where necessary, taking into consideration the identification of worst-case locations.

The most recent version of ADMS-Roads (v5) was issued in April 2020 and requires the following information to assess the impact at sensitive receptor locations:

- **Setup:** General site details and modelling options to be used
- **Source:** Source dimensions and locations, release conditions, emissions
- **Meteorology:** hourly meteorological data
- **Background:** Background concentration data
- **Grids:** Type and size of grid for output

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[7] https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=289
[8] https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=89
[9] https://www.uttlesford.gov.uk/media/7346/Air-Quality-Action-Plan-2017-2022/pdf/AQMA_Action_Plan_Nov_2017_pdfa.pdf?m=636988925812370000

- **Output:** Output required and sources/groups to include in the calculations.

2 Methodology

2.1 Local Pollutant Concentrations

It is good practice to include up-to-date local background pollutant concentrations in the assessment model, and also to verify modelled outputs against local monitoring data where available. This section provides an overview of the local data available for use in the assessment.

2.1.1 Local monitoring data

Uttlesford District Council has two automatic monitoring sites which measure nitrogen dioxide (NO_2); one of these sites also measures particulate matter (PM_{10}). Unfortunately, neither of these sites are located in close proximity to the development site and are therefore not discussed further. NO_2 concentrations are also measured passively at diffusion tube sites across the District. One of these diffusion tube sites lies within 500 m of the development site. Details of this monitoring site are given in **Table 3**.

Monitoring results have been taken from the Council's latest Annual Status Report (ASR)[10].

Table 3: Monitoring sites within 500 m of the Jack's Green development

Site Name	Site Type	Pollutant	Grid Reference	Distance to Kerb (m)	Approx. Distance to development site (m)
UT034	R	NO_2	556101, 221243	1.5	490

Note: R = roadside

The diffusion tubes were analysed by Socotec, who participate in the Proficiency scheme[11]. Whilst diffusion tubes provide an indicative estimate of pollutant concentrations, they tend to under or over read. The data is therefore corrected using a bias adjustment factor. There are two types of bias adjustment factor – local and national. The local factor is derived from co-locating diffusion tubes (usually in triplicate) with automatic monitors, whereas the national factor is obtained from the average bias from all local authorities using the same laboratory. Uttlesford District Council applied a national bias adjustment factor (0.75) to their 2019 diffusion tube results.

Monitoring results are presented in **Table 4**. The data shows that the annual mean NO_2 objective was not exceeded at the UT034 monitoring site between 2017 and 2020. As expected, concentrations were significantly lower in 2020 due to the Covid 19 pandemic. Diffusion tubes do not provide information on hourly exceedances, but research[12] identified a relationship between the annual and 1 hour mean objective, such that exceedances of the latter were considered unlikely where the annual mean was

[10] https://www.uttlesford.gov.uk/media/11129/2021-Air-Quality-Annual-Status-Report-ASR/pdf/Uttlesford-2021-ASRA.pdf?m=637701755131270000
[11] This is a national QA/QC scheme.
[12] Paragraph 7.97 of LAQM TG(22).

below 60 µg/m^3.Therefore, no exceedances of the hourly mean objectives are expected at the diffusion tube monitoring site between these years.

Table 4: Monitoring results for sites within 500m of the proposed development site, 2017-2020

Objective	Site Name	2017	2018	2019	2020
Annual mean NO_2 (µg/m^3)	UT034	27	27	25	17

2.1.2 Background mapped data

Background pollutant concentration maps are available from the Defra LAQM website[13] and data has been extracted for Takeley for this assessment. These 2018 baseline, 1 kilometre grid resolution maps are derived from a complex modelling exercise that takes into account emissions inventories and measurements of ambient air pollution from both automated and non-automated sites. The projections in the 2018 LAQM background maps are based on assumptions which were current before the Covid-19 outbreak in the UK. In consequence these maps do not reflect short or longer term impacts on emissions in 2020 and beyond resulting from behavioural change during the national or local lockdowns.

The estimated mapped background NO_x, NO_2 and PM_{10} concentrations around the development site are 15.2 µg/m^3, 11.4 µg/m^3 and 15 µg/m^3 respectively in 2019. For 2027 (the estimated first full year of occupation), the concentrations obtained for the same pollutants are 11.4 µg/m^3, 8.7 µg/m^3 and 13.9 µg/m^3 respectively.

Due to the lack of a nearby background monitoring site, the 2019 mapped background concentrations have been used in this assessment. To provide a conservative estimate, the projected improvements in background air quality by 2027 have not been used in the dispersion modelling. This is in line with best practice to apply worst-case assumptions.

2.2 Model input data

Hourly meteorological data from Stansted for 2019 has been used in the model. The wind-rose diagram (**Figure 2**) presents this below.

[13] http://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html

Figure 2: Wind-rose diagram for Stansted meteorological data, 2019

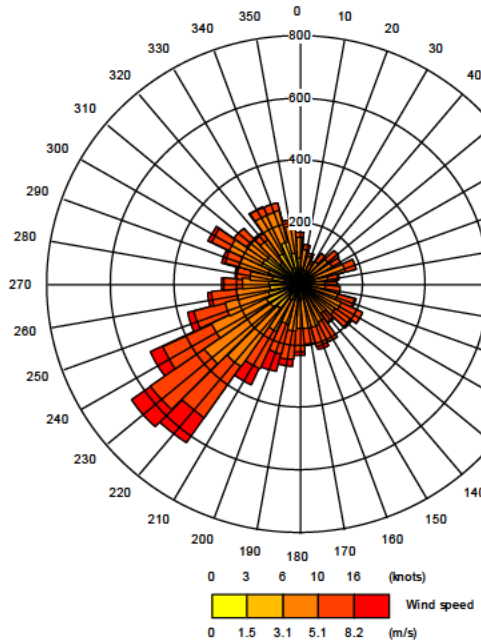

Figure 3: Road sources and receptors

Contains Ordnance Survey data © Crown copyright and database right [2021]

ArcMap software has been used to model the road source locations (red lines) that are within 200 metres of the residential (blue circles) and ecological (green circles) receptor locations. This data can then be automatically uploaded to ADMS-Roads. This generates an accurate representation of the surrounding area to be assessed in the model in terms of the length of roads and distances between sources and receptors. This is shown in

Figure 3 above. It is assumed that the contribution of other sources to NO_2 and PM_{10} is included in the background concentrations.

Six sensitive residential receptor locations have been selected for the assessment, three at the development site and three to assess the impact on existing nearby residents:

- D: representing the concentrations at the entrance to the site next to Smiths Green
- E: representing the concentrations at the south of the development site
- F: representing the concentrations at the northeast corner of the development site
- R1: representing the concentrations at the houses on Parsonage Road, close to the new western access road.
- R2: representing the concentrations at the houses on the Four Ashes crossroads (corner of Parsonage Road and Dunmow Rd (B1256) East)
- R3: representing concentrations at The White House hotel (corner of Dunmow Rs (B1256) and Smiths Green)

Five sensitive ecological receptor locations have been selected for the assessment:

- 1: Western extent of the woodland, located closest to 7 Acres
- 2: Southwest extent of the woodland, located close to the access road for 7 Acres.
- 3: Southern extent of the woodland
- 4: Northern side of the woodland, located away from the development for comparison with the other receptors.
- 5: Eastern side of the woodland, located closest to the Jacks Green site.

These sites have been chosen to reflect the extremities of the site and their proximity to road traffic sources. The architect's plans (**Figure 4**) show the development site in more detail with receptor locations highlighted (blue circles). Exposure has been assumed to be represented at the mid-point of the ground floor level for residential receptors.

Figure 4: The location of the receptors used in the modelling

2.3 Traffic data

Traffic data was provided by the Transport Consultants for the following roads[14]:

- Parsonage Road north of site access
- Parsonage Road south of site access
- Dunmow Rd (B1256) west of Four Ashes
- Station Road South of Four Ashes
- Dunmow Rd (B1256) east of Four Ashes, west of car park
- Dunmow Rd (B1256) east of car park
- Smiths Green Lane north of site access
- Smiths Green Lane south of site access
- Western site access to 7 Acres (development flows only)
- Eastern site access to Jacks (development flows only)

Data was provided for the base year (2019) and future scenario without and with the proposed development. Results (**Section 3** of this report) therefore refer to concentrations modelled in 2027 both without and with the proposed development. The future year scenarios consider the traffic impacts of other committed developments in the area. They also account for any potential increase in traffic due to the proposed development at the nearby Seven Acres development site.

[14] Provided via email Calum McGroff, motion 07/09/2022

In addition to the data provided by the Transport Consultants, for minor roads with no other available data, estimates are based upon average values for an 'urban minor road, South East' from the DfT National Road Traffic Survey, 2019[15]. A time variant factor was applied to all data based on the distribution on all roads by time of day and day of the week in Great Britain[16]. All roads within 200 metres of the modelled receptors have been included in the assessment. The values are shown in **Appendix B**.

In the absence of any other data being available, average speeds on local roads have been assumed based on the speed limit.

2.3.1 Queuing Traffic

Special consideration has been given to the Four Ashes crossroads in this assessment. CERC note 60[17] has been used for estimating emissions from queuing traffic. This defines a representative AADT for queuing traffic to be 30,000 at 5 kph, assuming an average vehicle length of 4 m. These figures, along with the traffic composition of the corresponding roads were then input into the Emission Factor Toolkit (EFT)[18] to calculate emission rates. The emission rates were then used within the dispersion model as separate road sources of pre-defined length, representing each queue with time-varying emission profiles applied to represent busy periods.

2.4 Conversion of NO_x to NO_2

Evidence shows that the proportion of primary NO_2 in vehicle exhaust has increased[19]. This means that the relationship between NO_x and NO_2 at the roadside has changed from that currently used in the ADMS model. A NO_x to NO_2 calculator (published in August 2020)[20] has therefore been developed and has been used in conjunction with the ADMS model to obtain a more accurate picture of NO_2 concentrations.

2.5 Model Verification

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

In the case of NO_2, the model should be verified for NO_x as the initial step and should be carried out separately for the background contribution and the source (i.e. road traffic). Once the NO_X has been verified and adjusted as necessary, a final check should be made against the measured NO_2 concentration.

For this project, modelled annual mean road-NO_X estimates have been verified against the concentrations measured at the UT034 diffusion tube site (see **Appendix A**). This site was selected because it represents the only monitoring site close to the proposed

[15] http://www.dft.gov.uk/statistics/series/traffic/
[16] https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra
[17] Cambridge Environmental Research Consultants Ltd, Modelling Queuing Traffic – note 60, 20th August 2004
[18] Latest version v11, https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/
[19] http://uk-air.defra.gov.uk/assets/documents/reports/aqeg/primary-no-trends.pdf
[20] https://laqm.defra.gov.uk/review-and-assessment/tools/background-maps.html#NOXNO2calc

development. Ideally three verification sites would have been used, but no other sites were deemed suitable due to their distance from the development site.

The adjustment factor determined for annual mean NO_x concentrations was also applied to the modelled annual mean PM_{10} concentrations. This was done as no PM_{10} monitoring data that is representative of the development site is available, and this approach was considered more appropriate than not applying any adjustment[21].

3 Results

3.1 Results of the Dispersion Modelling

Table 5 below provides the estimated pollutant concentrations in the development year (2027) without and with[22] the development, assuming no improvement in the environmental performance of the road traffic fleet between 2019 and 2027. Given the inherent uncertainties in the modelling, background pollutant concentrations have been maintained at 2019 levels in the development year scenarios to provide a worst case estimate. Traffic growth in the without and with development scenarios was provided by the Transport Consultants.

A comparison of the ecological receptors with the relevant NO_x objectives is presented in **Section 3.2**.

[21] Paragraph 7.572 of LAQM TG(22).
[22] 'With' development includes the impact of the additional traffic that will be generated with the development.

Table 5: Estimated pollutant concentrations in 2027 without and with the development at ground floor level (µg/m³), assuming no improvement in the environmental performance of the road fleet.

Receptor	Annual mean NO_2 concentration (µg /m³)		Annual mean PM_{10} concentration (µg /m³)		NO_2 Change	PM_{10} change
	Without development	With development	Without development	With development		
Residential receptors at the development site						
D	11.8	11.8	15.1	15.1	<0.1	<0.1
E	11.6	11.7	15.1	15.1	<0.1	<0.1
F	11.6	11.6	15.1	15.1	<0.1	<0.1
Ecological receptors						
1	11.7	11.7	15.1	15.1	<0.1	<0.1
2	11.9	11.9	15.1	15.1	<0.1	<0.1
3	11.8	11.8	15.1	15.1	<0.1	<0.1
4	11.6	11.7	15.1	15.1	<0.1	<0.1
5	11.7	11.7	15.1	15.1	<0.1	<0.1
Existing residential receptors						
R1	13.1	13.2	15.3	15.4	<0.1	<0.1
R2	27.4	27.5	16.7	16.8	<0.1	<0.1
R3	14.1	14.1	15.5	15.5	<0.1	<0.1

Note: The changes in NO_2 and PM_{10} presented may not exactly equal the difference in the constituent parts shown due to rounding.

Nitrogen dioxide

In the without development scenario, the model predicts annual mean NO_2 concentrations to be below (by 70 %) the annual mean objective at all development site locations. Similar concentrations are predicted across the development site as no receptors are located close to significant road sources.

The estimated annual mean NO_2 concentrations at the development site are reasonable when compared to the data collected at the UT034 diffusion tube monitoring site. The concentrations are higher at the monitoring site as it is located on a busy junction, whereas the development is located away from any main roads. Similar concentrations are predicted at the R2 receptor and UT034 site, which are both located by the Four Ashes crossroads.

The Guidance states that authorities may assume exceedances of the hourly mean objective are only likely to occur where annual mean concentrations are 60 µg/m^3 or above. Therefore, it is considered highly unlikely that this objective will be exceeded at any of the receptors.

The model has also been run for a with development scenario taking into account predicted increases to traffic levels due to the development. The results indicate that annual mean NO_2 concentrations would increase by less than 0.1 µg/m^3.

Particulate matter

The model estimates no exceedance against the annual mean PM_{10} objective. Potential exceedances of the daily mean PM_{10} objective can be estimated based on the annual mean[23], such that:

$$No.24 - hour\ mean\ exceedances = -18.5 + 0.00145 \times Annual\ Mean^3 + \left(\frac{206}{Annual\ Mean}\right)$$

On this basis, it is estimated that in 2027 there will be one exceedance of the daily mean PM_{10} limit value. Therefore, the daily mean PM_{10} objective would be met as 35 exceedances of limit value are allowed per year.

For estimating $PM_{2.5}$ concentrations, where no appropriate sites measuring both PM_{10} and $PM_{2\,5}$ are available, then a nationally derived correction ratio of 0.7 can be used[24]. If this factor is used, then all locations in the modelling meet the EU Directive annual mean $PM^2{}_{.5}$ limit value of 25 µg/m^3.

3.2 Ecological impact

The estimated concentrations and process contributions (PC) at the ecological receptors is presented in **Table 6**. The model predicts annual mean NOx concentrations to be below (by 47 %) the annual mean critical level of 30 µg NOx/m3 at all ecological receptors. A comparison of the baseline and with development scenario is presented as well as the combined PC from the development, other committed development and

[23] Paragraph 7.100 of LAQM TG(22)..

[24] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/estimating-pm2-5-from-pm10-measurements/

estimated traffic local growth. It is estimated that there will be a maximum PC of 0.03 µg /m3 at the worst-case location. The area of ancient woodland in the immediate proximity of ecological receptor 2 is just below a PC of 0.3 µg /m3. The significance of the impact of the development on ecological receptors is discussed in the following section.

Table 6: Estimated NO_2 concentrations and the process contributions at ecological receptors ($\mu g/m^3$)

Receptor	Annual mean NO_x concentration ($\mu g/m^3$)			NO_x process contribution ($\mu g/m^3$) (with - without development)
	Baseline (2019)	Without development (2027)	With development (2027)	
1	15.7	15.8	15.8	0.02
2	15.9	16.0	16.0	0.03
3	15.8	15.8	15.9	0.01
4	15.5	15.6	15.6	0.01
5	15.7	15.7	15.7	0.01

3.3 Significance

3.3.1 Human receptors

Professional judgement is an important part of the assessment of significance. However, there are various documents available that attempt to qualitatively or quantitatively provide ways of assessing the significance of a development on air quality. The most commonly applied is Environmental Protection UK's Air Quality Guidance Document[25] which outlines how impacts may be assessed quantitatively. The assessment is made up of two steps – firstly to assess the magnitude of change in concentration (e.g. between with and without development) relative to the objective level, and secondly the percentage above/below the objective based upon the total modelled concentration at a given location or receptor. By combining these two values, you can obtain the impact descriptor. This method is presented in **Table 7** below.

Table 7: Significance of change description

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

25 [redacted]

In addition to the criteria provided above, the Guidance document states that the table is intended to be used by rounding the change in percentage pollutant concentrations to whole numbers. Changes of 0 % i.e. less than 0.5 % are described as negligible.

In applying these criteria, it can be concluded that the impact of the development on local annual mean NO_2 concentrations is likely to be 'negligible', as the change in concentration due to the development is < 0.1 % of the Air Quality Assessment Level (AQAL) at all locations.

However, this is a fairly simplistic conclusion and other factors may also need to be considered in order to make transparent conclusions. Specific factors to consider may include:

1. Number of properties affected by the slight, moderate or major impacts and a judgement of the overall balance
2. Where new exposure is being introduced into an existing area of poor air quality, then the number of people exposed to levels above the objective or limit value will be relevant
3. The magnitude of the changes and descriptions of the impacts at the receptors
4. Whether or not an exceedance of an objective or limit value is predicted to arise in the study area where none existed before or an exceedance area is substantially increased
5. Whether or not the study area exceeds an objective or limit value and this exceedance is removed or the exceedance area is reduced
6. Uncertainty, including the extent to which worst case assumptions have been made
7. The extent to which an objective or limit value is exceeded, for example an annual mean of 41 $\mu g/m^3$ should attract less significance than an annual mean of 51 $\mu g/m^3$.

In this case, none of the above criteria are of significance, suggesting that there will be no concerns in terms of the exposure of residents to harmful pollutant concentrations across the study area.

3.3.2 Ecological receptors

Risk assessment guidance from the Environment Agency[26] provides criteria for screening out the impacts from individual installations for permitting purposes. These criteria are commonly applied to dispersion modelling assessments to estimate the PC. The latest IAQM guidance[4] suggests that the following criteria for determining an insignificant impact on ecological receptors as:

- the short-term PC is less than 10% of the short-term environmental standard
- the long-term PC is less than 1% of the long-term environmental standard

As discussed in **Section 1.2**, only the long-term objectives have been considered in this assessment as its effects are considered to be more significant. The long-term critical level is 30 $\mu g/m^3$, a PC of less than 0.3 $\mu g/m^3$ is therefore considered to be insignificant. On this basis, the development is not considered to have a significant impact on the adjacent ancient woodland (see **Table 6**).

[26] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

3.4 Mitigation Measures

Based on the ADMS results, there is no specific requirement for mitigation, as concentrations are estimated to meet all of the objective levels for public health and ecological impacts.

However, it is widely acknowledged that there is no safe level of exposure to air pollution[27], and as such, the developer is encouraged to consider mitigation measures to reduce emissions arising from the site. The National Planning Policy Framework[28], updated July 2021, requires new developments to support sustainable travel and air quality improvements. A key theme of the NPPF is that "*Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions and improve air quality and public health. However, opportunities to maximise sustainable transport solutions will vary between urban and rural areas, and this should be taken into account in both plan-making and decision-making*" (paragraph 105).

The NPPF also states that "*Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and Clean Air Zones, and the cumulative impacts from individual sites in local areas. Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications. Planning decisions should ensure that any new development in Air Quality Management Areas and Clean Air Zones is consistent with the local air quality action plan*" (paragraph 186).

In addition, the following relevant requirements for improving air quality are outlined (paragraph 112-113):

- Give priority first to pedestrian and cycle movements, both within the scheme and with neighbouring areas; and second – so far as possible – to facilitating access to high quality public transport, with layouts that maximise the catchment area for bus or other public transport services, and appropriate facilities that encourage public transport use
- Be designed to enable charging of plug-in and other ultra-low emission vehicles in safe, accessible and convenient locations
- All developments that will generate significant amounts of movement should be required to provide a travel plan, and the application should be supported by a transport statement or transport assessment so that the likely impacts of the proposal can be assessed.

[27] [redacted]

[28] https://www.gov.uk/government/publications/national-planning-policy-framework--2 Published in July 2018

Building on the NPPF, the Institute of Air Quality Management (IAQM) has provided guidance on the principles of good practice[29] which should be applied to all major development[30]. Examples of good practice include:

- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000 m^2 of commercial floor space. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made.
- Where the development generates significant additional traffic, a detailed travel plan should be implemented.
- All gas-fired boilers to meet a minimum standard of < 40 mg NO_X/kWh
- All gas-fired CHP plant to meet a minimum emissions standard of:
    - Spark ignition engine: 250 mg NO_X/Nm^3
    - Compression ignition engine: 400 mg NO_X/Nm^3
    - Gas turbine: 50 mg NO_X/Nm^3
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of:
    - Solid biomass boiler: 275 mg NO_X/Nm^3 and 25 mg PM/Nm^3

Additional measures to enhance the woodland are presented in the Ecological Assessment[31]. These include:

- Selective thinning of the canopy to create glades and rides, promoting natural regeneration of the understory and field layer.
- Including fencing in selected areas to prevent deer browsing.
- Landscaping of the new site to provide new open space comprising of grassland and wetland habitats, new native hedgerow and tree planting and woodland extension on the eastern side of Priors Wood.

3.5 Mitigating the Impacts of the Construction Phase

Emissions and dust from the construction phase of a development can have a significant impact on local air quality. The IAQM has produced a document titled 'Guidance on the assessment of dust from demolition and construction'[32] published in May 2015. This guidance contains a methodology for determining the significance of construction developments on local air quality using a simple four step process:

- STEP 1: Screen the requirement for a more detailed assessment
- STEP 2: Assess the risk of dust impacts
- STEP 3: Determine any required site-specific mitigation
- STEP 4: Define post mitigation effects and their significance.

The risk of dust emissions from a demolition/construction site causing loss of amenity and/or ecological impacts is related to a number of factors, including: the activities being undertaken; the duration of these activities; the size of the site; the mitigation

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29 [redacted]

30 Major developments can be defined as developments where:
(1) The number of dwellings is 10 or above, (2) The residential development is carried out on a site of more than 0.5ha where the number of dwellings is unknown, (3) The provision of more than 1000 m^2 commercial floor space, (4) Development carried out on land of 1ha or more, (5) Developments which introduce new exposure into an area of existing poor air quality (e.g. an AQMA) should also be considered in this context.

31 Warish Hall Farm, Takeley, Essex. Ecological Assessment, draft May 2021. Ecology Solutions

32 [redacted]

measures implemented and meteorological conditions. In addition, the proximity of receptors to the site and the sensitivity of these receptors to dust, impacts the level of risk from dust emissions. Receptors include both 'human receptors' and 'ecological receptors'. The former refers to a location where a person or property may experience adverse effects for airborne dust or dust soiling, or exposure to PM_{10}, over a time period relevant to the air quality objectives (see **Table 1**). Ecological receptors are defined as any sensitive habitat affected by dust soiling, through both direct and indirect effects. .Following assessment of the impacts of dust as a result of the development, a qualitative risk impact level can be assigned, ranging from 'negligible' to 'high risk'. Based on the designated risk impact level, the mitigation measures which are appropriate for all sites and are applicable specifically to demolition, earthworks, construction and trackout can be determined. Examples of the general measures include:

- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site
- Ensure all vehicles switch off engines when stationary – no idling vehicles
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable
- Ensure all loads entering and leaving the site are covered
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation

The use of the outlined IAQM methodology for assessing the impacts of dust from demolition/construction is considered to be current best practice. Therefore, it is recommended that the developer refers to the relevant IAQM documentation, to help reduce the impact of dust and vehicle exhaust emissions, and liaises with the Local Authority to come up with an acceptable dust management strategy.

Measures to mitigate the impact of the construction phase on the ancient woodland include the erection of an exclusion zone. The exclusion zone will be marked out with road pins and hazard tape/ fencing around the retained woodland to prevent damage during the construction phase[31].

4 Summary and Conclusions

An air quality assessment has been undertaken for a proposed residential development at Warish Hall Farm. Uttlesford District Council has declared one Air Quality Management Area (AQMA) due to the exceedance of the annual mean nitrogen dioxide (NO_2) objective. The proposed development falls outside the AQMA.

A conservative approach with regards to expected improvements to air quality has been taken in that no improvement in the pollutant background concentrations or road transport emission factors has been assumed between the base year (2019) and the first year of occupation (2027). With expected improvements to the traffic fleet, improvements in pollutant concentrations may however materialise. This is in line with best practice to apply worst-case assumptions.

The ADMS-Roads dispersion model has been used to determine the impact of emissions from road traffic on sensitive receptors. Predicted concentrations have been compared with the air quality objectives. The results of the assessment indicate that annual mean NO_2 and particulate matter (PM_{10}) concentrations are substantially below the objective in the 'without' development scenario. Based on the evidence it is also estimated that there will be no exceedances of either short term objective for NO_2 or PM_{10}. The 'with' development scenario predicts that the development will cause NO_2 and PM_{10} concentrations to increase by less than 0.1 $\mu g/m^3$, at the development and nearby residential receptors. Therefore, no mitigation is required as the air quality objectives are predicted to be met and only a negligible increase is predicted.

The impact of the development on the adjacent woodland is considered to fall below the level of significance (1 %), with NO_x concentrations increases of 0.1 % of the critical level. The development this therefore not considered to have a significant impact on ecological receptors.

The developer is encouraged to refer to the IAQM's 'Guidance on the assessment of dust from demolition and construction' in order to minimise the impact of the construction phase on local air quality.

Appendix A – Model Verification

In order to verify modelled pollutant concentrations generated in the assessment, the model has been run to predict the annual mean road-NO_X concentration during 2019 at the UT034 diffusion tube site described in **Table 2**.

The model output of road-NO_X has been compared with the 'measured' road-NO_X. Measured NO_X for the monitoring sites was calculated using the NO_x to NO_2 calculator[20].

A primary adjustment factor was determined to convert between the 'measured' road contribution and the model derived road contribution (**Table A.1**). This factor was then applied to the modelled road-NO_X concentration for each receptor to provide adjusted modelled road-NO_x concentrations. Total NO_2 concentrations were then determined by combining the adjusted modelled road-NO_x concentrations with the 2019 background NO_2 concentration.

The results imply that the model was very accurate at predicting the road-NO_x contribution.

Table A.1: Comparison of Measured road-NO_X to unadjusted modelled road-NO_X concentrations

Receptor	Measured road-NO_x	Unadjusted modelled road-NO_x concentrations	Adjustment factor
UT034	25.82	25.42	1.015663722

RMSE

The root mean square error (RMSE) is used to define the average error or uncertainty of the model. The following RMSE value has been calculated:

NO_2: 0.14

If the RMSE values are higher than ±25 % of the objective being assessed, it is recommended that the model inputs and verification should be revisited to make improvements. Ideally an RMSE within 10 % of the objective would be derived. In this case the model is being assessed against the annual mean objective, which is 40 µg/m^3 for NO_2. An RMSE value of less than 10 % of the objective (less than 4 µg/m^3) is obtained and therefore the model behaviour is acceptable.

Appendix B – Traffic Data

Table B.1: Traffic data for 2019 and predictions for 2027 with and without development

Road links	Annual Average Daily Traffic (AADT)			% Heavy Duty Vehicles	Speed (kph)
	2019	2027 without development	2027 with development		
Parsonage Road North of Site Access	6,439	7,411	7,446	10.7	48
Parsonage Road South of Site Access	7,303	8,619	8,855	5.6	48
Dunmow Rd (B1256) West of Four Ashes	8,877	10,332	10,624	5.6	48
Station Road South of Four Ashes	7,059	8,393	8,422	2.7	48
Dunmow Rd (B1256) East of Four Ashes (west of car park)	11,060	13,340	13,539	5.5	48
Dunmow Rd (B1256) East of car park	11,060	13,309	13,508	5.5	
Smiths Green Lane South of Site Accesses	662	733	919	0.8	48
Smiths Green Lane North of Site Accesses	662	733	766	0.8	48
Western Site Access (Development flows only)	0	0	271	7.0	48
Eastern Site Access (Jacks Development Flows Only)	0	0	218	1.0	48
Minor Road	2,100	2,474	*	1.9	48
TQ: Parsonage Road South of Site Access**	30,000	*	*	5.6	5
TQ: Dunmow Rd (B1256) West of Four Ashes**	30,000	*	*	5.6	5
TQ: Station Road South of Four Ashes**	30,000	*	*	2.7	5
TQ: Dunmow Rd (B1256) East of Four Ashes**	30,000	*	*	5.5	5

*Note: * no traffic growth assumed, ** traffic queues have been modelled on the Four Ashes crossroads.*

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[redacted]