

*National Environment Protection
(Ambient Air Quality) Measure*

Technical Paper No. 3

Monitoring Strategy

Prepared by the
Peer Review Committee

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PREAMBLE

The National Environment Protection Measure (NEPM) for Ambient Air Quality was made in June 1998 with the desired environmental outcome of “ambient air quality that allows for the adequate protection of human health and well-being” across Australia. The NEPM sets national standards against which ambient air quality can be assessed. The NEPM includes a monitoring protocol to determine whether these standards are being met. Each jurisdiction is required to submit to the National Environment Protection Council (NEPC) a monitoring plan consistent with the protocol.

The Peer Review Committee (PRC) was established to assist NEPC in its task of assessing and reporting on the implementation and effectiveness of the NEPM by participating jurisdictions. The PRC includes government experts from all participating jurisdictions, in addition to representatives from industry and community groups. A significant activity of the PRC is the provision of advice to NEPC on the adequacy of jurisdictional monitoring arrangements, to ensure as far as possible that a nationally consistent data set is obtained.

To assure the consistency and transparency of its advisory function, the PRC has developed a set of guidance papers that clarify a number of technical issues in interpretation of the NEPM protocol. These Technical Papers provide the basis for PRC assessment of jurisdictional plans, aimed at assuring the quality and national consistency of NEPM monitoring.

The PRC Technical Papers are advisory for jurisdictions, and they will evolve with time as the science of air quality monitoring and assessment develops and as practical experience with monitoring increases.

A handwritten signature in black ink, appearing to read 'M J Manton', written in a cursive style.

M J Manton
Chair
Peer Review Committee

1. PURPOSE

The purpose of this technical paper is to present an air monitoring strategy which ensures a nationally consistent approach to the implementation of the Ambient Air Quality - National Environment Protection Measure (AAQ NEPM) in Australia.

2. INTRODUCTION

The AAQ NEPM is made under the National Environment Protection Council (NEPC) Acts which aim to provide equivalent environmental protection to all Australians wherever they live. The desired environmental outcome of the AAQ NEPM is ambient air quality that allows for the adequate protection of human health and well-being. The objective of the AAQ NEPM Monitoring Protocol is to provide a consistent approach to the measurement of ambient air quality experienced in populated areas throughout Australia. Ambient air quality monitoring must be conducted in a manner that provides confidence to assessing whether or not the general population is being exposed to levels greater than the specified standards.

Clause 14 of the AAQ NEPM provides some guidance on the number of sites at which monitoring should be carried out across an airshed for AAQ NEPM purposes, and Clause 17(2a) requires jurisdictions to provide a determination of the exposed population represented by each site. The Peer Review Committee (PRC) has carefully developed a strategy to implement these aspects of the AAQ NEPM in a manner which:

- satisfies the basic goal of the AAQ NEPM;
- recognises the complexity of the actual distribution of pollutants across an airshed; and
- recognises the specific aims of AAQ NEPM monitoring within the broader overall monitoring framework of jurisdictions.

In particular, the PRC has sought to fulfil the requirement of Clause 13(2) that performance monitoring stations (PMSs) "contribute to obtaining a representative measure of the air quality likely to be experienced by the general population in the region".

In developing the strategy, the PRC drew on the final impact statement for the AAQ NEPM that accompanied the AAQ NEPM and on the report of the AAQ NEPM Monitoring Protocol Working Group. The report of the working group was developed during the final phases of the AAQ NEPM development process, so that its deliberations impacted on the final form of the AAQ NEPM although they did not feed directly into the final impact statement. In particular, the working group developed the concept of an upper bound site to provide a means of using sparse monitoring data to determine whether air quality complies with the AAQ NEPM Standards over a large region, such as a major urban area. This concept was discussed during the public consultation process carried out by NEPCC before the AAQ NEPM was finalised in mid 1998.

3. GENERAL STRATEGY

Performance monitoring under the AAQ NEPM is required to determine whether the AAQ NEPM standards and goal have been met within populated areas in a region. To achieve this adequately, it is necessary to locate some monitoring stations in populated areas which are expected to experience relatively high concentrations, providing a basis for reliable statements about compliance within the region as a whole. These stations are called generally representative upper bound (GRUB) for community exposure sites.

However, it is also necessary to ensure that a AAQ NEPM monitoring network provides a widespread coverage of the populated area in a region and provides data indicative of the air

quality experienced by most of the population. Monitoring plans must demonstrate an adequate balance of GRUB and population-average measurements. In regions where only one PMS is required, it is expected that the PMS will tend to be a GRUB site.

Clause 14(1) of the AAQ NEPM gives a formula for estimating the number of PMSs to be maintained in a region. It provides an *ab initio* estimate of the network needs of a region in the absence of detailed scientific studies and understanding of the region. The adequacy of a network based on this formula can only be determined in regions where monitoring has been carried out over an extended period and where scientific investigations have been conducted. In major airsheds in Australia, the existing networks maintained for the purpose of regional air quality management and public information are generally much larger than the size implied by the AAQ NEPM formula.

It is recognised that the AAQ NEPM networks may need to evolve with time as the understanding of the distribution of pollutant increases, bearing in mind the aim to maintain long-term consistency in the data.

4. GENERALLY REPRESENTATIVE UPPER BOUND (GRUB) FOR COMMUNITY EXPOSURE SITES

GRUB stations are performance monitoring stations located so as to monitor the upper bound of the distribution of pollutant concentrations likely to be experienced by portions of the population, while avoiding the direct impacts of localised pollutant sources. Where there is to be more than one GRUB station, these stations will be distributed to measure upper bound concentrations in different portions of the populated area, reflecting different emission or dispersion regimes, as opposed to being concentrated in a single portion of the airshed measuring the same characteristics. Stations will be at sites where the pollutant gradients are generally low, so that they can represent the pollution level across a substantial area and fraction of the population. It follows that stations will not usually be located at peak-level sites around which the pollutant gradients are high, such as at the boundaries of individual industrial premises or where traffic flow is high. Thus GRUB sites are generally consistent with the concept of neighbourhood stations used in the current Australian Standard (AS2922-1987).

Factors including meteorology, topography and the distribution of emissions sources should be considered in order to select the number and location of GRUB stations required to characterise upper bound concentrations for a region.

Some pollutants, such as lead, currently have concentrations across urban airsheds well below the AAQ NEPM standard level. These pollutants may have been monitored at CBD sites, or peak sites where maximum concentrations are expected, for many years and may now show a consistent downward trend. Data from such sites will demonstrate that reduced or even no further monitoring is needed to ensure that all the community is not exposed to ambient air with excessive pollutant levels. For the example of lead, where there has been a pollution concern in the past, there is clear value in continuing to track the downward trend of concentrations for some time at these peak sites (see NEPC (AAQ) Measure Technical Paper No. 9, "Lead Monitoring").

5. POPULATION-AVERAGE SITES

An examination of the distribution of GRUB stations relative to the distribution of population will determine the need and location of additional stations to achieve adequate representation of population-average concentrations. Population-average stations are those sited to ensure adequate monitoring of large portions of the populated area and of the total population within a region.

For example, population-average sites additional to GRUB sites may be needed in the monitoring of ozone in large urban airsheds where the prime GRUB stations will tend to be located in outlying suburbs. Under these circumstances, additional population-average sites may be needed to provide adequate estimates of the ambient air quality actually experienced by the majority of the population.

There may be instances where the total number of Performance Monitoring Stations (PMSs) may exceed the number specified by the formula in Clause 14(1) when both GRUB and population-average sites are required. In regions where the AAQ NEPM standard is likely to be exceeded, the number of GRUB stations should not be reduced simply to provide population-based stations.

6. ADDITIONAL MONITORING

The PRC recognises the role and responsibility of individual jurisdictions to carry out additional monitoring and research to enable the adequate understanding and effective management of major airsheds. Such understanding helps to determine the appropriate locations for PMSs, and to explain any observed exceedences, trends or changes in pollutant levels at PMSs.

In general, the AAQ NEPM network will be a subset of the total monitoring network over a region. The future development of the AAQ NEPM will benefit from data from these more extensive networks operated by jurisdictions.

7. EXPOSED POPULATION

Clause 17(2) requires jurisdictions to determine the exposed population in the region represented by each PMS. As discussed above, each PMS is sited in an area of relatively low gradient of pollutant. This strategy should maximise the representativeness of PMSs.

Because of the uncertainty associated with any quantitative measure of the exposed population based on current information, the AAQ NEPM requirement will be met by a qualitative description of the exposed population that indicates those communities which are expected to experience similar levels of air quality either due to geographic proximity or similarity of emissions, meteorology and topography.

8. SUMMARY

The aim of AAQ NEPM performance monitoring is to determine compliance within regions of major population. To achieve this aim, performance monitoring must measure the upper bound of concentrations experienced within a populated area while also obtaining a representative measure of the air quality experienced by the general population. GRUB stations provide an estimate of the upper bound of pollutant level experienced within a populated area, while population-average sites are needed to provide an adequate representation of concentrations experienced by the general population. A succinct description of the monitoring strategy is given in Attachment 1, which was endorsed by NEPCC in March 2000.

ATTACHMENT 1

MONITORING STRATEGY FOR THE AMBIENT AIR QUALITY NEPM

This paper has been prepared by the AAQ NEPM Peer Review Committee (PRC) as a summary of the monitoring strategy to be used in implementing the AAQ NEPM. One of the functions of the PRC is to provide advice on the interpretation of the AAQ NEPM. The strategy for locating performance monitoring stations is a key issue in the implementation of the AAQ NEPM.

Q1. What is the purpose of the monitoring?

The AAQ NEPM sits under the framework of the NEPC which aims inter alia to ensure equivalent environmental protection for the health of all Australians. The AAQ NEPM has a desired outcome of ensuring that our ambient air quality allows for the adequate protection of human health and well being (Clause 5). In particular, the AAQ NEPM has a goal of achieving specific Standards in the levels of key air pollutants within ten years of the commencement of the AAQ NEPM in 1998 (Clause 6). The concentration of pollutants in the air is to be measured at performance monitoring stations in order to assess progress towards achievement of the AAQ NEPM goal.

Q2. What pollutants are being monitored?

The AAQ NEPM provides for the monitoring of six key pollutants. They are carbon monoxide (CO), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), ozone (O₃), lead (Pb), and particles smaller than or equal to 10 micrometres (PM₁₀). Because the distribution of pollutants across a region is different for each pollutant, it will not usually be necessary or appropriate to co-locate the measuring instrumentation for all pollutants at each performance monitoring station (Clause 11(a)).

Q3. Will all regions be monitored?

Monitoring under the AAQ NEPM will occur in regions with a total population of 25,000 or more. However, direct monitoring of a specific pollutant will not be required in regions where it can be demonstrated that the pollutant level is likely to be consistently below the AAQ NEPM Standard level (Clause 14(3)). Thus monitoring under the AAQ NEPM is focused on regions where pollutant levels are reasonably expected to be near or in excess of the Standard.

Q4. Where will monitoring stations be sited?

The AAQ NEPM provides a formula for the basic number of monitoring stations required for each pollutant in a given region (Clause 14(1)). The formula depends upon the population of the region; for example, a city of 1.1 million people will need 3 stations. It is recognised that additional stations may be required where the pollutant levels are influenced by local characteristics such as topography, weather or emission sources (Clause 14(2)).

In order to monitor compliance with the AAQ NEPM Standards, stations will generally be located so as to monitor the upper bound of the distribution of pollutant concentration likely to be experienced by portions of the population, while avoiding the direct impacts of localised pollutant sources. These stations are called generally representative upper bound for community exposure (GRUB) stations. In regions where there are to be more than one GRUB station, the stations will be distributed to measure the upper bound concentrations in different portions of the populated area, reflecting different emission or dispersion regimes.

An examination of the distribution of GRUB stations relative to the distribution of population

and pollutant will determine the need and location of additional stations to achieve adequate representation of population-average concentrations. These additional stations will be sited to provide adequate estimates of the ambient air quality actually experienced by the overall population.

Q5. What fraction of the population will be represented by each monitoring station?

By using GRUB stations to monitor the ambient air across a region, we can be reasonably sure that, if the AAQ NEPM Standards are met at those sites, then most of the total population of the region will be exposed to air that meets the Standards. In this way, the NEPC aim of equivalent environmental protection is assured.

The actual representativeness of an individual monitoring station will depend upon the details of the topography and variations in the concentration of pollutant. However, for an average urban area in Australia, we expect about 25,000 people to be living within a few km of each monitoring station. Moreover, stations will be located at sites where the pollutant gradients are generally low, so that they can represent the pollutant level across a substantial area and fraction of the population.

Q6. Will AAQ NEPM stations be monitoring industrial sources?

The AAQ NEPM monitoring stations will be located such that collectively they provide a representative measure of the air quality likely to be experienced by the general population in a region (Clause 13(2)). They are not intended to be located at peak-level sites, such as the boundaries of individual industrial premises, around which the gradients of pollutant levels are high. Nevertheless, the air quality measured by AAQ NEPM monitoring stations in some populated areas will be affected by industrial emissions.

It is the responsibility of individual jurisdictions to conduct additional monitoring and research to enable the adequate understanding and effective management of major airsheds. In general, the AAQ NEPM stations will be a subset of the total monitoring network over a region. The future development of the AAQ NEPM will benefit from data from those more extensive networks operated by jurisdictions.