Langtree PP and Panattoni

Six 56 Warrington

Environmental Statement

Part 2 – Air Quality, Odour and Dust Technical

Paper 8

Revision 2 18 February 2019

SIX 56 WARRINGTON

rps MAKING COMPLEX EASY

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1. Introduction

1.1. This Paper details the air quality assessment undertaken by RPS for the Proposed Six 56 Warrington Development. The local planning authority, Warrington Borough Council (WBC) has designated three Air Quality Management Areas (AQMAs) due to high levels of nitrogen dioxide (NO_2) pollution from road traffic. The nearest, AQMA No 1, is a 50 m continuous strip on both sides of the M6, M62 and M56 motorway corridors. A small part of the development is within this AQMA.

1.2. This air quality assessment covers the:

- Construction phase - an evaluation of the temporary effects from fugitive construction dust and construction-vehicle exhaust emissions; and the
- Operational phase – an evaluation of the impacts of the development traffic on the local area including any effects on the AQMAs

1.3. This Paper begins by setting out the policy and legislative context for the assessment. The methods and criteria used to assess potential air quality effects have then been described. The baseline air quality conditions have been established taking into account Defra estimates, local authority documents and the results of any local monitoring. The results of the assessment of air quality impacts have been presented. A conclusion has been drawn on the significance of the residual construction-phase effects and the residual operational-phase effects.

2. Documents Consulted

National Planning Policy Framework

2.1. The National Planning Policy Framework (The Framework) (2018) [1] is a material consideration for local planning authorities and decision-takers in determining applications. At the heart of the Framework is a presumption in favour of sustainable development. For determining planning applications, this means approving development proposals if they accord with an up-to-date local development plan, unless material considerations indicate otherwise. If the development plan does not contain relevant policies, or the policies are out of date, then planning permission should be granted unless the application of policies in the Framework that protect areas or assets of particular importance provides a clear reason for refusing the development, or any adverse impacts would significantly outweigh the benefits.

2.2. The Framework sets out three overarching objectives to achieve sustainable development. The relevant objective in the context of this air quality assessment is:

***"an environmental objective** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution and adapting to climate change, including moving to a low carbon economy"* (Paragraph 8c)

2.3. Under the heading 'Promoting sustainable transport', the Framework states:

"The planning system should actively manage patterns of growth in support of these objectives. 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 103)

2.4. Under the heading 'Conserving and enhancing the natural environment', the Framework states:

"Planning policies and decisions should contribute to and enhance the natural and local environment by: …

e) *Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; …"* (Paragraph 170)

"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 181)

National Planning Practice Guidance

2.5. The National Planning Practice Guidance (PPG) was issued on-line in March 2014 and is updated periodically by Government as a live document. The Air Quality section of the PPG describes the circumstances when air quality and dust can be a planning concern, requiring assessment.

2.6. The PPG advises that whether or not air quality is relevant to a planning decision will depend on the proposed development and its location. Concerns could arise if the development is likely to generate air quality impact in an area where air quality is known to be poor. They could also arise where the development is likely to adversely impact upon the implementation of air quality strategies and action plans and/or, in particular, lead to a breach of EU legislation (including that applicable to wildlife).

2.7. The PPG states that when deciding whether air quality is relevant to a planning application, considerations could include whether the development would:

- *"Significantly affect traffic in the immediate vicinity of the proposed development site or further afield. This could be by generating or increasing traffic congestion; significantly changing traffic volumes, vehicle speed or both; or significantly altering the traffic composition* *on local roads. Other matters to consider include whether the proposal involves the development of a bus station, coach or lorry park; adds to turnover in a large car park; or result in construction sites that would generate large Heavy Goods Vehicle flows over a period of a year or more.*

- *Introduce new point sources of air pollution. This could include furnaces which require prior notification to local authorities; or extraction systems (including chimneys) which require approval under pollution control legislation or biomass boilers or biomass-fuelled CHP plant; centralised boilers or CHP plant burning other fuels within or close to an air quality management area or introduce relevant combustion within a Smoke Control Area;*
- *Expose people to existing sources of air pollutants. This could be by building new homes, workplaces or other development in places with poor air quality.*
- *Give rise to potentially unacceptable impact (such as dust) during construction for nearby sensitive locations.*
- *Affect biodiversity. In particular, is it likely to result in deposition or concentration of pollutants that significantly affect a European-designated wildlife site, and is not directly connected with or necessary to the management of the site, or does it otherwise affect biodiversity, particularly designated wildlife sites."*

2.8. The PPG provides advice on how air quality impacts can be mitigated and notes:

"Mitigation options where necessary will be locationally specific, will depend on the proposed development and should be proportionate to the likely impact. It is important therefore that local planning authorities work with applicants to consider appropriate mitigation so as to ensure the new development is appropriate for its location and unacceptable risks are prevented. Planning conditions and obligations can be used to secure mitigation where the relevant tests are met."

The Ambient Air Quality Directive and Air Quality Standards Regulations

2.9. The 2008 Ambient Air Quality Directive (2008/50/EC) [2] aims to protect human health and the environment by avoiding, reducing or preventing harmful concentrations of air pollutants; it sets legally binding concentration-based limit values, as well as target values. There are also information and alert thresholds for reporting purposes. These are to be achieved for the main air pollutants: particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene. This Directive replaced most of the previous EU air quality legislation and in England was transposed into domestic law by the Air Quality Standards (England) Regulations 2010 [3].

UK Air Quality Strategy

2.10. The Environment Act 1995 established the requirement for the Government and the devolved administrations to produce a National Air Quality Strategy (AQS) for improving ambient air quality [4]. The Strategy sets UK air quality standards♦ and objectives# for the pollutants in the Air Quality Standards Regulations plus 1,3-butadiene. There is no legal requirement to meet objectives set within the UK AQS except where equivalent limit values are set within the EU Directives.

2.11. The 1995 Environment Act also established the UK system of Local Air Quality Management (LAQM), this requires local authorities to go through a process of review and assessment of air quality, identifying places where objectives are not likely to be met, and then declaring Air Quality Management Areas (AQMAs) before putting in place Air Quality Action Plans to improve air quality. These plans also contribute, at a local level, to the achievement of EU limit values.

2.12. For the purposes of this assessment, the limit values set out in the Air Quality Standards Regulations 2010 and the objective levels specified under the current UK AQS have been used. The limit values and objectives relevant to this assessment are summarised below.

Pollutant	**Averaging Period**	**Objectives/Limit Values**	**Not to be Exceeded More Than**	**Target Date**
Nitrogen Dioxide (NO_2)	1 hour	200 $\mu g.m^{-3}$	18 times per calendar year	-

♦ Standards are concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. Standards, as the benchmarks for setting objectives, are set purely with regard to scientific evidence and medical evidence on the effects of the particular pollutant on health, or on the wider environment, as minimum or zero risk levels.
Objectives are policy targets expressed as a concentration that should be achieved, all the time or for a percentage of time, by a certain date.

	Annual	40 µg.m^{-3}	-	-
Particulate Matter (PM_{10})	24 hour	50 µg.m^{-3}	35 times per calendar year	-
	Annual	40 µg.m^{-3}	-	-
Particulate Matter ($PM_{2.5}$)	Annual	Target of 15% reduction in concentrations at urban background locations	-	Between 2010 and 2020 (a)
		Variable target of up to 20% reduction in concentrations at urban background locations (c)		Between 2010 and 2020 (b)
	Annual	25 µg.m^{-3}	-	01.01.2020 (a)
		25 µg.m^{-3}		01.01.2015 (b)

Table 8.1 Summary of Relevant Air Quality Limit Values and Objectives
(a) Target date set in UK Air Quality Strategy 2007
(b) Target date set in Air Quality Standards Regulations 2010
(c) Aim to not exceed 18 µg.m^{-3}by 2020

UK Air Quality Plan

2.13. In July 2017, Defra published the *'UK plan for tackling roadside nitrogen dioxide concentrations'*. This describes the Government's plan for bringing roads with NO_2 concentrations above the EU Limit Value back into compliance within the shortest possible time. A Supplement to the plan was published in October 2018. The Supplement sets out measures to bring forward compliance in those 33 local authorities projected to comply with the EU Limit Value by 2021 in the July 2017 plan.

2.14. On 14 January 2019, Defra published the *'Clean Air Strategy 2019'*. The report sets out actions that the Government intends to take to reduce emissions from transport, in the home, from farming and from industry.

Local Policy

2.15. In 2014, the Local Plan Core Strategy (Warrington Borough Council, 2015) was adopted by WBC setting out a planning framework of development in the Borough up to 2027.

2.16. Policies within the Local Plan Core Strategy that are relevant to air quality include:

"Policy QE 6 – Environment and Amenity Protection

The Council, in consultation with other Agencies, will only support development which would not lead to an adverse impact on the environment or amenity of future occupiers or those currently occupying adjoining or nearby properties, or does not have an unacceptable impact on the surrounding area. The Council will take into consideration the following:

- *…Air Quality;*
- *…Levels of odours, fumes, dust, litter accumulation and refuse collection/storage;…*

Proposals may be required to submit detailed assessments in relation to any of the above criteria to the Council for approval.

Where development is permitted which may have an impact on such considerations, the Council will consider the use of conditions or planning obligations to ensure any appropriate mitigation or compensatory measures are secured.

Development proposals on land that is (or suspected to be) affected by contamination or ground instability or has a sensitive end use must include an assessment of the extent of the issues and any possible risks. Development will only be permitted where the land is, or is made, suitable for the proposed use."

3. Consultations

3.1. A Scoping Request was submitted in February 2018 and a Scoping Opinion was received from WBC on 6 April 2018. Table 8.2 provides a summary of consultation undertaken for this Paper.

Theme / Issue	Date	Consultee	Method	Summary of Discussion	Outcome / Output
Air Quality Assessment	06-04-18	Warrington Borough Council	Scoping Opinion	Scope and methodology of Air Quality Assessment, proposed sensitive receptors.	"The scoping proposed a detailed air quality assessment, which is acceptable." GMEU requested that the impacts on natural receptors (such as existing habitats/designated sites) should be assessed. This has been assessed in Appendix 8.1.
Air Quality Assessment	04-09-17	Warrington Borough Council Environmental Health Department (Mr Richard Moore)	Email	Scope and methodology of Air Quality Assessment.	General agreement with proposed scope and methodology. Council requested meteorological data from Rostherne station should be used. Latest Annual Status Report provided.

Table 8.2 Summary of Consultations and Discussions

4. Methodology and Approach

4.1. For the construction phase, a risk assessment of dust and emissions during construction of the Proposed Development, having regard to the Institute of Air Quality Management (IAQM) 'Guidance on the assessment of dust from demolition and construction' was undertaken [5]. Appendix 8.2 outlines the methodology of this risk assessment. The assessment is provided in Section 7.

4.2. For the operational phase, modelling of NO_2, PM_{10} and $PM_{2.5}$ from traffic emissions was undertaken using the ADMS-Roads dispersion model. The following scenarios were modelled:

- Without the Proposed Development in 2017;
- Without the Proposed Development in 2021;
- With the Proposed Development in 2021;
- Without the Proposed Development in 2029;
- With the Proposed Development in 2029;

4.3. The 2021 and 2029 scenarios include traffic from the following developments:

	Cumulative Development	Details	Status
1	Land bounded by Pewterspear Green Road, Ashford Drive, Stretton, Warrington LPA Ref: 2016/28807 Applicant - HCA	Outline Planning Application for 180 dwellings.	Planning permission granted by WMBC 28-09-2017 (3 years to implement planning permission)
2	Land bounded by Green Lane &, Dipping Brook Avenue, Appleton, Warrington, WA4 5NN LPA Ref: 2017/29930 Applicant - HCA	Outline Planning Application for 370 dwellings	Planning permission granted by WMBC 22-01-2018 (3 years to implement planning permission)
3	Land South of Astor Drive, East of Lichfield Avenue &, South of Witherwin Avenue, Grappenhall Heys, Warrington, WA4 3LG	Outline Planning Application for 400 dwellings	Planning permission granted by WMBC 22-01-2018 (3 years to implement planning permission)

	Cumulative Development	Details	Status
	LPA Ref: 2017/29929 Applicant - HCA		
4	Land North of Barleycastle Lane, Appleton, Warrington Liberty Properties Development Ltd & Eddie Stobart LPA Ref: 2017/31757	Full Planning application (Major) - Demolition of all existing on-site buildings and structures and construction of a National Distribution Centre building (Use Class B8) with ancillary office accommodation (Class B1(a)), vehicle maintenance unit, vehicle washing area, internal roads, gatehouse, parking areas, perimeter fencing, waste management area, sustainable urban drainage system, landscaping, highways improvements and other associated works. (Gross internal floor space of 56,197m², together with 1,858m² of ancillary office)	Refused Planning Permission by WMBC 14-11-2018
5	Land to the east of Stretton Road, north of Pepper Street, Stretton Road, Appleton Thorn, Warrington LPA Ref: 2017/31848	Full Planning Application for 71 dwellings	Planning permission granted by WMBC 24-10-2018 (3 years to implement planning permission)

Table 8.3: Cumulative Developments Included in Traffic Data Modelled

4.4. These are also considered in the Cumulative Impacts section of this Technical Paper.

4.5. Appendix 8.3 outlines the detailed methodology of the operational phase dispersion modelling.

Receptors

4.6. For the construction-phase risk assessment, the IAQM dust guidance sets out 350 m as the distance from the site boundary and 50 m from the site traffic routes up to 500 m of the entrance, within which there could potentially be nuisance dust and PM_{10} effects on human receptors. Receptors within these distances were identified and their sensitivity was established with reference to the principles set out in the IAQM dust guidance.

4.7. For the operational phase, using the threshold criteria for determining when an assessment is required set out in the EPUK & IAQM Land-Use Planning & Development Control: Planning

For Air Quality [6] document, the extent of the study area for the assessment were determined by the local road network on which annual average daily light duty vehicle flows are expected to increase by more than 500 and annual average daily heavy duty vehicle flows are expected to increase by more than 100 outside an AQMA and by 100 light duty vehicles or 25 heavy duty vehicles within an AQMA. Receptors were selected in locations within the study area where concentrations are already high and/or where concentrations are expected to change most as a consequence of the development. All human-health receptors are considered to be high sensitivity receptors in the context of air pollution.

Designation	Receptors
International	None
National	None
Regional	None
County	None
Borough / District	Areas where the public is regularly present and likely to be exposed over the averaging period of the objective.
Local/Neighbourhood	Areas where the public is regularly present and likely to be exposed over the averaging period of the objective.

Table 8.4: Receptors

4.8. Sensitive receptors for the assessment have been selected at representative properties where pollutant concentrations and/or changes in pollutant concentrations are anticipated to be greatest and are listed in Table 8.5. Appendix 8.4 shows detailed maps of the receptors modelled. The sensitive receptors modelled are different to those shown in the scoping opinion. This is due to the traffic affecting different road links than previously thought.

Receptor ID	Receptor Name	x	Y
1	Intack Farm	367001	383414
2	Massey Avenue	366476	386920
3	Masseybrook Farm	366297	386553
4	Howshoots Farm	366009	385005
5	Cartridge Lane	365506	384888
6	Stockport Road 1	365559	387158
7	Stockport Road 2	365913	387481
8	Cliff Lane	366919	384923
9	Primrose Hill	367908	384455
10	Tan House Farm	365738	383800
11	Crows Nest Farm	366888	383825
12	Mill Farm	367706	382537
13	Grappenhall Lodge	364669	384641

Receptor ID	Receptor Name	x	Y
14	Crofton Close	363994	384082
15	Hatchery Close	363643	383622
16	St Matthews CofE Primary School	362159	382770
17	Knutsford Road	365028	385960
18	Cliff Lane	364649	386272
19	Gilwell Close	364376	386650
20	Westminster Close	364374	386957
21	Summit Close	362189	382078
22	Bradley View	365862	384877
23	Bradley Hall Cottages	365824	384695
24	Bradley Hall	365775	384551
25	Chester Road 1	364169	386786
26	Chester Road 2	363563	386438
27	Chester Road 3	363280	386414
28	Church Lane 1	363804	386262
29	Church Lane 2	363710	386309
30	Barleycastle Lane	364627	384154
31	Broad Lane	364549	384759

Table 8.5 Sensitive Receptors

Environmental Impacts

Construction Phase

4.9. The IAQM dust guidance aims to estimate the impacts of both PM_{10} and dust through a risk-based assessment procedure. The IAQM dust guidance document states: *"The impacts depend on the mitigation measures adopted. Therefore the emphasis in this document is on classifying the risk of dust impacts from a site, which will then allow mitigation measures commensurate with that risk to be identified."*

4.10. The IAQM dust guidance provides a methodological framework, but notes that professional judgement is required to assess effects: *"This is necessary, because the diverse range of projects that are likely to be subject to dust impact assessment means that it is not possible to be prescriptive as to how to assess the impacts. Also a wide range of factors affect the amount of dust that may arise, and these are not readily quantified."*

4.11. Consistent with the recommendations in the IAQM dust guidance, a risk-based assessment has been undertaken for the development, using the well-established source-pathway-receptor approach:

- The dust impact (the change in dust levels attributable to the development activity) at a particular receptor will depend on the magnitude of the dust source and the effectiveness of the pathway (i.e. the route through the air) from source to receptor.
- The effects of the dust are the results of these changes in dust levels on the exposed receptors, for example annoyance or adverse health effects. The effect experienced for a given exposure depends on the sensitivity of the particular receptor to dust. An assessment of the overall dust effect for the area as a whole has been made using professional judgement taking into account both the change in dust levels (as indicated by the Dust Impact Risk for individual receptors) and the absolute dust levels, together with the sensitivities of local receptors and other relevant factors for the area.

4.12. The dust risk categories that have been determined for each of the four activities (demolition, earthworks, construction and trackout) have been used to define the appropriate site-specific mitigation measures based on those described in the IAQM dust guidance. The guidance states that provided the mitigation measures are successfully implemented, the resultant effects of the dust exposure will normally be *"not significant"*.

As outlined in the Energy Paper, there is the potential for emissions of NO_x during the construction phase. At this stage the exact sources are unknown so have not been specifically assessed in this Paper.

Operational Phase

4.13. The severity of the environmental impacts will be described using the EPUK/IAQM Land-Use Planning & Development Control: Planning For Air Quality document which advises that:

"The significance of the effects arising from the impacts on air quality will depend on a number of factors and will need to be considered alongside the benefits of the development in question. Development under current planning policy is required to be sustainable and the definition of this includes social and economic dimensions, as well as environmental. Development brings opportunities

for reducing emissions at a wider level through the use of more efficient technologies and better designed buildings, which could well displace emissions elsewhere, even if they increase at the development site. Conversely, development can also have adverse consequences for air quality at a wider level through its effects on trip generation."

4.14. When describing the air quality impact at a sensitive receptor, the change in magnitude of the concentration should be considered in the context of the absolute concentration at the sensitive receptor. Table 8.6 provides the EPUK/IAQM approach for describing the human-health air quality impacts at sensitive receptors. The impact descriptors have been changed from "Slight" to "Minor" to fit in with the common methodology.

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

Table 8.6 Impact Descriptors for Individual Sensitive Receptors

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 user is encouraged to treat the numbers with recognition of their likely accuracy and not assume a false level of precision. 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 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.

6. The total concentration categories reflect the degree of potential harm by reference to the AQAL value. At exposure less than 75% of this value, i.e. well below, the degree of harm is likely to be small. As the exposure approaches and exceeds the AQAL, the degree of harm increases. This change naturally becomes more important when the result is an exposure that is approximately equal to, or greater than the AQAL.

7. It is unwise to ascribe too much accuracy to incremental changes or background concentrations, and this is especially important when total concentrations are close to the AQAL. For a given year in the future, it is impossible to define the new total concentration without recognising the inherent uncertainty, which is why there is a category that has a range around the AQAL, rather than being exactly equal to it.

4.15. The Environmental Impacts will be determined using the impact descriptors in the table above at each selected receptor.

4.16. As outlined in the Energy Paper, there is the potential for emissions of NO_x from possible gas fired boilers during the operational phase. At this stage the exact type and size of plant are unknown so have not been specifically assessed in this Paper.

4.17.

Significance of Effects

4.18. The human-health impact descriptors above apply at individual receptors. The EPUK/IAQM guidance states that the impact descriptors *"are not, of themselves, a clear and unambiguous guide to reaching a conclusion on significance. These impact descriptors are intended for application at a series of individual receptors. Whilst it maybe that there are 'slight', 'moderate' or 'substantial' impacts at one or more receptors, the overall effect may not necessarily be judged as being significant in some circumstances."*

4.19. Professional judgement by a competent, suitably qualified professional is required to establish the significance associated with the consequence of the impacts. This judgement is likely to take into account the extent of the current and future population exposure to the impacts and the influence and/or validity of any assumptions adopted during the assessment process.

Impact Prediction Confidence

4.20. It is also of value to attribute a level of confidence by which the predicted impact has been assessed. The criteria for these definitions are set out below:

Confidence Level	Description
High	The predicted impact is either certain i.e. a direct impact, or believed to be very likely to occur, based on reliable information or previous experience.
Low	The predicted impact and its levels are best estimates, generally derived from first principles of relevant theory and experience of the assessor. More information may be needed to improve confidence levels.

Table 8.7: Confidence Levels

5. Baseline Information

5.1. A review of local monitoring data has been undertaken to characterize the existing baseline air quality as outlined below. Measured concentrations from both background monitoring locations (away from busy roads) and roadside locations have been considered.

Overview

5.2. The background concentration often represents a large proportion of the total pollution concentration, so it is important that the background concentration selected for the assessment is realistic. National Planning Practice Guidance and EPUK/IAQM guidance highlight public information from Defra and local monitoring studies as potential sources of information on background air quality. LAQM.TG16 [7] recommends that Defra mapped concentration estimates are used to inform background concentrations in air quality modelling and states that: "*Where appropriate these data can be supplemented by and compared with local measurements of background, although care should be exercised to ensure that the monitoring site is representative of background air quality*".

5.3. For this assessment, the background air quality has been characterised by drawing on information from the following public sources:

- Defra maps, which show estimated pollutant concentrations across the UK in 1 km grid squares; and
- published results of local authority Review and Assessment (R&A) studies of air quality, including local monitoring and modelling studies.

5.4. A detailed description of how the baseline air quality has been derived is summarised in the following paragraphs.

Review and Assessment Process

5.5. WBC has designated three AQMAs due to high levels of NO_2 pollution from road traffic. The nearest, AQMA No. 1, is a 50 m continuous strip on both sides of the M6, M62 and M56 motorway corridors. A small part of the Proposed Development is within this AQMA.

5.6. WBC has implemented a number of actions to improve air quality. These include:

- Implementing the 'Eco Stars Fleet Recognition Scheme' to target freight and bus/coach operators to encourage improved environmental performance to reduce emissions.
- Encouraging sustainable transport
- Extending the off road cycle network to link up employment areas, encouraging cycling for health and commuting reasons.
- Encouraging the uptake of electric vehicles via the planning process with charging points being required in all new car parks and residential schemes.
- The publishing of a Low Emissions Strategy (LES) feasibility Study in 2016.

Local Urban Background Monitoring

5.7. Monitors at urban background locations measure concentrations away from the local influence of emission sources and are therefore broadly representative of residential areas within large conurbations. Monitoring at local urban background locations is considered an appropriate source of data for the purposes of describing baseline air quality for the Application Site.

5.8. There is one local monitoring station where urban background concentrations are measured using continuous automatic instruments. WBC automatically monitors NO_2 and PM_{10} at the Selby Street urban background location. The most recently measured annual-mean concentrations are presented in Table 8.8.

Monitor Name	Approximate Distance to Site (km)	Pollutant	Air Quality Assessment Level (µg.m^{-3})	Concentration (µg.m^{-3})					
				2013	2014	2015	2016	2017	Average
Selby Street (Warrington)	7.5	NO_2	40	25.6	20.5	24.4	25.0	21.0	23.3
		PM_{10}	40	18	16	15	16.1	12.2	15.5
		$PM_{2.5}$	25	14	14	11	10.6	9.7	11.9

Table 8.8 Automatically Monitored Urban Background Annual-Mean Concentrations

5.9. In addition WBC manually monitors NO_2 concentrations at one urban background location using passive diffusion tubes and the measured annual-mean concentrations are presented in Table 8.9.

Monitor Code (Borough)	Approximate Distance to Site (km)	Concentration (µg.m^{-3})				
		2012	2013	2014	2015	2016
WA14 (Warrington)	5.9	24.5	24.5	19.1	23.3	23.6

Table 8.9 Passively Monitored Urban Background Annual-Mean NO2 Concentrations

Defra Mapped Concentration Estimates

5.10. Defra's total annual-mean NO_2 concentration estimates have been collected for the 1 km grid squares of the monitoring sites and the Proposed Development and are summarised in Table 8.10.

Monitor Name (Borough)	Distance to Site (km)	Concentration (µg.m^{-3})	
		Range of Monitored	Estimated Defra Mapped (2015)
Proposed Development	-	-	14.6
Selby Street (Warrington)	7.5	20.5 – 25.6 (2013 – 2017)	21.9
WA14 (Warrington)	5.9	19.1 – 24.5 (2012 – 2016)	18.2

Table 8.10 Defra Mapped Annual-Mean Background NO_2 Concentration Estimates

5.11. Similarly, the Defra total annual-mean PM_{10} and $PM_{2.5}$ concentration estimates have been collected for the grid square of the monitoring sites and the Proposed Development and are summarised in Table 8.11 and Table 8.12.

Monitor Name (Borough)	Distance to Site (km)	Concentration (µg.m^{-3})	
		Range of Monitored	Estimated Defra Mapped (2015)
Proposed Development	-	-	13.7
Selby Street (Warrington)	7.5	12.2 – 19 (2013 – 2017)	13.6

Table 8.11 Defra Mapped Annual-Mean Background PM_{10} Concentration Estimates

Monitor Name (Borough)	Distance to Site (km)	Concentration (µg.m^{-3})	
		Range of Monitored	Estimated Defra Mapped (2015)
Proposed Development	-	-	8.3
Selby Street (Warrington)	7.5	9.7 – 14 (2013 – 2017)	8.7

Table 8.12 Defra Mapped Annual-Mean Background $PM_{2.5}$ Concentration Estimates

Appropriate Background Concentrations for the Development Site

5.12. For NO_2, the Defra mapped background concentration estimates are below the range of the results from monitoring at WA14 and within the range at the Selby Street monitor. The use of the Defra mapped background concentration estimates would therefore not be conservative. To ensure the assessment is conservative, the background annual-mean NO_2 concentration has been derived from the five year average of 23.3 $\mu g.m^{-3}$ measured at the Selby Street monitor.

5.13. For PM_{10}, the Defra mapped background concentration estimate is towards the lower end of the range of the results from monitoring and the use of these data would not be conservative. To ensure the assessment is conservative, the background annual-mean PM_{10} concentration has been derived from the five year average of 15.5 $\mu g.m^{-3}$ measured at the Selby Street monitor.

5.14. For $PM_{2.5}$, the Defra mapped background concentration estimate is below the range of the results from monitoring and the use of these data would not be conservative. To ensure the assessment is conservative, the background annual-mean $PM_{2.5}$ concentration has been derived from the five year average of 11.9 $\mu g.m^{-3}$ measured at the Selby Street monitor.

5.15. Table 8.13 summarises the annual-mean background concentrations for NO_2, PM_{10} and $PM_{2.5}$ used in this assessment.

Pollutant	Data Source	Concentration ($\mu g.m^{-3}$)
NO_2	Selby Street Automatic Monitor (2012)	23.3
PM_{10}	Selby Street Automatic Monitor (2012)	15.5
$PM_{2.5}$	Selby Street Automatic Monitor (2013 and 2014)	11.9

Table 8.13 Summary of Background Annual-Mean Concentrations used in the Assessment

Local Roadside Monitoring

5.16. Monitors at roadside locations measure the influence of road traffic emission sources and are therefore broadly representative of areas within 10 metres of the kerbside.

5.17. There is one local monitoring location within 3 km of the Application Site in the neighbouring borough of Cheshire East where roadside NO_2 concentrations are measured using passive diffusion tubes. The measured annual-mean concentrations are presented in Table 8.14.

Monitor Name	Approximate Distance to Site (km)	Pollutant	Concentration (µg.m^{-3})			
			2013	2014	2015	2016
CE65 Intack Farm	1.5	NO_2	38.5	35.1	30.9	34.5

Table 8.14 Automatically Monitored Roadside Annual-Mean Concentrations

5.18. The annual-mean NO_2 Air Quality Strategy Objective of 40 µg.m^{-3} has not been exceeded for the last four years at the nearest roadside monitoring location.

Future Baseline

5.19. Historically the view has been that background traffic-related NO_2 concentrations in the UK would reduce over time, due to the progressive introduction of improved vehicle technologies and increasingly stringent limits on emissions. However, the results of recent monitoring across the UK suggest that background annual-mean NO_2 concentrations have not decreased in line with expectations. Inspection of the results of local monitoring presented here indicates that in recent years no discernable trend over time is evident for concentrations of NO_2, PM_{10} or $PM_{2.5}$ in the vicinity of the Application Site.

5.20. To ensure that the assessment presents conservative results, no reduction in the background has been applied for future years.

6. Alternatives Considered

6.1. While a series of alternatives have been considered as part of the evolution of the proposals, these have not been specifically influenced by the need to address air quality impacts and are therefore not discussed within this Technical Paper. Section 4 of the ES Part I Report provides details of the alternatives considered.

7. Potential Environmental Effects

Construction Phase

7.1. Whilst no detailed construction phase information is currently available, the type of activities that could cause fugitive dust emissions are: demolition; earthworks; handling and disposal of spoil; wind-blown particulate material from stockpiles; handling of loose construction materials; and movement of vehicles, both on and off site.

7.2. The level and distribution of construction dust emissions will vary according to factors such as the type of dust, duration and location of dust-generating activity, weather conditions and the effectiveness of suppression methods.

7.3. The main effect of any dust emissions, if not mitigated, could be annoyance due to soiling of surfaces, particularly windows, cars and laundry. However, it is normally possible, by implementation of proper control, to ensure that dust deposition does not give rise to significant adverse effects, although short-term events may occur (for example, due to technical failure or exceptional weather conditions). The following assessment, using the IAQM methodology, predicts the risk of dust impacts and the level of mitigation that is required to control the residual effects to a level that is "not significant".

Risk of Dust Impacts

Source

7.4. As the volume of buildings to be demolished is estimated from the demolition parameter plan to be between 20,000 to 50,000 m^3, the dust emission magnitude for the demolition phase is classified as medium.

7.5. As the site area is greater than 10,000 m^2 and there is a very large and extensive cut and fill operation, the dust emission magnitude for the earthworks phase is classified as large.

7.6. As the total volume of the buildings to be constructed would exceed 100,000 m^3, the dust emission magnitude for the construction phase is classified as large.

7.7. Assuming that the maximum number of outwards movements in any one day is greater than 50 HDVs, the dust emission magnitude for trackout would be classified as large.

Demolition	Earthworks	Construction	Trackout
Medium	Large	Large	Large

Table 8.15 Dust Emission Magnitude for Demolition, Earthworks, Construction and Trackout

Pathway and Receptor - Sensitivity of the Area

7.8. All demolition, earthworks and construction activities are assumed to occur within the site boundary. As such, receptors at distances within 20 m, 50 m, 100 m, 200 m and 350 m of the site boundary have been identified and are illustrated in Appendix 8.5. The sensitivity of the area has been classified and the results are provided in Table 8.16 below.

Potential Impact	Sensitivity of the Surrounding Area	Reason for Sensitivity Classification
Dust Soiling	Medium	Between 1 and 10 residential receptors (high sensitivity) located within 20 m of site boundary. 1 – 10 high sensitivity receptors located within 20 m of the site boundary (Appendix 8.2, A.8.2.5)
Human Health	Low	Between 1 and 10 residential receptors (high sensitivity) located within 20 m of site boundary. Background PM_{10} concentrations for the assessment = 15.5 µg.m^{-3} 1 – 10 high sensitivity receptors located within 20 m of the site boundary and PM_{10} concentrations below 24 µg.m^{-3} (Appendix 8.2, A.8.2.6)

Table 8.16 Sensitivity of the Surrounding Area for Demolition, Earthworks and Construction

7.9. The Dust Emission Magnitude for trackout is classified as large and trackout may occur on roads up to 500 m from the site. The major routes within 500 m of the site is Grappenhall Lane, Broad Lane, Barleycastle Lane and the M6. The sensitivity of the area has been classified and the results are provided in Table 8.17.

Potential Impact	Sensitivity of the Surrounding Area	Reason for Sensitivity Classification
Dust Soiling	Medium	1 -10 high sensitivity receptors located within 20 m of the roads (Appendix 8.2, A.8.2.5)
Human Health	Low	Background PM_{10} concentrations for the assessment = 15.5 $\mu g.m^{-3}$ 1-10 high sensitivity receptor located within 20 m of the roads and PM_{10} concentrations below 24 $\mu g.m^{-3}$ (Appendix 8.2, A.8.2.6)

Table 8.17 Sensitivity of the Surrounding Area for Trackout

Overall Dust Risk

7.10. The Dust Emission Magnitude has been considered in the context of the Sensitivity of the Area (Appendix 8.2, Tables A.8.2.5 and A.8.2.6) to give the Dust Impact Risk. Table 8.18 summarises the Dust Impact Risk for the four activities.

Source	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	Medium	Medium	Medium
Human Health	Low	Low	Low	Low
Risk	Medium	Medium	Medium	Medium

Table 8.18 Dust Impact Risk for Demolition, Earthworks, Construction and Trackout

7.11. Taking the site as a whole, the overall risk is deemed to be medium. The mitigation measures appropriate to a level of risk for the site as a whole and for each of the phases are set out in Section 8.

7.12. Provided the package of mitigation measures set out in Section 8 is implemented, the residual construction dust effects will not be significant. The IAQM dust guidance states that "*For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant'.*" The IAQM dust guidance recommends that significance is only assigned to the effect after the activities are considered with mitigation in place.

Nature of Impact	Receptor	Environmental Impact	Significance of Effect	Confidence Level
Increase in suspended particulate matter concentrations and deposited dust	Local	'Medium' Dust Impact Risk, prior to application of IAQM control and mitigation measures	Not significant after application of IAQM control and mitigation measures.[1]	High

Table 8.19 Significance of Effect - Construction Phase

Operational Phase

7.13. This section of the report summarises the future operational-phase air quality impacts of the key pollutants associated with the development traffic of the proposed scheme. The following scenarios were modelled:

7.14. The following scenarios were modelled:

- Without the Proposed Development in 2017;
- Without the Proposed Development in 2021;
- With the Proposed Development in 2021;
- Without the Proposed Development in 2029; and
- With the Proposed Development in 2029.

Nitrogen Dioxide (NO_2) - 2021

7.15. Table 8.20 presents the annual-mean NO_2 concentrations predicted at the façades of existing receptors. Appendix 8.4 shows detailed maps of the receptor locations.

Receptor ID	Concentration (µg.m^{-3})			With (2021) - Without Dev (2021) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2021)	With Development (2021)		
1*	**52.4**	**44.0**	**44.8**	2	Substantial

[1] The IAQM dust guidance recommends that significance is only assigned to the effect after the activities are considered with mitigation in place. In practice the environmental impact without mitigation in place to control dust emissions during construction is not a realistic scenario.

Receptor ID	Concentration (µg.m^{-3})			With (2021) - Without Dev (2021) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2021)	With Development (2021)		
2*	**40.0**	35.0	35.5	1	Negligible
3*	**45.5**	39.0	39.6	2	Moderate
4*	34.8	31.6	33.4	4	Minor
5	34.6	31.8	36.6	12	Moderate
6	32.1	29.7	29.9	1	Negligible
7	33.3	30.5	30.8	1	Negligible
8	34.3	31.2	31.6	1	Negligible
9*	28.9	27.3	27.5	0	Negligible
10*	33.3	30.6	30.9	1	Negligible
11*	37.2	33.0	33.4	1	Negligible
12*	**55.8**	**46.7**	**47.6**	2	Substantial
13	30.7	28.8	29.6	2	Negligible
14	30.5	28.9	29.5	2	Negligible
15	30.7	29.1	29.7	1	Negligible
16	33.9	31.8	32.8	2	Minor
17	34.0	31.1	31.5	1	Negligible
18	35.4	32.1	32.8	2	Minor
19	35.1	31.9	32.6	2	Minor
20	31.4	29.3	29.6	1	Negligible
21*	29.4	27.7	27.8	0	Negligible
22	33.4	30.5	31.7	3	Minor
23	31.1	28.8	29.5	2	Negligible
24	30.2	28.2	28.9	2	Negligible
25	35.9	32.8	33.0	0	Negligible
26	31.2	29.2	29.6	1	Negligible
27	31.2	29.3	29.7	1	Negligible
28	27.2	26.1	26.3	0	Negligible

Receptor ID	Concentration (µg.m-3)			With (2021) - Without Dev (2021) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	**Without Development (2021)**	**With Development (2021)**		
29	28.6	27.2	27.7	1	Negligible
30	38.1	34.4	34.6	1	Negligible
31	29.9	28.2	29.0	2	Negligible
Maximum	**55.8**	**46.7**	**47.6**	**12**	**-**
Minimum	**27.2**	**26.1**	**26.3**	**0**	**-**

Table 8.20 Predicted Annual-Mean NO_2 Impacts at Existing Receptors (2021)
AQS Objective = 40 µg.m^{-3}. Figures in bold show where there is an exceedance of the AQS objective.
*Receptors are close to motorway so an adjustment factor of 1 has been applied as set out in Appendix 8.6. For all other receptors an adjustment factor of 1.9372 has been applied.

7.16. Predicted annual-mean NO_2 concentrations in 2021 at the façades of the existing receptors are below the AQS objective for NO_2 for all but two receptors (1 – Intack Farm and 12 – Mill Farm). At both receptors the predicted NO_2 concentration is forecast to exceed the AQS objective of 40 µg.m^{-3} either with or without the development.

7.17. When the magnitude of change is considered in the context of the absolute concentrations, the impact descriptor is 'negligible' at 22 receptors and 'minor adverse' at five receptors.

7.18. At 1 – Intack Farm and 12 – Mill Farm the impact descriptors are 'substantial adverse' and at 3 – Masseybrook Farm and 5 – Clif Lane Farm the impact descriptors are 'moderate adverse'. Receptors 1, 12 and 3 are all within 30m of the M6 and predicted concentrations are likely to be an overestimate as the model verification study shoes that the model is over predicting near to the motorways; the results in Appendix 8.6 indicates that the model is overpredicting by 47.1% at monitoring location CE65 (Intack Farm).

7.19. Table 8.21 shows the most-recent monitored concentrations at CE65 Intack Farm.

Monitoring Location	2012	2013	2014	2015	2016	Average
CE65 Intack Farm	33.78	38.48	35.06	30.87	34.54	34.5

Table 8.21 Measured annual-mean NO2 concentrations

7.20. The five year average monitored NO_2 concentration at Intack Farm has been used as the 'Without Development (2021)' concentration and the predicted road contribution added to derive a new 'With Development (2021)' in Table 8.22 below.

Receptor ID	Concentration (µg.m^{-3})		With (2021) - Without Dev (2021) as % of the AQS Objective	Impact Descriptor
	Without Development (2021)	With Development (2021)		
1 – Intack Farm*	34.5	35.4	2	Minor
3 – Masseybrook Farm*	34.5	35.2	2	Minor
12 – Mill Farm*	34.5	35.5	2	Minor

Table 8.22 Predicted Annual-Mean NO2 Impacts at Existing Receptors (2021)

7.21. Taking into account the measured concentrations at CE65 Intack Farm, the impact descriptors at receptors 1, 3 and 12 are reduced to 'minor adverse'.

7.22. As all predicted annual-mean NO_2 concentrations are below 60 µg.m^{-3}, the hourly-mean objective for NO_2 is likely to be met at all receptors. The short-term NO_2 impact can be considered 'negligible' and is not considered further within this assessment.

7.23. There is one receptor where the impact descriptor is 'moderate adverse' (Cliff Lane Farm) and a further eight which have a 'minor adverse' impact descriptor. It is worth noting that the concentrations predicted with the development in 2021 are lower than the existing concentrations in 2017, so there is an improvement in air quality predicted with the development in place, between 2017 and 2021. This is true for all receptors considered. The impact descriptor at the remaining 22 receptors is 'negligible'.

7.24. Furthermore the traffic data modelled for this 2021 scenario assumed full build out of the development in 2021 rather than a partial build out. Therefore the results can be considered to be highly conservative.

7.25. Overall, the impact on the surrounding area from NO_2 is considered to be 'minor adverse', using the criteria adopted for this assessment and based on professional judgement.

Particulate Matter (PM_{10}) - 2021

7.26. Table 8.23 presents the annual-mean PM_{10} concentrations predicted at the façades of existing receptors. Appendix 8.4 shows detailed maps of the receptor locations.

Receptor ID	Concentration (µg.m^{-3})			With (2021) - Without Dev (2021) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2021)	With Development (2021)		
1*	21.9	21.1	21.4	1	Negligible
2*	18.8	18.4	18.6	0	Negligible
3*	20.2	19.6	19.9	1	Negligible
4*	18.2	18.1	19.2	3	Negligible
5	17.2	17.3	18.9	4	Negligible
6	16.7	16.7	16.7	0	Negligible
7	16.7	16.7	16.7	0	Negligible
8	16.9	16.8	16.9	0	Negligible
9*	16.7	16.6	16.6	0	Negligible
10*	17.2	17.0	17.1	0	Negligible
11*	18.3	17.9	18.1	0	Negligible
12*	22.8	21.9	22.3	1	Negligible
13	16.5	16.6	16.8	0	Negligible
14	16.6	16.6	16.7	0	Negligible
15	16.5	16.6	16.7	0	Negligible
16	17.2	17.3	17.5	1	Negligible
17	17.1	17.0	17.1	0	Negligible
18	17.4	17.3	17.4	0	Negligible
19	17.4	17.2	17.4	0	Negligible
20	16.8	16.7	16.8	0	Negligible
21*	16.5	16.3	16.4	0	Negligible
22	16.6	16.5	16.9	1	Negligible
23	16.3	16.2	16.4	0	Negligible

Receptor ID	Concentration (µg.m-3)			With (2021) - Without Dev (2021) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2021)	With Development (2021)		
24	16.2	16.1	16.3	0	Negligible
25	17.4	17.4	17.4	0	Negligible
26	16.7	16.7	16.7	0	Negligible
27	16.7	16.7	16.8	0	Negligible
28	15.9	15.9	15.9	0	Negligible
29	16.2	16.2	16.3	0	Negligible
30	17.9	18.2	18.2	0	Negligible
31	16.4	16.4	16.5	0	Negligible
Maximum	22.8	21.9	22.3	4	
Minimum	15.9	15.9	15.9	0	

Table 8.23 Predicted Annual-Mean PM_{10} Impacts at Existing Receptors (2021)
AQS Objective = 40µg.m^{-3}

*Receptors are close to motorway so an adjustment factor of 1 has been applied as set out in Appendix 8.6. For all other receptors an adjustment factor of 1.9372 has been applied.

7.27. Predicted annual-mean PM_{10} concentrations in 2021 at the façades of the existing receptors are well below the AQS objective for PM_{10} at all receptors. When the magnitude of change is considered in the context of the absolute concentrations, the impact descriptor is categorised as 'negligible' at all receptors.

7.28. As all predicted annual mean PM_{10} concentrations are below 31.5 µg.m^{-3}, the daily-mean PM_{10} objective is expected to be met at all receptors and the short-term PM_{10} impact is not considered further within this assessment.

7.29. Overall, the impact on the surrounding area from PM_{10} is considered to be 'negligible', using the criteria adopted for this assessment and based on professional judgement.

Fine Particulate Matter ($PM_{2.5}$) - 2021

7.30. Table 8.24 presents the annual-mean $PM_{2.5}$ concentrations predicted at the façades of existing receptors. Appendix 8.4 shows detailed maps of the receptor locations.

Receptor ID	Concentration (μg.m^{-3})			With (2021) - Without Dev (2021) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2021)	With Development (2021)		
1*	16.2	15.4	15.6	1	Negligible
2*	14.1	13.7	13.8	0	Negligible
3*	15.0	14.5	14.6	1	Negligible
4*	13.6	13.4	14.0	2	Negligible
5	12.9	12.9	13.8	3	Negligible
6	12.6	12.5	12.6	0	Negligible
7	12.6	12.6	12.6	0	Negligible
8	12.8	12.6	12.7	0	Negligible
9*	12.6	12.5	12.6	0	Negligible
10*	13.1	12.8	12.9	0	Negligible
11*	13.8	13.4	13.5	0	Negligible
12*	16.8	15.9	16.2	1	Negligible
13	12.5	12.5	12.6	0	Negligible
14	12.5	12.5	12.6	0	Negligible
15	12.5	12.5	12.6	0	Negligible
16	12.9	12.9	13.0	1	Negligible
17	12.8	12.7	12.8	0	Negligible
18	13.0	12.9	13.0	0	Negligible
19	13.0	12.9	12.9	0	Negligible
20	12.6	12.6	12.6	0	Negligible
21*	12.6	12.4	12.4	0	Negligible
22	12.6	12.5	12.7	1	Negligible
23	12.4	12.3	12.4	0	Negligible
24	12.3	12.2	12.3	0	Negligible
25	13.0	12.9	13.0	0	Negligible
26	12.6	12.5	12.6	0	Negligible

Receptor ID	Concentration (μg.m^{-3})			With (2021) - Without Dev (2021) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2021)	With Development (2021)		
27	12.6	12.5	12.6	0	Negligible
28	12.1	12.1	12.1	0	Negligible
29	12.3	12.3	12.3	0	Negligible
30	13.3	13.4	13.4	0	Negligible
31	12.4	12.4	12.5	0	Negligible
Maximum	**16.8**	**15.9**	**16.2**	**3**	-
Minimum	**12.1**	**12.1**	**12.1**	**0**	-

Table 8.24 Predicted Annual-Mean $PM_{2.5}$ Impacts at Existing Receptors (2021)
AQS Objective = 25 μg.m^{-3}
*Receptors are close to motorway so an adjustment factor of 1 has been applied as set out in Appendix 8.6. For all other receptors an adjustment factor of 1.9372 has been applied.

7.31. Predicted annual-mean $PM_{2.5}$ concentrations in 2021 at the façades of the existing receptors are well below the AQS objective for $PM_{2.5}$ at all receptors. When the magnitude of change is considered in the context of the absolute concentrations, the impact descriptor is categorised as 'negligible' at all receptors.

7.32. Overall, the impact on the surrounding area from $PM_{2.5}$ is considered to be 'negligible', using the criteria adopted for this assessment and based on professional judgement.

Nitrogen Dioxide (NO_2) - 2029

7.33. Table 8.25 presents the annual-mean NO_2 concentrations predicted at the façades of existing receptors. Appendix 8.4 shows detailed maps of the receptor locations.

Receptor ID	Concentration (μg.m^{-3})			With (2029) - Without Dev (2029) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2029)	With Development (2029)		
1*	**52.4**	34.3	34.7	1	Negligible

Receptor ID	Concentration (μg.m-3)			With (2029) - Without Dev (2029) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2029)	With Development (2029)		
2*	**40.0**	29.4	29.6	1	Negligible
3*	**45.5**	31.6	31.9	1	Negligible
4*	34.8	26.9	27.6	2	Negligible
5	34.6	25.5	29.2	9	Minor
6	32.1	25.0	26.8	4	Negligible
7	33.3	25.3	27.2	5	Negligible
8	34.3	25.5	27.6	5	Negligible
9*	28.9	25.4	25.5	0	Negligible
10*	33.3	27.2	27.3	0	Negligible
11*	37.2	28.3	28.5	0	Negligible
12*	**55.8**	35.9	36.3	1	Negligible
13	30.7	24.7	26.4	4	Negligible
14	30.5	24.9	26.6	4	Negligible
15	30.7	24.9	26.7	4	Negligible
16	33.9	25.7	28.4	7	Minor
17	34.0	25.4	27.6	5	Negligible
18	35.4	25.7	28.3	6	Minor
19	35.1	25.7	28.2	6	Minor
20	31.4	25.0	26.6	4	Negligible
21*	29.4	25.6	25.7	0	Negligible
22	33.4	25.1	27.3	5	Negligible
23	31.1	24.8	26.4	4	Negligible
24	30.2	24.6	26.1	4	Negligible
25	35.9	25.9	28.3	6	Minor
26	31.2	24.9	26.6	4	Negligible
27	31.2	24.9	26.6	4	Negligible

Receptor ID	Concentration ($\mu g.m^{-3}$)			With (2029) - Without Dev (2029) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2029)	With Development (2029)		
28	27.2	24.1	24.8	2	Negligible
29	28.6	24.4	25.6	3	Negligible
30	38.1	26.1	28.7	6	Minor
31	29.9	24.6	26.2	4	Negligible
Maximum	**55.8**	**35.9**	**36.3**	**9**	**-**
Minimum	**27.2**	**24.1**	**24.8**	**0**	**-**

Table 8.25 Predicted Annual-Mean NO_2 Impacts at Existing Receptors (2029)
AQS Objective = 40µg.m^{-3} Figures in bold show where there is an exceedance of the AQS objective.
*Receptors are close to motorway so an adjustment factor of 1 has been applied as set out in Appendix 8.6. For all other receptors an adjustment factor of 1.9372 has been applied.

7.34. Predicted annual-mean NO_2 concentrations in 2029 at the façades of the existing receptors are all well below the AQS objective for NO_2. Improvements in air quality are predicted at all receptors from 2017.

7.35. When the magnitude of change is considered in the context of the absolute concentrations, the impact descriptor ranges from 'negligible' to 'minor adverse'.

7.36. As all predicted annual-mean NO_2 concentrations are below 60 µg.m^{-3}, the hourly-mean objective for NO_2 is likely to be met at al receptors. The short-term NO_2 impact can be considered 'negligible' and is not considered further within this assessment.

7.37. Overall, the impact on the surrounding area from NO_2 is considered to be 'minor adverse', using the criteria adopted for this assessment and based on professional judgement.

Particulate Matter (PM_{10}) - 2029

7.38. Table 8.26 presents the annual-mean PM_{10} concentrations predicted at the façades of existing receptors. Appendix 8.4 shows detailed maps of the receptor locations.

Receptor ID	Concentration (µg.m-3)			With (2029) - Without Dev (2029) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2029)	With Development (2029)		
1*	21.9	21.0	21.4	1	Negligible
2*	18.8	18.4	18.5	0	Negligible
3*	20.2	19.6	19.8	1	Negligible
4*	18.2	17.5	18.5	2	Negligible
5	17.2	17.3	18.8	4	Negligible
6	16.7	16.7	16.7	0	Negligible
7	16.7	16.7	16.8	0	Negligible
8	16.9	16.8	16.9	0	Negligible
9*	16.7	16.6	16.6	0	Negligible
10*	17.2	17.0	17.1	0	Negligible
11*	18.3	17.9	18.0	0	Negligible
12*	22.8	21.9	22.3	1	Negligible
13	16.5	16.6	16.8	0	Negligible
14	16.6	16.6	16.7	0	Negligible
15	16.5	16.6	16.7	0	Negligible
16	17.2	17.3	17.6	1	Negligible
17	17.1	17.0	17.1	0	Negligible
18	17.4	17.3	17.5	0	Negligible
19	17.4	17.3	17.4	0	Negligible
20	16.8	16.8	16.8	0	Negligible
21*	16.5	16.3	16.4	0	Negligible
22	16.6	16.5	16.8	1	Negligible
23	16.3	16.2	16.4	0	Negligible
24	16.2	16.1	16.2	0	Negligible
25	17.4	17.4	17.5	0	Negligible
26	16.7	16.7	16.8	0	Negligible

Receptor ID	Concentration ($\mu g.m^{-3}$)			With (2029) - Without Dev (2029) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2029)	With Development (2029)		
27	16.7	16.7	16.8	0	Negligible
28	15.9	15.9	15.9	0	Negligible
29	16.2	16.2	16.3	0	Negligible
30	17.9	18.2	18.3	0	Negligible
31	16.4	16.4	16.6	0	Negligible
Maximum	**22.8**	**21.9**	**22.3**	**4**	-
Minimum	**15.9**	**15.9**	**15.9**	**0**	-

Table 8.26 Predicted Annual-Mean PM_{10} Impacts at Existing Receptors (2029)
AQS Objective = 40 $\mu g.m^{-3}$
*Receptors are close to motorway so an adjustment factor of 1 has been applied as set out in Appendix 8.6. For all other receptors an adjustment factor of 1.9372 has been applied.

7.39. Predicted annual-mean PM_{10} concentrations in 2029 at the façades of the existing receptors are well below the AQS objective for PM_{10} at all receptors When the magnitude of change is considered in the context of the absolute concentrations, the impact descriptor is categorised as 'negligible' at all receptors.

7.40. As all predicted annual mean PM_{10} concentrations are below 31.5 $\mu g.m^{-3}$, the daily-mean PM_{10} objective is expected to be met at all receptors and the short-term PM_{10} impact is not considered further within this assessment.

7.41. Overall, the impact on the surrounding area from PM_{10} is considered to be 'negligible', using the criteria adopted for this assessment and based on professional judgement.

Fine Particulate Matter ($PM_{2.5}$) - 2029

7.42. Table 8.27 presents the annual-mean $PM_{2.5}$ concentrations predicted at the façades of existing receptors. Appendix 8.4 shows detailed maps of the receptor locations.

Receptor ID	Concentration (µg.m^{-3})			With (2029) - Without Dev (2029) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2029)	With Development (2029)		
1*	21.9	15.2	15.4	1	Negligible
2*	18.8	13.6	13.7	0	Negligible
3*	20.2	14.4	14.5	1	Negligible
4*	18.2	13.1	13.6	2	Negligible
5	17.2	12.9	13.6	3	Negligible
6	16.7	12.5	12.6	0	Negligible
7	16.7	12.5	12.6	0	Negligible
8	16.9	12.6	12.7	0	Negligible
9*	16.7	12.5	12.5	0	Negligible
10*	17.2	12.8	12.9	0	Negligible
11*	18.3	13.3	13.4	0	Negligible
12*	22.8	15.8	16.0	1	Negligible
13	16.5	12.5	12.6	0	Negligible
14	16.6	12.5	12.6	0	Negligible
15	16.5	12.5	12.5	0	Negligible
16	17.2	12.9	13.0	1	Negligible
17	17.1	12.7	12.8	0	Negligible
18	17.4	12.9	13.0	0	Negligible
19	17.4	12.9	12.9	0	Negligible
20	16.8	12.6	12.6	0	Negligible
21*	16.5	12.4	12.4	0	Negligible
22	16.6	12.4	12.6	1	Negligible
23	16.3	12.3	12.4	0	Negligible
24	16.2	12.2	12.3	0	Negligible
25	17.4	12.9	13.0	0	Negligible
26	16.7	12.5	12.6	0	Negligible

Receptor ID	Concentration (µg.m-3)			With (2029) - Without Dev (2029) as % of the AQS Objective	Impact Descriptor
	Without Development (2017)	Without Development (2029)	With Development (2029)		
27	16.7	12.5	12.6	0	Negligible
28	15.9	12.1	12.1	0	Negligible
29	16.2	12.3	12.3	0	Negligible
30	17.9	13.4	13.4	0	Negligible
31	16.4	12.4	12.5	0	Negligible
Maximum	22.8	15.8	16.0	3	-
Minimum	15.9	12.1	12.1	0	-

Table 8.27 Predicted Annual-Mean $PM_{2.5}$ Impacts at Existing Receptors (2029)
AQS Objective = 25 µg.m^{-3}
*Receptors are close to motorway so an adjustment factor of 1 has been applied as set out in Appendix 8.6. For all other receptors an adjustment factor of 1.9372 has been applied.

7.43. Predicted annual-mean $PM_{2.5}$ concentrations in 2029 at the façades of the existing receptors are below the AQS objective for $PM_{2.5}$ at all receptors. When the magnitude of change is considered in the context of the absolute concentrations, the impact descriptor is categorised as 'negligible' at all receptors.

7.44. Overall, the impact on the surrounding area from $PM_{2.5}$ is considered to be 'negligible', using the criteria adopted for this assessment and based on professional judgement.

Significance of Effects

7.45. It is generally considered good practice that, where possible, an assessment should communicate effects both numerically and descriptively. Professional judgement by a competent, suitably qualified professional is required to establish the significance associated with the consequence of the impacts.

7.46. The impacts predicted at individual receptors and the geographical extent over which such impacts occur, can be used to inform the judgement on the impact on the surrounding area as a whole, and whether the resulting overall effect is significant or not. The IAQM guidance states, *"Whilst it may be that there are 'slight', 'moderate', or 'substantial' impacts at one or more receptors, the overall effect may not necessarily be judged as being significant in some circumstances."*

and *"…a 'moderate' or 'substantial' impact may not have a significant effect if it is confined to a very small area and where it is not obviously the cause of harm to human health."*

7.47. The results of the modelling indicate that with the development, the predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at existing receptors are below the relevant long and short-term AQS objectives for both 2021 and 2029. When the magnitude of change in annual-mean NO_2, PM_{10} and $PM_{2.5}$ concentrations is considered in the context of the absolute predictions, the air quality impacts of the development on existing receptors are categorised as 'negligible' at all receptors for 2029 and PM in 2021. For NO_2 in 2021 the impact descriptors range from 'negligible' to 'moderate adverse'. There is one receptor where the impact descriptor is 'moderate adverse' for NO_2 in 2021 and a further eight where the impact descriptor is 'minor adverse'. At all other receptors the impact descriptor is 'negligible'. Taking into account the geographical extent of the impacts predicted in this study, the overall impact of the development on the surrounding area as a whole is considered to be 'negligible', using the descriptors adopted for this assessment.

7.48. Using professional judgement, the resulting air quality effect is considered to be 'not significant' overall.

Sensitivity and Uncertainty

7.49. Appendix 8.3 provides an analysis of the sources of uncertainty in the results of the assessment. The conclusion of that analysis was that, overall, the predicted total concentration is likely to be towards the top of the uncertainty range rather than being a central estimate. The actual concentrations that will be found when the development is operational are therefore unlikely to be higher than those presented within this report and are more likely to be lower.

7.50. The impacts at existing receptors are shown to be not significant even for this conservative scenario. Consequently, further sensitivity analysis has not been undertaken and, in practice, the impacts at sensitive receptors are likely to be lower than those reported in this conservative assessment.

7.51. Table 8.28 provides a summary of the significance of the operational phase.

Nature of Impact	**Receptor**	**Environmental Impact**	**Significance of Effect**	**Confidence Level**
Increase in NO_2, PM_{10} and $PM_{2.5}$ concentrations from traffic generated by the development	Local	Negligible	Negligible	High

Table 8.28: Significance of Effect - Operation Phase

8. Proposed Mitigation

Construction Phase

8.1. The IAQM dust guidance lists mitigation measures for low, medium and high dust risks.

8.2. As summarised in Table 8.18, the predicted Dust Impact Risk is classified as medium for Demolition, Earthworks, Construction and Trackout. The general site measures described as 'highly recommended' for medium risks are listed below. The 'highly recommended' measures for medium risk demolition, construction sites and trackout are also listed. There are no 'highly recommended' measures for medium risk earthworks.

8.3. Appendix 9 of the ES Part One Report will include a Framework Construction Environmental Management Plan (CEMP). The mitigation measures within the framework CEMP, and below table, are to be incorporated into the final Construction Management Plan.

Communications
• Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. • Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager. • Display the head or regional office contact information
Dust Management Plan
• Develop and implement a Dust Management Plan (DMP) (which may include measures to control other emissions), approved by the Local Authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in the IAQM dust guidance. The desirable measures should be included as appropriate for the site. The DMP may include monitoring of dust. The DMP can be included as part of the Construction Environmental Management Plan (CEMP).
Site Management
• Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. • Make the complaints log available to the local authority when asked. • Record any exceptional incidents that cause dust and/or air emissions, either on- or off- site, and the action taken to resolve the situation in the log book.

Monitoring
• Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked. • Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions. • Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. A shorter monitoring period or concurrent upwind and downwind monitoring may be agreed by the local authority. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction [8].
Preparing and maintaining the site
• Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible. Use screening intelligently where possible – e.g. locating site offices between potentially dusty activities and the receptors. • Erect solid screens or barriers around the site boundary. • Avoid site runoff of water or mud. • Keep site fencing, barriers and scaffolding clean using wet methods. • Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below. • Depending on the duration that stockpiles will be present and their size - cover, seed, fence or water to prevent wind whipping.
Operating vehicle/machinery and sustainable travel
• 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. • Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
Operations
• Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems. • Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible. • Use enclosed chutes, conveyors and covered skips, where practicable. • Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.

• Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
Waste management
• Avoid bonfires and burning of waste materials.
Medium risk measures specific to demolition
• Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground. • Avoid explosive blasting, using appropriate manual or mechanical alternatives. • Bag and remove any biological debris or damp down such material before demolition
Medium risk measures specific to construction
• Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
Medium risk measures specific to trackout
• Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use. • Avoid dry sweeping of large areas. • Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport. • Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. • Record all inspections of haul routes and any subsequent action in a site log book. • Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned. • Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable). • Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits. • Access gates to be located at least 10m from receptors where possible.

Table 8.29: Construction Phase Mitigation Measures

Operational Phase

8.4. When the change in concentration at existing sensitive receptors is considered in the context of the absolute concentration, the overall air quality impact on the surrounding area as a whole is categorised as "negligible" and the resulting effect is considered to be "not significant". On that basis, no mitigation measures are considered necessary. Nevertheless, as outlined in Technical Paper 2: Traffic and Transportation, the development will include vehicle charging points and a Travel Plan.

9. Potential Residual Effects

Potential Residual Effects – Construction Phase

9.1. Section 8.8 outlines the recommended dust mitigation measures to reduce suspended particulate matter and deposited dust during the construction phase. The IAQM dust guidance states that with the recommended dust mitigation measures in place the residual effect will normally be "*not significant*", and recommends the mitigation is secured by for example planning conditions, a legal obligation, or by legislation.

9.2. The overall impact of the proposal in terms of Air Quality and Dust issues during the construction phase is highlighted in the table below:

Nature of Impact	Receptor	Environmental Impact	Significance of Effect	Confidence Level	Mitigation	Residual Significance of Effect
Increase in suspended particulate matter concentrations and deposited dust	Local	'Medium' Dust Impact Risk, prior to application of IAQM control and mitigation measures	N/A[2]	High	See IAQM control and mitigation measures in section 8	Negligible (Not significant after application of IAQM control and mitigation measures)

Table 8.30: Residual Significance of Effect - Construction Phase

Potential Residual Effects – Operational Phase

9.3. As the overall effect of the operational phase of the development is 'Not Significant' no mitigation measures were recommended. Therefore the residual effects are the same as presented in section 8.7. The overall residual impact of the proposal in terms of Air Quality and Dust issues during the operational phase is summarised in the Table 8.31.

[2] The IAQM dust guidance recommends that significance is only assigned to the effect after the activities are considered with mitigation in place. The environmental impact without dust control measures in place is not a likely scenario.

Nature of Impact	Receptor	Environmental Impact	Significance of Effect	Confidence Level	Mitigation	Residual Significance of Effect
Increase in NO_2, PM_{10} and $PM_{2.5}$ concentrations from traffic generated by the development	Local/ Borough	Negligible	Not Significant	High	-	Negligible (Not Significant)

Table 8.31: Residual Significance of Effect - Operation Phase

10. Additive Impacts (Cumulative Impacts and their Effects)

10.1. For the purposes of this ES we define the additive cumulative effects as:

> ***'Those that result from additive impacts (cumulative) caused by other existing and/or approved projects together with the project itself'***

10.2. The developments that are likely to have a cumulative impact when considered with the proposed development have been scoped with the Local Authority and Key Consultees during the preparation of this ES (a full list is included within Section 9 of the ES Part One Report). The following table includes the agreed list of cumulative developments that have been assessed in respect of Air Quality, Odour and Dust. These are also shown geographically on the plan included at **Appendix 11** of the ES Part One Report.

No.	Cumulative Development	Details	Status	Justification for Inclusion in Cumulative Assessment for Air Quality
1	Land bounded by Pewterspear Green Road, Ashford Drive, Stretton, Warrington LPA Ref: 2016/28807 Applicant - HCA	Outline Planning Application for 180 dwellings.	Planning permission granted by WMBC 28-09-2017 (3 years to implement planning permission)	It is a committed development and therefore included within the traffic data modelled for the future baseline and assessed within the assessment of the Proposed Development. It does not therefore need reconsidering in the cumulative assessment for air quality.
2	Land bounded by Green Lane &, Dipping Brook Avenue, Appleton, Warrington, WA4 5NN LPA Ref: 2017/29930 Applicant - HCA	Outline Planning Application for 370 dwellings	Planning permission granted by WMBC 22-01-2018 (3 years to implement planning permission)	
3	Land South of Astor Drive, East of Lichfield Avenue &, South of Witherwin Avenue, Grappenhall Heys, Warrington, WA4 3LG	Outline Planning Application for 400 dwellings	Planning permission granted by WMBC 22-01-2018 (3 years to implement planning permission)	

No.	Cumulative Development	Details	Status	Justification for Inclusion in Cumulative Assessment for Air Quality
	LPA Ref: 2017/29929 Applicant - HCA			
4	Land North of Barleycastle Lane, Appleton, Warrington Liberty Properties Development Ltd & Eddie Stobart LPA Ref: 2017/31757	Full Planning application (Major) - Demolition of all existing on-site buildings and structures and construction of a National Distribution Centre building (Use Class B8) with ancillary office accommodation (Class B1(a)), vehicle maintenance unit, vehicle washing area, internal roads, gatehouse, parking areas, perimeter fencing, waste management area, sustainable urban drainage system, landscaping, highways improvements and other associated works. (Gross internal floor space of 56,197m², together with 1,858m² of ancillary office)	Refused Planning Permission by WMBC 14-11-2018	Whilst the planning application has been refused it still forms part of the traffic data and therefore included within the assessment of the Proposed Development. It does not therefore need reconsidering in the cumulative assessment for air quality.
5	Land to the east of Stretton Road, north of Pepper Street, Stretton Road, Appleton Thorn, Warrington LPA Ref: 2017/31848	Full Planning Application for 71 dwellings	Planning permission granted by WMBC 24-10-2018 (3 years to implement planning permission)	It is a committed development and therefore included within the traffic data modelled for the future baseline and assessed within the assessment of the Proposed Development. It does not therefore need reconsidering in the cumulative assessment for air quality.
6	Blue Machinery Ltd, Barleycastle Trading Estate, Lyncastle Road, Warrington, WA4 4SY LPA Ref: 2016/28994	Full Planning Application for new industrial warehouse building for storage (replacing smaller storage building), single storey extension to existing building for further storage and two storey extension for additional office space, associated parking provision and landscaping. (1,699m² new build, 180m² and 265m² extensions)	Planning permission granted by WMBC 17-02-2017 (3 years to implement planning permission)	The traffic generation is not considered to be significant and therefore there is not considered to be a relationship in respect of traffic and transport and therefore air quality.
7	Land off Lyncastle Way, Barleycastle	Full Planning Application for industrial / warehouse	Planning permission granted by WMBC 16-10-	The traffic generation is not considered to be significant

No.	Cumulative Development	Details	Status	Justification for Inclusion in Cumulative Assessment for Air Quality
	Lane, Appleton, Warrington, WA4 4SN LPA Ref: 2015/25255 Morley Estates	development (Sui Generis) to facilitate a plant hire business with elements of vehicle / plant repair, servicing, maintenance and plant storage / distribution / parking and associated offices / welfare facilities, vehicular access via existing service road, acoustic bunding and fencing and other means of enclosure, soft landscaping, 36 car park spaces, fuel pumps (and associated underground tanks), vehicle / plant wash bay and sub-station (Resubmission of 2014/24618) (4,545sqm industrial warehouse building)	2015	and therefore there is not considered to be a relationship in respect of traffic and transport and therefore air quality.
8	Former Stretton Airfield, Warrington, WA4 4RG LPA Ref: 2014/2332 Hensmill Property	Proposed construction of subterranean car storage facility (B8 Use Class) with ancillary office development and associated demolition and landscaping accessed from Crowley Lane.	Planning permission granted 23-06-2015	The traffic generation is not considered to be significant and therefore there is not considered to be a relationship in respect of traffic and transport and therefore air quality.
9*	Warrington Garden Suburb (as identified in the Council's Preferred Development Option Consultation Document (July 2017)	The Warrington Garden Suburb is identified as a Preferred Development Option, which provides the potential development of around 7,000 new homes to be delivered over the full 20 years of the Plan, therefore we have assessed relevant phases with the Cumulative Assessment. Using the Development Trajectory (Table 20 Garden City Suburb Employment Land Trajectory of the Preferred Development Option Consultation Document) we have based the cumulative assessment ONLY on the quantum of development within the Garden Suburb expected to come forward in parallel with the delivery timeframe for the		The 1021 dwellings that form part of the Garden Suburb Phase 1 are already assessed as committed development and therefore included within the traffic data modelled for the future baseline and assessed within the assessment of the Proposed Development. It does not therefore need reconsidering in the cumulative assessment for air quality.

No.	Cumulative Development	Details	Status	Justification for Inclusion in Cumulative Assessment for Air Quality
		Six 56 Application Proposals. *Due to the limited information available in respect of the Garden Suburb, the Six 56 Warrington Cumulative Assessment will be a non-spatial assessment.		
	Warrington Garden Suburb Phase	**Uses and Quantum identified in Preferred Development Option (July 2017)**	**Uses and Quantum to be identified in Six 56 Cumulative Assessment**	
	Phase 1 0-5 years Assumed 2020-2025	406 residential units (non-Green Belt sites) 22ha employment (employment areas include Six 56 Warrington and Land around Barley Castle Lane)	Six 56 Proposals will be under construction, with part delivered within Phase 1 of the Garden Suburb. The following form part of the Garden Suburb Phase 1 and will be included within the Cumulative Assessment: • HCA sites (950 dwgs)* • 71 dwgs associated with land to east of Stretton Road* • Land North of Barley Castle Lane (Liberty Properties and Stobart) (LPA Ref: 2017/31757) - 15.7ha* *Note that these sites are already included as part of the Cumulative Assessment and already referenced as sites 1, 2, 3 and 4.	
	Phase 2 6-10 years Assumed 2026-2030	2610 residential units (includes 496 non-Green Belt sites and 2,114 Green Belt sites) 30.3 ha employment (employment areas include Six 56 Warrington and Land around Barley Castle Lane)	Six 56 Proposals will be completed during 2027/2028. The following form part of the Garden Suburb Phase 2 and will be included within the Cumulative Assessment: Garden City Suburb Phase 1 and 2 employment land	

No.	Cumulative Development	Details	Status	Justification for Inclusion in Cumulative Assessment for Air Quality
			equates to 52.3ha, beyond the 30 ha referenced in the Phase 1 and Phase 2 employment trajectory set out in the PDO. Six 56 Warrington developable area and planning application for Land North or Barley Castle Lane (LPA Ref: 2017/31757) already equates to 77.52 ha and is already included as part of the Cumulative Assessment. Garden Suburb Phase 1 and 2 residential units equates to a total of 3016 units. The Cumulative Assessment already includes 1,021 residential units. Therefore this Cumulative Assessments should include an **additional 1995 residential units** (i.e. the residual number of units identified in Preferred Development Option that not already included within Six 56 Cumulative Assessment)	
	Phase 3 11-15 years Assumed 2031-2035	2,144 ha residential units 45.9 ha employment	The Six 56 Proposals will be fully operational Given this Phase of the Garden City Suburb will be beyond the delivery of Six 56 Proposals this phase will not be included within the Six 56 Cumulative Assessment	
	Phase 4 16-20 years Assumed 2036-2040	2,144 residential units 18.6ha employment	The Six 56 Proposals will be fully operational Given this Phase of the Garden City Suburb will be beyond the delivery of Six 56 Proposals this phase will not be included within the Six 56 Cumulative Assessment	

Table 8.32: Cumulative Development

10.3. Both Construction and Operational phases will be considered and the short, medium and long term impacts assessed.

Short Term

10.4. During the construction-phase there is the potential for cumulative impacts to arise if construction activities at other development sites take place within a distance of 700 m of the proposed development site boundary, during the same period as construction activities at the proposed development. Mitigation of construction-phase dust is best applied at source. Therefore, provided the sites successfully implement site-specific mitigation measures that are proportionate to their level of dust risk, no significant cumulative effects would occur.

Medium Term

10.5. During the operational-phase there is the potential for medium term cumulative impacts to occur from cumulative traffic. The traffic data modelled in Section 7 includes traffic from cumulative developments 1 to 5. As outlined in paragraph 7.48 the air quality effects are considered to be 'not significant'. On that basis, the cumulative effects are also considered to be 'not significant'.

Long Term

10.6. During the operational-phase there is the potential for long term cumulative impacts to occur from cumulative traffic. The traffic data modelled in Section 7 includes traffic from cumulative developments 1 to 5. As outlined in paragraph 7.48 the air quality effects are considered to be 'not significant'. On that basis, the cumulative effects are also considered to be 'not significant'.

Summary

10.7. During the construction phase provided the sites successfully implement site-specific mitigation measures that are proportionate to their level of dust risk, no significant cumulative effects would occur.

10.8. During the operational-phase the cumulative effects are considered to be 'not significant'.

11. Conclusion

11.1. This assessment has considered dust effects during the construction phase and the air quality impacts during the operational phase of the Six 56 development.

11.2. Impacts during construction, such as dust generation and plant vehicle emissions, are predicted to be of short duration and only relevant during the construction phase. The results of the risk assessment of construction dust impacts undertaken using the IAQM dust guidance, indicates that before the implementation of mitigation and controls, the risk of dust impacts will be medium. Implementation of the highly-recommended mitigation measures described in the IAQM construction dust guidance would reduce the residual dust effects to a level categorised as "*not significant*".

11.3. Regarding the operational impact of the Six 56 development on the surrounding area, detailed atmospheric dispersion modelling has been undertaken for 2021 and 2029. The operational impact of the development on existing receptors in the local area is predicted to be 'negligible' taking into account the changes in pollutant concentrations and absolute levels. Using the criteria adopted for this assessment together with professional judgement, the overall impact on the area as a whole is described as 'negligible'.

11.4. Using professional judgement, the resulting air quality effect of the Six56 development is considered to be 'not significant' overall.

11.5. At the heart of the NPPF is a presumption in favour of sustainable development. For determining planning applications, this means approving development proposals if they accord with the local development plan, unless material considerations indicate otherwise. If the development plan is absent, silent or the policies are out of date, then planning permission should be granted unless any adverse impacts would significantly outweigh the benefits, or specific policies in the NPPF indicate development should be restricted.

11.6. The NPPG advises that in considering planning permission, the relevant question for air quality is "*will the proposed development (including mitigation) lead to an unacceptable risk from air pollution, prevent sustained compliance with EU limit values or national objectives for pollutants or fail to comply with the requirements of the Habitats Regulations?*" The proposed development will not.

11.7. The Six 56 development does not, in air quality terms, conflict with national or local policies, or with measures set out in WBC's Air Quality Action Plan. There are currently no constraints to the development in the context of air quality.

12. Reference List

1 Communities and Local Government, March 2012, National Planning Policy Framework

2 Council Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe.

3 Defra, 2010, The Air Quality Standards (England) Regulations.

4 Defra, 2007, The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. Volume 2.

5 IAQM (2014) Guidance on the assessment of dust from demolition and construction

6 EPUK & IAQM (January 2017) Land-Use Planning & Development Control: Planning For Air Quality

7 Defra (2016) Local Air Quality Management Technical Guidance, 2016 (LAQM.TG16)

8 IAQM, 2012, Air Quality Monitoring in the Vicinity of Demolition and Construction Sites

13. Appendices

Appendix 8.1 – Air Quality Impacts on Designated Sites

This appendix considers the likely air quality impacts associated with the traffic generated by the development on the European designated nature conservation sites.

The Highways Agency (now Highways England) and others have published the *Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1* (HA207/07) which provides guidance on the assessment of the impact that road projects may have on local air quality.

The DMRB HA207/07 states that "*Affected roads are those that meet any of the following criteria:*

- *road alignment will change by 5 m or more; or*
- *daily traffic flows will change by 1,000 AADT or more; or*
- *Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or*
- *daily average speed will change by 10 km/hr or more; or*
- *peak hour speed will change by 20 km/hr or more.*"

It continues by stating that "*Only properties and Designated Sites within 200m of roads affected by the project need to be considered. If none of the roads in the network meet any of the traffic/alignment criteria or there are no properties or relevant Designated Sites near the affected roads, then the impact of the scheme can be considered to be neutral in terms of local air quality and no further work is needed.*"

The Woolston Eyes is designated as a Site of Special Scientific Interest (SSSI) and is the only designated site within 200 m of an affected road where the traffic flows exceed the above thresholds.

Assessment Methodology

For sites that have not been scoped out, i.e. the Upper Nene Valley Gravel Pits, the DMRB guidance requires a simple assessment to be undertaken in two stages. The first stage considers the pollutant of most concern for sensitive vegetation near roads, which is nitrogen oxides (NOx). NOx comprises nitric oxide (NO) and nitrogen dioxide (NO_2).

Concentrations of NOx can damage vegetation directly or affect plant health and productivity. Deposition of pollutants to the ground and onto the surfaces of the vegetation can alter the characteristics of the soil, which can, in turn affect plant health, productivity and species composition. If changes in NOx concentrations cannot be screened out as insignificant, the second stage requires that nutrient nitrogen (N) deposition impacts are assessed.

Nitrogen Oxides

The ADMS-Roads model has been used to predict the air quality impacts from changes in traffic on the roads affecting the designated sites. The ADMS-Roads model has been used to predict the annual-mean NOx road contribution at ground level receptors at the nearest points of the designated site to the road.

Critical levels are maximum atmospheric concentrations of pollutants for the protection of vegetation and ecosystems and are specified within relevant European air quality directives and corresponding UK air quality regulations. The critical level for annual-mean NO_x concentration is 30 $\mu g.m^{-3}$. The UK Air Quality Strategy also includes an annual-mean NO_x objective of 30 $\mu g.m^{-3}$ for the protection of vegetation.

The road contribution has been compared with the 30 $\mu g.m^{-3}$ annual-mean critical level/objective. The existing NO_x concentration at the Woolston Eyes SSSI has been derived from the UK Air Pollution Information System (APIS) database [i]. The road contribution and the background NO_x concentration have been added to determine a total predicted annual-mean NO_x concentration. This has also been compared with the 30 $\mu g.m^{-3}$ annual-mean critical level/objective.

Highways England's Interim Advice Note 174/13 (IAN 174/13) Evaluation of Significant Local Air Quality Effects is supplementary to the guidance given in DMRB Volume 11, Section 3, Part 1 (HA207/07). IAN 174/13 states that:

"If the objective is exceeded, then significant effects may occur, and further consideration should be given to the magnitude of change. The exception to this is where changes are less than 0.4 $\mu g.m^{-3}$, then effects are considered to be imperceptible and unlikely to be significant.

Where changes in NOx concentrations are greater than 0.4 $\mu g.m^{-3}$ then this information along with changes in nutrient nitrogen deposition should be provided to the scheme ecologist to determine the significance of effects based on their professional judgement."

Nutrient Nitrogen Deposition

Annex F of the DMRB HA207/07 provides a procedure for assessing nutrient N deposition. Annual-mean NO_2 road contributions have been derived from the modelled annual-mean NO_x road contribution using Defra's calculator [ii] and the existing NOx concentration for the SSSI site.

The dry deposition flux ($\mu g.m^{-2}.s^{-1}$) has been calculated by multiplying the ground level NO_2 concentrations ($\mu g.m^{-3}$) by the deposition velocity. Annex F states that a deposition velocity of 0.001 $m.s^{-1}$ should be used; however, it is generally accepted that this velocity is too low and a deposition velocity of 0.0015 $m.s^{-1}$ for short habitats and 0.003 $m.s^{-1}$ for tall habitats (e.g. Woodlands) may be more appropriate. These are the values set out by the Environment Agency in AQTAG06 *Technical guidance on detailed modelling approach for an appropriate assessment for emissions to air*. These velocities have been used, where applicable, to give a more conservative prediction of the likely impacts.

The dry deposition in units of $kgN.ha^{-1}.year^{-1}$ has then been derived by multiplying the dry deposition flux in units of $\mu g.m^{-2}.s^{-1}$ by $(14/46 \times 3600 \times 24 \times 365 \times 10^{-9})/0.0001$. The road contribution has then been compared with the relevant critical load.

The critical load of a habitat represents an annual rate of nutrient nitrogen deposition "*below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge*" [iii]. They are set based on a combination of experimental evidence and expert judgement and provided as a range for each habitat to account for variability in soil types, rainfall etc.

Critical loads for nutrient nitrogen deposition for interest features at the SSSI site have been obtained from the Site-Relevant Critical Load tool on APIS [iv]. The DMRB does not provide criteria for determining the potential significance of effects in relation to nutrient nitrogen deposition; however, the Environment Agency's on-line risk assessment guidance [v], provides the following hierarchy of assessment:

- If PC[3] < 1% of relevant EQS[4] the emission is considered not significant;

[3] The term PC is the Process Contribution. In this case, it can be considered synonymous with the change in deposition rate.
[4] This term is the Environmental Quality Standard. In this case, it can be considered synonymous with the critical load.

- If PC > 1% but the resulting PEC[5] < 70% (European and SSSI sites) of the relevant EQS, the emission is not considered significant;
- If PC > 1% and PEC > 70% (for European and SSSI sites) the emission is considered to result a potentially significant result and further, more detailed assessment undertaken to determine likely significant effect.

In the absence of any criteria in the DMRB guidance for determining the significance of effect for nutrient nitrogen deposition, the change in deposition has been compared to the critical load and any change of < 1% is considered not significant.

Results

The maximum predicted annual-mean NOx concentrations for the 2021 and 2029 modelled scenarios are compared with the critical level in Table 8.1.1. The maximum predicted nutrient N deposition rates for 2021 and 2029 are compared with the critical load in Table 8.1.2. The results presented in these tables are based on the predicted concentrations at the roadside and are therefore worse case. Concentrations for the majority of the SSSI is likely to be lower as distance from the motorway increases.

Designated Site	CL ($\mu g.m^{-3}$)	PC ($\mu g.m^{-3}$)	PC/CL (%)	PEC* ($\mu g.m^{-3}$)	PEC/CL (%)
Woolston Eyes SSSI (2021)	30	2.9	10	26.4	88
Woolston Eyes SSSI (2029)	30	1.4	5	24.9	83

Table 8.1.1 Predicted Annual-Mean NOx Concentrations at Designated Sites

*The existing background NOx concentration at Woolston Eyes SSSI is 23.51 $\mu g.m^{-3}$.

Designated Site	Interest Feature	CL ($kgN.ha^{-1}.yr^{-1}$)	PC ($kgN.ha^{-1}.yr^{-1}$)	PC/CL (%)	PEC* ($\mu g.m^{-3}$)	PEC/ CL (%)
Woolston Eyes SSSI (2021)	Shoveler	20	0.42	2	20.41	102
	Teal	20	0.42	2	20.41	102
	Gadwell	No data	0.42	-	20.41	-
	Pochard	No data	0.42	-	11.79	-

[5] The term PEC is the Predicted Environmental Concentration. The total amount of a chemical substance in the environment; calculated as the existing background plus the PC.

Designated Site	Interest Feature	CL ($kgN.ha^{-1}.yr^{-1}$)	PC ($kgN.ha^{-1}.yr^{-1}$)	PC/CL (%)	PEC* ($\mu g.m^{-3}$)	PEC/ CL (%)
	Lowland open waters and their margins	No data	0.42	-	11.79	-
	Black-Necked Grebe	No data	0.42	-	11.79	-
Woolston Eyes SSSI (2029)	Shoveler	20	0.20	1	20.19	101
	Teal	20	0.20	1	20.19	101
	Gadwell	No data	0.20	-	20.19	-
	Pochard	No data	0.20	-	11.57	-
	Lowland open waters and their margins	No data	0.20	-	11.57	-
	Black-Necked Grebe	No data	0.20	-	11.57	-

Table 8.1.2 Predicted Nutrient N Deposition at Designated Sites

Note: Critical loads (CLs) for nutrient nitrogen deposition are provided as a range. In this case, the lower limit of the CL range has been used in the assessment.

*The existing background N deposition rate at Woolston Eyes SSSI is 19.99 $\mu g.m^{-3}$ for Shoveler, Teal and Gadwell. For Pochard, lowland open waters &their margins and Black-Necked Grebe the background rate is 11.37 $\mu g.m^{-3}$.

For 2021 and 2029, the maximum NO_X PCs exceed 1% of the critical level and the effects can't be screened out as insignificant based on the PC alone. However, the PEC is less than 100% of the critical level and the effects can be screened out as insignificant.

For 2021, the maximum N deposition PC exceeds 1% of the critical load for all interest features and the effects can't be screened out as insignificant based on the PC alone. The PEC is also more than 100% of the CL and the effects can't be screened out based on the PEC.

However, the critical loads for nutrient nitrogen deposition are provided as a range and the results presented in Table 8.1.2 are based on the lower limit of the range. For Shoveler and Teal the upper limit of the CL range is 30 $kgN.ha^{-1}.yr^{-1}$. If the upper limit of the range was used, the PC as a % of the CL is 1% and the PEC as a % of the CL is 68%. As the PC does not exceed 1% of the critical load, the effects can be screened out as insignificant based on the upper limit of the range. Furthermore the traffic data modelled for this 2021 scenario assumed full build out of the development in 2021 rather than a partial build out. Therefore the results can be considered to be highly conservative.

For 2029, the maximum N deposition PC does not exceed 1% of the critical load for all interest features and the effects can be screened out as insignificant.

References

i Air Pollution Information Systems, www.apis.ac.uk

ii http://laqm.defra.gov.uk/review-and-assessment/tools/tools.html

iii http://www.unece.org/env/lrtap/WorkingGroups/wge/definitions.htm

iv APIS Site Relevant Critical Load tool www.apis.ac.uk/srcl

v Environment Agency (2012a) Operational Instruction 66_12 Simple assessment of the impact of aerial emissions from new or expanding IPPC regulated Industry for impacts on nature conservation. EA.

Environment Agency (2012b) Operational Instruction 67_12 Detailed assessment of the impact of aerial emissions from new and expanding IPPC regulated industry for impacts on nature conservation. EA.

Appendix 8.2 – Construction Dust Methodology

Source

The IAQM dust guidance gives examples of the dust emission magnitudes for demolition, earthworks and construction activities and trackout. These example dust emission magnitudes are based on the site area, building volume, number of HDV movements generated by the activities and the materials used. These example magnitudes have been combined with details of the period of construction activities to provide the ranking for the source magnitude that is set out in Table 8.2.1.

Features of the Source of Dust Emissions	Dust Emission Magnitude
Demolition - building over 50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities > 20 m above ground level. **Earthworks** – total site area over 10,000 m^2, potentially dusty soil type (e.g. clay), >10 heavy earth moving vehicles active at any one time, formation of bunds > 8 m in height, total material moved > 100,000 tonnes. **Construction** - total building volume over 100,000 m^3, activities include piling, on-site concrete batching, sand blasting. Period of activities more than two years. **Trackout** – 50 HDV outwards movements in any one day, potentially dusty surface material (e.g. High clay content), unpaved road length > 100 m.	Large
Demolition - building between 20,000 to 50,000 m^3, potentially dusty construction material and demolition activities 10 - 20 m above ground level. **Earthworks** – total site area between 2,500 to 10,000 m^2, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 4 - 8 m in height, total material moved 20,000 to 100,000 tonnes. **Construction** - total building volume between 25,000 and 100,000 m^3, use of construction materials with high potential for dust release (e.g. concrete), activities include piling, on-site concrete batching. Period of construction activities between one and two years. **Trackout** – 10 - 50 HDV outwards movements in any one day, moderately dusty surface material (e.g. High clay content), unpaved road length 50 – 100 m.	Medium
Demolition - building less than 20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities < 10 m above ground, demolition during winter months. **Earthworks** – total site area less than 2,500 m^2. Soil type with large grain size (e.g. sand), < 5 heavy earth moving vehicles active at any one time, formation of bunds < 4 m in height, total material moved < 10,000 tonnes earthworks during winter months. **Construction** - total building volume below 25,000 m^3, use of construction materials with low potential for dust release (e.g. metal cladding or timber). Period of construction activities less than one year. **Trackout** – < 10 HDV outwards movements in any one day, surface material with low potential for dust release, unpaved road length < 50 m.	Small

Table 8.2 1 Risk Allocation – Source (Dust Emission Magnitude)

Pathway and Receptor - Sensitivity of the Area

Pathway means the route by which dust and particulate matter may be carried from the source to a receptor. The main factor affecting the pathway effectiveness is the distance from the receptor to the source. The orientation of the receptors to the source compared to the prevailing wind direction is a relevant risk factor for long-duration construction projects; however, short-term construction projects may be limited to a few months when the most frequent wind direction might be quite different, so adverse effects can potentially occur in any direction from the site.

As set out in the IAQM dust guidance, a number of attempts have been made to categorise receptors into high, medium and low sensitivity categories; however there is no unified sensitivity classification scheme that covers the quite different potential effects on property, human health and ecological receptors.

Table 8.2 2 and Table 8.2.3 sets out the IAQM basis for categorising the sensitivity of people and property to dust and PM_{10} respectively. Table 8.2.4 sets out the basis for determining the sensitivity of ecological receptors to dust.

Receptor	Sensitivity
Principles:- • Users can reasonably expect enjoyment of a high level of amenity; or • the appearance, aesthetics or value of their property would be diminished by soiling; and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land. Indicative Examples:- • Dwellings. • Museums and other culturally important collections. • Medium and long-term car parks and car showrooms.	High
Principles:- • Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or • the appearance, aesthetics or value of their property could be diminished by soiling; or • the people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Indicative Examples:- ▪ Parks. ▪ Places of work.	Medium
Principles:- ▪ the enjoyment of amenity would not reasonably be expected; or	Low

Receptor	Sensitivity
▪ there is property that would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or ▪ there is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Indicative Examples:- ▪ Playing fields, farmland (unless commercially-sensitive horticultural). ▪ Footpaths and roads. ▪ Short-term car parks.	

Table 8.2 2 Sensitivities of People and Property Receptors to Dust

Receptor	Sensitivity
Principles:- ▪ Locations where members of the public are exposed over a time period relevant to the air quality objective (in the case of the 24-hour objective for PM_{10}, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative Examples:- ▪ Residential properties. ▪ Schools, hospitals and residential care homes.	High
Principles:- ▪ Locations where the people exposed are workers and exposure is over a time period relevant to the air quality objective (in the case of the 24-hour objective for PM_{10}, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative Examples:- ▪ Office and shop workers (but generally excludes workers occupationally exposed to PM_{10} as protection is covered by Health and Safety at Work legislation).	Medium
Principles:- ▪ Locations where human exposure is transient exposure. Indicative Examples:- ▪ Public footpaths. ▪ Playing fields, parks. ▪ Shopping streets.	Low

Table 8.2 3 Sensitivities of People and Property Receptors to PM10

Receptor	Sensitivity
Principles:- ▪ Locations with an international or national designation and the designated features may be affected by dust soiling; or ▪ locations where there is a community of a particularly dust sensitive species such as vascular species included in the Red Data List For Great Britain. Indicative Examples:- ▪ Special Area of Conservation (SAC) designated for acid heathlands adjacent to the demolition of a large site containing concrete (alkali) buildings or for the presence of lichen.	High
Principles:- ▪ Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; or ▪ locations with a national designation where the features may be affected by dust deposition. Indicative Examples:- ▪ Site of Special Scientific Interest (SSSI) with dust sensitive features.	Medium
Principles:- • Locations with a local designation where the features may be affected by dust deposition. Indicative Examples:- • A Local Nature Reserve with dust sensitive features	Low

Table 8.2 4 Sensitivities of Ecological Receptors to Dust

The IAQM methodology combines consideration of the pathway and receptor to derive the 'sensitivity of the area'. Table 8.2 5, Table 8.2.6 and Table 8.2 7 show how the sensitivity of the area has been derived for this assessment.

Receptor Sensitivity	Number of Receptors	Distance from the Source (m) b			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 8.2 5 Sensitivity of the Area to Dust Soiling Effects on People and Property

The sensitivity of the area has been derived for demolition, construction, earthworks and trackout.

a The total number of receptors within the stated distance has been estimated. Only the highest level of area sensitivity from the table has been recorded.

b For trackout, the distances have been measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and trackout impacts have only been considered up to 50 m from the edge of the road.

Receptor Sensitivity	Annual Mean PM_{10} Concentration a	Number of Receptors b, c	Distance from the Source (m) d				
			<20	<50	<100	<200	<350
High	> 32 µg.m^{-3}	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28 - 32 µg.m^{-3}	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24 - 28 µg.m^{-3}	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	< 24 µg.m^{-3}	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	> 32 µg.m^{-3}	>10	High	Medium	Low	Low	Low
		1 – 10	Medium	Low	Low	Low	Low
	28 – 32 µg.m^{-3}	> 10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	< 28 µg.m^{-3}	>1	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table 8.2 6 Sensitivity of the Area to Human Health Impacts

The sensitivity of the area has been derived for demolition, construction, earthworks and trackout.

a This refers to the background concentration derived from the assessment of baseline conditions later in this report. The concentration categories listed in this column apply to England, Wales and Northern Ireland but not to Scotland.

b The total number of receptors within the stated distance has been estimated. Only the highest level of area sensitivity from the table has been recorded.

c For high sensitivity receptors with high occupancy (such as schools or hospitals), the approximate number of occupants has been used to derive an equivalent number of receptors.

d For trackout, the distances have been measured from the side of the roads used by construction traffic. Without site-specific mitigation, trackout may occur from roads up to 500 m from large sites, 200 m from medium sites and 50 m from small sites, as measured from the site exit. The impact declines with distance from the site, and trackout impacts have only been considered up to 50 m from the edge of the road.

Receptor Sensitivity	Distance from the Source (m) a	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

The sensitivity of the area has been derived for demolition, construction, earthworks and trackout and for each designated site.
a Only the highest level of area sensitivity has been recorded.

Table 8.2 7 Sensitivity of the Area to Ecological Impacts

The IAQM dust guidance lists the following additional factors that can potentially affect the sensitivity of the area and, where necessary, professional judgement has been used to adjust the sensitivity allocated to a particular area:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant the season during which the works will take place;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which are considered go beyond the classifications given in the table above.

The matrices in Table 8.2 8, Table 8.2 9, Table 8.2.10 and Table 8.2 11 have been used to assign the risk for each activity to determine the level of mitigation that should be applied. For those cases where the risk category is 'negligible', no mitigation measures are required beyond those mandated by legislation.

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table 8.2 8 Risk of Dust Impacts – Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 8.2 9 Risk of Dust Impacts – Earthworks

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table 8.2 10 Risk of Dust Impacts – Construction

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Table 8.2 11 Risk of Dust Impacts – Trackout

Appendix 8.3 – Operational Phase Methodology

Atmospheric Dispersion Modelling of Pollutant Concentrations

In urban areas, pollutant concentrations are primarily determined by the balance between pollutant emissions that increase concentrations, and the ability of the atmosphere to reduce and remove pollutants by dispersion, advection, reaction and deposition. An atmospheric dispersion model is used as a practical way to simulate these complex processes; such a model requires a range of input data, which can include emissions rates, meteorological data and local topographical information. The model used and the input data relevant to this assessment are described in the following sub-sections.

The atmospheric pollutant concentrations in an urban area depend not only on local sources at a street scale, but also on the background pollutant level made up of the local urban-wide background, together with regional pollution and pollution from more remote sources brought in on the incoming air mass. This background contribution needs to be added to the fraction from the modelled sources, and is usually obtained from measurements or estimates of urban background concentrations for the area in locations that are not directly affected by local emissions sources. Background pollution levels are described in detail in Section 4.

The ADMS-Roads model has been used in this assessment to predict the air quality impacts from changes in traffic on the local road network and from building emissions. This is a version of the Atmospheric Dispersion Modelling System (ADMS), a formally validated model developed in the United Kingdom (UK) by Cambridge Environmental Research Consultants Ltd (CERC) and widely used in the UK and internationally for regulatory purposes.

Modelled Scenarios

The following scenarios were modelled:

- Without the Proposed Development in 2017;
- Without the Proposed Development in 2021;
- With the Proposed Development in 2021;
- Without the Proposed Development in 2029;
- With the Proposed Development in 2029;

Model Input Data

Traffic Flow Data

Traffic data used in the assessment have been provided by the project's transport consultants, Curtins. The traffic flow data provided for this assessment are summarised in Table 8.3.1, Table 8.3.2 and Table 8.3.3. The modelled road links are illustrated in Appendix 8.4.

Road Link ID	Road Link Name	Speed (km.hr^{-1})	Daily Two Way Vehicle Flow			
			Without Development		With Development	
			Total Vehicles	HDV %	Total Vehicles	HDV %
1	A50 Knutsford Road , north of a56 Chester Road	48	17288	3.7	17288	3.7
2	Stockport Road	64	11273	3.4	11552	3.4
3	A56 Chester Road, east of Church Lane	48	8290	3.4	8290	3.4
4	A56 Chester Road, west of Church Lane	48	10580	2.8	11560	2.6
5	Church Lane, north of Broad Lane	48	4409	2.0	5389	1.6
6	Stockton Lane	48	158	0.0	158	0.0
7	Church Lane, east of Broad Lane	32	1537	2.8	1537	2.8
8	Broad Lane	96	3183	2.1	4163	1.6
9	Broad Lane, South of Grappenhall Road	96	16698	12.4	18515	11.2
10	Grappenhall Lane	64	11315	2.0	13133	1.7
11	Barleycastle Lane	64	11859	16.4	11859	16.4
12	Grappenhall Road, west of Secondary Access	96	14279	14.2	17076	11.8
13	Grappenhall Road, east of Secondary Access	96	14197	14.3	21954	19.4
14	Grappenhall Road, east of Primary Access	96	14099	14.5	26816	24.3
15	Secondary Access	32	0	0	7757	28.8
16	Primary Access	32	0	0	7757	28.8
17	A50 Knutsford Road South	96	14722	4.2	15407	4.0
18	A50 Knutsford Road North	96	14830	4.3	16198	4.0
19	A50 Cliff Lane	96	27371	9.4	38720	18.2
20	M56 North Slip Road	113	12375	14.7	14769	21.3
21	M6 Northbound Slip Road	113	14610	11.2	17751	14.5
22	M6 Southbound Slip	113	11311	11.7	14393	16.1
23	M6 Slip Road South	113	9926	15.5	12287	22.5

Road Link ID	Road Link Name	Speed (km.hr-1)	Daily Two Way Vehicle Flow			
			Without Development		With Development	
			Total Vehicles	HDV %	Total Vehicles	HDV %
24	Cherry Lane	64	7286	2.5	7286	2.5
25	Cliff Lane East of M6	80	17585	19.3	17957	18.9
26	Cliff Lane East of Lymm Services	80	8416	3.9	8788	3.7
27	Lymm Services	48	8794	32.5	8794	32.5
28	M6	113	134728	18.0	140951	18.5
29	M56	113	81605	8.2	83983	9.5

Table 8.3. 1Traffic Data Used Within the Assessment - 2021

Notes:(km.hr^{-1}) = kilometres per hour
HDV = Heavy Duty Vehicle - vehicles greater than 3.5 t gross vehicle weight including buses
LDV = Light Duty Vehicle

Road Link ID	Road Link Name	Speed (km.hr-1)	Daily Two Way Vehicle Flow			
			Without Development		With Development	
			Total Vehicles	HDV %	Total Vehicles	HDV %
1	A50 Knutsford Road , north of a56 Chester Road	48	18388	3.7	18388	3.7
2	Stockport Road	64	12012	3.4	12291	3.4
3	A56 Chester Road, east of Church Lane	48	8825	3.4	8825	3.4
4	A56 Chester Road, west of Church Lane	48	11271	2.8	12251	2.6
5	Church Lane, north of Broad Lane	48	4709	2.0	5689	1.6
6	Stockton Lane	48	169	0.0	169	0.0
7	Church Lane, east of Broad Lane	32	1641	2.8	1641	2.8
8	Broad Lane	96	3400	2.1	4379	1.6
9	Broad Lane, South of Grappenhall Road	96	17674	12.4	19492	11.2
10	Grappenhall Lane	64	12005	2.0	13823	1.8
11	Barleycastle Lane	64	12559	16.3	12559	16.3
12	Grappenhall Road, west of Secondary Access	96	15089	14.1	17886	11.9
13	Grappenhall Road, east of Secondary Access	96	15010	14.2	22767	19.2
14	Grappenhall Road, east of Primary Access	96	14906	14.5	27623	24.0
15	Secondary Access	32	0	0	7757	28.8
16	Primary Access	32	0	0	7757	28.8
17	A50 Knutsford Road South	96	15722	4.2	16406	4.0
18	A50 Knutsford Road North	96	15837	4.3	17205	4.0
19	A50 Cliff Lane	96	14664	8.3	26013	21.9

Road Link ID	Road Link Name	Speed (km.hr^{-1})	Daily Two Way Vehicle Flow			
			Without Development		With Development	
			Total Vehicles	HDV %	Total Vehicles	HDV %
20	M56 North Slip Road	113	13193	14.7	15588	21.0
21	M6 Northbound Slip Road	113	15553	11.2	18694	14.3
22	M6 Southbound Slip	113	12042	11.7	15123	15.9
23	M6 Slip Road South	113	10576	15.5	12937	22.1
24	Cherry Lane	64	7780	2.5	7780	2.5
25	Cliff Lane East of M6	80	18770	19.3	19142	18.9
26	Cliff Lane East of Lymm Services	80	8988	3.9	9360	3.7
27	Lymm Services	48	9392	32.6	9392	32.6
28	M6	113	143711	18.0	149934	18.5
29	M56	113	87115	8.2	89493	9.4

Table 8.3.2Traffic Data Used Within the Assessment - 2029

Road Link ID	Road Link Name	Speed (km.hr^{-1})	Daily Two Way Vehicle Flow	
			Without Development	
			Total Vehicles	HDV %
1	A50 Knutsford Road , north of a56 Chester Road	48	15802	3.9
2	Stockport Road	64	10613	3.6
3	A56 Chester Road, east of Church Lane	48	7698	3.6
4	A56 Chester Road, west of Church Lane	48	9936	2.9
5	Church Lane, north of Broad Lane	48	4310	2.0
6	Stockton Lane	48	155	0.0
7	Church Lane, east of Broad Lane	32	1502	2.8
8	Broad Lane	96	3111	2.1
9	Broad Lane, South of Grappenhall Road	96	14039	11.3
10	Grappenhall Lane	64	9915	2.3
11	Barleycastle Lane	64	10048	14.6
12	Grappenhall Road, west of Secondary Access	96	11695	13.2
13	Grappenhall Road, east of Secondary Access	96	11695	13.2
14	Grappenhall Road, east of Primary Access	96	11599	13.5
15	Secondary Access	32	0	0
16	Primary Access	32	0	0
17	A50 Knutsford Road South	96	14359	4.2
18	A50 Knutsford Road North	96	14464	4.3

Road Link ID	Road Link Name	Speed (km.hr^{-1})	Daily Two Way Vehicle Flow Without Development	
			Total Vehicles	HDV %
19	A50 Cliff Lane	96	24604	8.5
20	M56 North Slip Road	113	11780	14.6
21	M6 Northbound Slip Road	113	13570	10.6
22	M6 Southbound Slip	113	10501	11.4
23	M6 Slip Road South	113	9318	15.0
24	Cherry Lane	64	7097	2.5
25	Cliff Lane East of M6	80	17028	19.5
26	Cliff Lane East of Lymm Services	80	8226	3.9
27	Lymm Services	48	8594	32.5
28	M6	113	129069	17.9
29	M56	113	79170	8.0

Table 8.3.3Traffic Data Used Within the Assessment – 2017

The average speed on each road has been reduced by 10 km.hr^{-1} to take into account the possibility of slow moving traffic near junctions and at roundabouts in accordance with LAQM.TG16.

Vehicle Emission Factors

The modelling has been undertaken using Defra's 2017 emission factor toolkit (version 8.0) which draws on emissions generated by the European Environment Agency (EEA) COPERT 5 emission calculation tool.

Meteorological Data

ADMS-Roads requires detailed meteorological data as an input. The most representative observing station for the region of the study area that supplies all the data in the required format is Rostherne approximately 8.5 km east of the Application Site. Meteorological data from that station for 2016 have been used within the dispersion model. The wind rose is presented below.

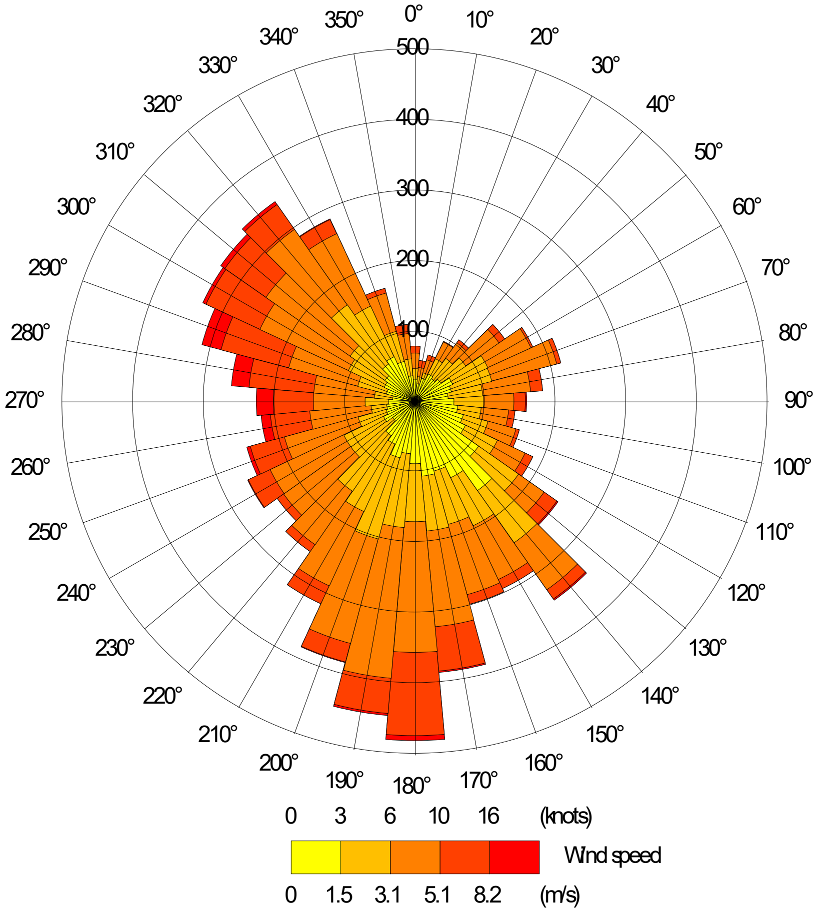


Figure 8.3.1 Wind Rose – Rostherne, 2016

Receptors

The air quality assessment predicts the impacts at locations that could be sensitive to any changes. For assessing human-health impacts, such sensitive receptors should be selected where the public is regularly present and likely to be exposed over the averaging period of the objective. LAQM.TG16 [6] provides examples of exposure locations and these are summarised in Table 8.3.4.

6 Defra (2016) Local Air Quality Management Technical Guidance, 2016 (LAQM.TG16)

Averaging Period	Objectives should apply at:	Objectives should generally not apply at:
Annual-mean	All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes.	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's façades), or any other location where public exposure is expected to be short-term.
Daily-mean	All locations where the annual-mean objective would apply, together with hotels. Gardens of residential properties.	Kerbside sites (as opposed to locations at the building's façade), or any other location where public exposure is expected to be short-term.
Hourly-mean	All locations where the annual and 24 hour mean would apply. Kerbside sites (e.g. pavements of busy shopping streets). 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. Any outdoor locations to which the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access

Table 8.3.4 Example of Where Air Quality Objectives Apply

Sensitive receptors for this assessment have been selected at properties where pollutant concentrations and/or changes in pollutant concentrations are anticipated to be greatest as listed in Table 8.3.4.

Long-Term Pollutant Predictions

Annual-mean NO_X and PM_{10} concentrations have been predicted at selected sensitive receptors using ADMS-Roads, then added to relevant background concentrations. Primary NO in the NO_X emissions is converted to NO_2 to a degree determined by the availability of atmospheric oxidants locally and the strength of sunlight. For road traffic sources, annual-mean NO_2 concentrations have been derived from the modelled road-related annual-mean NO_X concentration using the Defra's calculator [7].

Short-Term Pollutant Predictions

7 http://laqm.defra.gov.uk/review-and-assessment/tools/tools.html

In order to predict the likelihood of exceedences of the hourly-mean AQS objectives for NO_2 and the daily-mean AQS objective for PM_{10}, the following relationships between the short-term and the annual-mean values at each receptor have been considered.

Hourly-Mean AQS Objective for NO_2

Research undertaken in support of LAQM.TG16 has indicated that the hourly-mean limit value and objective for NO_2 is unlikely to be exceeded at a roadside location where the annual-mean NO_2 concentration is less than 60 $\mu g.m^{-3}$. In May 2008, a re-analysis of the relationship between annual and hourly-mean NO_2 concentrations was undertaken using data collated between 2003 and 2007 [8]. The conclusions and recommendations of that report are:

"Analysis shows that statistically, on the basis of the dataset available here, the chance of measuring an hourly nitrogen dioxide objective exceedence whilst reporting an annual-mean NO_2 of less than 60 $\mu g.m^{-3}$ is very low….

It is therefore recommended that local authorities continue to use the threshold of 60 $\mu g.m^{-3}$ NO_2 as the guideline for considering a likely exceedence of the hourly-mean nitrogen dioxide objective."

Daily-Mean AQS Objective for PM_{10}

The number of exceedences of the daily-mean AQS objective for PM_{10} of 50 $\mu g.m^{-3}$ may be estimated using the relationship set out in LAQM.TG16:

*Number of Exceedences of Daily Mean of 50 $\mu g.m^{-3}$ = -18.5 + 0.00145 * (Predicted Annual-mean PM_{10})^3 + 206 / (Predicted Annual-mean PM_{10} Concentration)*

This relationship suggests that the daily-mean AQS objective for PM_{10} is likely to be met if the predicted annual-mean PM_{10} concentration is 31.8 $\mu g.m^{-3}$ or less.

The daily mean objective is not considered further within this assessment if the annual-mean PM_{10} concentration is predicted to be less than 31.5 $\mu g.m^{-3}$.

Fugitive PM_{10} Emissions

Transport PM_{10} emissions arise from both the tailpipe exhausts and from fugitive sources such as brake and tyre wear and re-suspended road dust. Improvements in vehicle technologies

8 AEAT, 2008, Analysis of the relationship between annual-mean nitrogen dioxide concentration and exceedences of the 1-hour mean AQS Objective.

are reducing PM_{10} exhaust emissions; therefore, the relative importance of fugitive PM_{10} emissions is increasing. Current emission factors for particulate matter include brake dust and tyre wear (which studies suggest may account for approximately one-third of the total particulate emissions from road transport); however, no allowance is made for re-suspended road dust as this remains unquantified.

Uncertainty

All air quality assessment tools, whether models or monitoring measurements, have a degree of uncertainty associated with the results. The choices that the practitioner makes in setting-up the model, choosing the input data, and selecting the baseline monitoring data will decide whether the final predicted impact should be considered a central estimate, or an estimate tending towards the upper bounds of the uncertainty range (i.e. tending towards worst-case).

The atmospheric dispersion model itself contributes some of this uncertainty, due to it being a simplified version of the real situation: it uses a sophisticated set of mathematical equations to approximate the complex physical and chemical atmospheric processes taking place as a pollutant is released and as it travels to a receptor. The predictive ability of even the best model is limited by how well the turbulent nature of the atmosphere can be represented.

Each of the data inputs for the model, listed earlier, will also have some uncertainty associated with them. Where it has been necessary to make assumptions, these have mainly been made towards the upper end of the range informed by an analysis of relevant, available data.

The atmospheric dispersion model used for this assessment, ADMS Roads, has been validated by its supplier and is widely used by professionals in the UK and overseas. A site-specific verification (calibration) provides additional certainty and is particularly important when air quality levels are close to exceeding the objectives/limit values.

LAQM.TG16 requires that local authorities verify the results of any detailed modelling undertaken for the purposes of fulfilling their R&A duties. Model verification refers to the checks that are carried out on model performance at a local level. Modelled concentrations are compared with the results of monitoring. Where there is a disparity between modelled and monitored concentrations, the first step is to review the appropriateness of the data inputs to determine whether the performance of the model can be improved. Once reasonable efforts have been made to reduce the uncertainties in the data inputs, an adjustment may be established and applied to reduce any remaining disparity between modelled and monitored concentrations. No adjustment factor is deemed necessary where the modelled concentrations are within 25% of the monitored concentrations.

For the verification and adjustment of NO_X/NO_2 concentrations for R&A purposes, it is recommended that the comparison involves a combination of automatic and diffusion monitoring, rather than a single automatic monitor. This is to ensure any adjustment factor derived is representative of all locations modelled and not unduly weighted towards the characteristics at a single site. Where only diffusion tubes are used for the model verification, the study should consider a broad spread of monitoring locations across the study area to provide sufficient information relating to the spatial variation in pollutant concentrations.

Local Authorities generally implement a broad spread of monitoring, particularly in areas that are known to be sensitive to changes in air quality. Consequently, Local Authorities are usually able to verify the models they use for R&A purposes; however for individual developments, there is less likely to be a broad range of monitoring locations within the relevant study area. Notwithstanding this, a small number of monitoring locations have been identified within the study area and a model verification study has been undertaken for the proposed development and is included at Appendix 8.6.

The main components of uncertainty in the total predicted concentrations, made up of the background concentration and the modelled fraction, include those summarised in Table 8.3.5.

Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
Background Concentration	Characterisation of current baseline air quality conditions	The background concentration used within the assessment is the most conservative value from a comparison of measured and Defra mapped concentration estimate.	The background concentration is the major proportion of the total predicted concentration.
	Characterisation of future baseline air quality (i.e. the air quality conditions in the future assuming that the development does not proceed)	The future background concentration used in the assessment is the same as the current background concentration and no reduction has been assumed. This is a conservative assumption as, in reality, background concentrations are likely to reduce over time as cleaner vehicle technologies form an increasing proportion of the fleet.	The conservative assumptions adopted ensure that the background concentration used within the model is towards the top of the uncertainty range, rather than a central estimate.
Fraction from Modelled Sources	Traffic flow estimates	High growth assumptions have been used to develop the traffic dataset used within the model.	The modelled fraction is a minor proportion of the

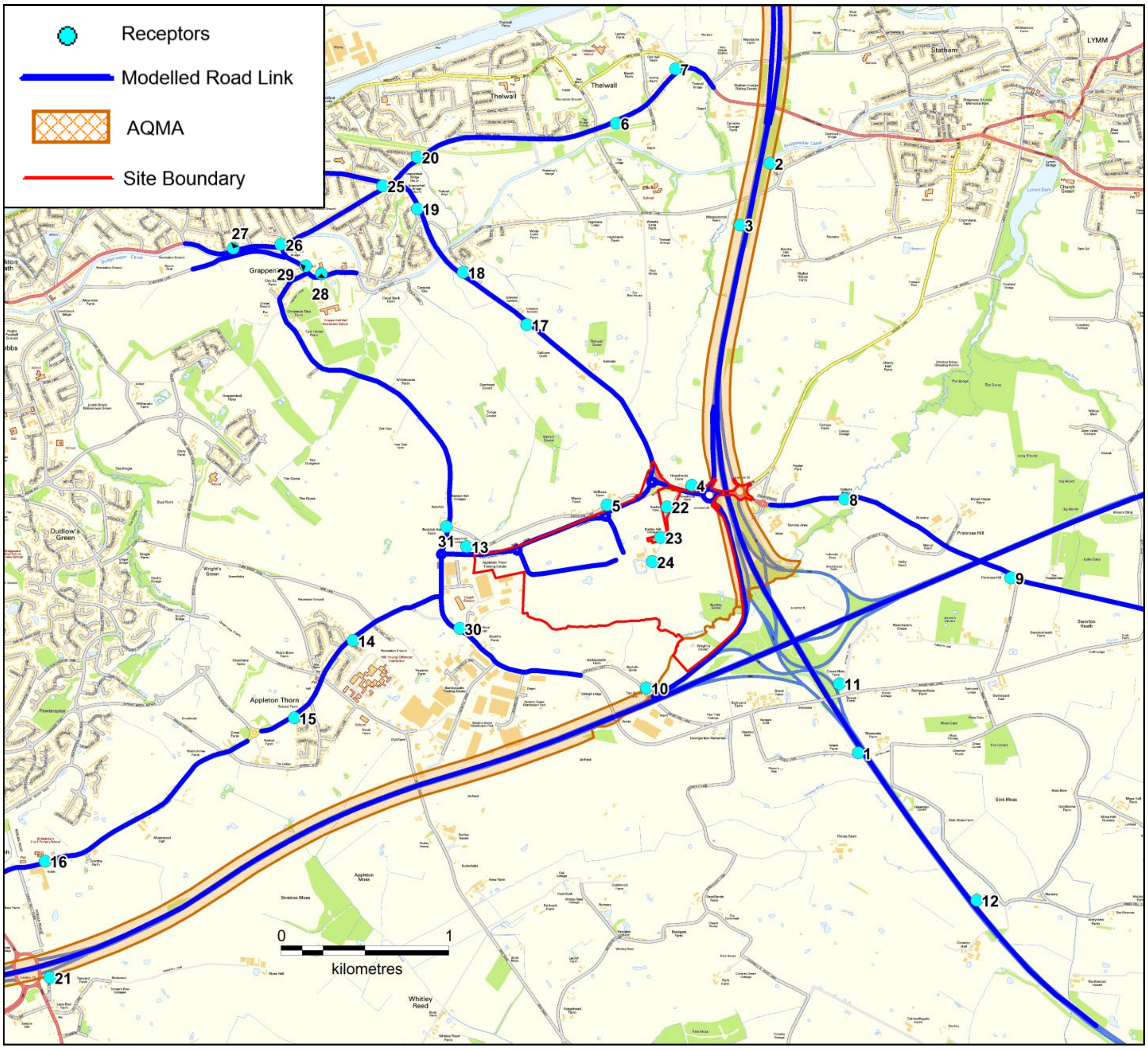
Concentration	Source of Uncertainty	Approach to Dealing with Uncertainty	Comments
	Traffic speed estimates	The average speed has been reduced in congested areas to take account of slow-moving and queuing traffic.	total predicted concentration. The modelled fraction is likely to be between a central estimate and the top of the uncertainty range.
	Road-related emission factors – projection to future years	The most recently published emission factors have been used within the modelling and these are based on the current and best understanding of the variation in emission factors in future years.	
	Meteorological Data	Uncertainties arise from any differences between the conditions at the met station and the development site, and between the historical met years and the future years. These have been minimised by using meteorological data collated at a representative measuring site. The model has been run for a full year of meteorological conditions. This means that the conditions in 8,760 hours have been considered in the assessment.	
	Receptors	Receptor locations have been identified where concentrations are highest or where the greatest changes are expected.	
	Dispersion Modelling	The model predictions have been compared with monitored concentrations. The model outputs have been adjusted accordingly.	

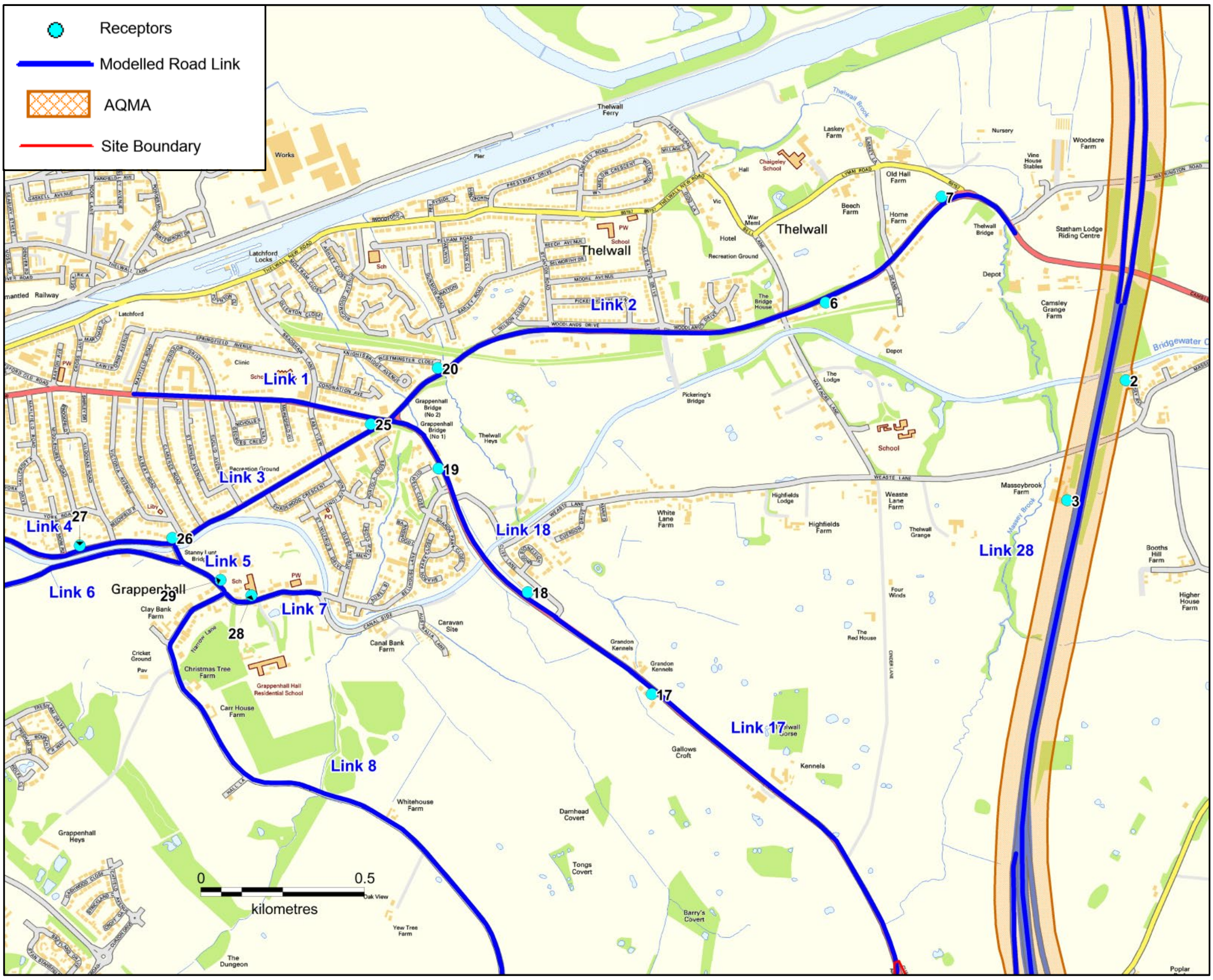
Table 8.3.5 Approaches to Dealing with Uncertainty used Within the Assessment

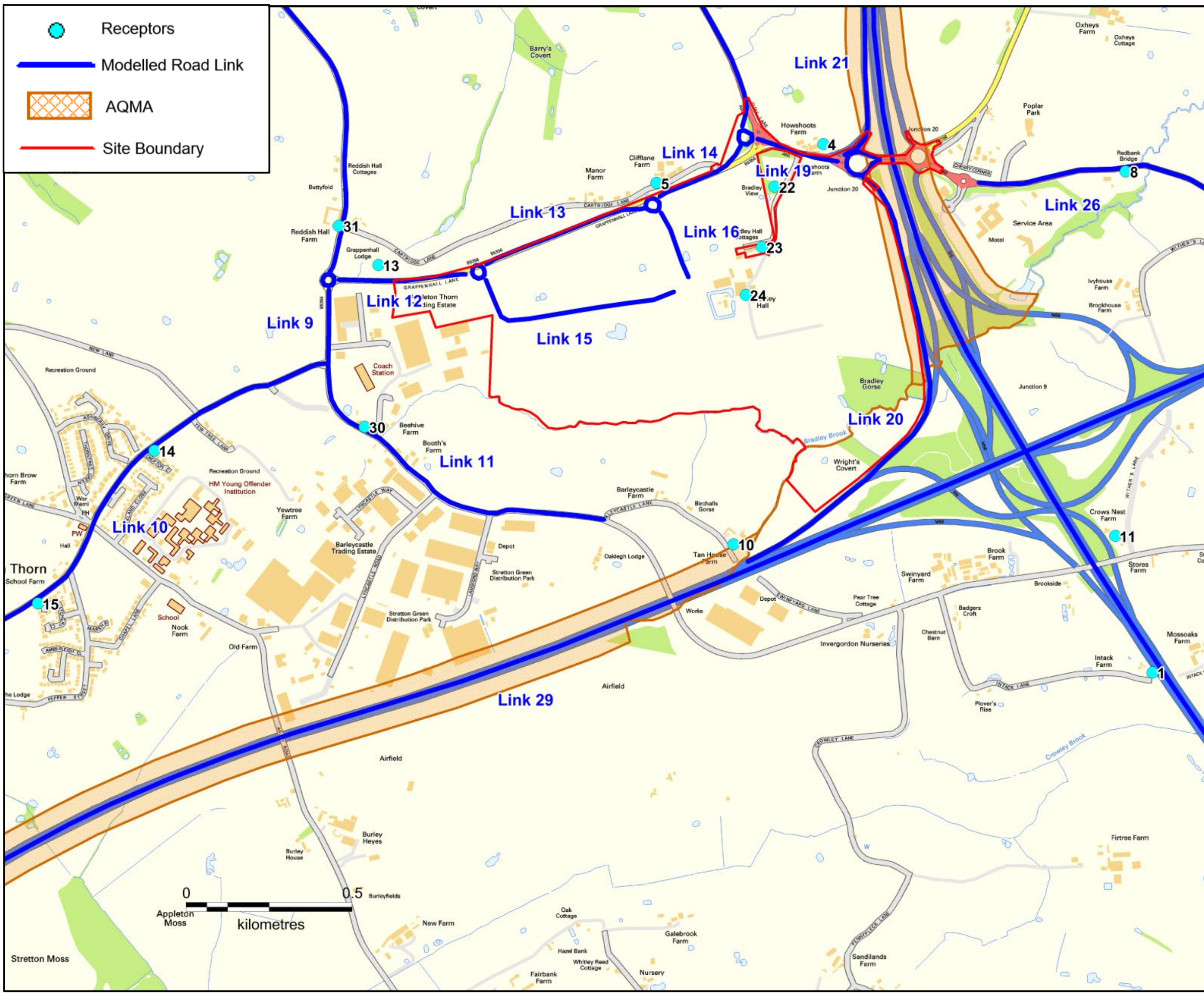
The analysis of the component uncertainties indicates that, overall, the predicted total concentration is likely to be towards the top of the uncertainty range rather than being a central estimate. The actual concentrations that will be found when the development is operational are unlikely to be higher than those presented within this report and are more likely to be lower.

Appendix 8.4 – Map of Receptors and AQMA

The map below shows the modelled road links, receptors and AQMA.

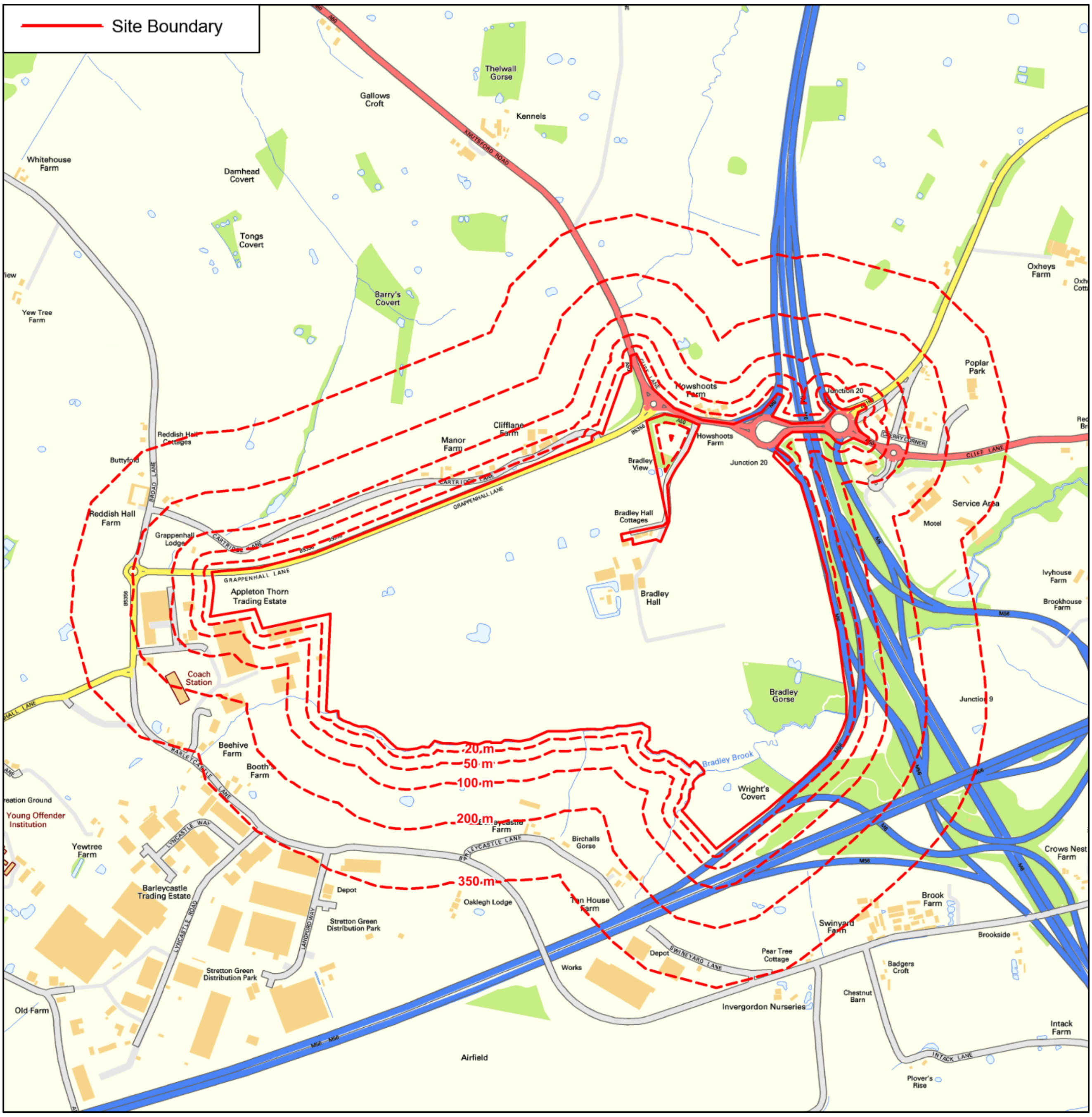



Receptors
Modelled Road Link
AQMA
Site Boundary
Link 1
Link 2
Link 3
Link 4
Link 5
Link 6
Link 7
Link 8
Link 17
Link 18
Link 28
Thelwall
Grappenhall
0
0.5
kilometres



Receptors
Modelled Road Link
AQMA
Site Boundary
Link 9
Link 10
Link 11
Link 12
Link 13
Link 14
Link 15
Link 16
Link 19
Link 20
Link 21
Link 26
Link 29
Thorn
0
0.5
kilometres

Appendix 8.5 – Construction Dust Assessment Study Area



Appendix 8.6 – Model Verification

The approach to model verification that LAQM.TG16 recommends for local authorities when they carry out their LAQM duties is summarised in Appendix 8.3. For the verification and adjustment of NO_x/NO_2 concentrations, the guidance recommends that the comparison considers a broad spread of automatic and diffusion monitoring. Warrington Borough Council monitors roadside NO_2 concentrations at 14 locations passively using diffusion tubes in the vicinity of the Application Site. The neighboring borough of Cheshire East monitors at a further two locations in the vicinity of the Application Site.

The concentrations monitored over recent years are provided in Table 8.6.1

Site ID	Monitoring Site	Measured Annual-mean NO_2 Concentrations ($\mu g.m^{-3}$)				
		2012	2013	2014	2015	2016
CE65	Intack Farm, Intack Lane, High Legh (M6)	33.78	38.48	35.06	30.87	34.54
CE68	Newlyn West Lane, High Legh (M56)	30.16	31.29	30.21	28.62	29.76
DT18	WA68 Chester Road	47	51.2	35.7	44.7	46.8
DT19	WA72 Chester Road 3	44	44.7	34.2	39.9	39.2
CM3	Chester Road	42.9	37.7	32.2	37	34
DT20	WA87 Chester Road 5	45	37.9	30.1	40.1	38.4
DT21	WA93 Walton Terrace	41	44.7	33.2	45.1	40.9
DT22	WA76 Wilderspool Causeway	43	39.8	30.4	39.1	38.7
DT23	WA94 Wilderspool Causeway 2	40	42.2	31.8	45.6	40.4
DT24	WA03 Stockton Heath 1	53	52.2	37.1	50.5	48.5
DT25	WA90 Stockton Heath 3	39	36.3	29.5	35.3	33.4
DT26	WA77 Knutsford Road 1	44	43	31.9	40.2	38
DT27	WA103 Jbutsford Road 2	-	39	28.2	36	34.9
DT28	WA101 York Street	-	39.6	26.5	32.9	33
DT32	WA104 Kingsway South 2	-	39.6	29.6	38.9	36.7
DT6	WA111 M6 Manchester Road	-	-	41.7	55.5	44.2

Table 8.6.1 Measured Annual-mean NO_2 Concentrations ($\mu g.m^{-3}$)

Traffic data and emission factors for 2016 have been used in the model, together with meteorological data from Rostherne in 2016, to predict concentrations that can be compared with the 2016 monitored concentrations in the vicinity of the Application Site. This comparison is provided in Table 8.6.2.

Monitoring Site	Monitored NO_2 Concentrations 2016	Modelled NO_2 Concentrations	Difference [(modelled-monitored)/monitored]* 100
CE65	34.54	50.8	47.1
CE68	29.76	36.0	20.8
DT18	46.8	30.0	-35.8
DT19	39.2	30.8	-21.4
CM3	34	35.6	4.8
DT20	38.4	32.6	-15.1
DT21	40.9	31.6	-22.8
DT22	38.7	27.7	-28.4
DT23	40.4	30.2	-25.3
DT24	48.5	28.5	-41.2
DT25	33.4	29.1	-12.9
DT26	38	26.1	-31.4
DT27	34.9	28.9	-17.3
DT28	33	25.5	-22.9
DT32	36.7	35.3	-4.0
DT6	44.2	55.0	24.5

Table 8.6.2 Comparison of Total Monitored and Modelled NO_2 Concentrations ($\mu g.m^{-3}$)

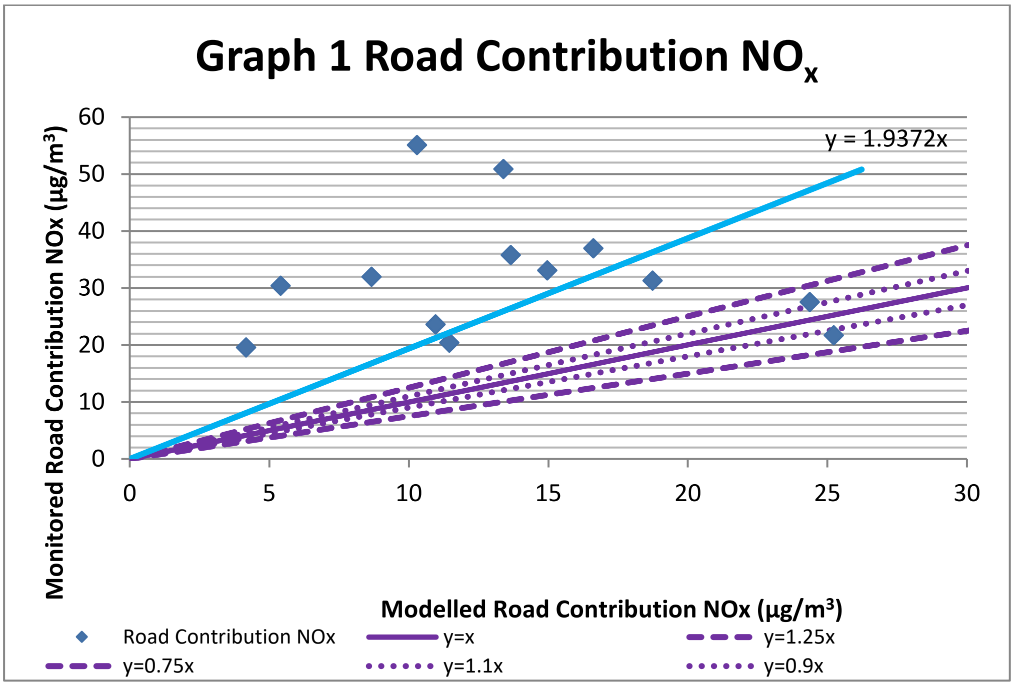
It is clear from the above that the model is under-predicting at all but four locations. At CE65, CE68 and DT6 the model is over-predicting by more than 20%. These monitoring locations are all near to the M6 or M56 indicating that at the motorways the model is over-predicting. These three monitors have not been considered further in this model verification to ensure a conservative adjustment factor is derived.

The approach to model verification set out in LAQM.TG16 involves a comparison of the modelled road-related annual-mean NO_x concentrations with the monitored road-related annual mean NO_x concentrations. This comparison is set out in Table 8.6.3

Monitoring Site	Modelled NO_x Road Contribution (µg.m^{-3})	Monitored NO_x Road Contribution (µg.m^{-3})
DT18	13.4	50.9
DT19	15.0	33.1
CM3	25.2	21.7
DT20	18.7	31.3
DT21	16.6	37.0
DT22	8.7	32.0
DT23	13.6	35.8
DT24	10.3	55.1
DT25	11.4	20.4
DT26	5.4	30.4
DT27	11.0	23.6
DT28	4.2	19.6
DT32	24.4	27.5
DT18	13.4	50.9

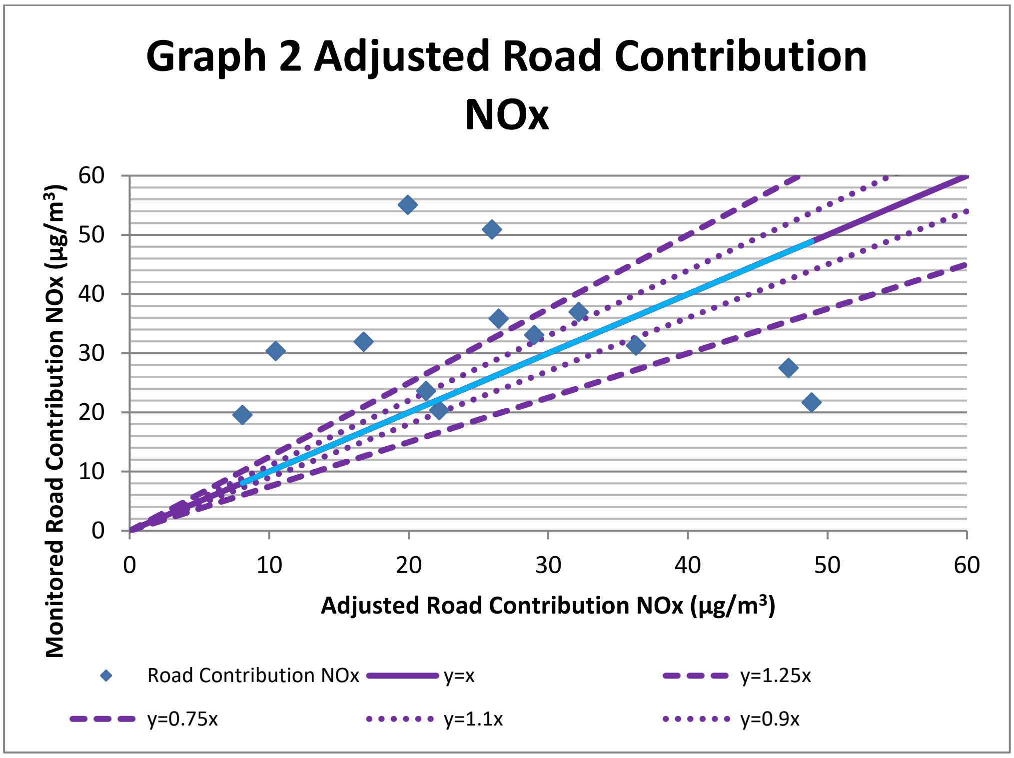
Table 8.6.3 Comparison of Monitored and Modelled Annual-mean Road NO_x Contribution (µg.m^{-3})

The monitored road contribution NO_x has been plotted against the modelled road contribution NO_x in Graph 1 below.

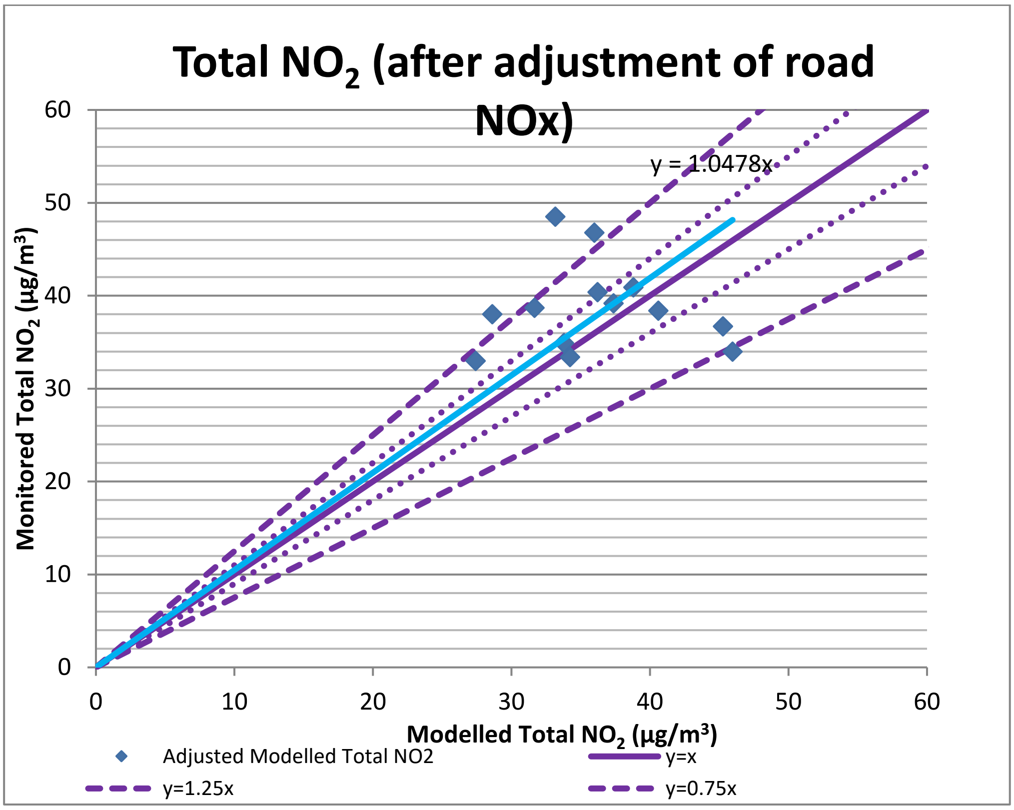


Graph 1 indicates that the model is under-predicting at the non-motorway locations by a factor of 1.9372.

A correction factor of 1.9372 has therefore been applied to the modelled road contribution at non-motorway locations, and the results reviewed to determine whether this improves the modelling performance. The monitored road contribution NO_x has been plotted against the adjusted modelled road contribution NO_x in Graph 2 below using the correction factor.



Finally, a comparison of the adjusted modelled NO_2 concentrations with the monitored NO_2 concentrations is provided in Graph 3 below.



The results in Graph 3 indicate that the difference with the correction factor is now within 25% of the monitored concentration for the majority of the locations. The correction factor therefore improves the modelled concentrations and has been applied to all predictions at a non-motorway location used within the assessment. For predictions in a motorway location no adjustment factor has been applied.

The fractional bias can also be used to determine whether the corrected model has a tendency to over or under-predict. The fractional bias is calculated as:

(Average Monitored NO_X Concentration – Average Predicted NO_x Concentration) / 0.5 x (Average Monitored NO_X + Average Predicted NO_x Concentration)

Fractional bias values vary between +2 and -2 and has an ideal value of zero. A negative value suggests a model over-prediction and a positive value suggests a model under-prediction.

Table 8.6.4 sets out the average monitored concentration and the average predicted concentration.

Monitoring Site	Annual-mean Road NO_x Contribution ($\mu g.m^{-3}$)	
	Monitored	Corrected Modelled
DT18	50.9	25.9
DT19	33.1	29.0
CM3	21.7	48.9
DT20	31.3	36.3
DT21	37.0	32.2
DT22	32.0	16.8
DT23	35.8	26.4
DT24	55.1	19.9
DT25	20.4	22.2
DT26	30.4	10.5
DT27	23.6	21.2
DT28	19.6	8.1
DT32	27.5	47.2
Average	**32.2**	**26.5**

Table 8.6.4 Comparison of Monitored and Adjusted Modelled Annual-mean Road NOx Contribution (µg.m-3)

The fractional bias for this study is therefore (32.2 – 26.5) / (0.5 x (32.2 + 26.5)) = 0.19. As the fractional bias is close to zero and the adjusted model is performing well.