Air Quality Dispersion Model Verification

Predicted NO_2 and PM_{10} concentrations based on ADMS-ROADS (v2.2) were verified by comparison against available monitoring data and an adjustment (or correction) factor was calculated. All predicted results (at sensitive receptors) were then adjusted based on this factor.

NO_x / NO_2 model verification

NO_x modelled results have been verified against monitoring data and adjusted accordingly. NO_2 predicted results have then been derived based on the latest equations representing the conversion of NO_x to NO_2 (REF 30). Kerbside sites from the Project diffusion tube survey and from the Council diffusion tube network have been excluded from the model verification as these sites are not suitable for adjustment of dispersion modelling predictions.

The model verification for NO_2 is presented in further details below:

a. Both monitored (from continuous analysers and diffusion tubes) and predicted road-NOx concentrations (i.e. the contribution of traffic road sources to the total NOx) were calculated by subtracting the background NOx concentration (see Table A19.1). NOx concentrations at diffusion tubes were estimated based on the latest NOx / NO_2 relationship. The average ratio between monitored road-NOx and modelled road-NOx was calculated (1.03).

ID	Modelled NO_x 2006 - µg/m^3	Estimated monitored NO_x - µg/m^3 (derived from NO_2)	Background NO_x - µg/m^3	Modelled Road-NO_x - µg/m^3	Monitored Road-NO_x - µg/m^3	Ratio Road-NO_x monitored / modelled
HBC6	85.2	95.2	26.4	58.8	68.8	1.2
HBC1	72.9	77.5		46.5	51.1	1.1
HBC2	78.1	101.4		51.7	75.0	1.5
HBC3	57.3	59.5		30.9	33.1	1.1
HBC4	66.0	77.5		39.6	51.1	1.3
HBC5	92.4	93.2		66.0	66.8	1.0
HBC9	88.8	77.5		62.4	51.1	0.8
HBC10	59.4	52.8		33.0	26.4	0.8
HBC13	66.3	97.3		39.9	70.9	1.8
HBC14	71.8	59.5		45.4	33.1	0.7
HBC15	83.6	156.2		57.2	129.8	2.3
HBC18	89.8	105.6		63.4	79.2	1.2
MG1	68.4	74.5		42.0	48.1	1.1
MG4	78.0	97.7		51.6	71.3	1.4
MG5	73.9	80.6		47.5	54.2	1.1
MG6	67.6	69.4		41.2	43.0	1.0
MG7	75.8	64.4		49.4	38.0	0.8
MG8	86.8	66.1		60.4	39.7	0.7
MG9	65.7	58.8		39.3	32.4	0.8
MG10	65.3	76.0		38.9	49.6	1.3
MG11	55.6	64.0		29.2	37.6	1.3
HBC0	63.2	52.4		36.8	26.0	0.7
MG15	115.9	128.6		89.5	102.2	1.1
MG16	82.6	86.4		56.2	60.0	1.1
MG17	51.0	39.3		24.6	12.9	0.5
MG18	53.3	39.6		26.9	13.2	0.5
MG19	58.2	40.5		31.8	14.1	0.4

ID	Modelled NO_x 2006 - µg/m^3	Estimated monitored NO_x - µg/m^3 (derived from NO_2)	Background NO_x - µg/m^3	Modelled Road-NO_x - µg/m^3	Monitored Road-NO_x - µg/m^3	Ratio Road-NO_x monitored / modelled
MG20	54.2	35.2		27.8	8.8	0.3
MG22	63.3	63.0		36.9	36.6	1.0
MG23	60.9	67.2		34.5	40.8	1.2
					Average	**1.03**

Table A19.1 – Calculation of Road-NO_x concentrations (2006 - µg/m^3)

b. The predicted road-NO_x was then adjusted based on this average ratio, and the total predicted NO_x was obtained by adding the background NO_x concentration. Predicted road-NO_2 was then calculated using the following updated empirical NO_x / NO_2 relationship:

$$\text{Road-NO}_2 = (-0.0719 \times \text{Ln(total-NOx)} + 0.6248) \times \text{road-NOx}$$

(Equation for areas outside London)

c. The total predicted NO_2 was then calculated by adding the local background NO_2 concentration (18.9µg/m^3 in 2006 for Runcorn/Widnes area). The results are shown in Table A19.2.

ID	Corrected Modelled Road-NO_x - µg/m^3	Corrected Modelled Total NO_x - µg/m^3	Predicted NO_2 - µg/m^3
HBC6	60.9	87.3	37.4
HBC1	48.1	74.5	34.1
HBC2	53.5	79.8	35.5
HBC3	32.0	58.4	29.6
HBC4	41.0	67.3	32.1
HBC5	68.3	94.7	39.3
HBC9	64.6	91.0	38.4
HBC10	34.2	60.6	30.2
HBC13	41.3	67.6	32.2
HBC14	47.0	73.3	33.8
HBC15	59.2	85.5	37.0
HBC18	65.7	92.0	38.6
MG1	43.5	69.9	32.8
MG4	53.4	79.8	35.5
MG5	49.2	75.6	34.4
MG6	42.7	69.0	32.6
MG7	51.1	77.5	34.9
MG8	62.5	88.9	37.8
MG9	40.7	67.1	32.1
MG10	40.3	66.7	32.0
MG11	30.2	56.6	29.1
HBC0	38.1	64.5	31.3
MG15	92.7	119.0	45.0
MG16	58.2	84.5	36.7
MG17	25.5	51.8	29.0
MG18	27.9	54.2	28.3
MG19	32.9	59.3	29.8

ID	Corrected Modelled Road-NO_x - µg/m^3	Corrected Modelled Total NO_x - µg/m^3	Predicted NO_2 - µg/m^3
MG20	28.8	55.2	28.6
MG22	38.2	64.6	31.4
MG23	35.7	62.1	30.7

Table A19.2 – Predicted NO_2 (µg/m^3)

d. The final NO_2 results were then compared to the monitoring data to check if an additional adjustment was required. In this case, as shown in Table A3, results are in good agreement with monitoring data, and it was not necessary to proceed to a further adjustment.

ID	Location	Monitored NO_2 2006 - µg/m^3	Modelled NO_2 2006 (verified) - µg/m^3	Difference (Modelled-Monitored) NO_2 - µg/m^3	Difference (Modelled-Monitored) NO_2 - (%)
HBC6	Deacon Road 3	38.0	37.4	-0.6	-2%
HBC1	Saxon Road 1	35.0	34.1	-0.9	-3%
HBC2	Deacon Road 1	41.0	35.5	-5.5	-13%
HBC3	Carey Street	30.0	29.6	-0.4	-1%
HBC4	Shopping Centre exit	35.0	32.1	-2.9	-8%
HBC5	Deacon Road 2	39.0	39.3	0.3	1%
HBC9	Saxon Terrace 2	35.0	38.4	3.4	10%
HBC10	Lower House Lane 1	28.0	30.2	2.2	8%
HBC13	Peel House Lane 1	40.0	32.2	-7.8	-19%
HBC14	Peel House Lane 2	30.0	33.8	3.8	13%
HBC15	Peel House Lane 3	53.0	37.0	-16.0	-30%
HBC18	Greenway Road	42.3	38.6	-3.7	-9%
MG1	48 Cholmondeley Street, West Bank, Widnes	34.2	32.8	-1.4	-4%
MG4	25 Wilkinson Close, West Bank, Widnes	40.1	35.5	-4.6	-11%
MG5	31 Wright Crescent, West Bank, Widnes	35.8	34.4	-1.4	-4%
MG6	West Bank Primary School (2nd Floor), Widnes	32.8	32.6	-0.2	-1%
MG7	13 Waterloo Road, Runcorn	31.4	34.9	3.5	11%
MG8	28 Egerton Street, Runcorn	31.9	37.8	5.9	19%
MG9	Opposite 23 Ashridge Street, Runcorn	29.8	32.1	2.3	8%
MG10	42 Rutland Street, Runcorn	34.6	32.0	-2.6	-8%
MG11	Castner Avenue 'Weston Point	31.3	29.1	-2.2	-7%
HBC0	Lower House Lane CM	27.9	31.3	3.4	12%
MG15	Ditton Roundabout, Widnes	47.2	45.0	-2.2	-5%
MG16	Catherine Street, Widnes	37.3	36.7	-0.6	-2%
MG17	69 Brookfield Avenue, Runcorn	23.7	29.0	5.3	22%
MG18	36 Fenwick Lane, Runcorn	23.8	28.3	4.5	19%
MG19	30 Millersdale Grove, Runcorn	24.1	29.8	5.7	24%
MG20	26 Steventon, Runcorn	22.3	28.6	6.3	28%
MG22	Traffic Sign (at top of steps), Bridgewater Expressway	31.0	31.4	0.4	1%
MG23	Traffic Sign (on bridge over canal), Bridgewater	32.2	30.7	-1.5	-5%

ID	Location	Monitored NO_2 2006 - µg/m^3	Modelled NO_2 2006 (verified) - µg/m^3	Difference (Modelled-Monitored) NO_2 - µg/m^3	Difference (Modelled-Monitored) NO_2 - (%)
	Expressway				
Summary					
Number of sites	Within ±10%			18	
	Between ± 10-25%			10	
	Exceeds ±25%			2	
	Total			30	

Table A19.3 – Comparison with NO_2 monitoring results

PM_{10} model verification

Similarly, PM_{10} results have been verified and adjusted based on available monitoring data. The only monitoring site within the modelled area is the continuous monitoring station in Lower House Lane; therefore, all predicted PM_{10} results have been adjusted based on this station only. Details of the model verification for PM_{10} are described below:

a. The predicted PM_{10} road contribution at Lower House Lane (19.7µg/m^3) was calculated by subtracting the PM_{10} background (18.5µg/m^3 in 2006):

$$\text{Predicted Road-PM}_{10} = 19.7 - 18.5 = 1.15\mu g/m^3$$

b. The monitored PM_{10} road contribution was calculated in a similar way:

$$\text{Monitored Road-PM}_{10} = \text{Total Monitored PM}_{10} - \text{Background PM}_{10}$$
$$= 24.2 - 18.5 = 5.7\mu g/m^3$$

c. The ratio Monitored Road-PM10 / Predicted Road-PM10 was then calculated:

$$\text{Ratio Monitored/Predicted Road-PM}_{10} = 5.7 / 1.15 = 4.91$$

The PM_{10} road contribution at all modelled receptors was adjusted based on this factor.