APPENDIX 11.1
AIR QUALITY ASSESSMENT DETAILED METHODOLOGY

A11.1 Air Quality Assessment Detailed Methodology

Introduction

11.1 This appendix presents the technical information and data upon which the air quality assessment is based.

Construction Dust Assessment

11.2 Table A11.1 provides examples of the potential dust emissions classes for each of the construction activities, as provided in the IAQM 2014 'Guidance on the Assessment of Dust from Demolition and Construction'[1]. Noted not all the criteria need to be met for a particular class. Once the class has been determined, the risk category can be determined from the matrices presented in Tables 11.4 to 11.7 in Chapter 11 Air Quality.

Table A11.1: Criteria for the Potential Dust Emissions Class

Activity	Class	Example Criteria
Demolition	Large	Total Building volume >50,000m^3, potentially dusty construction material (e.g. concrete), on site crushing and screening, demolition activities >20m above ground level.
	Medium	Total Building volume 20,000-50,000m^3, potentially dusty construction material, demolition activities 10-20m above ground level.
	Small	Total Building volume <20,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.
Earthworks	Large	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 stockpile enclosures >8m in height, total material moved >100,000 tonnes.
	Medium	Total site area 2,500m^2 - 10,000m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of stockpile enclosures 4m-8m in height, total material moved 20,000 tonnes – 100,000 tonnes (where known).
	Small	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 stockpile enclosures <4m in height, total material moved <10,000 tonnes, earthworks during wetter months.
Construction	Large	Total Building volume >100,000m^3, piling, on site concrete batching, sand blasting.
	Medium	Total building volume 25,000 m^3 - 100,000m^3, potentially dusty construction material (e.g. concrete), on site concrete batching.
	Small	Total building volume <25,000m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
Trackout	Large	>50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay/silt content), unpaved road length >100m.

1 Institute of Air Quality Management, 2014, 'Guidance on the Assessment of Dust from Demolition and Construction.

Activity	Class	Example Criteria
	Medium	10-50 HDV (>3.5t) trips in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50-100m (high clay content).
	Small	<10 HDV (>3.5t) trips in any one day, surface material low potential for dust release, unpaved road length <50m.

11.3 Once the risk category has been defined, the significance of the likely dust effects can be determined, taking into account the factors that define the sensitivity of the surrounding area. Examples of the factors defining the sensitivity of the area, as set out in the IAQM guidance, are presented in Table A11.2.

Table A11.2: Examples of Factors Defining Sensitivity of the Area

Type of Effect	Sensitivity of Receptor	Examples
Sensitivities of People to Dust Soiling Effects	High	Users can reasonably expect a 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[1] to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks[2] and car showrooms.
	Medium	Users would expect[1] 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[1] to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. Indicative examples include parks and places of work.
	Low	The enjoyment of amenity would not reasonably be expected[1]; or property would not reasonably be expected[1] to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. Indicative examples include playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks[2] and roads.
Sensitivities of People to Health Effects of PM_{10}	High	Locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, relevant location would be one where individuals may be exposed for eight hours or more in a day).[3] Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.
	Medium	Locations where the people exposed are workers[4], and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include office and shop workers, but will generally not include workers occupationally exposed to PM_{10}, as protection is covered by Health and Safety at Work legislation.

Type of Effect	Sensitivity of Receptor	Examples
	Low	Locations where human exposure is transient.[5] Indicative examples include 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 such as vascular species included in the Red Data List For Great Britain[6]. Indicative examples include a Special Area of Conservation (SAC) designated for acid heathlands or a local site designated for lichens adjacent to the demolition of a large site containing concrete (alkali) buildings.
	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. Indicative example is a Site of Special Scientific Interest (SSSI) with dust sensitive features.
	Low	Locations with a local designation where the features may be affected by dust deposition. Indicative example is a local Nature Reserve with dust sensitive features.

1 People's expectations will vary depending on the existing dust deposition in the area.

2 Car parks can have a range of sensitivities depending on the duration and frequency that people would be expected to park their cars there, and the level of amenity they could reasonably expect whilst doing so. Car parks associated with work place or residential parking might have a high level of sensitivity compared to car parks used less frequently and for shorter durations, such as those associated with shopping. Cases should be examined on their own merits.

3 This follows Defra guidance as set out in LAQM.TG (16).

4 Notwithstanding the fact that the air quality objectives and limit values do not apply to people in the workplace, such people can be affected to exposure of PM_{10}. However, they are considered to be less sensitive than the general public as a whole because those most sensitive to the effects of air pollution, such as young children are not normally workers. For this reason workers have been included in the medium sensitivity category.

5 There are no standards that apply to short-term exposure, e.g. one or two hours, but there is still a risk of health impacts, albeit less certain.

6 Cheffing C. M. & Farrell L. (Editors) (2005), The Vascular Plant. Red Data List for Great Britain, Joint Nature Conservation Committee.

11.4 Table A11.3, Table A11.4 and Table A11.5 show how the sensitivity of the area may be determined for effects related to dust soiling (nuisance), human health and ecosystem respectively. Distances are to the dust source and so a different area may be affected by the on-Site works than by trackout (i.e. along the routes used to access the Site). The IAQM guidance advises that the highest level of sensitivity from each table should be recorded.

Table A11.3: Sensitivity of the Area to Dust Soiling Effects on People and Property

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

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

Table A11.4: Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors	Distance from the Source (m)				
			<20	<50	<100	<200	<350
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
	24-28μg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<24μg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Table A11.5: Sensitivity of the Area to Ecological Impacts

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

Completed Development Assessment

ADMS-Roads

11.5 The ADMS-Roads model is a comprehensive tool for investigating air pollution in relation to road networks. On review of the Site, and its surroundings, ADMS-Roads was considered appropriate for the assessment of the potential long and short term effects of the Development on air quality. The model uses advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of air pollutant concentrations. It can predict long-term and short-term concentrations, including percentile concentrations. The approach of using the ADMS-Roads model was previously provided to the Environmental Health Officer at South Ribble Borough Council (SRBC) in 2016 - see correspondence at the end of this Appendix.

11.6 ADMS-Roads model is a formally validated model, developed in the United Kingdom (UK) by CERC (Cambridge Environmental Research Consultants). This includes comparisons with data from the UK's air quality Automatic Urban and Rural Network (AURN) and specific verification exercises using standard field, laboratory and numerical data sets. CERC is also involved in European programmes on model harmonisation and their models were compared favourably against other E.U and U.S. EPA systems. Further information in relation to this is available from the CERC website at www.cerc.co.uk.

Model Scenarios

11.7 To assess the effect of the Development on local air quality, future 'without Development' and 'with Development' scenarios were assessed. The Development is anticipated to be completed in 2032, however emission rates and background maps are predicted only as far as 2030. 2030 has therefore been used to assess the future 'without Development' and 'with Development' scenarios, which represents a conservative assessment.

11.8 The year 2019 was also modelled to establish the existing baseline situation as this is the latest full year of available SRBC monitoring data. Base year traffic data for 2019 and meteorological data for 2019 were also used to be consistent with the verification year.

Traffic Data

11.9 Traffic flow data comprising Annual Average Daily Traffic (AADT) flows, traffic composition (% Heavy-Duty Vehicles (HDVs)) were used in the model as provided by WSP for the surrounding road network.

11.10 The methodology for calculating the expected change in vehicle trips as a result of the Development, once completed and operational, is set out in detail within Chapter 10 Transport and Access. For the future year flows, local traffic growth factors were applied to take into account traffic growth in the area.

11.11 Table A11.6 presents the traffic data used within the Air Quality Assessment.

Table A11.6: 24 hour AADT Data Used within the Assessment

Link Name	Speed (kph)	Base 2019		Without 2032		With 2032	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
B5254 (Northbound)	65	12320	2.5	14598	2.5	14978	2.5
B5254 (Southbound)	65	12668	1.9	16448	1.9	17207	1.9
A582 Lostock Ln (Eastbound)	70	33940	3.4	43592	3.4	45796	3.4
A582 Lostock Ln (Westbound)	66	31985	4.0	42360	4.0	43108	4.0

Link Name	Speed (kph)	Base 2019		Without 2032		With 2032	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
Stanifield Ln (Northbound)	65	10883	4.5	13641	4.5	14476	4.5
Stanifield Ln (Southbound)	62	9546	4.3	11345	4.3	11641	4.3
Farington Road (Eastbound)	70	18971	5.0	30275	5.0	30589	5.0
Farington Road (Westbound)	66	19209	5.4	27381	5.4	28231	5.4
A6 London Way (Northbound)	80	25667	1.6	29434	1.6	30090	1.6
A6 London Way (Southbound)	90	21099	1.7	24648	1.7	26440	1.7
J2/J3 A6 Lostock Ln (Eastbound)	77	18803	2.6	23635	2.6	24150	2.6
J2/J3 A6 Lostock Ln (Westbound)	77	13320	2.6	17313	2.6	18463	2.6
M65 Access (Northbound)	77	38437	3.7	44452	3.7	46077	3.7
M65 Access (Southbound)	77	31236	3.3	36435	3.3	41288	3.3
A582 Lostock Ln (Eastbound)	70	35189	3.3	44513	3.3	46717	3.3
A582 Lostock Ln (Westbound)	66	31809	3.9	41389	3.9	42137	3.9
Cuerden Way (Northbound)	65	9433	2.5	11101	2.5	11101	2.5
Cuerden Way (Southbound)	65	6244	2.8	7090	2.8	7090	2.8
J3/J4 A6 Lostock Ln (Eastbound)	77	14679	3.0	17944	3.0	18459	3.0
J3/J4 A6 Lostock Ln (Westbound)	77	13665	2.8	16630	2.8	17780	2.8
Three Rings Retail Park (Northbound)	50	1535	0.5	2569	0.5	2569	0.5
Three Rings Retail Park (Southbound)	50	3335	0.5	4726	0.5	4726	0.5
J2/J3 A6 Lostock Ln (Eastbound)	77	18803	2.5	23635	2.5	24150	2.5
J2/J3 A6 Lostock Ln (Westbound)	77	13320	2.6	17313	2.6	18463	2.6
B6258 (Northbound)	66	8884	3.5	10448	3.5	10562	3.5
B6258 (Southbound)	66	9218	3.1	10949	3.1	11242	3.1
J4/J5 A6 Lostock Ln (Eastbound)	77	18461	4.5	21845	4.5	22539	4.5
J4/J5 A6 Lostock Ln (Westbound)	77	15068	4.3	17540	4.3	19310	4.3
J4/9 A49 Wigan Rd (Northbound)	66	5533	3.2	7121	3.2	7414	3.2
J4/9 A49 Wigan Rd (Southbound)	66	6251	1.9	7398	1.9	8310	1.9
J3/J4 A6 Lostock Ln (Eastbound)	77	18803	3.0	23635	3.0	24150	3.0
J3/J4 A6 Lostock Ln (Westbound)	77	13320	3.2	17313	3.2	18463	3.2
M6 North (Northbound)	66	11379	5.8	12712	5.8	13613	5.8
M6 North (Southbound)	66	1020	6.9	620	6.9	2565	6.9
Church Rd (Eastbound)	77	4615	6.9	5029	6.9	5029	6.9
Church Rd (Westbound)	77	7003	6.0	7956	6.0	9008	6.0
M6 J8/5 (Northbound)	66	6063	8.4	6101	8.4	8046	8.4
M6 J8/5 (Southbound)	66	4173	8.1	4159	8.1	4835	8.1
J4/J5 A6 Lostock Ln (Eastbound)	77	18461	4.5	21845	4.5	22539	4.5
J4/J5 A6 Lostock Ln (Westbound)	77	15068	4.3	17540	4.3	19310	4.3
A5083 Stanified Ln (Northbound)	65	11360	4.2	13842	4.2	14400	4.2
A5083 Stanified Ln (Southbound)	62	7178	4.2	8464	4.2	8689	4.2
B5083 Lydiate Ln (Eastbound)	66	2158	3.1	2635	3.1	2681	3.1
B5083 Lydiate Ln(Westbound)	66	6286	4.2	7294	4.2	7310	4.2
B5254 Stanifield Lane (Northbound)	65	11360	4.7	13842	4.7	14400	4.7
B5254 Stanifield Lane (Southbound)	62	7178	5.3	8464	5.3	8689	5.3
J9/7 A49 (Northbound)	66	6813	2.0	8525	2.0	9415	2.0
J9/7 A49 (Southbound)	66	4855	1.7	5863	1.7	6158	1.7

Link Name	Speed (kph)	Base 2019		Without 2032		With 2032	
		AADT	%HDV	AADT	%HDV	AADT	%HDV
J7/13 A49 (Northbound)	66	9155	3.4	11498	3.4	12405	3.4
J7/13 A49 (Southbound)	66	7784	2.4	2488	2.4	2488	2.4
B5083 Lydiate Ln (Eastbound)	66	2158	3.2	2635	3.2	2681	3.2
B5083 Lydiate Ln (Westbound)	66	6286	4.2	7294	4.2	7310	4.2
M6 J8/5 (Northbound)	65	12207	6.1	12759	6.1	13436	6.1
M6 J8/5 (Southbound)	62	7986	8.8	8879	8.8	10824	8.8
M6 South (Northbound)	66	34826	7.0	38591	7.0	40470	7.0
M6 South (Southbound)	66	27092	7.2	30421	7.2	31169	7.2
M65 (Eastbound)	77	31236	7.7	36487	7.7	39488	7.7
M65 (Westbound)	77	38114	5.3	43972	5.3	44126	5.3
J4/9 A49 Wigan Rd (Northbound)	66	8368	3.2	10207	3.2	10500	3.2
J4/9 A49 Wigan Rd (Southbound)	66	6266	1.9	7415	1.9	8327	1.9
J9/7 A49 Wigan Rd (Northbound)	66	8251	2.5	10079	2.5	10372	2.5
J9/7 A49 Wigan Rd (Southbound)	66	6115	1.8	7249	1.8	8162	1.8
M65 Access (Northbound)	77	38437	3.7	44452	3.7	46077	3.7
M65 Access (Southbound)	77	31236	3.3	36435	3.3	41288	3.3
M65 (Westbound)	77	38114	3.7	43972	3.7	44126	3.7
Proposed Development Link (Eastbound)	60	0	0.0	0	0.0	4175	0.0
Proposed Development Link (Westbound)	60	0	0.0	0	0.0	11861	0.0
J7/13 A49 (Northbound)	66	9155	3.5	11498	3.5	12405	3.5
J7/13 A49 (Southbound)	66	7784	2.0	10359	2.0	10702	2.0
B5256 Lancaster Ln (Eastbound)	60	5130	1.5	5732	1.5	5732	1.5
B5256 Lancaster Ln (Westbound)	60	9592	1.4	10541	1.4	10541	1.4
A49 (Northbound)	66	15898	3.1	17703	3.1	18609	3.1
A49 (Southbound)	66	15449	3.2	17624	3.2	17967	3.2
B5256 Leyland Way (Eastbound)	60	10350	4.8	11691	4.8	11691	4.8
B5256 Leyland Way (Westbound)	60	14124	3.7	16422	3.7	16422	3.7

Vehicle Speeds

11.12 To take into account the presence of slow moving traffic near junctions and at roundabouts, the speed at each junction was reduced because of congestion to 30kph using the following criteria recommended within LAQM.TG(16)[2]:

- Traffic pulling away from the lights, e.g. 40-50 kph;
- Traffic approaching the lights when green, e.g. 20-50 kph; and
- Traffic on the carriageway approaching the lights when red, e.g. 5-20 kph, depending on the time of day and how congested the junction is.

2 DEFRA, 2016, Local Air Quality Management Technical Guidance LAQM.TG (16)

Car Park

11.13 The retail element of the Development will introduce a surface car park. Consequently LAQM.TG(16) and the Environmental Protection UK and Institute of Air Quality Management (IAQM)[3] both state surface car parks are unlikely to give rise to significant emissions to air and instead the impact of queuing or congestion should be considered. As above, the ADMS-Roads modelling has adjusted vehicle speeds in order to replicate traffic speeds along the traffic network, including traffic entering the car park.

Diurnal Profile

11.14 The ADMS-Roads model uses an hourly traffic flow based on the daily (AADT) flows. Traffic flows follow a diurnal variation throughout the day and week. Therefore, a diurnal profile was used in the model to replicate how the average hourly traffic flow would vary throughout the day and the week. This was based on data (the latest available at the time of the assessment) collated by Waterman from the Department for Transport (DfT) statistics Table TRA0307: 'Traffic Distribution by Time of Day on all roads in Great Britain', 2019[4], which is the latest data available at the time of undertaking the air quality assessment. Figure A1 presents the diurnal variation in traffic flows which has been used within the model.

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3 Environmental Protection UK and Institute of Air Quality Management UK, 2017, Land-Use Planning & Development Control: Planning For Air Quality

4 Department for Transport (DfT) Statistics, www.dft.gov.uk/statistics/series/traffic

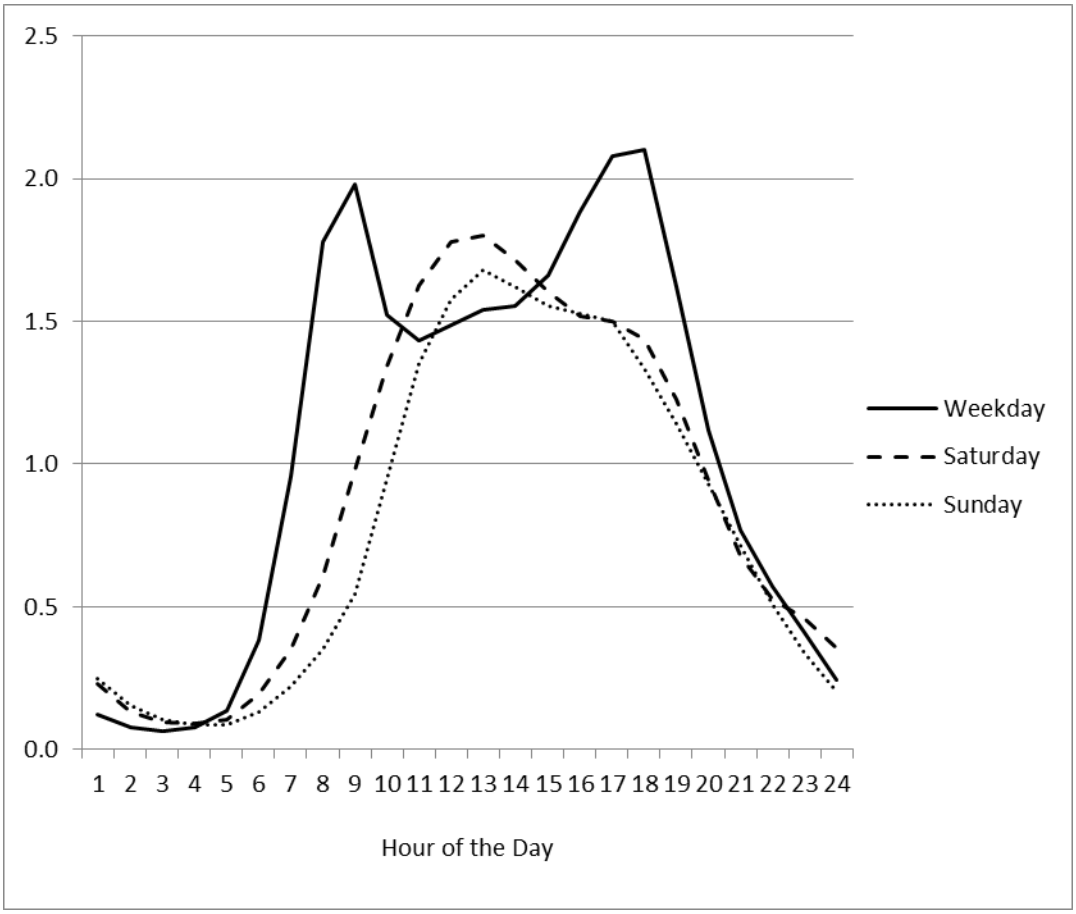

Figure A11.1: Department for Transport Diurnal Traffic Variation

Street Canyon Effect

11.15 Narrow streets with tall buildings on either side have the potential to create a confined space, which can interfere with the dispersion of traffic pollutants and may result in pollutant emissions accumulating in these streets. In an air quality model, these narrow streets are described as street canyons.

11.16 ADMS-Roads includes a street canyon model to take account of the additional turbulent flow patterns occurring inside such a narrow street with relatively tall buildings on both sides. LAQM.TG(16) identifies a street canyon "*as narrow streets where the height of buildings on both sides of the road is greater than the road width*."

11.17 Following a review of the road network to be included within the model and the current scheme layouts, it was considered that modelled roads are relatively wide and the existing buildings along these roads are not considered to be tall. The Development would not cause any street canyons to be created. Therefore, no street canyons were included within the model for any of the scenarios considered.

Road Traffic Emission Factors

11.18 The latest version of the ADMS-Roads model (version 5.0.1.3) was used for the assessment. The model was input with the latest vehicle emission factors published by Defra in the Emission Factors Toolkit (v11.0 published in November 2021) and is based on the latest COPERT database published by the European Environment Agency.

The EFT has emission rates for vehicles for the years 2018 to 2030. As the Development is anticipated to be completed in 2032, the 2030 emission rates have been used, which represents a conservative assessment

11.19 The EFT uses several parameters (traffic flow, percentage of HDV, speed and road type) to calculate road traffic emissions for the selected pollutants.

Background Pollutant Concentrations

11.20 Background pollutant concentration data, concentrations of pollution sources not directly taken into account in the dispersion modelling, have been added to contributions from the modelled pollution sources, for each year of assessment.

11.21 Background monitoring of NO_2 is undertaken within SRBC using triplicate diffusion tubes at Leyland Civic Centre (2.8km south-west of the Site). Table A11.7 presents the average annual mean NO_2 concentration from the Leyland Civic Centre triplicate diffusion tubes.

Table A11.7: Annual Mean Concentrations at the Leyland Civic Centre Urban Background Non-Automatic Monitor (Diffusion Tube)

Pollutant	AQS Objective	2019
NO_2	Annual Mean (40µg/m^3)	17.2

Source: Data obtained directly from South Ribble Borough Council

11.22 Table A11.7 shows the average annual mean NO_2 concentration from the Leyland Civic Centre triplicate diffusion tubes is below the objective in 2019.

11.23 In addition to the background monitoring undertaken by SRBC, background concentrations of NO_X, NO_2, PM_{10} and $PM_{2.5}$ are available from the Defra Local Air Quality Management website[5] for 1x1km grid squares, for years 2018 to 2030. As the Development is anticipated to be complete and operational in 2032 the last year of available background concentrations (as 2030) have been used for the opening year of 2032. This is considered a conservative

5 http://uk-air.defra.gov.uk/

assumption. Table A11.8 presents the Defra mapped NO_2 background concentrations for the grid squares the Site is located within (355500, 425500; 355500, 424500; 356500, 424500) for 2019 and 2030.

Table A11.8: Defra background maps in 2019 and 2030 for the grid squares at the Site

Pollutant	Annual Mean Concentration (μg/m^3)					
	Grid Square 355500,425500		Grid Square 355500,424500		Grid Square 356500,424500	
	2019	2030	2019	2030	2019	2030
NO_x	22.2	14.1	22.9	14.0	31.0	17.2
NO_2	16.1	10.6	16.6	10.6	21.7	12.8
PM_{10}	12.3	11.5	13.1	12.3	13.1	12.3
$PM_{2.5}$	8.2	7.6	8.3	7.7	8.4	7.8

11.24 The average 2019 annual mean NO_2 concentration 17.2μg/m^3 from the Leyland Civic Centre triplicate diffusion tubes are slightly above the Defra background maps for the 355500,425500 and 355500,424500 grid squares and slightly below the Defra background maps for Grid Square 356500,424500. As the Defra background maps show a higher concentration at Grid Square 356500,424500 - Defra background NO_2 concentrations have been used within the air quality assessment.

11.25 SRBC do not undertake any background monitoring of NOx, PM_{10} and $PM_{2.5}$. Therefore, background concentrations have also been obtained from the Defra background maps.

11.26 Table A11.9 presents the background concentrations used within the air quality assessment.

Table A11.9: Background concentrations used in the assessment

Pollutant	Annual Mean Concentration (μg/m^3)	
	2019	2030
Grid Square 354500,424500; Receptors 2 and 10		
NO_X	16.7	11.8
NO_2	12.5	9.0
PM_{10}	11.4	10.6
$PM_{2.5}$	7.4	6.8
Grid Square 354500,425500; Verification DT (28-30 Watkin Lane)		
NO_X	18.4	n/a
NO_2	13.6	n/a
PM_{10}	11.7	n/a
$PM_{2.5}$	8.1	n/a
Grid Square 355500,423500; Receptor 14		

Pollutant	Annual Mean Concentration (µg/m³)	
	2019	2030
NO_X	25.6	15.0
NO_2	18.4	11.3
PM_{10}	14.1	13.3
$PM_{2.5}$	8.9	8.3
Grid Square 355500,424500; Receptors 1, 3, 4, 5, 6, 7, 8 and 9		
NO_X	22.9	14.0
NO_2	16.6	10.6
PM_{10}	13.1	12.3
$PM_{2.5}$	8.3	7.7
Grid Square 355500,425500; Receptors 11, 12 and 13		
NO_X	22.2	14.1
NO_2	16.1	10.6
PM_{10}	12.3	11.5
$PM_{2.5}$	8.2	7.6
Grid Square 356500,424500; Receptor 15		
NO_X	31.0	17.2
NO_2	21.7	12.8
PM_{10}	13.1	12.3
$PM_{2.5}$	8.4	7.8
Grid Square 356500,425500; Verification DT (361 Station Road)		
NO_X	24.5	n/a
NO_2	17.6	n/a
PM_{10}	13.4	n/a
$PM_{2.5}$	8.9	n/a

Meteorological Data

11.27 Local meteorological conditions strongly influence the dispersal of pollutants. Key meteorological data for dispersion modelling include hourly sequential data including wind direction, wind speed, temperature, precipitation and the extent of cloud cover for each hour of a given year. As a minimum ADMS-Roads requires wind speed, wind direction, and cloud cover.

11.28 Meteorological data to input into the model was obtained from the Manchester Airport Ringway Meteorological Station - considered to be the most representative. The 2019 data was used to be consistent with the base traffic year and model verification year and was also used for the 2032 future scenarios. Figure A11.2 presents the wind-rose for the meteorological data.

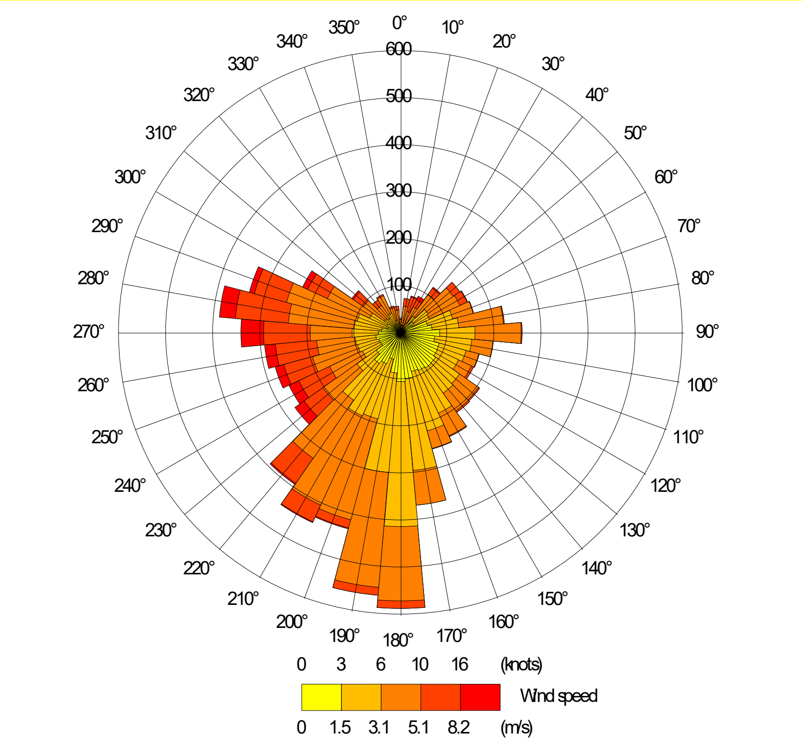

Figure A11.2: 2019 Wind Rose for the Manchester Airport Ringway Meteorological Site

11.29 Most dispersion models do not use meteorological data if they relate to calm winds conditions, as dispersion of air pollutants is more difficult to calculate in these circumstances. ADMS-Roads treats calm wind conditions by setting the minimum wind speed to 0.75 m/s. It is recommended in LAQM.TG(16) that the meteorological data file be tested within a dispersion model and the relevant output log file checked, to confirm the number of missing hours and calm hours that cannot be used by the dispersion model. This is important when considering predictions of high percentiles and the number of exceedances. LAQM.TG(16) recommends that meteorological data should only be used if the percentage of usable hours is greater than 85%. 2019 meteorological data from Manchester Airport Ringway includes 8,426 usable hours, which equates to 96.2%. The Manchester Airport Ringway Meteorological Station meteorological data is above the 85% threshold and therefore adequate for the dispersion modelling.

11.30 A surface roughness value of 0.5 was used for the Manchester Airport Ringway Meteorological Station, which is representative of parkland and open suburbia, and is considered appropriate following a review of the local area surrounding the Meteorological Station.

Model Data Processing

11.31 The modelling results were processed to calculate the averaging periods required for comparison with the Air Quality Strategy Objectives.

11.32 NO_X emissions from combustion sources (including vehicle emissions and energy centres) comprise principally nitric oxide (NO) and NO_2. The emitted NO reacts with oxidants in the air (mainly ozone) to form more NO_2. Since only NO_2 is associated with impacts on human health, the air quality standards for the protection of human health are based on NO_2 and not total NO_X or NO.

11.33 The ADMS-Roads model was run without the Chemistry Reaction option to allow verification (see below). Therefore, a suitable NO_X:NO_2 conversion was applied to the modelled NO_X concentrations. There are a variety of different approaches to dealing with NO_X:NO_2 relationships, a number of which are widely recognised as being acceptable. However, the current approach was developed for roadside sites, and is detailed within the Technical Guidance LLAQM.TG(16).

11.34 The LAQM Support website provides a spreadsheet calculator[6] to allow the calculation of NO_2 from NO_X concentrations, accounting for the difference between primary emissions of NO_X and background NO_X, the concentration of O_3, and the different proportions of primary NO_2 emissions, in different years. This approach is only applicable to annual mean concentrations.

11.35 LAQM.TG(16) states that where stacks are included within models representing wider urban areas and where the annual mean concentrations are the main focus (as is the case in this assessment) then the spreadsheet calculator, described above, can be used for the conversion of total annual mean NO_X to annual average NO_2 concentrations. This guidance was followed for the assessment NO_X concentrations due to the heating plant emissions.

11.36 Research[7] undertaken on behalf of Defra has indicated that the hourly mean limit value and objective for NO_2 is unlikely to be exceeded at a roadside location where the annual-mean NO_2 concentration is less than 60µg/m^3, LLAQM.TG(16) confirms that this assumption is still valid. The hourly objective is, therefore, not considered further within this assessment where the annual-mean NO_2 concentration is predicted to be less than 60µg/m^3.

6 AEA, NOX to NO2 Calculator, http://laqm1.defra.gov.uk/review/tools/monitoring/calculator.php Version 8.1, August 2020

7 Defra (2016), 'Local Air Quality Management Policy guidance PG(16)', DEFRA, London

11.37 To calculate the number of daily exceedances of 50µg/m^3 PM_{10}, the relationship between the number of 24-hour exceedances of 50µg/m^3 and the annual mean PM10 concentration from LLAQM.TG (16) was applied as follows:

Number of Exceedances = -18.5+0.00145 x annual mean^3 + (206/annual mean)

Other Model Parameters

11.38 There are several other parameters that are used within the ADMS-Roads model which are described for completeness and transparency:

11.39 The model requires a surface roughness value to be inputted.

- A value of 0.5 was used for the Site, which is representative of parkland and open suburbia; and
- A value of 0.5 was used for the Manchester Airport Ringway Meteorological Station, which is representative of parkland and open suburbia.

11.40 The model requires the Monin-Obukhov length (a measure of the stability of the atmosphere) to be inputted. A value of 30m (representative of mixed urban/industrial) was used for the modelling; and

11.41 The model requires the Road Type to be inputted. '*England [Urban]*' and '*England [Motorway]*' were selected where appropriate and used for the modelling of the road links.

Model Verification

11.42 Model verification is the process of comparing monitored and modelled pollutant concentrations for the same year, at the same locations, and adjusting modelled concentrations if necessary to be consistent with monitoring data. This increases the robustness of modelling results.

11.43 Discrepancies between modelled and measured concentrations can arise for a number of reasons, for example:

- Traffic data uncertainties;
- Background concentration estimates;
- Meteorological data uncertainties;

- Sources not explicitly included within the model (e.g. car parks and bus stops);
- Overall model limitations (e.g. treatment of roughness and meteorological data, treatment of speeds); and
- Uncertainty in monitoring data, particularly diffusion tubes.

11.44 Verification is the process by which uncertainties such as those described above are investigated and minimised. Disparities between modelling and monitoring results are likely to arise as result of a combination of all of these aspects.

Nitrogen Dioxide

11.45 The ADMS-Roads dispersion model was run to predict annual mean NO_X concentrations at the 28-30 Watkin Lane NO_2 diffusion tube, located in AQMA 3 (Junction of Leyland Road and Brownedge Road, Lostock Hall,) and at the 361 Station Road NO_2 diffusion tube located in AQMA 4 (Station Road, Bamber Bridge).

11.46 The NO_2 concentrations are a function of NO_X concentrations, therefore the predicted roadside NO_X concentration was then converted to NO_2 using the NO_X to NO_2 calculator provided by Defra on the LAQM Support website. The background data for 2019, as presented in Table A11.9 was used.

11.47 The modelled and equivalent measured roadside NO_2 concentrations at the diffusion tube sites were compared as shown in Table A11.10 below.

Table A11.10: 2019 Annual Mean NO_2 Modelled and Monitored Concentrations

Site ID	Monitored Annual Mean NO_2 ($\mu g/m^3$)	Modelled Total Annual Mean NO_2 ($\mu g/m^3$)	% Difference (modelled – monitored)
28-30 Watkin Lane	30.2	19.7	-34.9
361 Station Road	35.9	24.3	-32.5

11.48 **Table A11.10** indicates that the model is under predicting at both diffusion tubes. Technical Guidance LAQM.TG(16) suggests that where there is disparity of more than 10% between modelled and monitored results, adjustment of the modelling results is necessary. The steps involved in the adjustment process are presented in Tables A11.11 and A11.12 and Figure A11.3.

Table A11.11: Model Verification Result for Adjustment NO_x Emissions

Site ID	Monitored NO_2 (µg/m³)	Monitored Road NO_x (µg/m³)	Modelled Road NO_x (µg/m³)	Ratio of Monitored Road Contribution NO_x/Modelled Road Contribution NO_x
28-30 Watkin Lane	30.2	32.5	11.4	2.85
361 Station Road	35.9	36.6	12.7	2.89

11.49 Table A11.11 presents the adjusted annual mean NO_X concentrations at the monitoring locations with the adjustment factor applied with the monitored roadside NO_2 concentrations converted to NO_X using the NO_X to NO_2 calculator.

11.50 Figure A3 shows the mathematical relationship between modelled and monitored roadside NOx (i.e. total NO_X minus background NO_X) in a scatter graph (data taken from Table A11.11), with its derived equation.

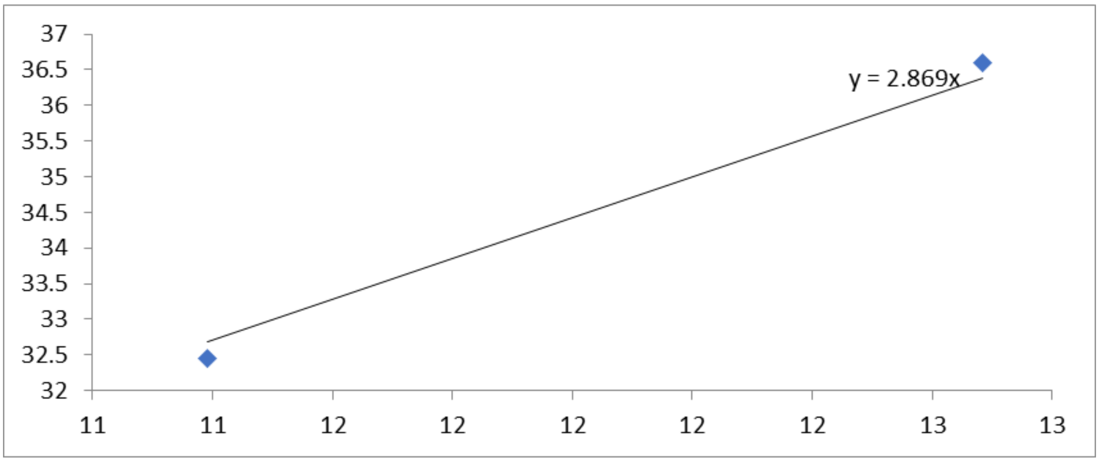

Figure A11.3: Unadjusted Modelled versus Monitored Annual Mean Roadside NOx (µg/m³)

11.51 Consequently, in Table A11.12 the adjustment factor (2.869) obtained from Figure A3 was applied to the relevant modelled NO_X Roadside concentrations before being converted to annual mean NO_2 using the NO_X: NO_2 spreadsheet calculator.

Table A11.12: Final Adjusted Annual Average NO_2 Concentration Compared to Monitored Annual Mean NO_2 Concentration

Site ID	Adjusted Modelled Road NOx (µg/m³)	Modelled Total NO_2 (µg/m³)	Monitored Total NO_2 (µg/m³)	% Difference
28-30 Watkin Lane	32.9	30.5	30.2	0.7
361 Station Road	36.6	36.0	35.9	0.0

11.52 The data from the adjusted/verified model in Table A11.12 indicates a more conservative agreement between monitored and modelled annual mean NO_2 results compared to the unadjusted/unverified model. The NO_X adjustment process was subsequently applied to all of roadside NO_X modelling for 2019 and 2032 'without' and 'with' the Development.

Particulate Matter (PM_{10} and $PM_{2.5}$)

11.53 PM_{10} and $PM_{2.5}$ monitoring data is not available for the Site and local area. Therefore, the roadside modelled NO_X adjustment factor of 2.869 was subsequently applied to all the roadside PM_{10} and $PM_{2.5}$ modelling results.

Verification Summary

11.54 Any atmospheric dispersion model study will always have a degree of inaccuracy due to a variety of factors. These include uncertainties in traffic emissions data, the differences between available meteorological data and the specific microclimate at each receptor location, and simplifications made in the model algorithms that describe the atmospheric dispersion and chemical processes. There will also be uncertainty in the comparison of predicted concentrations with monitored data, given the potential for errors and uncertainty in sampling methodology (technique, location, handling, and analysis) as well as processing of any monitoring data.

11.55 Whilst systematic under or over prediction can be taken into account through the model verification / adjustment process, random errors will inevitably occur and a level of uncertainty will still exist in corrected / adjusted data.

11.56 Model uncertainties arise because of limited scientific knowledge, limited ability to assess the uncertainty of model inputs, for example, emissions from vehicles, poor understanding of the interaction between model and / or emissions inventory parameters, sampling and measurement error associated with monitoring sites and whether the model itself completely describes all the necessary atmospheric processes.

11.57 Overall, it is concluded that with the adjustment factors applied to the ADMS-Roads model, it is performing well and modelled results are considered to be suitable to determine the potential effects of the Development on local air quality.

Proposed Methodology Sent to South Ribble Borough Council in 2016

From: [redacted]
Sent: 29 June 2016 13:03
To: [redacted]
Subject: Cuerden Retail Park, South Ribble

[redacted]

I have been instructed to undertake an air quality assessment to accompany the planning application for a proposed mixed use Development compromising a retail park, employment uses and residential uses on land off Wigan Road (south of the M65) and would like to agree the scope and methodology for the assessment with South Ribble Council.

The planning application is hybrid. The large retail elements (including an IKEA), infrastructure (including access off the M65 roundabout) and replacement tree planting are in detail whilst the employment uses and proposed residential are in outline.

In terms of our approach we propose to use the detailed dispersion model ADMS roads and would model the existing, future without development and future with development scenarios at sensitive receptors in proximity to the Site and within the roads modelled. At this stage I do not believe that a centralised combustion plant is proposed, however should one be included this would be assessed using ADMS.

With regards to the model verification, I plan to use the monitoring undertaken at in Bamber Bridge as these are the closest monitors to the Site. Would you agree to the use of these monitors for the verification? I have data for 2014 but not for 2015, can you provide me with the 2015 data?

To take into account the trend that NOx and NO2 concentrations are not declining as expected, the results will include an uncertainty section which will assess the future traffic on the basis of no future reductions (i.e. considering the potential effect of the Development against the current baseline conditions).

Further to the operational assessment, a qualitative assessment of the potential impacts of the development on local air quality during demolition and construction would be undertaken. This would use the IAQM best practice guidance to assess dust nuisance and construction plant/ vehicles, detailing any mitigation measures required.

I welcome your thoughts on the above scope and would appreciate any recommendations.

Kind Regards

[redacted]
Waterman Infrastructure & Environment Ltd

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Assessor Experience

Name: Andy Fowler

Years of Experience: 11

Qualifications:

- CEnv
- BSc (Hons)
- Member of the IAQM
- Full Member of the Institution of Environmental Sciences (IES)

Andy has been involved in the technical delivery of a wide range of air quality projects for a variety of clients in both the public and private sector. These projects include consideration of emissions from both transportation and industrial sources, through both monitoring and modelling, and therefore he has an in depth understanding of the regulatory requirements for these sources and the published technical guidance for their assessment.