Appendix 7.3: Model Verification

7.1.1 RPS undertook a six-month monitoring scheme monitoring roadside NO_2 concentrations passively using diffusion tubes at ten locations in the vicinity of the Application Site. Note that data from only eight of these locations was used for the purpose of model verification, due to difficulties with calculating a suitable fractional bias when including the entire dataset. The approach was taken to remove the two locations where, following adjustment, the modelled outputs remained markedly dissimilar from the monitoring data (suggesting local variation not compensated for by the verification procedure itself).

7.1.2 The concentrations monitored over recent years are provided in Table 7.3.1.

Table 7.3.1 Measured Annual-mean NO_2 Concentrations ($\mu g.m^{-3}$)

Monitoring Site	Measured Annual-mean NO_2 Concentrations ($\mu g.m^{-3}$)
7	19.8
8	9.0
9	13.6
13	15.1
14	10.8
15	17.8
16	22.3
17	17.4

7.1.3 The monitored annual-mean NO_x road contributions have been derived from the monitored annual-mean NO_2 concentrations using the LAQM.TG22 calculator. The monitored annual-mean NO_X road contributions have then been compared with the modelled annual-mean NO_x road contributions. This comparison is provided in Table 7.3.2 below.

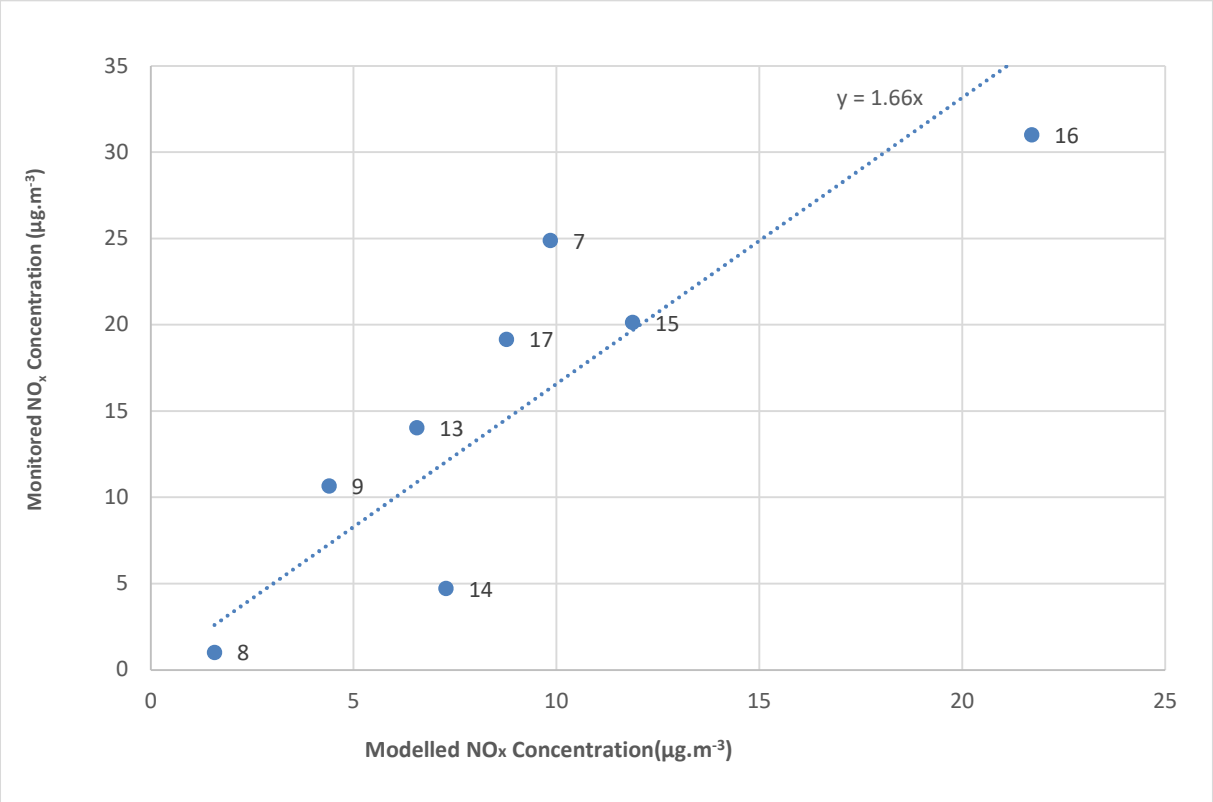
Table 7.3.2 Comparison of Monitored and Modelled Annual-mean Road NOx Contribution (µg.m-3)

Monitoring Site	Annual-mean Road Nox Concentration ($\mu g.m^{-3}$)	
	Monitored	Modelled
7	24.9	9.8
8	1.0	1.6
9	10.7	4.4
13	14.0	6.6
14	4.7	7.3
15	20.1	11.9
16	31.0	21.7
17	19.2	8.8

7.1.4 It should be borne in mind that the monitored concentrations are themselves only estimates to the true concentrations at each point; the EU Directive on air quality [i] designates passive NO_2 samplers indicative measures with a potential uncertainty of +/-30 %. Ignoring any uncertainty errors in the monitoring results, the table above indicates that the model is under-predicting.

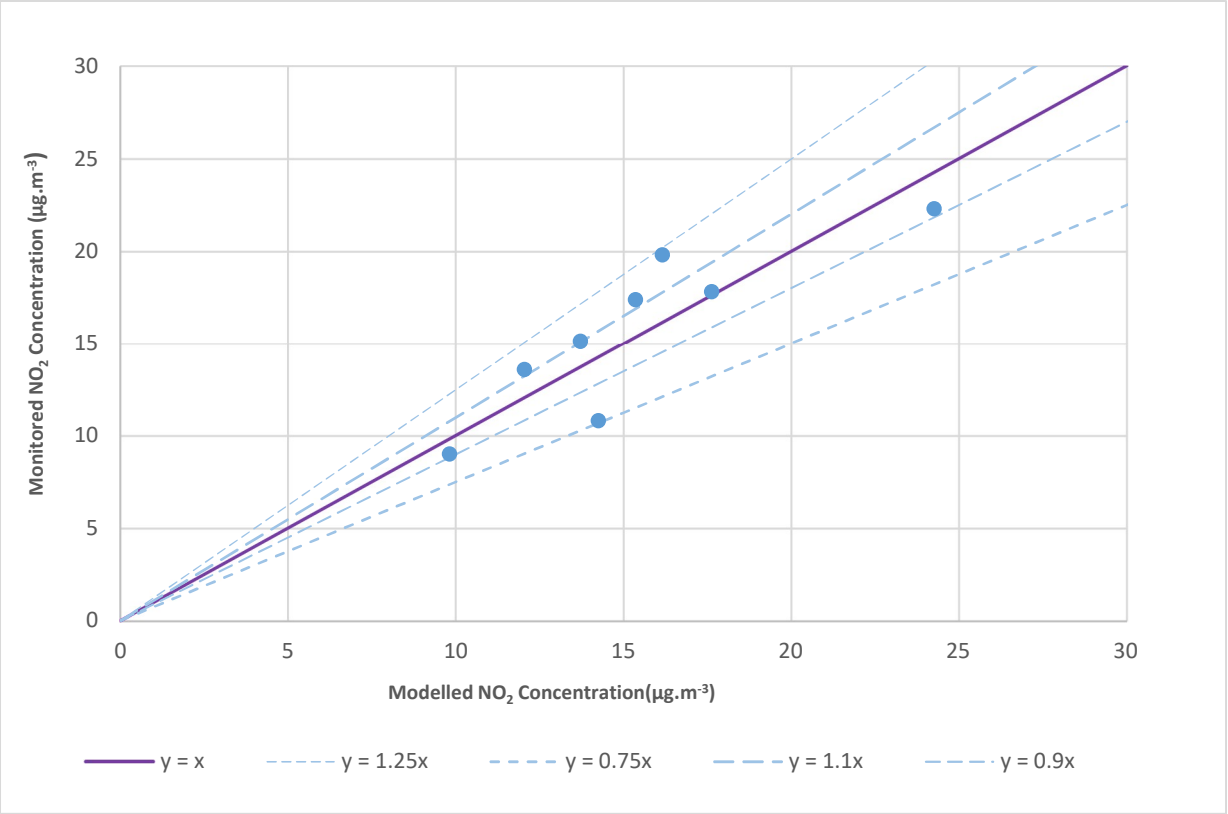
7.1.5 The modelled annual-mean NO_x road contributions have been plotted against the monitored annual-mean NO_x road contributions in Graph 1.

Graph 1 Monitored Annual-Mean Nox Road Concentrations



7.1.6 The modelled NO_x contributions have been multiplied by the gradient of the trend line (1.66) to determine the corrected NO_x contributions. Modelled annual-mean NO_2 concentrations have been derived from the corrected modelled annual-mean NO_x road contributions. The corrected modelled annual-mean NO_2 concentrations have been plotted against the monitored annual-mean NO_2 concentrations in Graph 2.

Graph 2 Corrected Modelled Annual-Mean NO_2 Concentrations



7.1.7 The corrected modelled annual-mean NO_2 concentrations are all within 25% of the monitored annual-mean NO2 concentrations. The correction factor therefore improves the modelled concentrations and has been applied to all predictions used within the assessment.

7.1.8 The fractional bias can also be used to determine whether the corrected model has a tendency to over or under-predict. The fractional bias is calculated as:

7.1.9 (Average Monitored NOX Concentration – Average Predicted NOx Concentration) / 0.5 x (Average Monitored NOX + Average Predicted NOx Concentration)

7.1.10 Fractional bias values vary between +2 and -2 and has an ideal value of zero. A negative value suggests a model over-prediction and a positive value suggests a model under-prediction.

7.1.11 Table 7.3.3 sets out the average monitored concentration and the average predicted concentration.

Table 7.3.3 Comparison of Monitored and Adjusted Modelled Annual-mean Road NO_X Contribution ($\mu g.m^{-3}$)

Monitoring Site	Annual-mean Road Nox Concentration (µg.m^{-3})	
	Monitored	Corrected Modelled
7	24.9	16.3
8	1.0	2.6
9	10.7	7.3
13	14.0	10.9
14	4.7	12.1
15	20.1	19.7
16	31.0	36.0
17	19.2	14.5

7.1.12 The fractional bias for this study is therefore (15.7 – 14.9) / (0.5 x (15.7 + 14.9)) = 0.05. As the fractional bias is close to zero, the adjusted model is working well.

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i Council Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe