

## Appendix 11.4 -Model Verification

1.1 The approach to model verification that LAQM.TG16 recommends for local authorities when they carry out their LAQM duties is summarised in Section 3. For the verification and adjustment of NO<sub>x</sub> /NO<sub>2</sub> concentrations, the guidance recommends that the comparison considers a broad spread of automatic and diffusion-tube monitoring. ADC monitors roadside NO<sub>2</sub> concentrations passively using diffusion tubes at three locations in the vicinity of the Application Site.

1.2 The concentrations monitored over recent years are provided in Table 11.4.1.

**Table 11.4.1 Measured Annual-mean NO<sub>2</sub> Concentrations (µg.m<sup>-3</sup>)**

| Monitoring Site | Measured Annual-mean NO <sub>2</sub> Concentrations (µg.m <sup>-3</sup> ) |      |      |      |
|-----------------|---------------------------------------------------------------------------|------|------|------|
|                 | 2016                                                                      | 2017 | 2018 | 2019 |
| Bog21           | -                                                                         | 26.5 | 29   | 26   |
| Bog18           | -                                                                         | -    | 21   | 18   |
| Bog10           | 25.8                                                                      | 25.5 | 25   | 20   |

1.3 Ideally, any model verification study should use background concentrations, emissions factors and meteorological data relating to the same year. On that basis, the model verification study has been undertaken using meteorological data and measured data (the most recent available) collated in 2019 with emissions factors and traffic data from 2019

1.4 The monitored annual-mean NO<sub>x</sub> road contributions have been derived from the monitored annual-mean NO<sub>2</sub> concentrations using the LAQM.TG16 calculator. The monitored annual-mean NO<sub>x</sub> road contributions have then been compared with the modelled annual-mean NO<sub>x</sub> road contributions. This comparison is provided in Table 11.4.2.

**Table 11.4.2 Comparison of Monitored and Modelled Annual-mean Road NO<sub>x</sub> Contribution (µg.m<sup>-3</sup>)**

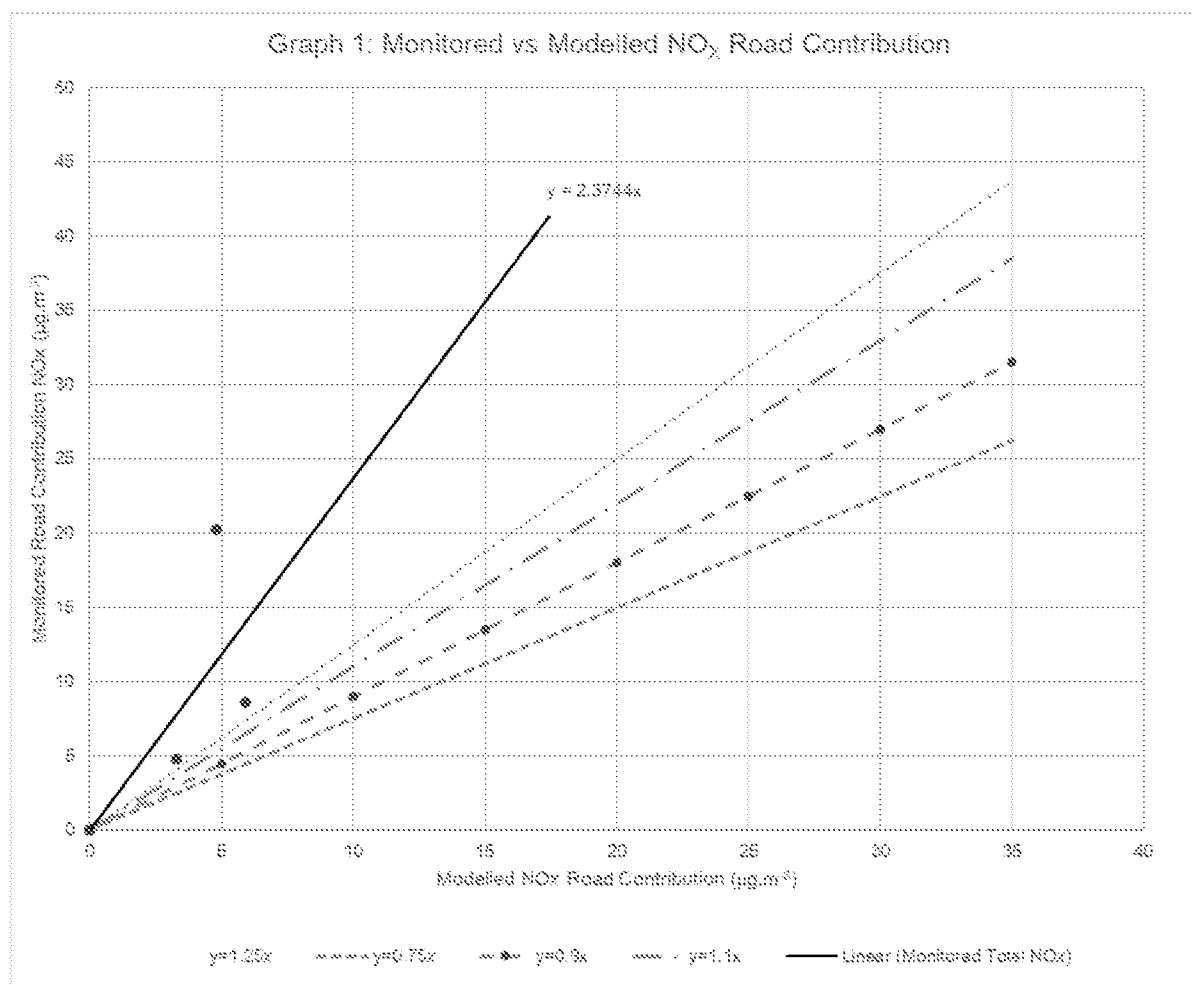
| Monitoring Site | Annual-mean Road NO <sub>x</sub> Contribution (µg.m <sup>-3</sup> ) |          |
|-----------------|---------------------------------------------------------------------|----------|
|                 | Monitored                                                           | Modelled |
| Bog21           | 20.26                                                               | 4.81     |
| Bog18           | 4.81                                                                | 3.30     |
| Bog10           | 8.58                                                                | 5.92     |

1.5 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 [1] designates passive NO<sub>2</sub> samplers indicative measures with a potential uncertainty of +/-30 %. Ignoring any uncertainty errors in the monitoring results, Table 11.4.2 above indicates that the model is

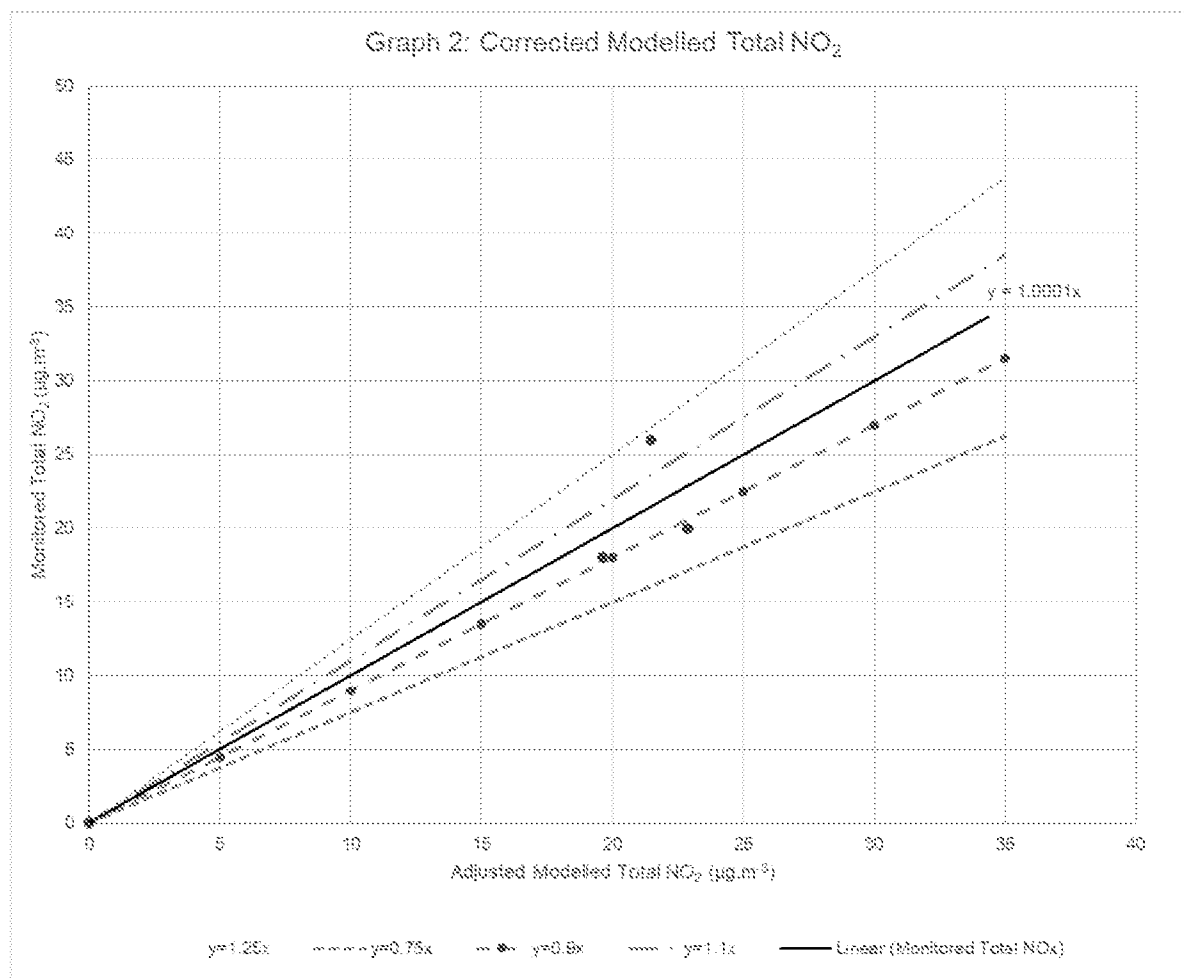
<sup>1</sup> Council Directive 2008/50/EC of 21 May 2008 on ambient air quality and cleaner air for Europe

under-predicting.

- 1.6 The modelled annual-mean NO<sub>x</sub> road contributions have been plotted against the monitored annual-mean NO<sub>x</sub> road contributions in Graph 1.



- 1.7 The modelled NO<sub>x</sub> contributions have been multiplied by the gradient of the trend line (2.3744) to determine the corrected NO<sub>x</sub> contributions. Modelled annual-mean NO<sub>2</sub> concentrations have been derived from the corrected modelled annual-mean NO<sub>x</sub> road contributions. The corrected modelled annual-mean NO<sub>2</sub> concentrations have been plotted against the monitored annual-mean NO<sub>2</sub> concentrations in Graph 2.



1.8 The corrected modelled annual-mean NO<sub>2</sub> concentrations are all within 25% of the monitored annual-mean NO<sub>2</sub> concentrations. The correction factor therefore improves the modelled concentrations and has been applied to all predictions used within the assessment.

1.9 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:

$$\frac{(\text{Average Monitored NO}_x \text{ Concentration} - \text{Average Predicted NO}_x \text{ Concentration})}{0.5 \times (\text{Average Monitored NO}_x + \text{Average Predicted NO}_x \text{ Concentration})}$$

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.

1.11 Table 11.4.3 sets out the average monitored concentration and the average predicted concentration.

**Table 11.4.3 Comparison of Monitored and Adjusted Modelled Annual-mean Road NO<sub>x</sub> Contribution (µg.m<sup>-3</sup>)**

| Monitoring Site | Annual-mean Road NO <sub>x</sub> Contribution (µg.m <sup>-3</sup> ) |                    |
|-----------------|---------------------------------------------------------------------|--------------------|
|                 | Monitored                                                           | Corrected Modelled |
| Bog21           | 20.3                                                                | 11.4               |
| Bog18           | 4.8                                                                 | 7.8                |
| Bog10           | 8.6                                                                 | 14.1               |
| <b>Average</b>  | <b>11.1</b>                                                         | <b>11.2</b>        |

- 1.12 The fractional bias for this study is therefore  $(11.2 - 11.1) / (0.5 \times (11.2 + 11.1)) = 0.010$ . As the fractional bias is close to zero, the adjusted model is performing well.