

APPENDIX 12.1
Air Quality Model Verification

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MODEL VERIFICATION

1.1 Nitrogen Dioxide

- 1.1.1 Most nitrogen dioxide (NO₂) 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 (NO_x = NO + NO₂). The model has been run to predict the annual mean road-NO_x concentration during 2009 at the diffusion tube monitoring sites located at Ewenny Court.
- 1.1.2 The model output of road-NO_x (i.e. the component of total NO_x coming from road traffic) has been compared with the 'measured' road-NO_x. Measured road-NO_x was calculated from the measured NO₂ concentrations and the predicted background NO₂ concentration using the recently updated NO_x from NO₂ calculator available on the Air Quality Archive website (Defra, 2009c).
- 1.1.3 A primary adjustment factor was determined as the slope of the best fit line between the calculated (measured) road contribution and the model derived road contribution, forced through zero (Figure A12.1). This factor was then applied to the modelled road-NO_x concentration for each receptor to provide adjusted modelled road-NO_x concentrations. The total nitrogen dioxide concentrations were then determined by combining the adjusted modelled road-NO_x concentrations with the predicted background NO₂ concentration within the recently updated NO_x from NO₂ calculator available on the Air Quality Archive website (Defra, 2009c). A secondary adjustment factor was finally calculated as the slope of the best fit line applied to the adjusted data and forced through zero (Figure A12.2).
- 1.1.4 The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data:
- Primary adjustment factor : 5.310
 - Secondary adjustment factor: 0.968
- 1.1.5 The results imply that the model was under-predicting the road-NO_x contribution. This is a common experience with this and most other models. The final NO₂ adjustments are minor.
- 1.1.6 Figure A12.3 compares final adjusted modelled total NO₂ at the six diffusion tube sites, to measured total NO₂, and shows a 1:1 relationship.

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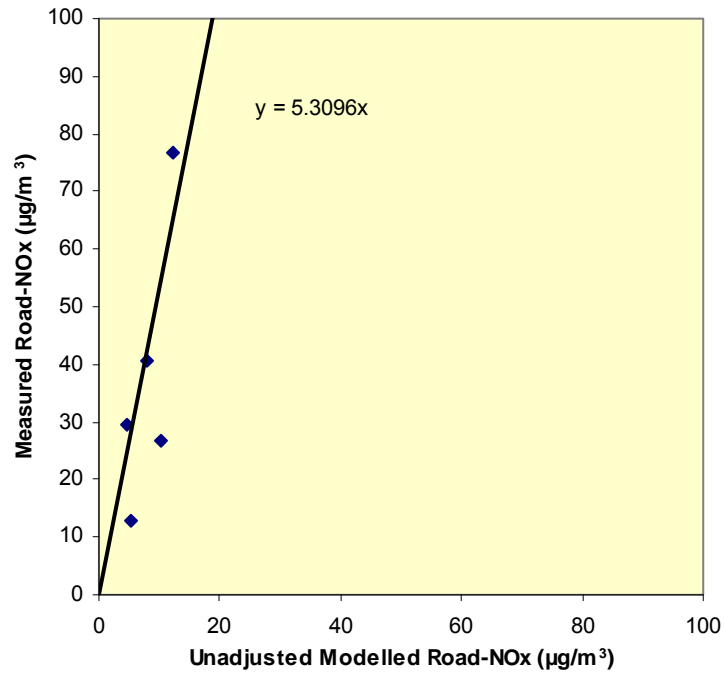


Figure A12.1: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations

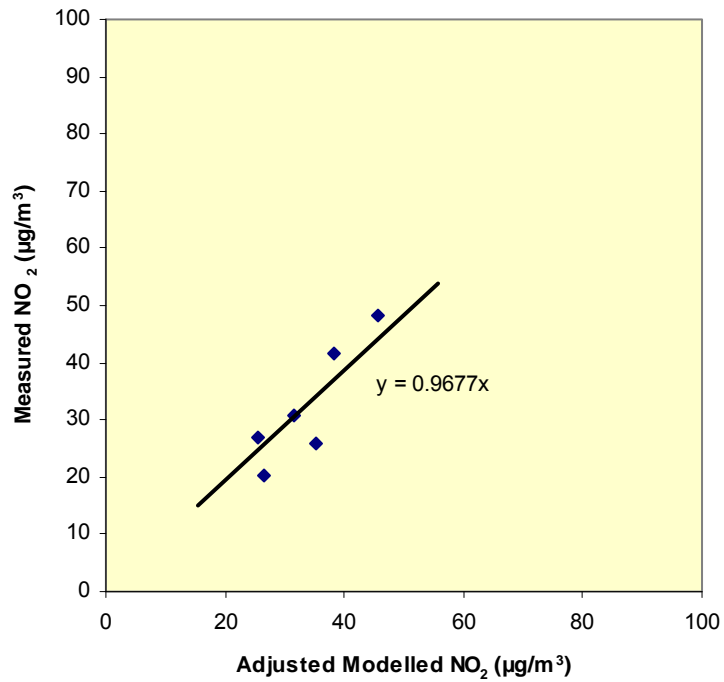


Figure A12.2: Comparison of Measured Total NO₂ to Primary Adjusted Modelled Total NO₂ Concentrations

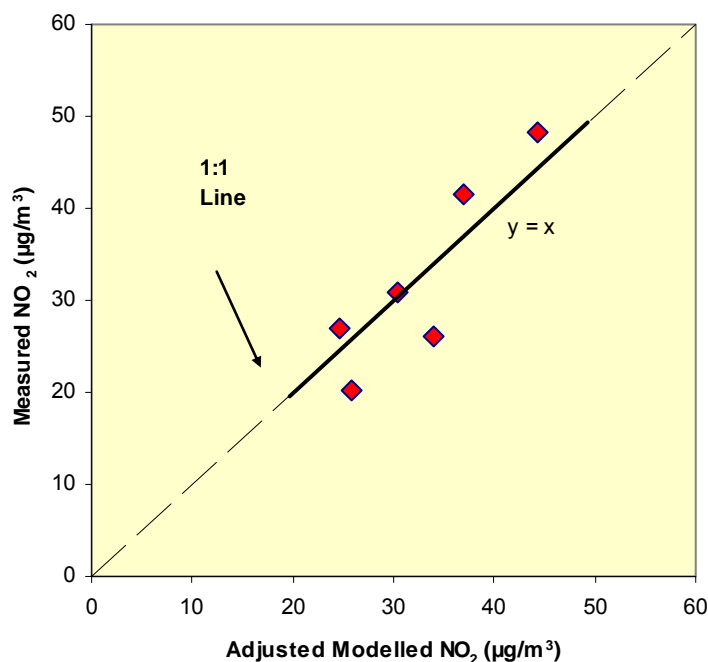


Figure A12.3: Comparison of Measured Total NO₂ to Final Adjusted Modelled Total NO₂ Concentrations

1.2 PM₁₀

1.2.1 There are no nearby PM₁₀ or PM_{2.5} monitors. It has therefore not been possible to verify the model for PM₁₀ or PM_{2.5}. The model output of road-PM₁₀ has therefore been adjusted by applying the primary adjustment factor calculated for road NO_x. Road PM_{2.5} is determined from the adjusted road PM₁₀ and therefore this has also been adjusted in the same manner. Non-exhaust PM₁₀ and PM_{2.5} model outputs have not been adjusted, as these represent a worst-case assessment, as described in Chapter 12.

1.2.2 The number of exceedences of 50 µg/m³ as a 24-hour mean PM₁₀ concentration has been calculated from the adjusted-modelled total annual mean concentration following the relationship advised by Defra (2009a):

$$A = -18.5 + 0.00145 B^3 = + 206/B$$

1.2.3 where A is the number of exceedences of 50 µg/m³ as a 24-hour mean PM₁₀ concentration and B is the annual mean PM₁₀ concentration. The relationship is only applied to annual mean concentrations greater than 16.5 µg/m³, below this concentration, the number of 24-hour exceedences is assumed to be zero.

1.3 Traffic Data Assumptions

Table A12.1 Summary of Traffic Data used in the Air Quality Assessment (AADT)

Road Link	2009 ^a	2012 Without Scheme ^a	2012 With Scheme (except park and ride buses) ^{a, b}	2012 With Scheme park and ride bus flows ^c
A48 (west of Broadlands junction)	15,761 (2.2%)	16,962 (2.1%)	19,108 (1.9%)	
A48 (east of Broadlands junction, east of proposed site entrance)	22,752 (1.7%)	25,665 (1.6%)	28,923 (1.4%)	
A48 (east of Broadlands junction, west of proposed site entrance)	10,750 (1.1%)	13,331 (0.9%)	29176 (1.4%)	
Broadlands access	10,750 (1.1%)	13,331 (0.9%)	14,509 (0.9%)	
Ewenny Road (north of Ewenny junction)	9,514 (2.6%)	10,282 (2.5%)	12,325 (2.1%)	72
Ewenny Road (south of Ewenny junction)	8,848 (3.8%)	9,430 (3.7%)	12,189 (3.1%)	72
A48 (east of Ewenny junction)	20,585 (2.9%)	23,068 (2.7%)	27,258 (2.3%)	
Technology Drive	1,840 (0.3%)	1,917 (0.3%)	4,802 (0.8%)	72
Ewenny Road (south of Technology Drive)	6,783 (3.9%)	7,272 (3.8%)	7,420 (3.7%)	
A48 (east of Picton Court junction)	17,488 (2.9%)	19,455 (2.7%)	23,544 (2.2%)	

Cowbridge Road	13,938 (3.0%)	15,384 (2.8%)	15,384 (2.8%)	
Crack Hill	12,730 (3.6%)	13,809 (3.5%)	14,291 (3.4%)	
A473 (east of Waterton junction)	21,522 (3.3%)	23,333 (3.1%)	26,992 (2.7%)	
Committed development road	0 (0.0%)	1,749 (0.0%)	1,749 (0.0%)	
A473 (east of Coychurch junction)	31,815 (5.9%)	33,874 (5.8%)	37,227 (5.2%)	
Site access road (from A48)	0	0	7,751 (0.0%)	

^a Values in parentheses are proportions of HDVs.

^b These include match-event flows averaged out across a full year.

^c These flows are presented separately since they were entered into the model as buses and not as HDVs.