A2 Modelling Methodology

Model Inputs

A2.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road and the road characteristics (such as road width). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 9.0) published by Defra (2019).

A2.2 Hourly sequential meteorological data from Pershore for 2018 have been used in the model. The Pershore meteorological monitoring station is located at Pershore College, approximately 22 km to the north of the proposed development site. It is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the proposed development site with adequate data capture[2]; both the development site and the Pershore meteorological monitoring station are located in the southwest of England where they will be influenced by the effects of inland meteorology over flat-lying topography.

A2.3 AADT flows, diurnal flow profiles, speeds, and vehicle fleet composition data have been provided by PFA Consulting Ltd, who have undertaken the transport assessment work for the proposed development. These data have been supplemented with 2018 data determined from the interactive web-based map provided by DfT (2019a), for model verification purposes. The traffic data used in this assessment are summarised in Table A2.1. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2019b).

[2] The closest meteorological station is the Gloucestershire station, however data capture in 2018 was just 55% making it unsuitable for use.

Table A2.1: Summary of Traffic Data used in the Assessment (AADT Flows)

Road Link	2018		2024 (Without Scheme)		2024 (With Scheme)	
	AADT	%HDV	AADT	%HDV	AADT	%HDV
A40 London Rd east of Copt Elm Rd	11,554	3	12,119	3	12,301	3
A40 London Rd west of Copt Elm Rd	11,474	3	12,036	3	12,036	3
A40 Old Bath Rd	10,275	3	10,853	3	11,248	3
A435 London Rd northwest of Old Bath Rd	10,546	8	11,059	8	11,158	8
A435 London Rd southeast of Old Bath Rd	16,808	6	17,636	6	17,713	6
B4075 Hales Rd	12,801	4	13,536	4	14,107	4
B4075 Tatchley Ln	7,935	4	8,349	4	8,582	4
Blacksmiths Ln	117	0	123	0	123	0
Bouncers Ln north of B4075	5,665	5	6,150	5	6,319	5
Bouncers Ln south of Blacksmiths Ln	4,716	5	5,019	5	5,188	5
Copt Elm Rd	4,103	2	4,299	2	4,299	2
Deep St	13,541	5	14,256	5	14,338	5
Greenway Ln	3,501	1	3,668	1	3,850	1
Harp Hill west of Stanley Rd	3,822	3	4,031	3	5,152	3
Harp Hill west of Site Access	3,517	2	3,711	2	4,833	2
Harp Hill east of Site Access	3,517	2	3,711	2	3,904	2
Hewlett Rd	9,150	3	9,643	3	9,789	3
B4632 Prestbury Rd west of B4075	4,903	6	5,139	6	5,184	6
B4632 Prestbury Rd east of B4075	13,595	4	14,285	4	14,431	4
B4075 Priors Rd north of Harp Hill	17,794	4	18,859	4	19,263	4
B4075 Priors Rd north of Bouncers Lane	10,392	4	10,923	4	11,115	4
B4075 Priors Rd north of Redmarley Rd	15,097	4	16,033	4	16,394	4
Redmarley Rd	7,573	1	7,931	1	7,974	1
Ryeworth Rd	1,130	1	1,184	1	1,184	1
Site Access	-	-	-	-	1,314	0
Hewlett Road	9,150	3	-	-	-	-
Bath Road	14,260	2	-	-	-	-
Berkeley Street	13,910	3	-	-	-	-
College Road	9,515	2	-	-	-	-
High Street	14,260	2	-	-	-	-

A2.4 Figure A2.1 shows the road network included within the model, along with the speed at which each link was modelled, and defines the study area.

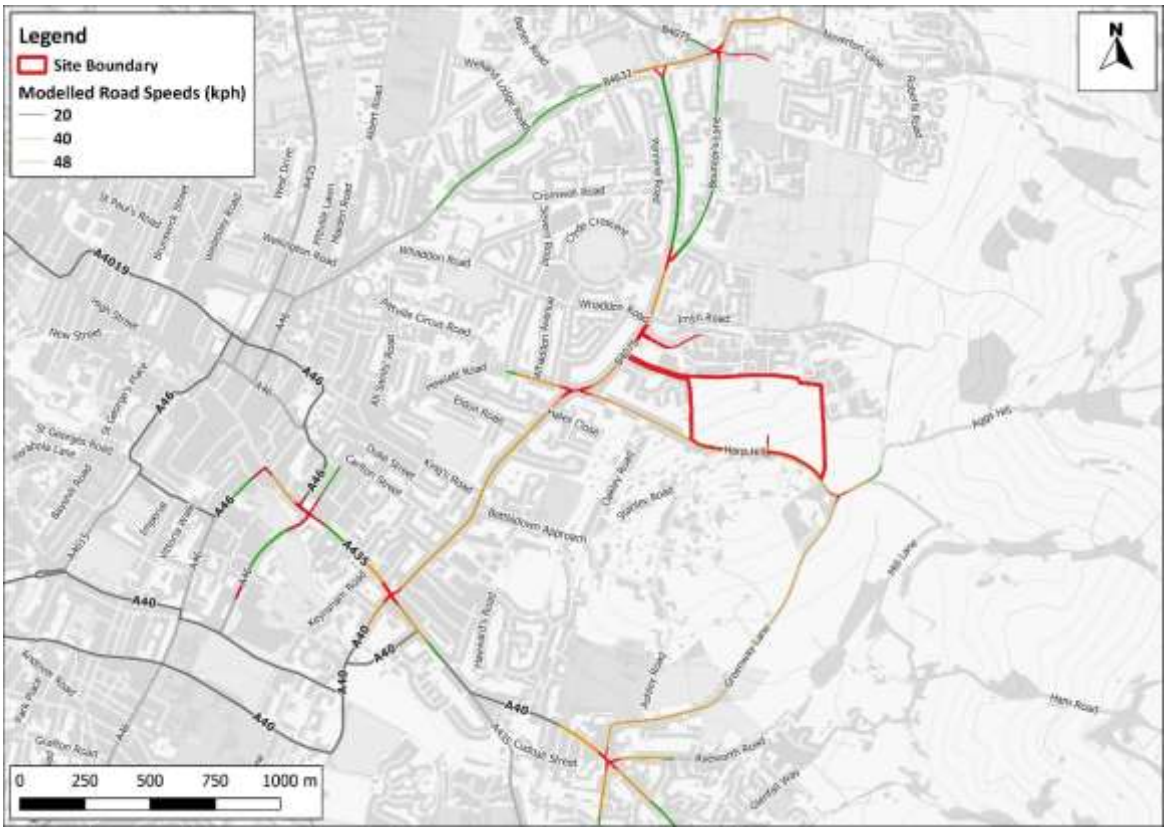

Figure A2.1: Modelled Road Network & Speed

Sensitivity Test for Nitrogen Dioxide

A2.5 AQC has carried out a detailed analysis which showed that, whereas previous standards had had limited on-road success in reducing nitrogen oxides emissions from diesel vehicles, the 'Euro VI' and 'Euro 6' standards are delivering real on-road improvements (AQC, 2016). Defra's EFT v9.0 takes account of these observed improvements, but also makes additional assumptions regarding the performance of diesel cars and vans that will be produced in the future. In particular, it assumes that diesel cars and vans registered for type approval after 2020 will, on average, emit significantly less NOx than earlier models. A sensitivity test has been carried out using AQC's CURED v3A model (AQC, 2017), which assumes that this post-2020 technology does not deliver any benefits. Further details of CURED v3A are provided in the supporting report prepared by AQC (2018a).

Background Concentrations

A2.6 The background pollutant concentrations across the study area have been defined using the 2017-based national pollution maps published by Defra (2019). These cover the whole of the UK on a

1x1 km grid and are published for each year from 2017 until 2030. The background annual mean nitrogen dioxide maps for 2018 have been calibrated against concurrent measurements from national monitoring sites (AQC, 2019). The calibration factor calculated has also been applied to future year backgrounds. This has resulted in slightly higher predicted nitrogen dioxide concentrations for the future assessment year than those derived from the Defra maps.

Background NO_2 Concentrations for Sensitivity Test

A2.7 The road-traffic components of nitrogen dioxide in the Defra's 2015-based background maps have been uplifted in order to derive future year background nitrogen dioxide concentrations for use in the sensitivity test. Details of the approach are provided in the report prepared by AQC (2018b). CURED v3A is largely based on the assumptions within EFT v8.0.1, and it would not be appropriate to make adjustments to Defra's latest tools, such as the 2017-based background maps, to enable their use alongside it; this is why the 2015-based background maps have been used for the sensitivity test.

Model Verification

A2.8 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements.

Nitrogen Dioxide

A2.9 Most nitrogen dioxide (NO_2) is produced in the atmosphere by reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2018 at diffusion tube monitoring sites 14, 15, 16 and 18. Concentrations have been modelled at the height of the monitors, as defined in Cheltenham Borough Council's Annual Status Report 2019.

A2.10 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the 'measured' road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 7.1) available on the Defra LAQM Support website (Defra, 2019).

A2.11 The unadjusted model has under predicted the road-NOx contribution; this is a common experience with this and most other road traffic emissions dispersion models. An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero for both the 'official' scenario and for the sensitivity scenario (Figure A2.2 and Figure A2.3). The calculated adjustment factor of 3.184 has been applied to the modelled road-NOx concentration for each receptor to provide adjusted

modelled road-NOx concentrations, for the 'official' emission predictions scenario. For the sensitivity scenario, the calculated adjustment factor of 3.393 has been applied.

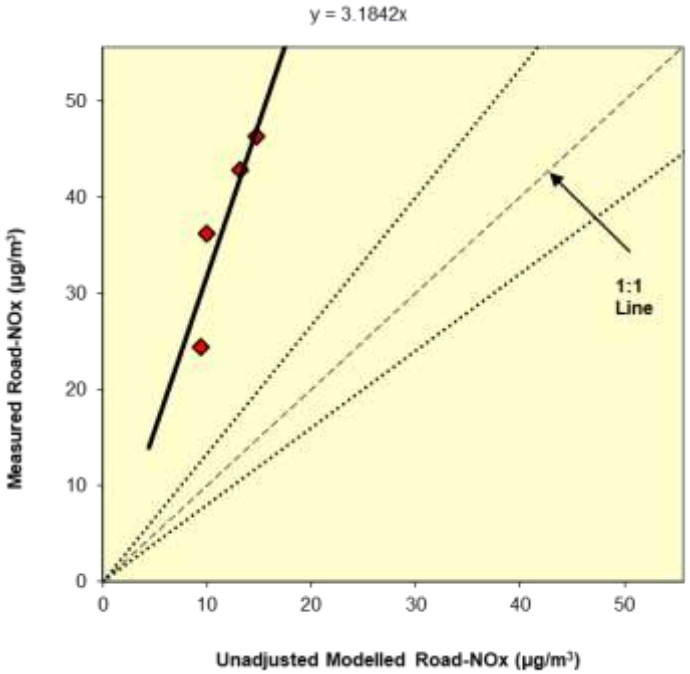

Figure A2.2: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations – 'official' scenario. The dashed lines show ± 25%.

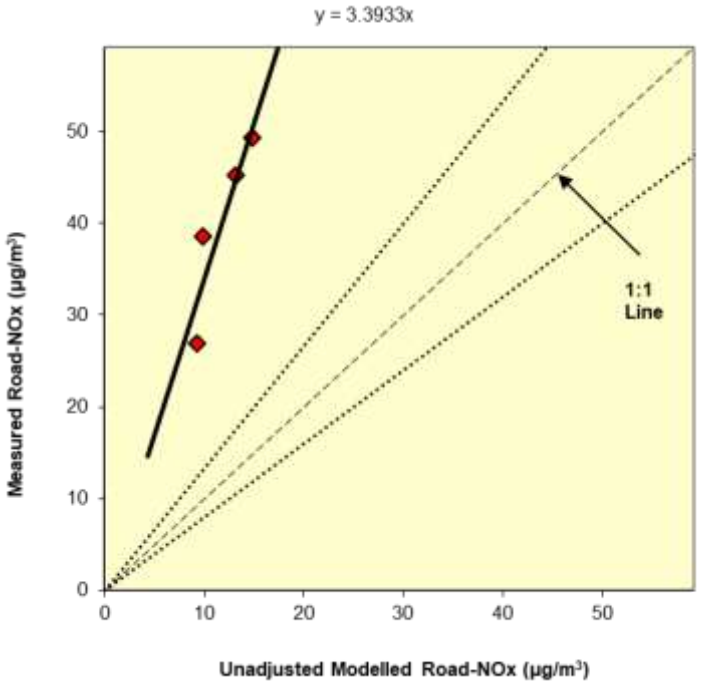

Figure A2.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations – sensitivity scenario. The dashed lines show ± 25%.

A2.12 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. Figure A2.4 and Figure A2.5 compare final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and show a close agreement.

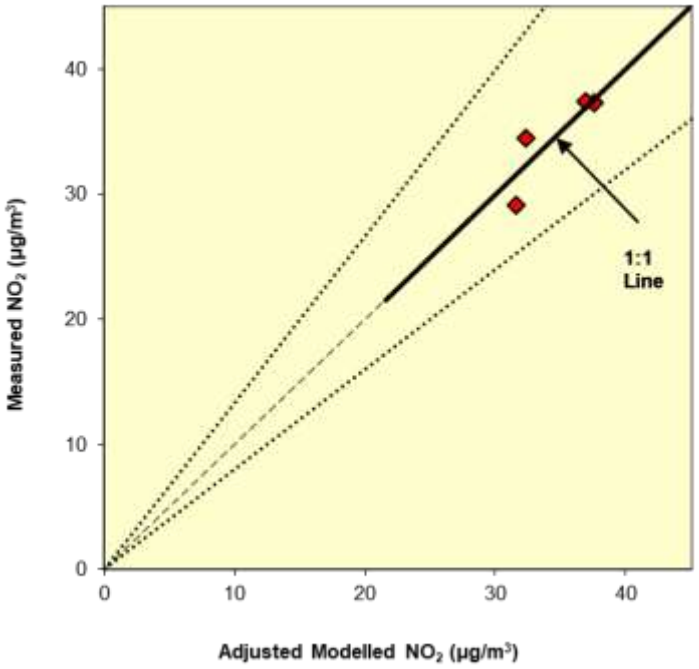

Figure A2.4: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations – 'official' scenario. The dashed lines show ± 25%.

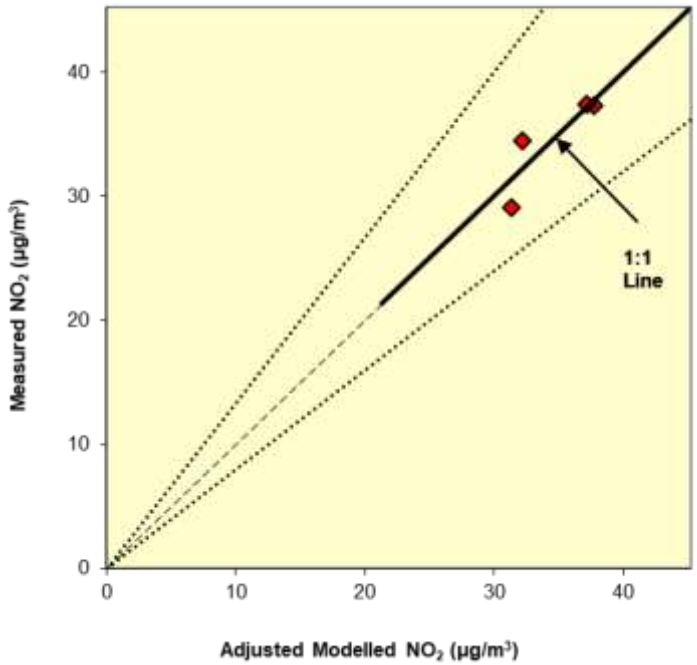

Figure A2.5: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations – sensitivity scenario. The dashed lines show ± 25%.

PM_{10} and $PM_{2.5}$

A2.13 There are no nearby PM_{10} or $PM_{2.5}$ monitors. It has therefore not been possible to verify the model for PM_{10} or $PM_{2.5}$. The model outputs of road-PM_{10} and road-$PM_{2.5}$ have therefore been adjusted by applying the adjustment factor calculated for road NOx ('official scenario').

Model Post-processing

A2.14 The model predicts road-NOx concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2019). The traffic mix within the calculator has been set to "All other urban UK traffic", which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2. Version 7.1 of the calculator has been used alongside the EFT v9.0 emission factors, while version 6.1 has been used for the CURED v3A sensitivity test (see Paragraph A2.7 for the reasoning behind this).