OMEGA ZONE 8, ST HELENS

Omega St Helens Ltd / T. J. Morris Limited

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6 AIR QUALITY - APPENDICES

6.1 GLOSSARY

Term	Definition
AADT	Annual Average Daily Traffic - A daily total traffic flow (24hrs), expressed as a mean daily flow across all 365 days of the year.
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
Adjustment	Application of a correction factor to modelled results to account for uncertainties in the model
Accuracy	A measure of how well a set of data fits the true value.
Air quality standard	The concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on the assessment of the effects of each pollutant on human health including the effects on sensitive sub groups (see also air quality objective).
Annual mean	The average (mean) of the concentrations measured for each pollutant for one year.
AQAL	Air Quality Assessment Level
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area.
AQO	Air quality objective - Policy target generally expressed as a maximum ambient concentration to be achieved, either without exception or with a permitted number of exceedances within a specific timescale (see also air quality standard).
AQS	Air Quality Strategy
ASR	Annual Status Report
AURN	Automatic Urban and Rural (air quality monitoring) Network
CEMP	Construction Environment Management Plan
Conservative	Tending to over-predict the impact rather than under-predict.
CURED	Calculator Using Realistic Emissions for Diesels
Defra	Department for Environment, Food and Rural Affairs.
DfT	Department for Transport
DMP	Dust Management Plan
EFT	Emissions Factor Toolkit
Emission rate	The quantity of a pollutant released from a source over a given period.
EPUK	Environmental Protection UK
Exceedance	A period where the concentrations of a pollutant is greater than the appropriate air quality objective / standard, which applies to specific / relevant locations of exposure.
HDV / HGV	Heavy Duty Vehicle / Heavy Goods Vehicle (more than 3.5 tonnes)

Term	Definition
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management.
LDV / LGV	Light Duty Vehicle / Light Goods Vehicle (less than 3.5 tonnes)
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NPPF	National Planning Policy Framework
NRMM	Non-Road Mobile Machinery
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 micrometres.
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 micrometres.
Road link	A length of road which is considered to have the same flow of traffic along it. Usually, a link is the road from one junction to the next.
SAC	Special Area of Conservation
SPA	Special Protection Area
SSSI	Site of Specific Scientific Interest
Uncertainty	A measure, associated with the result of a measurement, which characterizes the range of values within which the true value is expected to lie. Uncertainty is usually expressed as the range within which the true value is expected to lie with a 95% probability, where standard statistical and other procedures have been used to evaluate this figure. Uncertainty is more clearly defined than the closely related parameter 'accuracy' and has replaced it on recent European legislation.
Validation (modelling)	Refers to the general comparison of modelled results against monitoring data carried out by model developers.
$\mu g/m^3$	A measure of concentration in terms of mass per unit volume. A concentration of 1 $\mu g/m^3$ means that one cubic metre of air contains one microgram (millionth of a gram) of pollutant.

6.2 CONSTRUCTION PHASE - DUST ASSESSMENT

METHODOLOGY

Dust comprises particles typically in the size range 1-75 micrometres (µm) in aerodynamic diameter and is created through the action of crushing and abrasive forces on materials. The larger dust particles fall out of the atmosphere quickly after initial release and therefore tend to be deposited near the source of emission. Larger dust particles are therefore unlikely to cause long-term or widespread changes to local air quality; however, its deposition on property and cars can cause 'soiling' and discolouration. This may result in complaints of nuisance through amenity loss or perceived damage caused, which is usually temporary.

The smaller particles of dust (less than 10 µm in aerodynamic diameter) are known as particulate matter (PM_{10}) and represent only a small proportion of total dust released; this includes a finer fraction, known as $PM_{2.5}$ (with an aerodynamic diameter less than 2.5 µm). As these particles are at the smaller end of the size range of dust particles, they remain suspended in the atmosphere for a longer period than the larger dust particles and can therefore be transported by wind over a wider area. PM_{10} and $PM_{2.5}$ are small enough to be drawn into the lungs during breathing, which in sensitive members of the public could have a potential impact on health.

The IAQM has developed best practice guidance with reference to the assessment of dust from demolition and construction (Ref 6.1). The methodology is outlined below.

Step 1 – Screening the need for a detailed assessment

An assessment will normally be required where there are:

- 'human receptors' within 350 m of the site boundary; 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); and/or
- 'ecological receptors' within 50 m of the site boundary; 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).

Where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is 'negligible'.

Step 2A – Define the potential dust emission magnitude

The following are examples of how the potential dust emission magnitude for different activities can be defined. (Note that not all the criteria need to be met for a class). Other criteria may be used if justified in the assessment

Table A6-2-1 - Examples of human receptor sensitivity to demolition and construction stage impacts

Dust Emission Magnitude	Activity	Criteria
Large	**Demolition**	More than 50,000 m^3 building demolished, dusty material (e.g. concrete), on-site crushing/screening, demolition More than 20 m above ground level
	Earthworks	More than 10,000 m^2 site area, dusty soil type (e.g. clay), more than 10 earth moving vehicles active simultaneously, more than 8 m high bunds formed, more than 100,000 tonnes material moved
	Construction	More than 100,000 m^3 building volume, on site concrete batching, sandblasting
	Trackout	More than 50 HDVs out / day, dusty surface material (e.g. clay), more than 100 m unpaved roads
Medium	**Demolition**	20,000 - 50,000 m^3 building demolished, dusty material (e.g. concrete) 10 – 20 m above ground level
	Earthworks	Between 2,500 - 10,000 m^2 site area, moderately dusty soil (e.g. silt), 5-10 earth moving vehicles active simultaneously, between 4 m – 8 m high bunds, between 20,000 -100,000 tonnes material moved
	Construction	Between 25,000 - 100,000 m^3 building volume, dusty material e.g. concrete, on site concrete batching
	Trackout	Between 10 - 50 HDVs out / day, moderately dusty surface material (e.g. clay), 50 -100 m unpaved roads
Small	**Demolition**	Less than 20,000 m^3 building demolished, non-dusty material (e.g. metal cladding), Less than 10 m above ground level, work during wetter months
	Earthworks	Less than 2,500 m^2 site area, soil with large grain size (e.g. sand), Less than 5 earth moving vehicles active simultaneously, less than 4 m high bunds, less than 20,000 tonnes material moved, earthworks during wetter months
	Construction	Less than 25,000 m^3, non-dusty material (e.g. metal cladding or timber)
	Trackout	Less than 10 HDVs out / day, non-dusty soil, Less than 50 m unpaved roads

Step 2B – Define the sensitivity of the study area

The tables below present the IAQM construction dust assessment methodology (Ref 6.1) to determine the sensitivity of the area to dust soiling, human health, and ecological impacts respectively.

The IAQM guidance (Ref 6.1) provides guidance to allow the sensitivity of individual receptors to dust soiling and health effects to assist in the assessment of the overall sensitivity of the study area.

Table A6-2-2 - Sensitivity of the area to dust soiling effects

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		Less than 20	Less than 50	Less than 100	Up to 350 m
High	More than 100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	More than 1	Medium	Low	Low	Low
Low	More than 1	Low	Low	Low	Low

Table A6-2-3 - Sensitivity of the area to human health impacts

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

Table A6-2-4 - Sensitivity of the area to ecological impacts

Receptor Sensitivity	Distance from the Source	
	Less than 20 m	Less than 50 m
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Step 2C – Define the risk of impacts

The dust emissions magnitude determined at Step 2A are combined with the sensitivity of the area determined at Step 2B to determine the risk of impacts without mitigation applied. For those cases where the risk category is 'negligible' no mitigation measures beyond those required by legislation will be required.

Table A6-2-5 - Risk of dust impacts

Sensitivity of Surrounding 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 and 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

Step 3 – Site specific mitigation

Having determined the risk categories for each of the four activities it is possible to determine the site-specific measures to be adopted. These measures will be related to whether the site is a low, medium or high-risk site. The IAQM guidance (Ref 6.1) details the mitigation measures required for high, medium, and low risk sites as determined in Step 2C.

Step 4 – Determine significant effects

To determine the appropriate dust mitigation measures identified in Step 3, the final step is to establish whether significant effects are likely to arise from the construction stage. For almost all construction activities, the proposed mitigation should prevent significant effects occurring to sensitive receptors and therefore the residual effect will normally be negligible.

ASSESSMENT

Table A6-2-6 to **Table A6-2-8** outlines the potential dust emission magnitudes, the sensitivity of the study area and the subsequent summary dusk risk table used to determine site specific mitigation, pertinent to the Proposed Development and supplemental to the pertinent information provided in Section 6.6 of the ES.

Table A6-2-6 - Potential Dust Emissions Magnitudes

Activity	Dust Emission Magnitude
Demolition	Not Applicable
Earthworks	Large
Construction Activities	Large
Trackout	Large

Table A6-2-7 - Sensitivity of the study area

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Not Applicable	Low	Low	Low
Human Health	Not Applicable	Low	Low	Low

Table A6-2-8 below provides a summary of the risk of dust impacts for the Proposed Development. The risk category identified for each construction activity has been used to determine the level of mitigation required.

Table A6-2-8 - Summary Dust Risk table to define Site Specific Mitigation

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Not Applicable	Low Risk	Low Risk	Low Risk
Human Health	Not Applicable	Low Risk	Low Risk	Low Risk

MITIGATION

Based on the construction stage dust assessment (see above), which has been determined as 'Low Risk' for construction activities for the Proposed Development, recommended mitigation measures are provided below.

An overview is provided in Section 6.6 of the ES.

General Communication

- The name and contact details of person(s) accountable for air quality and dust issues should be displayed on the Site boundary. This may be the environment manager/engineer or the site manager. The head or regional office contact information should also be displayed.

General Dust Management

- A Dust Management Plan (DMP), which may include measures to control other emissions, in addition to the dust and PM_{10} mitigation measures given in this report, should be developed and implemented, and approved by the Local Authority.

Site Management

- All dust and air quality complaints should be recorded, and causes identified. Appropriate remedial action should be taken in a timely manner with a record kept of actions taken including of any additional measures put in-place to avoid reoccurrence.
- The complaints log should be made available to the Local Authority on request.
- Any exceptional incidents that cause dust and/or air emissions, either on- or off- site should be recorded, and then the action taken to resolve the situation recorded in the log book.

Monitoring

- Regular Site inspections to monitor compliance with the Construction Environmental Management Plan (CEMP) and/or the DMP should be carried out, inspection results recorded, and an inspection log made available to the Local Authority when asked.
- The frequency of site inspections should be increased when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

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 practicable.
- Where practicable, erect solid screens or barriers around dusty activities or the Site boundary that are as least as high as any stockpiles on site.
- Avoid site runoff of water or mud.

Operating Vehicle/Machinery and Sustainable Travel

- Ensure all vehicle operators switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable.

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 and 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.

Waste Management

- Avoid bonfires and burning of waste materials.

Measures Specific to Earthworks

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- Stockpile surface areas should be minimised (subject to health and safety and visual constraints regarding slope gradients and visual intrusion) to reduce area of surfaces exposed to wind pick-up.

Measures Specific to Construction

- Avoid scabbling (roughening of concrete surfaces) if possible.
- All construction plant and equipment should be maintained in good working order and not left running when not in use.

Measures Specific to Trackout

- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Record all inspections of haul routes and any subsequent action in a site log book.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

Detailed mitigation measures to control construction traffic should be discussed with the Local Authority to establish the most suitable access and haul routes for the site traffic.

The most effective mitigation will be achieved by ensuring that construction traffic does not pass along sensitive roads (residential roads, congested roads, via unsuitable junctions, etc.) where possible, and that vehicles are kept clean (using wheel washers, etc.) and sheeted when on public highways. Timing of large-scale vehicle movements to avoid peak hours on the local road network will also be beneficial.

6.3 OPERATIONAL PHASE – SUPPORTING INFORMATION

ATMOSPHERIC DISPERSION MODEL

The predicted impacts on local air quality associated with changes to road vehicle exhaust emissions because of the operation of the Proposed Development were assessed using the Cambridge Environmental Research Consultants (CERC) atmospheric dispersion modelling system for roads (ADMS-Roads v4.1.1).

ADMS-Roads applies advanced algorithms for the height-dependence of wind speed, turbulence and stability to produce improved predictions of long and short-term air pollutant concentrations within the given model domain.

ADMS-Roads is a validated model, developed in the UK by CERC. The model validation process includes comparisons with data from the UK's Automatic Urban 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 EU and U.S. EPA systems. Further information in relation to this is available from the CERC web site at http://www.cerc.co.uk/environmental-software/model-validation.html

MODEL PROCEDURE

The following procedures were carried out to facilitate in the compilation of the dispersion model and subsequent operational phase assessment:

- Collation of input data – traffic data (flows, speeds, percentage of HDVs), road network mapping, sensitive receptor coordinates and meteorological data;
- Input of data in to the ADMS-Roads model for the scenarios to be modelled (see Section 6.2);
- Calculation of emissions for each pollutant to be assessed through ADMS-Roads and incorporating the Defra's EFT (V9.0) (Ref 6.4) and AQC CURED V3A emissions factors (Ref 6.5);
- Running the ADMS-Roads model for each considered scenario (see Section 6.2);
- Conversion of modelled NO_X concentrations to NO_2 concentrations using Defra's NO_x to NO_2 calculator (v7.1) (Ref 6.6);
- Addition of Defra background values (see **Appendix 6.5**, Ref 6.7) to the respective scenario modelled concentrations;
- Verification and adjustment of modelled road-NO_x contributions from the assessed road through analysing the ADMS-Roads modelled road-NO_x outputs versus Local Authority monitored road-NO_x for the baseline scenario of 2018;
- Comparison of predicted NO_2, PM_{10} and $PM_{2.5}$ concentrations at all considered receptors to the relevant air quality objectives in each scenario; and
- Analysis of changes in pollutant concentrations between the Do Minimum and Do Something scenarios to assess the significance of impacts associated with the Proposed Development on local air quality.

A summary of the dispersion modelling parameters included in the ADMS-Roads dispersion models is included in Table A6-3-1.

Table A6-3-1 - ADMS-Roads Model Inputs

Parameter	Value	Description
Latitude	53.41	Representative of study area, set in the North West of England.
Surface Roughness	0.5	Study area comprises of open suburbia with a mix of residential and business park land uses.
Minimum Monin-Obukhov Length (m)	10	

TRAFFIC DATA

This section contains the traffic data and respective emission rates applied in the dispersion modelling assessment and the respective sensitivity tests.

The traffic data presented includes traffic flow as AADT, broken down to LDV and HDV, the speed included for each road link and the diurnal profile used.

Several traffic data assumptions have been made in the compilation of this assessment and are provided at the end of this section.

Table A6-3-2 - 2018 - Baseline / Model Verification Scenario

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
1	Burtonwood Rd_1	LDV	10143	52	0.039	0.004	0.002
2	Burtonwood Rd_1	HDV	35	47			
3	Burtonwood Rd_1a	LDV	10143	20	0.055	0.004	0.003
4	Burtonwood Rd_1a	HDV	35	15			
5	Burtonwood Rndbt	LDV	10143	20	0.055	0.004	0.003
6	Burtonwood Rndbt	HDV	35	15			
7	Burtonwood Rd_1b	LDV	10143	20	0.055	0.004	0.003
8	Burtonwood Rd_1b	HDV	35	15			
9	Burtonwood Rd_2a	LDV	5025	25	0.026	0.002	0.001
10	Burtonwood Rd_2a	HDV	18	20			
11	Burtonwood Rd_2b	LDV	5118	25	0.026	0.002	0.001
12	Burtonwood Rd_2b	HDV	18	20			
13	M62 J8 Rndbt	LDV	31687	40	0.182	0.015	0.009
14	M62 J8 Rndbt	HDV	1901	35			
15	Skyline Drive_1a	LDV	4506	25	0.043	0.003	0.002
16	Skyline Drive_1a	HDV	469	20			
17	Skyline Drive_1b	LDV	4461	25	0.042	0.003	0.002
18	Skyline Drive_1b	HDV	454	20			
19	Skyline Drive_1	LDV	8967	61	0.049	0.005	0.003
20	Skyline Drive_1	HDV	923	56			

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
21	Skyline_Rndbt1	LDV	8967	20	0.098	0.005	0.003
22	Skyline_Rndbt1	HDV	923	15			
23	Skyline Drive_2	LDV	8967	61	0.049	0.005	0.003
24	Skyline Drive_2	HDV	923	56			
25	Skyline_Rndbt2	LDV	8115	20	0.082	0.005	0.003
26	Skyline_Rndbt2	HDV	684	15			
27	Skyline Drive_3	LDV	7090	53	0.036	0.003	0.002
28	Skyline Drive_3	HDV	425	48			
29	Skyline_Omega_Rndbt	LDV	7090	20	0.061	0.004	0.002
30	Skyline_Omega_Rndbt	HDV	425	15			
31	Omega Blvd	LDV	7090	53	0.036	0.003	0.002
32	Omega Blvd	HDV	425	48			
33	Burtonwood Rd_3a	LDV	6631	25	0.034	0.003	0.002
34	Burtonwood Rd_3a	HDV	40	20			
35	Burtonwood Rd_3b	LDV	7226	25	0.043	0.003	0.002
36	Burtonwood Rd_3b	HDV	164	20			
37	Burtonwood Rd_3	LDV	13653	61	0.054	0.006	0.003
38	Burtonwood Rd_3	HDV	204	56			
39	Burtonwood Rd_3c	LDV	7226	20	0.047	0.003	0.002
40	Burtonwood Rd_3c	HDV	164	15			
41	Burtonwood Rd_3d	LDV	6631	20	0.037	0.003	0.002
42	Burtonwood Rd_3d	HDV	40	15			
43	M62 EB_OffSlip_1a	LDV	4859	35	0.037	0.002	0.001
44	M62 EB_OffSlip_1a	HDV	484	30			
45	M62 WB_OffSlip_1a	LDV	10573	35	0.077	0.003	0.002
46	M62 WB_OffSlip_1a	HDV	889	30			
47	M62 WB_OnSlip	LDV	4639	80	0.025	0.002	0.001
48	M62 WB_OnSlip	HDV	486	75			
49	M62_EB_OnSlip	LDV	9070	80	0.052	0.003	0.002
50	M62_EB_OnSlip	HDV	1183	75			
51	M62_WB_OffSlip_1	LDV	10573	80	0.056	0.003	0.002
52	M62_WB_OffSlip_1	HDV	889	75			
53	M62_EB_OffSlip_1	LDV	4859	80	0.026	0.002	0.001
54	M62_EB_OffSlip_1	HDV	484	75			
55	M62 EB_1	LDV	48586	113	0.371	0.017	0.012

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
56	M62 EB_1	HDV	4840	97			
57	M62 WB_1	LDV	46389	113	0.356	0.016	0.011
58	M62 WB_1	HDV	4864	97			
59	M62 EB_1a	LDV	43727	113	0.334	0.015	0.011
60	M62 EB_1a	HDV	4356	97			
61	M62 WB_1a	LDV	41750	113	0.320	0.015	0.010
62	M62 WB_1a	HDV	4378	97			
63	M62 EB_2	LDV	52797	113	0.405	0.019	0.013
64	M62 EB_2	HDV	5539	97			
65	M62 WB_2	LDV	52324	113	0.400	0.018	0.013
66	M62 WB_2	HDV	5267	97			
67	A49 Winwick Rd_NB_1	LDV	19907	48	0.098	0.009	0.005
68	A49 Winwick Rd_NB_1	HDV	940	43			
69	A49 Winwick Rd_SB_1	LDV	19907	48	0.098	0.009	0.005
70	A49 Winwick Rd_SB_1	HDV	940	43			
71	A49 Winwick Rd_NB_1a	LDV	19907	25	0.139	0.010	0.006
72	A49 Winwick Rd_NB_1a	HDV	940	20			
73	A49 Winwick Rd_SB_1a	LDV	19907	25	0.139	0.010	0.006
74	A49 Winwick Rd_SB_1a	HDV	940	20			
75	A49/A574 Rndbt	LDV	40274	20	0.310	0.020	0.012
76	A49/A574 Rndbt	HDV	1754	15			
77	A49 Winwick Rd_NB_2a	LDV	20367	25	0.136	0.010	0.006
78	A49 Winwick Rd_NB_2a	HDV	814	20			
79	A49 Winwick Rd_SB_2a	LDV	20367	25	0.136	0.010	0.006
80	A49 Winwick Rd_SB_2a	HDV	814	20			
81	A49 Winwick Rd_NB_2	LDV	20367	45	0.100	0.009	0.005
82	A49 Winwick Rd_NB_2	HDV	814	40			
83	A49 Winwick Rd_SB_2	LDV	20367	45	0.100	0.009	0.005
84	A49 Winwick Rd_SB_2	HDV	814	40			
85	A49 Winwick Rd_NB_2b	LDV	20367	20	0.153	0.010	0.006
86	A49 Winwick Rd_NB_2b	HDV	814	15			
87	A49 Winwick Rd_SB_2b	LDV	20367	20	0.153	0.010	0.006
88	A49 Winwick Rd_SB_2b	HDV	814	15			
89	A49 Winwick Rd_NB_3a	LDV	17688	20	0.131	0.008	0.005
90	A49 Winwick Rd_NB_3a	HDV	664	15			

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
91	A49 Winwick Rd_SB_3a	LDV	17688	20	0.131	0.008	0.005
92	A49 Winwick Rd_SB_3a	HDV	664	15			
93	A49 Winwick Rd_NB_3	LDV	17688	45	0.086	0.008	0.005
94	A49 Winwick Rd_NB_3	HDV	664	40			
95	A49 Winwick Rd_SB_3	LDV	17688	45	0.086	0.008	0.005
96	A49 Winwick Rd_SB_3	HDV	664	40			
97	Site Access Road	LDV	203	40	0.001	0.000	0.000
98	Site Access Road	HDV	8	35			
99	M62 EB_1b	LDV	48586	113	0.371	0.017	0.012
100	M62 EB_1b	HDV	4840	97			
101	M62 WB_1b	LDV	46389	113	0.356	0.016	0.011
102	M62 WB_1b	HDV	4864	97			

* Emission rates rounded to three decimal places

Table A6-3-3 - 2021 – Without Proposed Development / Do-Minimum Scenario

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
1	Burtonwood Rd_1	LDV	11541	52	0.037	0.004	0.002
2	Burtonwood Rd_1	HDV	37	47			
3	Burtonwood Rd_1a	LDV	11541	20	0.051	0.005	0.003
4	Burtonwood Rd_1a	HDV	37	15			
5	Burtonwood Rndbt	LDV	11541	20	0.051	0.005	0.003
6	Burtonwood Rndbt	HDV	37	15			
7	Burtonwood Rd_1b	LDV	11541	20	0.051	0.005	0.003
8	Burtonwood Rd_1b	HDV	37	15			
9	Burtonwood Rd_2a	LDV	5734	25	0.024	0.002	0.001
10	Burtonwood Rd_2a	HDV	18	20			
11	Burtonwood Rd_2b	LDV	5807	25	0.024	0.002	0.001
12	Burtonwood Rd_2b	HDV	18	20			
13	M62 J8 Rndbt	LDV	39092	40	0.166	0.018	0.010
14	M62 J8 Rndbt	HDV	2184	35			
15	Skyline Drive_1a	LDV	5853	25	0.039	0.003	0.002
16	Skyline Drive_1a	HDV	624	20			
17	Skyline Drive_1b	LDV	5740	25	0.038	0.003	0.002
18	Skyline Drive_1b	HDV	595	20			
19	Skyline Drive_1	LDV	11592	61	0.046	0.006	0.003

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
20	Skyline Drive_1	HDV	1219	56			
21	Skyline_Rndbt1	LDV	11592	20	0.090	0.006	0.004
22	Skyline_Rndbt1	HDV	1219	15			
23	Skyline Drive_2	LDV	11592	61	0.046	0.006	0.003
24	Skyline Drive_2	HDV	1219	56			
25	Skyline_Rndbt2	LDV	10543	20	0.073	0.005	0.003
26	Skyline_Rndbt2	HDV	871	15			
27	Skyline Drive_3	LDV	8245	53	0.030	0.004	0.002
28	Skyline Drive_3	HDV	442	48			
29	Skyline_Omega_Rndbt	LDV	8245	20	0.050	0.004	0.002
30	Skyline_Omega_Rndbt	HDV	442	15			
31	Omega Blvd	LDV	8245	53	0.030	0.004	0.002
32	Omega Blvd	HDV	442	48			
33	Burtonwood Rd_3a	LDV	9900	25	0.041	0.004	0.002
34	Burtonwood Rd_3a	HDV	42	20			
35	Burtonwood Rd_3b	LDV	9930	25	0.044	0.004	0.002
36	Burtonwood Rd_3b	HDV	170	20			
37	Burtonwood Rd_3	LDV	19618	61	0.061	0.008	0.004
38	Burtonwood Rd_3	HDV	212	56			
39	Burtonwood Rd_3c	LDV	9930	20	0.048	0.004	0.002
40	Burtonwood Rd_3c	HDV	170	15			
41	Burtonwood Rd_3d	LDV	9900	20	0.044	0.004	0.002
42	Burtonwood Rd_3d	HDV	42	15			
43	M62 EB_OffSlip_1a	LDV	5224	35	0.029	0.002	0.001
44	M62 EB_OffSlip_1a	HDV	510	30			
45	M62 WB_OffSlip_1a	LDV	12308	35	0.065	0.004	0.002
46	M62 WB_OffSlip_1a	HDV	989	30			
47	M62 WB_OnSlip	LDV	4999	80	0.020	0.001	0.001
48	M62 WB_OnSlip	HDV	513	75			
49	M62_EB_OnSlip	LDV	10976	80	0.046	0.003	0.002
50	M62_EB_OnSlip	HDV	1310	75			
51	M62_WB_OffSlip_1	LDV	12308	80	0.049	0.003	0.002
52	M62_WB_OffSlip_1	HDV	989	75			
53	M62_EB_OffSlip_1	LDV	5224	80	0.021	0.002	0.001
54	M62_EB_OffSlip_1	HDV	510	75			

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
55	M62 EB_1	LDV	52236	113	0.309	0.016	0.010
56	M62 EB_1	HDV	5102	97			
57	M62 WB_1	LDV	49994	113	0.296	0.016	0.010
58	M62 WB_1	HDV	5135	97			
59	M62 EB_1a	LDV	47012	113	0.278	0.014	0.009
60	M62 EB_1a	HDV	4592	97			
61	M62 WB_1a	LDV	44995	113	0.267	0.014	0.009
62	M62 WB_1a	HDV	4621	97			
63	M62 EB_2	LDV	57988	113	0.344	0.018	0.012
64	M62 EB_2	HDV	5902	97			
65	M62 WB_2	LDV	57303	113	0.339	0.018	0.011
66	M62 WB_2	HDV	5610	97			
67	Site Access Road	LDV	1308	40	0.006	0.001	0.000
68	Site Access Road	HDV	77	35			
69	M62 EB_1b	LDV	52236	113	0.309	0.016	0.010
70	M62 EB_1b	HDV	5102	97			
71	M62 WB_1b	LDV	49994	113	0.296	0.016	0.010
72	M62 WB_1b	HDV	5135	97			

* Emission rates rounded to three decimal places

Table A6-3-4 - 2021 – With Proposed Development / Do-Something Scenario

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
1	Burtonwood Rd_1	LDV	11741	52	0.037	0.004	0.003
2	Burtonwood Rd_1	HDV	37	47			
3	Burtonwood Rd_1a	LDV	11741	20	0.052	0.005	0.003
4	Burtonwood Rd_1a	HDV	37	15			
5	Burtonwood Rndbt	LDV	11741	20	0.052	0.005	0.003
6	Burtonwood Rndbt	HDV	37	15			
7	Burtonwood Rd_1b	LDV	11741	20	0.052	0.005	0.003
8	Burtonwood Rd_1b	HDV	37	15			
9	Burtonwood Rd_2a	LDV	5824	25	0.024	0.002	0.001
10	Burtonwood Rd_2a	HDV	18	20			
11	Burtonwood Rd_2b	LDV	5917	25	0.024	0.002	0.001
12	Burtonwood Rd_2b	HDV	18	20			
13	M62 J8 Rndbt	LDV	40618	40	0.179	0.019	0.011

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
14	M62 J8 Rndbt	HDV	2767	35			
15	Skyline Drive_1a	LDV	6762	25	0.051	0.004	0.002
16	Skyline Drive_1a	HDV	968	20			
17	Skyline Drive_1b	LDV	6845	25	0.053	0.004	0.002
18	Skyline Drive_1b	HDV	1017	20			
19	Skyline Drive_1	LDV	13607	61	0.060	0.008	0.004
20	Skyline Drive_1	HDV	1985	56			
21	Skyline_Rndbt1	LDV	13607	20	0.123	0.009	0.005
22	Skyline_Rndbt1	HDV	1985	15			
23	Skyline Drive_2	LDV	13607	61	0.060	0.008	0.004
24	Skyline Drive_2	HDV	1985	56			
25	Skyline_Rndbt2	LDV	13254	20	0.110	0.008	0.005
26	Skyline_Rndbt2	HDV	1637	15			
27	Skyline Drive_3	LDV	8942	53	0.033	0.004	0.002
28	Skyline Drive_3	HDV	442	48			
29	Skyline_Omega_Rndbt	LDV	8942	20	0.053	0.004	0.002
30	Skyline_Omega_Rndbt	HDV	442	15			
31	Omega Blvd	LDV	8942	53	0.033	0.004	0.002
32	Omega Blvd	HDV	442	48			
33	Burtonwood Rd_3a	LDV	9900	25	0.041	0.004	0.002
34	Burtonwood Rd_3a	HDV	42	20			
35	Burtonwood Rd_3b	LDV	9930	25	0.044	0.004	0.002
36	Burtonwood Rd_3b	HDV	170	20			
37	Burtonwood Rd_3	LDV	19618	61	0.061	0.008	0.004
38	Burtonwood Rd_3	HDV	212	56			
39	Burtonwood Rd_3c	LDV	9930	20	0.048	0.004	0.002
40	Burtonwood Rd_3c	HDV	170	15			
41	Burtonwood Rd_3d	LDV	9900	20	0.044	0.004	0.002
42	Burtonwood Rd_3d	HDV	42	15			
43	M62 EB_OffSlip_1a	LDV	5251	35	0.029	0.002	0.001
44	M62 EB_OffSlip_1a	HDV	520	30			
45	M62 WB_OffSlip_1a	LDV	12787	35	0.070	0.004	0.003
46	M62 WB_OffSlip_1a	HDV	1218	30			
47	M62 WB_OnSlip	LDV	5022	80	0.021	0.002	0.001
48	M62 WB_OnSlip	HDV	523	75			

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
49	M62_EB_OnSlip	LDV	11290	80	0.048	0.004	0.002
50	M62_EB_OnSlip	HDV	1472	75			
51	M62_WB_OffSlip_1	LDV	12787	80	0.052	0.004	0.002
52	M62_WB_OffSlip_1	HDV	1218	75			
53	M62_EB_OffSlip_1	LDV	5251	80	0.022	0.002	0.001
54	M62_EB_OffSlip_1	HDV	520	75			
55	M62 EB_1	LDV	52509	113	0.311	0.016	0.011
56	M62 EB_1	HDV	5201	97			
57	M62 WB_1	LDV	50219	113	0.298	0.016	0.010
58	M62 WB_1	HDV	5228	97			
59	M62 EB_1a	LDV	47258	113	0.280	0.014	0.009
60	M62 EB_1a	HDV	4681	97			
61	M62 WB_1a	LDV	45197	113	0.268	0.014	0.009
62	M62 WB_1a	HDV	4705	97			
63	M62 EB_2	LDV	58548	113	0.348	0.018	0.012
64	M62 EB_2	HDV	6152	97			
65	M62 WB_2	LDV	57984	113	0.344	0.018	0.012
66	M62 WB_2	HDV	5923	97			
67	Site Access Road	LDV	4020	40	0.026	0.003	0.002
68	Site Access Road	HDV	843	35			
69	M62 EB_1b	LDV	52509	113	0.311	0.016	0.011
70	M62 EB_1b	HDV	5201	97			
71	M62 WB_1b	LDV	50219	113	0.298	0.016	0.010
72	M62 WB_1b	HDV	5228	97			

* Emission rates rounded to three decimal places

Table A6-3-5 - 2036 – Without Proposed Development / Do-Minimum Scenario

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
1	Burtonwood Rd_1	LDV	11991	52	0.018	0.004	0.002
2	Burtonwood Rd_1	HDV	38	47			
3	Burtonwood Rd_1a	LDV	11991	20	0.025	0.004	0.003
4	Burtonwood Rd_1a	HDV	38	15			
5	Burtonwood Rndbt	LDV	11991	20	0.025	0.004	0.003
6	Burtonwood Rndbt	HDV	38	15			
7	Burtonwood Rd_1b	LDV	11991	20	0.025	0.004	0.003

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
8	Burtonwood Rd_1b	HDV	38	15			
9	Burtonwood Rd_2a	LDV	5957	25	0.011	0.002	0.001
10	Burtonwood Rd_2a	HDV	19	20			
11	Burtonwood Rd_2b	LDV	6034	25	0.011	0.002	0.001
12	Burtonwood Rd_2b	HDV	19	20			
13	M62 J8 Rndbt	LDV	40675	40	0.076	0.018	0.010
14	M62 J8 Rndbt	HDV	2284	35			
15	Skyline Drive_1a	LDV	6053	25	0.017	0.003	0.002
16	Skyline Drive_1a	HDV	645	20			
17	Skyline Drive_1b	LDV	5937	25	0.017	0.003	0.002
18	Skyline Drive_1b	HDV	615	20			
19	Skyline Drive_1	LDV	11990	61	0.021	0.006	0.003
20	Skyline Drive_1	HDV	1260	56			
21	Skyline_Rndbt1	LDV	11990	20	0.039	0.006	0.003
22	Skyline_Rndbt1	HDV	1260	15			
23	Skyline Drive_2	LDV	11990	61	0.021	0.006	0.003
24	Skyline Drive_2	HDV	1260	56			
25	Skyline_Rndbt2	LDV	10903	20	0.033	0.005	0.003
26	Skyline_Rndbt2	HDV	901	15			
27	Skyline Drive_3	LDV	8560	53	0.014	0.004	0.002
28	Skyline Drive_3	HDV	461	48			
29	Skyline_Omega_Rndbt	LDV	8560	20	0.023	0.004	0.002
30	Skyline_Omega_Rndbt	HDV	461	15			
31	Omega Blvd	LDV	8560	53	0.014	0.004	0.002
32	Omega Blvd	HDV	461	48			
33	Burtonwood Rd_3a	LDV	10194	25	0.019	0.004	0.002
34	Burtonwood Rd_3a	HDV	44	20			
35	Burtonwood Rd_3b	LDV	10251	25	0.021	0.004	0.002
36	Burtonwood Rd_3b	HDV	177	20			
37	Burtonwood Rd_3	LDV	20224	61	0.030	0.008	0.004
38	Burtonwood Rd_3	HDV	221	56			
39	Burtonwood Rd_3c	LDV	10251	20	0.023	0.004	0.002
40	Burtonwood Rd_3c	HDV	177	15			
41	Burtonwood Rd_3d	LDV	10194	20	0.021	0.004	0.002
42	Burtonwood Rd_3d	HDV	44	15			

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
43	M62 EB_OffSlip_1a	LDV	5495	35	0.014	0.002	0.001
44	M62 EB_OffSlip_1a	HDV	537	30			
45	M62 WB_OffSlip_1a	LDV	12899	35	0.032	0.003	0.002
46	M62 WB_OffSlip_1a	HDV	1039	30			
47	M62 WB_OnSlip	LDV	5258	80	0.010	0.001	0.001
48	M62 WB_OnSlip	HDV	541	75			
49	M62_EB_OnSlip	LDV	11482	80	0.023	0.003	0.002
50	M62_EB_OnSlip	HDV	1376	75			
51	M62_WB_OffSlip_1	LDV	12899	80	0.025	0.003	0.002
52	M62_WB_OffSlip_1	HDV	1039	75			
53	M62_EB_OffSlip_1	LDV	5495	80	0.011	0.002	0.001
54	M62_EB_OffSlip_1	HDV	537	75			
55	M62 EB_1	LDV	54947	113	0.154	0.015	0.010
56	M62 EB_1	HDV	5372	97			
57	M62 WB_1	LDV	52583	113	0.148	0.015	0.009
58	M62 WB_1	HDV	5406	97			
59	M62 EB_1a	LDV	49453	113	0.139	0.014	0.009
60	M62 EB_1a	HDV	4835	97			
61	M62 WB_1a	LDV	47325	113	0.133	0.013	0.008
62	M62 WB_1a	HDV	4866	97			
63	M62 EB_2	LDV	60935	113	0.171	0.017	0.011
64	M62 EB_2	HDV	6211	97			
65	M62 WB_2	LDV	60223	113	0.169	0.017	0.010
66	M62 WB_2	HDV	5904	97			
67	Site Access Road	LDV	1317	40	0.002	0.001	0.000
68	Site Access Road	HDV	77	35			
69	M62 EB_1b	LDV	54947	113	0.154	0.015	0.010
70	M62 EB_1b	HDV	5372	97			
71	M62 WB_1b	LDV	52583	113	0.148	0.015	0.009
72	M62 WB_1b	HDV	5406	97			

* Emission rates rounded to three decimal places

Table A6-3-6 - 2036 – With Proposed Development / Do-Something Scenario

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
1	Burtonwood Rd_1	LDV	12191	52	0.019	0.004	0.002

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
2	Burtonwood Rd_1	HDV	38	47			
3	Burtonwood Rd_1a	LDV	12191	20	0.025	0.005	0.003
4	Burtonwood Rd_1a	HDV	38	15			
5	Burtonwood Rndbt	LDV	12191	20	0.025	0.005	0.003
6	Burtonwood Rndbt	HDV	38	15			
7	Burtonwood Rd_1b	LDV	12191	20	0.025	0.005	0.003
8	Burtonwood Rd_1b	HDV	38	15			
9	Burtonwood Rd_2a	LDV	6047	25	0.012	0.002	0.001
10	Burtonwood Rd_2a	HDV	19	20			
11	Burtonwood Rd_2b	LDV	6144	25	0.012	0.002	0.001
12	Burtonwood Rd_2b	HDV	19	20			
13	M62 J8 Rndbt	LDV	42200	40	0.082	0.019	0.011
14	M62 J8 Rndbt	HDV	2867	35			
15	Skyline Drive_1a	LDV	6962	25	0.022	0.004	0.002
16	Skyline Drive_1a	HDV	989	20			
17	Skyline Drive_1b	LDV	7043	25	0.022	0.004	0.002
18	Skyline Drive_1b	HDV	1037	20			
19	Skyline Drive_1	LDV	14005	61	0.026	0.008	0.004
20	Skyline Drive_1	HDV	2026	56			
21	Skyline_Rndbt1	LDV	14005	20	0.052	0.008	0.005
22	Skyline_Rndbt1	HDV	2026	15			
23	Skyline Drive_2	LDV	14005	61	0.026	0.008	0.004
24	Skyline Drive_2	HDV	2026	56			
25	Skyline_Rndbt2	LDV	13614	20	0.047	0.007	0.004
26	Skyline_Rndbt2	HDV	1667	15			
27	Skyline Drive_3	LDV	9256	53	0.015	0.004	0.002
28	Skyline Drive_3	HDV	461	48			
29	Skyline_Omega_Rndbt	LDV	9256	20	0.024	0.004	0.002
30	Skyline_Omega_Rndbt	HDV	461	15			
31	Omega Blvd	LDV	9256	53	0.015	0.004	0.002
32	Omega Blvd	HDV	461	48			
33	Burtonwood Rd_3a	LDV	10194	25	0.019	0.004	0.002
34	Burtonwood Rd_3a	HDV	44	20			
35	Burtonwood Rd_3b	LDV	10251	25	0.021	0.004	0.002
36	Burtonwood Rd_3b	HDV	177	20			

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
37	Burtonwood Rd_3	LDV	20224	61	0.030	0.008	0.004
38	Burtonwood Rd_3	HDV	221	56			
39	Burtonwood Rd_3c	LDV	10251	20	0.023	0.004	0.002
40	Burtonwood Rd_3c	HDV	177	15			
41	Burtonwood Rd_3d	LDV	10194	20	0.021	0.004	0.002
42	Burtonwood Rd_3d	HDV	44	15			
43	M62 EB_OffSlip_1a	LDV	5522	35	0.014	0.002	0.001
44	M62 EB_OffSlip_1a	HDV	547	30			
45	M62 WB_OffSlip_1a	LDV	13377	35	0.034	0.004	0.002
46	M62 WB_OffSlip_1a	HDV	1268	30			
47	M62 WB_OnSlip	LDV	5281	80	0.010	0.001	0.001
48	M62 WB_OnSlip	HDV	550	75			
49	M62_EB_OnSlip	LDV	11797	80	0.024	0.004	0.002
50	M62_EB_OnSlip	HDV	1538	75			
51	M62_WB_OffSlip_1	LDV	13377	80	0.026	0.004	0.002
52	M62_WB_OffSlip_1	HDV	1268	75			
53	M62_EB_OffSlip_1	LDV	5522	80	0.011	0.002	0.001
54	M62_EB_OffSlip_1	HDV	547	75			
55	M62 EB_1	LDV	55221	113	0.155	0.016	0.010
56	M62 EB_1	HDV	5471	97			
57	M62 WB_1	LDV	52808	113	0.149	0.015	0.009
58	M62 WB_1	HDV	5500	97			
59	M62 EB_1a	LDV	49698	113	0.140	0.014	0.009
60	M62 EB_1a	HDV	4924	97			
61	M62 WB_1a	LDV	47527	113	0.134	0.014	0.008
62	M62 WB_1a	HDV	4950	97			
63	M62 EB_2	LDV	61495	113	0.173	0.018	0.011
64	M62 EB_2	HDV	6462	97			
65	M62 WB_2	LDV	60904	113	0.171	0.017	0.011
66	M62 WB_2	HDV	6217	97			
67	Site Access Road	LDV	4029	40	0.011	0.003	0.001
68	Site Access Road	HDV	843	35			
69	M62 EB_1b	LDV	55221	113	0.155	0.016	0.010
70	M62 EB_1b	HDV	5471	97			
71	M62 WB_1b	LDV	52808	113	0.149	0.015	0.009

Link ID	Road Name	Vehicle Category	AADT	Speed (km/h)	Emission Rate (g/km/sec)		
					NO_x	PM_{10}	$PM_{2.5}$
72	M62 WB_1b	HDV	5500	97			

* Emission rates rounded to three decimal places

Table A6-3-7 - Emission Rates – EFT Sensitivity Test – 2018 Emission Year (g/km/s)

Link ID	Road Name	2021 Do-Minimum			2021 Do-Something			2021 Do-Minimum			2021 Do-Something		
		NO_x	PM_{10}	NO_x	PM_{10}	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$
1 2	Burtonwood Rd_1	0.045	0.005	0.003	0.046	0.005	0.003	0.047	0.005	0.003	0.047	0.005	0.003
3 4	Burtonwood Rd_1a	0.063	0.005	0.003	0.064	0.005	0.003	0.066	0.005	0.003	0.067	0.005	0.003
5 6	Burtonwood Rndbt	0.063	0.005	0.003	0.064	0.005	0.003	0.066	0.005	0.003	0.067	0.005	0.003
7 8	Burtonwood Rd_1b	0.063	0.005	0.003	0.064	0.005	0.003	0.066	0.005	0.003	0.067	0.005	0.003
9 10	Burtonwood Rd_2a	0.029	0.002	0.001	0.030	0.002	0.001	0.030	0.002	0.001	0.031	0.002	0.001
11 12	Burtonwood Rd_2b	0.029	0.002	0.001	0.030	0.002	0.001	0.030	0.002	0.001	0.031	0.003	0.002
13 14	M62 J8 Rndbt	0.221	0.019	0.011	0.243	0.020	0.012	0.230	0.020	0.012	0.252	0.021	0.013
15 16	Skyline Drive_1a	0.056	0.003	0.002	0.076	0.004	0.003	0.058	0.004	0.002	0.078	0.005	0.003
17 18	Skyline Drive_1b	0.055	0.003	0.002	0.078	0.005	0.003	0.057	0.004	0.002	0.080	0.005	0.003

Link ID	Road Name	2021 Do-Minimum			2021 Do-Something			2021 Do-Minimum			2021 Do-Something		
		NO_x	PM_{10}	NO_x	PM_{10}	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$
19 20	Skyline Drive_1	0.064	0.006	0.004	0.085	0.008	0.005	0.066	0.007	0.004	0.087	0.009	0.005
21 22	Skyline_Rndbt1	0.130	0.007	0.004	0.183	0.009	0.006	0.133	0.007	0.005	0.187	0.010	0.006
23 24	Skyline Drive_2	0.064	0.006	0.004	0.085	0.008	0.005	0.066	0.007	0.004	0.087	0.009	0.005
25 26	Skyline_Rndbt2	0.104	0.006	0.004	0.161	0.009	0.005	0.109	0.006	0.004	0.165	0.009	0.005
27 28	Skyline Drive_3	0.040	0.004	0.002	0.043	0.004	0.002	0.042	0.004	0.002	0.044	0.004	0.003
29 30	Skyline_Omega_Rndbt	0.068	0.004	0.003	0.071	0.004	0.003	0.071	0.004	0.003	0.074	0.005	0.003
31 32	Omega Blvd	0.040	0.004	0.002	0.043	0.004	0.002	0.042	0.004	0.002	0.044	0.004	0.003
33 34	Burtonwood Rd_3a	0.050	0.004	0.002	0.050	0.004	0.002	0.052	0.004	0.003	0.052	0.004	0.003
35 36	Burtonwood Rd_3b	0.056	0.004	0.003	0.056	0.004	0.003	0.057	0.004	0.003	0.057	0.004	0.003
37	Burtonwood Rd_3	0.076	0.008	0.005	0.076	0.008	0.005	0.078	0.008	0.005	0.078	0.008	0.005

Link ID	Road Name	2021 Do-Minimum			2021 Do-Something			2021 Do-Minimum			2021 Do-Something		
		NO_x	PM_{10}	NO_x	PM_{10}	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$
38													
39 40	Burtonwood Rd_3c	0.062	0.004	0.003	0.062	0.004	0.003	0.063	0.004	0.003	0.063	0.004	0.003
41 42	Burtonwood Rd_3d	0.055	0.004	0.002	0.055	0.004	0.002	0.056	0.004	0.003	0.056	0.004	0.003
43 44	M62 EB_OffSlip_1a	0.039	0.002	0.001	0.040	0.002	0.001	0.041	0.002	0.001	0.042	0.002	0.001
45 46	M62 WB_OffSlip_1a	0.088	0.004	0.003	0.096	0.004	0.003	0.092	0.004	0.003	0.101	0.005	0.003
47 48	M62 WB_OnSlip	0.027	0.002	0.001	0.027	0.002	0.001	0.029	0.002	0.001	0.029	0.002	0.001
49 50	M62_EB_OnSlip	0.062	0.004	0.003	0.064	0.004	0.003	0.064	0.004	0.003	0.067	0.004	0.003
51 52	M62_WB_OffSlip_1	0.064	0.004	0.003	0.069	0.004	0.003	0.068	0.004	0.003	0.072	0.004	0.003
53 54	M62_EB_OffSlip_1	0.028	0.002	0.001	0.029	0.002	0.001	0.030	0.002	0.001	0.030	0.002	0.001
55 56	M62 EB_1	0.398	0.018	0.013	0.401	0.018	0.013	0.419	0.019	0.013	0.421	0.019	0.013

Link ID	Road Name	2021 Do-Minimum			2021 Do-Something			2021 Do-Minimum			2021 Do-Something		
		NO_x	PM_{10}	NO_x	PM_{10}	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$
57 58	M62 WB_1	0.383	0.018	0.012	0.385	0.018	0.012	0.403	0.019	0.013	0.405	0.019	0.013
59 60	M62 EB_1a	0.358	0.016	0.011	0.360	0.016	0.011	0.377	0.017	0.012	0.379	0.017	0.012
61 62	M62 WB_1a	0.345	0.016	0.011	0.347	0.016	0.011	0.362	0.017	0.012	0.364	0.017	0.012
63 64	M62 EB_2	0.444	0.020	0.014	0.449	0.021	0.014	0.466	0.021	0.015	0.472	0.022	0.015
65 66	M62 WB_2	0.437	0.020	0.014	0.444	0.020	0.014	0.459	0.021	0.015	0.466	0.021	0.015
67 68	Site Access Road	0.007	0.001	0.000	0.039	0.003	0.002	0.007	0.001	0.000	0.039	0.003	0.002
69 70	M62 EB_1b	0.398	0.018	0.013	0.401	0.018	0.013	0.419	0.019	0.013	0.421	0.019	0.013
71 72	M62 WB_1b	0.383	0.018	0.012	0.385	0.018	0.012	0.403	0.019	0.013	0.405	0.019	0.013

* Emission rates rounded to three decimal places

Table A6-3-8 - Emission Rates – CURED V3A Sensitivity Test - NO_x (g/km/s)

Link ID	Road Name	2018 BVY	2021 Do-Minimum	2021 Do-Something	2036 Do-Minimum	2036 Do-Something
1/2	Burtonwood Rd_1	0.039	0.038	0.039	0.029	0.029
3/4	Burtonwood Rd_1a	0.055	0.053	0.054	0.039	0.040
5/6	Burtonwood Rndbt	0.055	0.053	0.054	0.039	0.040
7/8	Burtonwood Rd_1b	0.055	0.053	0.054	0.039	0.040
9/10	Burtonwood Rd_2a	0.025	0.025	0.025	0.018	0.018
11/12	Burtonwood Rd_2b	0.026	0.025	0.025	0.018	0.019
13/14	M62 J8 Rndbt	0.183	0.173	0.188	0.115	0.122
15/16	Skyline Drive_1a	0.043	0.041	0.054	0.024	0.030
17/18	Skyline Drive_1b	0.042	0.040	0.056	0.023	0.030
19/20	Skyline Drive_1	0.049	0.048	0.062	0.031	0.038
21/22	Skyline_Rndbt1	0.100	0.094	0.129	0.054	0.069
23/24	Skyline Drive_2	0.049	0.048	0.062	0.031	0.038
25/26	Skyline_Rndbt2	0.082	0.077	0.116	0.046	0.064
27/28	Skyline Drive_3	0.035	0.032	0.034	0.022	0.023
29/30	Skyline_Omega_Rndbt	0.061	0.052	0.055	0.033	0.035
31/32	Omega Blvd	0.035	0.032	0.034	0.022	0.023
33/34	Burtonwood Rd_3a	0.034	0.043	0.043	0.031	0.031
35/36	Burtonwood Rd_3b	0.042	0.046	0.046	0.032	0.032
37/38	Burtonwood Rd_3	0.053	0.064	0.064	0.047	0.047
39/40	Burtonwood Rd_3c	0.047	0.051	0.051	0.035	0.035
41/42	Burtonwood Rd_3d	0.037	0.046	0.046	0.033	0.033
43/44	M62 EB_OffSlip_1a	0.036	0.030	0.030	0.021	0.021
45/46	M62 WB_OffSlip_1a	0.075	0.068	0.073	0.049	0.051
47/48	M62 WB_OnSlip	0.025	0.021	0.021	0.016	0.016
49/50	M62_EB_OnSlip	0.051	0.047	0.049	0.035	0.036
51/52	M62_WB_OffSlip_1	0.055	0.051	0.054	0.038	0.040
53/54	M62_EB_OffSlip_1	0.026	0.022	0.022	0.016	0.017
55/56	M62 EB_1	0.360	0.316	0.318	0.241	0.242
57/58	M62 WB_1	0.346	0.303	0.305	0.231	0.232
59/60	M62 EB_1a	0.324	0.284	0.286	0.217	0.218
61/62	M62 WB_1a	0.311	0.273	0.274	0.208	0.208
63/64	M62 EB_2	0.394	0.351	0.355	0.267	0.270
65/66	M62 WB_2	0.389	0.346	0.351	0.264	0.267
67/68	Site Access Road	0.001	0.006	0.028	0.004	0.014

Link ID	Road Name	2018 BVY	2021 Do-Minimum	2021 Do-Something	2036 Do-Minimum	2036 Do-Something
69/70	M62 EB_1b	0.360	0.316	0.318	0.241	0.242
71/72	M62 WB_1b	0.346	0.303	0.305	0.231	0.232

* Emission rates rounded to three decimal places

TIME VARYING EMISSIONS

The ADMS-Roads model uses an hourly traffic flow based on the daily (AADT) flows. Traffic flows follow a diurnal variation throughout the day, thus emissions throughout a 24-hour period are weighted according to the profile of traffic during peak, inter-peak and off-peak periods.

The traffic data provided for this assessment has been derived from Automatic Traffic Counts (ATC) which were conducted in association with the Proposed Development. The ATC data for each site has been factored to AADT for use in the road vehicle exhaust emissions assessment.

Vehicle emission sources relative to each period of the day were assigned to the appropriate hours within ADMS-Roads, based on the respective ATC data, thus allowing the respective time-varying nature of emissions to be simulated within dispersion modelling.

As such, a diurnal profile has then been included within the ADMS-Roads model to replicate how the average hourly traffic flow varies throughout weekdays and the weekend.

The diurnal profile has created by taking an average of the ATC locations to the Proposed Development based on surveys completed in June 2019.

Figure A6-3-1: Diurnal Profile – Road Vehicle Exhaust Emissions Assessment presents the diurnal profile calculated for this assessment.

Figure A6-3-1 - Diurnal Profile – Road Vehicle Exhaust Emissions Assessment

TRAFFIC DATA ASSUMPTIONS

There are a number of assumptions made, in regard to the application and treatment of the supplied traffic data for this assessment. These are as follows:

Speeds

- Majority of links have HDV speeds reduced by 5 km/h from the respective LDV speed;
- Motorway average speed set to 113 km/h for LDV and 97 km/h for HDV;
- Speeds reduced along A49 given this road is in an AQMA and known to be congested in sections; and,
- Approaches to / exits from junctions and roundabouts have been given reduced speeds as per LAQM.TG16 guidance (Ref 6.9).

Road Links:

- Roundabout with more than two joining links are equal to sum of all links entering the roundabout;
- An assumption of 10 % has been assigned to the M62 eastbound off-slip and M62 westbound on-slip, with the corresponding off/on-slips equal to the difference between the main M62 links;
- The directional flows obtained for the A49 Winwick Road (for inclusion in the model verification exercise) have assumed a 50 / 50 northbound to southbound split in absence of any other information.
- The majority of other modelled links represented as two-way flows using the road centre line (i.e. not split by direction).

Model Verification Exercise:

- Traffic data obtained from the Department for Transport (DfT) traffic count data source (Ref 6.27) for the A49 Winwick Road is only used for the model verification exercise. These road links have not been treated for the respective future year assessment scenarios.

MODEL VALIDATION

ADMS-Roads is commonly used in the UK for an array of air quality management and assessment studies. ADMS-Roads is continually validated against available measured data obtained from real world conditions, field studies and research experiments which improves model performance.

However, any model validation carried out by CERC is unlikely to have been carried out for the study area which encompasses the Proposed Development.

Therefore, a comparison of the modelling results against representative monitoring data is required to minimise model uncertainties, by revising modelled results with an adjustment factor to give greater confidence in the final outputs and to confirm that the final pollutant concentrations predicted are representative of the local monitoring information from the study area.

MODEL VERIFICATION

The comparison of modelled concentrations with local monitored concentrations is a process termed ‘verification’. Model verification investigates the discrepancies between modelled and measured concentrations, which can arise due to the presence of inaccuracies and/or uncertainties in model input data, modelling and monitoring data assumptions.

The following are examples of potential causes of such uncertainties:

- Estimates of background pollutant concentrations;
- Meteorological data uncertainties;
- Traffic data uncertainties;
- Model input parameters, such as ‘roughness length’; and
- Overall limitations of the dispersion model.

LAQM.TG16 (Ref 6.9) states that,

“Model verification is the process by which these and other uncertainties are investigated and where possible minimised. In reality, the differences between modelled and monitored results are likely to be a combination of all of these aspects.”

Through appropriate adjustment of the modelled road NO_x contribution, uncertainties such as those identified above can be minimised where possible to progress consistency with available measured data. An adjustment factor has been derived and applied to all scenario model outputs.

Air quality monitoring from Warrington Borough Council has been used for the verification process which is described below.

MODEL PERFORMANCE

An evaluation of model performance has been undertaken to establish confidence in the model results. LAQM.TG16 (Ref 6.9) identifies several statistical procedures that are appropriate to evaluate model performance and assess the uncertainty.

These include:

- Root mean square error (RMSE);
- Fractional bias (FB); and
- Correlation coefficient (CC).

These parameters estimate how the model results agree or diverge from the observations.

These calculations can be carried out prior to, and after adjustment, or based on different options for adjustment, and can provide useful information on model improvement.

A brief explanation of each statistic is provided in **Table A6-3-9**, and further details can be found in Box 7.17 of LAQM.TG16 (Ref 6.9).

Table A6-3-9 - Statistical parameters for describing Model Performance

Statistical Parameter	Comment	Ideal Value
Root Mean Square Root (RMSE)	RMSE is used to define the average error or uncertainty of the model. The units of RMSE are equivalent to the quantities compared. If the RMSE values are higher than 25%, of the objective being assessed, it is recommended that the model inputs and verification should be revisited to make improvements. For example, if the model predictions are for the annual mean NO_2 objective of 40µg/m^3, if an RMSE of 10µg/m^3 is determined for a model, it is advised to revisit the model parameters and model verification. Ideally, an RMSE within 10% of the air quality objective would be derived, which equates to 4µg/m^3 for the annual mean NO_2 objective.	0.00
Fractional Bias (FB)	FB is used to identify if the model shows a systematic tendency to over or under predict. FB values vary between +2 and -2 and has an ideal value of zero. Negative values suggest a model overprediction and positive values suggest a model under-prediction.	0.00
Correlation Coefficient (CC)	It is 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. This statistic can be particularly useful when comparing a series of modelled and observed data points.	1.00

To assess the uncertainty of a model, the RMSE is the simplest parameter to calculate providing an estimate of the average error of the model in the same units as the modelled predictions.

ASSESSMENT VERIFICATION PROCESS

Approach

The model verification process contains a review of the modelled pollutant concentrations against corresponding monitoring data to determine how well the air quality model performed.

Depending on the outcomes of the initial review, it may be considered that the model has performed to an adequate level and that no further adjustment is required to be carried out for the modelling results, as per LAQM.TG16 (Ref 6.9).

Alternatively, the model may have performed outside of the ideal performance limits quoted within LAQM.TG16 (Ref 6.9) (i.e. model agrees within +/-25% of monitored equivalent, but ideally within +/- 10%). There is then a need to check all the input data to ensure that it is reasonable and accurately represented in the air quality modelling process.

Where all input data, such as traffic data, emissions rates, and background concentrations have been checked and considered as practical, then the modelled results require adjustment to best align with the monitoring data.

This may either be a single verification adjustment factor to be applied to the modelled concentrations across the entire study area, or a range of different adjustment factors to account for different zones such as motorway, urban or rural areas or for each identified local authority's jurisdiction.

Model verification is predominantly undertaken based on concentrations of nitrogen dioxide (NO_2). Most NO_2 is produced in the atmosphere by the reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of the primary pollutant emissions of nitrogen oxides (NO_x = NO + NO_2), in accordance with LAQM.TG16 (Ref 6.9). As such, adjustment has been applied to the road NO_x source contribution, thus ensuring that any adjustment has been applied prior to being converted from NO_x to NO_2.

Monitoring Data for Assessment Verification Process

The dispersion model was set to predict the 2018 annual mean road-NO_x contribution at identified monitoring locations to carry out an appropriate model adjustment exercise.

The model outputs of road-NO_x have been compared with the 'measured' road-NO_x, which was determined from the NO_2 concentrations measured at each monitoring location, utilising the NO_x from NO_2 calculator provided by Defra (Ref 6.6) and the NO_2 background concentration (from the Defra background mapping) (Ref 6.7).

For this assessment, there were a number of local authority diffusion tube monitoring sites positioned on the A49 Winwick Road, for which Department for Transport (DfT) traffic count data for 2018 were available (Ref 6.27).

These were identified through the Warrington Borough Council 2019 ASR (Ref 6.12) and are as follows:

Warrington Borough Council

- DT42 – WA95 A49 Winwick Road (1)
- DT43 – WA96 A49 Winwick Road (2)
- DT44 – WA112 A49 Winwick Road (3)

Background pollutant concentrations of NO_x and NO_2 were revised for the model verification exercise only, to remove the 'in square' road source contributions from the total mapped backgrounds applicable for each 1 km x 1 km grid square encompassing each identified monitoring location.

The NO_2 mapping concentrations were adjusted accordingly with use of the Defra NO_2 adjustment for NO_x Sector Removal Tool (Ref 6.8).

The respective monitoring location results used in the verification process are contained in **Table A6-3-10** which presents the initial model verification exercise of applying no adjustment to Road-NO_x contributions.

It contains a comparison of the monitored and modelled NO_2 results for the base year of 2018 to ascertain whether any further adjustment would be required, based on the guidance provided in LAQM.TG16 (Ref 6.9).[Error! Bookmark not defined.]

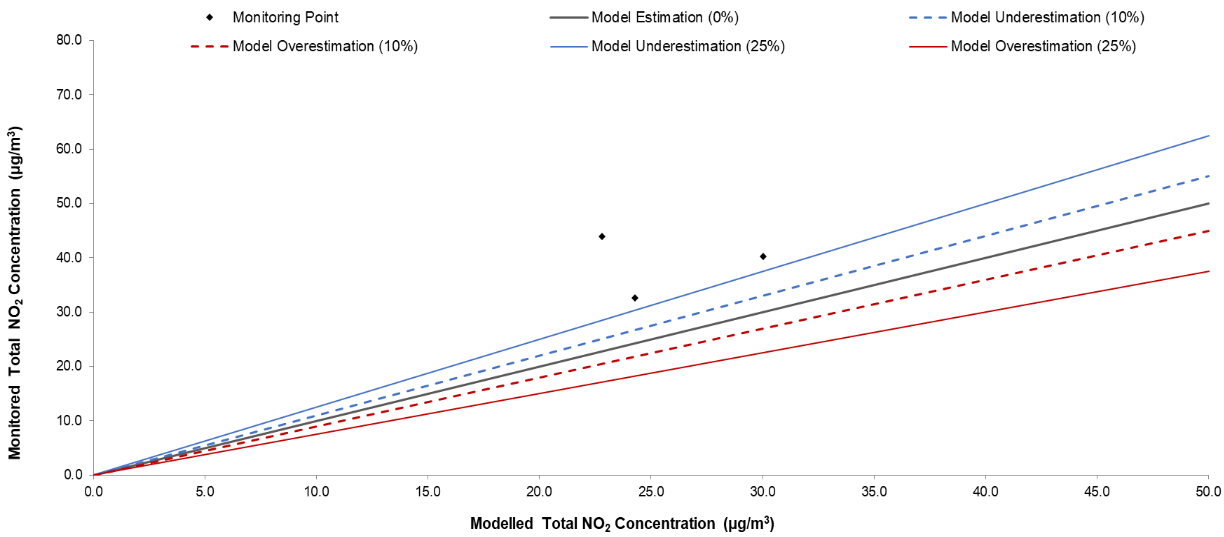
Table A6-3-10 - NO_2 Model Verification Procedure – No Adjustment

Model Verification Procedure	NO_2 Diffusion Tubes		
	Warrington Borough Council		
	DT42	DT43	DT44
2018 Background NO_X	22.3	22.5	22.5
2018 Background NO_2	15.6	15.7	15.7
2018 Monitored Total NO_2 (from diffusion tube results)	32.6	40.3	43.9
2018 Monitored Road NO_2	17.0	24.6	28.2
Monitored Road NO_x (from NO_x to NO_2 Calculator for diffusion tubes)	34.8	52.2	61.0
Modelled Road Contribution NO_x (from ADMS-Roads)	17.0	28.8	13.7
Modelled Total NO_2 based on Empirical NO_x to NO_2 Relationship (from NO_x to NO_2 calculator)	24.3	30.0	22.8
Monitored Total NO_2	32.6	40.3	43.9
% Difference ((Modelled - Monitored / Monitored) x 100)	**-25.5**	**-25.5**	**-48.1**

Data reported to one decimal place

Figure A6-3-2 shows the comparison of unadjusted modelled total NO_2 against the monitored NO_2 concentrations (see **Table A6-3-10**) with all the identified monitoring locations considered in the model verification exercise.

Figure A6-3-2 - NO_2 Model Verification Procedure – Comparison of Unadjusted Modelled Total NO_2 vs Monitored Total NO_2 – No Adjustment



Box 7.14 of LAQM.TG16 (Ref 6.9) outlines the following:

"If your checks confirm that:

- *There is no systematic under or over prediction;*
- *Predictions at sites where monitoring shows concentrations are close to the objective show good comparison; and*
- *The majority of results are within 25% as a minimum, but preferably within 10%, of monitored concentrations.*

Then you do not necessarily need to adjust your modelling results. However, you may consider model adjustment as this can lead to further improvements in the results obtained, for example where all results move to within 10% of monitored concentrations."

The model verification exercise showed that the difference between the total modelled NO_2 and total monitored NO_2 at all three identified local authority diffusion tube monitoring locations (DT44) is above ± 25% when processed and no adjustment is made to the modelled road-NO_x contributions (see **Table A6-3-10**).

As such, it was deemed necessary to carry out adjustment to the modelled road-NO_x contributions to gain improvements in the dispersion modelling results, as per LAQM.TG16 (Ref 6.9).

Preliminary Model Adjustment

Table A6-3-11 presents the preliminary model adjustment exercise, which considers the comparison of modelled and monitored total annual mean NO_2 once adjustment was made to the modelled road-NO_x contributions.

Table A6-3-11-NO_2 Model Verification Procedure – Preliminary Adjustment

Model Verification Procedure	NO_2 Diffusion Tubes		
	Warrington Borough Council		
	DT42	DT43	DT44
2018 Background NO_x	22.3	22.5	22.5
2018 Background NO_2	15.6	15.7	15.7
2018 Monitored Total NO_2 (from diffusion tube results)	32.6	40.3	43.9
2018 Monitored Road NO_2	17.0	24.6	28.2
Monitored Road NO_x (from NO_x to NO_2 Calculator for diffusion tubes)	34.8	52.2	61.0
Modelled Road Contribution NO_x (from ADMS-Roads)	17.0	28.8	13.7
Ratio of Monitored to Modelled Road Contribution NO_x	2.0	1.8	4.4
Adjustment Factor	2.24 (2.2427)		
Adjusted Road Contribution NO_x	38.2	64.5	30.8
Adjusted Modelled Total NO_x	60.5	87.0	53.3
Modelled Total NO_2 based on Empirical NO_x to NO_2 Relationship (from NO_x to NO_2 calculator)	34.2	45.3	31.0
Monitored Total NO_2	32.6	40.3	43.9
% Difference ((Modelled - Monitored / Monitored) x 100)	**4.8**	**12.4**	**-29.5**

Figure A6-3-3 below presents the calculation to derive the road-NO_x model adjustment factor for the preliminary adjustment exercise. This factor was then applied to the modelled road-NO_x concentration for the monitoring locations to provide adjusted modelled road-NO_x values to then be compared to the total NO_2 monitoring concentrations, once converted from NO_x to NO_2 (Ref 6.6).

Figure A6-3-3 - NO_2 Model Verification Procedure – Comparison of Unadjusted Modelled Road NO_x vs Monitored Road NO_x – Preliminary Adjustment

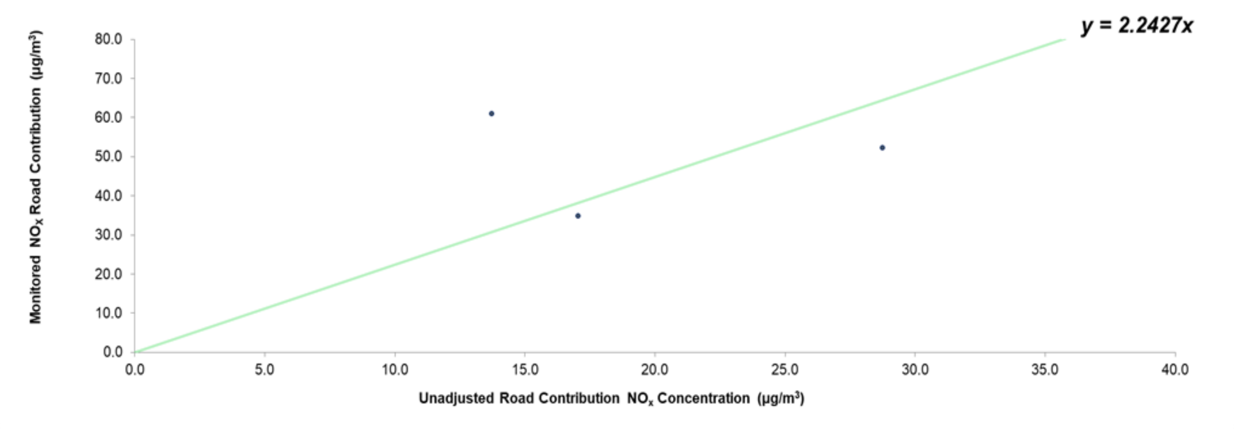
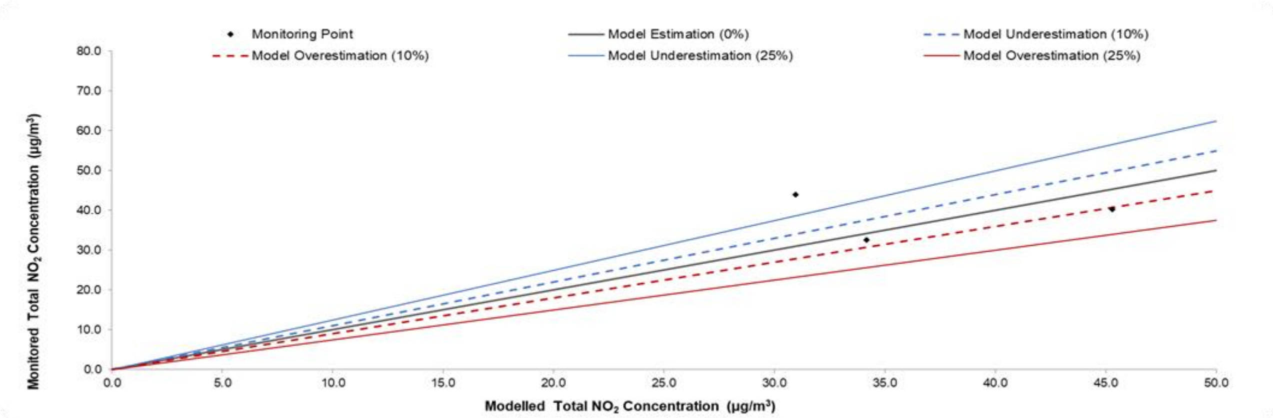


Figure A6-3-4 below presents the comparison of monitored versus modelled NO_2 for each monitoring locations in the preliminary model adjustment procedure, with the adjustment factor of 2.24 applied to the modelled road-NO_x contributions.

Figure A6-3-4 - NO_2 Model Verification Procedure – Comparison of Adjusted Modelled Total NO_2 vs Monitored Total NO_2 – Preliminary Adjustment



Two monitoring locations (DT42 and DT43) were predicted to be within ± 15% of the respective 2018 annual mean NO_2 concentrations obtained from the identified monitoring network. The DT44 monitoring location was still exhibiting a difference between the total modelled NO_2 and total monitored NO_2 above ± 25% after adjustment was applied to the modelled road-NO_x contributions.

The DT44 (WA112 Win Rd 3) monitoring location is positioned in a location approximately 45 m from the A574 Cromwell Avenue and Sand Lane West roundabout. Traffic data were not available for the Winwick Road link, adjacent to which the DT44 monitoring location is positioned. As such, there is the potential for road-NO_x emissions to be under estimated at this location, as indicated by the results presented above.

Given the lack of traffic data adjacent to the DT44 monitoring location, the site was removed from the verification process.

Revised Model Adjustment

Table A6-3-12 provides the relevant data required to generate the revised adjustment exercise, following removal of the DT44 monitoring location from the model verification procedure.

Table A6-3-12 - NO_2 Model Verification Procedure – Revised Adjustment

Model Verification Procedure	NO_2 Diffusion Tubes	
	Warrington Borough Council	
	DT42	DT43
2018 Background NO_x	22.3	22.5
2018 Background NO_2	15.6	15.6
2018 Monitored Total NO_2 (from diffusion tube results)	32.6	40.3
2018 Monitored Road NO_2	17.0	24.6
Monitored Road NO_x (from NO_x to NO_2 Calculator for diffusion tubes)	34.8	52.2
Modelled Road Contribution NO_x (from ADMS-Roads)	17.0	28.8
Ratio of Monitored to Modelled Road Contribution NO_x	2.0	1.8
Adjustment Factor	**1.87 (1.8722)**	
Adjusted Road Contribution NO_x	31.9	53.8
Adjusted Modelled Total NO_x	54.2	76.4
Modelled Total NO_2 based on Empirical NO_x to NO_2 Relationship (from NO_x to NO_2 calculator)	31.3	41.0
Monitored Total NO_2	32.6	40.3
% Difference ((Modelled - Monitored / Monitored) x 100)	**-4.0**	**1.7**

Data reported to one decimal place

Figure A6-3-5 below presents the calculation to derive the road NO_x model adjustment factor for the revised model verification exercise. This factor was then reapplied to the modelled road-NO_x concentration for the remaining monitoring locations to provide adjusted modelled road-NO_x values in the revised model verification exercise.

Figure A6-3-5 - NO$_2$ Model Verification Procedure – Comparison of Unadjusted Modelled Road NO$_x$ vs Monitored Road NO$_x$ – Revised Adjustment

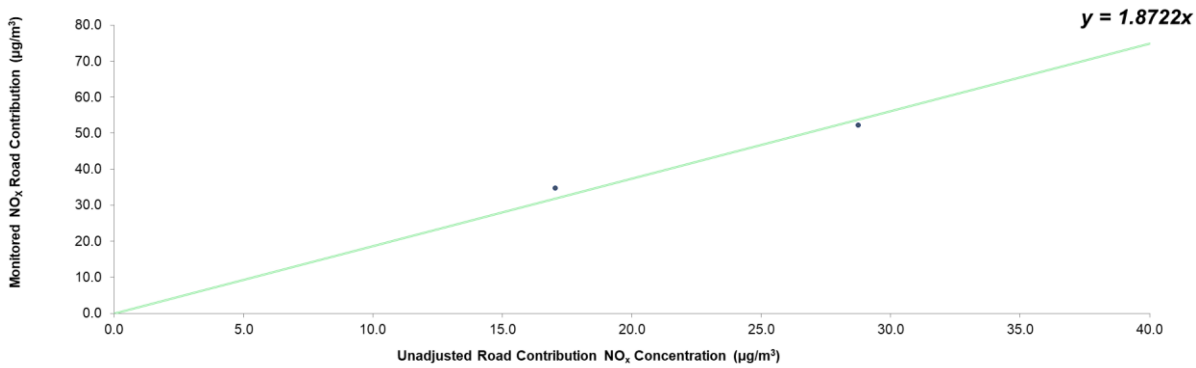
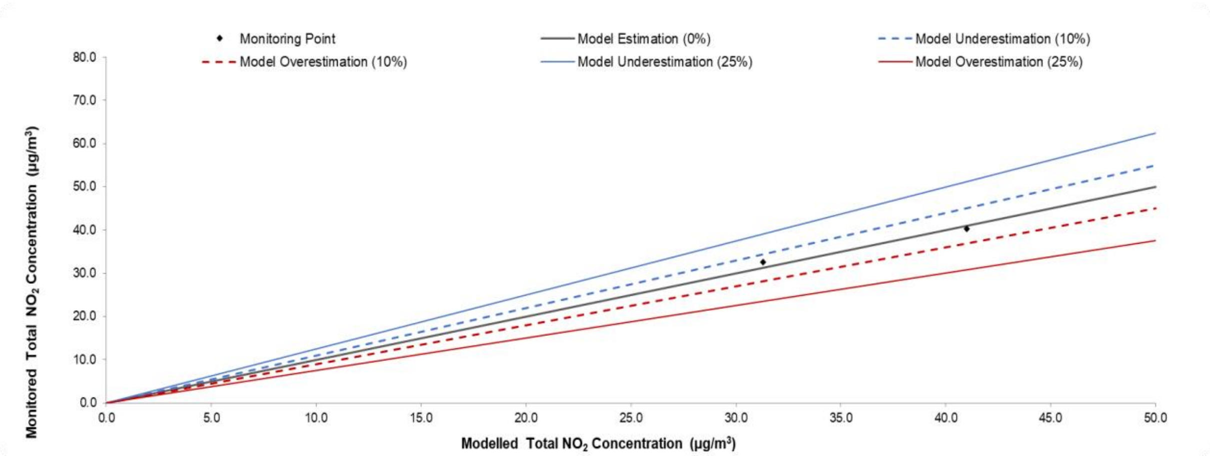


Figure A6-3-6 below presents the comparison of monitored versus modelled NO$_2$ for each monitoring locations in the revised model verification procedure.

Figure A6-3-6 NO$_2$ Model Verification Procedure – Comparison of Adjusted Modelled Total NO$_2$ vs Monitored NO$_2$ – Revised Adjustment



The two remaining sites demonstrate agreement within ± 10% once the revised adjustment is completed. As such, the air quality model, after appropriate verification can be considered to be suitable.

Figure A6-3-7 presents the spatial locations of the monitoring used in the model verification process.

Summary

The summary of model performance statistics, as outlined in LAQM.TG16 (Ref 6.9) are provided in **Table A6-3-13** below.

Table A6-3-13 Model Performance Statistics

Model Verification Exercise	No. of Sites	No. of Sites within +/- 25%	No. of Sites within +/- 10%	Root Mean Square Error (RMSE)		Fractional Bias (FB)	Correlation Co-efficient (CC)
				µg/m³	% of AQO		
No Adjustment	3	0	0	14.4	36.0 %	0.41	0.0
Preliminary Adjustment	3	2	1	8.1	20.25 %	0.06	0.0
Revised AdjustmentRevised Adjustment	2	0	2	1.0	2.5 %	0.01	1.0

A comparison of the performance of the modelled total NO_2 concentrations against the monitoring data used in each model verification step has been carried out.

The RMSE value calculated when no adjustment to the modelled road-NO_x contribution was 14.4 µg/m³, equating to 36.0% of the annual mean NO_2 objective. The FB value is calculated as 0.41 and the CC is calculated as 0.0. None of the considered monitoring locations are preforming at an adequate level (within +/- 25%) and therefore it was deemed acceptable to complete a model adjustment exercise.

When the preliminary adjustment was made to the road-NO_x contributions, the RMSE value calculated was reduced to 8.1 µg/m³, equating to 20.25% of the annual mean NO_2 objective. The FB value is calculated as 0.06 and the CC is calculated as 0.0.

On interpretation of these statistics, one of the three considered monitoring locations contained within the preliminary adjustment exercise would be judged to not be performing within a suitable range of agreement (within +/- 25%).

With inclusion of all three monitoring sites, the RMSE equates to more than twice of the ideal value. The FB indicates that, at 0.06, the model is under-predicting in its output.

Once the relevant monitoring location was removed, due the lack of available traffic data on the adjacent road, and modelled road-NO_x adjustment factor derived, the RMSE value calculated reduces to 1.0 µg/m³, which is 2.5% of the annual mean air quality objective. The FB value is calculated as 0.01 and the CC is calculated as 1.0.

The RMSE sits within the ideal value of 4.0 µg/m³ or within 10% of the annual mean NO_2 objective, representing an improvement in model performance and demonstrating a near-ideal value for FB (i.e. no tendency for the model to over or under predict).

After the revised adjustment, the remaining two monitoring sites are within ± 5% of the monitoring equivalent. Consequently, a road-NO_x verification factor of 1.87 was used to adjust the modelled concentrations for each scenario included in the road vehicle exhaust emissions assessment.

PM_{10} and $PM_{2.5}$ Adjustment

There were no identified PM_{10} or $PM_{2.5}$ monitoring locations situated adjacent to the modelled road network.

As such, the verification factor determined above for adjusting the road-NO_X contribution has been applied to the predicted road-PM_{10} and road-$PM_{2.5}$ contributions, consistent with the guidance set out in LAQM.TG16 (Ref 6.9), which states:

"In the absence of any PM_{10} data for verification, it may be appropriate to apply the road-NO_x adjustment to the modelled road-PM_{10}. If this identifies exceedances of the objective, then it would be appropriate to monitor PM_{10} to confirm the findings."

Modelling Uncertainty

Further modelling uncertainty could be reduced with the refinement of the dispersion model, in particular in areas where traffic may experience reduced speeds on the approach to all junctions contained within the dispersion model, which may improve the overall model performance. However, to limit this uncertainty within the air quality model, vehicle speeds were manually reduced on the approach to junctions and roundabouts, with reference to LAQM.TG16 (Ref 6.9) guidance.

The overall modelling assessment has been carried out with using AADT traffic flow and associated speed and composition data. To reduce further uncertainty, time period modelling may have been carried out which may have highlighted periods of congestion. To minimise this uncertainty, a time-varying emissions profile was included in the air quality model to represent the differing vehicle flows throughout peak, interpeak, and off-peak periods of the day.

Not all road links will have been included within the dispersion model, which may inhibit the performance of the model at those identified monitoring locations that are situated in highly urbanised areas or situated at complex junctions. This is emphasised with the removal of one of the monitoring locations (DT44) from the model verification exercise as traffic data were not available for all road links associated with this monitoring site.

The monitoring data acquired for the model verification exercise is predominantly focused along the A49 Winwick Road which is contained with an AQMA.

Given the size of the study area included within the air quality model, the spread of available monitoring data applicable to the traffic dataset provided, uncertainty associated with the traffic model, and assumptions inherent to the air quality model (e.g. meteorological data representative at all monitoring sites, surface roughness and minimum measure of atmospheric stability consistent throughout modelled domain), the adjusted model is considered to be performing adequately within the context of the input parameters.

However, the results of the local air quality assessment do need to be viewed within the limitations of the model uncertainty.

Meteorological Data

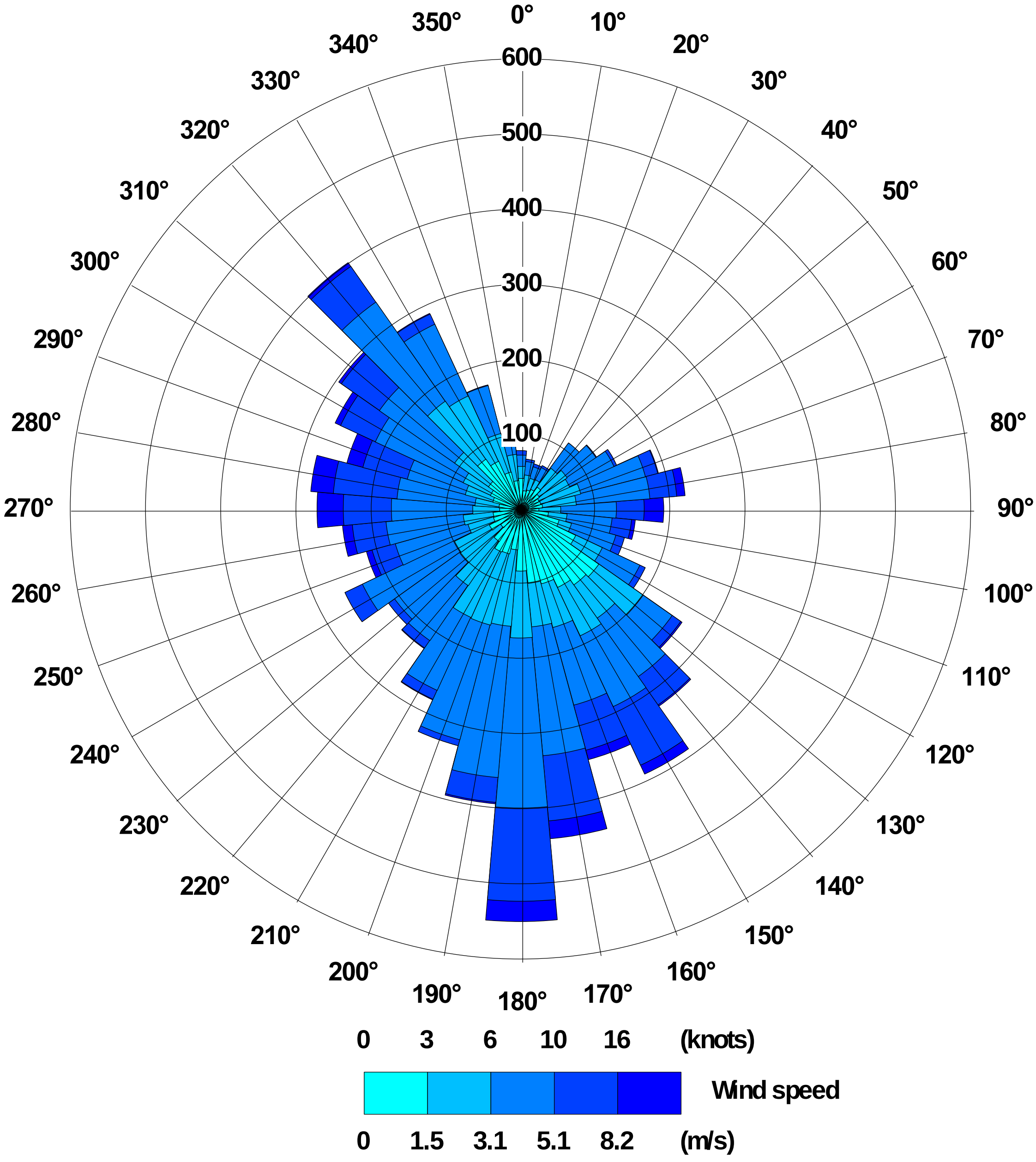
ADMS-Roads utilises hourly sequential meteorological data; including wind direction, wind speed, temperature, precipitation and cloud cover, to facilitate the prediction of pollution dispersion between source and receptor.

Meteorological data input to the model were obtained from the closest meteorological station, Rostherne, for the year 2018. The meteorological dataset has been supplemented with cloud cover data from two other supporting meteorological sites (Manchester and RAF Leeming).

The 2018 data was used to be consistent with the base / verification traffic year and were applied to the remaining scenarios for the air quality assessment.

The 2018 wind rose is presented as **Figure A6-3-8: Rostherne Meteorological site – 2018 (cloud cover supplemented by Manchester and RAF Leeming)** below.

Figure A6-3-8: Rostherne Meteorological site – 2018 (cloud cover supplemented by Manchester and RAF Leeming)



6.4 RELEVANT UK AIR QUALITY STRATEGY OBJECTIVES

RELEVANT UK AIR QUALITY STRATEGY OBJECTIVES

National Air Quality Objectives and European Directive Limit Values for the Protection of Human Health

Pollutant	Applies to	Objective	Measured as	Date to be achieved by and maintained thereafter	European Obligations	Date to be achieved by and maintained thereafter
Nitrogen dioxide (NO_2)	UK	40 µg/m³	annual mean	31.12.2005	40 µg/m³	01.01.2010
		200 µg/m³ not to be exceeded more than 18 times a year	1 hour mean	31.12.2005	200 µg/m³ not to be exceeded more than 18 times a year	01.01.2010
Particulate Matter (PM_{10}) (gravimetric)	UK (except Scotland)	40 µg/m³	annual mean	31.12.2004	40 µg/m³	01.01.2005
		50 µg/m³ not to be exceeded more than 35 times a year	24 hours mean	31.12.2004	50 µg/m³ not to be exceeded more than 35 times a year	01.01.2005
Particulate Matter ($PM_{2.5}$)	UK (except Scotland)	25 µg/m³	annual mean	2020	Target value 25 µg/m³	2010

National Air Quality Objectives and European Directive Limit and Target Values for the Protection of Vegetation and Ecosystems

Pollutant	Applies to	Objective	Measured as	Date to be achieved by and maintained thereafter	European Obligations	Date to be achieved by and maintained thereafter
Nitrogen Oxides (NO_X)	UK	30 µg/m³	annual mean	31.12.2000	30 µg/m³	19.07.2001

6.5 BACKGROUND POLLUTANT INFORMATION

Background pollutant concentrations used in the assessment have been taken from the national maps provided on the Defra website (Ref 6.7), where background concentrations of those pollutants included within the Air Quality Strategy (Ref 6.14) have been mapped at a grid resolution of 1 km x 1 km for the whole of the UK. Estimated concentrations are available for all years between 2017 and 2030.

Table A6-5-1 summarises the background pollutant concentrations of NO_X, NO_2, PM_{10} and $PM_{2.5}$ for 2018, 2021 and 2030 (in lieu of 2036) that encompass the Proposed Development and the surrounding locality.

Table A6-5-1 - Background Pollutant Annual Mean Concentrations (µg/m³)

Grid Square	NO_X			NO_2			PM_{10}			$PM_{2.5}$		
	2018	2021	2030	2018	2021	2030	2018	2021	2030	2018	2021	2030
St. Helen's Council												
353500 391500	18.6	16.1	12.2	13.4	11.8	9.2	12.4	12.1	11.7	7.8	7.5	7.2
354500 391500	17.7	15.3	11.7	12.8	11.3	8.8	11.9	11.5	11.2	7.5	7.3	7.0
355500 391500	19.0	16.2	12.1	13.7	11.9	9.1	11.9	11.5	11.2	7.6	7.4	7.1
353500 390500	25.7	21.6	15.0	17.9	15.4	11.1	14.1	13.8	13.5	8.6	8.4	8.0
354500 390500	25.1	21.1	14.8	17.5	15.1	10.9	13.6	13.2	12.9	8.5	8.2	7.9
353500 389500	18.1	15.7	12.1	13.1	11.6	9.1	12.0	11.7	11.3	7.8	7.5	7.2
354500 389500	17.3	15.1	11.8	12.6	11.1	8.9	11.8	11.5	11.1	7.7	7.4	7.1
Warrington Borough Council												
356500 391500	25.1	21.1	14.9	17.5	15.1	11.0	13.3	13.0	12.6	8.3	8.0	7.7
357500 391500	25.3	21.3	15.0	17.7	15.2	11.0	13.3	12.9	12.6	8.3	8.0	7.7
355500 390500	23.6	20.0	14.3	16.7	14.4	10.6	13.2	12.8	12.5	8.3	8.1	7.8
356500 390500	18.0	15.6	12.0	13.0	11.5	9.0	10.5	10.2	9.8	7.2	6.9	6.6
357500 390500	18.3	16.0	12.3	13.2	11.7	9.2	10.5	10.2	9.8	7.2	6.9	6.6

Grid Square	NO_X			NO_2			PM_{10}			$PM_{2.5}$		
	2018	2021	2030	2018	2021	2030	2018	2021	2030	2018	2021	2030
355500 389500	19.6	17.3	14.0	14.0	12.6	10.3	11.0	10.7	10.3	7.5	7.2	6.9
356500 389500	18.3	16.0	12.6	13.2	11.7	9.4	10.9	10.5	10.2	7.5	7.2	6.9
357500 389500	18.9	16.5	12.9	13.6	12.0	9.6	11.2	10.8	10.4	7.6	7.3	7.0

Background concentrations rounded to one decimal place

6.6 SCHEDULE OF DISPERSION MODEL RESULTS

ASSESSMENT - DEFRA EMISSIONS AND BACKGROUNDS

Table A6-6-1 - Annual mean NO_2 concentrations (µg/m^3)

Receptor	2018 Base	2021 DM	2021 DS	Change (µg/m^3)	Magnitude of Change	2036 DM	2036 DS	Change (µg/m^3)	Magnitude of Change
R1	22.7	20.4	20.6	0.2	Negligible	13.5	13.6	0.1	Negligible
R2	17.4	15.8	15.9	0.1	Negligible	11.2	11.2	0.0	Negligible
R3	20.6	19.3	19.4	0.1	Negligible	12.9	13.0	0.1	Negligible
R4	17.7	15.5	15.7	0.2	Negligible	10.9	11.0	0.1	Negligible
R5	18.1	15.9	16.2	0.3	Negligible	11.4	11.5	0.1	Negligible
R6	20.3	18.9	19.0	0.1	Negligible	12.7	12.8	0.1	Negligible
R7	16.2	14.2	14.4	0.2	Negligible	10.6	10.7	0.1	Negligible
R8	39.5	34.0	34.1	0.1	Negligible	20.6	20.6	0.0	Negligible
R9	**41.7**	35.9	36.1	0.2	Negligible	21.7	21.7	0.0	Negligible
R10	36.3	31.2	31.3	0.1	Negligible	19.2	19.2	0.0	Negligible
R11	28.3	24.3	24.4	0.0	Negligible	15.6	15.6	0.0	Negligible
R12	**40.5**	35.2	35.4	0.2	Negligible	21.2	21.3	0.1	Negligible
Annual mean objective – 40 µg/m^3									

Results reported to one decimal place
Exceedances of annual mean objective in ***Bold***

Table A6-6-2 - Annual mean PM_{10} concentrations (µg/m³)

Receptor	2018 Base	2021 DM	2021 DS	Change (µg/m³)	Magnitude of Change	2036 DM	2036 DS	Change (µg/m³)	Magnitude of Change
R1	11.7	11.5	11.6	0.1	Negligible	11.2	11.2	0.0	Negligible
R2	11.1	10.9	10.9	0.0	Negligible	10.5	10.5	0.0	Negligible
R3	11.7	11.7	11.7	0.0	Negligible	11.3	11.3	0.0	Negligible
R4	11.2	10.9	11.0	0.1	Negligible	10.6	10.6	0.0	Negligible
R5	11.6	11.3	11.4	0.1	Negligible	11.0	11.0	0.0	Negligible
R6	11.6	11.6	11.6	0.0	Negligible	11.2	11.2	0.0	Negligible
R7	11.3	11.0	11.0	0.0	Negligible	10.6	10.6	0.0	Negligible
R8	16.2	15.8	15.8	0.0	Negligible	15.4	15.4	0.0	Negligible
R9	16.0	15.6	15.6	0.0	Negligible	15.1	15.2	0.1	Negligible
R10	15.5	15.0	15.0	0.0	Negligible	14.6	14.6	0.0	Negligible
R11	14.6	14.3	14.3	0.0	Negligible	13.9	13.9	0.0	Negligible
R12	15.5	15.1	15.2	0.1	Negligible	14.7	14.8	0.1	Negligible
Annual mean objective – 40 µg/m³									

Results reported to one decimal place
Exceedances of annual mean objective in ***Bold***

Table A6-6-3 - Daily mean PM_{10} (No. of days exceedance)

Receptor	2018 Base	2021 DM	2021 DS	2036 DM	2036 DS
R1	1	2	2	2	2
R2	2	2	2	3	3
R3	1	1	1	2	2
R4	2	2	2	3	3
R5	1	2	2	2	2
R6	2	2	2	2	2
R7	2	2	2	3	3
R8	0	0	0	0	0
R9	0	0	0	0	0
R10	0	0	0	0	0
R11	0	0	0	0	0
R12	0	0	0	0	0
Daily mean objective – 50 µg/m^3 not to be exceeded more than 35 times a year					

Results reported to absolute days

Table A6-6-4 - Annual mean $PM_{2.5}$ concentrations (µg/m^3)

Receptor	2018 Base	2021 DM	2021 DS	Change (µg/m^3)	Magnitude of Change	2036 DM	2036 DS	Change (µg/m^3)	Magnitude of Change
R1	7.9	7.7	7.8	0.1	Negligible	7.4	7.4	0.0	Negligible
R2	7.5	7.3	7.3	0.0	Negligible	7.0	7.0	0.0	Negligible
R3	7.9	7.8	7.8	0.0	Negligible	7.5	7.5	0.0	Negligible
R4	7.6	7.3	7.3	0.0	Negligible	7.0	7.0	0.0	Negligible
R5	8.0	7.7	7.7	0.0	Negligible	7.3	7.4	0.1	Negligible
R6	7.9	7.7	7.7	0.0	Negligible	7.4	7.4	0.0	Negligible
R7	7.8	7.5	7.5	0.0	Negligible	7.1	7.2	0.1	Negligible
R8	10.1	9.6	9.7	0.1	Negligible	9.2	9.2	0.0	Negligible
R9	10.2	9.7	9.7	0.0	Negligible	9.3	9.3	0.0	Negligible
R10	9.8	9.4	9.4	0.0	Negligible	9.0	9.0	0.0	Negligible
R11	9.2	8.9	8.9	0.0	Negligible	8.5	8.5	0.0	Negligible
R12	9.9	9.4	9.5	0.1	Negligible	9.0	9.0	0.0	Negligible
Annual mean objective – 25 µg/m^3									

Results reported to one decimal place
Exceedances of annual mean objective in ***Bold***

SENSITIVITY TEST - DEFRA EMISSIONS AND BACKGROUNDS HELD AT 2018

Table A6-6-5 - Annual mean NO_2 concentrations (µg/m³)

Receptor	2018 Base	2021 DM	2021 DS	Change (µg/m³)	Magnitude of Change	2036 DM	2036 DS	Change (µg/m³)	Magnitude of Change
R1	22.7	24.2	24.5	0.3	Negligible	24.7	25.0	0.3	Negligible
R2	17.4	18.4	18.5	0.1	Negligible	18.6	18.7	0.1	Negligible
R3	20.6	22.6	22.7	0.1	Negligible	22.9	23.0	0.1	Negligible
R4	17.7	18.2	18.5	0.3	Negligible	18.4	18.7	0.3	Negligible
R5	18.1	18.6	18.9	0.3	Negligible	18.8	19.1	0.3	Negligible
R6	20.3	22.1	22.2	0.1	Negligible	22.4	22.6	0.2	Negligible
R7	16.2	16.5	16.6	0.1	Negligible	16.6	16.8	0.2	Negligible
R8	39.5	**40.9**	**41.1**	0.2	Negligible	42.0	42.2	0.2	Negligible
R9	**41.7**	**43.2**	**43.3**	0.1	Negligible	44.4	44.5	0.1	Negligible
R10	36.3	37.5	37.6	0.1	Negligible	38.4	38.6	0.2	Negligible
R11	28.3	29.0	29.1	0.1	Negligible	29.6	29.6	0.0	Negligible
R12	**40.5**	**42.3**	**42.7**	0.4	Moderate Adverse	43.5	43.8	0.3	Moderate Adverse
Annual mean objective – 40 µg/m³									

Results reported to one decimal place
Exceedances of annual mean objective in ***Bold***

Table A6-6-6 - Annual mean PM_{10} concentrations (µg/m³)

Receptor	2018 Base	2021 DM	2021 DS	Change (µg/m³)	Magnitude of Change	2036 DM	2036 DS	Change (µg/m³)	Magnitude of Change
R1	11.7	12.0	12.0	0.0	Negligible	12.0	12.1	0.1	Negligible
R2	11.1	11.2	11.2	0.0	Negligible	11.3	11.3	0.0	Negligible
R3	11.7	12.1	12.1	0.0	Negligible	12.1	12.2	0.1	Negligible
R4	11.2	11.3	11.3	0.0	Negligible	11.3	11.4	0.1	Negligible
R5	11.6	11.7	11.8	0.1	Negligible	11.8	11.8	0.0	Negligible
R6	11.6	12.0	12.0	0.0	Negligible	12.0	12.0	0.0	Negligible
R7	11.3	11.3	11.4	0.1	Negligible	11.4	11.4	0.0	Negligible
R8	16.2	16.4	16.4	0.0	Negligible	16.5	16.5	0.0	Negligible
R9	16.0	16.2	16.2	0.0	Negligible	16.3	16.3	0.0	Negligible
R10	15.5	15.6	15.6	0.0	Negligible	15.7	15.7	0.0	Negligible
R11	14.6	14.7	14.7	0.0	Negligible	14.8	14.8	0.0	Negligible
R12	15.5	15.7	15.8	0.1	Negligible	15.9	15.9	0.0	Negligible
Annual mean objective – 40 µg/m³									

Results reported to one decimal place
Exceedances of annual mean objective in ***Bold***

Table A6-6-7 - Daily mean PM_{10} (No. of days exceedance)

Receptor	2018 Base	2021 DM	2021 DS	2036 DM	2036 DS
R1	1	1	1	1	1
R2	2	2	2	2	2
R3	1	1	1	1	1
R4	2	2	2	2	2
R5	1	1	1	1	1
R6	2	1	1	1	1
R7	2	2	2	2	2
R8	0	0	0	1	1
R9	0	0	0	0	0
R10	0	0	0	0	0
R11	0	0	0	0	0
R12	0	0	0	0	0
Daily mean objective – 50 µg/m^3 not to be exceeded more than 35 times a year					

Results reported to one decimal place

Table A6-6-8 - Annual mean $PM_{2.5}$ concentrations (µg/m³)

Receptor	2018 Base	2021 DM	2021 DS	Change (µg/m³)	Magnitude of Change	2036 DM	2036 DS	Change (µg/m³)	Magnitude of Change
R1	7.9	8.1	8.1	0.0	Negligible	8.1	8.2	0.1	Negligible
R2	7.5	7.6	7.6	0.0	Negligible	7.7	7.7	0.0	Negligible
R3	7.9	8.1	8.1	0.0	Negligible	8.2	8.2	0.0	Negligible
R4	7.6	7.6	7.7	0.1	Negligible	7.7	7.7	0.0	Negligible
R5	8.0	8.0	8.0	0.0	Negligible	8.0	8.1	0.1	Negligible
R6	7.9	8.1	8.1	0.0	Negligible	8.1	8.1	0.0	Negligible
R7	7.8	7.8	7.8	0.0	Negligible	7.8	7.8	0.0	Negligible
R8	10.1	10.2	10.2	0.0	Negligible	10.3	10.3	0.0	Negligible
R9	10.2	10.3	10.3	0.0	Negligible	10.4	10.4	0.0	Negligible
R10	9.8	9.9	9.9	0.0	Negligible	9.9	9.9	0.0	Negligible
R11	9.2	9.3	9.3	0.0	Negligible	9.3	9.3	0.0	Negligible
R12	9.9	10.0	10.1	0.1	Negligible	10.1	10.1	0.0	Negligible
Annual mean objective – 25 µg/m³									

Results reported to one decimal place
Exceedances of annual mean objective in ***Bold***

SENSITIVITY TEST - CURED V3A EMISSIONS

Table A6-6-9 - Annual mean NO_2 concentrations (µg/m³)

Receptor	2018 Base	2021 DM	2021 DS	Change (µg/m³)	Magnitude of Change	2036 DM	2036 DS	Change (µg/m³)	Magnitude of Change
R1	22.3	20.5	20.7	0.2	Negligible	15.6	15.7	0.1	Negligible
R2	17.4	16.0	16.1	0.1	Negligible	12.3	12.4	0.1	Negligible
R3	20.6	19.6	19.7	0.1	Negligible	15.0	15.1	0.1	Negligible
R4	17.7	15.7	15.9	0.2	Negligible	11.9	12.1	0.2	Negligible
R5	18.1	16.2	16.4	0.2	Negligible	12.5	12.7	0.2	Negligible
R6	20.2	19.2	19.3	0.1	Negligible	14.7	14.7	0.0	Negligible
R7	16.1	14.3	14.5	0.2	Negligible	11.2	11.3	0.1	Negligible
R8	38.6	34.0	34.1	0.1	Negligible	25.2	25.3	0.1	Negligible
R9	**41.2**	36.5	36.6	0.1	Negligible	27.2	27.3	0.1	Negligible
R10	35.7	31.5	31.6	0.1	Negligible	23.3	23.4	0.1	Negligible
R11	27.6	24.2	24.2	0.0	Negligible	17.7	17.7	0.0	Negligible
R12	39.3	35.0	35.2	0.2	Negligible	25.9	26.1	0.2	Negligible
Annual mean objective – 40 µg/m³									

Results reported to one decimal place
Exceedances of annual mean objective in ***Bold***

6.7 LEGISLATION, POLICY AND GUIDANCE

LEGISLATION

EUROPEAN UNION DIRECTIVE ON AMBIENT AIR QUALITY (2008/50/EC)

The EU Directive on ambient air quality (2008/50/EC) (Ref 6.15) is the primary driver for managing and improving air quality for each member state of the European Union (EU). The Directive sets legally binding limit values for concentrations in ambient (outdoor) air of pollutants that can impact public health, including NO_2 and particulate matter (PM_{10}, $PM_{2.5}$).

EU limit values are set for individual pollutants and comprise a concentration value, an averaging time over which it is to be measured, the number of allowed exceedances per year (if any), and a date by which it must be achieved. Some pollutants (e.g. PM_{10}) have more than one limit value covering different averaging times.

Member states are required to report on the status of air quality and to assess compliance with the EU Directive on ambient air quality (2008/50/EC) (Ref 6.15) on an annual basis. Defra carries out this task on behalf of the UK government and published the latest submission to the EU Commission in September 2019. Compliance assessment modelling is carried out using a series of national models known collectively as the Pollution Climate Mapping (PCM) model.

UK Air Quality Strategy

The Government's policy on air quality within the UK is set out in the Air Quality Strategy for England, Scotland, Wales, and Northern Ireland (AQS) (Ref 6.14). The AQS provides a framework for reducing air pollution in the UK with the aim of meeting the requirements of European Union legislation.

The AQS also sets standards and objectives for nine key air pollutants to protect health, vegetation, and ecosystems. These are benzene (C_6H_6), 1,3 butadiene (C_4H_6), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), particulate matter (PM_{10} and $PM_{2.5}$), sulphur dioxide (SO_2), ozone (O_3), and polycyclic aromatic hydrocarbons (PAHs). The standards and objectives for the pollutants considered in this assessment are given in Appendix 6.4.

The air quality standards are levels recommended by the Expert Panel on Air Quality Standards (EPAQS) and the World Health Organisation (WHO) with regards to current scientific knowledge about the effects of each pollutant on health and the environment.

The air quality objectives are medium-term policy-based targets set by the Government, which consider economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance, i.e. a limited number of permitted exceedances of the standard over a given period.

For the pollutants considered in this assessment, there are both long-term (annual mean) and short-term standards. In the case of NO_2, the short-term standard is for a 1-hour averaging period, whereas for PM_{10} it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants, for example temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road.

The AQS contains a framework for considering the effects of a finer group of particles known as '$PM_{2.5}$' as there is increasing evidence that this size of particles can be more closely associated with observed adverse health effects than PM_{10}. Local Authorities are required to work towards reducing emissions/concentrations of particulate matter within their administrative area.

Air Quality Regulations

Many of the objectives in the AQS have been made statutory in England with the Air Quality (England) Regulations 2000 (Ref 6.18) and the Air Quality (England) (Amendment) Regulations 2002 (Ref 6.19) for Local Air Quality Management (LAQM).

These Regulations require that likely exceedances of the AQS objectives are assessed in relation to:

"…the quality of air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present…"

The Air Quality Standards (Amendment) Regulations 2016 (Ref 6.20) amends the Air Quality Standards Regulations 2010 that transpose the EU Directive on ambient air quality (2008/50/EC) (Ref 6.15) into law in England.

The limit values for NO_2 and PM_{10} are the same concentration levels as the relevant AQS objectives and the objective for $PM_{2.5}$ is a concentration of 25 µg/m^3.

Appendix 6.4 presents the applicable air quality objectives and limit values applicable to this assessment.

Environment Act 1995

Under Part IV of the Environment Act 1995 (Ref 6.16), local authorities must review and document local air quality within their area by way of staged appraisals and respond accordingly, with the aim of meeting the air quality objectives defined in the Regulations. Where the objectives are not likely to be achieved, an authority is required to designate an Air Quality Management Area (AQMA).

For each AQMA the local authority is required to draw up an Air Quality Action Plan (AQAP) to secure improvements in air quality and show how it intends to work towards achieving air quality standards in the future.

Environmental Protection Act 1990 - Control of Dust and Particulates associated with Construction

Section 79 of the Environmental Protection Act 1990 (Ref 6.17) gives the following definitions of statutory nuisance relevant to dust and particles:

"Any dust, steam, smell or other effluvia arising from industrial, trade or business premises or smoke, fumes or gases emitted from premises to be prejudicial to health or a nuisance";

"Any accumulation or deposit which is prejudicial to health or a nuisance"

Following this, Section 80 says that where a statutory nuisance is shown to exist, the local authority must serve an abatement notice. Failure to comply with an abatement notice is an offence and if necessary, the local authority may abate the nuisance and recover expenses.

There are no statutory limit values for dust deposition above which 'nuisance' is deemed to exist. Nuisance is a subjective concept and its perception is highly dependent upon the existing conditions and the change which has occurred.

PLANNING POLICY

A summary of the national, regional and local planning policy relevant to the Proposed Scheme and air quality is provided below.

Clean Air Strategy

In January 2019, the UK government published its Clean Air Strategy (Ref 6.21) which shows what measures will be implemented to tackle all sources of air pollution, to make air healthier to breathe, protecting nature and to improve the economy. The strategy sets out the comprehensive actions required across all parts of government and society to improve air quality.

Chapter five of the Clean Air Strategy (Ref 6.21) focuses on actions to reduce emissions from transport, stating that, *"Our most immediate air quality challenge is to bring roadside concentrations of nitrogen oxides within legal limits in the shortest possible time."*

National Planning Policy Framework

The Government's overall planning policies for England are described in the National Planning Policy Framework (Ref 6.22). the core underpinning principle of the Framework is the presumption in favour of sustainable development, defined as:

"…meeting the needs of the present without compromising the ability of future generations to meet their own needs.

One of the three overarching objectives of the NPPF is that planning should *"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."*

In relation to air quality, the following paragraphs in the document are relevant:

- Paragraph 54, which states *"Local planning authorities should consider whether otherwise unacceptable development could be made acceptable through the use of conditions or planning obligations. Planning obligations should only be used where it is not possible to address unacceptable impacts through a planning condition."*
- Paragraph 103, which states *"Significant development should be focused on locations which are or can be made sustainable, through limiting the need to travel and offering a genuine choice of transport modes. This can help to reduce congestion and emissions and improve air quality and public health.";*
- Paragraph 170, which states *"Planning policies and decisions should contribute to and enhance the natural and local environment by: …e) preventing new and existing*

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

- Paragraph 180, which states *"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."*
- Paragraph 181, which states *"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."*; and
- Paragraph 183, which states *"The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities."*

St. Helens Local Plan Core Strategy

The St. Helens Local Plan Core Strategy (Ref 6.23) was adopted by St. Helens Council in October 2012 and contains strategic policies which provides an overall plan of where development should be located and how the needs of the Borough are met.

Policy CP 1: Environmental Quality includes a narrative in regard to air quality:

All proposals for development within the Borough will be expected, where appropriate, to meet the following standards as a minimum:

<u>Environmental Quality</u>

- *Minimise and mitigate against the effects of air, light and water pollution (including contamination of soil, surface water and groundwater resources) and noise, vibration, smells, dust and electromagnetic fields caused by the development;*
- *Development that is located within or would impact on Air Quality Management Areas will require special consideration with regard to their impacts on air quality.*

St Helens Borough Local Plan 2020 - 2035

The St Helens Borough Local Plan 2020 - 2035 Submission Draft (Ref 6.24) was published for consultation between January and May 2019. Contained within the submission draft is an Air quality specific policy:

Policy LPD09: Air Quality

Development proposals must demonstrate that they will not:

- *Impede the achievement of any objective(s) or measure(s) set out in an Air Quality Management Area (AQMA) Action Plan; or*
- *Introduce a significant new source of any air pollutant, or new development whose users or occupiers would be particularly susceptible to air pollution, within an AQMA; or*
- *Lead to a significant deterioration in local air quality resulting in unacceptable effects on human health, local amenity or the natural environment, that would require a new AQMA to be created; or*
- *Having regard to established local and national standards, lead to an unacceptable decline in air quality in any area*.

Major development schemes should demonstrably promote a shift to the use of sustainable modes of transport to minimise the impact of vehicle emissions on air quality

Other policies that air quality is referenced to within the St Helens Borough Local Plan 2020-2035 Submission Draft are outlined below:

Policy LPA07: Transport and Travel

The Council's strategic priorities for the transport network are to facilitate economic growth, enable good levels of accessibility between homes, jobs and services, improve air quality and minimise carbon emissions.

The priorities identified in this policy similarly form important part of St. Helens Council's drive to tackle air quality issues, particularly (but not exclusively) within Air Quality Management Areas, some of which adjoin major roads.

Policy LPA09: Green Infrastructure

The Council will work with other organisations where necessary to:

- *Expand tree cover in appropriate locations across the Borough to improve landscape character, water and air quality and the value of trees to wildlife;*

The Green Infrastructure network in the Borough has a wide range of functions and values for recreation and tourism, air quality, public access, health, heritage, biodiversity, water management and landscape character; providing a sense of place, distinctiveness and quality of life.

Policy LPA11: Health and Wellbeing

The Council will work with its health and wellbeing partners to promote public health principles, maximise opportunities for people to lead healthy and active lifestyles, and *reduce health inequalities for residents within the Borough. Planning decisions and processes will be used to: Manage air quality and pollution*

Policy LPD01: Ensuring Quality Development

All proposals for development will be expected, as appropriate having to their scale, location and nature, to meet or exceed the following requirements:

Environmental Quality

Minimise and mitigate to acceptable levels any effects that the development may have on: air quality; light, land and / or water pollution (including contamination of soil, surface water and groundwater resources); and levels of noise, vibration, smells, dust and electromagnetic fields in the area.

Warrington Local Plan Core Strategy

The Warrington Local Plan Core Strategy (Ref 6.25) was adopted in July 2014. The Local Plan Core Strategy is the overarching strategic policy document in the Local Planning Framework and sets out the planning framework for guiding the location and level of development in the borough up to 2027.

Two pertinent objectives in regard to air quality are reported in the Core Strategy (Ref 6.25).

- *Ensure that potential environmental problems arising from the impacts of new development are avoided by adopting appropriate policies to safeguard and ensure prudent use of resources including land, air, water, biodiversity and heritage taking opportunities to create new and enhance existing provision where ever possible (Objective S5); and*
- *Reduce the impacts of climate change and secure improvements to air quality within the borough through the sustainable location of development and reductions in congestion as a result of demand management measures and realistic alternatives to using the private car (Objective T9).*

Air quality is referenced in a number of policies contained within the Core Strategy (Ref 6.25):

Policy QE6: Environment and Amenity Protection

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

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

Policy CS4: Overall Spatial Strategy – Transport

The Council will support improvements to Warrington's Transport Network that:

- *reduce the impact of traffic on air quality and reduce carbon emissions to help tackle climate change.*

Warrington Proposed Submission Version Local Plan 2017 – 2037

Warrington Borough Council published a draft Local Plan in March 2019 (Ref 6.26) with the intention that the Local Plan will replace the Local Plan Core Strategy (Ref 6.25).

The Proposed Submission Version Local Plan (Ref 6.26) will set out the legal planning framework for Warrington's development for the next 20 years. One of the visions set out by Warrington in the Local Plan 2017 – 2037 (Ref 6.26) is that:

New development will be successfully integrated into Warrington's transformed public transport system. The enhanced Green Space and Waterways network will provide popular, high quality walking and cycling routes that promote active lifestyles, reduce carbon emissions and contribute to improving air quality

Plan Objective W6 is outlined below:

To minimise the impact of development on the environment through the prudent use of resources and ensuring development is energy efficient, safe and resilient to climate change and makes a positive contribution to improving Warrington's air quality.

Policy ENV8 (Environmental and Amenity Protection) contains relevant details in relation to air quality:

<u>Air Quality</u>

- *The Council will seek to ensure that proposals for new development will not have an unacceptable negative impact on air quality and will not further exacerbate air quality in the Council's designated Air Quality Management Areas (AQMAs); or will contribute to air pollution in areas which may result in further areas being designated.*
- *New development that would result in increased traffic flows on the M62 past Manchester Mosses Special Area of Conservation (SAC) of more than 1000 vehicles per day or 200 Heavy Goods Vehicles (HGVs) per day must be accompanied by evidence identifying whether the resultant impacts on air quality would cause a significant effect on ecological interests within the SAC. Where such effects are identified they would need to be considered in accordance with Policy DC4 (Ecological Network).*
- *Development proposals for sensitive end uses (including but not limited to residential, schools, nurseries, hospitals) are not desirable where they are located in areas of poor air quality including AQMAs, unless a suitable assessment, review and identification of mitigation to lessen the effects on future site users is provided. An air quality assessment will be required where a development may place new sensitive receptors in areas of poor air quality; and/or that may lead to a deterioration in local air quality resulting in unacceptable effects on human health, and/or the environment.*

The Council is committed to reducing the exposure of people in Warrington to poor air quality in order to improve the health and wellbeing of all residents. Whilst the majority of Warrington has good air quality, there are areas close to the major roads and the Town Centre that have raised pollution levels and are of concern. We continue to review pollution levels and will designate AQMAs where there is a risk that national limits may be exceeded

Other policies with contain reference to air quality include Policy INF1 (Sustainable Travel and Transport), Policy DC1 (Warrington's Places) and Policy DC3 (Green Infrastructure).

Warrington Environmental Protection Supplementary Planning Document

The Warrington Borough Council supplementary planning document (SPD) was produced in 2013 (Ref 6.28) and is a principal document to advise developers on when and how to assess air quality within their applications. The Air Quality section of the SPD outlines the planning conditions and obligations that the local authority encourages developers to consider:

"The Council will encourage design solutions, and use conditions, S106 Agreements and unilateral undertakings to mitigate impacts from any developments that are detrimental to air quality.

The following should be considered although this is not an exhaustive list:

- *Design of development proposals to mitigate against exposure on the development from existing air quality issues; for example, the location of building inlet ventilation, or set back residential buildings away from roadside to reduce receptor exposure;*
- *Measures during the construction of new development including dust control, site monitoring and plant emissions;*
- *Contributions for the introduction of new or improved low emission public transport;*
- *The provision of on and off-site facilities for cycling and walking;*
- *The provision of electric car charging points;*
- *Preferential permission and parking charges for low emission vehicles and car share;*
- *The management of car parking;*
- *Traffic management;*
- *Road infrastructure;*
- *Green Travel Plans;*
- *Monitoring of air pollution:*
- *Financial contribution towards local air quality review and assessment."*

GUIDANCE

A summary of the publications referred to in the completion of this assessment is provided below.

Land-Use Planning & Development Control: Planning for Air Quality

Environmental Protection UK (EPUK) and Institute of Air Quality Management (IAQM) have published guidance (Ref 6.2) for developers and air quality professionals to provide a consistent approach to air quality assessments throughout the UK. Significance descriptors within this assessment have been applied where necessary to determine potential air quality impacts.

Guidance on the Assessment of Dust from Demolition and Construction

This document (Ref 6.1) was published by the IAQM to provide guidance to developers, consultants and environmental health officers on how to assess the impacts arising from construction activities.

The emphasis of the methodology is on classifying sites according to the risk of impacts (in terms of dust nuisance, PM_{10} impacts on public exposure and impact upon sensitive ecological receptors) and to identify mitigation measures appropriate to the level of risk identified.

Local Air Quality Management Review and Assessment Technical Guidance

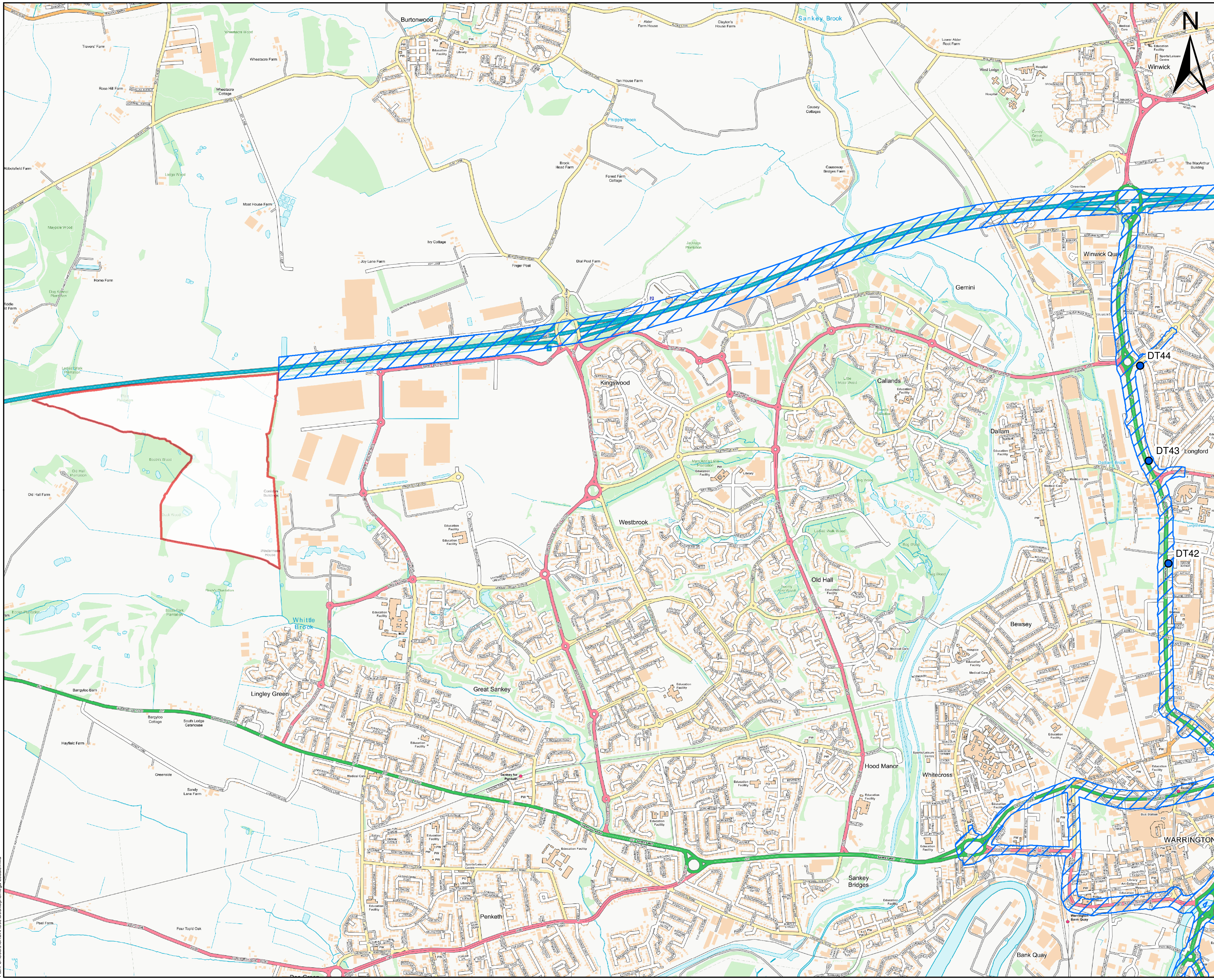
The Department for Environment, Food, and Rural Affairs (Defra) has published technical guidance for use by local authorities in their review and assessment work (Ref 6.9). This guidance, referred to in this document as LAQM.TG16 (Ref 6.9), has been used where appropriate in the assessment presented herein.

Air Quality Consultants (AQC) Calculator Using Realistic Emissions for Diesel (CURED) Methodology

Air Quality Consultants (AQC) Ltd have carried out research into the performance of diesel vehicles to support a methodology (Ref 6.5) that may be adopted for the completion of sensitivity test for air quality assessment.

This led to the publishing of the Calculator Using Realistic Emissions for Diesels (CURED) approach, which attempted to take account the real-world emissions performance of diesel vehicles.

The approach is generally accepted to be conservative when considering developments in the future, as the CURED approach accepts that the technology and subsequent performance of diesel cars and vans do not improve post 2020, which is contrary to the predictions made from the Defra EFT (Ref 6.4) in regard to vehicle exhaust emissions of NO_x.



Legend

Application Site

Air Quality Management Area

Local Authority Monitoring Locations

Warrington Borough Council

Revision Details	By / Check	Date	Suffix

Drawing Status

FINAL

Job Title

Omega Zone 8

Drawing Title

Figure A6-3-7: NO_2 Model Verification Procedure Local Authority Monitoring Sites

Scale at A3: 1:20,000

Drawn: UKDXA600

Stage 1 check	Stage 2 check	Originated	Date
DP	MM	DA	16/12/2019

0 100 200 400 600 800

Meters

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Drawing Number

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