

Appendix 6-A - Air Quality - Assessment Input Data

6.1 INTRODUCTION

6.2 The proposed development has the potential to exposure future occupants to poor air quality impacts. In order to assess nitrogen dioxide (NO₂), particulate matter with an aerodynamic diameter of less than 10µm (PM₁₀) and particulate matter with an aerodynamic diameter of less than 2.5µm (PM_{2.5}) concentrations across the site, detailed dispersion modelling was undertaken in accordance with the following methodology.

6.3 DISPERSION MODEL

6.3.1 Dispersion modelling was undertaken using the ADMS-Roads dispersion model (version 5.0.0.1). ADMS-Roads is developed by Cambridge Environmental Research Consultants (CERC) and is routinely used throughout the world for the prediction of pollutant dispersion from road sources. Modelling predictions from this software package are accepted within the UK by the Environment Agency and Department for Environment, Food and Rural Affairs (DEFRA).

6.3.2 The model requires input data that details the following parameters:

- Assessment area;
- Traffic flow data;
- Vehicle emission factors;
- Spatial co-ordinates of emissions;
- Street width;
- Meteorological data;
- Roughness length (z₀); and,
- Monin-Obukhov length.

6.3.3 Additional options can also be selected within the ADMS-Roads interface to take account of site specific characteristics that may affect model output, such as canyons.

6.3.4 The following Sections detail the relevant inputs utilised in the assessment.

6.4 ASSESSMENT AREA

6.4.1 Ambient concentrations were predicted over National Grid Reference (NGR): 383620, 397570 to 383710, 397660. One Cartesian grid was used within the model to produce data suitable for contour plotting using the Surfer software package.

6.4.2 Reference should be made to Figure 6-9 within the ES chapter for a map of the assessment area.

6.5 TRAFFIC FLOW DATA

6.5.1 Baseline traffic data for use in the assessment, including 24-hour Annual Average Daily Traffic (AADT) flows and fleet composition as Heavy Duty Vehicle (HDV) proportion, was obtained from the Department for Transport (DfT). The DfT web tool enables the user to view and download traffic flows on every link of the 'A' road and motorway network, as well as selected minor roads, in Great Britain for the years 1999 to 2020. It should be noted that the DfT web tool is referenced in Department for Environment, Food and Rural Affairs (DEFRA) guidance (DEFRA, 2021) as being a suitable source of data for air quality assessments and it is therefore considered to provide a reasonable estimate of traffic flows in the vicinity of the site.

6.5.2 The baseline traffic data was converted to the site opening year utilising a factor obtained from TEMPro (version 7.2). This software package has been developed by the DfT to calculate future traffic growth throughout the UK.

6.5.3 Road widths were estimated from aerial photography and UK highway design standards. A summary of the traffic flow data is provided in Table 6-A-1.

Table 6-A-1 Traffic Data

Link		24-hour AADT Flow		HDV Prop. of Fleet (%)	Average Vehicle Speed (km/h)	Road Width (m)
		Verif.	2024			
L1	Peter Street, North of Chepstow Street	5,147	5,568	5.27	20	10.3
L2	Oxford Street, South of Chepstow Street	12,085	13,072	15.66	25	11.3
L3	Oxford Street, North of Whitworth Street West, Slow Phase (SP)	12,085	13,072	15.66	20	9.9
L4	Oxford Road, South of Whitworth Street West, SP	12,085	13,072	15.66	20	9.9
L5	Oxford Road	12,085	13,072	15.66	20	9.1
L6	Chepstow Street	12,085	13,072	15.66	25	8.9
L7	Great Bridgewater Street	12,085	13,072	15.66	20	10.5
L8	Great Bridgewater Street, Westbound (WB), SP	6,043	6,536	15.66	20	12
L9	Great Bridgewater Street, Eastbound (EB), SP	6,043	6,536	15.66	20	5.5
L10	A5103 Intersection with Great Bridgewater Street	16,913	18,295	3.54	20	13.1
L11	A5103 Albion Street, North of Whitworth Street West	16,913	18,295	3.54	25	17.7
L12	A5103 Albion Street	16,913	18,295	3.54	20	13.9
L13	A5103 Albion Street, South of Great Bridgewater Street, SP	16,913	18,295	3.54	20	14.1
L14	A5103 Lower Mosley Street, North of Great Bridgewater Street, SP	16,913	18,295	3.54	20	13.4
L15	A5103 Lower Mosley Street	16,913	18,295	3.54	25	7.9

6.5.4 Reference should be made to Figure 6-A.1 for a graphical representation of the road link locations.

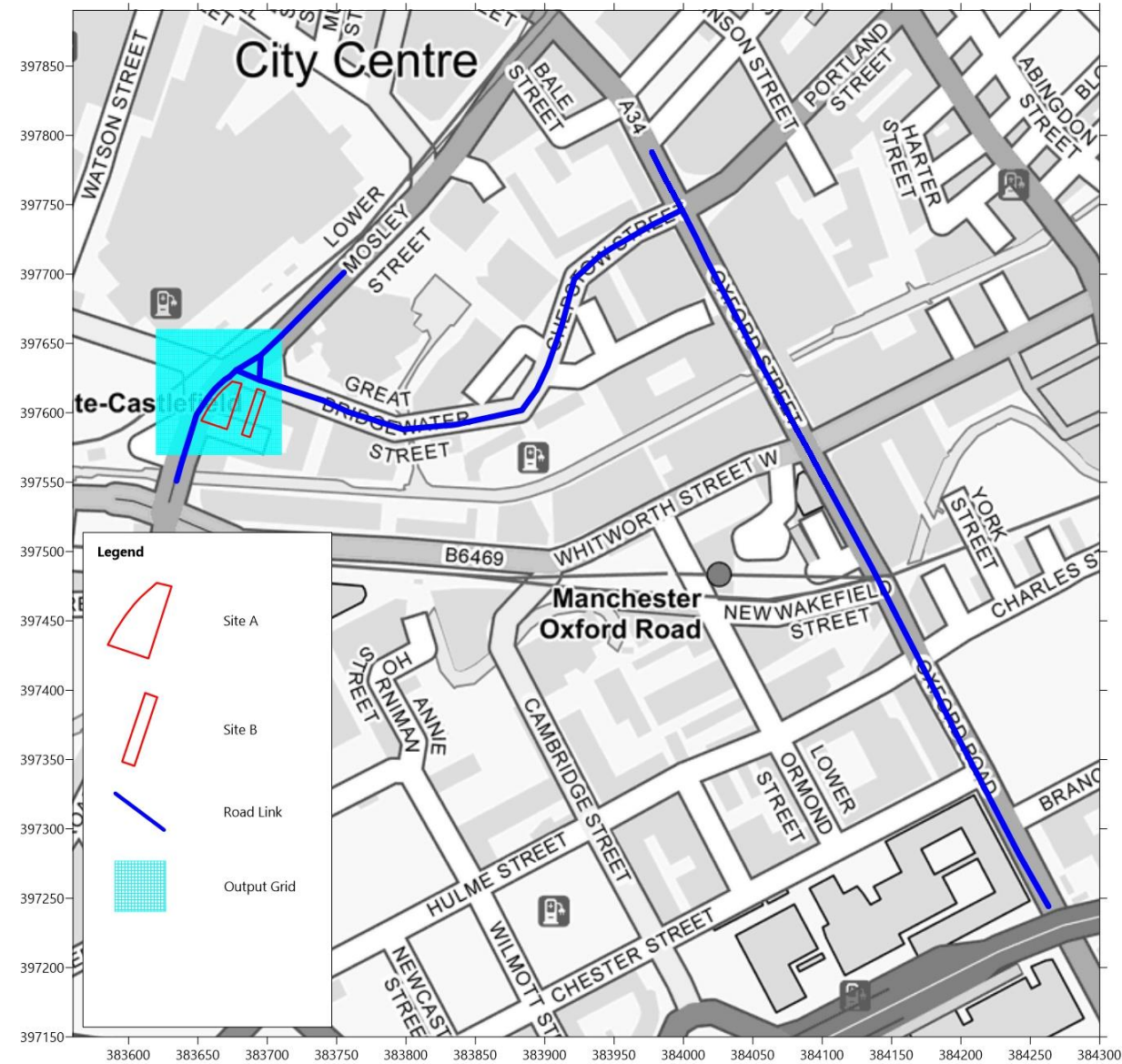


Figure 6-A-1 ADMS-Roads Inputs

6.6 CANYONS

- 6.6.1 Where buildings or walls surround roads, pollutant dispersion patterns are altered which can lead to high pollutant concentrations. These street canyons can significantly influence air quality along a road and therefore it is important to take consideration of their effects when undertaking dispersion modelling.
- 6.6.2 The release of ADMS-Roads version 4.0.1.0 in December 2015 incorporated a number of new features including an advanced street canyon module, which have been retained in version 5.0.0.1. Advanced street canyon modelling allows a number of parameters to be included in the dispersion model in order to predict pollutant dispersion patterns which better reflect air flow within complex urban geometries.
- 6.6.3 Canyons have five principal effects on dispersion which can influence pollutant concentrations. These are:
- Pollutants are channelled along street canyons;
 - Pollutants are dispersed across street canyons by circulating flow at road height;
 - Pollutants are trapped in recirculation regions;

- Pollutants leave the canyon through gaps between buildings - as if there was no canyon; and,
- Pollutants leave the canyon from the canyon top.

- 6.6.4 The combined modelling of these effects will result in concentration patterns unique to each canyon.
- 6.6.5 The canyon parameters used in the assessment are outlined in Table 6-A-2.

Table 6-A-2 Canyon Parameters

Link	Parameter (m)					
	Canyon Width to Left	Average Height of Buildings to Left	Building Length Left	Canyon Width Right	Average Height of Buildings to Right	Building Length Right
L4	15.3	18.5	25.6	7.1	13.5	20.2
L5	13.5	22.5	202.4	8.5	15.5	258.7
L7	10.4	19.5	48.1	10.4	1.5	48.3
L11	9.9	1.5	53.4	9.9	20.0	28.6
L12	8.3	1.5	32.9	8.3	85.2	28.5

- 6.6.6 A choice of two modes is provided for use in the advanced canyon module. Standard mode assumes that each road is part of a continuous network of roads with similar canyon properties. Network mode analyses the road network to determine transport of pollutants between adjoining street canyons, allowing for varying concentrations along the canyon and accounts for transport of pollutants out of the end of a canyon. Network mode is considered most accurate for detailed local analysis and as such was selected for use in the model.

6.7 EMISSION FACTORS

- 6.7.1 Emission factors for each link were calculated using the relevant traffic flows and the Emissions Factor Toolkit (version 11.1). This has been produced by DEFRA and incorporates COPERT 5.3 vehicle emission factors and fleet information.

6.8 METEOROLOGICAL DATA

- 6.8.1 Meteorological data used in the assessment was taken from Manchester Airport meteorological station over the period 1st January 2019 to 31st December 2019 (inclusive). Manchester Airport is located at NGR: 381792, 384116, which is approximately 13.6km south of the proposed development. It is anticipated that conditions would be reasonably similar over a distance of this magnitude. The data was therefore considered suitable for an assessment of this nature.
- 6.8.2 All meteorological records used in the assessment were provided by Atmospheric Dispersion Modelling (ADM) Ltd, which is an established distributor of data within the UK. Reference should be made to Figure 6-2 of the air quality ES chapter, for a wind rose of the utilised meteorological data.

6.9 ROUGHNESS LENGTH

- 6.9.1 The z_0 is a modelling parameter applied to allow consideration of surface height roughness elements. A z_0 of 1m was used to describe the modelling extents. This is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'cities, woodlands'.
- 6.9.2 A z_0 of 0.2m was used to describe the meteorological site. This value is considered appropriate for the morphology of the area and is suggested within ADMS-Roads as being suitable for 'agricultural areas (min)'.

6.10 MONIN-Obukhov LENGTH

6.10.1 The Monin-Obukhov length provides a measure of the stability of the atmosphere. A minimum Monin-Obukhov length of 30m was used to describe the modelling extents and meteorological site. This value is considered appropriate for the nature of both areas and is suggested within ADMS-Roads as being suitable for 'cities and large towns'.

6.11 BACKGROUND CONCENTRATIONS

6.11.1 Background mean NO₂, PM₁₀ and PM_{2.5} concentrations for use in the assessment were obtained from the DEFRA mapping study for the grid square containing the site, as shown in Table 6-14 of the air quality ES chapter.

6.12 NO_x to NO₂ CONVERSION

6.12.1 Predicted annual mean oxides of nitrogen (NO_x) concentrations were converted to NO₂ concentrations using the spreadsheet (version 8.1) provided by DEFRA, which is the method detailed within DEFRA guidance (DEFRA, 2021).

6.13 VERIFICATION

- 6.13.1 The predicted results from a dispersion model may differ from measured concentrations for a large number of reasons, including:
- Estimates of background concentrations;
 - Uncertainties in source activity data such as traffic flows and emission factors;
 - Variations in meteorological conditions;
 - Overall model limitations; and,
 - Uncertainties associated with monitoring data, including locations.
- 6.13.2 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.
- 6.13.3 For the purpose of the assessment model verification was undertaken for 2019 using traffic data, meteorological data and monitoring results from this year.
- 6.13.4 MCC undertook monitoring of NO₂ concentrations at two locations within the vicinity of roads included within the model during 2019. The results were obtained and the road contribution to total NO_x concentrations calculated following the methodology contained within DEFRA guidance (DEFRA, 2021). The monitored annual mean NO₂ concentrations and calculated road NO_x concentrations are summarised in Table 6-A-3.

Table 6-A-3 Verification - Monitoring Results

Monitoring Location		Monitored NO ₂ Concentration (µg/m³)	Calculated Road NO _x Concentration (µg/m³)
MAN1	Manchester, Oxford Road	59.0	69.19
MA29ANO	Oxford Street	55.4	60.04

6.13.5 The annual mean road NO_x concentrations predicted from the dispersion model and the 2019 road NO_x concentrations calculated from the monitoring results are summarised in Table 6-A-4.

Table 6-A-4 Verification - Monitoring Results

Monitoring Location		Calculated Road NO _x Concentration (µg/m³)	Modelled Road NO _x Concentration (µg/m³)
MAN1	Manchester, Oxford Road	69.19	41.23
MA29ANO	Oxford Street	60.04	33.55

6.13.6 The monitored and modelled road NO_x concentrations were graphed and the equation of the trendline based on linear progression through zero calculated. This indicated that a verification factor of 1.7226 was required to be applied to all road NO_x modelling results, as shown in Figure 6-A-2.

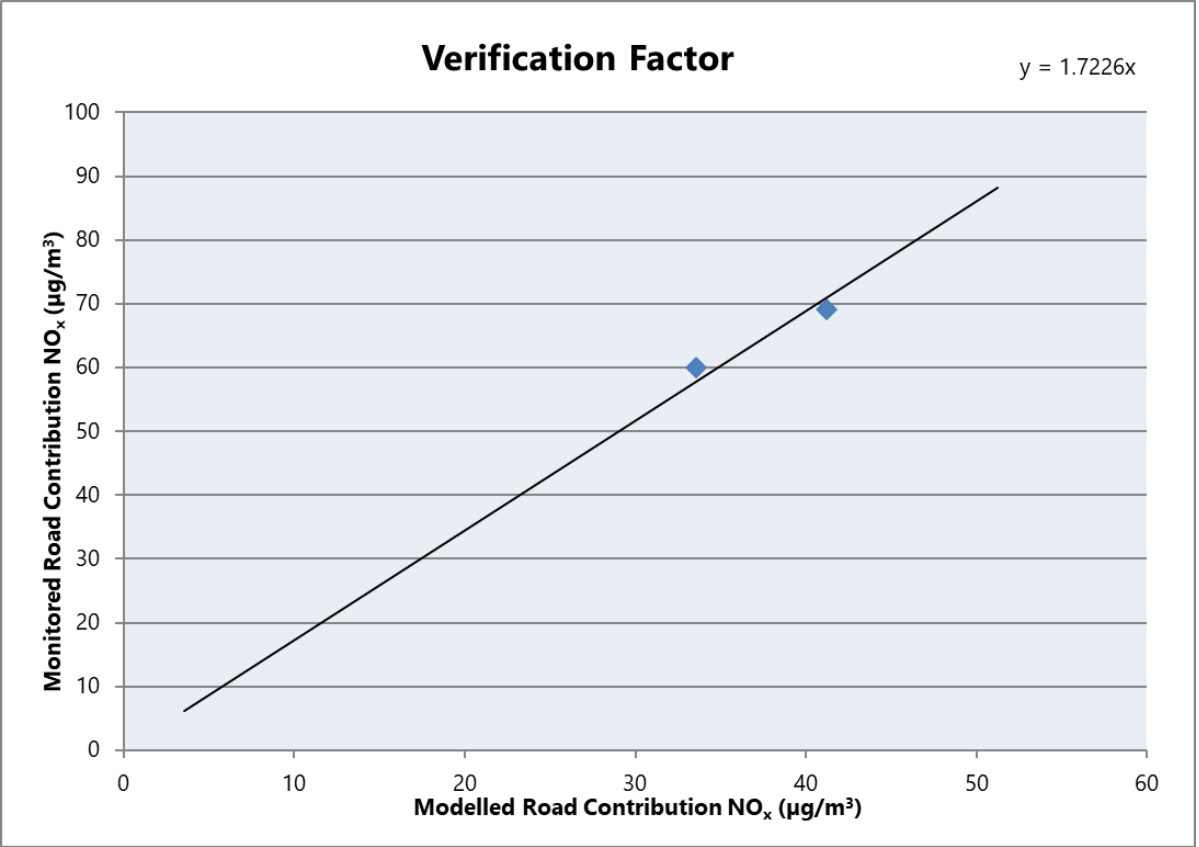


Figure 6-A-2 NO_x Verification Factor

6.13.7 Monitoring of PM₁₀ concentrations was undertaken at one location within the vicinity of roads included within the model during 2019. The monitored annual mean PM₁₀ concentration and modelled PM₁₀ concentration is shown in Table 6-A-5.

Table 6-A-5 Verification - Monitoring Results

Monitoring Location		Monitored PM ₁₀ Concentration (µg/m³)	Modelled Road PM ₁₀ Concentration (µg/m³)
MAN1	Manchester, Oxford Road	26.0	16.9

6.13.8 The monitored and modelled PM₁₀ concentrations were compared to calculate the associated ratio. This indicated a verification factor of 1.5347 was required to be applied to all modelling results.