Appendix 12.3: Methodology

Construction Phase

The methodology for the construction phase dust assessment is set out in guidance from the Institute of Air Quality Management (IAQM)[1].

Significance Criteria

The IAQM guidance details criteria for assessing the sensitivity of an area to dust soiling and human health effects of PM_{10}, as summarised in Tables 12.3 to 12.7 below.

The guidance then goes on to provide significance criteria for the classification of dust soiling and human health effects from demolition, earthworks, construction activities and trackout, as summarised in Tables 12.8 to 12.10 below.

Step 1

Step 1 is to screen the requirement for a more detailed assessment. The guidance states that an assessment will normally be required where there are existing sensitive human receptors within 350m of the site boundary and/or within 100m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

With regards to ecological receptors, the guidance states that an assessment will normally be required where there are existing receptors within 50m of the site boundary and/or within 50m of the route(s) used by construction vehicles on the public highway, up to 500m from the site entrance(s).

Where any of these criteria are met, it is necessary to proceed to Step 2.

Step 2

Step 2 determines the potential risk of dust arising in sufficient quantities to cause annoyance and/or health or ecological impacts. The risk is related to:

- The activities being undertaken (demolition, number of vehicles and plant etc);
- The duration of these activities;
- The size of the site;
- The meteorological conditions (wind speed, direction and rainfall);
- The proximity of receptors to the activity;
- The adequacy of the mitigation measures applied to reduce or eliminate dust; and
- The sensitivity of receptors to dust.

The risk of dust impacts is determined using four risk categories: negligible, low, medium and high risk. A site is allocated to a risk category based upon the following two factors.

[1] Institute of Air Quality Management, Guidance on the Assessment of Dust from Demolition and Construction, February 2014

Step 2A assesses the scale and nature of the works which determines the potential dust emission magnitude as small, medium or large. Examples of how the magnitude may be defined are included in Table 12.3.

Table 12.3: Determining the Dust Emission Magnitude of Construction Phase Activities

Activity	Dust Emission Class		
	Large	**Medium**	**Small**
Demolition	Total building volume >50,000m^3; Potentially dusty construction material (e.g. concrete); On-site crushing and screening; Demolition activities >20m above ground level	Total building volume 20,000-50,000m^3; Potentially dusty construction material; Demolition activities 10-20m above ground level	Total building volume <20,000m^3; Construction material with low potential for dust release (e.g. metal cladding or timber)
Earthworks	Total site area >10,000m^2; Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size); >10 heavy earth moving vehicles active at any one time; Formation of bunds >8m in height; Total material moved >100,000 tonnes	Total site area 2,500-10,000m^2; Moderately dusty soil type (e.g. silt); 5-10 heavy earth moving vehicles active at any one time; Formation of bunds 4-8m in height; Total material moved 20,000-100,000 tonnes	Total site area <2,500m^2; Soil type with large grain size (e.g. sand); <5 heavy earth moving vehicles active at any one time; Formation of bunds <4m in height; Total material moved <20,000 tonnes; Earthworks during wetter months

Activity	Dust Emission Class		
	Large	**Medium**	**Small**
Construction	Total building volume >100,000m^3; On-site concrete batching; Sandblasting	Total building volume 25,000-100,000m^3; Potentially dusty construction material (e.g. concrete); On-site batching	Total building volume <25,000m^3; Construction material with a low potential for dust release (e.g. metal cladding or timber)
Trackout	>50 HDV (>3.5t) outward movements[a] in any one day[b]; Potentially dusty surface material (e.g. high clay content); Unpaved road length >100m	10-50 HDV (>3,5t) outward movements[a] in any one day[b]; Moderately dusty surface material (e.g. high clay content); Unpaved road length 50-100m	<10 HDV (>3.5t) outward movements[a] in any one day[b]; Surface material with low potential for dust release; Unpaved road length <50m
a. A vehicle movement is a one way journey i.e. from A to B, and excludes the return journey *b. HDV movements during a construction project may vary over its lifetime, and the number of movements is the maximum not the average*			

Step 2B considers the sensitivity of the area to dust impacts which is defined as low, medium or high. The sensitivity categories for different types of receptors are described in Table 12.4. Based on the sensitivity of individual receptors, the overall sensitivity of the area to dust soiling, human health and ecological effects is then determined using the criteria detailed in Tables 12.5 to 12.7, respectively.

Table 12.4: Sensitivity Categories for Dust Soiling, Human Health and Ecological Effects

Sensitivity Category	Dust Soiling Effects	Health effects of PM_{10}	Ecological Effects
High	Users can reasonably expect to enjoy a high level of amenity; Appearance, aesthetics or value of a property would be diminished; Examples include dwellings, museums	Locations where members of the public are exposed over a period of time relevant to the air quality objective for PM_{10}; Examples include residential properties, hospitals, schools, and residential care homes	Locations with an international or national designation and the designated features may be affected by dust soiling; Locations where there is a community of a particularly dust sensitive species;

Sensitivity Category	Dust Soiling Effects	Health effects of PM_{10}	Ecological Effects
	and other culturally important collections, medium and long term car parks and car show rooms		Examples include a Special Area of Conservation with dust sensitive features
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; The appearance, aesthetics or value of their property could be diminished; People or property wouldn't reasonably be expected to be continuously present or regularly for extended periods of time; Examples include parks and places of work	Locations where people are exposed as workers and exposure is over a period of time relevant to the air quality objective for PM_{10}; Examples include office and shop workers but will generally not include workers occupationally exposed to PM_{10}	Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown; Locations with a national designation where the features may be affected by dust deposition; Examples include a Site of Special Scientific Interest with dust sensitive features
Low	Enjoyment of amenity would not reasonably be expected; Property would not be diminished in appearance, aesthetics or value; People or property would be expected to be present only	Locations where human exposure is transient; Examples include public footpaths, playing fields, parks and shopping streets	Locations with a local designation where the features may be affected by dust deposition; Examples include a Local Nature Reserve with dust sensitive features

Sensitivity Category	Dust Soiling Effects	Health effects of PM_{10}	Ecological Effects
	for limited periods of time; Examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads		

Table 12.5: Sensitivity of the Area to Dust Soiling Effects on People and Property[ab]

Receptor Sensitivity	Number of Receptors	Distance from Source (m)[c]			
		<20m	<50m	<100m	<350m
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

a. The sensitivity to the area should be derived for each of the four activities
b. Estimate the total number of receptors within the stated distance. Only the highest level of sensitivity from the table needs to be considered
c. For trackout, distances should be measured from the side of the roads used by construction traffic. Without site specific mitigation, trackout may occur for up to 500m from large sites, 200m from medium sites and 50m from small sites, measured from the site exit. The impact declines with distance from the site and it is only necessary to consider trackout impacts up to 50m from the edge of the road

Table 12.6: Sensitivity of the Area to Human Health Impacts[ab]

Receptor Sensitivity	Annual Mean PM_{10} Concentration[c]	Number of Receptors[d]	Distance from Source (m)[e]				
			<20m	<50m	<100m	<200m	<350m
High	>32μg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	28-32μg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low

Receptor Sensitivity	Annual Mean PM_{10} Concentration[c]	Number of Receptors[d]	Distance from Source (m)[e]				
			<20m	<50m	<100m	<200m	<350m
	24-28µg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24µg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>32µg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	28-32µg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	24-28µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<24µg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

a. *The sensitivity to the area should be derived for each of the four activities*
b. Estimate the total number of receptors within the stated distance. Only the highest level of sensitivity from the table needs to be considered
c. Most straightforwardly taken from the national background maps, but should also take account of local sources. The values are based on 32µg/m^3 being the annual mean concentration at which an exceedance of the 24-hour mean objective is likely in England, Wales and Northern Ireland. In Scotland, there is an annual mean objective of 18µg/m^3
d. In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties
c. For trackout, distances should be measured from the side of the roads used by construction traffic

Table 12.7: Sensitivity of the Area to Ecological Impacts[abc]

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

a. *The sensitivity to the area should be derived for each of the four activities*
b. Only the highest level of sensitivity from the table needs to be considered
c. For trackout, distances should be measured from the side of the roads used by construction traffic

These two factors are combined in **Step 2C** to determine the risk of dust impacts with no mitigation applied.

The risk of dust effects is determined for four types of construction phase activities, with each activity being considered separately. If a construction phase activity is not taking place on the site, then it does not need to be assessed. The four types of activities to be considered are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

The risk of dust being generated by demolition activities at the site is determined using the criteria in Table 12.8.

Table 12.8: Risk of Dust Impacts for Demolition

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

The risk of dust being generated by earthworks and construction at the site is determined using the criteria in Table 12.9.

Table 12.9: Risk of Dust Impacts for Earthworks and Construction

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

The risk of dust being generated by trackout at the site is determined using the criteria in Table 12.10.

Table 12.10: Risk of Dust Impacts for Trackout

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

<u>Step 3</u>

Step 3 of the assessment determines the site-specific mitigation required for each of the activities, based on the risk determined in Step 2. Mitigation measures are detailed in guidance published by the Greater London Authority[2], recommended for use outside the capital by LAQM guidance, and the IAQM guidance document itself. Professional judgement should be used to determine the type and scale of mitigation measures required.

If the risk is classed as negligible, no mitigation measures beyond those required by legislation will be necessary.

Step 4

Step 4 assesses the residual effect, with mitigation measures in place, to determine whether or not these are significant.

Professional Judgement

The IAQM guidance makes reference to the use of professional judgement when assessing the risks of dust and PM_{10} from demolition and construction sites.

[11] Greater London Authority, The Control of Dust and Emissions from Construction and Demolition: Best Practice Guidance, 2006

Operational Phase

Assessing the Impact of a Proposed Development on Human Health

Guidance has been prepared by Environmental Protection UK (EPUK) and the IAQM[3] with relation to the assessment of the air quality impacts of proposed developments and their significance.

The impact of a development is usually assessed at specific receptors, and takes into account both the long term background concentrations, in relation to the relevant Air Quality Assessment Level (AQAL) at these receptors, and the change with the development in place.

The impact descriptors for individual receptors are detailed in Table 12.11.

Table 12.11: Impact Descriptors for Individual Receptors

Long Term Average Concentration at Receptor in Assessment Year*	Percentage Change in Concentration Relative to Air Quality Assessment Level (AQAL)*			
	1%	2-5%	6-10%	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109% of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial
**Percentage pollutant concentrations have been rounded to whole numbers, to make it easier to assess the impact. Changes of 0% (i.e. less than 0.5% or 0.2µg/m^3) should be described as Negligible*				

Determining the Significance of Effects

Impacts on air quality, whether adverse or beneficial, will have an effect on human health that can be judged as either ‘significant’ or ‘not significant’.

Once the impact of the proposed development has been assessed for the individual impacts, the overall significance is determined using professional judgement. This takes into account a number of factors such as:

- The existing and future air quality in the absence of the development;
- The extent of the current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

[3] Environmental Protection UK and Institute of Air Quality Management, Land-Use Planning and Development Control: Planning for Air Quality, January 2017

Ecological Receptors

The Guidance published by Natural England (NE)[4] provides advice on the assessment of road traffic emissions on sensitive designated habitat sites with international and/or European designations, i.e SAC (SCI or cSAC), SPA, pSPA and Ramsar sites. The screening criteria follow the superseded Design Manual for Roads and Bridges (DMRB) guidance, requiring that sites which are located within 200m of an 'affected' road, need to be considered.

Roads are deemed 'affected' if a proposed development leads to:

- A change in road alignment of 5m or more;
- A change in daily traffic flow of 1,000 AADT or more;
- A change in HGV flow of 200 AADT or more;
- A change in daily average speed of 10 kph or more; and
- A change in peak hour speed of 20kph or more.

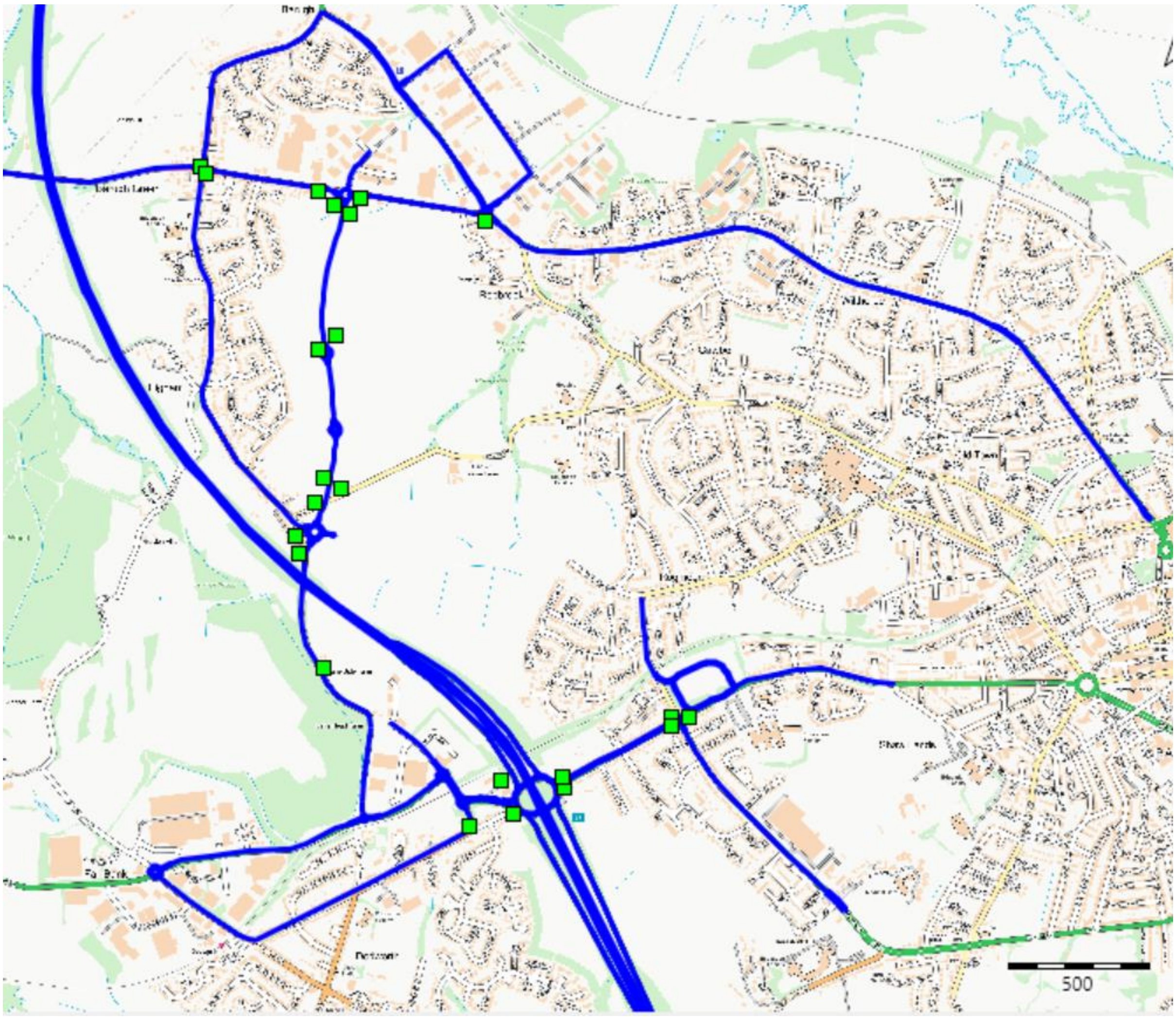
Air Dispersion Modelling Inputs

The air dispersion model ADMS-Roads (CERC, Version 5) has been used to assess the potential air quality impacts associated with development-generated road traffic emissions. This dispersion model is widely used and accepted for the purpose of undertaking assessments to support both planning and Environmental Permit applications.

Traffic Flow Data

The ADMS-Roads model requires the input of detailed road traffic flow data for those routes which may be affected by the proposed development. Traffic flow data has been provided for this project by Fore Consulting, the appointed transport consultants for the project. The study extent of the model is shown below.

[4] Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitat's Regulations (June 2018)



Data has been provided as 24-hour Annual Average Daily Traffic (AADT) flows, with HGV percentages. Average speed data was used where available; otherwise, speed limits were used, with a reduction to 20kph in locations where congestion or the slowing down of vehicles would be expected, including on the A628 between Pogmoor Crossroads and the M1 junction, as this section of road is subject to heavy congestion.

The traffic flow data used in the assessment is included in Table 13.12.

Table 13.12: Traffic data used in the air quality assessment

Link no	Link	2018 Base Year		2026 No Dev		2026 With Dev		2033 No Dev		2033 With Dev	
		AADT	HGV %	AADT	HGV %	AADT	HGV %	AADT	HGV %	AADT	HGV %
1	Cawthorne Road	8,574	2.19%	9,640	1.98%	9,895	2.39%	10,260	2.34%	9,274	2.55%
2	B6428 Barugh Lane	8,358	3.68%	9,397	3.33%	9,949	4.09%	10,001	4.12%	5,843	6.80%
3	Barugh Green Road	8,819	3.74%	9,915	3.39%	11,360	4.42%	10,553	4.83%	7,636	4.45%
4	Higham Common Road	6,645	3.17%	7,472	2.87%	9,299	5.60%	7,953	6.64%	4,953	6.81%
5	Barugh Green Road west	9,541	3.52%	10,728	3.18%	12,172	4.18%	11,418	4.51%	9,676	3.57%
6	Cannon Way	2,230	6.38%	2,508	5.77%	2,508	5.77%	2,669	5.50%	2,487	5.89%
7	Barugh Green Road east	9,906	3.68%	11,137	3.33%	12,502	4.30%	11,853	4.59%	22,566	2.37%
8	Site Access	N/A	N/A	0	N/A	1,390	0.00%	0	N/A	13,995	1.16%
9	Barugh Green Road west	10,309	3.37%	12,290	2.87%	13,655	3.81%	13,036	4.04%	22,424	2.30%
10	A637 Claycliffe Road	14,497	1.88%	16,473	1.69%	16,624	1.67%	17,521	1.61%	21,834	1.29%
11	Whaley Road	4,540	3.13%	5,105	2.83%	5,105	2.83%	5,433	2.70%	5,289	2.77%
12	A635	23,913	2.05%	27,413	1.82%	28,626	2.32%	29,142	2.31%	31,332	2.12%
13	M1 southbound off slip	7,334	3.18%	8,320	2.85%	8,510	3.18%	8,850	3.10%	9,567	2.84%
14	A628 Dodworth Road	26,872	3.51%	30,485	3.15%	30,869	3.41%	32,428	3.29%	32,988	3.20%
15	M1 southbound on slip	12,363	3.64%	14,023	3.26%	14,464	3.67%	14,917	3.61%	16,209	3.28%
16	M1 northbound off slip	12,011	4.55%	13,630	4.08%	14,076	4.48%	14,499	4.40%	16,056	3.93%
17	Whinby Road	25,313	4.09%	29,124	3.62%	30,773	4.41%	30,955	4.45%	40,083	3.37%
18	M1 northbound on slip	7,698	3.25%	8,726	2.92%	8,913	3.23%	9,282	3.14%	10,293	2.81%
19	Whinby Road east	24,476	4.16%	28,178	3.68%	29,827	4.49%	29,948	4.54%	39,446	3.38%
20	B6449	9,348	1.52%	10,654	1.36%	10,775	1.53%	11,330	1.48%	15,389	1.08%
21	Whinby Road north	19,043	4.90%	22,214	4.27%	23,983	5.31%	23,591	5.47%	32,224	3.91%
22	Capitol Close	1,388	7.38%	2,584	4.03%	2,584	4.03%	2,684	3.93%	18,482	2.25%
23	Whinby Road south	19,134	5.11%	22,316	4.46%	24,086	5.48%	23,699	5.65%	32,284	4.04%
24	Whinby Road west	18,246	4.86%	20,734	4.35%	22,504	5.46%	22,054	5.64%	14,604	6.26%
25	Higham Lane	9,086	2.69%	10,331	2.41%	12,469	5.04%	10,988	5.80%	5,620	5.36%
26	Whinby Road east	18,485	4.74%	20,997	4.25%	22,767	5.34%	22,334	5.52%	15,495	5.82%

27	Whinby Road west	14,884	5.16%	16,833	4.64%	17,201	4.86%	17,909	4.73%	18,821	4.47%
28	Higham Common Road north	9,280	2.45%	10,433	2.22%	10,956	2.11%	11,104	2.11%	7,644	3.06%
29	Site Access Employment	N/A	N/A	0	N/A	2,919	23.52%	0	N/A	2,919	16.00%
30	Site Access Link Road	N/A	N/A	0	N/A	0	0.00%	0	N/A	13,626	1.20%
31	Higham Common Road south	9,280	2.45%	10,433	2.22%	10,956	2.11%	11,104	2.11%	7,644	3.06%
32	Northbound North of J37	43,983	11.12%	49,901	11.12%	50,088	11.14%	52,045	11.12%	52,752	11.03%
33	Southbound North of J37	45,788	10.23%	51,949	10.23%	52,139	10.26%	54,181	10.23%	54,800	10.18%
34	Northbound South of J37	48,474	11.58%	54,996	11.58%	55,442	11.62%	57,359	11.58%	58,435	11.50%
35	Southbound South of J37	49,715	10.31%	56,404	10.31%	56,845	10.36%	58,827	10.31%	60,034	10.23%
36	Northbound between sliproads	36,463	13.90%	41,366	14.05%	41,366	14.05%	43,147	13.90%	42,379	14.35%
37	Southbound between sliproads	42,381	11.55%	48,084	11.60%	48,335	11.63%	50,149	11.55%	50,467	11.63%
41	A6133 Broadway	11,428	3.11%	12,849	3.11%	13,009	3.24%	13,675	3.11%	13,509	3.03%
42	Dodworth Road east	15,444	3.02%	17,365	3.02%	17,742	3.32%	18,481	3.02%	18,741	3.06%
43	Pogmoor Road	10,295	4.11%	11,575	4.11%	11,777	4.09%	12,319	4.11%	13,260	3.53%

Vehicle Emission Factors

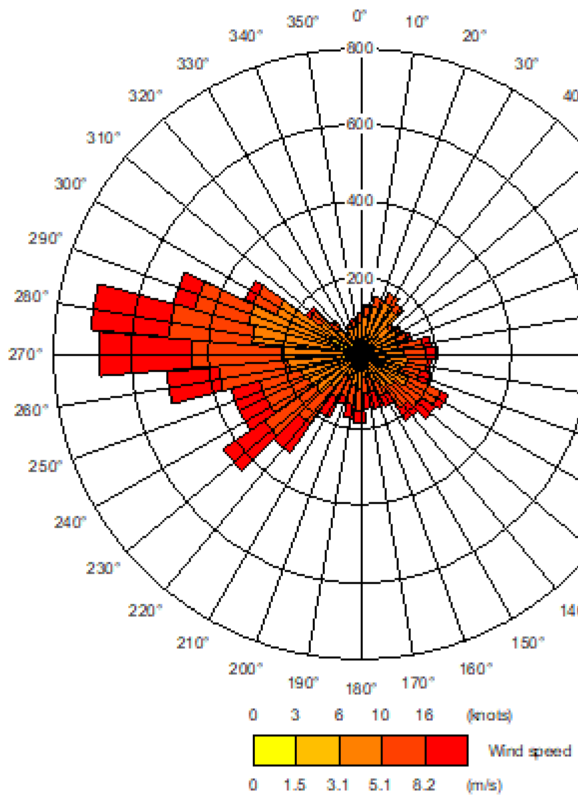
The air quality assessment has used vehicle emission factors calculated using the Emissions Factor Toolkit (EFT) version 10.1, released in August 2020. This is the most up-to-date version of the EFT currently available.

Meteorological Data

The meteorological data used in the air quality modelling has been obtained from ADM Limited and is from the Emley Moor recording station, covering the period between 1st January and 31st December 2018. This has complete data capture for wind and temperature.

The Emley Moor recording station is located approximately 10km north-west of the proposed development and is considered to be the most representative of the conditions at the proposed development, due to its relative location and similar altitude.

The 2018 wind rose for the Emley Moor meteorological recording station is shown below.



Dispersion and Meteorological Site Characteristics

The characteristics for the dispersion site and meteorological sites, included in the ADMS-Roads model, are detailed in Table 13.13.

Table 8.13: Dispersion and Meteorological Site Characteristics

Setting	Dispersion Site	Meteorological Site
Surface Roughness	0.5m	0.02m

Setting	Dispersion Site	Meteorological Site
Surface Albedo	0.23	0.23
Minimum Monin-Obukhov Length	30m	30m
Priestley-Taylor Parameter	1	1

NO_x to NO_2 Conversion

In accordance with the guidance within LAQM.TG(16), the ADMS-Roads model has been run to predict the road-contribution NO_x concentrations for each receptor location. These have then been converted to NO_2 concentrations using the Defra NO_x to NO_2 calculator[5].

Model Validation and Verification

LAQM.TG(16) refers to model validation as "the general comparison of modelled results against monitoring data carried out by model developers". ADMS-Roads is widely accepted by regulatory authorities for use in this type of assessment.

Model verification is used to check the performance of the model at a local level. The verification of the ADMS-Roads air dispersion model is achieved by modelling concentrations at existing monitoring locations in the vicinity of the proposed development, and comparing the modelled concentrations with the measured concentrations.

BMBC currently operates a number of roadside NO_2 diffusion tubes and one automatic monitor adjacent to roads in the area for which traffic flow information is available. These are located along the A628 Dodworth Road. A number of diffusion tubes were also set up by AECOM to support the Sheffield City Region Infrastructure Fund (SCRIF) work; this data has been provided to us and details of the tubes used in this assessment are included below.

The monitoring data which has been used in the model verification procedures for NO_2 and PM_{10} is detailed in Table 13.14 below.

Table 13.14: Details of monitoring locations used for model verification.

Monitoring Location Reference	Site Type	Approximate Grid Reference		2018 Bias Adjusted NO_2 Annual Average Concentration ($\mu g/m^3$)
		Easting	Northing	
AECOM 1	Roadside	431453	407966	21.15
AECOM 2a	Roadside	431073	408139	25.21
AECOM 2b	Roadside	431158	408046	27.87
AECOM 8	Roadside	431404	406895	23.26
AECOM 9	Roadside	431447	406356	29.21

[5] Defra Local Air Quality Management web pages (http://laqm.defra.gov.uk/tools-monitoring-data/no-calculator.html)

Monitoring Location Reference	Site Type	Approximate Grid Reference		2018 Bias Adjusted NO_2 Annual Average Concentration ($\mu g/m^3$)
		Easting	Northing	
AECOM 10	Roadside	431510	405804	24.47
BMBC CM2	Roadside	432680	406174	32.00
BMBC DT14	Roadside	432702	406160	39.40
BMBC DT20	Roadside	432535	406071	37.00
BMBC DT21	Roadside	432402	406013	45.80
BMBC DT22	Roadside	432351	405985	44.20
BMBC DT23	Roadside	432281	405951	43.40

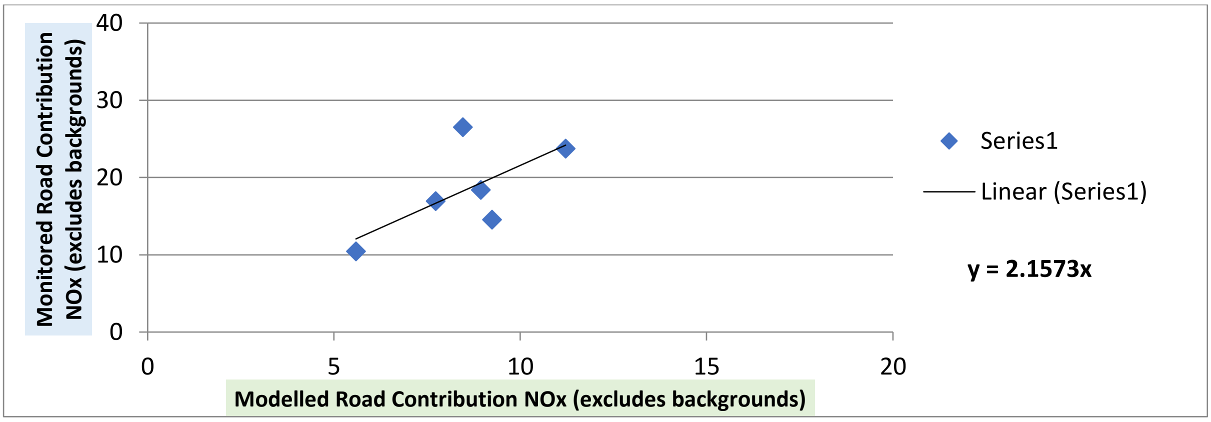
The modelled road-contribution NO_x concentration for the diffusion tube has been compared against the measured road-contribution NO_x concentration for the same location. The measured concentration has been derived using the Defra NO_x to NO_2 calculator, taking into account the background NO_x concentration for the local area.

It is considered that the area of BMBC's AQMA No.2A along the A628 Dodworth Road represents an area likely to be subject to traffic congestion which does not apply elsewhere in the study network and therefore, a separate adjustment factor was calculated for the BMBC automatic monitor CM2 and diffusion tubes DT14, DT20, DT21, DT 22 and DT23 located within this area and applied to the tubes and receptors in this area. Two tubes (DT18 and DT19) were excluded; DT18 as Street View imagery showed the tube obscured by thick foliage affecting dispersion around it, and DT19 because it was more than 5m from the nearest modelled roadside.

Following the model verification procedure for NO_2, an adjustment factor of 2.1573 was applied to NO_2 concentrations at ESRs 1 to 10 and ESRs 13 to 14 (outside AQMA No.2A), and an adjustment factor of 2.5903 applied to ESRs 11 to 12 and ESRs 15 to 17 inside AQMA No.2A.

<u>Model Validation and Verification – Outside AQMA No.2</u>

The comparison is shown in the below graph. The equation of the trend line is based on linear regression through zero, which provides an overall adjustment factor of 2.1573.



This adjustment factor has been applied to the modelled road-contribution NO_x concentrations. The total NO_2 concentrations have been derived by combining the adjusted road-contribution NO_x concentration and background NO_2 concentration, using the Defra NO_x to NO_2 calculator.

A final comparison has been made between the total measured NO_2 concentrations and total modelled NO_2 concentrations, as shown in Table 13.15. Following adjustment, modelled concentrations are within 25% of measured concentrations.

Table 13.15: Comparison Between Measured and Monitored NO_2 Concentrations

Monitoring Location Reference	Measured Total NO_2 Concentration (µg/m^3)	Modelled Total NO_2 Concentration (µg/m^3)	Difference (%)
AECOM 1	21.15	21.98	3.95
AECOM 2a	25.21	25.66	1.78
AECOM 2b	27.87	28.09	0.77
AECOM 8	23.26	25.98	11.69
AECOM 9	29.21	25.14	-13.95
AECOM 10	24.47	24.34	-0.55

A Root Mean Square Error (RMSE) calculation has been undertaken as part of the model verification for NO_2 concentrations. This has been carried out for the two monitoring locations included within the model verification, in accordance with the guidance detailed in LAQM.TG(16).

The RMSE calculation following adjustment is detailed in Table 13.16.

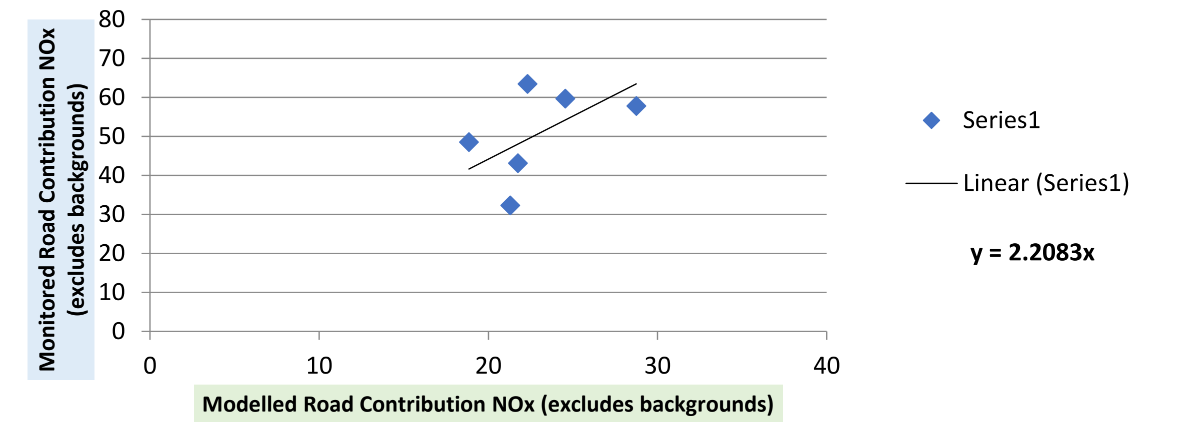
Table 13.16: RMSE Calculation for Nitrogen Dioxide Concentrations

Monitoring Location	After Verification				
	Observed Value	Predicted Value	Difference	RMSE	RMSE as %AQO
AECOM 1	21.15	21.98	-0.83	2.04	5.10%
AECOM 2a	25.21	25.66	-0.45		
AECOM 2b	27.87	28.09	-0.22		
AECOM 8	23.26	25.98	-2.72		
AECOM 9	29.21	25.14	4.07		
AECOM 10	24.47	24.34	0.13		

LAQM.TG(16) states that "ideally an RMSE value within 10% of the objective would be derived", a value of within 25% is considered acceptable. The results of the calculation show that following model verification, the RMSE value is within 10% (i.e. 4µg/m^3) of the objective (i.e. 40µg/m^3). Therefore, the model is considered to be performing to an acceptable standard.

Model Validation and Verification – Inside AQMA No.2

The comparison is shown in the below graph. The equation of the trend line is based on linear regression through zero, which provides an overall adjustment factor of 2.2083.



This adjustment factor has been applied to the modelled road-contribution NO_x concentrations. The total NO_2 concentrations have been derived by combining the adjusted road-contribution NO_x concentration and background NO_2 concentration, using the Defra NO_x to NO_2 calculator.

A final comparison has been made between the total measured NO_2 concentrations and total modelled NO_2 concentrations, as shown in Table 13.17. Following adjustment, modelled concentrations are within 25% of measured concentrations.

Table 13.17: Comparison Between Measured and Monitored NO_2 Concentrations

Monitoring Location Reference	Measured Total NO_2 Concentration ($\mu g/m^3$)	Modelled Total NO_2 Concentration ($\mu g/m^3$)	Difference (%)
BMBC CM2	32.00	39.40	23.13
BMBC DT14	39.40	36.92	-6.29
BMBC DT20	37.00	39.86	7.73
BMBC DT21	45.80	40.43	-11.72
BMBC DT22	44.20	42.62	-3.57
BMBC DT23	43.40	46.64	7.47

A Root Mean Square Error (RMSE) calculation has been undertaken as part of the model verification for NO_2 concentrations. This has been carried out for the two monitoring locations included within the model verification, in accordance with the guidance detailed in LAQM.TG(16).

The RMSE calculation following adjustment is detailed in Table 13.18.

Table 13.18: RMSE Calculation for Nitrogen Dioxide Concentrations

Monitoring Location	After Verification				
	Observed Value	Predicted Value	Difference	RMSE	RMSE as %AQO
BMBC CM2	32.00	39.40	-7.40	4.30	10.75%
BMBC DT14	39.40	36.92	2.48		
BMBC DT20	37.00	39.86	-2.86		
BMBC DT21	45.80	40.43	5.37		
BMBC DT22	44.20	42.62	1.58		
BMBC DT23	43.40	46.64	-3.24		

LAQM.TG(16) states that "ideally an RMSE value within 10% of the objective would be derived", a value of within 25% is considered acceptable. The results of the calculation show that following model verification, the RMSE value is within 10% (i.e. 4μg/m^3) of the objective (i.e. 40μg/m^3). Therefore, the model is considered to be performing to an acceptable standard.

There are no representative roadside PM_{10} or $PM_{2.5}$ monitoring locations along the road network for which traffic flow information is available. Therefore, PM_{10} and $PM_{2.5}$ concentrations have been adjusted using the appropriate NO_2 adjustment factor derived above for each receptor location.