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Dear Lynne

REVERIFICATION REPORT

In the Stage 3 Assessment carried out by netcen for Ballymoney Borough Council in December 2003, ADMS was used to model PM_{10} and SO_2 concentrations at areas of significant domestic solid fuel combustion. At the time of modelling local monitoring data was not available for Ballymoney Borough Council and so bias adjustment of the modelling was made using a correction factor from a study at Carrickfergus. Since the assessment, Ballymoney Borough Council have undertaken monitoring of PM_{10}, using a Beta Attenuation Monitor (BAM) analyser, and as of January 2005 have sufficient data for a local verification and bias adjustment exercise. Netcen were commissioned to undertake this exercise. This verification work completes the Stage 3 assessment for this source and determines whether there is a requirement for an Air Quality Management area in Ballymoney Borough Council.

We have now completed the additional verification work that forms part of your Stage 3 Review and Assessment and this letter report details the work undertaken and our recommendations.

Monitoring

Monitoring data used in the verification of this modelling was obtained using a Met One BAM model 1020. The data was supplied to netcen by Ballymoney Borough Council. The data had undergone quality control procedures by a third party (NPL). NPL comment that the ambient data appear high in comparison to other data commonly seen throughout Northern Ireland. Whether this is an artefact of the measurement method, or a true indication of PM_{10} concentrations in a predominantly solid fuel burning residential area, is not clear. NPL's comments on the ratified data set are provided in Appendix 2. The question of BAM's producing high data has further been explored in the Air Quality Expert Group (AQEG) draft report 'Particulate Matter in the UK' (2004). For the model verification detailed in this letter report we have followed the LAQM.TG (03) guidance that states that BAM data is suitable for model verification at the detailed assessment level in review and assessment.

A summary of the calender year 2004 of monitoring data is provided in appendix 1. The annual average is 37 $\mu g\ m^3$. There were 56 monitored exceedances of the daily objective of 50$\mu g\ m^3$. Data Capture was 70.2%, which is below the recommended 75%. Much of the missing data is during the summer periods, data capture over the winter coal burning periods is relatively good.

Background concentrations

The background concentration is taken from the netcen maps as 14.4μg m^3. This is then corrected to an estimate of the 90.4 percentile of daily means by multiplying by a factor of 1.68.

Background = 14.4 * 1.68 = 24.2μg m^3

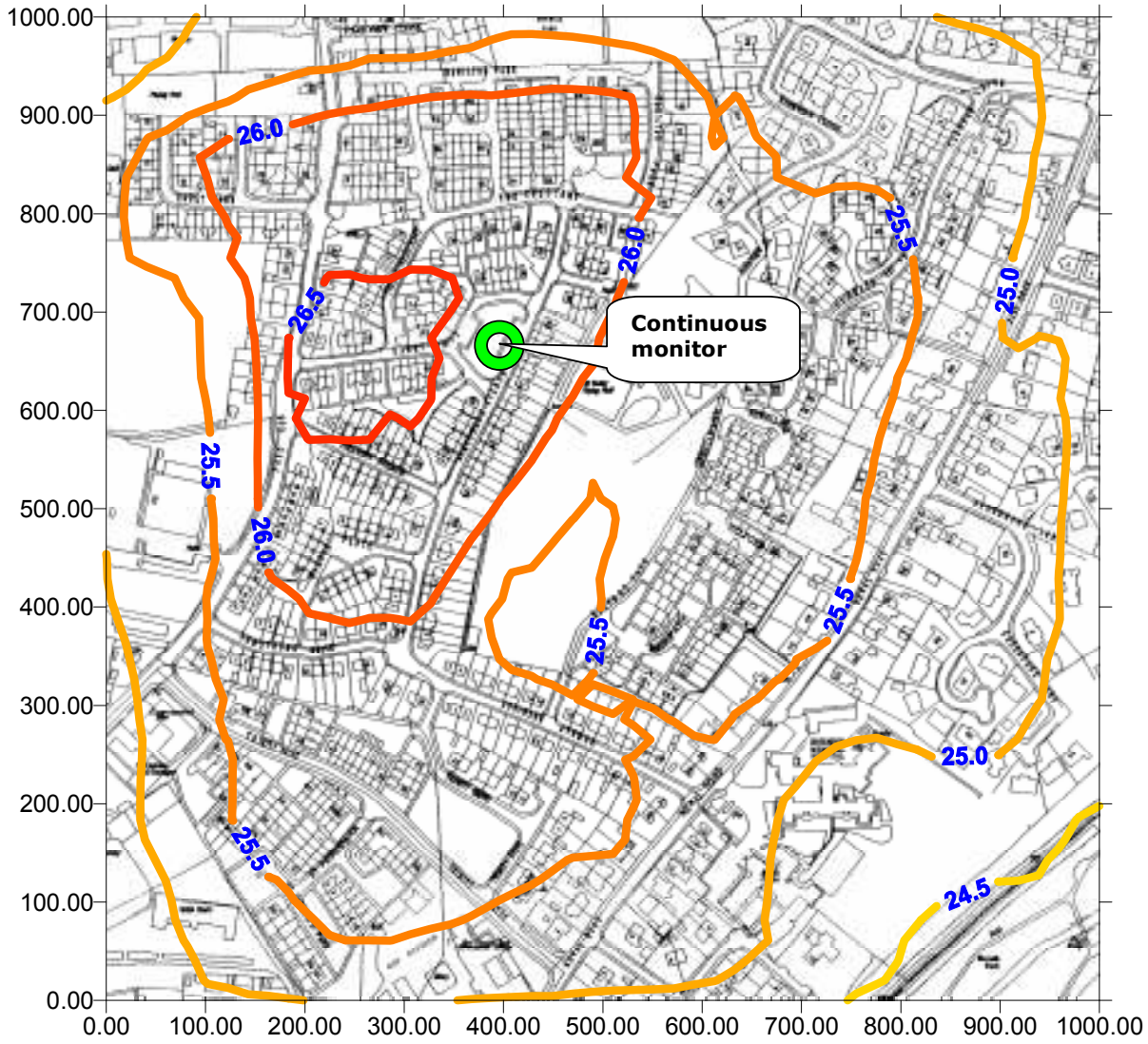
This background component is added into the modelled concentration (we appreciate that this is highly conservative).

Modelling

The bias correction originally applied to the Stage 3 model output has been removed. The raw model output can then be considered in combination with the newly available monitoring data.

The model output, without verification, is shown in Figure 1. The location of the BAM continuous monitor is shown. The background component, 24.2μg m^3, is included in this contour plot.

Figure 1 – Predicted 2004 90.4 percentile daily mean PM_{10} concentrations for the Glebeside Estate area, no correction applied for monitoring data (μg m^3)



The process of verification considers the concentration predicted by the model at the location of the continuous monitor. This modelled concentration is compared with the concentration actually monitored. An adjustment is then made, based on this comparison, of the modelled concentration, so that the modelling is brought in line with the monitored concentration.

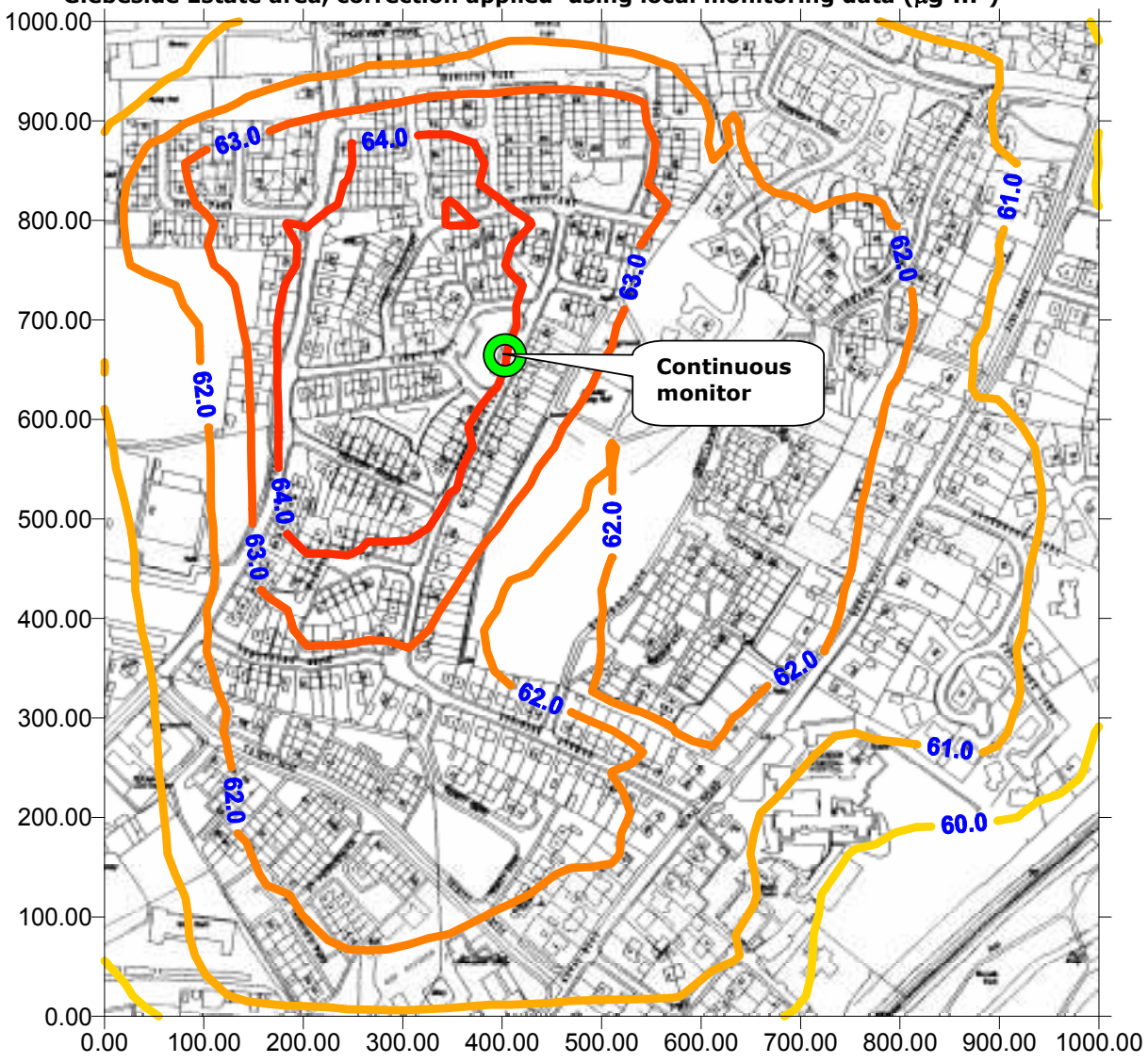
The monitor recorded a 90.4%ile of daily means of 64μg m^3. The model predicts a concentration, at that same location, of 26.3μg m^3. In order to adjust the model to reflect the concentration modelled by the BAM we need to apply a correction factor to all the modelled results. Calculation of this bias correction factor is given in Table 1.

Table 1 – Bias correction calculation

Monitored Concentration	64 μg m^3
Modelled Concentration	26.33 μg m^3
Bias Factor	B
B	= 64/26.33
B	= 2.43
Check	26.33 x 2.43 = 64 (ok)

The model is underpredicting when compared to monitored concentrations. The bias factor to be applied to the modelled results is 2.43. The model output therefore has had this bias correction applied and a revised model plot is given in Figure 2.

Figure 2 – Predicted 2004 90.4 percentile daily mean PM_{10} concentrations for the Glebeside Estate area, correction applied using local monitoring data (μg m^3)



Results

The modelling, corrected using monitoring data, has predicted an exceedance of the PM_{10} daily objective across the modelled area.

Discussion

The concentrations across the area are particularly high. While we have modelled using a highly conservative method of estimating concentrations (adding percentiles) the modelled concentrations are much lower than that indicated from the automatic monitoring. There are two possible causes for this weak agreement between the modelled and monitored concentrations:

- The model is underpredicting the concentrations, this could be attributable to a number of factors such as;
  - Uncertainty in the fuel use profile
  - Incorrect dispersion parameters definition
- The monitoring equipment is over-reading concentrations

It is usually determined that the difference in agreement (between modelled and monitored) will be a factor not accounted for correctly within the model (error in the data inputs). Hence the importance of verification as part of review and assessment. However, as the monitored concentrations are unusually high (when compared to the national picture), it should be considered whether there may be a factor associated with the monitoring, resulting in higher data than the actual ambient concentrations.

Recommendations

We recommend the following steps for Ballymoney Borough Council in order to progress the review and assessment process:

Ballymoney Borough Council have monitored an exceedance of the PM_{10} 2004 daily objective in the relevant year, at a relevant location. Ballymoney Borough Council should proceed to declare an Air Quality Management Area (AQMA) for PM_{10}. Ballymoney should also carry out further, more detailed studies in order to better define the full extent and source apportionment of the exceeding concentrations. Such information can then be used for informing the action plan that will need to be compiled following declaration of an AQMA. It is also recommended that a co-location study be carried out with the existing BAM instrument and a Partisol to provide further information on the high PM_{10} concentrations recorded in Ballymoney.

The subsequent reporting required by Ballymoney Borough Council is therefore Declaration of an AQMA, submission of a draft action plan to relevant authorities, consultation on the plan and submission of a final action plan. Also, submission of a Review and Assessment Progress Report is required in April 2005.

Kate Haigh

Air Quality Consultant

Appendix 1

Air Pollution Report

Produced by netcen on behalf of Ballymoney Borough Council

BALLYMONEY
01 January to 31 December 2004

POLLUTANT	PM_{10} *
Number Very High	16
Number High	21
Number Moderate	541
Number Low	5431
Maximum hourly mean	334 µg m^{-3}
Maximum running 8-hour mean	193 µg m^{-3}
Maximum running 24-hour mean	137 µg m^{-3}
Maximum daily mean	133 µg m^{-3}
Average	37 µg m^{-3}
90.4%ile daily means	64 µg m^{-3}
Data capture	70.2 %

* PM_{10} in gravimetric units
All mass units are at 20'C and 1013mb

Pollutant	Air Quality Regulations (Northern Ireland) 2003	Exceedences	Days
PM_{10} Particulate Matter (Gravimetric)	Daily mean > 50 µg m^{-3}	56	56
PM_{10} Particulate Matter (Gravimetric)	Annual mean > 40 µg m^{-3}	0	-

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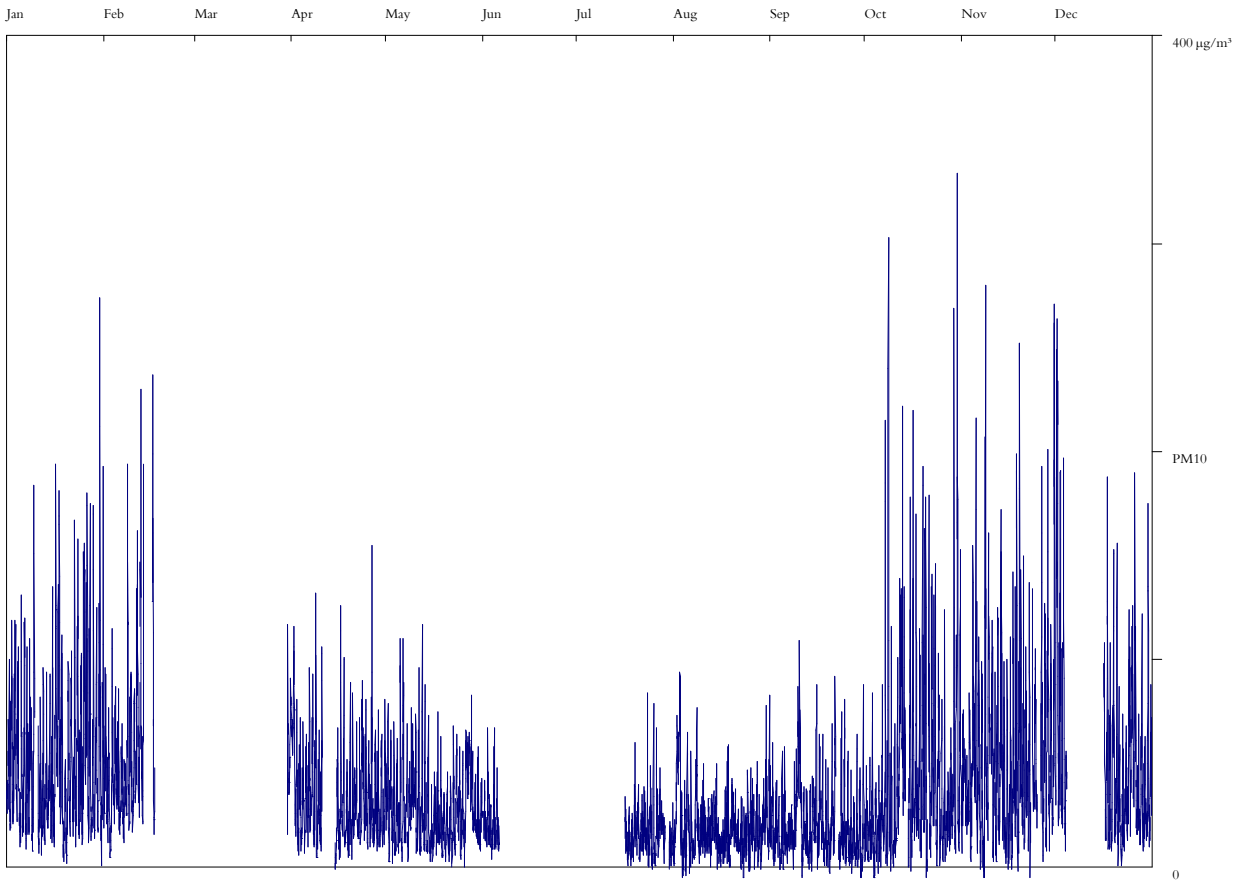
Air Pollution Report

Produced by netcen on behalf of Ballymoney Borough Council

Ballymoney Air Monitoring
Hourly Mean Data for 01 January to 31 December 2004



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Appendix 2

Lynne,

I attach a file containing the ratified data from January to December 2004. These data have been compiled in the absence of any instrument calibrations or service/repair reports other than those checks carried out by NPL.

The NPL checks have shown that the flow rate maintained by the analyser was within acceptable limits, and that the analyser sensitivity, when measured with an independent calibration plate, was correctly set. The instrument was not leaking. No data have, therefore, been lost as a result of issues to do with the analyser calibration.

As we have seen before, and has been noted previously, the ambient data seem high in comparison to those which are commonly seen throughout the United Kingdom, using TEOM analysers. Whether this is an artefact of the measurement method, or a true indication of PM10 concentrations in a predominantly coal burning residential area, is not clear.

As part of the CEN work on standardisation of particle monitoring methods, NPL have compared data from TEOM, BAM, and manual weighing samplers over a 16 week period (January to May 03) in Teddington. For daily average measurements, there was reasonable agreement between BAM and manual weighing methods, but the TEOM analyser under-read the manual method by approximately one half. Given these findings it is not surprising that higher concentrations were measured by your BAM analyser compared with network measurements using TEOMs. From the comparison with manual methods, though, it could be argued that the network data are too low.

While there are such large discrepancies between what are considered to be well tested measurement methods, it is clear that PM10 measurements have, at this stage, far larger uncertainties than we would hope for.

You will note that there are some data which are negative, down to -5 ug/m3. This, we believe, due to analyser noise. If these data were deleted, this would bias the resultant averaged data upwards. If -5 ug/m3 wre used as an offset this would have a larger systematic effect on the data. We believe that the most reliable way to treat these negative data, in the absense of any information to the contrary, is to assume they are due to signal noise at low concentrations, and as such to include them as we would other data.

The data summary is as follows:

Summary data for Ballymoney PM10 Automatic Monitoring Site for January to December 2004

Annual mean PM10 =	35.9 ugm-3
number of daily averages > 50 ugm-3 =	55
maximum hourly average =	334 ugm-3
maximum daily average =	129 ugm-3
data capture =	70 %

If you have any questions on this please contact me,

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