Appendix: Air Quality

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Woking Football Club, Woking - Air Quality Technical Appendices

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Experts in air quality
management & assessment

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A1 EPUK & IAQM Planning for Air Quality Guidance

A1.1 The guidance issued by EPUK and IAQM (Moorcroft and Barrowcliffe et al, 2017) is comprehensive in its explanation of the place of air quality in the planning regime. Key sections of the guidance not already mentioned above are set out below.

Air Quality as a Material Consideration

"Any air quality issue that relates to land use and its development is capable of being a material planning consideration. The weight, however, given to air quality in making a planning application decision, in addition to the policies in the local plan, will depend on such factors as:

- *the severity of the impacts on air quality;*
- *the air quality in the area surrounding the proposed development;*
- *the likely use of the development, i.e. the length of time people are likely to be exposed at that location; and*
- *the positive benefits provided through other material considerations".*

Recommended Best Practice

A1.2 The guidance goes into detail on how all development proposals can and should adopt good design principles that reduce emissions and contribute to better air quality management. It states:

"The basic concept is that good practice to reduce emissions and exposure is incorporated into all developments at the outset, at a scale commensurate with the emissions".

A1.3 The guidance sets out a number of good practice principles that should be applied to all developments that:

- include 10 or more dwellings;
- where the number of dwellings is not known, residential development is carried out on a site of more than 0.5 ha;
- provide more than 1,000 m^2 of commercial floorspace;
- are carried out on land of 1 ha or more.

A1.4 The good practice principles are that:

- New developments should not contravene the Council's Air Quality Action Plan, or render any of the measures unworkable;

- Wherever possible, new developments should not create a new "street canyon", as this inhibits pollution dispersion;
- Delivering sustainable development should be the key theme of any application;
- New development should be designed to minimise public exposure to pollution sources, e.g. by locating habitable rooms away from busy roads;
- The provision of at least 1 Electric Vehicle (EV) "rapid charge" point per 10 residential dwellings and/or 1000 m^2 of commercial floorspace. Where on-site parking is provided for residential dwellings, EV charging points for each parking space should be made available;
- Where development generates significant additional traffic, provision of a detailed travel plan (with provision to measure its implementation and effect) which sets out measures to encourage sustainable means of transport (public, cycling and walking) via subsidised or free-ticketing, improved links to bus stops, improved infrastructure and layouts to improve accessibility and safety;
- All gas-fired boilers to meet a minimum standard of <40 mgNOx/kWh;
- Where emissions are likely to impact on an AQMA, all gas-fired CHP plant to meet a minimum emissions standard of:
  - Spark ignition engine: 250 mgNOx/Nm^3;
  - Compression ignition engine: 400 mgNOx/Nm^3;
  - Gas turbine: 50 mgNOx/Nm^3.
- A presumption should be to use natural gas-fired installations. Where biomass is proposed within an urban area it is to meet minimum emissions standards of 275 mgNOx/Nm^3 and 25 mgPM/Nm^3.

A1.5 The guidance also outlines that offsetting emissions might be used as a mitigation measure for a proposed development. However, it states that:

"It is important that obligations to include offsetting are proportional to the nature and scale of development proposed and the level of concern about air quality; such offsetting can be based on a quantification of the emissions associated with the development. These emissions can be assigned a value, based on the "damage cost approach" used by Defra, and then applied as an indicator of the level of offsetting required, or as a financial obligation on the developer. Unless some form of benchmarking is applied, it is impractical to include building emissions in this approach, but if the boiler and CHP emissions are consistent with the standards as described above then this is not essential".

A1.6 The guidance offers a widely used approach for quantifying costs associated with pollutant emissions from transport. It also outlines the following typical measures that may be considered to offset emissions, stating that measures to offset emissions may also be applied as post assessment mitigation:

- Support and promotion of car clubs;
- Contributions to low emission vehicle refuelling infrastructure;
- Provision of incentives for the uptake of low emission vehicles;
- Financial support to low emission public transport options; and
- Improvements to cycling and walking infrastructures.

Screening

Impacts of the Local Area on the Development

"There may be a requirement to carry out an air quality assessment for the impacts of the local area's emissions on the proposed development itself, to assess the exposure that residents or users might experience. This will need to be a matter of judgement and should take into account:

- *the background and future baseline air quality and whether this will be likely to approach or exceed the values set by air quality objectives;*
- *the presence and location of Air Quality Management Areas as an indicator of local hotspots where the air quality objectives may be exceeded;*
- *the presence of a heavily trafficked road, with emissions that could give rise to sufficiently high concentrations of pollutants (in particular nitrogen dioxide), that would cause unacceptably high exposure for users of the new development; and*
- *the presence of a source of odour and/or dust that may affect amenity for future occupants of the development".*

Impacts of the Development on the Local Area

A1.7 The guidance sets out two stages of screening criteria that can be used to identify whether a detailed air quality assessment is required, in terms of the impact of the development on the local area. The first stage is that you should proceed to the second stage if any of the following apply:

- 10 or more residential units or a site area of more than 0.5 ha residential use; and/or
- more than 1,000 m^2 of floor space for all other uses or a site area greater than 1 ha.

A1.8 Coupled with any of the following:

- the development has more than 10 parking spaces; and/or

- the development will have a centralised energy facility or other centralised combustion process.

A1.9 If the above do not apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area. If they do apply then you proceed to stage 2, which sets out indicative criteria for requiring an air quality assessment. The stage 2 criteria relating to vehicle emissions are set out below:

- the development will lead to a change in LDV flows of more than 100 AADT within or adjacent to an AQMA or more than 500 AADT elsewhere;
- the development will lead to a change in HDV flows of more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere;
- the development will lead to a realigning of roads (i.e. changing the proximity of receptors to traffic lanes) where the change is 5m or more and the road is within an AQMA;
- the development will introduce a new junction or remove an existing junction near to relevant receptors, and the junction will cause traffic to significantly change vehicle acceleration/deceleration, e.g. traffic lights or roundabouts;
- the development will introduce or change a bus station where bus flows will change by more than 25 AADT within or adjacent to an AQMA or more than 100 AADT elsewhere; and
- the development will have an underground car park with more than 100 movements per day (total in and out) with an extraction system that exhausts within 20 m of a relevant receptor.

A1.10 The criteria are more stringent where the traffic impacts may arise on roads where concentrations are close to the objective. The presence of an AQMA is taken to indicate the possibility of being close to the objective, but where whole authority AQMAs are present and it is known that the affected roads have concentrations below 90% of the objective, the less stringent criteria are likely to be more appropriate.

A1.11 On combustion processes (including standby emergency generators and shipping) where there is a risk of impacts at relevant receptors, the guidance states that:

"Typically, any combustion plant where the single or combined NOx emission rate is less than 5 mg/sec is unlikely to give rise to impacts, provided that the emissions are released from a vent or stack in a location and at a height that provides adequate dispersion. As a guide, the 5 mg/s criterion equates to a 450 kW ultra-low NOx gas boiler or a 30kW CHP unit operating at <95mg/Nm^3.

In situations where the emissions are released close to buildings with relevant receptors, or where the dispersion of the plume may be adversely affected by the size and/or height of adjacent buildings (including situations where the stack height is lower than the receptor) then consideration will need to be given to potential impacts at much lower emission rates.

Conversely, where existing nitrogen dioxide concentrations are low, and where the dispersion conditions are favourable, a much higher emission rate may be acceptable".

A1.12 Should none of the above apply then the development can be screened out as not requiring a detailed air quality assessment of the impact of the development on the local area, provided that professional judgement is applied; the guidance importantly states the following:

"The criteria provided are precautionary and should be treated as indicative. They are intended to function as a sensitive 'trigger' for initiating an assessment in cases where there is a possibility of significant effects arising on local air quality. This possibility will, self-evidently, not be realised in many cases. The criteria should not be applied rigidly; in some instances, it may be appropriate to amend them on the basis of professional judgement, bearing in mind that the objective is to identify situations where there is a possibility of a significant effect on local air quality".

A1.13 Even if a development cannot be screened out, the guidance is clear that a detailed assessment is not necessarily required:

"The use of a Simple Assessment may be appropriate, where it will clearly suffice for the purposes of reaching a conclusion on the significance of effects on local air quality. The principle underlying this guidance is that any assessment should provide enough evidence that will lead to a sound conclusion on the presence, or otherwise, of a significant effect on local air quality. A Simple Assessment will be appropriate, if it can provide this evidence. Similarly, it may be possible to conduct a quantitative assessment that does not require the use of a dispersion model run on a computer".

A1.14 The guidance also outlines what the content of the air quality assessment should include, and this has been adhered to in the production of this chapter.

Impact Descriptors and Assessment of Significance

A1.15 There is no official guidance in the UK in relation to development control on how to describe the nature of air quality impacts, nor how to assess their significance. The approach within the EPUK/IAQM guidance has, therefore, been used in this assessment. This approach involves a two stage process:

- a qualitative or quantitative description of the impacts on local air quality arising from the development; and
- a judgement on the overall significance of the effects of any impacts.

Impact Descriptors

A1.16 Impact description involves expressing the magnitude of incremental change as a proportion of a relevant assessment level and then examining this change in the context of the new total concentration and its relationship with the assessment criterion. Table A1.1 sets out the method for determining the impact descriptor for annual mean concentrations at individual receptors, having been adapted from the table presented in the guidance document. For the assessment criterion the term Air Quality Assessment Level or AQAL has been adopted, as it covers all pollutants, i.e. those with and without formal standards. Typically, as is the case for this assessment, the AQAL will be the air quality objective value. Note that impacts may be adverse or beneficial, depending on whether the change in concentration is positive or negative.

Table A1.1: Air Quality Impact Descriptors for Individual Receptors for All Pollutants [a]

Long-Term Average Concentration At Receptor In Assessment Year [b]	Change in concentration relative to AQAL [c]				
	0%	1%	2-5%	6-10%	>10%
75% or less of AQAL	Negligible	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Negligible	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Negligible	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Negligible	Moderate	Substantial	Substantial	Substantial

[a] Values are rounded to the nearest whole number.

[b] This is the "Without Scheme" concentration where there is a decrease in pollutant concentration and the "With Scheme" concentration where there is an increase.

[c] 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)'.

Assessment of Significance

A1.17 The guidance recommends that the assessment of significance should be based on professional judgement, with the overall air quality impact of the development described as either 'significant' or 'not significant'. In drawing this conclusion, the following factors should be taken into account:

- the existing and future air quality in the absence of the development;
- the extent of current and future population exposure to the impacts;
- the influence and validity of any assumptions adopted when undertaking the prediction of impacts;
- the potential for cumulative impacts and, in such circumstances, several impacts that are described as '*slight*' individually could, taken together, be regarded as having a significant effect for the purposes of air quality management in an area, especially where it is proving difficult to reduce concentrations of a pollutant. Conversely, 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; and

- the judgement on significance relates to the consequences of the impacts; will they have an effect on human health that could be considered as significant? In the majority of cases, the impacts from an individual development will be insufficiently large to result in measurable changes in health outcomes that could be regarded as significant by health care professionals.

A1.18 The guidance is clear that other factors may be relevant in individual cases. It also states that the effect on the residents of any new development where the air quality is such that an air quality objective is not met will be judged as significant. For people working at new developments in this situation, the same will not be true as occupational exposure standards are different, although any assessment may wish to draw attention to the undesirability of the exposure.

A1.19 A judgement of the significance should be made by a competent professional who is suitably qualified. A summary of the professional experience of the staff contributing to this assessment is provided in Appendix A2.

A2 Professional Experience

Laurence Caird, MEarthSci CSci MIEnvSc MIAQM

Mr Caird is an Associate Director with AQC, with 13 years' experience in the field of air quality including the detailed assessment of emissions from road traffic, airports, heating and energy plant, and a wide range of industrial sources including the thermal treatment of waste. He has experience in ambient air quality monitoring for numerous pollutants using a wide range of techniques and is also competent in the monitoring and assessment of nuisance odours and dust. Mr Caird has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. He is a Member of the Institute of Air Quality Management and is a Chartered Scientist.

Pauline Jezequel, MSc MIEnvSc MIAQM

Miss Jezequel is a Principal Consultant with AQC with nine years' relevant experience. Prior to joining AQC she worked as an air quality consultant at AECOM. She has also worked as an air quality controller at Bureau Veritas in France, undertaking a wide range of ambient and indoor air quality measurements for audit purposes. She now works in the field of air quality assessment, undertaking air quality impact assessments for a wide range of development projects in the UK and abroad, including for residential and commercial developments, transport schemes (rail, road and airport), waste facilities and industrial sites. Miss Jezequel has also undertaken a number of odour surveys and assessments in the context of planning applications. She has experience in monitoring construction dust, as well as indoor pollutant levels for BREEAM purposes. She is a Member of the Institute of Air Quality Management.

Nicole Holland, BSc (Hons) AMIEnvSc AMIAQM

Miss Holland is a Consultant with AQC, having joined in March 2016. Nicole has experience in the assessment of air quality impacts for a range of projects using qualitative and quantitative methods, including dispersion modelling using ADMS-5 and ADMS-Roads. Nicole has also gained experience in undertaking construction dust risk assessments and Air Quality Neutral assessments, and in preparing local authority Annual Status Reports (ASRs), as well as undertaking odour assessments and preparing air quality chapters for Environmental Statements (ES). She is an Associate Member of the Institute of Air Quality Management and of the Institute of Environmental Sciences.

David Bailey, BSc (Hons)

Mr Bailey is an Assistant Consultant with AQC, having joined the Company in 2018. Prior to joining AQC he gained a degree in Environmental Science from the University of Brighton, where his studies included modules focused on Air Quality Management. He is now gaining experience in the field of air quality monitoring and assessment.

Full CVs are available at www.aqconsultants.co.uk.

A3 Modelling Methodology

Model Inputs

Road Traffic

A3.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (including road width). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 9.0) published by Defra (2019c).

A3.2 Hourly sequential meteorological data from Farnborough for 2018 have been used in the model. The Farnborough meteorological monitoring station is located at Farnborough Airfield, approximately 15 km to the southwest of the Proposed Development Site and approximately 14 km to the west of the Egley Road Site. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the Sites; both the Sites and the Farnborough meteorological monitoring station are located in the south of England where they will be influenced by the effects of inland meteorology over urban topography.

A3.3 Annual Average Daily Traffic (AADT) flows and the proportions of Heavy Duty Vehicles (HDVs) have been provided by Vectos, who have undertaken the transport assessment work for the Proposed Development and Egley Road scheme. Traffic speeds have also been provided by Vectos, with some having been amended based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A3.1. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2019b).

Table A3.1: Summary of Traffic Data used in the Assessment

Road Link	2018		2021 (Without Scheme)		2021 (With CC Scheme)		2021 (With CC & ER Schemes)	
	AADT	% HDV	AADT	% HDV	AADT	% HDV	AADT	% HDV
Kingfield Rd (A247) between Westfield Av & Elmbridge Ln	19,654	1.4	21,121	1.4	22,371	1.3	22,376	1.3
Kingfield Rd (A247) between Elmbridge Ln & Loop R	17,297	1.4	18,587	1.4	19,819	1.3	19,824	1.3
Kingfield Rd (A247) south of Loop Rd	13,002	1.4	13,976	1.4	14,807	1.4	14,815	1.4
Kingfield Rd (A247) between Westfield Av & Claremont Av (A247)	24,595	1.2	26,430	1.2	26,725	1.2	26,730	1.2
High St (A247)	20,321	1.3	21,905	1.2	22,660	1.2	23,088	1.2
Vicarage Rd (B380)	11,614	1.7	12,547	1.7	12,344	1.7	12,779	1.7
Westfield Avenue	7,120	0.3	7,651	0.3	7,903	0.3	7,903	0.3
Claremont Av (247)	6,852	1.5	7,363	1.5	7,411	1.5	7,411	1.5
Wych Hill Ln (A247)	19,558	1.1	21,017	1.1	25,108	0.9	25,113	0.9
Wych Hill Ln	22,493	1.3	24,258	1.3	24,428	1.3	25,068	1.2
York Road	4,914	1.5	5,280	1.5	5,296	1.5	5,296	1.5
Guildford Rd (A320) north of York Rd	24,685	1.9	26,954	1.9	27,199	1.9	27,805	1.9
Guildford Rd (A320) north of York Rd (northbound)	11,099	2.0	12,117	2.0	12,393	2.0	12,642	1.9
Station Approach (A320) / Victoria Rd (A320) (southbound)	13,586	1.9	14,837	1.8	14,806	1.8	15,163	1.8
Guildford Rd (A320) between York Rd & Claremont Av (A247)	21,146	1.9	23,151	1.9	23,380	1.9	23,987	1.8
Guildford Rd (A320) south of Claremont Av (A247)	19,558	1.8	21,596	1.8	21,649	1.8	22,611	1.7
Egley Rd (A320) north of Hillside	23,207	2.0	25,604	2.0	25,707	2.0	27,314	1.8
Egley Rd between Hillside & the Egley Road Site Access	20,988	1.9	23,219	1.8	23,318	1.8	24,933	1.7
Egley Rd (A320) between the Egley Road Site Assess and Mayford Roundabout	21,682	1.8	24,298	1.8	24,311	1.8	25,450	1.7
Egley Rd (A320) south of Mayford Roundabout	20,933	1.8	23,114	1.7	23,713	1.7	24,001	1.7
Mayford Green (B380)	15,002	1.6	16,434	1.6	16,249	1.6	16,658	1.6

Road Link	2018		2021 (Without Scheme)		2021 (With CC Scheme)		2021 (With CC & ER Schemes)	
	AADT	% HDV	AADT	% HDV	AADT	% HDV	AADT	% HDV
Guildford Rd / Westfield Rd (B380)	12,562	1.3	13,564	1.3	13,988	1.2	14,430	1.2
Egley Road Site Access	0	0.0	0	0.0	0	0.0	2,753	0.0

A3.4 Figure A3.1 shows the road network included within the model, along with the average speed (kph) at which each link was modelled.

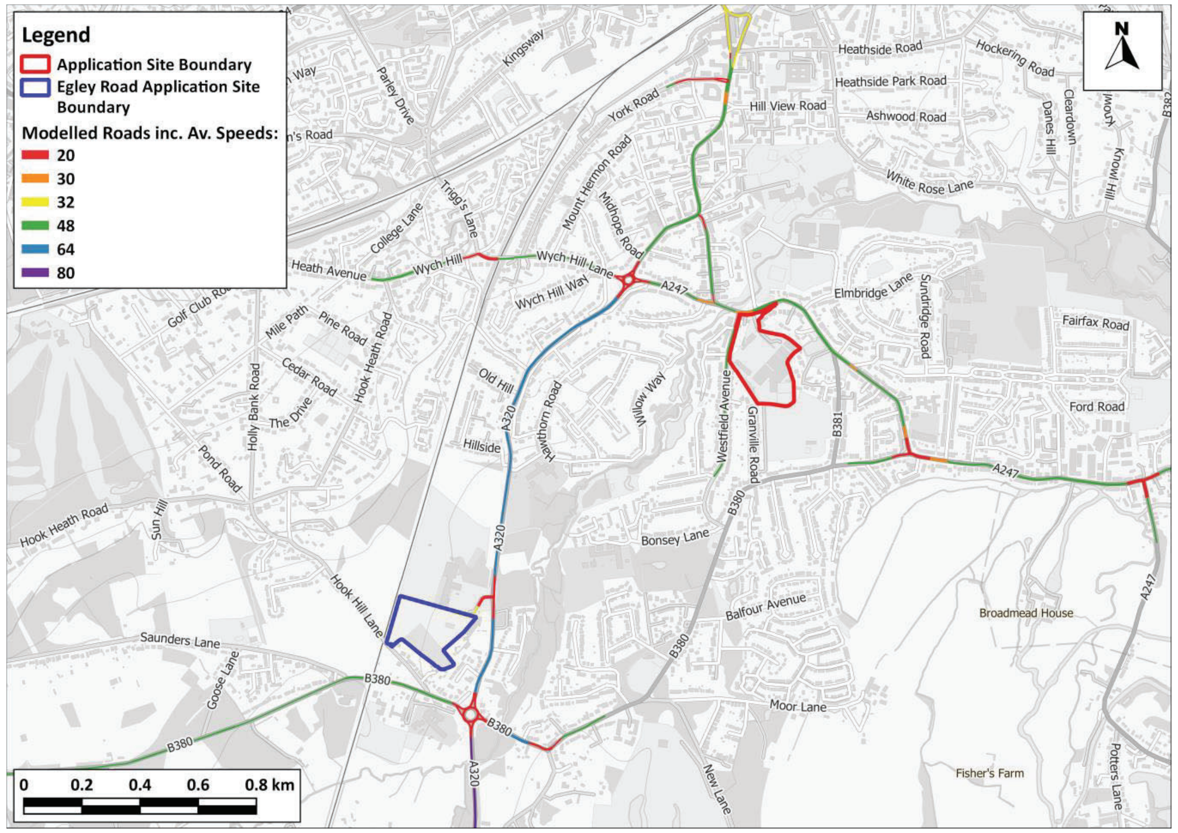

Figure A3.1: Modelled Road Network Including Average Speed (kph)

Sensitivity Test for Nitrogen Oxides and Nitrogen Dioxide

A3.5 AQC has carried out a detailed analysis which showed that, whereas previous standards had had limited on-road success in reducing nitrogen oxides emissions from diesel vehicles, the 'Euro VI' and 'Euro 6' standards are delivering real on-road improvements (AQC, 2016). Defra's EFT v9.0 takes account of these observed improvements, but also makes additional assumptions regarding the performance of diesel cars and vans that will be produced in the future. In particular, it assumes that diesel cars and vans registered for type approval after 2020 will, on average, emit significantly less NOx than earlier models. A sensitivity test has been carried out using AQC's CURED v3A model (AQC, 2017), which assumes that this post-2020 technology does not deliver any benefits. Further details of CURED v3A are provided in the supporting report prepared by AQC (2018a).

Point Sources

Energy Plant

A3.1 The impacts of emissions from the proposed five back-up boiler plant units have been predicted using the ADMS-5 dispersion model. ADMS-5 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. The model has been run to predict the contribution of the proposed back-up boiler plant emissions to annual mean concentrations of nitrogen oxides and the 99.79th percentile of 1-hour mean nitrogen oxides concentrations.

A3.2 The gas-fired boiler plant proposed to be installed into the Proposed Development will have a net fuel input of 239.6 kW (calculated gross input of 265.4 kW) per boiler. Emissions from each boiler unit will rise to roof level in an individual flue. The boiler plant will operate for the equivalent of 25% of the year (25% of the maximum annual load), with the modelling assuming that it is at full load when operational. The exhaust volume flow rate for the natural gas-fired plant has been calculated based on the complete combustion of the assumed natural gas composition in Table A3.2 and the following typical values for boilers of this size:

- 100% load;
- 83 ˚C exit temperature;
- 31% excess air in; and
- Condensing plant removing 50% of the water from the exhaust.

Table A3.2: Typical Gas Fuel Composition

Component	Natural Gas
Methane	90.76%
Ethane	4.64%
Propane	1.22%
Carbon Dioxide	1.07%
Nitrogen	2.32%
Net Calorific Value (LHV) (MJ/kg)	46.5
Gross Calorific Value (HHV) (MJ/kg)	51.5
HHV/LHV	1.11
Molecular Mass (g/mol)	17.61

A3.3 Entrainment of the plume into the wake of the buildings (the so-called building downwash effect) has been taken into account in the model. The building dimensions and flue locations have been obtained from drawings provided by Elementa Consulting. The locations of the flues are shown in Figure A3.3 along with the modelled buildings and their heights. The flues have been modelled at heights of 1.5 m above roof level.

A3.4 Hourly sequential meteorological data from Farnborough for 2018 have been used in the model, as detailed in Paragraph A3.2.

Egley Road Scheme Energy Plant

A3.5 The impacts of emissions from the proposed CHP plant and two[1] boiler plant unit have been predicted using the ADMS-5 dispersion model. I, following the same approach as described above.

A3.6 The gas-fired CHP plant proposed to be installed into the Proposed Egley Road Development will have a net fuel input of 432 kW_{th} (calculated gross input of 479 kW_{th}). Emissions will rise to roof level in a dedicated flue. A worst-case assumption has been made that the CHP unit will operate for the equivalent of 100% of the year, with the modelling assuming that it is at full load when operational. The exhaust volume flow rate for the natural gas-fired plant has been calculated based on the complete combustion of the assumed natural gas composition in Table A3.2 and the following typical values for CHP units of this size:

- 100% load; and
- 120 ˚C exit temperature.

A3.7 The gas-fired boiler plant proposed to be installed into the Egley Road development will have a net fuel input of 1,486 kW (calculated gross input of 1,646 kW). Emissions will rise to roof level. A

[1] There will be a third back-up boiler for emergencies, but only two boilers will be in use at any given time.

worst-case assumption has been made that the boiler plant will operate for the equivalent of 100% of the year, with the modelling assuming that it is at full load when operational. The exhaust volume flow rate for the natural-gas fired plant has been calculated based on the complete combustion of the assumed natural gas composition in Table A3.2 and the following typical values for boilers of this size:

- 100% load;
- 82 ˚C exit temperature;
- 40% excess air in; and
- Condensing plant removing 50% of the water from the exhaust.

A3.8 The emission parameters employed in the modelling are set out in Table A3.3. Further details of the energy plant parameters are provided in Appendix A5.

Table A3.3: Plant Specifications and Modelled Emissions and Release Conditions

Parameter	Value				
Proposed Development					
Gas Boilers – per unit (5 x Wessex Modumax mk3)					
Flue Internal Diameter (m)	0.4				
Calculated Actual Exhaust Volume Flow (m^3/s) [a]	0.110				
Calculated Exit Velocity (m/s)	0.8732				
Specified NOx Emission Rate (mg/kWh)	34.3				
Calculated Gross Fuel Input (kW)	265.4				
Calculated NOx Emission Rate (g/s)	0.00253				
Specified Exhaust Temperature (°C)	83				
Flue Locations (x,y)	500526 157420	500519 157376	500529 157292	500590 157218	500664 157207
Modelled Flue Height (m)	36	36	30.1	39	24
Egley Road Development					
CHP (ENER-G 150)					
Flue Internal Diameter (m)	0.2				
Calculated Actual Exhaust Volume Flow (m^3/s) [a]	0.185				
Calculated Exit Velocity (m/s)	5.8777				
Specified NOx Emission Rate (mg/Nm^3) [b]	250				
Calculated NOx Emission Rate (g/s)	0.03403				
Specified Exhaust Temperature (°C)	120				
Flue Location (x,y)	499384, 156444				
Modelled Flue Height (m)	11.5				
Gas Boilers – per unit (2 x Wessex Modumax)					
Specified Flue Internal Diameter (m)	0.2				
Calculated Actual Exhaust Volume Flow (m^3/s) [a]	0.362				
Calculated Exit Velocity (m/s)	11.539				
Specified NOx Emission Rate (mg/kWh)	38.8				
Calculated Gross Fuel Input (kW)	822.8				
Calculated NOx Emission Rate (g/s)	0.00887				
Specified Exhaust Temperature (°C)	82				
Flue Locations (x,y)	499384, 156444				
Modelled Flue Height (m)	11.5				

[a] Not normalised.

[b] 'Normal' here refers to 5% O_2, 0˚C, 101.325 kPa and 0% H_2O.

A3.9 Entrainment of the plume into the wake of the buildings (the so-called building downwash effect) has been taken into account in the model. The building dimensions and flue location have been obtained from drawings provided by Leach Rhodes Walker. The location of the flue is shown in Figure A3.3 along with the modelled buildings.

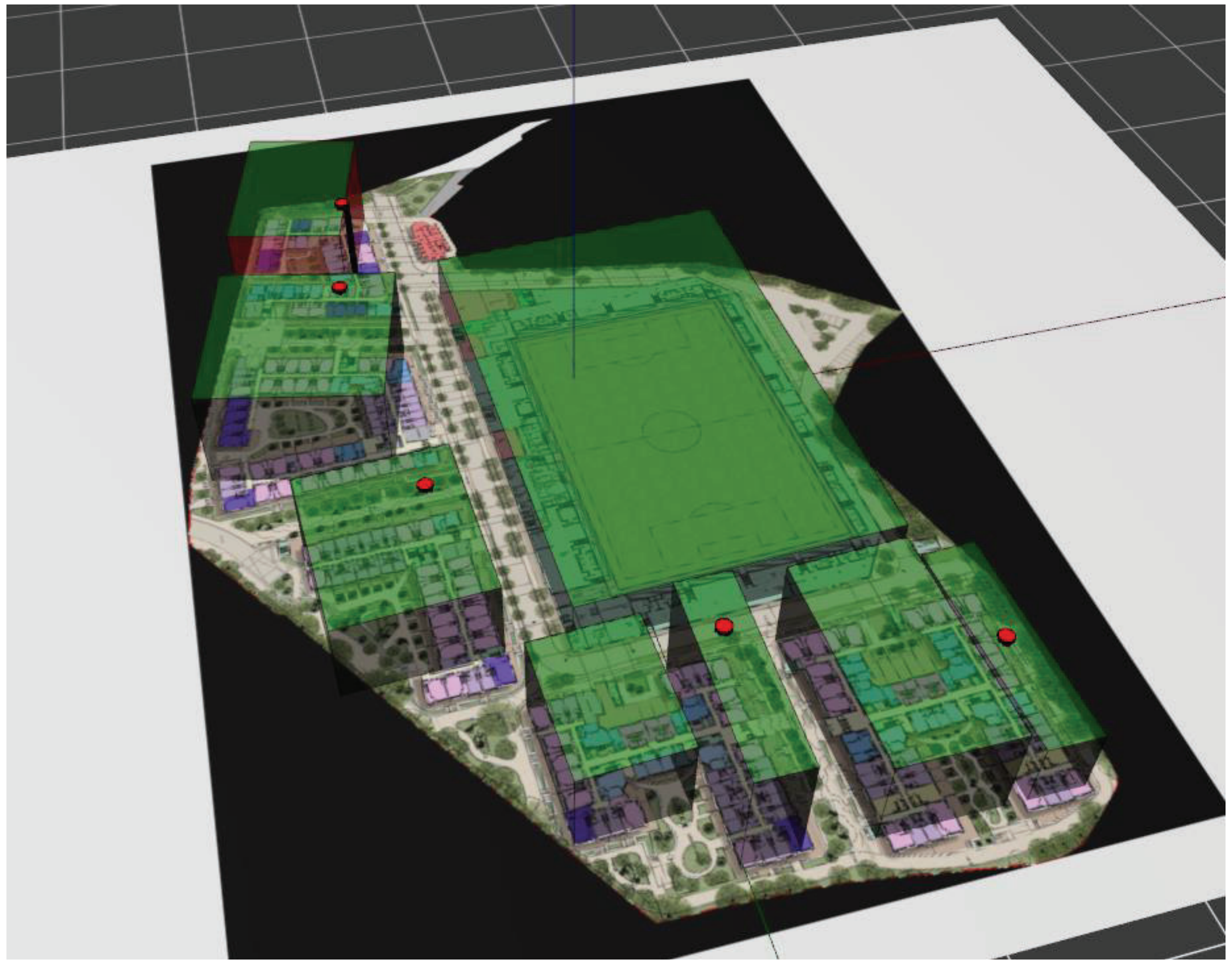

Figure A3.2: Proposed Development - Flue Location & Modelled Buildings

Contains data from Leach Rhodes Walker Architects drawing no. 7884-L(00)79L.

Figure A3.3: Egley Road Scheme - Flue Location & Modelled Buildings

Contains data from Leach Rhodes Walker Architects drawing no.7884-L(00)103J.

A3.10 Hourly sequential meteorological data from Farnborough for 2018 have been used in the model, as detailed in Paragraph A3.2.

Background Concentrations

A3.11 The background pollutant concentrations across the study area have been defined using the 2017-based national pollution maps published by Defra (2019c). These cover the whole of the UK on a 1x1 km grid and are published for each year from 2017 until 2030. The background annual mean nitrogen dioxide maps for 2018 have been calibrated against concurrent measurements from national monitoring sites (AQC, 2019b). The calibration factor calculated has also been applied to future year backgrounds. This has resulted in slightly higher predicted nitrogen dioxide concentrations for the future assessment year than those derived from the Defra maps.

Background NO_2 Concentrations for Sensitivity Test

A3.12 The road-traffic components of nitrogen dioxide in the Defra's 2015-based background maps have been uplifted in order to derive future year background nitrogen dioxide concentrations for use in the sensitivity test. Details of the approach are provided in the report prepared by AQC (2018b). CURED v3A is largely based on the assumptions within EFT v8.0.1, and it would not be appropriate to make adjustments to Defra's latest tools, such as the 2017-based background maps, to enable their use alongside it; this is why the 2015-based background maps have been used for the sensitivity test.

Model Verification

A3.13 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. Seven local diffusion tube monitoring sites located adjacent to Guildford Road (A320) have been used to verify the model; sites YR, YR1, LTK, CH, CH2, CH3 and CH4.

A3.14 It is not practical, nor usual, to verify the ADMS-5 model, and, because ADMS-5 does not rely on estimated road-vehicle emission factors, the adjustment used for ADMS-Roads cannot be applied to ADMS-5. Predictions made using ADMS-5 have thus not been verified.

Background Concentrations

A3.15 The 2018 background concentrations for the monitoring sites have been derived from the national maps, having been calculated using the same approach as described in Paragraph A3.11, and are presented in Table A3.4.

Table A3.4: Background Annual Mean Concentrations used in the Verification for 2018 (μg/m^3)

Site	NO_2
YR	17.7
YR1	17.7
LTK	17.7
CH	17.7
CH2	17.7
CH3	17.7
CH4	14.7
Objective	40

Traffic Data

A3.16 Traffic data used for the model verification is as described in Paragraphs A3.3 and A3.4 and presented in Table A3.1 and Figure A3.1.

Nitrogen Dioxide

A3.17 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2018 at the YR, YR1, LTK, CH, CH2, CH3 and CH4 monitoring sites at heights of 2.9 m, 2.7 m, 2.5 m, 2.5 m, 2.5 m, 2.5 m and 2.4 m, the respective heights of the monitoring sites.

A3.18 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 7.1) available on the Defra LAQM Support website (Defra, 2019c).

A3.19 The unadjusted model has under-predicted the road-NOx contribution; this is a common experience with this and most other road traffic emissions dispersion models. An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A3.4 and Figure A3.5). The calculated adjustment factor of 3.735 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations, for the 'official' emission predictions scenario. For the sensitivity test scenario the calculated adjustment factor of 3.921 has been applied.

A3.20 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure A3.6 and Figure A3.7 compare final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and show a close agreement.

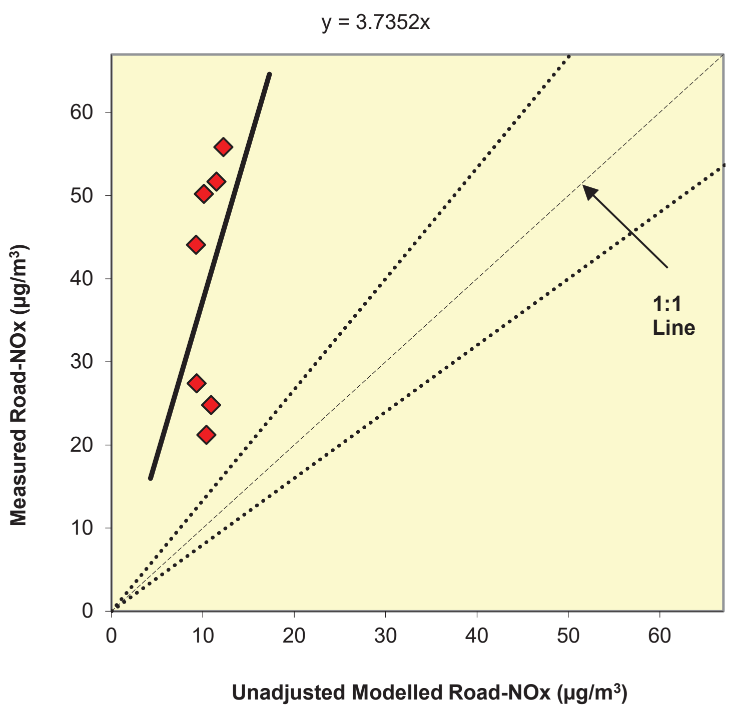

Figure A3.4: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations for the 'Official' Scenario. The dashed lines show ± 25%.

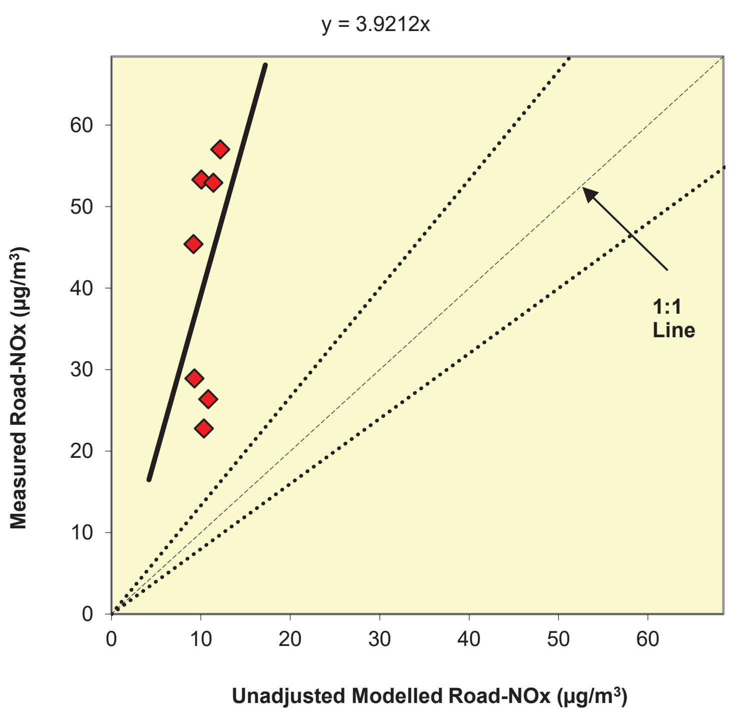

Figure A3.5: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations for the 'Sensitivity Test' Scenario. The dashed lines show ± 25%.

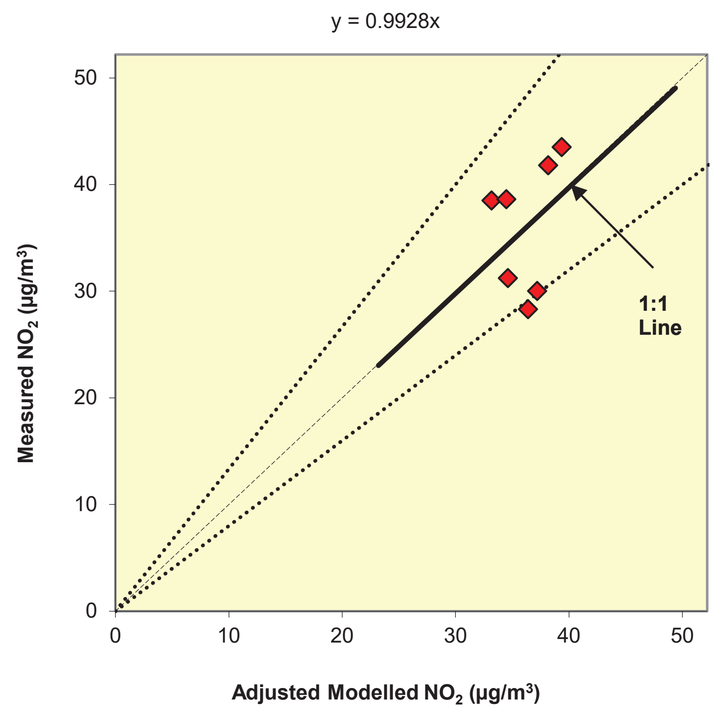

Figure A3.6: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations for the 'Official' Scenario. The dashed lines show ± 25%.

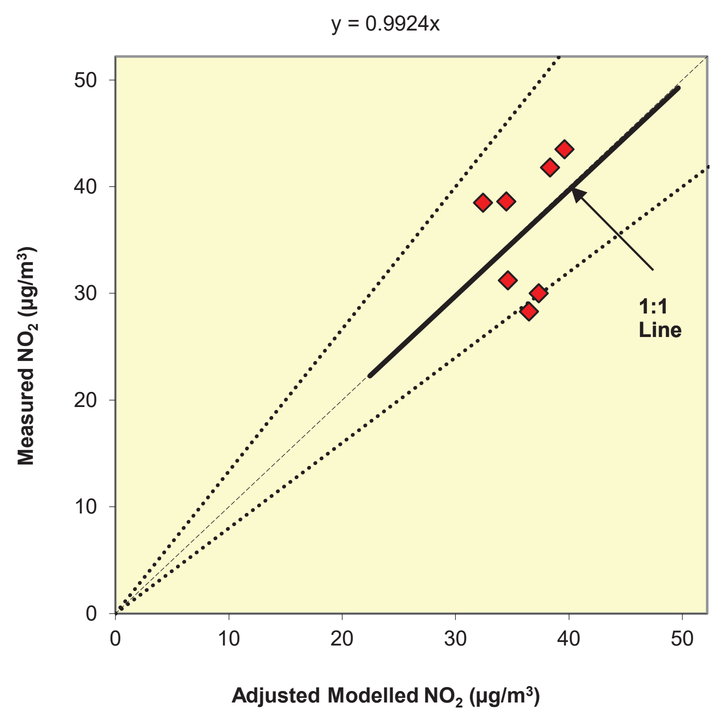

Figure A3.7: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations for the 'Sensitivity Test' Scenario. The dashed lines show ± 25%.

3.20.1 Table A3.5 shows the statistical parameters relating to the performance of the model, as well as the 'ideal' values (Defra, 2018b). The values calculated for the model demonstrate that it is performing within the range that is considered by Defra to be acceptable.

Table A3.5: Statistical Model Performance

Statistical Parameter	Model-Specific Value	'Ideal' Value
'Official' Scenario		
Correlation Coefficient [a]	0.29	1
Root Mean Square Error (RMSE) [b]	5.40	0
Fractional Bias [c]	-0.01	0
'Sensitivity Test' Scenario		
Correlation Coefficient [a]	0.25	1
Root Mean Square Error (RMSE) [b]	5.52	0
Fractional Bias [c]	-0.01	0

[a] Used to measure the linear relationship between predicted and observed data. A value of zero means no relationship and a value of 1 means absolute relationship.

[b] Used to define the average error or uncertainty of the model. The units of RMSE are the same as the quantities compared (i.e. μg/m^3). TG16 (Defra, 2018b) outlines that, ideally, a RMSE value within 10% of the air quality objective (4μg/m^3) would be derived. If RMSE values are higher than 25% of the objective (10 μg/m^3) it is recommended that the model is revisited.

[c] Used to identify if the model shows a systematic tendency to over or under predict. Negative values suggest a model over-prediction and positive values suggest a model under-prediction.

PM_{10} and $PM_{2.5}$

A3.21 There are no nearby PM_{10} or $PM_{2.5}$ monitors. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the adjustment factor calculated for road NOx.

Model Post-processing

Road Traffic

A3.22 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2019c). The traffic mix within the calculator has been set to "All other urban UK traffic", which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2. Version 7.1 of the calculator has been used alongside the EFT v9.0 emission factors, while version 6.1 has been used for the CURED v3A sensitivity test (see Paragraph A3.12 for the reasoning behind this).

Point Sources

A3.23 Emissions from the proposed CHP and boiler plant will be predominantly in the form of nitrogen oxides (NOx) and PM_{10}. ADMS-5 has been run to predict the contribution of the proposed plant emissions to annual mean concentrations of nitrogen oxides and to the 99.79th percentile of 1-hour mean nitrogen oxides concentrations. The approach recommended by the Environment Agency (2005) has been used to predict nitrogen dioxide concentrations, assuming that:

- annual mean NO_2 concentration = annual mean NOx concentration multiplied by 0.7; and
- 99.79th percentile of 1-hour mean NO_2 concentrations = 99.79th percentile of 1-hour mean NOx concentrations multiplied by 0.35.

A4 Construction Dust Assessment Procedure

A4.1 The criteria developed by IAQM (2016), divide the activities on construction sites into four types to reflect their different potential impacts. These are:

- demolition;
- earthworks;
- construction; and
- trackout.

A4.2 The assessment procedure includes the four steps summarised below:

STEP 1: Screen the Need for a Detailed Assessment

A4.3 An assessment is required where there is a human receptor within 350 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s), or where there is an ecological receptor within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

A4.4 Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is *negligible* and that any effects will be 'not significant'. No mitigation measures beyond those required by legislation will be required.

STEP 2: Assess the Risk of Dust Impacts

A4.5 A site is allocated to a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude (Step 2A); and
- the sensitivity of the area to dust effects (Step 2B).

A4.6 These two factors are combined in Step 2C, which is to determine the risk of dust impacts with no mitigation applied. The risk categories assigned to the site may be different for each of the four potential sources of dust (demolition, earthworks, construction and trackout).

Step 2A – Define the Potential Dust Emission Magnitude

A4.7 Dust emission magnitude is defined as either 'Small', 'Medium', or 'Large'. The IAQM guidance explains that this classification should be based on professional judgement, but provides the examples in Table A4.1.

Table A4.1: Examples of How the Dust Emission Magnitude Class May be Defined

Class	Examples
	Demolition
Large	Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on site crushing and screening, demolition activities >20 m above ground level
Medium	Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level
Small	Total building volume <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 wetter months
	Earthworks
Large	Total site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry to due small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes
Medium	Total site area 2,500 m^2 – 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 m – 8 m in height, total material moved 20,000 tonnes – 100,000 tonnes
Small	Total site area <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 wetter months
	Construction
Large	Total building volume >100,000 m^3, piling, on site concrete batching; sandblasting
Medium	Total building volume 25,000 m^3 – 100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching
Small	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber)
	Trackout [a]
Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m
Medium	10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m
Small	<10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m

[a] These numbers are for vehicles that leave the site after moving over unpaved ground.

Step 2B – Define the Sensitivity of the Area

A4.8 The sensitivity of the area is defined taking account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM_{10}, the local background concentration; and
- site-specific factors, such as whether there are natural shelters to reduce the risk of wind-blown dust.

A4.9 The first requirement is to determine the specific sensitivities of local receptors. The IAQM guidance recommends that this should be based on professional judgment, taking account of the principles in Table A4.2. These receptor sensitivities are then used in the matrices set out in, Table A4.4 and Table A4.5 to determine the sensitivity of the area. Finally, the sensitivity of the area is considered in relation to any other site-specific factors, such as the presence of natural shelters etc., and any required adjustments to the defined sensitivities are made.

Step 2C – Define the Risk of Impacts

A4.10 The dust emission magnitude determined at Step 2A is combined with the sensitivity of the area determined at Step 2B to determine the *risk* of impacts with no mitigation applied. The IAQM guidance provides the matrix in Table A4.6 as a method of assigning the level of risk for each activity.

STEP 3: Determine Site-specific Mitigation Requirements

A4.11 The IAQM guidance provides a suite of recommended and desirable mitigation measures which are organised according to whether the outcome of Step 2 indicates a low, medium, or high risk. The list provided in the IAQM guidance has been used as the basis for the requirements set out in Appendix A6.

STEP 4: Determine Significant Effects

A4.12 The IAQM guidance does not provide a method for assessing the significance of effects before mitigation, and advises that pre-mitigation significance should not be determined. With appropriate mitigation in place, the IAQM guidance is clear that the residual effect will normally be 'not significant'.

A4.13 The IAQM guidance recognises that, even with a rigorous dust management plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all of the time, for instance under adverse weather conditions. The local community may therefore experience occasional, short-term dust annoyance. The scale of this would not normally be considered sufficient to change the conclusion that the effects will be 'not significant'.

Table A4.2: Principles to be Used When Defining Receptor Sensitivities

Class	Principles	Examples
Sensitivities of People to Dust Soiling Effects		
High	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 a to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land	dwellings, museum and other culturally important collections, medium and long term car parks and car showrooms
Medium	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	parks and places of work
Low	the enjoyment of amenity would not reasonably be expected; or 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	playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads
Sensitivities of People to the Health Effects of PM_{10}		
High	locations where members of the public may be exposed for eight hours or more in a day	residential properties, hospitals, schools and residential care homes
Medium	locations where the people exposed are workers, and where individuals may be exposed for eight hours or more in a day.	may include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}
Low	locations where human exposure is transient	public footpaths, playing fields, parks and shopping streets
Sensitivities of Receptors to Ecological Effects		
High	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	Special Areas of Conservation with dust sensitive features
Medium	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	Sites of Special Scientific Interest with dust sensitive features
Low	locations with a local designation where the features may be affected by dust deposition	Local Nature Reserves with dust sensitive features

Table A4.3: Sensitivity of the Area to Dust Soiling Effects on People and Property [2]

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		<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

[2] For demolition, earthworks and construction, distances are taken either from the dust source or from the boundary of the site. For trackout, distances are measured from the sides of roads used by construction traffic. Without mitigation, trackout may occur from roads up to 500 m from sites with a *large* dust emission magnitude for trackout, 200 m from sites with a *medium* dust emission magnitude and 50 m from sites with a *small* dust emission magnitude, as measured from the site exit. The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road.

Table A4.4: Sensitivity of the Area to Human Health Effects [2]

Receptor Sensitivity	Annual Mean PM_{10}	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
High	>32 $\mu g/m^3$	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32 $\mu g/m^3$	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	24-28 $\mu g/m^3$	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24 $\mu g/m^3$	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32 $\mu g/m^3$	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32 $\mu g/m^3$	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28 $\mu g/m^3$	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24 $\mu g/m^3$	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table A4.5: Sensitivity of the Area to Ecological Effects [2]

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

Table A4.6: Defining the Risk of Dust Impacts

Sensitivity of the Area	Dust Emission Magnitude		
	Large	Medium	Small
Demolition			
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible
Earthworks			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Construction			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible
Trackout			
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

A5 Energy Plant Specifications

Woking Football Club Scheme Plant (Proposed Development)

A5.1 The Proposed Development will be provided with heat and hot water using five natural gas-fired boilers, one to be located within each of the five proposed residential apartment blocks. Specifications for these plant, upon which the assessment has been based, are shown in Table A5.1

Table A5.1: Boiler Plant Specifications (Per Unit)

Parameter	Value	Restriction
Gross Peak Fuel Input (kW)	265.4	Max
Hours of Use per Annum	2,190	Max
Annual Fuel Input (kWh/annum)	581,157	Max
Exhaust Temperature (°C)	83	Min
Flue Internal Diameter (m)	0.4	Max
Efflux Velocity (m/s)	0.87315	Min
NOx Emission Rate (mg/kWh)	0.00253	Max

A5.2 The restrictions set out in Table A5.1 should be adhered in order to ensure that the final plant design does not lead to impacts greater than those modelled. To further emphasise these, the final design should adhere to the following minimum specifications:

- a boiler system with a maximum total of 1.198 MkW fuel input (distributed evenly between five boilers) will be installed; each boiler with its own individual flue outlet with a maximum internal diameter of 0.4 m at the exit point, terminating at least 1.5 m above the roof level;
- all stacks should discharge vertically upwards and be unimpeded by any fixture on top of the stack (e.g., rain cowls or 'Chinaman's Hats');
- the gas boilers must conform to a maximum NOx emission of 34.3 mg/kWh. Compliance with this standard will be confirmed prior to occupation, based on:
  - monitoring undertaken on the actual installed plant; or
  - manufacturer guaranteed performance levels supported by type approval monitoring undertaken by the equipment supplier.
- in order to attain these values, relevant catalyst or alternative abatement may be required.

A5.3 If the design of the energy centre deviates significantly from the modelled specification, additional future modelling may be required in order to ensure that there are no significant adverse air quality impacts.

A5.4 The measures set out in Technical Guidance Note D1 (Dispersion) (1993) should also be adhered to in order to ensure adequate dispersion of emissions from discharging stacks and vents. These include the following:

- Discharges should be vertically upwards and unimpeded by cowls or any other fixtures on top of the stack. However, the use of coning or of flame traps at the tops of stacks is acceptable. In the case of discharge stacks (whether single or multiple stack) with shrouds or casings around the stack(s), the stack(s) alone should extend above the shroud or casing. This extension should be at least 50% of the shroud or casing's greatest lateral dimension;
- Irrespective of the pollutant discharge, there are minimum discharge stack heights based on the heat release and the discharge momentum. These can be calculated following calculations set out in the guidance note, but the absolute minimum value is 1 m;
- No discharge stack should be less than 3 m above the ground or any adjacent area to which there is general access. For example, roof areas and elevated walkways;
- A discharge stack should never be less than the height of any building within a distance of 5 times the stack height; and
- A discharge stack should be at least 3 m above any opening windows or ventilation air inlets within a distance of 5 times the stack height.

Egley Road Scheme Plant

A5.5 The Egley Road development will be provided with heat, hot water and some electricity using a small natural gas-fired CHP unit and three additional natural gas-fired boilers to be located within the proposed leisure centre. One of the boiler plant will be used as a backup, and so only the emissions from two boilers have been modelled. Specifications for these plant, upon which the assessment has been based, are shown in Table A5.2.

Table A5.2: Energy Plant Specifications

Parameter	Value	Restriction
CHP		
Gross Peak Fuel Input (kW)	432.0	Max
Hours of Use per Annum	8,760	Max
Annual Fuel Input (kWh/annum)	4,191,318	Max
Exhaust Temperature (°C)	120	Min
Flue Internal Diameter (m)	0.2	Max
Efflux Velocity (m/s)	5.8777	Min
NOx Emission Rate (mg/Nm^3)	0.03403	Max
Boiler		
Gross Peak Fuel Input (kW)	742.9	Max
Hours of Use per Annum	8,760	Max
Annual Fuel Input (kWh/annum)	7,207,708	Max
Exhaust Temperature (°C)	82	Min
Flue Internal Diameter (m)	0.2	Max
Efflux Velocity (m/s)	11.539	Min
NOx Emission Rate (mg/kWh)	38,8	Max
Condensing	Yes	-

A5.6 The restrictions set out in Table A5.2 should be adhered in order to ensure that the final plant design does not lead to impacts greater than those modelled.

A6 Construction Mitigation

A6.1 The following is a set of best-practice measures from the IAQM guidance (IAQM, 2016) that should be incorporated into the specification for the works. These measures should ideally be written into a Dust Management Plan. Some of the measures may only be necessary during specific phases of work, or during activities with a high potential to produce dust, and the list should be refined and expanded upon in liaison with the construction contractor when producing the Dust Management Plan

Communications

- develop and implement a stakeholder communications plan that includes community engagement before and during work 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 environmental manager/engineer or the site manager; and
- display the head or regional office contact information.

Dust Management Plan

- Develop and implement a Dust Management Plan (DMP) approved by the Local Authority which documents the mitigation measures to be applied, and the procedures for their implementation and management.

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; and
- hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.

Monitoring

- Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust. Record inspection results, and make the log available to the Local

Authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of the site boundary, with cleaning to be provided if necessary;
- 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; and
- agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it is a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction (IAQM, 2018).

Preparing and Maintaining the Site

- Plan the site layout so that machinery and dust-causing activities are located away from receptors, as far as is possible;
- erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site;
- fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period;
- 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; and
- cover, seed, or fence stockpiles to prevent wind whipping.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all vehicles switch off their 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;
- impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on un-surfaced haul roads and work areas (if long haul routes are required these speeds may be

increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate);

- produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials; and
- implement a Travel Plan that supports and encourages sustainable staff travel (public transport, cycling, walking, and car-sharing).

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 and appropriate;
- use enclosed chutes, conveyors and covered skips;
- minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate; and
- 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.

Measures Specific to Demolition

- Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust);
- 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; and
- bag and remove any biological debris or damp down such material before demolition.

Measures Specific to Earthworks

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable;
- use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable; and
- only remove the cover from small areas during work, not all at once.

Measures Specific to Construction

- Avoid scabbling (roughening of concrete surfaces), if possible;
- 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;
- ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery; and
- for smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.

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; and

- access gates should be located at least 10 m from receptors, where possible.

A7 Policy Context and Assessment Criteria

Air Quality Strategy

A7.1 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives.

Medium Combustion Plant Directive (MCPD)

A7.2 Pollutant emissions from combustion plant with a rated input between 1 and 50 megawatts (MW_{th}) are regulated through the MCPD (The European Parliament and the Council of the European Union, 2015). The MCPD was transposed into UK law in January 2018 through an amendment to the Environmental Permitting Regulations (2018).

The Environmental Permitting (England and Wales) (Amendment) Regulations 2018

A7.3 The legislation sets emission limits to be applied from December 2018 for new plant and from 2025 or 2030 for existing plant (depending on the rated input). In addition to addressing emissions from plant with a rated input of 1 to 50 MW_{th}, as required by the MCPD, the amendment also introduces emission limits on all generator plant <1 MW_{th}. Generators whose sole purpose is maintaining power supply at a site during an on-site emergency, that are operated for the purpose of testing/maintenance for no more than 50 hours per year, will be exempt from the emission limits, but will be required to apply for an exemption with the regulating authority.

The boiler plant within the Proposed Development will not require a permit under these regulations, as their thermal input rates are below the 1 MW threshold. Clean Air Act 1993 & Environmental Protection Act

A7.4 Small combustion plant of less than 20 MW net rated thermal input are controlled under the Clean Air Act 1993 (1993). This requires the local authority to approve the chimney height. Plant which are smaller than 366 kW have no such requirement. The local authority's approval will, therefore, not be required for the plant to be installed in the Proposed Development.

A7.5 Measures to ensure adequate dispersion of emissions from discharging stacks and vents are included in Technical Guidance Note D1 (Dispersion) (1993), issued in support of the Environmental Protection Act (1990).

Clean Air Strategy 2019

A7.6 The Clean Air Strategy (Defra, 2019a) sets out a wide range of actions by which the UK Government will seek to reduce pollutant emissions and improve air quality. Actions are targeted at four main sources of emissions: Transport, Domestic, Farming and Industry. At this stage, there is no straightforward way to take account of the expected future benefits to air quality within this assessment.

Reducing Emissions from Road Transport: Road to Zero Strategy

A7.7 The Office for Low Emission Vehicles (OLEV) and Department for Transport (DfT) published a Policy Paper (DfT, 2018) in July 2018 outlining how the government will support the transition to zero tailpipe emission road transport and reduce tailpipe emissions from conventional vehicles during the transition. This paper affirms the Government's pledge to end the sale of new conventional petrol and diesel cars and vans by 2040, and states that the Government expects the majority of new cars and vans sold to be 100% zero tailpipe emission and all new cars and vans to have significant zero tailpipe emission capability by this year, and that by 2050 almost every car and van should have zero tailpipe emissions. It states that the Government wants to see at least 50%, and as many as 70%, of new car sales, and up to 40% of new van sales, being ultra-low emission by 2030.

A7.8 The paper sets out a number of measures by which Government will support this transition, but is clear that Government expects this transition to be industry and consumer led. If these ambitions are realised then road traffic-related NOx emissions can be expected to reduce significantly over the coming decades, likely beyond the scale of reductions forecast in the tools utilised in carrying out this air quality assessment.

Planning Policy

National Policies

A7.9 The National Planning Policy Framework (NPPF) (2019a) sets out planning policy for England. It states that the purpose of the planning system is to contribute to the achievement of sustainable development, and that the planning system has three overarching objectives, one of which 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 mitigating and adapting to climate change, including moving to a low carbon economy".

A7.10 To prevent unacceptable risks from air pollution, the NPPF states that:

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

and

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development".

A7.11 More specifically on air quality, the NPPF makes clear that:

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

A7.12 The NPPF is supported by Planning Practice Guidance (PPG) (Ministry of Housing, Communities & Local Government, 2019b), which includes guiding principles on how planning can take account of the impacts of new development on air quality. The PPG states that "*Defra carries out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU Limit Values*" and "*It is important that the potential impact of new development on air quality is taken into account … where the national assessment indicates that relevant limits have been exceeded or are near the limit*". The role of the local authorities is covered by the LAQM regime, with the PPG stating that local authority Air Quality Action Plans "*identify measures that will be introduced in pursuit of the objectives*". The PPG makes clear that "*…dust can also be a planning concern, for example, because of the effect on local amenity*".

A7.13 The PPG states 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…".

1.1 The PPG sets out the information that may be required in an air quality assessment, making clear that *"Assessments should be proportionate to the nature and scale of development proposed and the level of concern about air quality"*. It also provides guidance on options for mitigating air quality impacts, as well as examples of the types of measures to be considered. It makes clear that *"Mitigation options where necessary, will depend on the proposed development and should be proportionate to the likely impact".*

Local Transport Plan

A7.14 The Woking Borough Local Transport Strategy (Woking Borough Council & Surrey County Council, 2014) includes as one of its three Objectives the Objective to "*Manage congestion through Woking town centre and at other identified congestion hotspots through…implementing measures to improve air quality.*"

Local Policies

A7.15 The Woking Core Strategy (Woking Borough Council, 2012) was adopted by Woking Borough Council in October 2021 and includes the objective "*to maintain and improve air…quality…*". The Strategy also include a one Policy relating to dust emissions (Policy CS21 'Design') which states that "*Proposals for new development should meet the criteria below:…be designed to avoid significant harm to the environment and general amenity, resulting from…dust…or other releases*".

A7.16 The Development Management Policies Development Plan Document (Woking Borough Council, 2016) was adopted by Woking Borough Council in October 2016 and includes the following two relevant policies:

- Policy DM5 'Environmental Pollution' states that "*When assessed individually or cumulatively, development proposals should ensure that there will be no unacceptable impacts on…air quality…Development which has the potential, either individually or cumulatively, for an unacceptable impact on environmental amenity, biodiversity…by reason of pollution but is considered desirable for reasons of economic or wider social need will be expected to provide an appropriate scheme of mitigation…In assessing a scheme of mitigation, account will be taken of:*
    - *the location, design and layout of the proposed development; and*

    - *measures to bring levels of pollution to an acceptable level; and*
    - *measures to control…diffuse pollution; and*
    - *hour of operation.*

  Development will not be permitted if mitigation cannot be provided to an appropriate standard with an acceptable design, particularly in proximity to sensitive existing uses or sites…

  …In areas of existing…pollution, new development sensitive to the effects of that pollution is unlikely to be permitted where the presence of that sensitive development could threaten the ongoing viability of existing uses that are considered desirable for reasons of economic or wider social need, such as safeguarding industrial uses, through the imposition of undue operational constraints."; and

- Policy CM6 'Air and Water Quality' states that "*Development that has the potential, either individually or cumulatively, for significant emissions to the detriment of air quality, particularly in designated Air Quality Management Areas (declared under the Environment Act 1995) or in areas at risk of becoming an Air Quality Management Area, should include an appropriate scheme of mitigation which may take the form of on-site measures or, where appropriate, a financial contribution to off-site measures. An Air Quality Assessment will be required for schemes that meet the thresholds set out in paragraph 4.15* [i.e. development in excess of 10 dwellings or 1,000 m^2 other floorspace (or an equivalent combination) within or adjacent to a designated Air Quality Management Area AND / OR development in excess of 100 dwellings or 10,000 m^2 other floorspace (or an equivalent combination) anywhere in the Borough AND / OR development that falls within Class B2 of the Use Classes Order AND / OR all waste applications]. *Development in designated Air Quality Management Areas should take account of existing air pollution and include measures to mitigate its impact on future occupiers where possible and consistent with other policies of the Development Plan such as those on climate change and design…Development proposals that are likely to affect nationally and internationally designated wildlife sites such as Thames Basin Heaths Special Protection Areas (SPA) or Thursley, Ash, Pirbright and Chobnam Special Area of Conservation (SAC) through deteriorating air…quality will be required to carry out an assessment of the impacts, followed by avoidance and mitigation measures if necessary.*".

Air Quality Action Plans

National Air Quality Plan

A7.17 Defra has produced an Air Quality Plan to tackle roadside nitrogen dioxide concentrations in the UK (Defra, 2017); a supplement to the 2017 Plan (Defra, 2018a) was published in October 2018 and sets out the steps Government is taking in relation to a further 33 local authorities where shorter-term exceedances of the limit value were identified. Alongside a package of national measures, the 2017 Plan and the 2018 Supplement require those identified English Local Authorities (or the GLA in the case of London Authorities) to produce local action plans and/or feasibility studies. These plans and feasibility studies must have regard to measures to achieve the statutory limit values within the shortest possible time, which may include the implementation of a Clean Air Zone (CAZ). There is currently no straightforward way to take account of the effects of the 2017 Plan or 2018 Supplement in the modelling undertaken for this assessment; however, consideration has been given to whether there is currently, or is likely to be in the future, a limit value exceedance in the vicinity of the proposed development. This assessment has principally been carried out in relation to the air quality objectives, rather than the EU limit values that are the focus of the Air Quality Plan.

Local Air Quality Action Plan

A7.18 Woking Borough Council has declared two AQMAs for exceedances of the annual mean nitrogen dioxide objective, including one (AQMA Order 2) that is located within the study area. The Council has since developed an Air Quality Action Plan (Woking Borough Council & Amec Foster Wheeler, 2018) for this AQMA; this plan identifies road traffic emissions as the cause of exceedances predicted within the AQMA, and recommends road improvement measures such as cycling lanes and electric charging points to improve air quality.

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A9 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
ADMS-5	Atmospheric Dispersion Modelling System model for point sources
AQC	Air Quality Consultants
AQAL	Air Quality Assessment Level
AQMA	Air Quality Management Area
ASR	Annual Status Report
AURN	Automatic Urban and Rural Network
CAZ	Clean Air Zone
CHP	Combined Heat and Power
CURED	Calculator Using Realistic Emissions for Diesels
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMP	Dust Management Plan
EFT	Emission Factor Toolkit
EPUK	Environmental Protection UK
Exceedance	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
EU	European Union
EV	Electric Vehicle
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HMSO	Her Majesty's Stationery Office
IAQM	Institute of Air Quality Management
ICCT	International Council on Clean Transportation
JAQU	Joint Air Quality Unit
kph	Kilometres Per hour
kW	Kilowatt

LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
LGV	Light Goods Vehicle
$\mu g/m^3$	Microgrammes per cubic metre
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Nitrogen oxides (taken to be NO_2 + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
OLEV	Office for Low Emission Vehicles
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
$PM_{2.5}$	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance
RDE	Real Driving Emissions
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide