



Importance of Model Verification and Adjustment

Prof. Duncan Laxen

Air Quality Consultants Ltd.



Outline of Presentation

- **Definitions**
- **Verification**
- **Adjustment**





Definitions

➤ Model Validation

- *validation* generally refers to detailed, peer-reviewed studies that have been carried out by the model supplier or a regulatory agency (e.g. USEPA)

➤ Model Verification

- *verification* refers to checks carried out on model performance at a local level. This basically involves comparison of predicted versus measured concentrations. Where there is a disparity between predicted and measured concentrations, the first step should always be to check the input data and model parameters in order to minimise the errors. If required, the second step will be to determine an appropriate adjustment factor that can be applied.

(paras 6.10 and 6.11 in LAQM.TG(09))



Validation

➤ Point Sources

- Long history of validation – perform well, especially for tall stacks in open flat terrain

➤ Roads

- ADMS Roads validated for M4 and M25 in UK and Highway 99 in USA
- Caline 4 validated during development for Highway 99 in USA

➤ Note for roads

- These are straightforward open roads with fairly fast moving traffic

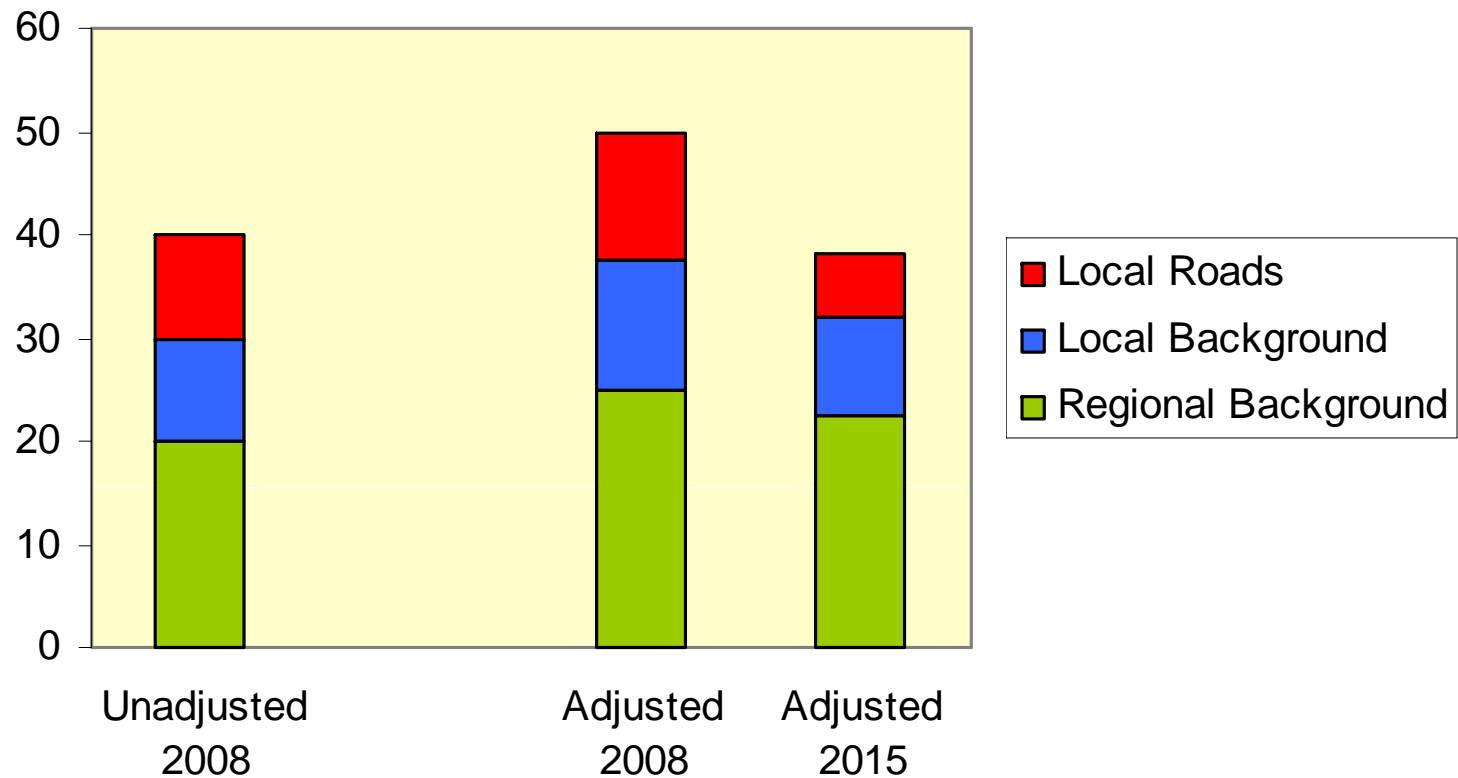


Verification

- **Essentially 3 components to consider**
 - Regional background
 - Local background
 - Local roads
- **Usually just background and local roads**
- **Important to verify component separately**
- **Example:**
 - **Measure 50 $\mu\text{g}/\text{m}^3$ and model 40 $\mu\text{g}/\text{m}^3$ in 2008**
 - **What happens in 2015**
 - **Assume that between 2008 and 2015:**
 - road goes down 50%,
 - local background 25%
 - regional background 10%

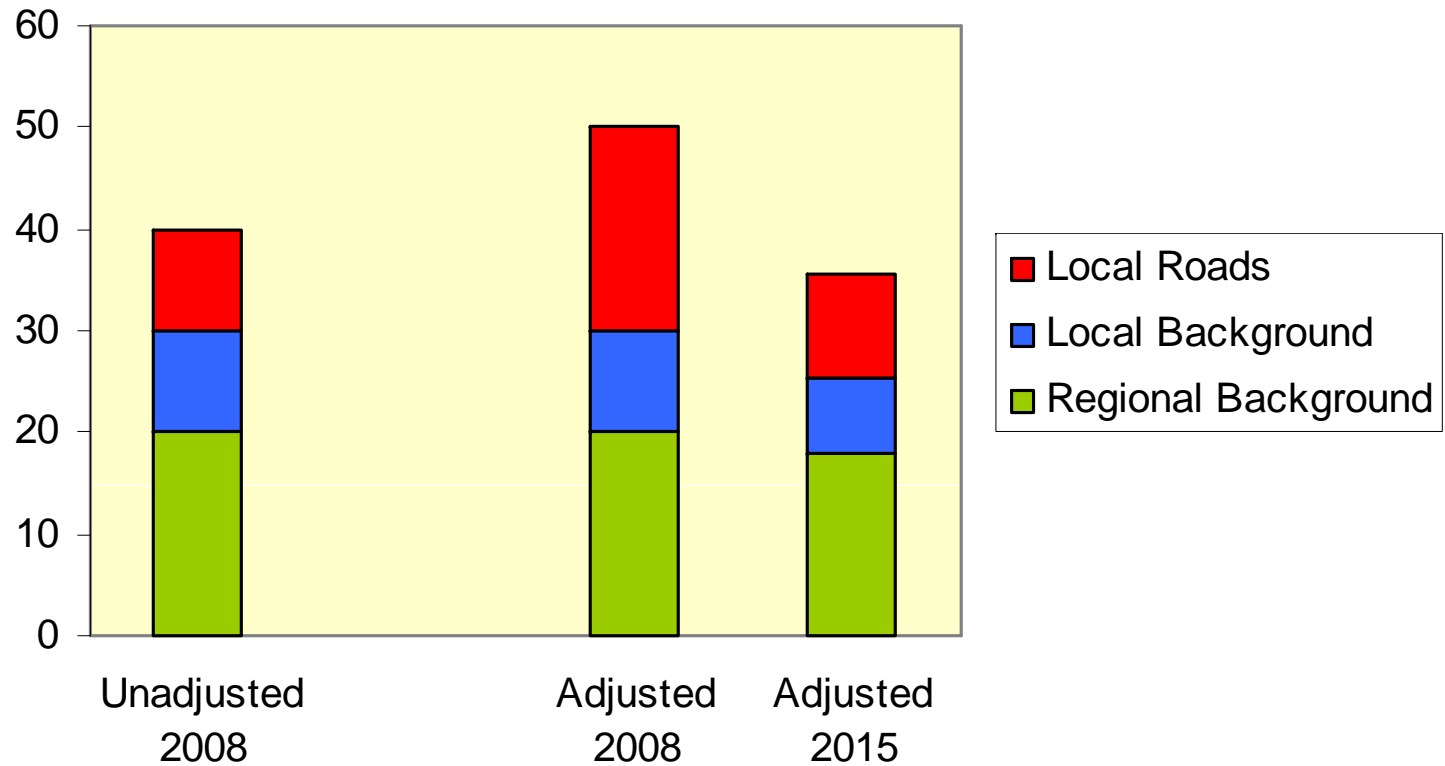


Approach 1 Adjust Total



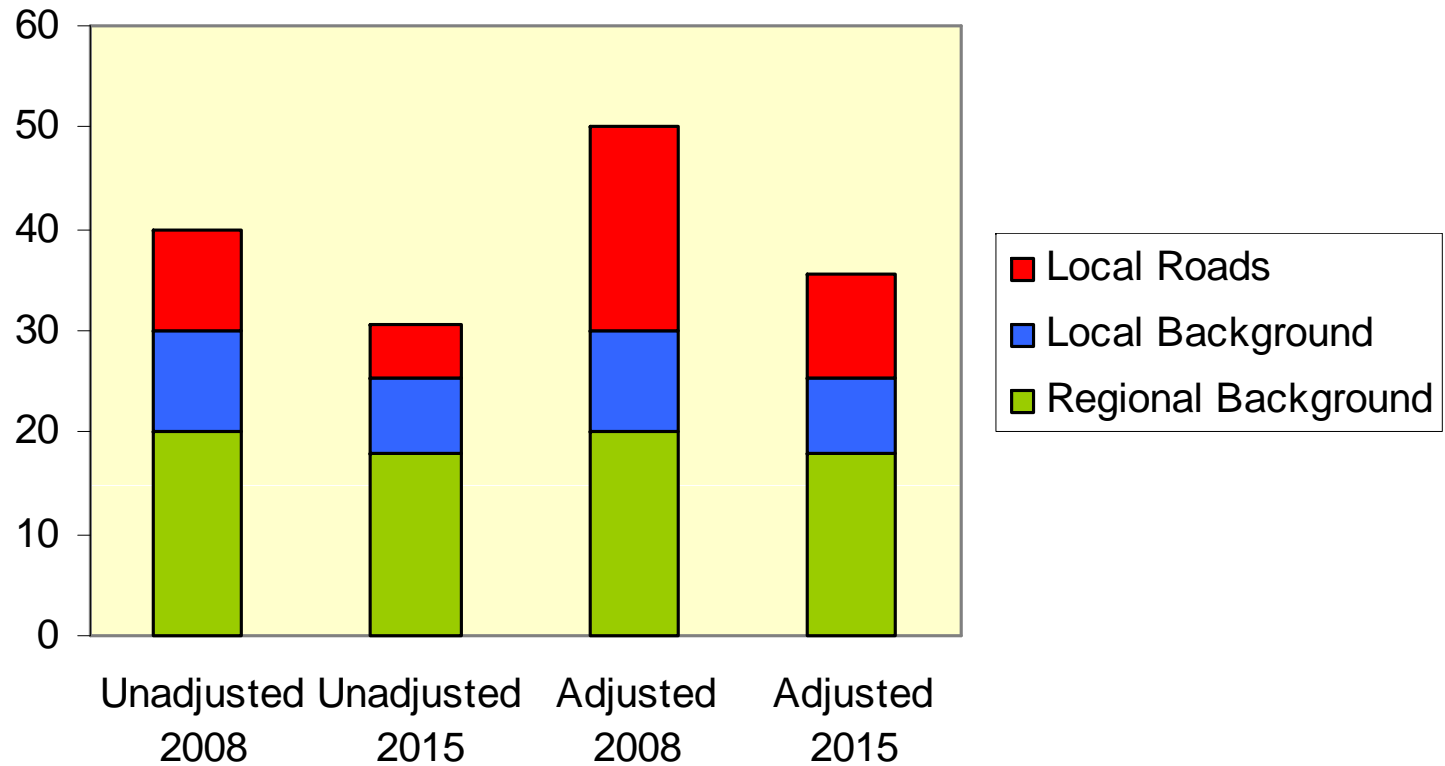


Approach 2 Adjust Road





Approach 3 No Adjustment





Example Summary

- Approach 1 - adjust total
 - 2015 Concentration **38.1** $\mu\text{g}/\text{m}^3$
- Approach 2 - adjust road
 - 2015 Concentration **35.5** $\mu\text{g}/\text{m}^3$
- Approach 3 – no adjustment
 - 2015 Concentration **30.5** $\mu\text{g}/\text{m}^3$



Verification and Adjustment

- Why is it important to adjust?
 - Modelling is often designed to help reach a decision as to whether or not to declare an AQMA
 - This decision is based on comparison with an objective
 - Therefore important that decisions are based on **best estimate** of 'true' concentration
 - In addition, action plans are based on understanding of sources and the magnitude of exceedence, and it is clearly important to have best estimates of both of these to ensure appropriate actions are taken



Typical Approach

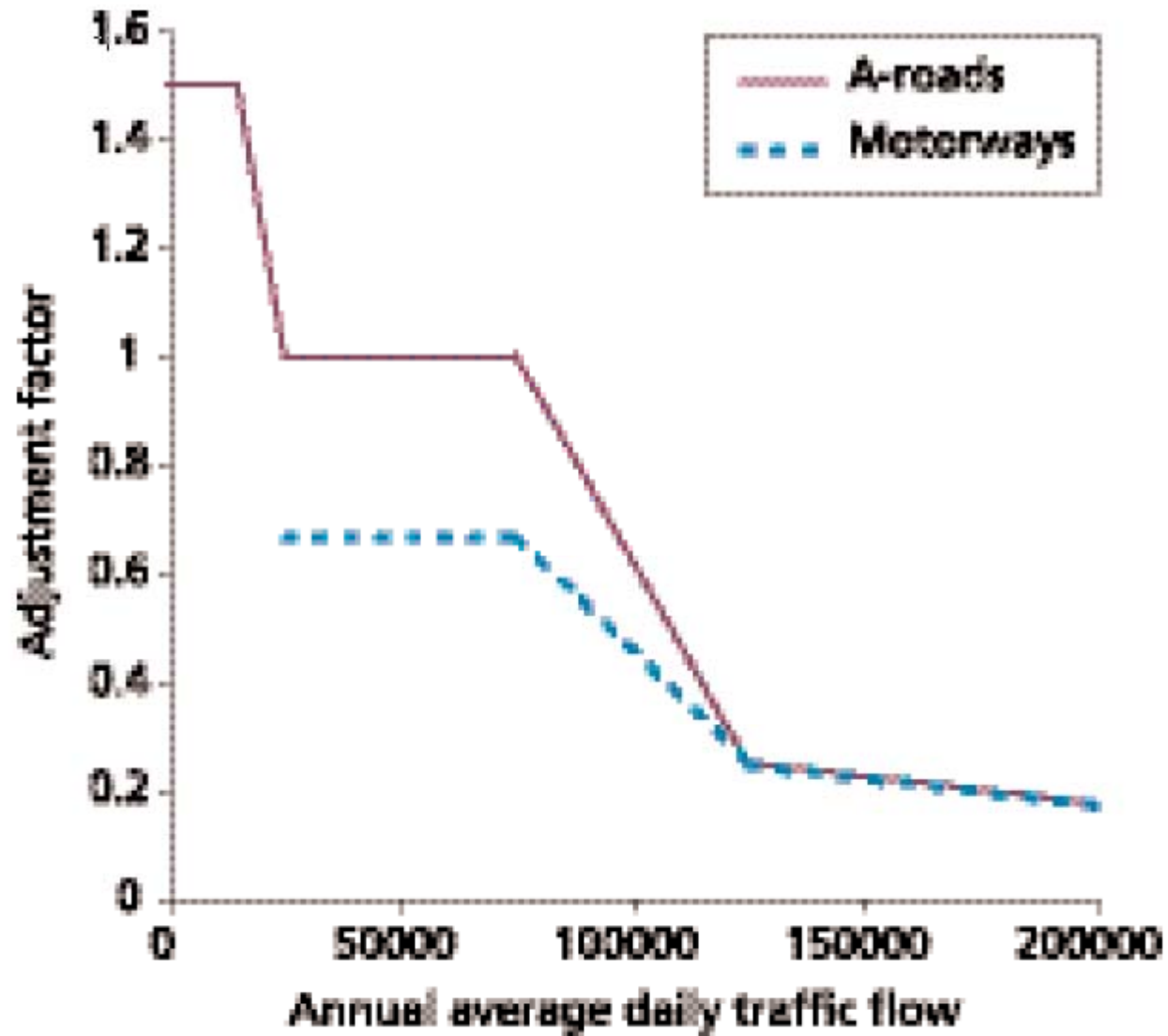
- **Assume**
 - **Background from national maps is correct – it is a calibrated model**
- **Therefore**
 - **Verify the road component and adjust as necessary**
 - **Adjust NO_x first then NO₂**



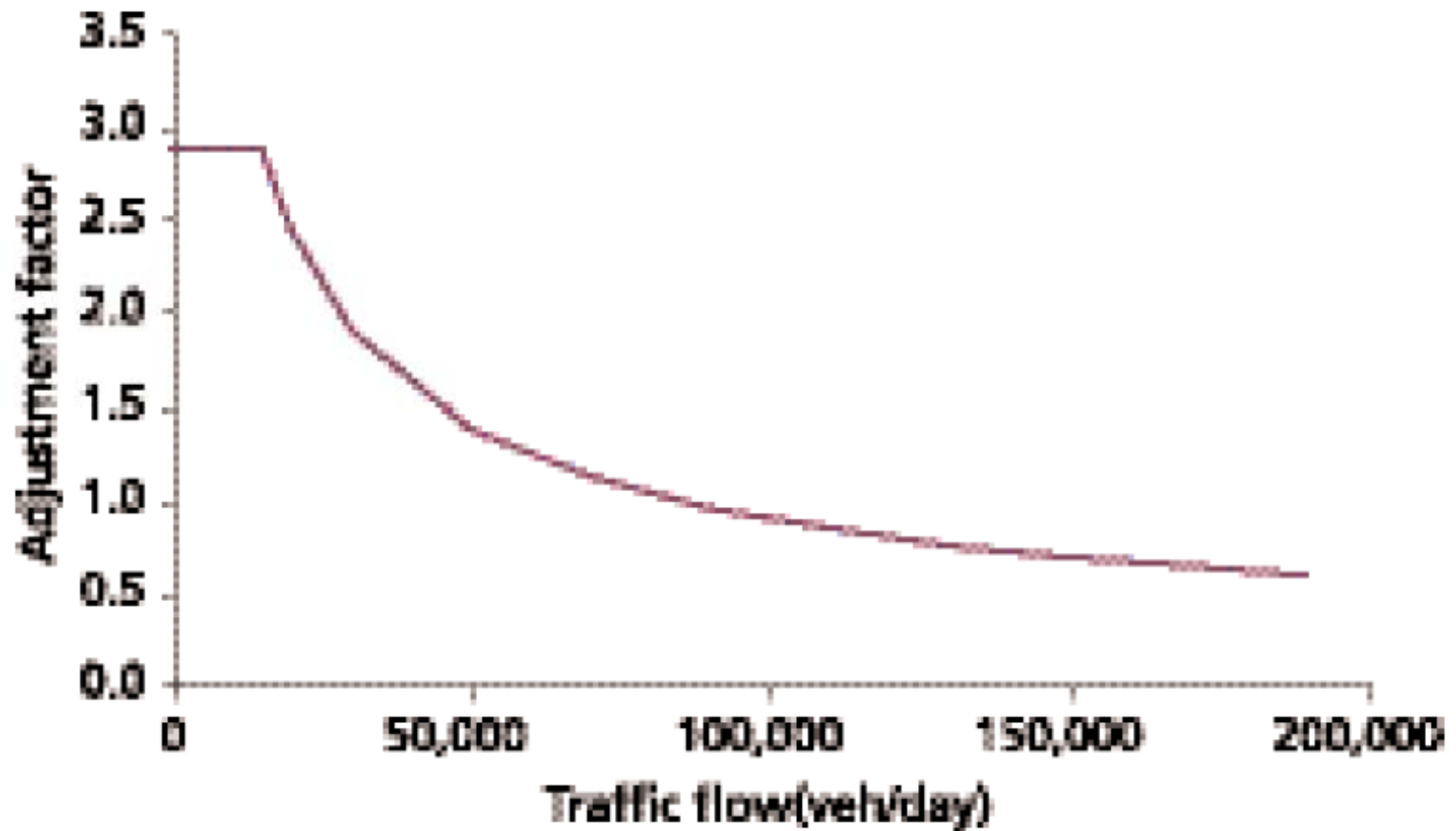
Road Model Verification

- **In general**
 - **Road NO_x component is under-predicted**
 - **The under-prediction depends on road type**
 - **Models perform well for fast moving traffic on open roads**
 - **Under-predict most for roads with slow moving traffic with buildings on either side**
 - **This is confirmed in national model development – AEA model and DMRB**

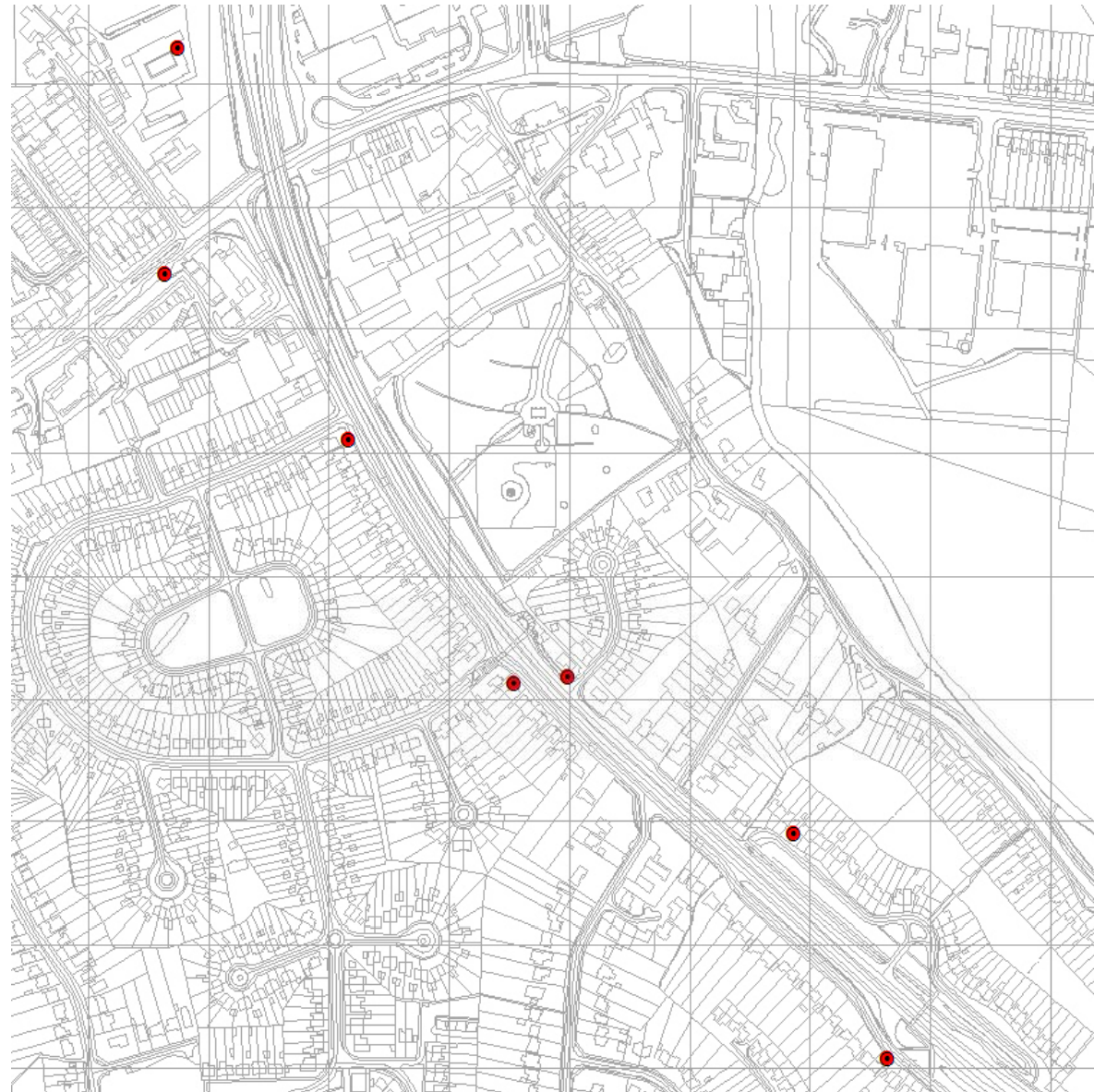
Adjustment Factors for AEA Roads Model



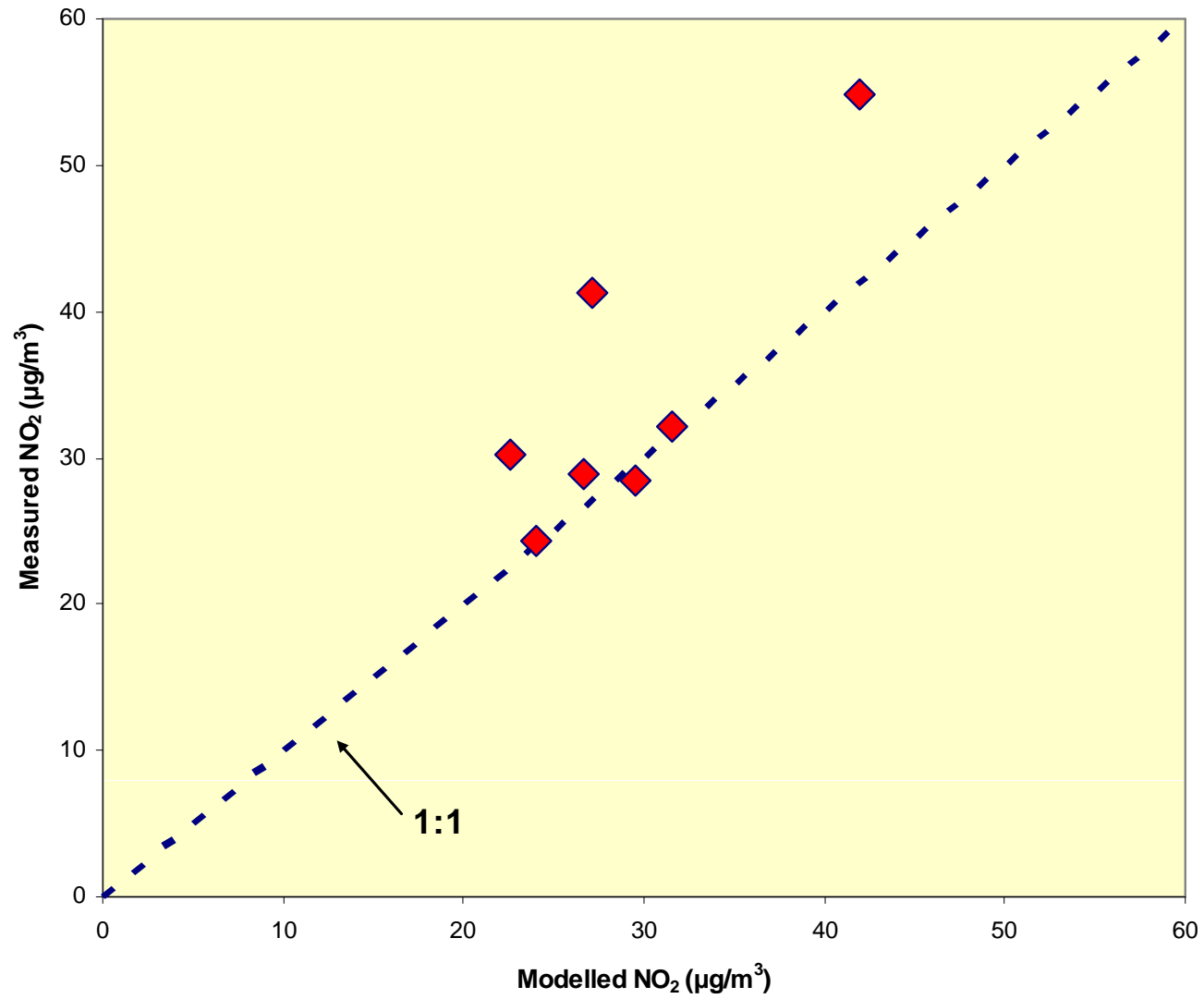
Adjustment Factors for DMRB Model



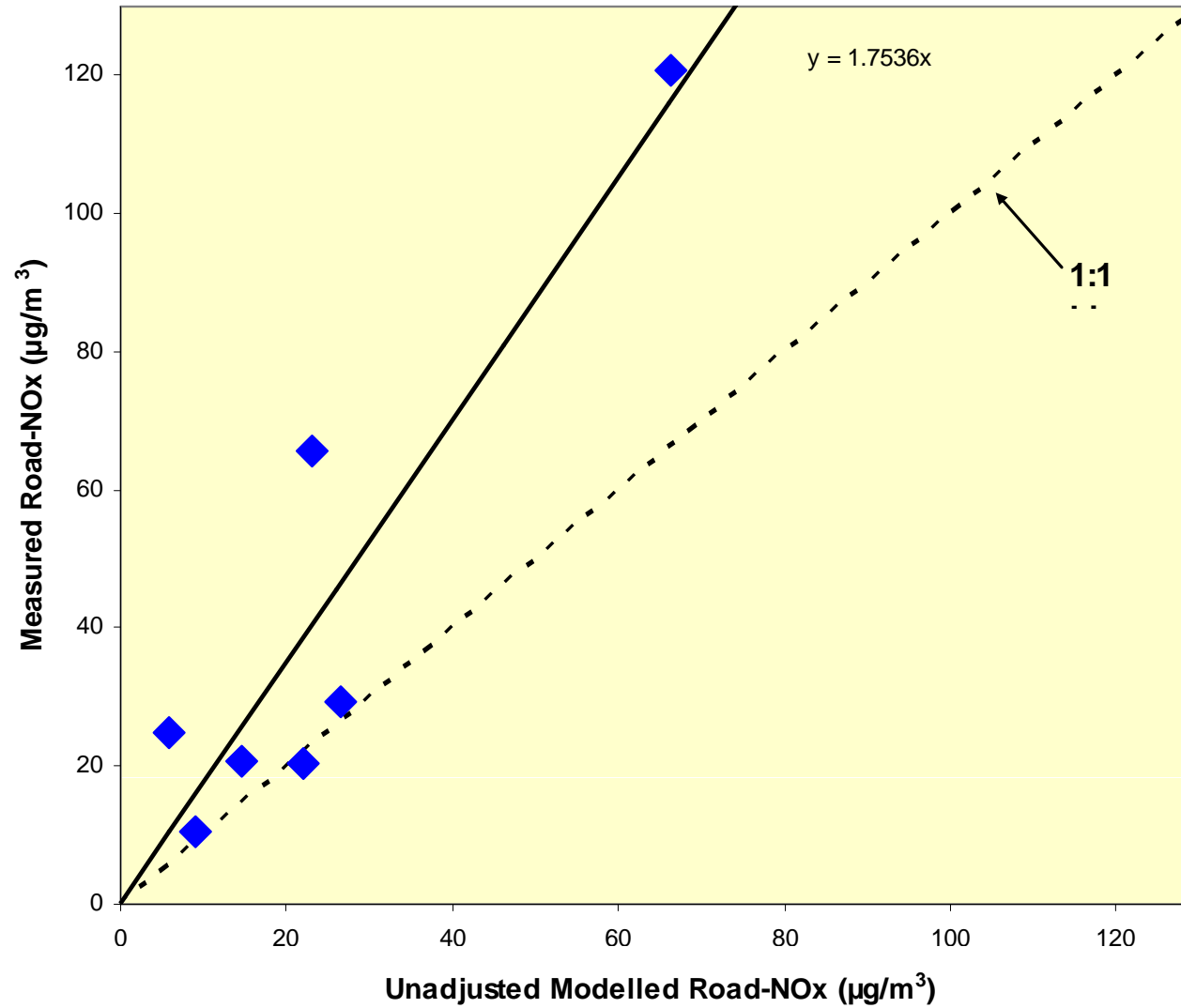
Typical Verification by AQC



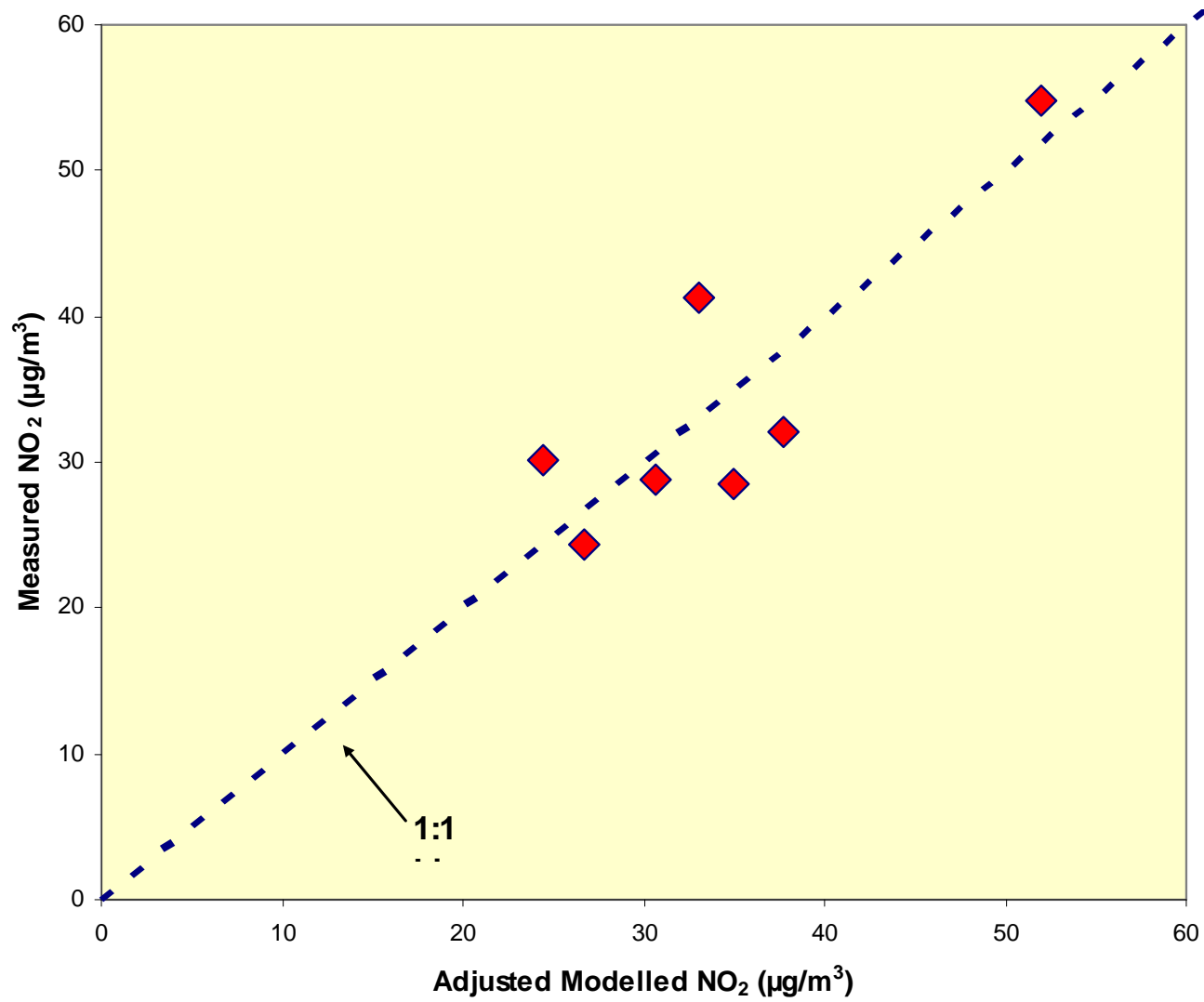
Typical Verification – No adjustment



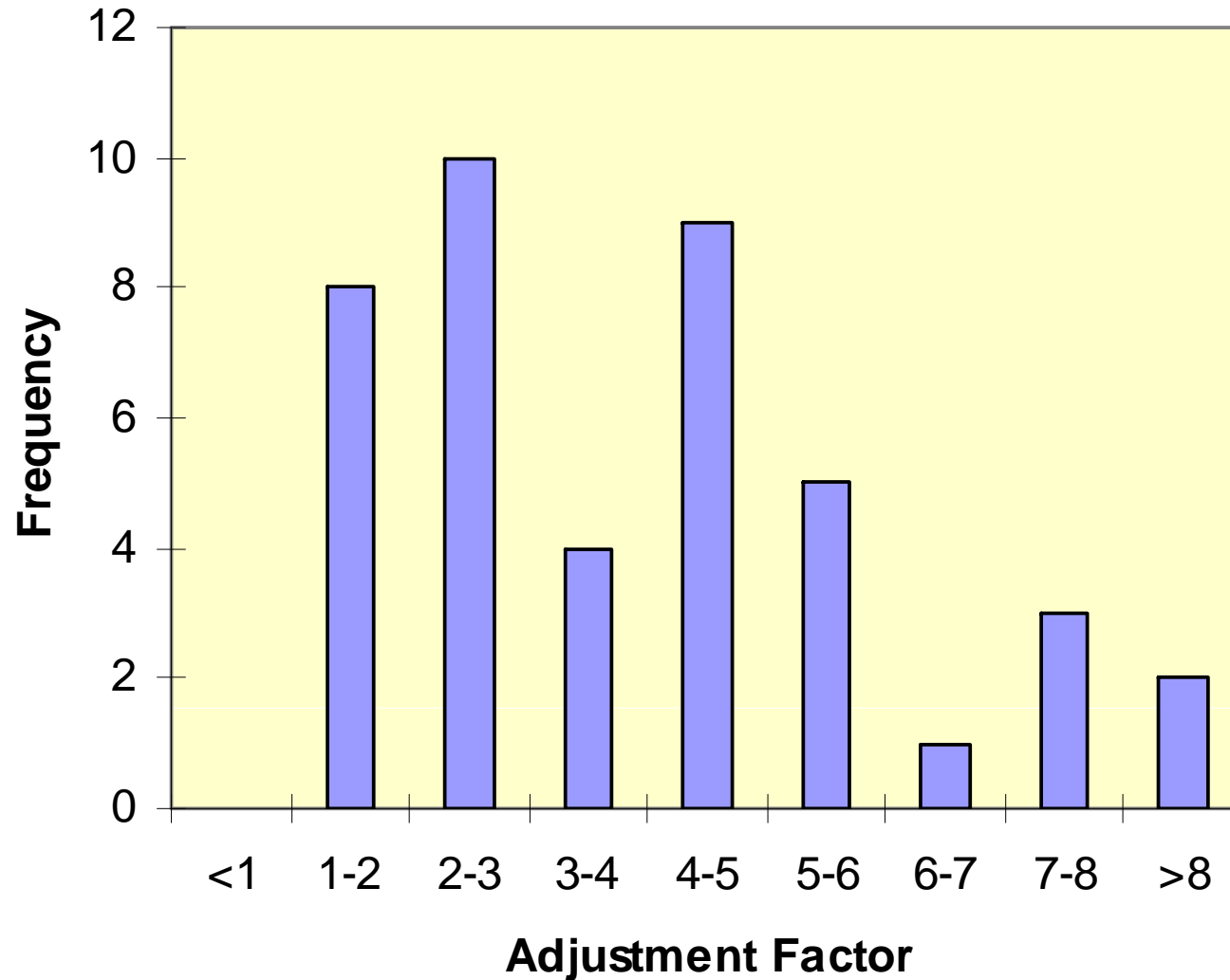
Typical Verification – Road NOx



Typical Verification – Total NO₂



Road NO_x Adjustment Factors in 40 Recent AQC Studies





Conclusions

- **The key message is that road models must be verified and adjusted to give reliable results**
- **This is experience of AQC using both Caline 4 and ADMS Roads**
- **It is the experience of most local authorities completing R&A reports - AQC has seen hundreds of these reports over many years**
- **My suspicion is that road models are getting dispersion in the near road environment wrong, by not adequately accounting for the influence of traffic speed (and possibly volume) and buildings near to the roads (not just canyons) on dispersion**



Contact details

Prof. Duncan Laxen
Air Quality Consultants Ltd

0117 974 1086

DuncanLaxen@aqconsultants.co.uk

www.aqconsultants.co.uk