Guidance on Assessment under the EU Air Quality Directives

Final draft

Summary

This report gives technical guidance on how to assess air quality under the new EU air quality directives, in particular the Framework Directive 96/62/EC and the first Daughter Directive 1999/30/EC. The guidance is not given in the form of a recipe; the approach is to clarify which assessment outputs the directives require Member States to compile and report and to present possible assessment methods to generate this output. All reporting items are individually discussed. Methods are presented to designate zones, to measure concentrations, to determine the spatial concentration distribution in zones and to analyse the causes of air pollution problems. To make the necessarily very concise descriptions of the methods more concrete, an important place is given to practical examples of assessment methods that are already in use in Member States.

Note to the WG:
Responding to comments from the Air Quality Steering Group (during the meeting and in written form afterwards) and Working Group members, some changes compared to version V have been made. In addition, Frank Price has spent precious evening on improving the English. The final lay out (Commission's style) has not been applied yet. The changes can be identified using the WORD's Track Changes option. Three changes need some clarification:

- *A change has been made in reporting item 3.2.8 on reporting occurrences and reasons of individual exceedences of limit values. The original text proposed: "Reporting is done for all stations in zones with areas in exceedence, and not for stations in zones in compliance." So, also exceedences had to be reported for stations with levels in compliance. Finland is opposing this interpretation and it will probably not remain to be the only Member State. Another consideration is that it is not mandatory for Member States to report to which stations the reported exceedences belong. Obviously it would be rather useless to receive exceedence data without even knowing whether they belonged to stations in exceedence. A third consideration is that it would not be appropriate to ask Member States to specify the reasons of exceedence if the local levels are in reality in compliance. Fourth point: for LV for which no exceedences are allowed this provision would not apply, which might be regarded as inconsistent. Consequently we can expect that the Questionnaire will only ask exceedences of stations with levels about the LV+MOT. To avoid inconsistency between the Questionnaire and the Guidance I have changed the quoted sentence into "Reporting is done for all stations with levels in exceedence of the limit value plus the margin of tolerance."*

- *The sentence " It has to be noted that dust caused by erosion of roads due to the use of studded tyres is not included in this derogation." in Section 3.2.16 has been deleted. From an AQ management point of view, studded tyres (originally thought not to be a problem) logically fall in the same category as winter sanding, and if a debate on this would emerge in the future (as seems possible in view of Finland's reaction), possibly leading to a more differentiated conclusion, pre-emption by the Guidance document would be undesirable. The simple, straightforward clarification in the Guidance report, on the other hand, can be regarded as redundant and self-evident since the directive only mentions winter sanding.*

- *For the timetable for reporting required by the old directives, Table 3 referred to the Explanatory Memorandum of the proposal for the first Daughter Directive. Since this memorandum is difficult to find for the reader, and also since the memorandum contains other elements that have been amended later during the adoption process, the timetable has been copied and attached as Annex III.*

Contents

Foreword

The "Framework" Directive on ambient air quality assessment and management (96/62/EC) was adopted by the European Council in September 1996. The objectives of the Framework Directive are to:

- define and establish objectives for ambient air pollution in the Community designed to avoid, prevent and reduce harmful effects on human health and the environment as a whole;
- assess ambient air quality in Member States on the basis of common methods and criteria;
- obtain adequate information on ambient air quality and ensure that it is made available to the public inter alia by means of alert thresholds;
- maintain ambient air quality where it is good and improve it in other cases.

The Framework Directive obliges the European Commission to present proposals to Council for further legislation, which will fill in the basic structure that the Framework Directive establishes. The "first Daughter Directive" relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air (1999/30/EC) was adopted in April 1999. At the time of finalising this guidance report, the proposal for the second Daughter Directive on benzene and carbon monoxide had been just been adopted and the proposal on ozone was under discussion. Further proposals on arsenic, cadmium and nickel as well as on poly-aromatic hydrocarbons and on mercury are in preparation.

The Commission is being assisted in the technical work leading to proposals by the Air Quality Steering Group, in which Member States, Industry and NGOs and various other bodies participate. During the Steering Group Meeting of 8-9 February 1996 it was agreed that technical guidance should be developed to assist the competent authorities of the Member States in implementing the Framework Directive and subsequent daughter legislation.

Good air quality assessment is the key to implementation of the Framework Directive and daughter legislation. Articles 5 and 6 of the Framework Directive set out basic assessment requirements. Article 5 deals specifically with the initial identification of the levels of pollution (Preliminary Assessment), so that Member States can determine what the requirements for assessment in the individual zones are. A Guidance Report on Preliminary Assessment under EC Air Quality Directives has been finished in January 1998 and is available on the website of the European Environment Agency (Van Aalst et al., 1998).

Following the adoption of that document the Steering Group decided at its meeting in April 1998 that further assistance should be given to the Member States concerning ongoing air quality assessment under the Framework Directive and subsequent daughter legislation. This includes the requirements of Article 6, which requires Member States to:

- divide their territory into zones - whereby an agglomeration is a special type of zone - based on the results of the preliminary assessment according to Article 5;
- perform ongoing assessment requirements related to the levels of pollution within the zones.

This document details the scope and renders a synopsis of the air quality assessment reports required by the Framework Directive and subsequent Daughter Directives. By several examples guidance is given on the necessary steps to acquire the information to be forwarded to the European Commission.

Emphasis will be on those pollutants (SO_2, NO_2, particulate matter (PM_{10}), and lead) for which a Daughter Directive has been adopted. However, the methods are intended to be useful also for pollutants in forthcoming Daughter Directives.

Chapter 1 Introduction

1.1 Background

In recent years new EU air quality directives have been adopted: 96/62/EC (the "Framework Directive"[1]) and 1999/30/EC (the "first Daughter Directive"[2]) and several other daughter directives are to follow. These directives define the legislative basis for assessment and management of air quality in Member States. The Framework Directive gives general requirements and the Daughter Directives specify the requirements for the various pollutants in more detail. However, they are not technical manuals on implementation.

An important goal of the directives is that air quality be assessed and managed in a comparable way and on the basis of the same criteria in all Member States. The directives also require the Member States to report air quality to the European Commission and the public in the same way.

The aim of this document is to give guidance to Member States and authorities responsible for the establishment of an air quality assessment system in accordance with the directives. It gives guidance by interpretation and explanation of the main content of the directives, describing how existing assessment methods can be used and illustrates this by practical examples[3]. The target group for this document will typically be managers of the air quality monitoring systems in Members States, experts in the field of air quality assessment of governmental or local authorities and consultants. The document focuses on air quality assessment, which is one facet of the implementation of the directives. It is anticipated that guidance on other issues will be given later.

This guidance is not a textbook on basic assessment techniques such as measuring methods, models, and databases. These techniques can be learned from books, courses and practical experience; the Guidance on Preliminary Assessment (Van Aalst et al., 1998) gave an outline of these methods. This guidance will focus on how such techniques can be applied, improved and combined to assess air quality in the framework of the new directives.

1.2 Scopes of assessment

When considering the various reporting requirements on assessment in the Framework Directive and first Daughter Directive, we will see that a distinction can be made according to the scope of the assessment reports. Some reports concern *monitoring data only* - this is the current practice under the existing air quality directives and the Exchange of Information Decision and it is also required under some articles of the new Directives. Other reports require a more comprehensive assessment including a generalisation to territory-covering information: the *spatial distribution of concentrations*, such as maps. This is particularly the purpose of the introduction of "supplementary assessment methods" in the Daughter Directives. Full assessment also includes the analysis of the *causes of air pollution*; which are to be reported under the Daughter Directives for zones where levels exceed limit values.

1.3 Criteria for assessment systems

Before exploring the possibilities for an assessment system, it is important to list criteria to which such a system should conform:

1. *Conform to the Framework Directive and the Daughter Directive concerned*

This is the primary goal of the assessment described here.

2. *Suitable for use, processing and dissemination by the Commission and EEA*

For the Commission and European Environment Agency (EEA) to be able to communicate the information received to the Council, Parliament, Member States and the public, the information needs to be standardised

[1] Abbreviated as FWD in references in this guidance

[2] Abbreviated as DD1 in references in this guidance

[3] The guidance in this document is not a prescription but a recommendation, so the term "should" is avoided. To avoid continual reiteration of phrases like "it is recommended to write" the present tense ("write") is used, describing the recommended procedure.

as far as reasonably possible, to ensure completeness, to avoid ambiguities in data handling and to facilitate processing and presentation in statistics and maps. This guidance discusses the various types of reports needed, including the consequences for the assessment methods. Also it is very desirable to have as much consistency as possible in the system of designation of zones in the various Member States.

3. *Suitable for use by the Member States and/or the "zone authorities".*

For efficiency reasons advantage should be taken of the information that is needed at the national and local level.

4. *Suitable for public information*

For efficiency reasons the assessment results should include information that can also be (directly or indirectly) used for public information.

5. *Suitable for air quality management*

The assessment should provide to the local authorities, the Member States and the Commission the information needed for air quality management. This means that the assessment should go beyond mere description of pollution levels, and also provide insight in the *causes* of the pollution. (For management information on *solutions* is also needed, but this is not within the scope of this guidance.)

6. *Minimum duplication*

Besides the Daughter Directive concerned here, other legislation and international agreements require related data to be reported, in particular other (future) Daughter Directives, the Exchange Of Information Decision and the future National Emission Ceilings Directive. To minimise the reporting burden the data should as much as possible be mutually used.

7. *Attainable in practice*

In view of the large differences in conditions and experience between Member States it is important to avoid provisions that cannot be met by all Member States. This document does take a long-term perspective , but the focus is on possibilities that are attainable everywhere within a few years.

1.4 Output specification

The approach taken for the guidance is *output specification*. The results of assessment are described, but the choice of methods to achieve these results is left to the Member State. This was considered more appropriate than *specifying an assessment recipe*, which would mean defining in detail all steps to be executed by Member States to arrive at the desired results. To write such a recipe would be a very large task, but other drawbacks are even more important: a recipe-like specification of methods would put alternative systems that are currently in use in various Member States out of use, flexibility in the application would be difficult to accommodate and, finally, it would discourage the development of better methods.

To specify the output of air quality assessment, methods and reports of the results are described. The brief descriptions are illustrated by practical examples from Member States. The guidance report for the Preliminary Assessment (Van Aalst et al., 1998), giving detailed information on several issues, is an important starting point.

The new air quality directives take advantage of recent advances in air quality science and introduce assessment methods and concepts that have not been used before in legislation. These are not specified in any great detail, allowing insight in what is practically attainable to develop in time. Also the follow-up of this guidance is anticipated to be a dynamic process, in which stepwise improvements from year to year can be expected. The first step is to establish a system to assess and report air quality levels to the Commission and the public. Since the assessment methods will rapidly develop and consequently may change during the first stage, solid reporting on methods may lag somewhat behind.

Full consideration of uncertainties[4] is very important, but since even the concepts of uncertainty in assessment need scientific development, it is expected that full operational reporting of uncertainties will take even more time. Consequently the current guidance does not fully address these matters.

1.5 Structure of the guidance report

After the general introduction in Chapter 1, some elements of the directives that are known to be difficult to interpret are discussed in Chapter 2. Then, as the approach of this guidance is output specification, the reports to the Commission will be used to set the framework. Chapter 3 first lists the various types of reports that are

[4] In this guidance the term 'uncertainty' is preferred, following the convention recently recommended by CEN, as an equivalent to the term 'inaccuracy' which relates more directly to the use of 'accuracy' in the directives.

required under the Framework Directive and the first Daughter Directive (Section 3.1). In Section 3.2 the reports are individually described, identifying which items for reporting are needed as assessment outputs. In Chapter 4 the methods to generate the information for these reports will be described. Figure 1 sketches the approach. Chapter 5 gives some concluding remarks.

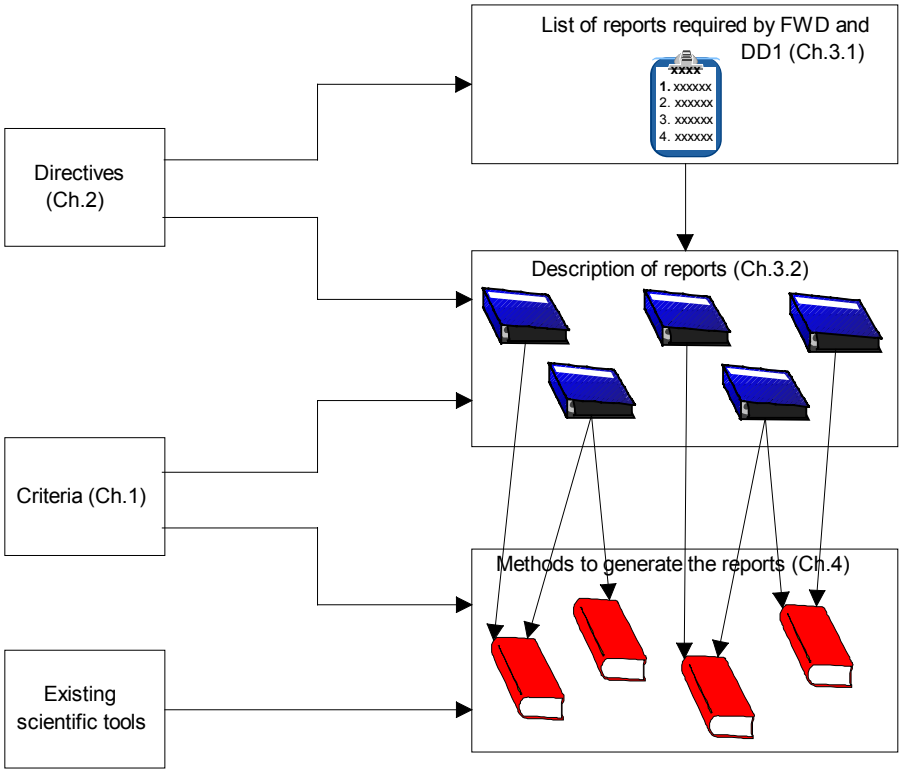


Figure 1 Approach and structure of the guidance report

Chapter 2 Elements of the Framework Directive and the first Daughter Directive

It is assumed that the reader of this guidance has studied both the Framework Directive and the first Daughter Directive. This chapter highlights some elements of these directives that are known to cause interpretation problems: margins of tolerance; the relationship between air quality levels and assessment requirements; assessment using models; the use of supplementary assessment methods and the starting date of the assessment under Article 6 of the Framework Directive. Other useful background information may be found in the Position Papers on SO_2, NO_2, Particulate Matter and lead (COM(500)97), which have been written by Working Groups under the Air Quality Steering Group to assist the Commission in the preparation of the first Daughter Directive.

2.1 Margin of Tolerance

The margin of tolerance is a new concept in EC legislation on air quality. Despite its name it is not a derogation from a limit value. It provides a trigger for action in the period before the limit value must be met.

As Figure 2 shows, the margin of tolerance is added to the limit value when the legislation setting the limit value comes into force. It is reduced each year to reach zero on the date by which the limit value must be met. It is important to understand that concentrations do not have to be kept below the margin of tolerance. Nor do they have to be reduced each year by the same amount as the margin of tolerance. The purpose of the margin of tolerance is simply to identify the zones with the worst air quality (Group 1 of Figure 2). Member States must prepare detailed action plans for these areas showing how the limit value will be met by the attainment date. These action plans must be made available to the public and sent to the Commission, which will monitor progress.

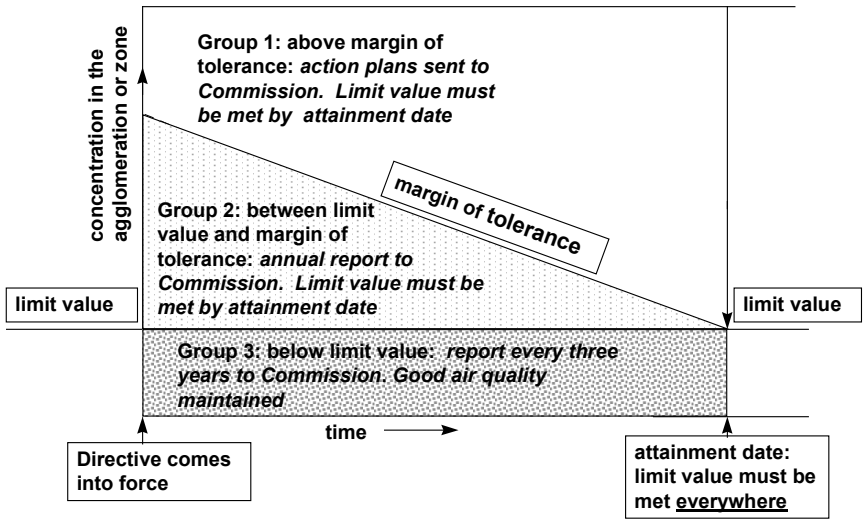


Figure 2 Schematic diagram of how reports to the Commission relate to exceedence of the limit value plus the margin of tolerance

Zones where maximum pollution levels are between the limit value and the limit value plus margin of tolerance (Group 2) are not required to forward detailed action plans to the Commission. But they must report concentrations annually to the Commission and must take any necessary steps to ensure that the limit value is met by the attainment date.

Member States' obligation therefore is to ensure that all zones with concentrations above the limit value during the period before the attainment date reach the limit value by the attainment date. The Commission will publish every year a list of the zones above the limit value plus the margin of tolerance, and zones above the limit value.

Zones where maximum pollution levels are below the limit value must maintain or continue to improve their good air quality. Under the Framework Directive the Member States will report to the Commission every three years.

All zones will also supply information on concentrations every year under the related Council Decision on exchange of information. The Commission, calling on the expertise of the European Environment Agency will publish a report every three years on the implementation of the legislation.

The effect of the margin of tolerance will therefore be to ensure that action is taken in problem areas well before the date by which a limit value must be met. The level at which it is set is important. If it were set too high, relatively few action plans will be made and problem areas may fail to take action soon enough. If it were set very low then zones which would easily meet limit values on current trends would waste effort and resources making detailed action plans. (If no margin of tolerance were set then all zones above the limit value would have to develop and forward detailed action plans to the Commission.) The information provisions will ensure that information is available at EC level on air quality throughout the Union, regardless of whether or not action plans are made for a particular area.

It should be noted that owing to a drafting problem, the margins of tolerance in Directive 1999/30/EC will decrease for the first time on 1 January 2001 – before the date by which the Directive must have been transposed by Member States (19 July 2001). This should not cause difficulties in practice. But it should be assumed on 19 July 2001 that all margins of tolerance are at the new lower level. This problem should not arise in future daughter Directives.

The figure shows the margin decreasing in a straight line. In practice, it decreases in steps, on 1 January each year. Annex II presents for each year the values of the limit value plus the margin of tolerance of the first Daughter Directive.

Finally it is remarked that the limit values and other thresholds of the "old" air quality directives on SO_2, NO_2, lead and ozone, including the reporting requirements, remain in force until the new ones take over.

2.2 Zones and assessment regimes

The new air quality directives oblige the Member States to divide their territories in zones. Zones are primarily units for air quality management, but the directives also specify assessment requirements per zone. These requirements depend on how far air quality levels are below a limit value. For each pollutant two thresholds are set in the Daughter Directives[5]: the upper assessment threshold (UAT) and the lower assessment threshold (LAT). The thresholds are lower than the limit value and are defined as percentages of the limit value. The assessment requirements in a zone depend on whether, in the preceding years, an assessment threshold is exceeded anywhere in the zone. In the first year of implementation of the Daughter Directive the assessment regime depends on the results of the Preliminary Assessment (Van Aalst, et al., 1998). If the UAT of a certain pollutant is exceeded, the most intensive assessment requirements apply for this pollutant; if LAT is exceeded, but UAT is not, slightly less intensive assessment requirements are prescribed; if the levels are everywhere below LAT the least intensive requirements apply. So, exceedence of the limit value does not determine the assessment requirements; it triggers air quality reporting and management actions. See Figure 2.

[5] The Daughter Directive on ozone, which does not set a limit value, takes a somewhat different approach.

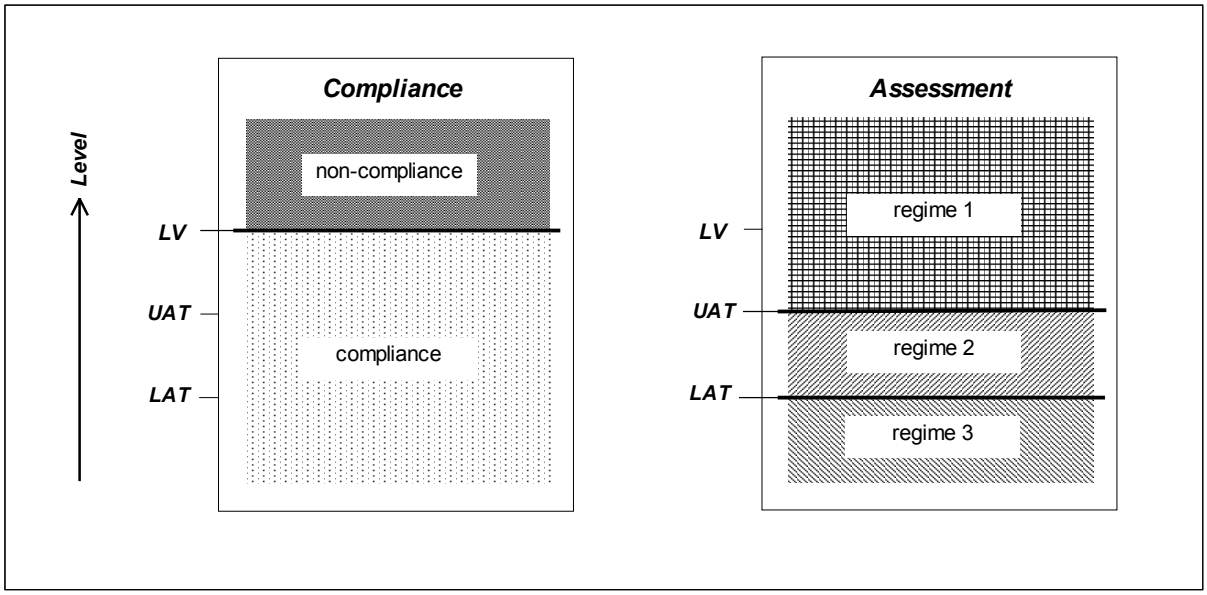


Figure 3 *Implication of exceedence of the limit value, the upper assessment threshold and the lower assessment threshold for compliance judgement and assessment requirements in a zone*

Table 1 summarizes the assessment requirements for the three assessment regimes.

Table 1 Air quality assessment and pollution levels

Maximum pollution level in agglomeration or zone	**Assessment Requirements***
Regime 1: Greater than the upper assessment threshold	High quality measurement is mandatory. Data from measurement may be supplemented by information from other sources, including air quality modelling.
Regime 2: Less than the upper assessment threshold but greater than the lower assessment threshold	Measurement is mandatory, but fewer measurements may be needed, or less intensive methods may be used, provided that measurement data are supplemented by reliable information from other sources.
Regime 3: Less than the lower assessment threshold	
a. In agglomerations, only for pollutants for which an alert threshold has been set**	At least one measuring site is required per agglomeration, combined with modelling, objective estimation, indicative measurements.
b. In non-agglomeration zones for all pollutants and in all types of zone for pollutants for which no alert threshold has been set	Modelling, objective estimation, and indicative measurements alone are sufficient.

* Data quality objectives are given in Annex VIII of the first Daughter Directive.

** In the first Daughter Directive this only applies to SO_2 and NO_2.

*** Indicative measurements are measurements using simple methods, or carried out for a restricted time. They are less accurate than continuous high quality measurement but can be used to explore air quality as a check where pollution levels are relatively low, and to supplement high quality measurement in other areas.

2.3 Air quality modelling

The Framework Directive and the first Daughter Directive introduce, for the first time in European air quality directives, the use of modelling in assessment and management of air quality. The Framework Directive refers in its preamble to "the use of other techniques of estimation of ambient air quality besides direct measurement", defines (Article 2) that assessment "shall mean any method used to measure, calculate, predict or estimate the level of a pollutant…" and then states specifically (Article 6) that modelling techniques may be used. The first Daughter Directive expands this by introducing the use of supplementary assessment methods (Article 6(3)), which is discussed in more detail in Section 2.4 of this guidance report. It also indicates data quality objectives for models, in terms of accuracy (Annex VIII).

It is clear that air quality models have an important place in air quality management. They are essential tools in the development of action plans for improving air quality, which is the ultimate goal of the Member States and local authorities in order to fulfil their obligations under the directives. Models improve the effectiveness of air quality management. Through models, the contributions to exceedences of limit values from various sources and source categories can be established.

Another main advantage to be gained from using models in assessment and management of air quality is that it enhances the ability to map the spatial distribution of the pollutant concentrations. By using models suitable for the scale and application in question, all scales (from regional background to city quarters and streets), may be mapped. This opens the possibility to relax on the measurement requirements (possibility to reduce the number of stations), and thus produce a more cost-effective, and yet complete, air quality assessment.

It is also clear that modelling has its important place in Preliminary Assessment. Based upon this, Member States will designate zones, and design measurement networks (i.e. (re)locate stations) in each zone. Knowledge about the spatial distribution of the pollutant concentrations in the zone is therefore required, and models are appropriate tools to obtain that information.

Thus the management aspect and the Preliminary Assessment requirement presupposes the use of models. The introduction of supplementary assessment methods in the first Daughter Directive has also created the possibility to use modelling in the assessment of compliance/non-compliance with limit values. The use of models for such compliance checking requires that the quality of the model and the calculations is sufficient to underpin whether a zone contains areas that are not in compliance. A more extensive discussion of compliance checking using models is given in Section 4.3.3.3.

2.4 Supplementary assessment methods

The first Daughter Directive makes a distinction between air quality assessment based on measurements alone and assessment that uses measurements and other techniques, such as emission inventories, indicative measurement methods and air quality modelling (Article 7(3)). This distinction was not made so clearly in the Framework Directive, but when the first Daughter Directive was developed it was felt appropriate to take into account the potential of supplementary techniques, which were gradually becoming more feasible, such as the combined use of measurements and models.

The first Daughter Directive introduced the use of supplementary methods for legislative purposes because such techniques will, in combination with fixed measurements, give considerably more information than measurements alone on for example: the spatial distribution of air quality levels; human exposure and risk and on the causes of air pollution. On this more extended basis, more rational and targeted action plans can be developed. For the first Daughter Directive, and also for this guidance document, it was difficult to give very concrete criteria on how to apply supplementary assessment methods. Assessment methods are described in Chapter 4, but more practical experience is needed before the uncertainty requirements for models can be made more concrete and operational. The use of supplementary assessment methods in legislation is new and needs considerable development in the next few years, and so it would not be appropriate to define here a too restricted framework. See also Section 4.3.3.3 on the status of modelled exceedences.

The number of stations given in Annex VII(I) is the legal minimum when fixed measurement is the sole source of information. If supplementary assessment methods are applied, Article 7(3) refers to the more indirect requirements on station density in Annex VI(I) and the data quality objectives (uncertainty requirements) given in Annex VIII(I). In view of the current state of the art, the Working Group expected that supplementary assessment methods will not often make it possible to reduce the number of stations to below the minimum specified in the table of Annex VII(I). From experience in Member States where such methods are already in use, the Working

Group felt that even a higher number of stations than this minimum might be needed in combination with an extensive application of supplementary assessment methods. In some cases, and more generally in the future when supplementary assessment methods will be more fully developed, a reduction in the number of fixed stations without compromising the quality of the assessment may become more feasible.

The framework of the reporting requirements was specified in the Framework Directive, at a time when the role of supplementary assessment methods was not yet clear. As a result, the Directives are not very clear on how the results of supplementary assessment methods should be reported. Annex VIII(II) gives an overview of the information that should be compiled, but it does not specify how to report it. One may well use results from the supplementary assessment methods as a basis for the annual reporting of the list of zones with areas in exceedence of the limit value, but as far as data are concerned, only measurement data are to be reported. So, the annual reports comprise only measurement data. The 3-yearly review of the levels is the most appropriate place for reporting the results to the Commission (see Section 3.2.18). In addition, however, a more frequent exchange of e.g. concentration maps may be arranged on a voluntary basis.

Extensive information on the use of mathematical methods is given in Sections 4.3 and 4.4.

2.5 The Questionnaire and the 'Article 12 Committee'

Article 12 of the Framework Directive requires that a Committee be established which has the explicit task to arrange the details of reporting to the Commission. At the time of finalising this guidance, the Commission was preparing a questionnaire to Member States to initiate this procedure. The questionnaire will have to be filled in and sent to the Commission on a yearly base by every Member State. In addition to mandatory reporting on zones out of compliance and on exceedences, it will include several voluntary items. This optional reporting is meant to support the Commission in the review required by Article 10 of the Daughter Directive. It covers items such as identifying responsible authorities, describing the definition of zones and reporting concentration levels in zones without exceedences etc. Since the Article 12 Committee will officially establish the details of the reports to the Commission, the description of the reports given in Chapter 3 of this guidance should be regarded as provisional.

2.6 Starting dates of the assessment

The Framework Directive and the first Daughter Directive do not clearly state which calendar year is to be the first full calendar year on which the assessment under Article 6 has to be reported: 2001 or 2002. The reporting structure of the directives assumes that reporting is for complete calendar years. The Air Quality Steering Group has recommended that Member States should if possible begin their new systems of assessment in January 2001 in order to be able to report for the full year 2001. Where this is not possible, Member States should supply all relevant data available for the period 19 July 2001 to 31 December 2001.

Regarding the first three-year reporting period (FWD Art. 11(1c)), the Air Quality Steering Group has recommended that the first reporting period would last from 2001 to 2003. The first reporting deadline would then be 1 October 2004. A more definite specification of this can be expected from the Article 12 Committee.

It should be pointed out that the existing limit values for SO_2, NO_2, Total Suspended Particles and lead as defined under Council Directives 80/779/EEC, 82/884/EEC and 85/203/EEC are still valid until the date when the new limit values actually come into force (2005 or 2010). Until then, Member States will continue to have to report on their compliance with the "old" limit values, as stated in Article 9 of the first Daughter Directive. During this time period the new limit value or limit value plus margin of tolerance will have the more restricted function described in Chapter 3.1.

Chapter 3 Air quality assessment reports

3.1 Overview of reporting requirements

Table 2 describes six categories of information to be reported to the Commission. This guidance does not discuss the items relating to management and administrative information. Reporting on Preliminary Assessment is not included in the table. Section 3.2 discusses the reporting of items related to assessment and the methods to generate the information are described in Chapter 4.

Table 2 ***Types of information to be reported to the Commission***

Types of information to be reported	
Monitoring data	***Subject of this guidance***
Spatial concentration distribution	
Causes of pollution	
Documentation of assessment methods	
Solutions to air quality problems and action plans	
Administrative information on implementation	

Table 3 lists all the items that Member States are required or implied to report by the Framework Directive and the first Daughter Directive. The table arranges the items in clusters according to the time schedule for their reporting. The items within each cluster could be combined into one report.

It is noted that reporting of air quality data at the EU level is not restricted to the reports under the Framework Directive and Daughter Directives. Under the Exchange of Information Decision 97/101/EC (EoI) complete sets of data from monitoring stations are annually reported to the Commission; in fact EoI is the framework for several of the reports under the Daughter Directives. In another framework, the EUROAIRNET set up by the European Environmental Agency, data are also reported; these reports are combined with the EoI reports.

Table 3 *Overview of information items to be reported*. (The items are grouped into possible reports)*

	Information to be reported	*Timetable*	*Section on reporting item*
1	**Information on implementation to the Commission**	**Before 19 July 2001**	
	Information on implementation		-
	Definition of zones**		3.2.1
	Implementation and responsibilities		3.2.2
	Text of transposition		-
2	**Report on Prelim. Assessment (PA) to the Commission**	**Before 19 January 2001**	
	Spatial distribution of levels found in the PA**		3.2.3
	Documentation of methods of the PA		3.2.4
3	**Information to the public**	**As soon as possible**	
	Summary of up-to-date levels	Depends on pollutant	3.2.5
	Exceedence of alert threshold		3.2.6
4	**Provisional Report to the Commission**	**Before 3 months after exceedence**	
	Exceedence of alert thresholds		3.2.7
5	**Annual report on ambient air quality to the Commission**	**Before 1 October of following year**	
	Occurrences and reasons of individual exceedences of limit values		3.2.8
	List of zones exceeding/not exceeding limit value or [limit value + margin of tolerance]		3.2.9
	Zones where the upper or lower assessment thresholds are exceeded**		3.2.10
	Statistics on threshold exceedence of 10-minutes averaged SO_2 concentrations		3.2.11
	If claimed: list of zones with exceedence due to natural SO_2 sources and justification		3.2.12
	Statistics on $PM_{2,5}$ concentrations		3.2.13
	Measuring methods employed for PM_{10} and $PM_{2,5}$		3.2.14
	If claimed: list of zones with exceedence of the PM_{10} limit value due to natural events and justification		3.2.15
	If claimed: list of zones with PM_{10} exceedence due to winter sanding of roads and justification		3.2.16
	Definition of zones and documentation of any modification**		3.2.1
	Documentation and results of supplementary assessment methods		3.2.17
6	**3-year report on ambient air quality to the Commission**	**Before 1 October every 3 year**	
	Review of levels in all zones and agglomerations		3.2.18
	Reduction plans and progress		-
7	**Documentation of network**		
	Documentation and review of network		3.2.19
8	**Additional measures, any use of other then EU thresholds**	**When appropriate**	
	More stringent measures than required by EU directives		-
	Other (additional or more stringent) air quality thresholds than EU		-
9	**Reports to the Commission as required by the old directives**	***	

* DD1 (An.VIII.I and IX) states in addition that Member States need to demonstrate the accuracy of the results of random measurements and of the equivalence of any non-reference measuring methods they use. This is not discussed in this guidance.

** Reporting of this information is not required by the Directives, but is deemed to be implied.

*** See the specification in the first Daughter Directive and Annex III of this guidance report.

3.2 Air quality assessment items to be reported

In this section an overview is given of the assessment related items that Member States have to report under the Framework Directive and the first Daughter Directive, following the list in Table 3. A detailed description of the report is not given. For each reporting item a short clarification of methods is given, often in the form of one or more references to sections of Chapter 4 where the methods to generate the information to be reported are described.

3.2.1 Definition of zones

Specification in the directives
FWD (Framework Directive), Article 2:

- " 'zone` shall mean part of their territory delimited by the Member States"
- " 'agglomeration` shall mean a zone with a population concentration in excess of 250 000 inhabitants or, where the population concentration is 250 000 inhabitants or less, a population density per km^2 which for the Member States justifies the need for ambient air quality to be assessed and managed."

The directives do not pose formal limitations to zone definitions, so the geographical definition is up to the Member States. An agglomeration is a special type of zone.

Timetable
The directives do not explicitly specify the reporting of the delineation of zones. Since the directives specify the assessment requirements per zone, the zones in a country should already be defined in the Preliminary Assessment, before the implementation date of the Daughter Directive (see Section 2.6). If the first full year of assessment is 2001, the zones need to be formally defined before the end of 2000. However, to allow time to install monitoring equipment in conformity with the assessment requirements, earlier designation of zones can be necessary.
Changes of zone definitions apply only to the turn of the year (no mid-year changes).

Information to be reported
The form of reporting is a matter for the Article 12 Committee. The zones are specified in such a way that for each point within the territory of a Member State it is simple to unambiguously determine to which zone it belongs.

Methods to define zones: see Chapter 4, method type 1.

3.2.2 Implementation and responsibilities

Specification in the directives
FWD Article 11.1: "Member States shall notify to the Commission the competent authorities, laboratories and bodies referred to in Article 3 …"
FWD Article 3: "For the implementation of this Directive, the Member States shall designate at the appropriate levels the competent authorities and bodies responsible for:
- implementation of this Directive,
- assessment of ambient air quality,
- approval of measuring devices (methods, equipment, networks, laboratories),
- ensuring accuracy of measurement by measuring devices and checking the maintenance of such accuracy by those devices, in particular by internal quality controls carried out in accordance, inter alia, with the requirements of European quality assurance standards,
- analysis of assessment methods,
- co-ordination on their territory of Community-wide quality assurance programmes organised by the Commission.
When they supply it to the Commission, the Member State shall make the information referred to in the first subparagraph available to the public."

Timetable
Before 19 July 2001.

Information to be reported
See the specification in the Framework Directive given above.

Methods to select the competent laboratories
Preferably, the approval of the competent laboratories is given in accordance with, inter alia, the requirements of European quality assurance standards. In the particular case of air quality laboratories, the EN 45000 standards concerning the accreditation of laboratories are relevant. In the application of these standards a laboratory may obtain a formal recognition of its competencies to perform a certain activity by an independent accreditation body. EN 45000 standards also allow for the nomination by competent national authorities of notified laboratories on the basis of their demonstrated experience. Notified laboratories are in that case exempted to follow the accreditation procedure.

Accreditation is the formal recognition, authorisation and registration of a laboratory that has demonstrated its
- capability,
- competence and
- credibility
to carry out the tasks it is claiming to be able to do. Accreditation is defined as the operation of a quality system in compliance with the European standard EN 45001 or the international ISO guide 25 (or the new ISO 17025). Accreditation is granted by an independent body and relies on the recognition of the competence by peers, i.e. people of the same profession. This competence is expressed in organisational terms as well as in terms of technical skill. A laboratory is never accredited as a whole, but only for a set of well-defined and validated methods. An accredited laboratory is able to demonstrate and document the technical training of staff, traceability of measurements and traceability of data and documents.

Other quality assurance standards, like the ISO 9000 certification or the OECD Good Laboratory Practice are also useful references for the approval of a laboratory. It is noted that EN 45000 is a quality system describing how to assess the technical performances of laboratories in terms of measurement accuracy, as required by Article 3 of the Framework Directive. This is not obligatory that all laboratories, but it is recommended that at least the national laboratories follow these systems.

3.2.3 Reporting item: Spatial distribution of levels found in the Preliminary Assessment

Specification in the directives
The directives do not ask specifically for a report on the results of the Preliminary Assessment. However, for the Commission to judge compliance with the assessment requirements in each zone it needs to be informed on whether levels exceed the upper and/or lower assessment thresholds.

Timetable
The Preliminary Assessment of the spatial distribution of air pollution levels should be completed soon enough to allow the required assessment methodology, including the monitoring system resulting from the Preliminary Assessment, to be put in place before the start of the first full year for which the air quality is to be reported under the first Daughter Directive. If the first full calendar year of assessment is 2001 (see Section 2.6), the Preliminary Assessment should be ready well before 2001. Assuming that the report is sent together with the documentation of methods (Section 3.2.4), it would be sent before 19 January 2001.

Information to be reported
This guidance does not address which information is to be reported to the Commission; this is a matter for the Article 12 Committee. However, as a preliminary guide the specification related to the use of supplementary assessment methods in Annex VIII(II) might be taken:
" The following information should be compiled for zones or agglomerations for which sources other than measurements are employed to supplement information from measurements or as a sole means of air quality assessment:
- […]
- a description of results, including accuracy's and, in particular, the extent of any area or, if relevant, the length of road within the zone or agglomeration over which concentrations exceed limit value(s) or, as may be, limit value(s) plus applicable margin(s) of tolerance and of any area within which concentrations exceed upper assessment or the lower assessment threshold;

- for limit values the object of which is the protection of human health, the population potentially exposed to concentrations in excess of the limit value.
- Where possible, Member States should compile maps showing concentration distributions within each zone and agglomeration."

The purpose of the Preliminary Assessment is to assess the pollution levels in order to define zones and determine the assessment requirements, so information related to health or exposure is not needed.

Methods to assess the spatial distribution of levels in the Preliminary Assessment are given in the Guidance Report on Preliminary Assessment (Van Aalst et al, 1998) and also in Section 4.3.

3.2.4 Reporting item: Documentation of the methods used in Preliminary Assessment

Specification in the directives
FWD Art. 11 (1d): "Member States (…) shall inform the Commission of the methods used for the preliminary assessment of air quality provided for in Article 5."
DD1 (first Daughter Directive) Art 7 (6): "The date by which Member States shall inform the Commission of the methods they have used for the preliminary assessment (…) shall be 18 months after the entry into force of this Directive."

Timetable
The entry into force being 20 days after official publication (29 June 1999), the report should be sent before 19 January 2001.

Information to be reported
The contents of the report from the Preliminary Assessment are not specified in the Directives. It is natural to use as a starting point the requirements for the contents of the annual report, which is detailed in the first Daughter Directive, Annex VIII (section II):
"The following information should be compiled for zones or agglomerations for which sources other than measurements are employed to supplement information from measurements or as a sole means of air quality assessment:
- a description of the assessment activities carried out;
- the specific methods used, with reference to descriptions of the method;
- the sources of data and information;
-

Methods to document techniques used in Preliminary Assessment: are discussed in the guidance report on preliminary assessment (Van Aalst et al. 1998). However, the methods description in Chapter 4 could also be applied to the Preliminary Assessment.

3.2.5 Reporting item: Summary of up-to-date levels

Specification in the directives
DD1 Art. 8.1: "Member States shall ensure that up-to-date information on ambient concentrations of sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead is routinely made available to the public as well as to appropriate organisations such as environmental organisations, consumer organisations, organisations representing the interests of sensitive populations and other relevant health-care bodies by means, for example, of broadcast media, press, information screens or computer-network services.
Information on ambient concentrations of sulphur dioxide, nitrogen dioxide and particulate matter shall be updated on at least a daily basis, and, in the case of hourly values for sulphur dioxide and nitrogen dioxide, wherever practicable, information shall be updated on an hourly basis. Information on ambient concentrations of lead shall be updated on a three-monthly basis.
Such information shall at least indicate any exceeding of the concentrations in the limit values and alert thresholds over the averaging periods laid down in Annexes I to IV. It shall also provide a short assessment in relation to limit values and alert thresholds and appropriate information regarding effects on health."

Timetable
See the specification in the first Daughter Directive above.

Information to be reported
Public reports on air pollution levels will preferably be comprised not only of monitoring data but also more accessible information such as maps based on the monitoring data. The use of sole modelling results not combined with monitoring data is not recommended.

Methods to assess up-to-date levels
Measurement: Chapter 4, method type 2;
Mapping: Chapter 4, method type 3.

3.2.6 Reporting item: Exceedence of Alert Value: public information

Specification in the directives
FWD Article 10: "When the alert thresholds are exceeded, Member States shall undertake to ensure that the necessary steps are taken to inform the public (e.g. by means of radio, television and the press). (…) A list of minimum details to be supplied to the public shall be drawn up together with the alert thresholds."
DD1 Article 8 on Public information: "Such information shall at least indicate any excesses of the concentrations in the limit values and alert thresholds over the averaging periods laid down in Annexes I to IV. It shall also provide a short assessment in relation to limit values and alert thresholds and appropriate information regarding effects on health. (…) When an alert threshold laid down in Annex I or II is exceeded, details made available to the public in accordance with Article 10 of Directive 96/62/EC shall at least include the items listed in Section III of the Annex in question."
DD1 Annex I and II: "Minimum details to be made available to the public when the alert threshold for sulphur dioxide / nitrogen dioxide is exceeded (…) should include at least:
— the date, hour and place of the occurrence and the reasons for the occurrence, where known;
— any forecasts of:
— changes in concentrations (improvement, stabilisation, or deterioration), together with the reasons for those changes;
— the geographical area concerned;
— the duration of the occurrence;
— the type of population potentially sensitive to the occurrence;
— the precautions to be taken by the sensitive population concerned."

- The first Daughter Directive specifies alert values for SO_2 and NO_2.

Timetable
This information is given as soon as possible, normally within a few hours after an exceedence has been measured. In case of prediction of exceedence the information is issued as soon as this prediction is judged to be reasonably certain.

Information to be reported
If the Alert Value is exceeded (or expected to be exceeded) the competent authority issues a message to the general public, usually via the media[6]. The assessment information needed for this message is specified in detail in the first Daughter Directive. Although it is not obligatory, it is recommended to estimate the air quality of the following day, quantitatively or qualitatively (better, similar, worse). The directives do not specify the size of the area or population to be informed. It is not necessarily the zone concerned. The size may be associated with the estimated extent of the area in exceedence. Another consideration could be that the information can be of interest to people outside the area intending to travel to the area, so information on a national or even transboundary scale might be deemed appropriate.

Methods to observe and assess exceedences:

- measurement: see Chapter 4, method type 2;
- forecasting: not discussed in this Guidance. A relevant review of forecasting methods is given in (Van Aalst and De Leeuw, 1997).
- analysis of causes: see Chapter 4, method type 4.

In practice the causes will be often be subjectively judged based on previous systematic analyses of causes of similar exceedences.

[6] Providing information to the media does not guarantee that the media will broadcast the information to the public.

3.2.7 Reporting item: Exceedence of Alert Value: report to Commission

Specification in the directives
FWD Article 10: "When the alert thresholds are exceeded (…) Member States shall also forward to the Commission on a provisional basis information concerning the levels recorded and the duration of the episode(s) of pollution no later than three months following their occurrence."

Timetable
Any further specification of the timetables is part of the work of the Article 12 Committee.

Information to be reported
The information to be reported is part of the information needed for public information described under reporting item 3.2.6.

Methods to observe exceedences:
See Chapter 4, method type 2.

3.2.8 Reporting item: Occurrences and reasons of individual exceedences of limit values

Specification in the directives
FWD, Article 11 sub 1a: "Member States shall (…) in the zones referred to in Article 8 (1) (…)
(i) inform the Commission of the occurrence of levels exceeding the limit value plus the margin of tolerance, of the dates or periods when such levels were observed and the values recorded in the nine-month period after the end of each year. When no margin of tolerance has been fixed for a given pollutant, the zones and agglomerations where the level of such pollutant exceeds the limit value shall be treated in the same way as the zones and agglomerations referred to in the first subparagraph;
(ii) inform the Commission of the reasons for each recorded instance, in the nine-month period after the end of each year".

Timetable
The report on all individual exceedences in a certain calendar year is sent before 1 October of the next year to the Commission.

Information to be reported
Several of the limit values in the first Daughter Directive allow a fixed number of exceedences per year of a certain numerical concentration value, so the provision in the directive is somewhat ambiguous. For such limit values the article is interpreted as follows. Reports are sent for all stations with levels in exceedence of the limit value plus the margin of tolerance. In these cases, all exceedences of the numerical value of the concentration given in the definition of the limit value (or limit value plus margin of tolerance) are reported.

There is no existing practice in reporting the reasons for exceedence. If exceedences are very rare, an elaborate analysis and report on each exceedence could be envisaged. However, if a Member States has to report a substantial number of exceedences it is more efficient to develop a classification of reasons for exceedences based on the occurrence of polluting activities and other information.

The Directives do not give a provision for reporting exceedences found by the formal use of modelling (see also Section 4.3.3.3). Often the statistics of modelled exceedences will be the basis for accepting modelling results as convincing evidence, rather than the individual exceedences calculated, so it would not be advisable to use the framework specified to report measured exceedences also for modelled data. Since there is currently no generally accepted procedure for reporting a modelled exceedence, a reporting procedure is not recommended here. However, in the case that a Member State designates a zone as having areas non-compliant with a limit value solely on the basis of modelled exceedence, it is recommended to inform the Commission that this conclusion is based solely on model calculation, when reporting the list of zones in exceedences (see reporting item 3.2.9).

Methods to assess individual exceedences:
- observation by measurement: see Chapter 4, method type 2;
- assessment of reason of exceedence: see Chapter 4, method type 4.

It is noted that when the limit value includes a certain number of exceedences, this number of exceedences also applies to the sum of the limit value plus the margin of tolerance.

3.2.9 Reporting item: List of zones exceeding/not exceeding the limit value or the limit value plus the margin of tolerance

Specification in the directives
FWD Art. 11, sub 1b: "Member States (…) shall forward to the Commission annually, and no later than nine months after the end of each year, the list of zones and agglomerations referred to in Article 8 (1) and (2) and in Article 9."
Article 8(1) and (2) and Article 9 refer to zones and agglomerations in which the levels of one or more pollutants are (a) higher than the limit value plus the margin of tolerance, (b) between the limit value and the margin of tolerance and (c) below the limit value.

Timetable
The report on a certain calendar year is sent before 1 October of the next year.

Information to be reported
The compliance status in each zone needs to be assessed for each limit value of each pollutant. Although the Framework Directive only requires Member States to report *whether* any of the limit values is exceeded, it is recommended that Member States report the compliance status in each zone for each limit value of each pollutant.

Methods to list zones:
The list follows directly from the assessment of exceedences (reporting item 3.2.8). When a zone is found to be in exceedence not by measurement, but only by modelling (see Section 4.3.3.3) the Member State informs the Commission that this was the result of modelling, to avoid the appearance that the compliance status may be inconsistent with the annual report on measurements.

3.2.10 Reporting item: zones where the upper or lower assessment thresholds are exceeded

Specification in the directives
The directives do not explicitly require Member States to report whether air pollution levels in a zone exceed the upper or lower assessment thresholds. However, for the Commission to judge compliance with the assessment requirements, it needs to be informed about this.
The first Daughter Directive does specify how often the status of zones should be re-assessed:
DD1 Art 7: "The classification of each zone or agglomeration for the purposes of the same Article 6 shall be reviewed at least every five years in accordance with the procedure laid down in Section II of Annex V. Classification shall be reviewed earlier in the event of significant changes in activities relevant to ambient concentrations of sulphur dioxide, nitrogen oxide or, where relevant, oxides of nitrogen, particulate matter or lead."
DD1, Annex V, Section II: "Exceedences of upper and lower assessment thresholds must be determined on the basis of concentrations during the previous five years where sufficient data are available. An assessment threshold will be deemed to have been exceeded if during those five years the total number of exceedences of the numerical concentration of the threshold is more than three times the number of exceedences allowed each year. Where fewer than five years' data are available Member States may combine measurement campaigns of short duration during the period of the year and at locations likely to be typical of the highest pollution levels with results obtained from information from emission inventories and modelling to determine exceedences of the upper and lower assessment thresholds."

Timetable
Although exceedences of upper and lower assessment thresholds are defined on a five-year basis, this has to be evaluated every year. So the five-year period changes every year. The simplest approach would be to apply the same reporting procedure and timetable as used for limit value exceedences. The first report, however, describes the results of the Preliminary Assessment and would consequently be sent before 1 October of the first year following the Preliminary Assessment.

Information to be reported

The information on the exceedence state is similar to that of the report on limit value exceedences. It should be noted that the criterion in Annex V of the first Daughter Directive for deeming an assessment threshold to have be exceeded in the previous five years is lower than intended. Also, it is not clearly defined for thresholds expressed as annual averages. At the time of finalisation of this Guidance Report, this problem had been discussed in the Air Quality Steering Group, but a decision on how to resolve the problem had not yet been made.

Methods to assess exceedences of upper and lower assessment thresholds
The methods to assess exceedences of upper or lower assessment thresholds are the same as those regarding limit value exceedences. However, the counting procedure of exceedence in the five preceding years specified in Annex V of the first Daughter Directive is different. See Chapter 4: method type 2 (when fixed measurement is the sole source of information as referred to in Art 7 of the First Daughter Directive) and method type 3 (when supplementary methods are also applied).

3.2.11 Reporting item: Statistics on threshold exceedence of 10-minutes averaged SO_2 concentrations

Specification in the directives
DD1 Art. 3 (3): "In order to assist the Commission in preparing the report provided for in Article 10, until 31 December 2003 Member States shall, where practicable, record data on concentrations of sulphur dioxide averaged over ten minutes from certain measuring stations which they have selected as representative of air quality in inhabited areas close to sources and at which hourly concentrations are measured. At the same time as data are supplied on hourly concentrations in accordance with Article 11(1) of Directive 96/62/EC, Member States shall report to the Commission, for those selected measuring stations, the number of ten-minute concentrations which have exceeded 500 $\mu g/m^3$, the number of days within the calendar year on which that occurred, the number of those days on which hourly concentrations of sulphur dioxide simultaneously exceeded 350 $\mu g/m^3$ and the maximum ten-minute concentration recorded."

Timetable
See reporting item 3.2.8.

Information to be reported
See the specification in the first Daughter Directive Art. 3(3) given above.

Methods to measure 10-minute SO_2 concentrations are given in Chapter 4, method type 2. See also the specification in the first Daughter Directive Art. 3(3) given above. Particularly relevant monitoring sites are those near point sources and intermittent sources, where relatively strong fluctuations in time tend to occur.

3.2.12 Reporting item: List of zones with exceedence due to natural SO_2 sources and justification

Specification in the directives
DD1 Art. 3 (4): "Member States may designate zones or agglomerations within which limit values for sulphur dioxide as laid down in Section I of Annex I are exceeded owing to concentrations of sulphur dioxide in ambient air due to natural sources. Member States shall send the Commission lists of any such zones or agglomerations together with information on concentrations and sources of sulphur dioxide therein. When informing the Commission in accordance with Article 11(1) of Directive 96/62/EC, Member States shall provide the necessary justification to demonstrate that any exceedences are due to natural sources.
Within such zones or agglomerations Member States shall be obliged to implement action plans in accordance with Article 8(3) of Directive 96/62/EC only where the limit values laid down in Section I of Annex I are exceeded owing to man-made emissions."

Timetable
The report is sent together with the annual report on concentrations, viz. before 1 October of the following year.

Information to be reported
To justify that an exceedence is due to natural sources a quantitative assessment of the natural contribution to each exceeded air quality parameter is needed. The definition of natural sources is a not a trivial matter, see also Section 4.4.3.2.

Methods to assess the contribution of natural SO_2 sources are discussed in Chapter 4, method type 4. The sole use of dispersion modelling (method 4B) is often not sufficient, because the emissions of natural sources are usually not accurately known and the method does not link directly to measured exceedences. Method 4A (local differences between measured levels) or 4C (receptor modelling, applied to isotope composition) or a combination of methods of type 4 may be more suitable.

3.2.13 Reporting item: Statistics of $PM_{2,5}$ concentrations

Specification in the directives
DD1 Art. 5 (2): "Member States shall ensure that measuring stations to supply data on concentrations of PM2,5 are installed and operated. Each Member State shall choose the number and the siting of the stations at which PM2,5 is to be measured as representative of concentrations of PM2,5 within that Member State. Where possible sampling points for PM2,5 shall be co-located with sampling points for PM_{10}.
Within nine months of the end of each year Member States shall send the Commission the arithmetic mean, the median, the ninety-eighth percentile and the maximum concentration calculated from measurements of PM2,5 over any twenty-four hours within that year. The ninety-eighth percentile shall be calculated in accordance with the procedure laid down in Section 4 of Annex I to Council Decision 97/101/EC of 27 January 1997 establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States."

Timetable
See reporting item 3.2.8.

Information to be reported
See the specification in the first Daughter Directive Art. 5 (2) given above.

Methods to measure $PM_{2,5}$ concentrations: the measurement methods for $PM_{2,5}$ are not yet prescribed (see also the reporting item below and Section 4.2). Since the directive does not give a detailed specification of macrositing for $PM_{2,5}$ it is important to know the reasons why measuring $PM_{2,5}$ is important. At the revision of the first Daughter Directive the possibility of a limit value for $PM_{2,5}$ will be considered. A reliable overview of $PM_{2,5}$ levels throughout the EU will therefore be needed, and also more insight in the relationship between PM_{10} and $PM_{2,5}$ levels. Because of this, the first Daughter Directive requires the monitoring of $PM_{2,5}$ levels in parallel with PM_{10}. Since the size distribution of PM varies per source and also depends the history after emission, the $PM_{2,5}/PM_{10}$ ratio depends on the measuring location. Consequently both background and local levels are relevant. Since secondary particulate matter, formed in the atmosphere after emission, contributes particularly to $PM_{2,5}$, background locations are of particular importance. Near sources primary emission due to combustion processes can be important. It should be realised that PM_{10} and even $PM_{2,5}$ monitoring equipment captures a small fraction of coarse dust, so sources of mechanical dust are also of potential interest. Important source types of fine particulates are: traffic (both paved and unpaved roads), domestic emissions (particularly burning of wood and other solid fuels), industrial emissions (particularly coal fires, quarrying and other fugitive emissions) and natural sources.

3.2.14 Reporting item: Measurement methods employed for PM_{10} and $PM_{2,5}$

Specification in the directives
DD1 Annex IX, paragraphs IV and V: "Each Member State must inform the Commission on the method used to sample and measure $PM_{10}/PM_{2,5}$."

Timetable
Before 19 July 2001.

Information to be reported
For PM_{10} measurements:
Member States will preferably use the reference method of the directive (sampling method according to CEN 12341 followed by gravimetric mass determination) or whatever method the Member State can demonstrate to produce equivalent results or to show a consistent relationship to the reference method. If a method other than the reference method is used, the report should also contain a demonstration of the equivalence or of the consistent relationship between the method and the reference method.

For $PM_{2,5}$ measurements:
As yet, the Commission has proposed no reference method and the Member States are allowed to use whatever measurement method they consider to be appropriate. The Member States should give a description of the method(s) they are implementing.

Methods to measure PM_{10} and $PM_{2,5}$: see Chapter 4, method type 2. It is not specified here how these methods are to be reported.

3.2.15 Reporting item: List of zones with exceedence of the limit value for PM_{10} due to natural events and justification

Specification in the directives
DD1 Art. 5 (4): "Where the limit values for PM_{10} laid down in Section I of Annex III are exceeded owing to concentrations of PM_{10} in ambient air due to natural events which result in concentrations significantly in excess of normal background levels from natural sources, Member States shall inform the Commission in accordance with Article 11(1) of Directive 96/62/EC, providing the necessary justification to demonstrate that such exceedences are due to natural events. In such cases, Member States shall be obliged to implement action plans in accordance with Article 8(3) of Directive 96/62/EC only where the limit values laid down in Section I of Annex III are exceeded owing to causes other than natural events.
Within such zones or agglomerations Member States shall be obliged to implement action plans in accordance with Article 8(3) of Directive 96/62/EC only where the limit values laid down in Section I of Annex III are exceeded owing to PM_{10} levels other than those caused by winter road sanding."
DD1 Art. 2: "'natural events' shall mean volcanic eruptions, seismic activities, geothermal activities, wild-land fires, high-wind events or the atmospheric resuspension or transport of natural particles from dry regions'.

Timetable
The report is sent together with the annual report on concentrations, viz. before 1 October of the following year.

Information to be reported
To justify that an exceedence is due to natural events a quantitative assessment of the natural contribution to each exceeded air quality parameter is needed. The definition of natural events is a non-trivial matter, see also Section 4.4.3.2.

Methods to assess the contribution of natural events to PM_{10} levels are discussed in Chapter 4, method type 4. The sole use of dispersion modelling (method 4B) is often not sufficient, because the emissions of natural sources are usually not accurately known and the method does not link directly to measured exceedences. Methods 4A (difference analysis, if applied to a sufficiently large spatial scale) and 4C (receptor modelling) are regarded as more suitable, but it may be necessary to combine of all three methods.

3.2.16 Reporting item: List of zones with PM_{10} exceedence due to winter sanding of roads and justification

Specification in the directives
DD1 Art. 5 (5): "Member States may designate zones or agglomerations within which limit values for PM_{10} as laid down in Section I of Annex III are exceeded owing to concentrations of PM_{10} in ambient air due to the resuspension of particulates following the winter sanding of roads. Member States shall send the Commission lists of any such zones or agglomerations together with information on concentrations and sources of PM_{10} therein. When informing the Commission in accordance with Article 11(1) of Directive 96/62/EC, Member States shall provide the necessary justification to demonstrate that any exceedences are due to such resuspended particulates, and that reasonable measures have been taken to lower the concentrations.
Within such zones or agglomerations Member States shall be obliged to implement action plans in accordance with Article 8(3) of Directive 96/62/EC only where the limit values laid down in Section I of Annex III are exceeded owing to PM_{10} levels other than those caused by winter road sanding."

Timetable
The report is sent together with the annual report on concentrations, viz. before 1 October of the following year.

Information to be reported

To justify that exceedence is due to winter sanding a quantitative assessment of the contribution to each exceeded air quality parameter is needed.

Methods to assess the contribution of winter sanding are discussed in Chapter 4, method type 4. The sole use of dispersion modelling (method 4B) is often not sufficient, because the emissions due to winter sanding are usually not accurately known and the method does not link directly to measured exceedences. Method 4C (receptor modelling) is less suitable here, since winter sanding is difficult to distinguish from other sources of air borne sand.

3.2.17 Reporting item: Documentation and results of supplementary assessment methods

Specification in the directives
DD1, Annex VIII (II): "The following information should be compiled for zones or agglomerations within which sources other than measurement are employed to supplement information from measurement or as the sole means of air-quality assessment:

- a description of assessment activities carried out;
- the specific methods used, with references to descriptions of the method;
- the sources of data and information;
- a description of results, including accuracy's and, in particular, the extent of any area or, if relevant, the length of road within the zone or agglomeration over which concentrations exceed limit value(s) or, as may be, limit value(s) plus applicable margin(s) of tolerance and of any area within which concentrations exceed the upper assessment threshold or the lower assessment threshold;
- for limit values the object of which is the protection of human health, the population potentially exposed to concentrations in excess of the limit value.

Where possible, Member States should compile maps showing concentration distributions within each zone and agglomeration."

Timetable
The directive does not specify a deadline for the compilation of the documentation. When the assessment in a zone formally uses supplementary assessment methods in a certain calendar year, the results and documentation are provided before 1 October of the following year, when also the yearly monitoring results are sent to the Commission. If the model calculations lead to a conclusion on the compliance state of a zone, this result is reported annually as described under item 3.2.9.
Information to be reported
When appropriate (see Section 4.3.3.3) the calculated compliance state of a zone is reported annually. The more extensive information indicated above in the quotation from the first Daughter Directive is discussed more extensively in Chapter 2.4 and below at reporting item 3.2.18.

Supplementary assessment methods and results
See Section 2.4 for a clarification of the supplementary assessment including references to methods elsewhere in this report.

3.2.18 Reporting item: Review of levels in all zones and agglomerations

Specification in the directives
FWD Art. 11 (1c): "Member States (…) shall forward to the Commission every three years within the framework of the sectoral report referred to in Article 4 of Council Directive 91/692/EEC of 23 December 1991 standardising and rationalising reports on the implementation of certain Directives relating to the environment, and no later than nine months after the end of each three-year period, information reviewing the levels observed or assessed, as appropriate, in the zones and agglomerations referred to in Article 8 and Article 9."
Council Directive 91/692/EEC Art.4: "At intervals of three years the Member States shall send information to the Commission on the implementation of this Directive, in the form of a sectoral report which shall also cover other pertinent Community Directives. This report shall be drawn up on the basis of a questionnaire or outline drafted by the Commission in accordance with the procedure laid down in Article 6 (…). The questionnaire or outline shall be sent to the Member States six months before the start of the period covered by the report. The report shall be sent to the Commission within nine months of the end of the three-year period covered by it.
The first report shall cover the period from 1994 to 1996 inclusive.

The Commission shall publish a Community report on the implementation of the Directive within nine months of receiving the reports from the Member States."
The Articles of the Framework Directive mentioned above refer to "zones where levels are higher than the limit value" (Art. 8) and "zones where levels are lower than the limit value" (Art. 9), so to all zones (including agglomerations).

Timetable
See Section 2.6. The final date for the first report is expected to be 1 October 2005, reviewing the levels in 2002 to 2004.

Information to be reported
The three-yearly report consists of information on the implementation status of the air quality directives (not the subject of this guidance) and reviews of the air quality levels in the zones. The structure of the report will be designed later by the Article 12 Committee. It will not be attempted here to anticipate in detail which information the Commission will need. The 3-year report is likely to be used to collect the information needed for a review of air quality across the EU. As the relevant monitoring data will already have been collected in the annual reports under the first Daughter Directive and the Exchange of Information Decision, it is not to be expected that new types of monitoring data will need to be reported. However, in zones where levels are below the lower assessment threshold, the assessment may have been done without any fixed monitoring stations, so in that case no annual reports would have been received. Also, the directives do not require annual reporting of results from Supplementary Assessment methods. The 3-yearly review is the appropriate occasion to collect results of these assessment methods at the EU level. Annex VIII(II) of the first Daughter Directive gives information on the type of information that is expected from the application of Supplementary Assessment methods:

- "a description of results, including uncertainties and in particular, the extent of any area or, if relevant the length of road within the zone or agglomeration over which concentrations exceed limit value(s), or as may be limit value(s) plus applicable margin(s) of tolerance and of any area within which concentrations exceed the upper assessment threshold or the lower assessment area;
- for limit values whose object is the protection of human health, the population potentially exposed to concentrations in excess of the limit value.

Where possible Member States should compile maps showing concentration distributions within each zone and agglomeration."

Methods to observe and assess the levels are given in Chapter 4. Since the scope of this report is very broad, virtually all methods could be useful.

3.2.19 Reporting Item: Documentation and review of monitoring networks

Specification in the directives
DD1, Annex IV (III): "The site-selection procedures should be fully documented at the classification stage by such means as compass-point photographs of the surrounding area and a detailed map. Sites should be reviewed at regular intervals with repeated documentation to ensure that selection criteria remain valid over time."

Timetable
In principle the documentation is prepared at the start of the regular assessment under Article 6 of the Framework Directive, see Section 2.6.

Information to be reported
The Directive not only requires the documentation of the results of the network design, but also the justification of the choices made. The most important aspect of this is an analysis of how the network, possibly in combination with Supplementary Assessment methods, covers and is representative of the entire territory being assessed.
It is recommended to publish this information in a report, but there is no formal requirement to actively disseminate it or send it to the Commission. The format for describing the stations under the Exchange of Information Decision obviously gives an important framework, but it does not include maps or photographs.

Methods to document the network
There is no internationally accepted framework for documenting a network, but examples may be found in many countries. Such documentation usually only describes the results of the site-selection procedure, but not the procedure itself. Section 4.3.4 gives an outline of the network design procedure.

Chapter 4 Air quality assessment methods

To generate the information to be reported as described above, a large variety of methods exists. In this chapter the methods are grouped according to their output, dividing them into four types:

1 ***Definition of zones***
2 ***Measurement of concentration***
3 ***Determination of spatial concentration distribution***
4 ***Assessment of causes of air quality problems***

In the following sections the four types of methods are described and discussed. Examples from Member States are added to give the general descriptions a more concrete form. For each example, a summary is given in this chapter, including a reference to a more extensive description if available. The European Commission is collecting the more extensive descriptions and will publishing these on its web site.

Aspects of the Preliminary Assessment are not discussed here, since it has been addressed by the report on guidance on the Preliminary Assessment (Van Aalst et al., 1998).

4.1 Methods of type 1: Definition of zones

The Framework Directive 96/62/EC states that it is up to the Member States to divide their territories into zones[7], thereby respecting the differences in administrative systems between the countries. Consequently, this guidance will not recommend any special method of designating zones. Obviously, however, the comparability between the Member States - one of the goals of the Framework Directive - would greatly benefit from similarities in the various approaches taken by individual countries. It is therefore strongly recommended to take approaches considered in other Member States into account and reconsider reasons for major deviations from the general trend before making the final decision. The guidance given here will give a general discussion and is supplemented by examples supplied by some countries.

It is important not to confuse the zone concept defined in the Framework Directive and the one used in the Exchange of Information Decision (EoI)[8]. The EoI uses "zone" in practice to describe the "local environment-/landscape morphology" of an individual station; for each station the EoI requires to specify: the type of zone (urban, suburban or rural), the characterisation of a zone (residential, commercial, industrial, agricultural or natural) and the number of inhabitants. The EoI concept should not be used in defining zones under the Framework Directive.

The concept of a zone in the Framework Directive enables Member States to sub-divide their very differently sized territories into basic areas for air quality management. For simplicity, the Framework Directive also uses zones to specify assessment requirements. The convenience of this approach brings along the difficulty of defining a system of zones that is both suitable for air quality management and for air quality assessment. When considering possibilities to combine areas in a zone, due regard needs to be given to similarities in air quality. It is, however, important to note that zones should primarily be regarded as administrative territories for which the Directive defines requirements (for assessment, reporting and management). So, when designating zones, ensuring a good link to action is the primary concern; this is generally served best when associating zones with administrative areas.

Consequently, zones cannot be regarded as the best entities to characterise how air pollution is distributed over a country. In particular, when the air quality in a zone does not comply with the limit value, the zone's air quality may be very good except at a single spot. A problem that seems difficult to avoid is that the public and media may perceive a zone listed as having areas exceeding the limit value as bad air quality all over the zone. A good approach to this problem is to disseminate additional information on the air quality, making clear where exceedences occur and conveying that non-compliance is an administrative statement that there is an air quality

[7] Because the directives use the redundant phrase "agglomerations and zones", it is remarked that the term "zone" in this report includes agglomerations as a particular type of zone.
[8] In the recent proposal to revise the EoI the term "zone" has been removed.

problem to be solved in the zone. The Commission also needs to receive more information than just the compliance state of zones to be able to give adequate overviews of the air quality in zones throughout the Community. This public perception problem could in principle also be reduced by constructing zone borders around all problem areas, separating them from surrounding good air quality areas. However, this will tend to lead to complicated zone systems that could change relatively fast over time and strongly differ by pollutant. It is recommended that Member States adopt a similar approach in this respect, to avoid that inconsistencies between countries make this even more difficult for the public to understand.

From the above it also follows that the assessment efforts and techniques do not need to be same everywhere in the zone, but preferably should depend on the local air quality.

To arrive at a satisfactory system of zones within a country or region the following ***zone designation process*** is recommended. It starts with the Preliminary Assessment of how air quality is spatially distributed in the territory of the country or region that is responsible for the designation of zones. This focuses on the pollutants addressed by the first Daughter Directive, but it is also wise to consider the pollutants of future daughter directives as far as possible. In the Preliminary Assessment, all relevant air quality parameters (annual averages, exceedences of hourly/daily values) are taken into account. Then an attempt is made to identify areas of similar air quality characteristics, in terms of exceedences, source types, climatologic and topography. The air quality picture emerging is then projected onto a map of territories of local administrations with competence regarding the control of sources. Taking the borders of administrations as possible delineations of zones, combinations of administrative territories are sought that have similar air quality characteristics. In this procedure the principles, tendencies and considerations listed below are taken into account.

Some general ***principles*** to ensure transparency are proposed:

- For each location in a Member State it should be clear to which zone it belongs. The definition should not only be administratively clear, but also for the public it should be easy to determine to which zone a location belongs. The best way to do this is specifying a zone as administrative areas like cities, provinces, departments and combinations of these.
- The borders of zones should be fixed in time, except for formal re-adjustments that may occur after a considerable number of years.
- Spatial statistics like population density will often guide the designation of zones, but they should not be used in the formal definition - for two reasons: they are undefined for individual locations and they change continuously over time.

Some general ***tendencies*** can be observed in the current developments in Member States (see also the examples):

- Zones coincide with the territory of administrations.
- An extended area without air quality problems tends to be designated as one zone.
- In not too sparsely populated regions zone dimensions tend to be of the order of 10 to 100 km and zone populations of 300 000 to 3 000 000 inhabitants.

It is recommended that the following (partly conflicting) ***considerations*** be taken into account in the definition of zones. In practice these may also conflict with other criteria that are more important for the country or region concerned.

- As emphasised above: to facilitate action it is advisable to link zone boundaries to administrative areas in the country.
- It is convenient to group adjacent administrative areas with similar air quality characteristics into one zone.
- Non-adjacent areas, e.g. two medium-sized cities, can be grouped to form a single zone.
- It is however not recommended to group a spatially separated agglomeration of more than 250 000 inhabitants together with other areas.
- Assessment requirements for agglomerations and non-agglomeration zones being somewhat different[9], Member States need to decide whether a zone is an agglomeration or not. To determine whether the population size criterion is exceeded, it is recommended to regard built-up areas that are not separated by more than a few kilometres as belonging to the same cluster and to designate this cluster as an agglomeration if its number of inhabitants exceeds 250 000.

[9] For pollutants for which an alert value has been set, viz. SO_2 and NO_2, measurements are obligatory in agglomerations, not in other zones (Annex VII of the first Daughter Directive).

- It is recommended not to include in agglomerations significant areas that are not built-up[10].
- It is recommended to regard a large conglomeration of e.g. one million inhabitants as one agglomeration and not to divide it into several smaller agglomerations.
- To provide comparable information to the European Parliament and the European Commission it is recommended to avoid concepts that deviate strongly from the mainstream emerging from the approaches taken by the other Member States. The comparability between Member States would suffer severely if single regions or countries employed a strongly deviating system, e.g. extremely small or large zones. Moreover, the public would find such deviations difficult to understand.
- Although highways have similar air quality characteristics and are in many countries controlled by special authorities, it is not recommended to construct zones from highways. The distance from a highway within which it causes significant pollution varies considerably and population exposure tends to be beyond the area controlled by highway authorities.
- Defining zones that differ by pollutant can simplify the assessment, but may complicate abatement actions that address various pollutants and tends to complicate the European view. If it is deemed better to define a specific set of zones for a particular pollutant it is recommended to do this by subdividing or aggregating zones used for other pollutants, thus maintaining common zone borders as far as possible.
- It is advised to consider the consequences for the *administrative* and *assessment* burden and efficiency when choosing between alternative zone systems. E.g. designating zones to small administrative territories without taking the distribution of air quality into account may result in too fine a zone structure, each with its own assessment requirements. The Working Group had hesitations about the possibility of defining zones of limited size around single industrial plants, unless it facilitates air quality management. It expects difficulties in defining appropriate borders of such zones. It is not advised to reduce the administrative burden by grouping local hot spots of limited size, e.g. industrial parks, into one special zone, with the aim to remove the problem areas from zones that have good air quality elsewhere.
- When the territories of several regional or local authorities are combined in one zone, without a single overarching authority, these authorities will usually have a shared responsibility for reporting and for developing action plans. It is important to ascertain that no major co-ordination problems will arise before deciding to join such territories.
- To avoid an unnecessary assessment burden Member States are also advised to consider the application of Supplementary Assessment methods (see Section 2.4) to assess levels in one zone using air quality information gathered in other zones.

The text frames below summarise the approaches taken in the UK, Germany and the Netherlands. It should be noted that the zone definition in these countries had not been finalised at the time of writing.

Example: Zone definition (UK - draft version)

Description of the zones: In total there are 28 agglomerations.
Criteria used: The UK proposal is to divide the UK into 16 zones, based on official government office boundaries within England and boundaries provided or authorised by the relevant offices within Scotland, Wales and Northern Ireland. A further 28 agglomeration zones (areas of urban population > 250000) have also been agreed based on GIS information for England and Wales, localities information in Scotland and CORINE land cover information within Northern Ireland.
More detailed description: To be provided on a web site; see the introduction of Chapter 4.

Example: Zone definition (Hesse / Germany - draft version)

Description of the zones: Two agglomerations and three additional zones have been proposed in the State of Hesse (one of the sixteen states of Germany)
Criteria used: The spatial resolution and boundaries of the zones are in general given by the administrative areas of the municipalities. The definition of the agglomerations was initially guided by the criterion of ≥250.000 inhabitants and additionally by a density of inhabitants of at least 1000 per km2 in an area of at least 100 km2. The boundaries of the agglomerations were partly extended and evened up based upon the detailed knowledge of the emission structure and the geographical and meteorological conditions of the region. As a result, the two agglomerations consist of one respectively three major big cities together with a number of neighbouring municipalities that was deemed to belong to the same general region of air pollution. To define the zones the

[10] The guideline of 1000 km^2 given in Annex VI(Ib) for the representativeness for sampling points targeted at ecosystems and vegetation could be used as an indication of the size of areas not to include in an agglomeration.

already available information on the ambient air quality has been taken into account. A detailed evaluation of this information with regard to the limit and threshold values of the first Daughter Directive was carried out as an additional and essential basis for the definition of zones.
More detailed description: To be provided on a web site; see the introduction of Chapter 4.

Example: Zone definition (Netherlands - draft version)
Description of the zones: Representatives of national, provincial and local authorities agreed on a preliminary definition of zones and agglomerations in The Netherlands. The Netherlands will have three non-agglomeration zones. The zone 'North' covers the provinces Groningen, Friesland, Drenthe, Overijssel and Flevoland; the zone 'Middle' covers Gelderland, Utrecht, Noord-Holland and Zuid-Holland; the zone 'South' covers Zeeland, Noord-Brabant and Limburg. The six agglomerations are Amsterdam/Haarlem, Den Haag/Leiden, Rotterdam/Dordrecht, Utrecht, Eindhoven and Heerlen/Kerkrade. Each agglomeration covers the central (one or two) municipalities and surrounding adjacent municipalities.
Criteria used:

- The borders of zones or agglomerations follow the borders of the areas of local air quality management authorities. These authorities are responsible for taking measures in case of exceedences in their area.
- The number and the location of the agglomerations is based on a map of the population density. Interconnected areas with a population density above 750 inhabitants per square kilometre with a total of more than 250 000 inhabitants are nominated as agglomeration. Municipalities adjacent to the bigger cities with interdependent air quality are combined into one agglomeration.
- Adjacent provinces with the same levels of air pollution with respect to the thresholds of the EU directives are combined into one zone. This enhances the possibility of getting a good overall picture of the air quality and increases the efficiency of reporting by restriction of the number of zones. Although levels of several pollutants were considered in investigating the definition of the zones, the resulting definition of the three zones is applicable to all pollutants.

More detailed description: To be provided on a web site; see the introduction of Chapter 4.

4.2 Methods of type 2: Measurement of concentration

Methods of type 2 comprise the sampling and analysis of polluted air at a particular location, including calibration techniques.

Reference methods

Specifications beyond those given in the first Daughter Directive will be discussed here only for PM. For PM_{10} measurements the reference method of the directive is described in CEN standard 12341, which essentially gives specifications of the size selective inlets or sampling heads to be used for sampling the PM_{10} fraction of the particles. The standard refers to the collection of the particles on a quartz fibre filter at ambient temperature. The collected mass of particles is determined gravimetrically. The filters are conditioned before and after sampling under well-established temperature (20 ± 1°C) and relative humidity (50 ± 5 %) conditions during 48 hours.

For $PM_{2,5}$ a reference method based on the gravimetric determination of the $PM_{2,5}$ fraction is currently being standardised by CEN. There are several difficulties in the selection of an appropriate measurement method. It is impossible to generate a primary calibration standard of $PM_{2,5}$ and it is needed to designate a reference size-specific $PM_{2,5}$ sampling head by convention. Furthermore, the possible loss of volatile particulate matter during sampling, which has been observed for PM_{10}, is known to be even more important for the $PM_{2,5}$ fraction.

Equivalent methods

Besides the reference measurement methods proposed by the directives for each single pollutant, the Member States are allowed to use whatever other method, provided they can demonstrate the method produces equivalent results or , for PM_{10}, to show a consistent relationship to the reference method. Equivalence is obtained if all the data quality requirements established for each single pollutant and expressed in terms of accuracy, data coverage and data availability are respected.

An important question is which methods are acceptable as non-reference methods. This matter has not yet been resolved and will not be discussed here. The position papers give an overview of methods.

For PM_{10} the following cases are important to note:

- Use of a sampling head other than the reference head

The EN 12341 standard refers to three different reference sampling devices: the Wide Range Aerosol Classifier (WRAC), the USEPA High Volume sampler (Sierra Andersen) and the Low Volume sampler (Kleinfiltergerät). The equivalence of whatever other sampling head with these reference devices can be established by using the procedure described in the EN 12341 standard.

- Use of automated PM_{10} analysers

Automated analysers working on the oscillating microbalance, the β-ray attenuation or the optical detection principle are of common and convenient use in the monitoring networks. The use of a measurement principle that is different of the gravimetric method may however induce differences in the measurement results. This is in particular true if the air probe is heated during sampling: losses of volatile particles, such as ammonium nitrates in particular, may in some cases reach 50% of the particle mass. In that case the measurement results need to be corrected by a factor to produce results equivalent to the reference method. If the factor is not constant over the year or over the territory, different correction factors or even correction functions may have to be used. To judge whether the deviations are acceptable the data-quality objectives in Annex VIII of the first Daughter Directive specify an accuracy of 25%[11].

Indicative measurements

Indicative measurements, which are generally less accurate than the reference method, may be implemented as an assessment method when ambient concentration levels for a given pollutant are lower than the upper assessment threshold. Indicative measurement techniques based on the use of a mobile laboratory (or any other mobile or transportable measurement platform) and manual measurement methods, such as the diffusive sampling technique in particular, are of particular interest, because of their relatively low cost and their simple operation in comparison with fixed monitoring stations.

Indicative measurement methods may also include the on-line automated methods used for compliance monitoring, when implemented with a lower degree of accuracy.

Guidance on the use of indicative measurements can be found in the Guidance Report on Preliminary Assessment under EC Air Quality Directives (Van Aalst et al., 1998). An example from the UK is given in the text frame below.

[11] The criteria for equivalence specified in EN12341, to which Annex XIII of the first Daughter Directive also refers, addresses only the sampling step, not the entire process including transport, conditioning and weighing of the samples. Also, EN12341 is intended for testing the performance of instruments that are intended to be used as "transfer"reference instruments by convention and should therefore not be regarded as a standard for equivalent monitoring equipment like automatic instruments in field monitoring stations.

Example: NO2 Diffusion Tube Network in the UK

Purpose of the method:

- to objectively assess the spatial and temporal distribution of NO2 concentrations in a variety of urban environments in the UK;
- to highlight areas where elevated concentrations of NO2 occur and which may justify more detailed investigation using automatic techniques.

Short description of the method:

The network measures at roadside, intermediate and urban background locations in urban areas using Palmes type diffusion tubes. The network has been in operation since 1993 and currently monitors at 1375 different locations throughout the UK. Its data have enabled the identification of trends in NO2 concentrations throughout the UK. Estimates of the overall spatial distribution of NO2 throughout the UK have also been made. Owing to the good geographical distribution of the UK NO2 Diffusion Tube Network, this network provides an excellent screening tool for the identification of areas with elevated nitrogen dioxide concentrations. Such areas have been targeted for monitoring with more accurate automatic techniques to identify formal compliance with EU and UK standards.

More detailed description:

- UK Nitrogen Dioxide Network – Annual Reports for 1993 - 1998
- Published by AEA Technology on behalf of DETR, Scottish Executive, National Assembly for Wales and DoE in N. Ireland. Available from Two Ten Publications, DETR Literature, P.O. Box 236, Wetherby, N. Yorks., LS23 7NB, UK
- Internet: http://www.aeat.co.uk/netcen/airqual/welcome.html - Select - Monitoring Networks – About Monitoring Networks – Non-automatic Networks – NO2 Diffusion Tube Survey.
- Stevenson K.J., Bush T. and Mooney D. Five Years of Nitrogen Dioxide Measurement with Diffusion Tube Samplers at over 100 Sites in the UK. Atmospheric Environment – in press.
- Bush T., Smith S., Stevenson K. and Moorcroft S. Validation of Nitrogen Dioxide Diffusion Tube Methodology. Atmospheric Environment. AEA Technology, in press. Report available at http://www.aeat.co.uk/netcen/airqual/reports/valid/nvalid.html
- See also the introduction to Chapter 4

Macrositing

Macrositing or network design describes the process of siting stations within a territory aimed at optimising the information on the spatial distribution of levels within the territory. Since the essence of macrositing is not the assessment of concentrations at the monitoring site, but the optimisation of monitoring locations for translating the measured levels to other locations, it is discussed under methods of type 3 in Section 4.3.4 (Network design).

Micrositing

Once the location of the station has been established by macrositing, micrositing criteria are used to specify where exactly a sampling inlet is placed. The first Daughter Directive gives a technical summary in Annex VI. Useful background information can be found in (DETR, 1997) used in the UK and (TA Luft, 1986) used in Germany. A matter to consider is the possibility of co-location of measurements for pollutants that have different micrositing specifications. Inlets for roadside NO_2 monitors should be less than 5 m from the kerbside, while inlets for PM_{10} and lead should be sited so as to be representative of air quality near to the building line. Although these criteria may be incompatible in many situations, it is recommended to use the same measuring site where possible, not only to save costs but also to facilitate the interpretation of the monitoring results.

Quality Assurance

One of the major concerns of the directives is the need to assess the ambient air quality in the Member States on one common basis, in a uniform and coherent way. The Framework Directive (Article 3) and the first Daughter Directive (Annex VIII) contain a series of provisions to ensure better and more comparable air quality data. These provisions include:

- criteria for network design and site selection (Annexes VI and VII of DD1);
- data quality objectives in terms of minimum accuracy, data capture and data coverage of the measurements (Annex VIII of DD1);
- standardised reference measurement or equivalent methods (Annex IX of DD1);
- the certification of equipment (Article 3 of FWD);
- the designation of a national reference laboratory (Article 3 of FWD);
- the approval of laboratories (Article 3 of FWD);

- the organisation of intercomparisons at national and EU level (Article 3 of FWD).

4.3 Methods of type 3: Determination of spatial concentration distribution

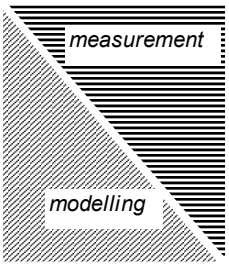
4.3.1 Introduction

The management and assessment requirements concerning a zone depend in principle on whether exceedence of the pertinent threshold occurs *anywhere* in the zone. Consequently the assessment of levels has to cover the entire zone and not only the spots where a fixed station exists. In current practice the measurements are taken as an approximation of this theoretical aim. A way to enlarge the spatial coverage of the assessment is to conduct indicative measurements. The new Directives, however, do not anymore assume that measurements are the sole tools to assess the levels in a zone. The Framework Directive also mentions "modelling techniques" and "objective estimation techniques"[12] (Art. 6); in addition, Art. 7 of the first Daughter Directive refers to information from other sources, such as "emission inventories (…) and air-quality modelling".

Automatic measurements are generally accepted as the most accurate methods to determine the levels at the sampling site, but standard methods of *spatial generalisation of measured levels* to determine the exceedence state of the entire zone do not seem to exist. Such methods have to be based in some way on concepts of representativeness of measuring sites and have inherent uncertainties that are difficult to quantify. Models, on the other hand, are by nature more suitable to provide a complete coverage of the territory, but they are generally regarded as less accurate than measurements.

Various combinations of measurements and modelling
It is important to note that the distinction between measurement and other assessment methods (interpretation, interpolation of measurements, modelling) is not as absolute as is often thought. There is no fundamental difference between assessment using common sense and assessment using mathematical techniques and models. Models may be described as mathematical formulations of one's understanding. Figure 4 illustrates that there is an almost continuous spectrum of combinations of measurements and other assessment methods. Neither of the two extremes is useful for investigating the state of compliance in a zone: 100% measuring (i.e. doing measurements that are not generalised at all) gives incomplete information, while, at the other extreme, 100% modelling (i.e. applying models that have not in any sense been validated) gives unreliable information. So, a useful assessment comprises elements of both.

100% measurement



a. Measurement, no interpretation
b. Measurement + interpretation
c. Measurement + interpolation
d. Measurement + model fitted to measurements
e. Data assimilation
f. Model validated by measurements in the same zone
g. Model validated elsewhere
h. Unvalidated model

100% modelling

Figure 4 - Combinations of measuring and modelling

[12] The term "objective estimation techniques" will be interpreted as mathematical methods to calculate concentrations from values measured at other locations and/or times, based on scientific knowledge of the concentration distribution. One example is linear interpolation based on the insight that the concentration pattern is sufficiently smooth. Another example is a dispersion model that has been adjusted to reproduce concentrations measured within its domain.

4.3.2 Groups of methods of type 3

In this section the most relevant methods to assess the spatial distribution of concentrations will be discussed. The range of methods suggested by Figure 4 will be grouped into four categories (rejecting the two extreme cases a and h):

A. Measurement + interpretation (b in Figure 4)
B. Measurement + mathematical generalisation (c and d)
C. Data assimilation (e)
D. Modelling (f and g)

Method 3A. Measurements + interpretation

The Directives allow the sole use of measurement data. This approach can also be regarded as assessment "where fixed measurement is the sole source of information" (DD1 Art. 7(2) and Annex VII) and assumes that the network covers and is representative of the entire territory. To fulfil this rather heavy demand the methods of type 2 need to be combined with a careful macro-siting strategy, in which the spatial representativeness of stations is well documented and the spatial coverage of the network is ensured. Part of this information is available through reports in the framework of the Exchange of Information Decision and EUROAIRNET, but information on the spatial coverage should be added. Macrositing is an essential part of network design, which is described separately in Section 4.3.4 (Network design). The text box below gives an example from Germany.

Example: Results from ambient air quality monitoring station and interpretation (Germany, State of Hesse)

Purpose of the method: Assessment of the air quality covering the total territory of the state. In preliminary assessment also to be used for a decision on how to locate zones.
Short description of the method: The results from all stations of the monitoring network are evaluated referring to the limit values and additional characteristic values of the first Daughter Directive (margin of tolerance, upper and lower assessment threshold). The air quality situation is documented by listing all stations in the order of their concentration level of specific components. The extent of exceedences of characteristic values (e.g. the limit value) can be easily assessed for each pollutant. Along with a good knowledge of the structure of the sources of air pollutants and of the geographical and meteorological conditions, this is also being used in preliminary assessment as basic information to define zones. As a precondition for this method the stations of the monitoring network must provide a sufficient spatial representation of the territory and must especially cover the areas where the highest load of air pollutants is to be expected. Once the zones are defined, this evaluation vice versa can be used to check the compliance with characteristic concentration levels (e.g. limit values), taking into account the points of highest concentration.
More detailed description:

- Beurteilung der Luftqualität im Lichtblick der neuen EU-Richtlinien zur Luftqualität (96/62/EG, 1999/30/EG), Schriftenreihe des Hessischen Landesamtes für Umwelt, to be published in 2000.
- See also the introduction to Chapter 4.

Indicative measurements as mentioned in Section 4.2 may also be used to supplement the information supplied by fixed measurements for the determination of the spatial concentration distribution. Their relatively low cost allow them to be used to measure air quality in numerous sites and to assess the distribution of pollutant over a given area. Maps of the pollutant concentrations can be obtained by interpolation of the measurements. As such they can be used for the mapping of air pollutants over an area in particular for the following applications: assessment of areas exceeding the limit value and of the population exposed; support for the definition of zones; classification of a territory in areas of homogeneous air quality; design and optimisation of monitoring networks; to help in the validation of mathematical models and in the control of the effectiveness of abatement measures.

Method 3B. Measurement + mathematical generalisation

This group of methods also relies fully on monitoring results, but the generalisation to territory-covering information is more elaborated. Also here a careful network design is needed (Section 4.3.4); the techniques to translate measured levels to other locations may allow a lower station density.

A common method to generalise the point-wise measuring data is spatial interpolation. An example from Belgium is given below. This technique is useful for uniform areas with smooth air quality gradients between stations, but small-scale variations between stations cannot be identified. It is used for large-scale distributions (continental, rural levels) and sometimes also for urban background patterns. From the maps produced, spatial statistics can be derived. The reliability of the highest spatial percentiles, including the zone's maximum (which is decisive for its compliance state), can be questionable in view of possible small-scale peaks.

Example: Spatial interpolation of measured concentrations (Belgium)
Purpose of the method: Calculation of territory-covering background levels of air pollutants
Short description of the method:
Concentrations at monitoring stations are interpolated using an Inverse Distance Power 4 method in which a weighting factor inversely proportional to the distance from a station is used. The concentrations are calculated for 5x5 km^2 squares covering the Belgium territory.
More detailed description: See the introduction to Chapter 4.

The interpolation is improved by using relationships between the air pollution levels and geographical characteristics, of which an example from Germany is given below.

Example: Model of LUA NRW, Beier and Doppelfeld (Germany)
Purpose of the method: Calculation of territory-covering maps of pollutant concentrations
Short description of the method:
The model is an intuitive approach to spatial interpolation of air quality data using local weight functions, normalised by a radius of influence. In addition, the resulting uncertainties are being quantified. The radius of influence used is an intuitive measure of the spatial representativeness of an air quality indicator of the monitoring site considered. Outside a circle characterised by the radius of influence, the monitoring data of the site considered are not taken into account in spatial interpolation.
More detailed description: See the introduction to Chapter 4.

The approach of using local characteristics for translating measured concentrations to other locations can also be used for the description of ensembles of similar small-scale situations like streets or surroundings of certain types of small businesses, for which it is at the Member State level not useful to give detailed individual maps. For selected key-parameters (regarding source magnitude, meteorological conditions, configuration) empirical relations with air quality levels are then established. From these relationships, pollution levels at other, similar locations are estimated and spatial statistics can be derived. This technique uses the key-parameters for the interpolation instead of the physical distance in case of spatial interpolation. An example from the UK is given below.

Example: High resolution background level mapping (UK)
Purpose of the method: Calculation of territory-covering 1km-resolution maps of background levels of air pollutants
Short description of the method:
Data from monitoring sites representative of rural concentrations are interpolated to produce a map of rural concentrations. The impact of local scale (<20 km) emissions of pollutants on ambient concentrations is then estimated using an empirical box modelling approach and added to the rural concentrations. The box models are calibrated using the relationships between measured concentrations and the values of surrogate local pollution statistics, such as emission intensity.
More detailed description:
- John Stedman, 1996. Revised High Resolution Maps of Background Air Pollutant Concentrations in the UK. AEA Technology. Report available at http://www.aeat.co.uk/netcen/airqual/reports/jsmaps/mphead.html.
- See also the introduction to Chapter 4.

When the relationships between air quality levels and local characteristics have a fair amount of detail, they can be regarded together as constituting a model. Models built from empirical relationships tend to be simple, whilst models based on physical, chemical and technological process information can range from simple to complex. But also in complex models, uncertain model parameters can be chosen for fitting the model results to measurements. This procedure of model fitting can give a detailed map or statistical overview of levels. This procedure does not take the uncertainties in the measured results into account. In some variants, the model can be

adjusted so as to exactly reproduce the measured key data (intelligent interpolation), but in general, the adapted model results are not identical to the measured data. Examples from Germany and the Netherlands are given below.

Example: FLADIS model (Germany)

Purpose of the method: Calculation of territory-covering maps of air pollutant concentrations taking also into account meteorological, topographical and emission data

Short description of the method:

Basic input to the model are the results of a continuous ambient air quality monitoring network. Additional information is linearly combined with the solution of the interpolation through a particular model formulation. Several well-known interpolation methods are installed under FLADIS to choose one that best represents a given situation. This is supported by using a weighing factor, equivalent to the modelled value. To take into account information such as emission structure, topography or meteorological data an additional balance model is introduced.

More detailed description: See the introduction to Chapter 4.

Example: Extrapolation of roadside measurements to the national scale (Netherlands)

Purpose of the method: Generalisation of levels measured in streets to statistics of all streets in the country

Short description of the method:

Results of the National Air Quality Monitoring Network, including 13 street stations, are used to estimate the total length of city roads in the Netherlands where standards are exceeded. The method consists of a dispersion model calibrated using of monitoring results (the CAR model), a database with model input information on roads in a number of cities and a statistical method to extrapolate the model results for the cities in the database to all cities in the country.

More detailed description: See the introduction to Chapter 4.

Example: Mapping PM_{10} concentrations (Netherlands)

Purpose of the method: Calculation of territory-covering maps of PM_{10} based on measurement and 5 km resolution model results.

Short description of the method: A 5 km resolution map of PM_{10} concentrations in the Netherlands is calculated using a long-range Lagrangian transport/deposition model. For all *regional* monitoring sites the difference between measured and modelled concentrations is determined; the differences are spatially interpolated on a 5 km grid. The PM_{10} concentration map is found by adding the difference map to the modelled map. In the resulting map the measured concentrations are reproduced and the local increases calculated by the model are also retained. PM measurements in cities are used for validation.

More detailed description: See the introduction to Chapter 4.

Method 3C. Data assimilation

The term data assimilation in principle encompasses methods under 3B, but usually it is refers to a more elaborate technique. It takes the uncertainties of model parameters as well as the measurement results simultaneously into account. It requires the user to quantify the uncertainty in the relevant model parameters (including input) and the measurement results used. The data assimilation technique adjusts the values of the uncertain parameters to find the best fit of the concentrations to the entire set of measurement and model data. The resulting map of concentration matches neither the original measurement nor the model results, but it gives the mathematically best approximation of both. Data assimilation thus takes the sometimes very different uncertainties in a balanced way into account, so it may be regarded as the optimum use of all information available. The application of this mathematical method to air pollution is fairly new. In its current state-of-the-art, data assimilation uses often a rather elaborate and specialised mathematical technique. A less complicated example from Norway is given below.

Example: Data assimilation (Norway)

Purpose of the method: Adjustment (assimilation) of calculated pollutant concentrations (by modelling) to results from a monitoring network, to improve the accuracy of modelled concentrations.
Short description of the method: Results from calculated concentrations, using an urban-scale dispersion model, are adjusted to measurements, using correction factors. Correction factors are calculated, by considering that the calculated pollutant concentrations at the measuring stations are linearly dependent upon the emissions from each of the main sources, source groups and the (extra-urban) background concentration. Also taken into account are the error functions resulting from uncertainties in measured pollutant data, emissions, dispersion data and model formulation. Using such procedures, the correlation factor and error statistics between measured and calculated values is usually significantly improved.
More detailed description: See the introduction to Chapter 4.

Method 3D. Modelling

When the levels are calculated by a validated model one usually has some insight into the accuracy of the results[13]. This insight tends to be better for models that have been validated under the local conditions. Often models are used that have been validated in other regions, with sometimes considerably different conditions (emissions, topography, climate) than those prevailing in the area concerned. Since not only the reliability of the dispersion model, but also the quality of the emissions and dispersion input parameters may be different, an evaluation of the uncertainty of the model results needs more judgement then and could include local validation. Complete validation should in principle also include a delineation of the applicability limits of the model. A description of modelling including an overview of emission data has been given in the Guidance Report on Preliminary Assessment (Van Aalst et al.,1998). A model documentation centre on the Internet has been made available by the European Topic Centre on Air Quality: http://aix.meng.auth.gr/lhtee/database.html. Some examples from Norway and Denmark are given below.

Example: Dispersion modelling (Norway)

Purpose of the method: Calculations using urban-scale dispersion model to determine spatial concentration distribution, and to assess causes of air quality problems.
Short description of the method: Concentrations of pollutants are calculated with an urban-scale dispersion model, which is a combined Eulerian/Lagrangian model combining modules for area, line and point sources (the NILU AirQUIS/EPISODE model system). It is possible to calculate concentrations in grid centre points and also in specified receptor points anywhere within the gridded area. Such models enable the calculation of spatial and temporal pollutant distributions, exposure distributions (in principle of any "object" population, buildings, etc.), as well as contributions to the concentrations from source groups or single sources. Such models require good emission inventories with high spatial and temporal resolution for the main sources and source groups. The model was validated for Oslo, using several monitoring stations. A variety of extracts of results can be made from such model applications. The example in the more detailed description shows the spatial distribution of the 8th highest 24-hour PM_{10} value (i.e. exceedence of the EU limit value); the population load distribution for PM_{10} above 35 ug/m3 (Norwegian guideline, as example), all sources are included as well as the contribution from the two main sources: traffic and wood combustion (for space heating).
More detailed description: See the introduction to Chapter 4.

Example: Modelling street pollution (Denmark)

Purpose of the method: Calculation of time series of air pollution in streets
Short description of the method: The Danish Operational Street Pollution Model (OSPM) belongs to a category of parameterised models. OSPM calculates the concentrations of exhaust gases using a combination of a plume model for the direct contribution and a box model for the re-circulating part of the pollutants in the street. Parameterisation of flow and dispersion conditions in street canyons was deduced from extensive analysis of experimental data and model tests. Results of these tests were used to further improve the model performance,

[13] The distinction between validated and unvalidated models is not always as clear as is sometimes believed. On the one hand, even unvalidated models have (indirectly) been based on measurements. On the other hand, even validated models can have erroneous results. For example, verification of point source models tends to focus on validation of the dispersion part of it. When such a model is applied to a very uncertain emission, calculated concentrations are very uncertain as well. So validation should include all elements involved in the calculations.

especially with regard to different street configurations and a variety of meteorological conditions. The model calculates a time series of the pollutant concentrations with a resolution of 1 hour. The calculations can be made for all points along the street and at different heights above the ground. The limit values are calculated from the modelled hourly time series. The model requires input regarding emissions from vehicles, street configurations, meteorology over roof tops (especially wind direction and wind speed) and urban background concentrations of the pollutants (measured or modelled). OSPM requires very modest computer power. Typically, calculation of a 1 year time series can be done in less than 20 sec on a 200 MHz Pentium PC. Although, the model results are still reasonably accurate and comparable to much more time demanding 3-D numerical models. The model is also an element of a new integrated 3 days forecasting system for regional, urban background and street pollution. The model gives easily time series of 1-hour averages over a year, which allows calculations of all limit value parameters.

Remarks:

More detailed description:

- Berkowicz, R. (1998) Street Scale Models. In: Urban Air Pollution- European Aspects, Edited by Fenger, J., Hertel, O. and Palmgren, F. Published by Kluwer Academic Publishers. Dordrecht. The Netherlands.
- Brandt, J., Christensen, J.H., Frohn, L.M. and Berkowicz,R. (2000). Integration of Regional, Urban Background and Street Canyon Models for Operational Air Pollution Forecasting. Presented at EUROTRAC-2 Symposium 2000. Garmish Partenkirchen 27-31 March, 2000.
- See also the introduction to Chapter 4.

Example: Utilisation of modelling results for selected streets (Denmark)

Purpose of the method: Generalisation of modelled levels for selected streets to statistics for all streets in the country.

Short description of the method: OSPM calculations were carried out for 103 selected streets in the Copenhagen area with a wide range of traffic loads and street configurations in order to generalise the results to traffic conditions in other urban areas. Results of these calculations, in the form of annual and percentile statistics, were subsequently generalised by plotting the concentrations as function of the traffic emission density in these streets. With these plots, a rough estimate of the expected air pollution levels in other streets can be made using the traffic density as the only input parameter. This method should be used for urban areas with similar meteorological and urban background conditions.

The impact of new EU vehicle emission and fuel quality directives on the future air quality in Danish cities has been modelled for comparison with new limit values in the Framework Directive. The assessment is carried out for the reference year 1995 and the scenario years: 2000, 2005, 2010, 2015 and 2020. Modelled health related substances include: NO_2 (NO_x), O_3, CO and benzene. The results were compared with the findings from the European AutoOil II Programme, which included calculations of traffic pollution in Milan and Berlin.

Remark:

More detailed description:

- Jensen, S.S., Berkowicz, R., Winter, M., Palmgren, F., Zlatev, Z. (2000): Future Air Quality in Danish Cities. Impact Study of the New EU Vehicle Emission Standards. To be published at the home page of Danish Environmental protection Agency (www.mst.dk).Berkowicz, R. (1999): Case Study of Traffic Pollution in Urban Streets in the Framework of AOPII. Application of the Operational Street Pollution Model (OSPM) for two Streets in Milan and Berlin. National Environmental Research Institute, Denmark. 34 p.
- See also the introduction to Chapter 4.

Combinations of the above methods

The assessment methods given above can be combined. E.g. in current practice the larger-scale background levels are often directly taken from measurements and added to the contribution of local sources calculated by a model.

4.3.3 General remarks on methods of type 3: the determination of exceedences

4.3.3.1 Spatial resolution of limit values

In principle, models can give values for concentrations at every square metre in a zone. When concentrations determined by such techniques are compared with air quality thresholds, the spatial resolution becomes important: a high resolution tends to result in higher maximum concentrations, found at small-scale hot spots, and consequently the exceedence state of a zone depends on the resolution[14]. The specifications in the first Daughter Directive of where stations should be sited with respect to peaks, give useful characterisations of the averaging area to be taken when relating model results to limit values. Annex VI of the first Daughter Directive makes a distinction between sampling points for the protection of human health and for the protection of ecosystems and vegetation.

Limit values for health

For health, Annex VI of the first Daughter Directive states that "… sampling point should in general be sited to avoid measuring very small micro-environments in their immediate vicinity. As a guideline, a sampling point should be sited to be representative of air quality in a surrounding area of no less than 200 m^2 at traffic-orientated sites and of several square kilometres at urban-background sites". The annex states that "…sampling points should be at least 25 m from the edge of major junctions and at least 4 m from the centre of the nearest traffic lane; for nitrogen dioxide, inlets should be no more than 5 m from the kerbside". These provisions not only guide the siting of stations, they also provide a rough guideline for the interpretation of detailed maps calculated by models or other mathematical techniques. For example in streets the strip of 5 meters along the kerbside within which the Directive allows the inlet location to be chosen would, combined with the area of 200 m^2, results in an averaging length of some 40 m alongside the vehicular traffic lane. Smaller-scale peaks must not be compared with these limit values.

The first Daughter Directive does not give indications of spatial resolution for hot spots around point sources. This matter is important, especially when considering a low source of e.g. a small enterprise in a residential area that causes concentrations at neighbouring houses to exceed a limit value. Reasoning from the principle that every citizen should be protected, the Working Group regarded it appropriate to use a minimum resolution of approximately the size of an individual house, which is of the same order of magnitude as the 200 m^2 for traffic situations. This high resolution is often not needed in assessments, though. For a residential neighbourhood in the direct vicinity of an industrial area, the assessment could be based on a larger resolution, e.g. 250x250 m^2 as is done in Germany. It is difficult to give more precise guidance; also considerations of population exposure during periods of the averaging times of the limit values should then be taken into account.

Limit values for ecosystems and vegetation

Annex VI of the first Daughter Directive defines the spatial resolution of the limit values for ecosystems and vegetation also in terms of the siting of stations[15]: it should be at least 1000 km^2, and areas in the vicinity of built-up areas, industrial installations or motorways should not be taken into account. The annex also gives some flexibility to Member States. Again, these provisions can be used as a guide to chose the resolution when techniques such as models are used.

4.3.3.2 Areas where the limit value is applicable

Limit values for health

The directive does not define types of areas that need not be protected by the limit values for health. The question arises whether types of "irrelevant" areas may exist to which the limit value does not apply. Also here, the territory-covering output of models makes this more relevant than previously: when assessing air quality solely by measurements, irrelevant locations could in practice be neglected by not placing measuring stations there, without formally deciding on the irrelevance.

[14] The resolution problem is not only restricted to model results; open path measuring techniques determine average concentrations along an extended path.

[15] Annex VI of the first Daughter Directive: "Sampling points targeted at the protection of ecosystems or vegetation should be sited more than 20 kilometres from agglomerations or more than five kilometres from other built-up areas, industrial installations or motorways. As a guideline, a sampling point should be sited to be representative of air quality in a surrounding area of at least 1 000 km^2 . A Member State may provide for a sampling point to be sited at a lesser distance or to be representative of air quality in a less extended area, taking account of geographical conditions."

The Working Group felt that the directives are ambiguous in this matter. On the one hand, all four aims of the Framework Directive pertain directly to ambient air quality (Article 1), while ambient air is defined in Article 2 as "outdoor air in the troposphere, excluding work places". On the other hand the first Daughter Directive, in Annex VI(I), relates the siting of monitoring stations to areas where "the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s)". It seems reasonable to assume that these siting criteria for monitors generally imply where air quality needs to be tested against the limit value. So, there seems to be an ambiguity as to whether exceedences at locations where exposure is not likely (or even virtually impossible) should be regarded as a legal exceedence to be reported to the Commission.
The Working Group felt that the general principles expressed by the Framework Directive are so clearly expressed that they can not be disregarded as the basis for the guidance: the limit values apply everywhere, except at work places. Consequently, the Working Group recommends that air quality is assessed throughout a Member State, except at workplaces and to regard any exceedence of the limit value (and limit value plus the margin of tolerance) as a legal exceedence.
Although issues related to air quality management are beyond the remit of this guidance, the Working Group notes that this view is based on the assumption that a pragmatic approach to the consequences of this interpretation will be taken in respect of reporting, monitoring and management. Where there is likely exposure to air pollution above a limit value, the full extent of this guidance should be followed in respect of reporting and assessment, and air quality management arrangements should be put in place in accordance with Article 8 of the Framework Directive. The position will be different in those cases where exposure to air pollution above a limit value is not likely, e.g. in the immediate vicinity of rural stretches of motorways. In those circumstances, it is judged that a cost-benefit approach to assessment will result in a strategic decision not to pursue monitoring where no exposures will be determined. Furthermore, as such areas will usually not be disconnected from other non-compliant areas where exposure is likely, it is most probable that management plans for the reduction of air pollution will also be effective in these areas where exposure is not likely.

Limit values for ecosystems and vegetation
For assessing exceedences of the limit value of ecosystems and other vegetation, Annex VI of the first Daughter Directive gives the siting specifications quoted in footnote 15 of the previous section. As the limit values for the protection of ecosystems and vegetation are more stringent than those for the protection of health, it can be concluded that the limit values for ecosystems and vegetation do not apply within or near built-up areas, industrial installations and roads, nor to individual ecosystems and vegetation areas smaller than about 1000 km^2. It should be noted that this does not imply that air quality assessment or protection of such areas is not needed. In view of the vast variety of these areas it was deemed to be impossible to address this at the EU level, and so this is the sole responsibility of the Member States, in correspondence with the subsidiarity principle. The directive does not specify how to deal with the transition areas between rural areas and e.g. cities.

4.3.3.3 Modelled exceedences and compliance status

The new air quality directives encourage assessing air quality by methods other than measurement alone. This makes it necessary to consider the possibility that limit value exceedences are found through the use of models . It is important to consider the situation that measurement has an outcome different from the results of another method such as a model. Even if the model[16] gave reliable results and was consistent with the measurement results (within their uncertainty ranges!), this could be regarded as conflicting information. This is particularly important when it concerns the exceedence of a threshold. **Error! Unknown switch argument.** illustrates this: (a) is the ideal case (modelled=measured, station sited exactly where the modelled maximum is calculated), (b) less ideal (modelled=measured, station not sited at the modelled maximum), (c) the realistic case (modelled≠measured, station not sited at the modelled maximum). The possibility that a model predicts an exceedence that is not measured is not at all trivial, since it is often not feasible to have a station at the location of the highest concentration in an area. Even if this had been the case at the design of the network, new developments, e.g. traffic changes or changes within industrial areas, may move the highest pollution levels to other places, since fixed monitoring stations should not be moved too readily as this would complicate the interpretation of air quality trends.

[16] The term "model" includes all other mathematical techniques.

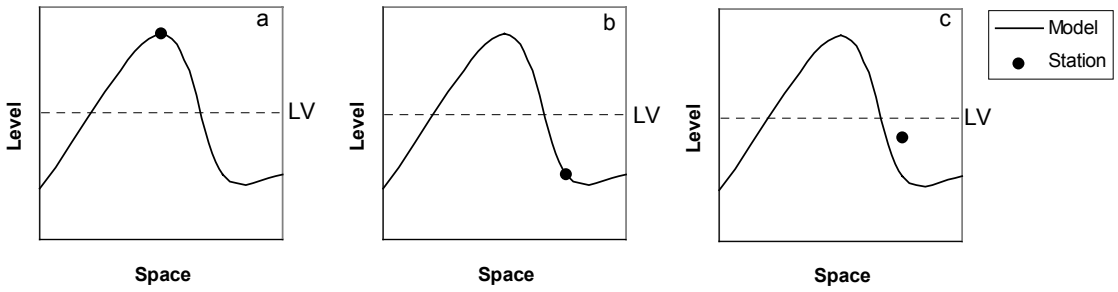


Figure 5 Measured versus modelled exceedence of a limit value (LV)

Legally, a zone is either in compliance with a limit value or not. There may be significant uncertainties, but for legal reports on the situation of the preceding year a clear yes/no decision needs to be taken. This section gives a recommendation on this decision procedure in case measurements and models give conflicting evidence on the compliance status[17].

(1) If high quality measurements show exceedence, while models do not, the zone is taken to be non-compliant, in accordance with the usual procedure.

(2) For the more difficult case that no exceedences at measurement locations in the zone have been found, but exceedences were found by model calculations at other locations, two lines of reasoning should be taken into account.

In the first place, models are, at least in most cases, less reliable than measurements. Moreover, the definition and determination of uncertainty is considerably less developed for models than for measurements. In view of the potentially large uncertainties and also from experience, inadequate use of models can be anticipated. In the air quality directives, reporting of exceedences is only specified for observed exceedences. A further point is that the uncertainty requirements for models given in Annex VIII of the first Daughter Directive are considerably less demanding than for measurements, indicating that the use of models was not intended to give legal evidence. These arguments would lead to the conclusion that modelled exceedences should not be taken as legal exceedences and that confirmation by fixed and high quality measurements is always needed for a legal conclusion on exceedence.

On the other hand, it is important to realise that one can not measure everywhere and that limit values apply not only where stations are situated; for locations without a station, the representativeness of measurements is uncertain, and may involve similar, sometimes even larger uncertainties than model results. Furthermore, excluding the use of models for compliance checking would force the Member States into a high monitoring effort. For pollutants for which busy streets are known to be in exceedence, this would mean having at least one busy street station in all zones, even if exceedence could be deduced with certainty from street measurements in other zones. Around point sources, several monitors would be needed for surveillance of maximum levels and the need to survey population exposure would suffer due to the very strong emphasis placed on attempting to monitoring maximum levels. Relying entirely on measurements also endangers the continuity of measurements: when situations change, monitors need to be replaced. Near point sources the short term maximum may even change position from year to year. Since the decision on a zone's compliance status refers to the past (or current) year, confirmation by measurements is in principle not possible by new additional measurements. In favour of model use one may legally argue that Art. 11(1b) of the Framework Directive requires the Member States to report a list of zones exceeding the limit values, which entails the possibility to report modelled exceedences.

The Working Group felt that the added value of models and other assessment techniques such as indicative measurements should not be disregarded in the assessment of the compliance state of a zone. At the same time, it acknowledged that the uncertainties of these methods, and the novelty of this approach, call for a more restrictive

[17] The procedure not only applies to limit values, but also to other thresholds like the upper and lower assessment thresholds.

attitude than in the case of measurements. Fixed measurements are regarded as more reliable than models by the public, policy makers and (implicitly) in the Framework Directive. Although this may not always be true, the Working Group proposes that in deciding legally whether an air quality threshold is exceeded, preference is always given to measured results in those cases where conflicts arise between measured and modelled data. It recommends making a distinction between model use for compliance checking and other model use. If a model is used to assess whether areas in exceedence exist within a zone, where no exceedence has been measured, the model result is only regarded as a legal exceedence if the Member State is able to show that the calculations are sufficiently reliable to warrant the important consequences of a limit value being exceeded[18]. Member States do not have to report modelled exceedences to the Commission if the calculations were not intended for compliance checking or if the quality of the calculations is not sufficient. In practice this will mean that the judgement of the Member State will be very important until more formal uncertainty criteria will be available. Modelled exceedences that are not judged to be reliable enough to be taken as evidence, should trigger further investigation by measurement. This restricted use of models for compliance checking could reduce the measuring burden, provided that the quality of the assessment does not suffer (see also Section 3.4 on Supplementary Assessment methods).

4.3.4 Network design

4.3.4.1 Introduction

Compared to the old air quality directives, which aimed mainly at compliance checking, the monitoring objectives of the Framework Directive and the first Daughter Directive are now much broader:

- to determine compliance with the air quality limit values of the first Daughter Directive (e.g. FWD, Art. 8);
- to assess exposure of people, addressing both the highest levels and the levels in other areas where the general population is exposed;
- to assess the exposure of ecosystems and vegetation (e.g. DD1, Annex VI); to inform the public (e.g. DD1, Art. 8);
- to produce emission/exposure relations (e.g. FWD, Annex IV); to support legislation development (e.g. DD1, Art. 5(2) on $PM_{2,5}$).

Consequently, it is difficult to adopt a very focussed approach to network design on the basis of the monitoring objectives.

Section 2.2 discusses how the requirements for measurements and other assessment methods depend on the pollution level in the zones. Monitoring at fixed stations is mandatory in the more polluted zones and a minimum number of stations is prescribed if monitoring is the sole assessment method. (However, in these circumstances the complexity of the air pollution distribution usually makes it preferable to use more stations.) It is appropriate here to point to one important item in the directives which may substantially influence the design of the network: the availability of information other than from the monitoring itself, that is: supplementary information (see Section 3.4). Obviously, if validated air quality models are available for an area, they would, as a general rule, decrease the extent of the monitoring required. Figure 4 and Section 4.3 indicate the interplay between monitoring and modelling in various combinations of the two.

4.3.4.2 Network design process

In discussing network design in connection with this guidance, three topics will be considered:

1. Station classification
2. Number of stations
3. Location of stations.

[18] This recommendation can be regarded as a logical extension of the general approach of the Framework Directive. Less accurate methods like models can be used to demonstrate the compliance state of a zone if the levels found are sufficiently far below the limit value (viz below the lower assessment threshold) or, as in this recommendation, above the limit value.

Station classification
Since a network in practice only has a limited number of stations, and since the monitoring must be part of the basis for assessing compliance and exposure, stations must in some way represent other pollution/exposure situations in the zone. Data for a small set of locations need to be translated into information on a much larger area (consisting of similar locations). This is the essence of network design. This is particularly important for the assessment of numerous similar small-scale situations, like streets or small industries, which cannot be individually assessed by monitoring. It is often assumed that concentrations monitored in one or a few streets are representative for all other streets of similar type. Similarly, the background levels in a city are often assumed to be characterised by one or two stations. So, it is often assumed that an assessment of one location can be used for other, similar locations.

Important tools to differentiate between the types of situations that stations characterise are *station classification schemes*. The scheme used in connection with EU air quality directives is the one defined in the Exchange of Information (EoI) Decision. It defines stations as traffic (T), industrial (I) or background (B), which are located in various types of areas: urban (U), suburban (S) or rural (R). Such surrounding areas are characterised as residential (R), commercial (C), industrial (I), etc. This classification is presently also used in the EUROAIRNET network of the EEA (Larssen et al., 1999). A revision of the EoI Decision, including its classification, had recently been proposed at the finalisation of this guidance.
The possibility of using this (or similar) classification schemes as a tool to using monitoring data for assessment in zones based upon a limited number of stations, is enhanced if some more specific data are collected from the stations:

- For T stations, traffic data, as well as distance from the kerb;
- For rural B stations, the distance to nearest main source areas.

Such data are being collected for EUROAIRNET stations. The report on Criteria for EUROAIRNET (Larssen et al., 1999) gives more details. The new proposed EoI Decision also requests such and other meta-data, which are necessary as a guide in assessing representativeness.

Number of stations
The first Daughter Directive (Annex VII) sets the minimum number of stations in a zone where levels above the upper or lower assessment threshold occur and where monitoring is the sole source of information about the air pollution level. Often a higher number is needed, depending on the complexity of the concentration distribution across the zone and the variety of source types. Even when Supplementary Assessment methods are applied, the number of stations needed is in many cases not expected to be below the minimum given in Annex VII (see Section 3.4).

Location of stations
Often a monitoring network already exists. For the purpose of complying with the requirements in the directive, the network "designer" (the institution which is responsible for designing the assessment system for a Member State or for a zone under the Directives) has to go through the steps of network design described here. The resulting design must then be compared with the existing network and, where needed, changes can be made.

The step-wise process would be along the following lines:

1. Preliminary assessment of where in the zone monitoring may be needed
To investigate how the spatial distribution of levels can best be assessed, the designer first estimates where in the zone relevant levels may be expected (in the first stage of implementation of the Daughter Directive this will be the Preliminary Assessment, later it will be the periodical revision of the assessment system). Two types of levels are relevant: (1) limit value exceedences and (2) typical exposure levels.
Then the designer classifies at which types of locations the relevant levels are expected[19]. For the location types the station classification described above is used. The relevant types of locations depend on the pollutant.

2. Distribution of locations of monitoring stations
The designer then investigates how a limited number of stations can be distributed over and within these location types to give the best description of the relevant levels in the territory. Each relevant location type should be represented by one or more stations of the corresponding type. Out of the very large number of locations of a certain type that are to be assessed, the designer selects one or several locations that are suitable, to the extent possible, representative of a larger set of relevant locations of this type.

[19] More types can be distinguished, but this would reduce the number of stations per type.

3. Applying the data from the network in assessing the spatial distribution

In this process the designer then takes into account the possibilities to generalise the measured concentrations, i.e. translate the results to the other locations of the area type considered. Several ways of describing the spatial distribution resulting from this generalisation can be aimed at. Often an informal method is used, without quantitatively specifying the size of the area that a station represents. More elaborate methods aim at deriving maps of concentration levels over the territory. On a national scale mapping is possible for rural levels and possibly for urban background levels, but for traffic and industrial locations maps are not always feasible or useful. In such cases statistics of the distribution of concentration levels are more appropriate, e.g. the total street length in exceedence of a threshold value. These methods are in development (see also the methods 3B).

Based on the possibilities of generalising the results of measurements at individual locations, the designer then determines the measurement locations. In the case of assessment by measurements alone, the levels at the station sites by themselves should be as much as possible representative of the levels throughout the territory. Annex VI(I) of the first Daughter Directive gives useful directions for this. In the case of assessment using mathematical methods as a supplement, the station locations are in addition chosen to optimise the possibilities for generalisation of measurement results using such supplementary methods.

4.3.4.3 Using data from other zones

One of the main reasons to introduce Supplementary Assessment methods was that this opened the possibility to use monitoring data from one zone in another, instead of relying only on monitor data collected in the zone under consideration. Obviously rural background can be better estimated when monitoring data from surrounding zones are also used, e.g. by interpolation. Also the assessment of levels in streets can be substantially improved by taking more than the (often very small) set of stations available in a single zone into account.
A difficult question is whether data from other zones can be used to assess non-compliance in a zone. A relevant example is whether it would be possible to demonstrate limit value exceedence near busy streets by analysis of monitoring data at similar station locations in surrounding zones, taking account of differences in meta-data (e.g. traffic data for a street). In Section 4.3.3.3, where this is discussed in more detail, it is concluded that this would be possible only when the conclusion on exceedence can be demonstrated to be reliable.

Example: Network design (France - draft version)

Purpose of the method: Identification of city areas where urban background air pollution is expected to be the highest.

Short description of the method:

Population iso-density zones of a city are distinguished on the basis of a related relative coefficient, which is ranked from 0 to 100 (100 for the highest density, proportionally lower for the others):

- Coefficient for population CP
- Coefficients CT for traffic, CC for domestic emissions and CI for industry emissions. A total emissions coefficient CE is deduced.
- A final coefficient of surveillance CS is calculated from CP and CE to characterise locations where a monitoring station is needed (CS > 60).

It is recommended to validate the monitoring locations with mobile laboratory or diffusion tubes campaigns.

More detailed description:

- Etude préliminaire à la mise en place d'un dispositif de surveillance de la qualité de l'air dans l'agglomération mancelle - LOIRESTU'AIR (Réseau de surveillance de la pollution de l'air Nantes-Estuaire de la Loire) DRIRE pays de la Loire (Direction Régionale de l'Industrie, de la Recherche et de l'Environnement) - 26/06/1996
- Original document edited for the Guidance Document
- See also the introduction to Chapter 4.

4.4 Methods of type 4: Analysis of the causes of air quality problems

4.4.1 Introduction

The title of the Framework Directive refers to both assessment and management. Management of air quality requires good insight in the causes of air pollution and so their analysis is a prominent element of the assessment procedure. In cases of exceedence of an air quality threshold, the Framework Directive requires the Member State inter alia to report on the reasons of exceedence. Local topography, climatological features or meteorological events may be important to explain the high levels, but conditions that exist beyond human control are not regarded as relevant reasons in this context. Consequently, "reasons of exceedence" is read as sources or source categories[20].

4.4.2 Groups of methods of type 4

There are several techniques of analysing the sources contributing to air quality levels. These methods may be categorised into three classes:

a) Analysis of differences between levels measured at different stations;
b) Dispersion modelling: calculation of how known emissions disperse in the atmosphere;
c) Receptor modelling: analysis of similarities in concentration patterns and known emission patterns.

When applying any of these methods, important assumptions have to be made (on source distribution, emissions, atmospheric transport) and consequently it is preferred to apply all three methods in an analysis.

Method 4A Analysis of differences between levels measured at different stations

There can be many reasons for differences between levels measured at different stations. Assuming that quality control problems can be excluded, differences in local topography, obstacles, surface properties, climatology and meteorology may by themselves cause air quality levels to be different. Often, however, differences can be mainly ascribed to the presence of nearby sources. The most common example is the difference between the level at a station situated near a significant source and the background level estimated from surrounding background stations. Simple subtraction yields an estimate of the contribution of the source at the local station site. A more detailed analysis by subdividing the hourly concentrations measurements into classes of meteorology is very useful to corroborate the conclusions; in particular comparison of concentration wind roses is important to confirm that differences occur at the expected wind directions. One should be aware of limitations of this method. In addition to the other possible causes of the differences mentioned above , uncertainties may arise from the assumptions made regarding the source configurations relative to the stations. When for instance, a more or less homogeneous air pollution pattern is observed in a network, it may be regarded as a large-scale background level caused by remote sources common to all stations, but it may also be due to local sources present near all stations (e.g. wind blown dust in rural areas, residential heating in a city). An essential requirement of this method is that at least two stations are needed; exchange of data between zones and between Member States greatly enhances the to use this method.

Method 4B Dispersion modelling

Dispersion modelling, as a method to analyse which sources contribute to air quality levels, is essentially the same as Method 3D (modelling to determine the spatial concentration distribution), see Section 4.3.2. Application of Method 3D is possible only when the sources concerned and their emissions are known inputs to the model. The use of the model here is to analyse the causes of air pollution by quantifying the fractions of the concentration levels associated with the various sources.

Example: Dispersion modelling (Norway)

See the example given for method 3D.

[20] Local configurations such as poorly ventilated street canyons are in principle also susceptible to improvement measures. In that case the configuration might also be regarded as a reason of exceedence.

Example: Utilisation of modelling results for analysis of measurements (Denmark)

Purpose of the method: To analyse the causes of air pollution and to quantify the fractions of the levels associated with the various sources.

Short description of the method: The relationship between emissions and pollution concentrations can be established by means of an air quality model describing the governing physical and chemical processes. However, when good quality air pollution measurements are available, emissions from traffic can be calculated applying the relationships described by an air quality model. Such a procedure was applied to measurements from an extensive monitoring site at Jagtvej, Copenhagen and using the Operational Street Pollution Model (OSPM). Calculating the diurnal emission profiles for several years provides estimation of the trends in the traffic contribution to air pollution. Concentrations depend on both emissions and meteorology, whereas the trend analysis of emissions is independent of the inter-annual variations in the meteorological conditions. Detailed traffic counts distributed on various vehicle categories provide the possibility for determination of emission factors for each category. For a specific hour the total emission can be expressed as a sum of contribution from different vehicle categories, inter alia diesel and petrol vehicles. Applying multiple regression analysis methods, the emission factors associated with the different vehicle categories may be determined by best fit to the diurnal air quality and traffic profiles.

More detailed description:

- Palmgren, F., Berkowicz, R. Ziv, A. and Hertel, O.: (1999), Actual car fleet emissions estimated from urban air quality measurements and street pollution models, The Science of the Total Environment, 235, 101-109.
- See also the introduction to Chapter 4.

Method 4C Receptor Modelling

The term receptor modelling refers to a group of statistical techniques to analyse concentrations measured at monitoring sites to estimate sources contributions to these levels. One of these methods is Principal Component Analysis (PCA) in which patterns in the concentration measurements are identified which can be associated with source categories. Input for PCA may consist of time-series of measurements of various compounds at one monitoring site or simultaneous measurements of various compounds at a number of monitoring stations. Prior information on potential sources such as emission profiles (ratios between compounds in the emission of a source category) and locations further supports PCA. Another technique, source apportionment by Chemical Mass Balance (CMB), results in more quantitative information on the contribution of the identified source categories to the air quality at a monitoring site. CMB requires similar data input as PCA, as well as emission profiles of the contributing sources. The above approaches can also be applied to physical characteristics such as the shape of particulates, blackness of filters or isotope composition.

Receptor modelling is based upon the assumption of conservation of mass of emitted components during transport from sources to monitoring sites. Thus, deposition processes and chemical reactions should be limited during atmospheric transport. Therefore, receptor modelling has been mainly applied on an urban and regional scale. The emphasis has been on source apportionment of particulate matter and volatile organic compounds.

Combinations of the above methods

Combinations of the above methods can be useful: measured concentration patterns can be analysed by methods 4A and/or 4C and models can be used to supplement the analysis for locations where no measurements are available.

4.4.3 General remarks on methods of type 4

4.4.3.1 Repetition of analysis

In contrast to the assessment of exceedences of methods of type 3, continual repetition of the analysis of causes is not always needed: classification of situations based on earlier analyses, confirmed by expert judgement, often gives sufficient information to report on the reasons of exceedence. E.g. repeated analysis of exceedences at traffic stations is not very useful when background levels remain essentially the same. This is even more relevant for exceedences of alert values, the reason of which has to be made public with a few hours.

4.4.3.2 Definition of exceedence due to natural sources, natural events or winter road sanding

Member States are not required to apply the standard procedure of reduction measures if limit value exceedence is due to natural sources (for SO_2), to natural events (for PM_{10}) or to the resuspension of particulates following winter road sanding (for PM_{10}). To justify this, the Member State needs to demonstrate that in the absence of the natural sources, natural events or winter road sanding the limit value would not have been exceeded. It should be noted that there are significant differences between the definitions of the derogation situations. In the case of PM_{10} the first Daughter Directive specifies also that the exceedence needs to be "due to natural events which result in concentrations significantly in excess of normal background levels from natural sources". Article 2 of the first Daughter Directive defines 'natural events' as 'volcanic eruptions, seismic activities, geothermal activities, wild-land fires, high-wind events or the atmospheric resuspension or transport of natural particles from dry regions'. Natural sources should not be confused with sources of natural material. Dust thrown up by traffic may consist of natural material like sand, but the cause being traffic, it is not a natural source.

Chapter 5 Concluding remarks

This guidance attempts to assist those responsible for the assessment of air quality under the new EU air quality directives. Although many aspects have been addressed, the Working Group is aware that the guidance is not complete: some issues have not been addressed at all and for some other issues problems have not been completely resolved.

The report only addresses implementation matters that relate directly to the assessment of air quality; other aspects such as action plans were beyond its scope. Another limitation is that only the first Daughter Directive has been considered. Most of the guidance given here can also be directly applied to subsequent Daughter Directives, but particularly the proposal for the new ozone directive has some new elements that have not been dealt with here.

The descriptions of assessment reports given in Chapter 3 will overlap with the results of the Article 12 Committee (see Section 2.5), which was not yet available at the finalisation of this guidance. The Committee will specify the reporting requirements officially and in more detail than this guidance, and it cannot be excluded that some differences to the description in Chapter 3 will occur. However, the description of reporting requirements in this guidance were given to clarify the output that assessment methods should be able to give, so minor discrepancies are not expected to be a problem.

A more important point is that the Working Group could not clarify all issues that were within its scope. This was partly due to the limited time available, but also lack of clarity in the directives themselves made it very difficult to develop straightforward and consistent guidance. Some problems were associated with the fact that the directives use zones to define assessment requirements, but do not pose any limitations to how Member States may define their zones. Another problem area is related to the introduction of new methods, in particular Supplementary Assessment methods such as models. Although the Working Group believes that this is a major step forward in making air quality assessments complete and useful, the fact that Supplementary Assessment was not foreseen in the Framework Directive gave rise to considerable ambiguities, such as the lack of clarity as to how to report the results of supplementary assessment methods. This type of legal assessment being new, the Working Group could not rely on existing practice.

The introduction of models brought along new issues to consider, such as the uncertainties of models. The issue of uncertainty is extremely important, but the Working Group recognised that the development of consistent and operational guidance would not be possible before better insight in the implementation system has been developed. It decided to leave detailed guidance on uncertainties and validation to a later stage. Another difficult point was that the potential of models to cover the entire territory made it more urgent to define the spatial aspects of the limit values. Since the directives are ambiguous in this field, the Working Group was not able to fully resolve these matters.

It is emphasised that assessment methods are in a process of continuous development, not in the least stimulated by the implementation work that is commencing now under the new air quality directives. One of the reasons why the air quality directives or this guidance did not specify the assessment requirements in great detail was the danger of blocking the development of new methods. During the next few years, new operational techniques will be become available and a great deal will be learned from practical experience. As a result, parts of this guidance, in particular the set of examples, will become outdated. The Working Group expects that, to maintain coherence in the assessment approaches throughout the EU also in the future, this guidance will need to be revisited in the forthcoming years.

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Annex I Members of the Working Group

DENMARK / CHAIR	Finn Palmgren National Environmental Research Institute P.O Box 358 Frederiksborgvej 399 DK – 4000 Roskilde
UNITED KINGDOM / CO-CHAIR	Trudie McMullen DETR Zone 4/E14 Ashdown House 123, Victoria Street UK – London SW1E 6DE
BELGIUM	Alain Derouane CELINE/IRCEL Avenue des arts, 10-11 B – 1210 Bruxelles
FRANCE	François Mathé Ecole des mines de Douai Département chimie et environnement 941 rue Charles Bourseul B.P 838 F – 59508 Douai Cedex
ITALY	Franco De Santis CNR – Istituto Inquinamento Atmosferico Area Ricerca Roma, Via Salaria Km 29,3 CP 10 I – 00016 Monterotondo Scalo, Roma
NETHERLANDS	Hub Diederen RIVM-LLO P.O. Box 1 NL – 3720 BA Bilthoven
SPAIN	Migual Méndez Consejeria Medie Ambiente Av. Manuel Sivrot, 50 41013 Sevilia
GERMANY	Stefan Jacobi Hessische Landesanstalt für Umwelt und Geologie Rheingaustrasse 186 D – 65203 Wiesbaden
EUROCITIES	Frank Price *Formerly:* Municipality of Sheffield *Currently:* WS Atkins 6a Campo Lane Sheffield, S1 1TP UK
Union of Industrial and Employer's Confederations of Europe (UNICE)	Ron A. Barnes Esso Research Centre Milton Hill Abingdon OX136AE UK

EUROPEAN ENVIRONMENTAL BUREAU	Duncan Laxen NSCA 12 St Oswalds Road UK – BS67HT Bristol
EUROPEAN COMMISSION / DG ENVIRONMENT	Lynne Edwards & Marion Wichmann-Fiebig European Commission, DG XI, TRMF 1/45, Rue de la Loi, B-1049 Brussel Belgium
TNO / CONSULTANT TO THE EUROPEAN COMMISSION	Dick van den Hout TNO PO Box 342 Laan van Westenenk 501 7300 AH, Apeldoorn Netherlands
EUROPEAN TOPIC CENTRE ON AIR QUALITY	Steinar Larssen Norsk institutt for luftforskning (NILU) Instituttveien 18, postboks 100, 2007 Kjeller, Norway
JOINT RESEARCH CENTRE / ENVIRONMENTAL INSTITUTE	Emile De Saeger EC – JRC Environment Institute Air quality Unit I – 21020 Ispra Italy

Annex II Stepwise reduction of the limit value plus margin of tolerance

Table A2.1 specifies the values of the limit value plus margin of tolerance for the years in which the margin of tolerance exists, according to Annexes I-V of the first Daughter Directive. The date of introduction of the margin of tolerance is 19/07/99 (date of entry into force of the first Daughter Directive); the first step of reduction is on 01/01/2001. The stage 2 indicative limit values of PM10 have not been included in view of the possible revision of these values in 2003.

Table A2.1 Stepwise reduction of the limit value plus margin of tolerance

	Averaging period	Limit value [µg/m3] *)	To be met by	Margin of tolerance	Until 31/12/00	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
					Limit value + margin of tolerance [µg/m3] *)										
SO2	1h	350	1/1/05	150µg/m3	500	470	440	410	380	350					
SO2	24h	125	1/1/05	-											
SO2	1a, 1/2a **)	20	19/07/01	-											
NO2	1h	200	1/01/10	50%	300	290	280	270	260	250	240	230	220	210	200
NO2	1a	40	1/01/10	50%	60	58	56	54	52	50	48	46	44	42	40
NOx	1a	30	19/07/01	-											
PM10	24h	50	1/01/05	50%	75	70	65	60	55	50					
PM10	1a	40	1/01/05	20%	48	46	45	43	42	40					
Pb	1a	0,.	1/01/05	100%	1.0	0.9	0.8	0.7	0.6	0.5					
Pb ***)	1a	0.5 (1.0)	1/1/10 (1/1/05)	100%	1.0	1.0	0.9	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5

*) Numerical value of the limit value

**) Calendar year and winter (1 October to 31 March)

***) Only valid for specific point sources, of which the Commission must be notified (according to annex IV of the first Daughter Directive); in these cases the intermediate limit value of 1.0 µg/m3 must be met by 01/01/2005.

Annex III: Time schedule for repeal of air quality directives that are replaced by the first Daughter Directive

This Annex has been taken from the Explanatory Memorandum of the proposal for the first Daughter Directive.

Article 9 of the first Daughter Directive sets out the timetable for replacing the requirements of Directive 80/779/EEC (sulphur dioxide and suspended particulates), 82/884/EEC (lead), and 85/203/EEC (nitrogen dioxide) by the new provisions of the Air Quality Framework Directive and the first Daughter Directive. Limit values set by Directives 80/779/EEC, 82/884/EEC and 85/203/EEC will remain in force until the dates on which the new limit values of the first Daughter Directive must be met. Most of the provisions of Directives 80/779/EEC, 82/884/EEC and 85/203/EEC concerning air quality measurement will however be replaced immediately by the more comprehensive requirements of the Air Quality Framework Directive and the first Daughter Directive. These new requirements will take effect from the date by which the first Daughter Directive must be transcribed by Member States into national law. An exception is made for the measurement of particulate matter.

The methods for measuring particulate matter under Directive 80/779/EEC are entirely different from the methods proposed under the first Daughter Directive. It is not possible to use the new methods to assess compliance with existing limit values with any accuracy. The assessment requirements of Directive 80/779/EEC with respect to PM will therefore remain in force until 1 January 2005, the proposed attainment date for first stage limit values for PM_{10}. Under Article 6 of Directive 80/779/EEC Member States will be required to monitor using the old methods in particular where limit values are likely to be approached or exceeded.

Table A3.1 provides full details.

Table A3.1 Schedules for repeal

a. Council Directive 80/779/EEC of 15 July 1980 on air quality limit values and guide values for sulphur dioxide and suspended particulates as amended by Council Directive 89/427/EEC

Provisions to be repealed from 1 January 2005	
Article 1	Purpose
Article 2.1	definition of limit value
Article 3.1	Member States' obligation to respect limit values
Article 6	Requirement to establish measuring stations in particular where limit values are likely to be approached or exceeded
Article 7.1, 7.2	Member States' obligation to report exceedances of limit values to the Commission
Article 8	Obligation of the Commission to publish an annual report
Article 9	Prevention of transboundary pollution
Article 10.1 - 10.3	Measurement methods
Article 15	Bringing into force of provisions
Article 16	Directive is addressed to Member States

Annex I	Limit values
Annex IIIb	Reference method for measurement of suspended particulates by the black smoke method
Annex IV	Limit values measured by gravimetric method
Provisions to be repealed on date by which present proposals should be brought into force in Member States	
Article 2.2	Definition of guide values
Article 3.2	Provision for derogations for identified zones
Article 4	Requirement to set lower limit values in certain zones
Article 5	Obligations of Member States with respect to guide values
Article 7.3	Reporting of concentrations in zones notified under Article 4.
Article 10.4	Obligation for Commission to report to the Council on measurement methods
Article 10.5	Promotion of harmonisation of measurement methods
Article 11	Provisions respecting limit values in Article 4 zones near international borders
Article 12	Adaptation to technical progress
Article 13	Setting up of Committee for purposes of Article 12
Article 14	Procedures of Committee established under Article 13
Annex II	Guide values
Annex IIIa	Reference methods for sampling and analysis of SO_2
Annex V	Reference method of analysis for SO_2
Annex B	Standardization of the sodium bisulphite stock solution

b. Council Directive 85/203/EEC of 7 March 1985 on air quality standards for nitrogen dioxide

Provisions to be repealed from 1 January 2010	
Article 1	Purpose and scope
Article 2	Definitions
Article 3.1	Member States' obligation to respect limit values
Article 5	Enables Member States to set lower limit values
Article 7.1 - 7.2	Member States' reporting obligations
Article 8	Obligation of the Commission to publish an annual report
Article 9	Prevention of trans-boundary pollution
Article 15	Bringing into force of provisions
Article 16	The Directive is addressed to Member States
Annex I	Limit value
Provisions to be repealed on date by which present proposals should be brought into force in Member States	

Article 3.2	Provision for derogations in identified zones
Article 4	Provision for Member States to set lower limit values in identified zones
Article 6	Obligation for Member States to establish measuring stations
Article 7.3	Member States' reporting obligations with respect to Article 4 zones
Article 10	Measurement methods
Article 11	Provisions applicable in Article 4 zones
Article 12	Adaptation to technical progress
Article 13	Setting up of Committee for the purposes of Article 12
Article 14	Procedures of Article 13 Committee
Annex II	Guide values
Annex III	Measurement requirements
Annex IV	Reference method of analysis

c. Council Directive 82/884/EEC of 3 December 1982 on lead in ambient air

Provisions to be repealed from 1 January 2005	
Article 1	Aim and scope
Article 2	Setting of limit values
Article 3.1	Member States' obligation to respect limit values
Article 5	Members States' reporting obligations
Article 6	Commission's obligation to publish a report
Article 7	Application of Directive should not bring about significant deterioration where air quality is good
Article 12	Bringing into force of provisions
Article 13	Directive is addressed to Member States
Provisions to be repealed on date by which present proposals should be brought into force in Member States	
Article 3.2, 3.3	Derogations
Article 4	Location of measurement stations
Article 8	Measurement methods
Article 9	Adaptation to technical progress
Article 10	Setting up of Committee for the purposes of Article 9
Article 11	Procedures of Article 10 Committee
Annex	Reference methods for sampling and analysis