APPENDIX 10.3 – DETAILED MODELLING OF OPERATIONAL PHASE ROAD VEHICLE EXHAUST EMISSIONS: MODEL VERIFICATION

Introduction

The potential error in the raw outputs from the ADMS-Roads dispersion modelling study was assessed through verification with BMBC diffusion tube monitoring results. This is detailed in the following Appendix.

Potential Sources of Error

Sources of error in the dispersion modelling of road traffic exhaust emissions may include the following:

- Omission of other local pollutant sources due to lack of appropriate data;
- Uncertainties in traffic flow model input data;
- Simplifications in emission factors used and their suitability for the for actual vehicle fleet within the modelling area, particularly in regard to engine size, age and type and the overall maintenance of the vehicle;
- Simplifications in building topography and the under-representation of the reduced ventilation effects in street canyons;
- Uncertainties and suitability in meteorological data used in modelling study, including model input parameters such as roughness length and Monin-Obukhov length; and,
- General limitations and assumptions contained within the dispersion model algorithms.

Model Verification Study

A model verification study was undertaken for the year 2009, which corresponds with the traffic data by MVA and monitoring results contained with BMBCs 2010 Progress Report.

PM_{10} is not monitored by BMBC within the modelling area therefore a site specific verification factor for PM_{10} could not be calculated. Alternatively, to determine modelled PM_{10} impacts it was considered appropriate to utilise the verification factor derived for NO_2.

It is recognised that it is not technically rigorous to assume the same dispersion characteristics for a gaseous pollutant, such as NO_2, to that of a particulate pollutant, such as PM_{10} for the application of a verification factor. However, as there is currently no AQMA declared for PM_{10}

within BMBC, it is considered that this locale is less sensitive to increases of PM_{10} compared to increases of NO_2. The House of Commons Environmental Audit Committee1 states that:

> "It is thought almost 70% of roadside particulate concentrations come from particulate matter on the road that it swept into the air in the wake of passing vehicles."

This Air Quality Assessment has determined potential air quality impacts resulting in the operational phase of the development solely from road-traffic exhaust emissions, and not for example from brake and tyre wear. Given the findings of the House of Commons Environmental Audit Committee report, it is considered that the greatest potential source of PM_{10} emission has therefore not been considered within the context of this Air Quality Assessment. On this basis, any calculated verification factor may over estimate actual impacts as a result of the underestimation of PM_{10} sources considered within this modelling assessment.

It should be noted that the marginal change in pollutant concentrations, on which the assessment criteria for this Air Quality Assessment is based, would be of the same scale regardless of the sources of PM_{10} considered within the modelling assessment.

The correction factor calculated for NO_2 was therefore considered to be appropriate for use for the correction of PM_{10} modelling outputs, in lieu of more accurate data.

Model Inputs

Verification Modelling Assessment Area

The verification study included BMBC monitoring data along with the road links where traffic data was available (provided by MVA).

Roughness Length

A roughness length z0 of 0.5m was used in this dispersion modelling study. This value of z0 is considered appropriate for the morphology of the verification modelling assessment area within the dispersion model.

Monin-Obukhov Length

A Monin-Obukhov length of 30m was used in the verification modelling assessment. This value is considered appropriate for the verification modelling assessment area within the dispersion model.

Meteorological Data

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[1] House of Commons Environmental Audit Committee, Air Quality, Fifth Report of Session 2009-2010 Volume 1.

Sequential 1-hour meteorological data used in this assessment were taken from Robin Hood Airport meteorological station for 2009, as previously described in Appendix 10.3.

Traffic Data

The traffic data used in the model verification study included 24-hour AADT flow data and fleet composition, provided by MVA. Emission rates were derived for each link using the EFT v4.2.2.

The traffic data used in the verification study is detailed within Table A10.3.1.

Table A10.3.1 Traffic Data Used in Detailed Modelling – 2009 Verification

Link	Location	2009	
		24-hour AADT	% HDV
1	West Way	32175	6.53
2	Harborough Hill Road (N)	23871	6.53
3	Upper Sheffield Road	13746	6.53
4	Lambra Road	5740	6.53
5	Interchange Way	3545	6.52
6	Sheffield Road North	30588	6.53
7	Park Road	12733	6.53
8	Cemetery Road	8959	6.53
9	Sheffield Road South	17106	6.53
10	Wesley Street	7919	6.53
11	Harborough Hill Road (S)	23944	6.53
12	Pontefract Road	12769	6.53
13	Doncaster Road	12214	6.53

Reference should be made to Figure A10.2 for details of the road speeds used. All speeds for HDVs were considered to be 5km.h-1 slower than LDVs except where LDV speeds were less than 25km.h-1.

NO_2 Monitoring Results

Table A10.3.3 displays the diffusion tube monitoring results for 2009, from BMBC LAQM 2010 Progress Report, and the calculated NO_x concentration using the methodology contained within LAQM.TG(09). The mapped background concentrations used to convert the monitoring to roadside NO_x was obtained from the average of the mapped background concentrations for each diffusion tube.

Reference should be made to Table A10.3.3 for details of the mapped background concentrations used. Reference should also be made to Figure A10.4 for the locations of each verification point and mapped background grid square.

Table A10.3.2 Mapped Background Concentrations

Mapped Background Square NGR (m)		Annual Mean Concentration (µg.m^{-3})	
X	Y	NO_2	NO_x
434500	405500	17.18	25.75
435500	405500	16.54	24.62
	Average	**16.86**	**25.18**

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Table A10.3.3 Monitored Annual Mean NO_2 for 2009 Converted to NO_X

ID	NGR (m)		Monitored NO_2 Concentration (µg.m^{-3})	Calculated Roadside NO_x Concentration (µg.m^{-3})
	X	Y		
11	434695	406110	51.7	92.99
68	435231	405852	39.1	52.91
69	435169	405885	30.7	30.74
70	435125	405890	38.9	52.35
71	435025	405947	42.5	62.86
72	434916	405930	45.6	72.47
92	434920	406277	35.8	43.81
94	434876	406491	41.6	60.17
96	434914	406746	30.4	30.01
97	434914	406746	31.8	33.47
98	434914	406746	31.9	33.72

Verification

Annual mean NO_X concentrations calculated from the monitoring of NO_2 during 2009 using the methodology contained within LAQM.TG(09) and predicted during the dispersion modelling study at the 11No. BMBC monitoring locations are presented in Table A10.3.4.

Table A10.3.4 Verification Data 2009

Tube Name	Modelled Road Contribution NO_X ($\mu g.m^{-3}$)	Calculated Monitored Roadside NO_X Concentration ($\mu g.m^{-3}$)	Ratio
11	36.82	92.99	2.53
68	18.17	52.91	2.91
69	13.07	30.74	2.35
70	10.44	52.35	5.02
71	10.81	62.86	5.81
72	17.13	72.47	4.23
92	21.42	43.81	2.05
94	15.68	60.17	3.84
96	8.32	30.01	3.61
97	8.32	33.47	4.02
98	8.32	33.72	4.05

The relationship between measured and predicted NO_x concentrations at the NO_2 monitoring locations was graphed following the procedure outlined in LAQM.TG(09) and the ratio found to be **3.0243**. All raw NO_x modelling results were subsequently corrected by this factor. Reference should be made to Figure A10.3.1 for the relevant graph.

Figure A10.3.1 Verification Calculation Graph

