An assessment of the contribution of industrial emission sources to the declaration of an Air Quality Management Area (AQMA) in England and Wales

N. S. Leksmono[1], B. E. A. Fisher[2], J. G. Irwin[2], K. A. Ling[1] & J. W. S. Longhurst[1]
[1]*Air Quality Management Resource Centre, Faculty of Applied Sciences, University of the West of England, Bristol, UK*
[2]*Environment Agency, Risk and Forecasting, Reading, UK*

Abstract

Local authorities in England and Wales have completed the first round of air quality review and assessment. Nearly 130 of them have or will declare an Air Quality Management Area (AQMA). Most AQMAs are declared due to traffic emissions but there is also some contribution from industrial sources. This paper outlines the Air Quality Management process within authorities declaring such an AQMA by examining how the authorities managed the industrial sources and assesses their relationships with the Environment Agency of England and Wales. Results are presented from questionnaire surveys involving 105 local authorities, which are considered to have industrial sources contributing to air quality within their areas and the Environment Agency (area and region offices) where such authorities are located. Data indicate that industrial sources are a mostly insignificant contributor to air quality problems although a small number of local authorities identified such sources as a major contributor to the risk of exceeding air quality objectives.
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1 Introduction

This paper focuses on local authorities with problems arising from industrial pollution sources and explores the extent of the industrial contribution to local


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air quality problems. It investigates how local authorities managed such sources and their co-operation with the Environment Agency (hereafter referred to as the EA) as the regulator of the most polluting industrial processes in England and Wales.

A significant development in UK air pollution control has been the introduction of the concept of Local Air Quality Management (LAQM). This marked the move away from an air pollution control system that was exclusively based on emission standards, to a system that placed greater emphasis on ambient Air Quality Objectives (AQOs) [1]. Air quality at a national level is managed in line with the AQOs whilst at local level by using the concept of LAQM. The primary legislation regarding the LAQM is part IV of the Environment Act 1995. The Act also anticipated the EU Framework Directive 96/62/EEC on Ambient Air Quality Assessment and Management [2], which requires the introduction of legally binding air quality standards and assessment procedures to maintain and improve air quality within Member States. In the UK, it is the local authority who has the statutory powers to conduct a review and assessment of air quality and to declare an Air Quality Management Area (AQMA) where necessary (sections 82 and 83 of the 1995 Act) [3]. One of the Act's requirements is to publish an Air Quality Strategy (AQS) focusing on health based AQO for eight pollutants. Two national strategies [4, 5] have been published and followed by the Air Quality Regulations 1997 [6] and 2000 [7], which provide the legal framework for standards and objectives for seven pollutants, excluding ozone, and target dates for their achievements.

Since 1998 local authorities in the UK have been conducting a review and assessment of air quality. This includes the compilation of emissions data from transport, industries and other significant sources and as well as information on background concentrations of the seven pollutants, and monitoring and modelling to predict pollutant concentrations by their target dates. The first round of review and assessment ended in 2003 and resulted in nearly 130 local authorities declaring AQMAs [8]. Reports appraisal of authorities in England and Wales who have declared or anticipated declaring AQMAs have shown that over three-quarters of air pollution problems arise from traffic only sources and the remainder arise from either a combination of traffic and industrial sources, industrial only sources or other source(s) [9].

2 Methodology

The data presented here are drawn from a questionnaire survey undertaken in mid 2002. The population comprised all those local authorities that had declared or proposed AQMAs on the basis of stationary sources of the pollutant in question or considered to be affected by the sources. In addition, the EA offices where the authorities located were surveyed. The criteria to identify such authorities are discussed elsewhere [9]. Questions were designed to assess current LAQM practice in local authorities affected by industrial sources, including local governments' working relationships with the EA.

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The method chosen for this research was a mail survey because it is a targeted survey to a homogenous population and therefore a low response rate, which is potentially a weakness, can be minimised. Samples were carefully chosen and targeted through an appraisal of the UK national archive of air quality review and assessment reports. Questionnaire questions included open and closed questions. Rating scales with linear numeric scale were one component of the closed questions. In total 105 authorities were sampled and the response rates were 66% whilst for the EA, 73% response rate was achieved (average of area and regional offices). Main respondents within local governments were Environmental Health Officers whilst within the EA they were Process Industries Regulation Inspectors.

Pilot questionnaires were sent to a small subset of the sample population (local authorities and the EA) prior to the main survey, and the questionnaires amended in the light of the participants comments.

3 Results and discussion

Results will focus on technical and management aspects of the LAQM related to industrial sources including co-operation with the EA as well as presentation of more general results, unrestricted to the industrial sources of air pollution.

3.1 LAQM and industrial sources

Figure 1 illustrates pollutants monitored and modelled by local governments in relation to industrial sources. In addition to pollutants prescribed in the Air Quality Regulations 2000 [7], almost 6% of survey participants monitored $PM_{2.5}$ and more than 10% carried out ozone monitoring, even though these pollutants are not part of LAQM. The most monitored pollutants were NO_2, PM_{10} and SO_2, monitored by around 40% of authorities. From 69 responses received on this question, approximately 30% of authorities carried out continuous and passive NO_2 monitoring whilst for PM_{10} and SO_2, nearly all who monitored these pollutants used real time monitoring. One authority used passive monitor for PM_{10} and five for SO_2. The use of continuous and passive monitors in relation to industrial sources is comparable to that of urban authorities undertaking monitoring reported by Beattie *et al.* [10].

Air pollution modelling is one of the key tools in air quality management. Air quality objectives are set in terms of concentrations, not emission rates and therefore modelling allows prediction of ground level concentrations within certain locations by having knowledge of pollutant emissions and atmospheric conditions. Nitrogen dioxide and particulate (PM_{10}) were modelled by half of the surveyed local governments. The use of modelling has increased dramatically over the past few years. Only 4.4% of urban authorities were carrying out air quality modelling in 1994 [11] and the number had increased to 99% by 2001 [10]. This survey has shown that the percentages of NO_2 and PM_{10} modelling were even higher than the monitoring. One explanation may be due to the timing of questionnaire distribution, which was at the end of the first round

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of review and assessment. Local authorities declaring an AQMA would have acquired comprehensive information of emissions and monitoring data, and therefore were well placed to perform more modelling exercises to calculate and predict exceedences of AQOs at target dates in specific areas. Nevertheless, it is still important to continue monitoring activities in order to verify the results of modelling exercise.

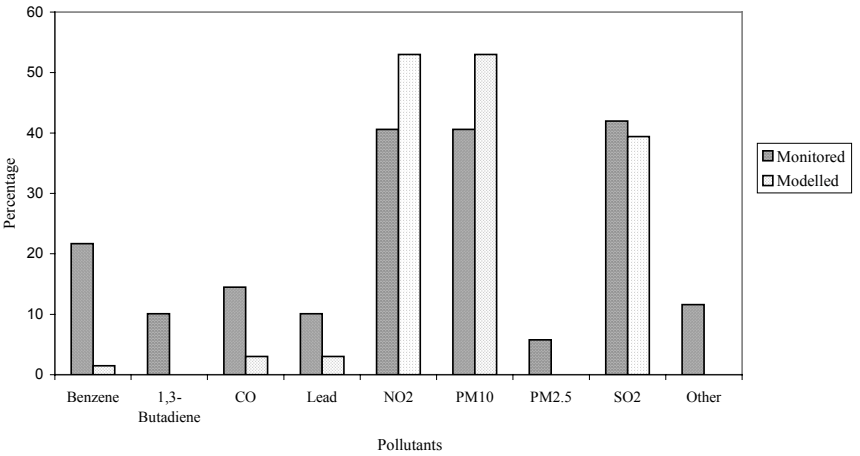

Figure 1: Pollutants monitored (n=69) and modelled (n=66) due to industrial sources.

A large majority of surveyed local authorities predicted exceedence of the NO_2 annual objective whilst around 40% predicted exceedence of the PM_{10} daily objective. Objectives of carbon monoxide, benzene, 1,3-butadiene and lead are currently not being exceeded in the UK. Table 1 presents objectives that were predicted to be exceeded by the target dates and the objective that was actually used as the basis of AQMA declaration. The NO_2 annual mean objective was used by 90% of survey participants as the basis of their AQMA declarations. There have been occasions where an authority has predicted exceedences of two different objectives but has only declared an AQMA for one. One of the reasons is because one objective has a larger area of exceedence than the other; thus it is more practical for the authority to declare an AQMA for the objective with the larger area.

Part IV of the Environment Act 1995 states the requirement to designate Air Quality Management Areas, as a result of air quality review and assessment, where AQOs are not likely to be achieved in areas of public exposure. There is no specific rule on AQMA spatial extent except that the area of exceedence is based on the outcome of review and assessment process, which provides the minimum size of AQMA. Table 2 presents the AQMA spatial extent chosen by surveyed authorities. Thirty-five percents of authorities declared larger AQMAs than the actual areas of exceedence and even designated AQMAs for the whole

authority area in several London Boroughs. Other spatial extent categories stated by participants included one authority predicting exceedence of SO_2 15 minute objective but not declaring an AQMA and a PM_{10} AQMA declaration around perimeter of an industrial area where public exposure was not thought to exist but was anticipated as part of a planning development. An AQMA is not required in the first case because the EA has advised local authorities that they should not declare AQMAs based on AQOs exceedences emanating from a single industrial source [12]. However, this only applies if the industry is the sole cause of the breach of the AQO and the EA then would require the industry to go beyond Best Available Technique (BAT) in order for the authority to achieve the AQOs. A local authority would still require an AQMA if an industrial source was partly responsible for the exceedence and other emission sources such as transport and other industries contribute to it. In this case, the EA would not require the industry to go beyond BAT. The second local authority, who declared an AQMA without current public exposure, based their argument on particulate monitoring which showed 118 exceedences (only 35 exceedences are allowed) in 1999. Prior to their declaration, the authority had discussions with the EA and came to an agreement about the need for this AQMA.

Table 1: Objectives exceeded and use as the basis of AQMA declaration.

Air Quality Objective	*Exceeded (%)* $^{(n=68)}$	*Basis (%)* $^{(n=68)}$
NO_2 1-hr mean	10	6
NO_2 annual mean	91	90
PM_{10} 24-hr mean	40	35
PM_{10} annual mean	16	12
SO_2 15-minute mean	7	4

Table 2: AQMA spatial extent.

Spatial extent	*Local authorities (%)* $^{(n=66)}$
Exactly where exceedence is predicted	17
As practically as possible to exceedence area	41
A whole authority declaration	9
Larger than exceedence area	35
Smaller than exceedence area	0
Other	3

Table 3 shows the main causes of AQMA declaration. It is clear that 'transport only' was the main cause whilst a combination between transport and

industrial sources was only stated by 6% of local authorities. Only two authorities declared AQMAs due solely to industrial sources. The source in one authority was a blast furnace that caught fire at the end of 2001. This furnace is to be rebuilt and undoubtedly will fulfil BAT requirements, hence the AQO exceedence has been addressed.

Table 3: Main cause of AQMA declaration.

Reason	*Local authorities (%)* $^{(n=68)}$
Transport	88
Transport and Industry	6
Industry	4
Transport and Domestic	2

Of the seventy authorities who responded to this survey, a small fraction identified industry as a sole or major contributor to a breach of one or more AQOs. The regulation of prescribed industrial processes is currently undergoing a major transformation from the Environmental Protection Act 1990 (part A and B processes) to the Pollution Prevention and Control Regulations 2000 (installations A1, A2 and B). This survey used the terms of part A (most polluting industrial processes regulated by the EA) and B (less polluting industrial processes regulated by local governments). Table 4 shows that PM_{10} from part B processes is the most common industrial contribution to AQO exceedence. In the UK, PM_{10} comes from a wide range of emission sources. These part B sources can be classified into primary particle emissions, which include small power generation plant and industrial processes, or coarse particles, which cover emissions from re-suspended dust from construction works and mineral extraction processes [13]. Further investigation is necessary to find out the actual sources of PM_{10}.

Table 4: Industry as a sole or major contributor to AQOs exceedences.

Pollutants	*Local authorities (%)* $^{(n=13)}$
NO_2 – part A	15
PM_{10} – part A	23
PM_{10} – part B	31
SO_2 – part A	23

3.2 Co-operation with the Environment Agency

One of the stakeholders in the LAQM process is the EA because of its status as one of the statutory consultees and its function to control the most polluting industrial processes. Local authorities may approach either area or regional offices. In this survey, the majority of authorities (72%) contacted their area

offices whilst 21% approached the regional offices and 6% contacted both. The EA is divided into 8 regions, which co-ordinate and provide technical and administrative support to the 26 area offices. On the other hand, the area offices are responsible for day-to-day management within their area [14] and thus have a closer relationship with local government.

In the questionnaires, the EA officers were asked what actions they would take if an industrial process was believed to contribute to an exceedence of an AQO. The results are summarised in Table 5. Over 80% of regional offices stated that they would conduct an air pollution modelling exercise and work with industry. Two thirds of officers would inform related local governments and half of them would ask the industry concerned to carry out modelling. With regards to area offices, almost all participants would work with an industry identified as the single cause of an exceedence. Under the PPC Regulations 2000 [15], an industrial operator needs to demonstrate to the regulators that their industry does not cause any harm to the environment. Thus, the EA and local authority can ask the operator to carry out air quality modelling in order to show no breach of AQOs arises from the industry.

Table 5: Role of Environment Agency offices in the case of air quality objectives exceedences.

Role	*Region (%)* $^{(n=6)}$	*Area (%)* $^{(n=11)}$
Inform affected LA	67	82
Conduct modelling	83	73
Industry to conduct modelling	50	82
Work with industry	83	91

The EA officers were then asked which pollutants from their regulated processes, were the most likely to contribute to the risk of an AQO exceedence (see Table 6). Sulphur dioxide is judged the most likely pollutant to give rise to the risk of AQOs exceedence for both region and area offices. According to region officers, SO_2 mean score was 1.57 compared to 4.00 and 3.57 (scale 1 = very significant to 5 = insignificant) for NO_2 and PM_{10} respectively. Local authorities were also asked to identify the effect of EA regulated processes on air quality in their area and the mean score for all pollutants is 4.0. This means the industrial sources regulated by the EA was considered to be relatively insignificant compared to the problem arising from transport sources.

The Environment Agency had been working with local governments in the first round of air quality review and assessment. There were several working relationships as described in Table 7.

The Environment Agency have produced working documents [16, 17] to fulfil their role as a statutory consultee in the AQS and to anticipate local authorities' requests and assistance with regards to industries they regulate. All offices played the role of statutory consultee and around 50% of officers from

each office were involved in declaring AQMA and as members of air pollution groups. Two thirds of regional offices helped local authorities in producing their action plans, which is a requirement under the Environment Act 1995 after an AQMA declaration.

Table 6: Importance of each pollutant to the risk of exceeding AQOs (scale 1 to 5, with 1 = very significant and 5 = insignificant).

Pollutant	*Region (%)* $^{(n=6)}$	*Area (%)* $^{(n=11)}$
Nitrogen dioxide (NO_2)	4.00	3.36
Sulphur dioxide (SO_2)	1.57	2.82
Particulate (PM_{10})	3.24	4.91

Table 7: Working relationships between the Environment Agency and local governments.

Relationships	*Region (%)* $^{(n=6)}$	*Area (%)* $^{(n=11)}$
AQMA declaration	50	67
Consultee	100	100
Air pollution group	50	56
Action plan	67	22

4 Conclusions

The purpose of this study was to evaluate the extent of contribution from industrial activities to local air pollution. Substantial improvement in controlling industrial pollution throughout the years as a consequence of national policy measures or European initiatives has resulted in industry no longer being the main source of air pollution. Although emissions from vehicles are significant for nearly all AQMA declarations in England and Wales, there are still a few areas where problems arise from industry. But it can be concluded that the significance of emissions from industrial sources is comparatively small when compared to transport related emissions. A greater number of authorities, even though not predicting a breach of AQOs because of industrial sources, still consider industry a major contributor to the exceedences identified. Industries identified were both part A, for NO_2, PM_{10} and SO_2 and part B, for PM_{10}. Of the three pollutants, SO_2 was considered the most likely to cause an exceedence. Local governments have been collaborating effectively with the EA as one of the key stakeholders in the LAQM process. It is very important to pursue these working relationships and investigate further the impacts of non-EA regulated processes, particularly those responsible for PM_{10} exceedences.

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