Review of the National Environment Protection (Ambient Air Quality) Measure

Discussion Paper

Prepared for the National Environment Protection Council

June 2007

NOTE

This Discussion Paper has been developed by a Project Team of government officers from Environmental Protection and Health portfolios, at the request of the National Environment Protection Council. The Paper is provided as a basis for discussion and does not necessarily reflect the views of NEPC Committee. The paper does not carry the endorsement of the National Environment Protection Council nor any member government.

The contents of the Paper should not be used for any purpose other than as a basis for providing comment to NEPC Committee.

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TABLE OF CONTENTS

1. INTRODUCTION

1.1 NATIONAL ENVIROMENT PROTECTION COUNCIL

The National Environment Protection Council (NEPC) is a national body with responsibility for making National Environment Protection Measures (NEPMs). As a statutory entity within the Environment Protection and Heritage Council (EPHC), its role is to harmonise environmental protection approaches across Australia. Appendix 1 provides contextual information on the NEPC and EPHC.

1.2 NATIONAL ENVIRONMENT PROTECTION MEASURES

A National Environment Protection Measure (NEPM) is legislation designed to protect particular aspects of the environment. A NEPM is similar to environmental protection policies existing in several states. It may have one or more goals, standards and protocols, and it may contain guidelines.

The NEPC Act requires that Council have regard to the Intergovernmental Agreement on the Environment (IGAE) 1992, when making NEPMs. A Schedule to the NEPC Act (1994) establishes the general provisions for the making of NEPMs, and as stated in the IGAE, the objectives of NEPMs are to ensure:

- That people enjoy the benefit of equivalent protection from air, water and soil pollution and from noise, wherever they live; and,
- That decisions by businesses are not distorted and markets not fragmented by variations between jurisdictions in relation to the adoption or implementation of major environment protection measures.

The IGAE also requires consideration of the Precautionary Principle in the development of NEPMs.

1.3 THE AMBIENT AIR QUALITY NEPM

In 1998, NEPC made the Ambient Air Quality National Environment Protection Measure (AAQ NEPM) that set national ambient air quality standards to apply in all States and Territories and over land controlled by the Commonwealth. These standards cover six pollutants – particles (PM_{10}), ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and lead. The NEPM provides a nationally consistent framework for the monitoring and reporting of these six pollutants. This was the first time that national air quality standards had been set in Australia.

At the time of making the AAQ NEPM a number of 'future actions' were initiated to facilitate the review of the NEPM. In addition, other associated work was commenced which also provides information for the review of the NEPM. These future actions and associated work included preliminary reviews of particular pollutant standards and a number of research studies. Accordingly, the NEPM was varied in 2003 to incorporate advisory reporting standards for fine particles ($PM_{2.5}$) and preliminary work for a review of the ozone standards and standard for sulfur dioxide was completed in 2005. The Time-Activity Study was completed in 2004, and the Multi-city Mortality and Morbidity Study completed in 2006. The Children's Health and Air Pollution Study is currently being conducted and it is anticipated that the results of the study will be available for consideration if a variation to the NEPM is decided.

Although the AAQ NEPM deals only with ambient air quality, it is acknowledged that indoor air quality is also an important factor in the exposure of individuals to air pollution. However studies in Australia and overseas have shown that outdoor air pollution infiltrates indoors and is a major driver of indoor air pollution levels. For some pollutants (e.g. ozone

and sulfur dioxide which are highly reactive gases) the main exposure is outdoors. The AAQ NEPM focuses on ambient air pollution whereby monitoring can be undertaken and management actions implemented by jurisdictions.

Given that infiltration of outdoor air into the indoor environment, reductions in ambient air pollution levels will also lead to reductions in indoor air pollution.

1.4 GOAL AND DESIRED ENVIRONMENTAL OUTCOME OF THE AAQ NEPM

The AAQ NEPM interprets the objectives of the IGAE for equivalent protection as its national environment protection goal and desired environmental outcome.

The National Environment Protection Goal of the AAQ NEPM is "to achieve the National Environment Protection Standards as assessed in accordance with the monitoring protocol (Part 4) within 10 years from commencement to the extent specified in Schedule 2 column 5 of the AAQ NEPM. " The desired environmental outcome of the AAQ NEPM is "ambient air quality that allows for the adequate protection of human health and well-being."

1.5 REVIEW OF THE AAQ NEPM

When the AAQ NEPM was made there was a commitment to initiate a full review of the measure in 2005. The overall purpose of the NEPM review is to evaluate the performance of the current AAQ NEPM in achieving the desired environmental outcome, and to recommend to Council any required changes to the NEPM.

In April 2005 NEPC initiated this review with the development of an Issues Scoping Paper (ISP). The ISP sought input from key stakeholders on issues that needed to be considered through the review of the AAQ NEPM. The feedback from consultation on the ISP was used to fully scope the review process. In April 2006 NEPC approved the scope, budget and timeline for the review.

1.6 TERMS OF REFERENCE FOR THE REVIEW

Terms of Reference (TOR) for the review have been drafted based on the outcomes of consultation. The TOR is consistent with the generic clause that is now incorporated into NEPMs that outlines the requirements for a review of a NEPM. Such a clause was not included in the Ambient Air Quality NEPM when it was made. Submissions on the Issues Scoping Paper supported terms of reference for the review that draw on this generic clause as well as on Section 15 of the *National Environmental Protection Council Act 1994*, which sets out the factors that Council must take into account in making national environmental protection measures.

In light of the comments received the review of the Ambient Air NEPM will consider:

i. the effectiveness of the Measure in achieving its desired environmental outcome, which is 'ambient air quality that allows for the adequate protection of human health and wellbeing';
ii. the effectiveness of the Measure in generating comparable, reliable information on the levels of air pollutants;
iii. the environmental, economic and social impact of the measure, including unintended consequences;
iv. the simplicity, efficiency and effectiveness of the administration of the measure, including the adequacy of its support mechanisms;
v. any regional environmental differences in Australia and the implications for the Measure;

vi. the links between the Ambient Air Quality NEPM and other Government policies (including other NEPMs) and the potential for integration; and

vii. the need, if any, for varying the Measure, (in accordance with the Act) including:

- whether any changes should be made to the Schedules;
- whether any changes should be made to improve the effectiveness of the Measure in achieving the desired environmental outcome set out within it;
- the potential costs and benefits of any proposed changes.

Consultation on the ISP also revealed the need for the review to examine international trends in approaches to air quality management and Australia's position in relation to these trends.

Discussion Papers seeking input to the options for addressing issues of effectiveness are being developed as a basis for key stakeholders and public consultation. The issues discussed and options presented in this paper are based on submissions on the ISP, information provided by jurisdictions and workshops held with key community, technical and health advisory groups.

1.7 PURPOSE OF THIS DISCUSSION PAPER

The purpose of this paper is to encourage discussion on the options put forward to address issues raised during the review. It is particularly aimed at gaining stakeholder and public views on improving the effectiveness of the NEPM and formulating recommendations to NEPC to consider in initiating potential variations to the NEPM. This Discussion Paper focuses on the issues and options regarding the effectiveness of policy decisions, the monitoring protocols and associated actions, and reporting and community communication methods.

A further Discussion Paper will be developed for public consultation on the air quality standards contained within the AAQ NEPM.

2. THE AMBIENT AIR QUALITY NEPM

2.1 INTENT OF THE NEPM

The intent of the NEPM was to ensure air quality that was protective of population health by providing a framework to monitor and assess air quality at locations that provide an average measure of air quality that is representative of the exposure of the general population.

The NEPM established a national environment protection goal that required the achievement of the air quality standards, assessed in accordance with the Monitoring Protocol, within 10 years from the commencement of the NEPM. Under the NEPM monitoring was not to be conducted at peak sites or sites impacted by individual sources (*Revised Impact Statement, p40*) since such sites would not represent general population exposure. The aim of this was to provide a measure by which jurisdictions could assess and report on progress in meeting the 10-year compliance standards and associated goals contained within the NEPM.

Implicit in the NEPM was the inference that meeting the compliance standards would ensure the achievement of the desired environmental outcome of the NEPM in providing adequate protection of human health and well-being.

2.2 MECHANISMS PUT INTO PLACE TO MEET THE REQUIREMENTS.

The AAQ NEPM requires jurisdictions to monitor air quality and report on progress towards meeting the air quality standards and associated goals in accordance with the requirements of the NEPM. To assist jurisdictions in achieving national consistency in monitoring and reporting on air quality in Australia, specific mechanism were put in place, which include:

1. Monitoring protocols;
2. Peer Review Committee;
3. Jurisdictional monitoring plans;
4. Jurisdictional/regional monitoring networks;
5. Reporting protocols;
6. Implementation by jurisdictions;
7. Air quality standards.

Information regarding these mechanisms is provided below, with the exception of air quality standards which will be the subject of a separate and subsequent discussion paper.

2.2.1 Monitoring protocols

As stated in the Revised Impact Statement for the NEPM (section 7.4, p40), '*Ambient air quality standards for the protection of human health rely on data on toxicology, controlled exposure studies, and epidemiology. Epidemiology relates observed effects to air quality monitoring data. Air quality data are normally based on monitoring stations sited to give an average representation of general air quality and of population exposure. These stations are normally sited away from the influence of specific sources such as major roads and other major sources.*

However, to provide a representative assessment of exposure, monitoring networks include regions of generally high or low air quality levels excluding localised source-related peaks. Understanding the implications of ambient air monitoring data measured in this way requires an understanding of the studies on which the standards are based. In line with the above discussion, programs aimed at achieving protection for the population in a region are usually designed to address regional air quality, and their success is therefore measured against a monitoring network that provides regional

data. They are also pollutant specific. Clearly within a region there will be a range of locations with high and low pollution levels to which individuals are exposed. The general level of protection provided for that region is therefore for the population on average'.

It is clear that the intent of the NEPM was to ensure air quality that was protective of population health by providing a framework to monitor and assess air quality at locations that provide an average measure of air quality that is representative of the exposure of the general population.

Monitoring protocols were established that required air monitoring stations located to assess the range of air pollution levels that would be experienced and enable an estimation of the exposure of the population to be determined. In developing the airshed monitoring plans, the protocol required assessment and reporting of the spatial and population representativeness of each station to ensure that the exposure of population was adequately considered in the design of the networks and that any data generated could be used to assess population exposure.

2.2.2 Peer Review Committee

Effective ambient air quality monitoring is a difficult and complex undertaking, subject to a range of factors and uncertainties. Each indicator is measured by a different method, which has its own characteristic responses and potential interferences. Apart from ensuring that the instruments themselves are correctly calibrated and operated, care is needed to ensure that sampled air is not modified in a way that introduces biases in the readings. Some of uncertainties arise from the measurement processes themselves and can therefore be estimated by well-established techniques. Australian and international standard methods have been established to ensure consistency in the way these machines are operated and maintained, to produce consistent data.

Other uncertainties are generated through external factors, such as the choice of sampling location, local interferences and sources, and the nature of the material being monitored. For the gaseous pollutants, consistent monitoring is relatively straightforward with modern technology. However monitoring of particles still poses many difficulties because they vary in nature and composition between locations. This is compounded by different methodologies available and in use by jurisdictions.

Australian Standards exist for the siting of stations but considerable professional judgement is nevertheless required in applying the siting criteria, and some uncertainties are less amenable to immediate calculation, perhaps only becoming obvious after data has accumulated over an extended period, by comparison with data collected elsewhere.

Due to the complexity inherent in establishing a nationally consistent system of monitoring and reporting the Peer Review Committee (PRC) was established with the role, to provide guidance on jurisdictional monitoring plans. Since its establishment, the PRC has provided advice to the jurisdictions by reviewing monitoring plans, publishing technical guidance papers, assessing and recommending alternative monitoring methodologies and developing compliance reporting systems.

The Revised Impact Statement provides context for the establishment of the PRC:

'The Measure therefore requires each participating jurisdiction to submit monitoring plans for approval. This provides a mechanism to take topography, demographics and other parameters into account and still produce data that are comparable between different airsheds. This approach has been adopted because of the complexity of producing a "one size fits all" formula for ambient monitoring.

To give effect to this requirement a peer review committee (PRC) will be established to advise on the adequacy of jurisdictional monitoring plans and to devise a consistent reporting format. The PRC will comprise an expert representative from each jurisdiction together with two community representatives, two industry representatives and a representative from local government.

In addition to assessing jurisdictional plans the PRC would devise a consistent reporting format, advise NEPC Committee on changes to monitoring policy, the acceptability of new measurement methods, the application of modelling techniques, exposure assessment, and the data collection needs for future NEPM development and review.'

The PRC was formed as an unfunded body to provide advice to jurisdictions, through the NEPC Committee, on the implementation of the Ambient Air Quality National Environment Protection Measure (AAQ NEPM). Its membership consists of two nominees from industry, two from the environmental movement, one from each jurisdiction, an executive officer from the NEPC, and is chaired by Dr Mike Manton, formerly of the Bureau of Meteorology.

The following Terms of Reference were established for the PRC:

1. to advise the NEPC Committee on the adequacy of the monitoring plans submitted by jurisdictions, both in terms of meeting the requirements of the NEPM, and national consistency of data and information.
2. to advise the NEPC Committee on the technical interpretation of the air quality NEPM, in relation to location of measurement sites, measurement and assessment techniques (including emerging technologies), assessment of represented population, quality control, data handling, and reporting
3. to advise the NEPC Committee on technical issues associated with the consistent implementation of the air quality NEPM monitoring protocol across jurisdictions
4. to advise the NEPC Committee on scientific and technical developments relevant to the monitoring protocol and its evolution
5. to conduct expert reviews of technical aspects of the interpretation and implementation of the air quality NEPM, as requested by the NEPC Committee from time to time and drawing upon external expertise as required

The following note was included with the TORs for the PRC when it was established:

"*The PRC will not address the scope of the NEPM, but has been established to assist in the management of the NEPM. As the PRC is a technical committee, it is not expected to address major policy issues. The PRC will also act as a resource for the sharing of knowledge and experience on air monitoring across jurisdictions.*" NEPC Web site http://www.ephc.gov.au/prc/index.html

To assist jurisdictions in implementation, reporting and interpretation a series of technical papers were prepared by the PRC. These papers were prepared by the committee with comment technical input from jurisdictions and relevant experts and are available on the EPHC web site: (http://www.ephc.gov.au/nepms/air/technical_papers.html)

1. Checklist for Monitoring Plans
2. Selection of regions
3. Monitoring strategy
4. Screening Procedures
5. A Screening Procedure for Monitoring Ozone and Nitrogen Dioxide in "Small to Medium-sized" Cities: Phase II – application of the procedure
6. Data Collection and Handling
7. Meteorological Measurements
8. Accreditation of Performance Monitoring
9. Annual reports
10. Lead Monitoring
11. Collection and reporting of TEOM PM_{10} Data

The aim of the papers is to achieve a nationally consistent approach to monitoring and assessment against the standards and associated goals included in the NEPM. Most of the papers deal with implementation and technical issues as well as reporting and assessment of data against standards and goals.

2.2.3 Jurisdictional monitoring plans

The jurisdictional monitoring plans established how requirements to monitor, assess and report on air quality for the purposes of the NEPM. The reports were structured according to the format specified by the PRC, which includes the consideration of the following:

- Regions to be monitored
- Monitoring requirements of each region, including physical and demographic characterisation, emissions, air quality, identification of pollutants not required to be monitored, and monitoring network
- Siting and instrumentation
- Accreditation
- Reporting.

All jurisdictions prepared monitoring plans setting out how they would monitor and report to meet the requirements of the NEPM. The reports are reviewed by the PRC and approved by NEPC. Monitoring and annual reporting to NEPC is done in accordance with these plans. Since the monitoring plans were approved some variations have been endorsed by NEPC. In particular, NEPC has agreed that due to low concentrations of lead monitored in ambient air that routine NEPM lead monitoring was no longer required.

2.2.4 Jurisdictional monitoring networks

Air quality is monitored through the establishment of a network of air monitoring stations designed to provide a representation of air quality within a region or sub region. Air monitoring stations within a network are sited to provide information for a number of purposes including the distribution of air pollutants within an air shed or the impact of specific sources on local air quality.

The following were taken into account in establishing networks for NEPM monitoring:

- Regions to be monitored
- Siting of air monitoring stations within the regions
- Selection of instrumentation and instrument standards
- Distribution of pollution levels and population within the region
- Pollution sources

The monitoring protocols and Schedules in the NEPM set out the requirements for the establishment of the air monitoring networks including the siting of the monitoring stations and the monitoring methods to be used. The NEPM states that monitoring methods must be Australian Standard methods. Alternative methods could be used if:

- They were internationally recognised methods or standards that provided equivalent information for assessment purposes
- Calibration and validation studies show
    - The accuracy and precision of the other method, and
    - The method can be compared with the relevant Australian standard
- The equipment is calibrated to the standard required by the equipment manufacturer,
- The equipment provides equivalent information for assessment purposes.

The PRC developed a series of guidance papers to assist in the establishment of air monitoring networks for NEPM purposes. These include:

- Technical paper 2 – Selection of Regions
- Technical paper 5 – Meteorological measurements
- Technical paper 7 - Accreditation of performance monitoring
- Technical paper 8 – Lead monitoring
- Technical paper 10 –Collection and reporting of TEOM PM_{10} data.

The Variation to the NEPM to incorporate standards for $PM_{2.5}$ established the monitoring requirements for $PM_{2.5}$. The establishment of monitoring stations to conduct a program to determine equivalency of methods for monitoring $PM_{2.5}$ is also a requirement of the Variation.

2.2.5 Reporting protocols

The national environment protection reporting protocol of the AAQ NEPM requires annual reporting to NEPC by each jurisdiction. This report must be submitted in an approved form, including the progress made towards meeting the standards and associated goals. Clauses 11, 17 and 18 of the AAQ NEPM (provided in Appendix 2) establish the reporting requirements for jurisdictions, which includes:

- An evaluation of performance against the standards and goal of the AAQ NEPM;
- A statement of the progress made towards achieving the goal;
- A description of the circumstances that led to any exceedences of the standards;
- The percentage of data available for each pollutant monitored during the reporting period.

In addition to the general requirements under Clauses 17 and 18, the Peer Review Committee (PRC) prepared a technical paper (No. 8) which provides guidance to jurisdictions regarding the format for reporting of air quality data. The aim of this document is to achieve a nationally consistent approach to air quality reporting in Australia under the NEPC process.

The main focus of the PRC paper is on assessment of compliance with the air quality standards and associated goals. Reporting is required in scientific format with peak values and percentiles reported. Jurisdictions are also encouraged to expand their reporting to include analysis of trends, pollutant distributions and a qualitative description of population exposure. It is suggested that evaluating long-term trends is important in assessing the effectiveness of control strategies, and the progress towards achieving the goal of the AAQ NEPM. Although the technical paper No. 8 does not go into detail, the PRC expect that graphical, including geographical and spatial, presentations will be used

extensively to supplement conventional tabulations of air quality summary statistics in AAQ NEPM reports.

2.2.6 Implementation by jurisdictions

Under Clause 7 of the NEPC Act any State or Territory in compliance with its obligations under the IGAE, must implement, by such laws and other arrangements as are necessary, each National Environment Protection Measure in respect of activities that are subject to the law of that State or Territory. This means that once a NEPM is made it becomes legally binding on a jurisdiction irrespective of whether it is adopted into legislation within that State or Territory.

In most jurisdictions the NEPM is being implemented under the provisions of the NEPC Act and no changes have been made legislative instruments to adopt the requirements of the NEPM into State/Territory legislation.

However in Victoria the AAQ NEPM was adopted into Victorian legislation by the creation of the State Environment Protection Policy (Ambient Air Quality) [SEPP (AAQ)] which adopts all provisions of the NEPM. At that time a new SEPP for Air Quality Management [SEPP (AQM)] was created. These two SEPPs replaced the existing SEPP (the Air Environment) that had been in place since 1981.

The SEPP (AQM) sets out the legislative framework for managing emissions to the air environment and was extensively reviewed in 2001. The aims of the policy are to ensure that air quality is managed so that the standards and goals of the SEPP (AAQ) (which reflect the AAQ NEPM) are met and that continuous improvement in air quality is achieved. The SEPP (AQM) guides the management of emissions from industrial and domestic sources as well as roads and other diffuse sources. Compliance with SEPP must be demonstrated by proponents in EPA's Works Approval and licencing processes. As an incorporated document to SEPP (AQM) EPA Victoria has also developed a draft Protocol for Environmental Management for the Mining and Extractive Industries to address emissions (primarily PM_{10} and $PM_{2.5}$) from these industries.

In Western Australia the NEPM has been made under the *National Environment Protection Council (Western Australia) Act 1996*. No additional legislation is necessary to enable the NEPM in Western Australia. The Department of Environment and Conservation (DEC) is proceeding with plans to meet the requirements of the NEPM with respect to monitoring, evaluation and reporting. A state-wide Air Quality Environmental Protection Policy is currently in development by the Environmental Authority of WA. It is likely this statutory policy will be supported by a non-statutory State Environmental Policy.

The South Australian Environment Protection Act 1993 allows for a simplified procedure for making certain policies, including adoption of NEPMs. Section 29 allows the Minister to refer the draft policy directly to the Governor without the need to go through the normal policy development procedure.

In Tasmania, all NEPMs (including the AAQ NEPM) are adopted into legislation as State Policies under the *State Policies and Projects Act 1993*.

3 REVIEW ASSESSMENT

3.1 PROCESS FOR ASSESSMENT

Assessment of the effectiveness of the AAQ NEPM has been undertaken in accordance with the terms of reference, and based on the expertise and knowledge of the Review teams, responses to questionnaires distributed to the jurisdictions, and analysis of responses to submissions on the Issues Scoping Paper.

Section 3.2 of this Discussion Paper assesses the policy decisions in relation to the application of the intent of the NEPM, evaluates progress towards the desired environmental outcome, and determines areas in which issues have arisen. This section addresses terms of reference (i). The review team developed a questionnaire to gain information from each jurisdiction to assist in evaluating the following:

1. The intent of the NEPM;
2. Air quality improvements;
3. Risk to human health.

Section 3.3 addresses item (ii) of the terms of reference, assessing "the effectiveness of the Measure in generating comparable, reliable information on the levels of air pollutants" by evaluating the mechanisms put in place to meet the requirements and their application and contribution to the achievement of the goal of the NEPM:

1. Monitoring protocols;
2. Peer Review Committee;
3. Jurisdictional monitoring plans;
4. Reporting processes;
5. Implementation by jurisdictions.

Section 3.4 evaluates the environmental, economic and social impacts of the measure, including unintended consequences, addressing terms of reference (iii), by considering:

1. Ecological considerations;
2. Cost benefit analysis;
3. Impacts for the community.

Section 3.5 examines the simplicity, efficiency and effectiveness of the administration of the measure including the adequacy of its support mechanisms and resources. This section addresses terms of reference (iv). The review team sought information from each of the jurisdictions, including:

1. Identification of any problems arising from implementing the NEPM.
2. An estimate of the costs of developing and preparing monitoring plans;
3. An estimate of the costs of establishing monitoring networks;
4. An estimate of the costs of changes to pre-existing monitoring networks.

Section 3.6 explores regional environmental differences in Australia and the implications for the NEPM.

Section 3.7 examines the links between the AAQ NEPM and other government policies (including other NEPMs) and the potential for integration. This section addresses terms of reference (vi) and looks at issues such as:

1. Sustainability objectives;
2. Natural resource management;
3. The Air Toxics NEPM.

Section 4 provides discussion on international trends in approaches to the management of air quality and Australia's position within this setting.

Section 5 contains discussion of options to address issues arising from the assessment and forms the basis for addressing terms of reference (vii);

"*the need, if any, for varying the Measure, (in accordance with the Act) including:*

- *whether any changes should be made to the Schedules;*
- *whether any changes should be made to improve the effectiveness of the Measure in achieving the desired environmental outcome set out within it;*
- *the potential costs and benefits of any proposed changes."*

3.2 ASSESSMENT OF PROGRESS IN MEETING THE DESIRED ENVIRONMENTAL OUTCOME

The following areas were identified to evaluate progress towards achieving the desired environmental outcome of ambient air quality that allows for the adequate protection of human health and wellbeing:

- The intent of the NEPM
- Air quality data; an analysis of air quality data from NEPM monitoring stations since 2000 to gauge progress toward meeting the air quality standards
- Risk to human health; including an assessment of the appropriateness of the criteria pollutants, what progress towards meeting the air quality standards means for human health risk, and adequacy of monitoring to be able to assess population exposure.

3.2.1 The intent of the NEPM

The intent of the NEPM was to ensure air quality that was protective of population health by providing a framework to monitor and assess air quality at locations that provide an average measure of air quality that is representative of the exposure of the general population.

During the development of the NEPM, there were difficulties encountered in identifying population exposure levels to the pollutants under consideration. These difficulties reinforced the understanding that the monitoring and reporting protocol was an integral part of the proposed measure, as it had a significant role to play in interpreting compliance with the standards. It was recognised that the number and siting of monitors would be critical in ensuring that the subsequent data were representative of population exposure and ambient concentrations of pollutants, and that reporting against the standards would actually be a way of measuring progress towards the attainment of the goal of the measure. The primary objective of monitoring was to provide data for each pollutant that are as representative as possible of the exposure of the general population. The NEPM provides a consistent basis to monitor and report the quality of the air in Australian cities by establishing a core group of indicators (the criteria pollutants). The air quality standards in the NEPM provide nationally consistent benchmarks to assess air quality.

In terms of the intent of the NEPM, to ensure 'adequate protection of human health and well-being', it appears that there is no shared understanding of what 'adequate protection' means. The concept of adequate protection implies a range of issues such as the appropriate balance between population health, economics, social equity and lifestyle. Implicit in the NEPM was the inference that meeting the compliance standards would ensure the achievement of the desired environmental outcome of the NEPM in providing adequate protection of human health and well-being.

3.2.2 Air quality

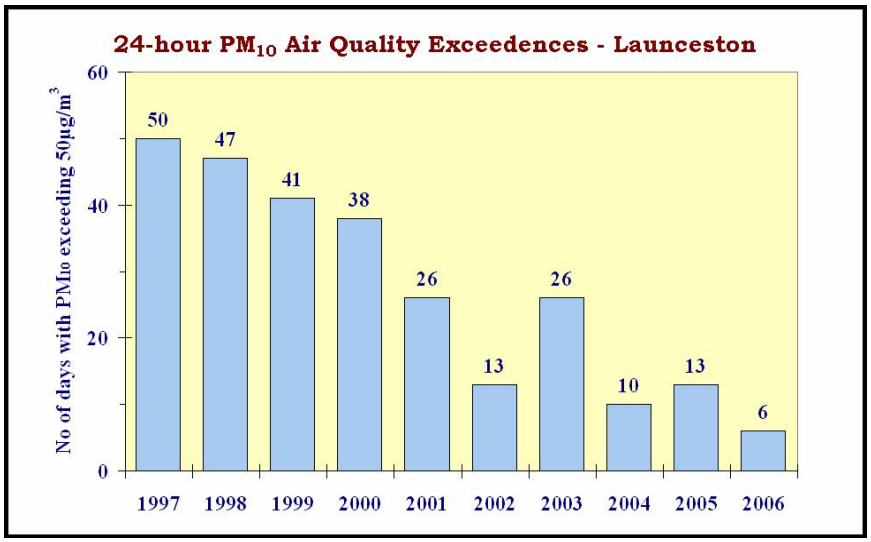
In implementing the NEPM jurisdictions undertake actions to drive improvements in air quality with the aim of meeting the standards and associated goals set by the NEPM. One method of determining how effective the NEPM has been in driving improvements in air quality is assessment of air quality data from NEPM monitoring stations. Jurisdictions have provided data from NEPM stations since 1998, although it should be noted that only data collected since 2000 has been collected in accordance with the approved jurisdictional NEPM monitoring plans.

Improvements in regional air quality directly related to implementation of the NEPM are hard to identify, as other actions and policies to improve air quality have also been implemented since the making of the NEPM. It is also difficult for most jurisdictions to determine any clear trend in air quality, given the short time period since the NEPM was made and commencement of air monitoring in accordance with NEPM requirements.

Jurisdictions have identified some inconsistencies in siting air monitoring stations that may influence the ability to identify any clear trend in air quality from NEPM monitoring stations. This is discussed further is Section 3.3.1.2. For jurisdictions that have sited NEPM monitoring stations close to specific sources, actions taken to manage emissions from those sources may show improvements that may not be reflected more broadly in regional air quality. Interpreting the data and ensuring that comparable data is being used both inter-jurisdictionally and within a jurisdiction is important in determining how effective the NEPM has been in driving improvements in air quality.

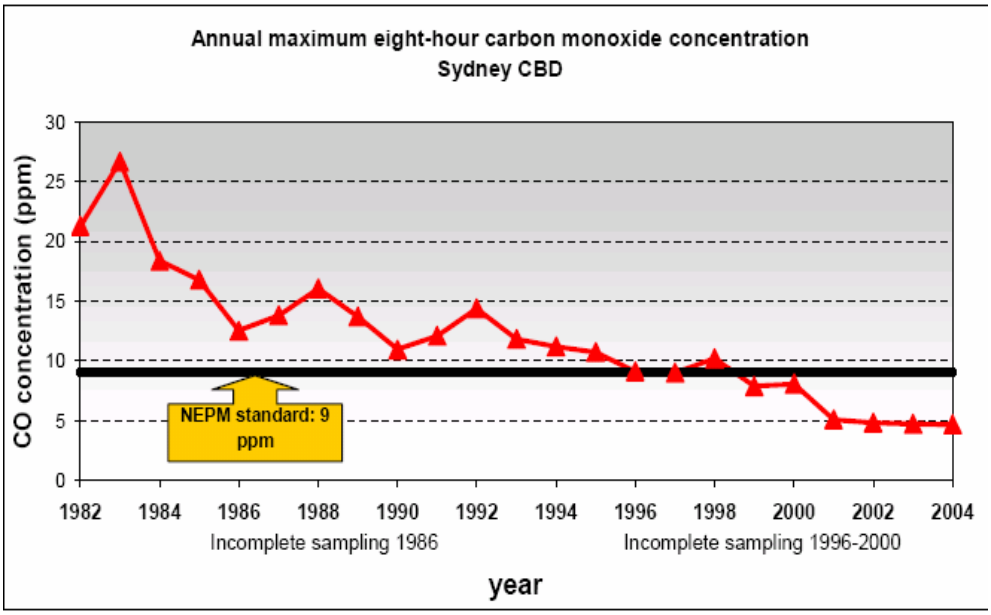
The City of Launceston provides an example of significant improvement in air pollution levels since 2000. At the time that the NEPM was made, winter particulate matter concentrations in Launceston were some of the highest in Australia. Since then a concerted effort by all levels of government and the community to reduce the generation of wood smoke from home heating has been successful in reducing the magnitude and number of exceedences of fine particle standards in Launceston (Figure 1).

Figure 1: 24-hour Air Quality Exceedences – Launceston



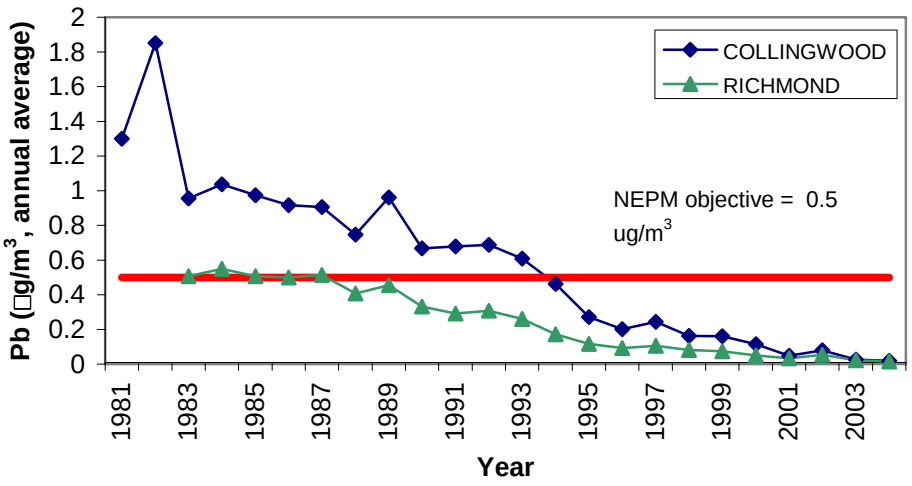
Generally air quality in Australian cities is good by international standards. Jurisdictional data collected at NEPM monitoring stations show that the levels of nitrogen dioxide, carbon monoxide, sulfur dioxide and lead are consistently below the NEPM air quality standards in all jurisdictions. Changes to Australian Design Rules for motor vehicles have led to a decrease in carbon monoxide levels in all urban airsheds. This trend is shown in Figure 2 for the CBD in Sydney; however the reduction in carbon monoxide levels is part of a longer-term trend and cannot be directly attributed to the implementation of the NEPM.

Figure 2: Carbon monoxide trend, Sydney CBD, 1980 – 2005



Similarly the phasing out of lead from petrol has reduced lead in ambient air to levels that in many cases can no longer be measured. However these changes in lead levels from improvements in fuel cannot be attributed to the NEPM as the policy direction was in place prior to the making of the NEPM in 1998. Data from the Collingwood and Richmond sites in Melbourne is shown in Figure 3. Reduction in lead levels has resulted in jurisdictions no longer monitoring lead in urban air sheds not impacted by significant industrial sources.

Figure 3: Lead annual average concentrations, Collingwood and Richmond sites, Vic, 1981-2004.



Although the air quality standards are met for nitrogen dioxide, carbon monoxide, sulfur dioxide and lead, most jurisdictions still experience exceedences of the standards for particles (both PM10 and PM2.5) and ozone on occasions. The preliminary review of the ozone standards (NEPC, 2006) considered the need for changes to the averaging times for the ozone standards and as part of that process analysed ozone data for all jurisdictions. The most significant exceedences of the ozone standards are experienced in Sydney. Figure 4 and Figure 5 show the data for the Blacktown site for 1-hour and 4-hour ozone levels. The outcomes of the preliminary review of the ozone standards are an important input to the review of the standards and will be considered in more detail in the subsequent discussion paper on air quality standards. It concluded that 1, 4, and 8 hour averaging times should be considered.

Number of exceedences does not provide good information about trends in air pollution as peak events can be strongly influenced by natural events such as bushfires, drought and dust storms, or meteorology. Consideration of the percentile and annual average values provides a better indication of the underlying distribution of air quality to assess trends. Such data are presented in Figures 4-7 where 50th, 95th and 98th percentile values are presented together with the maximum values.

Figure 4: 1-hour Ozone levels Blacktown NSW, 1996-2004

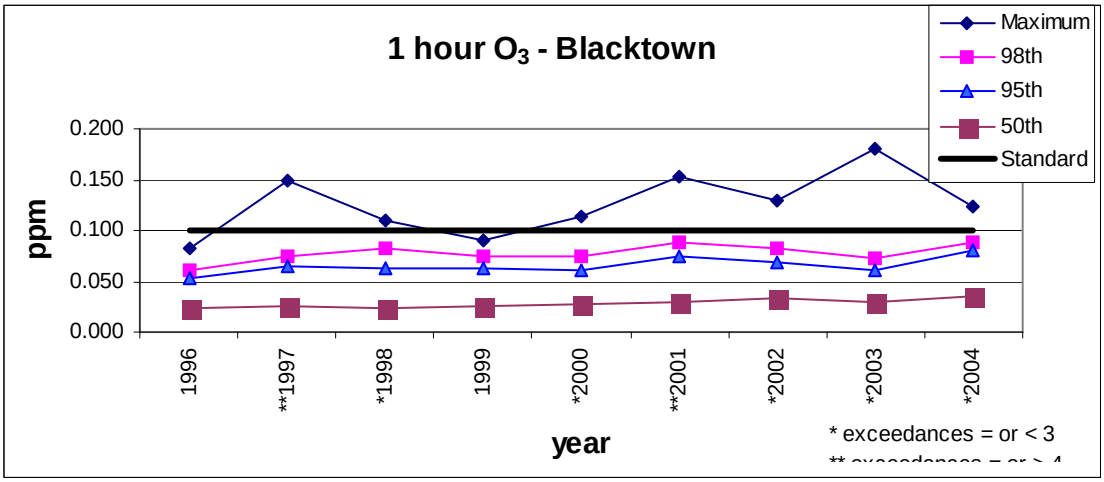
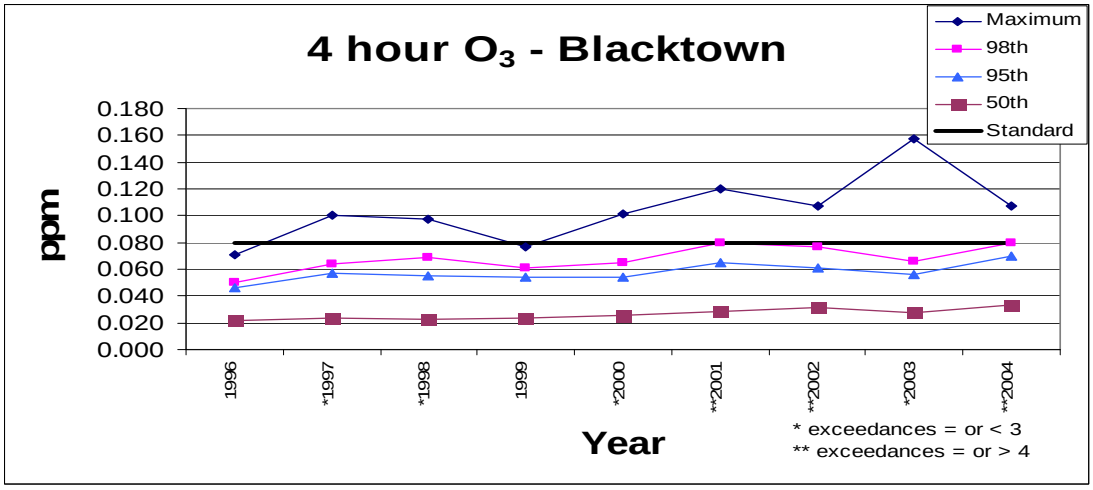


Figure 5: 4-hour Ozone Blacktown NSW 1996 to 2004



Particle levels also exceed air quality standards in most jurisdictions. Particles, measured in ambient air are not one pollutant but comprise a heterogeneous mixture in size and composition. Particles can range in size from particles with an equivalent aerodynamic diameter of up to 10 micrometres (PM_{10}) down to ultrafine particles that are less than 0.1 micrometres. PM_{10} includes all particles with diameter of 10 micrometres or less. $PM_{2.5}$ includes all particles less than 2.5 micrometres in diameter.

Combustion sources such as motor vehicles emit particles that are generally smaller than 1 micrometre (PM_1). It is now generally acknowledged that exposure to fine particles ($PM_{2.5}$) is more deleterious to health than exposure to the coarser fraction $PM_{10\text{-}2.5,}$ although recent studies have shown that adverse health effects are also associated with the coarse fraction of PM_{10}. These coarser particles are dominated by crustal particles and in some areas sea-salt. Studies into the composition of particles in Australian cities indicate that the coarse fraction is the major component of PM_{10} with the $PM_{2.5}$ fraction being approximately 40%.

Ultrafine particles are a subset of fine particles, with a diameter less than 0.1 micrometre, and are measured by number but are virtually weightless. They can penetrate deep into the lungs and may pass into the bloodstream. Being smaller, fine particles have a far greater surface area than coarse particles for a given mass and can carry minute quantities of chemical pollutants on their surfaces. The association between fine particle pollution and cardiovascular disease is recognised and evidence regarding a causal mechanism for effect is emerging.

Fine particles have a low settling velocity and become widely dispersed. Larger particles are deposited nearer sources, unless carried by strong winds. PM_{10} and smaller fractions of particulate matter are also transmitted to indoor environments, as well as being generated indoors from cooking, smoking or heating.

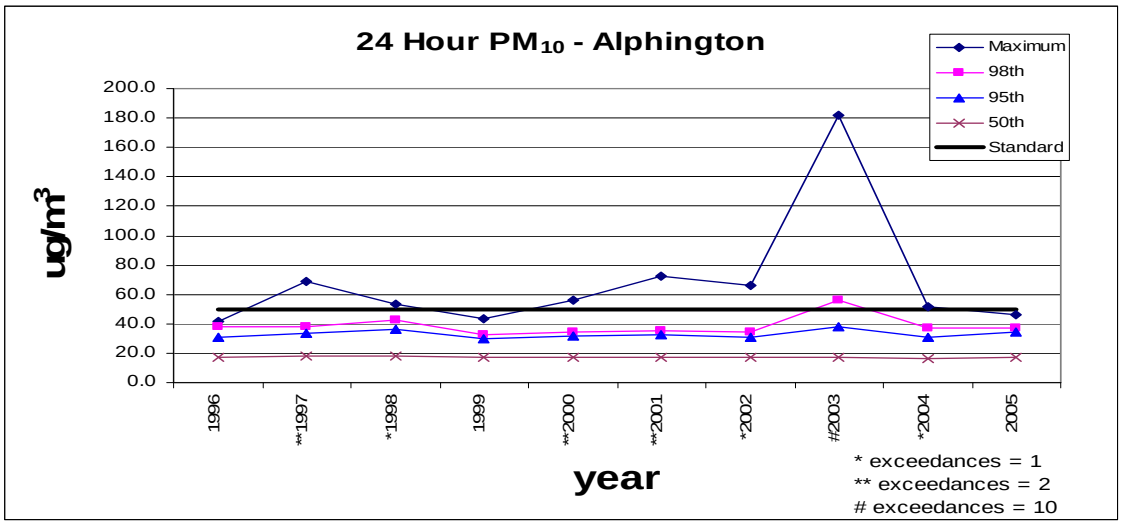
The particulate matter measured under the NEPM includes background levels of pollution from biogenic or natural sources like sea salt, dust and bushfire smoke and also from distant human or anthropogenic sources.. Added to these are closer industrial point sources and diffuse sources like motor vehicles and urban woodsmoke. This can make air quality management and source apportionment difficult to quantify, given the mixture of particle size and composition in urban airsheds. Particles can either be primary (i.e. emitted directly from source) or secondary (ie., formed by chemical processes from precursors) in nature.

In May 2003, the NEPC made the Variation to the Ambient Air Quality NEPM which strengthened air quality standards to help protect Australians from the adverse health impacts of $PM_{2.5}$. The Variation introduced advisory reporting standards for $PM_{2.5}$. These advisory reporting standards are helping to gather data nationally on fine particles, with the information used to inform this Review process. The review will consider the adoption of PM2.5 as a compliance standard in the future. This will be further discussed in a later Discussion Paper that will be prepared during the review of the air quality standards.

In recent years the number of exceedences has been influenced by bushfires and the effects of drought. The allowable number of exceedences, specified in the NEPM at 5 per year for PM10, was set to account for natural events such as bushfires and dust storms as well as the impact of prescribed burning for fire management purposes. These exceedences cannot be considered representative of general air quality management within an airshed, since these events may be remote from the effects they cause. It may be appropriate to reconsider the '5

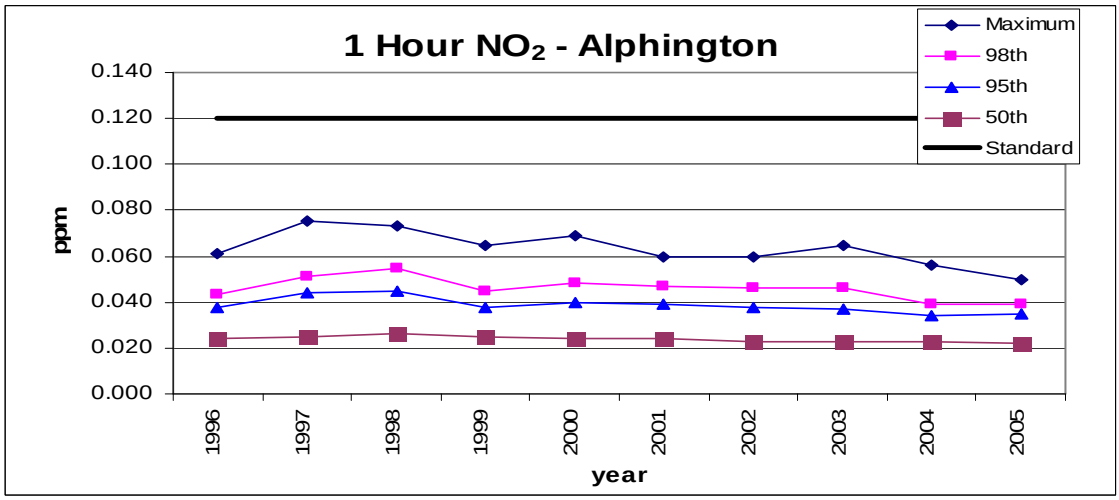
exceedences' model in the light of climate change. Data for PM10 for the Alphington site in Melbourne is shown in Figure 6. The peak value shown in 2003 was due to an unseasonable dust storm due to prolonged drought conditions.

Figure 6: 24-hour PM_{10} levels Alphington, Victoria, 1996-2005.



Data for 1-hour maximum nitrogen dioxide from the Alphington site in Melbourne is shown in Figure 7. In most jurisdictions there is no discernible trend for particles, ozone and nitrogen dioxide in the period since the NEPM was introduced. The complexity of air quality management usually means that multiple sources of pollution need to be controlled in order to significantly reduce air pollution concentrations.

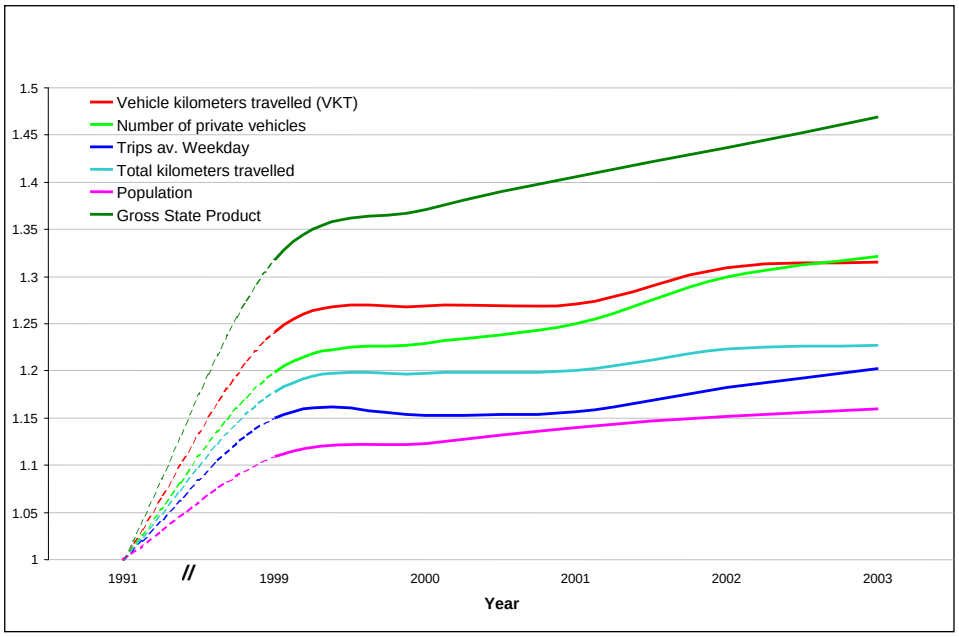
Figure 7: Highest daily NO2 concentrations (1-hour average), Alphington, Vic, 1996-2005.



Most regions have experienced an increase in vehicle kilometres travelled (VKT), a measure of motor vehicle usage (Fig 5). For example, over the last 20 years, Sydney's population has grown by 21%, while the number of car trips has increased 41% and the number of cars by 58%. Between 1999 and 2003, population grew by 4.6%, VKT increased by 6.0%, the number of vehicles by 10.2% and Gross State Product by 11.5%. The rate of increase in growth of VKT slowed during 2002–03. Figure 8 shows these changes indexed to 1991 levels. That there has not been a commensurate increase in vehicle related air pollution (fine particles,

nitrogen dioxide, carbon monoxide and ozone) with the increase in VKT suggests a positive effect of air quality management strategies.

Figure 8: Growth in population, trips and VKT in Sydney, 1999–2003 indexed to 1991



Source: TPDC data 2003. **Note:** Data is indexed to 1991 levels.

3.2.3 Risk to human health

The desired environmental outcome of the NEPM is air quality that provides adequate protection of human health and well-being. In assessing how effective the NEPM has been in achieving this, an evaluation of the risk posed by air pollution to human health needs to be considered.

Three areas have been considered in evaluating how the NEPM has addressed this risk:

- Whether the appropriate pollutants are included in NEPM,
- Whether the NEPM standards and associated goal have been met,
- Whether monitoring has been established to determine population exposure to these pollutants.

When considering the need for air quality standards in Australia it was noted that Australia did not have the significant air quality problems faced by other countries. However, it was acknowledged that there were a number of areas where problems did exist and the potential for air pollution to become a problem remained.

The discussion paper considers the inclusion or exclusion of indicator substances. There is no structure in the NEPM to determine criteria for inclusion or exclusion of a pollutant. It may be appropriate to develop a set of criteria against which the inclusion of indicators can be judged.

When the NEPM was made the pollutants included were those that were widely distributed in the environment and arose from a wide variety of sources. The criteria pollutants (nitrogen dioxide, ozone, particles, carbon monoxide, sulfur dioxide and lead) were identified as the pollutants of most concern in Australia and were established as indicators of the quality of the air in cities and large regional areas. These criteria pollutants were also consistent with the set of pollutants for which air quality standards had been set in other

countries. The main sources of these pollutants were identified as motor vehicles, domestic and commercial heating and cooking, and industrial activities. Precursors of ozone also arose from evaporating solvents, liquid fuels and fugitive vapours. These pollutants are also emitted from natural sources and events, such as bushfires.

No Adverse Effect Levels (NOAELs) or Lowest Observed Adverse Effect Levels (LOAELs) can be identified for some pollutants (e.g. nitrogen dioxide and carbon monoxide) from controlled exposure studies, and these have been useful in some standards setting processes. Epidemiological studies have identified health effects for most pollutants at levels below current air quality standards, especially for ozone and particles. These studies have not found a clear threshold for effects. This had led to a shift in the policy framework within overseas agencies to adopt an exposure reduction approach (which is discussed further in section 4.1).

As discussed in section 3.2.2 the standards for nitrogen dioxide, carbon monoxide, sulfur dioxide and lead are met in most jurisdictions. There are still exceedences of the standards for ozone and particles in all jurisdictions on occasion. It should be noted however that the standards have been set based on the results of epidemiological studies and carry an inherent level of risk associated with these pollutants.

There have been significant changes in automotive fuels that bring into question whether the current set of indicators remain the most relevant for assessing air quality in Australian cities. With the removal of lead from petrol ambient levels of lead are below detectable levels except in areas that are impacted by industrial sources. Many jurisdictions have ceased lead monitoring in urban areas. This raises the question as to whether lead should remain in the AAQ NEPM as it is no longer a pollutant that is ubiquitous in the air environment.

In 2005 a review of the need to include a 10-minute standard for SO_2 in the AAQ NEPM was undertaken as part of the Future Actions agreed to at the time of making the NEPM. The outcome of this review was that short-term peaks (i.e. less than 1-hour) of SO_2 are linked with industrial emissions and are not experienced widely in urban airsheds. Given that the NEPM is about regional air quality and not management of individual industrial sources it was recommended that a 10-minute standard for SO_2 not be included in the AAQ NEPM. However, it was further recommended that the health and environment sectors should work together to develop a 10-minute guideline outside the NEPM that could be used by jurisdictions to assist in the management of industrial emissions and assess the impact in affected communities (NEPC, 2005).

There is also an increased understanding of the distribution of other pollutants in Australia. Benzene and polycyclic aromatic hydrocarbons are pollutants associated with increased cancer in humans and were included in the Air Toxics NEPM when it was made in 2004. Benzene and PAHs are widespread in the air environment in Australian cities, being sourced from both motor fuels and combustion. Submissions on the ISP canvassed the inclusion of benzene and PAHs in the AAQ NEPM however these pollutants are being addressed through the Air Toxics NEPM with monitoring and reporting required through that mechanism.

As discussed previously particles are not one pollutant but a mixture of particles that vary in size and composition. The NEPM contains standards for PM_{10} and advisory reporting standards for $PM_{2.5}$. There is evidence that the health effects of $PM_{2.5\text{-}10}$ differ from those of

$PM_{2.5}$. This led the USEPA in the recent review of the particle standards in the US to propose standards for the two size fractions. However, the final outcome of the review was that PM_{10} and $PM_{2.5}$ were retained as the indicators of particle pollution in the US. For the review of the NEPM consideration could be given to establishing standards for ultra-fine particles and the coarse fraction of PM_{10}. In establishing such standards the difficulties in monitoring these size fractions would need to be acknowledged. Further consideration could also be given to setting standards on the basis of particle composition although the health evidence to support such standards is very limited at this time. This will be explored further in a separate paper on the review of the air quality standards.

The NEPM standards were developed based on epidemiological studies using data from non-peak sites. Monitoring was designed to be used in the assessment of air quality at locations that give an 'average' representation of air quality. Some jurisdictions use the NEPM standards to assess air quality at locations that do not fit the requirements of the NEPM monitoring, or for the control of individual industries. The use of standards to assess local air quality issues, or as individual licence conditions for industry, is not in accordance with the intent of the NEPM.

NEPM monitoring was intended to provide data that represented the *exposure* of the population to ambient air pollution. However, as there has been no agreed protocol on how to assess exposure or what is required to assess exposure, the monitoring networks have been established to provide an assessment of the upper bound of regional air quality. Note that population exposure to ambient or outdoor air pollution should not be confused with personal exposure of individuals which is influenced strongly by personal behaviours and activities. The NEPM is focussed exposure of large populations to ambient levels of air pollution.

In determining population exposure it is clear that there is a role for air quality modelling to support data generated from NEPM monitoring stations. This requires the development of emission inventories at a relatively fine grid (eg., 1 km x 1km) to enable predictions of air pollution levels across an entire airshed including the variability in air pollution levels encountered across the population.

The PRC guidance has focussed on a strict network design to assess compliance with NEPM standards, not to determine population exposure as was intended when the NEPM was made. Jurisdictions have advised that they have not been able to determine accurately the percentage of the population that may experience pollution levels monitored by NEPM stations. Some jurisdictions have provided qualitative descriptors of the type of sites; others have estimated populations that live within a certain distance from an air monitoring station. Estimates from jurisdictions, that have used differing methods to assess percentage of population covered, range from 32% to approximately 50%. No guidance has been provided on modelling approaches to assist in the determination of population exposure. This is discussed further in section 3.3, but is a limitation to assessing health risk.

Issues arising in section 3.2

1. There is no shared understanding of what "adequate protection" means.

2. Some of the criteria pollutants have no identified thresholds for human health effects and exposures below the standards may still represent significant health risk to Australian communities.

3. The NEPM included compliance standards for lead when it was made. However, lead levels are now below detectable levels (except in areas that are impacted by industrial sources). Many jurisdictions have gained approval to cease NEPM lead monitoring in urban areas as it is no longer a pollutant that is ubiquitous in the air environment.

4. Monitoring has been established to provide assessment of compliance, but has not been established to enable the assessment population exposure as required of the NEPM.

3.3 ASSESSMENT OF PROGRESS TOWARDS ACHIEVING NEPM GOAL

Air quality monitoring is conducted for a variety of reasons including:

- assessment of compliance with air quality standards
- management of air quality within an air shed or region
- provide information to the public
- assessment of the effects of individual management programs
- management of industrial emissions
- air pollution and health research

In establishing an air quality network the overall design of the network aims to provide information to inform all of these issues. However, establishing an air monitoring network usually requires compromise of competing needs. This is due to resource constraints – both financial and human resources required in maintaining an air quality network. In designing a network a balance needs to be achieved whereby information can be generated to meet the broad requirements of air quality data as outlined above. Although the resulting network may not provide information that 'perfectly' answers all the questions that are required to be answered, the networks usually provide data that suffice for most of these purposes. Since the development of the NEPM, jurisdictions have modified monitoring networks to focus on the need to report compliance with the NEPM.

3.3.1 Assessment of monitoring protocols

The Ambient Air Quality NEPM establishes protocols for the monitoring of the criteria pollutants. As part of the future actions agreed to by NEPC when the NEPM was made, a Peer Review Committee (PRC) was established to review the NEPM monitoring plans developed by jurisdictions to assist in the consistent collection and reporting of air quality data across Australia. The PRC interpreted the monitoring protocol and developed a number of technical guidance papers to assist jurisdictions in the development of monitoring plans.

The monitoring protocol in the NEPM has led to consistency in monitoring methods used in Australia as well as an increase in monitoring in smaller jurisdictions and in regional centres. Monitoring of both PM_{10} and $PM_{2.5}$ has also increased as a result of the NEPM. The monitoring methods used are generally consistent with best practice for the monitoring of these pollutants. The requirement for NATA accreditation has ensured that good QA/QC procedures are in place.

The PRC has provided guidance on establishing national consistency in air monitoring to enable an assessment of compliance with NEPM standards and goals. Although this is only one aspect of the NEPM it is an important first step. The guidance papers prepared by the PRC have provided technical guidance that is considered by all jurisdictions to have assisted in the development of the NEPM air monitoring networks. However information provided by jurisdictions has indicated that there are some inconsistencies in how the monitoring networks have been established for NEPM purposes. The interaction between PRC members has also been considered as a valuable exercise in exchanging views and experience across the jurisdictions.

The following components of the monitoring protocol have been identified for evaluation:

1. **Evaluation of the number of monitoring stations** including the population formula concept and population threshold for monitoring to assess facilitation toward achievement of the desired environmental outcome.
2. **Evaluation of the siting of monitoring stations** including the GRUB concept to determine whether it fits with the NEPM goal.
3. **Evaluation of the monitoring methods in Schedule 3** to assess whether they are the most effective methods for monitoring the pollutants included in the NEPM.

3.3.1.1 Evaluation of the number of monitoring stations

The monitoring protocol in the NEPM establishes a population formula to determine the number of monitoring stations required per million people. The monitoring protocol also states that monitoring is not required in communities with a population of less than 25,000.

Clause 14 of the monitoring protocol states:

> *(1) Subject to sub-clauses (2) and (3) below, the number of performance monitoring stations for a region with a population of 25,000 people or more must be the next whole number above the number calculated in accordance with the formula: 1.5P + 0.5, where P is the population of the region (in millions).*
>
> *(2) Additional performance monitoring stations may be needed where pollutant levels are influenced by local characteristics such as topography, weather or emission sources.*
>
> *(3) Fewer performance monitoring stations may be needed where it can be demonstrated that pollutant levels are reasonably expected to be consistently lower than the standards mentioned in this Measure.*

The formula was taken from a consultancy done by HRL Technology (Joynt, 1997). The basis of the formula is unclear and has been drawn from an unpublished draft report from the Australian Environment Council (1983). The HRL report states that '*a rigorous justification of the formula cannot be given; it is based on past and present judgements of what network size is adequate, taking into account current network sizes*'. The HRL report also states that the formula applies to the number of neighbourhood stations for a given population in a region. This implies that the formula was not intended to determine the total number of stations within a region.

The HRL report goes further to say that "*this sort of estimate of network size based on population gives a number of stations for an airshed which is well mixed and where mesoscale and local perturbing influences are small. In order to obtain an appropriate understanding of exposure to air pollution of the population in any region, the effects of topography, meteorological influences such as prevailing wind patterns, recirculation and variability in different seasons, and the spatial distribution of sources need to be taken into account. These influences may result in the airshed being*

considered as a number of sub-airsheds for monitoring purposes. These divisions may differ with time of year.

Further, what is an adequate network for one pollutant may be inadequate for another since each may be subject to quite different seasonal and other influences. A detailed knowledge of the region which is to be monitored and the pollutants which are of potential concern in that region is needed before the requirements of an adequate monitoring network can be determined. To provide proper assessment of population exposure to a range of pollutants in the relatively complex topographical situations often found in Australia, real world networks may need to be significantly larger than a theoretical lower limit derived from population data."

Most jurisdictions have utilised the population formula to determine the number of performance monitoring stations required for NEPM monitoring purposes. These sites form a subset of total monitoring conducted in those airsheds. However, there are some jurisdictions that have applied the formula to determine the total number of air monitoring stations required in a region. As discussed in the HRL report and NEPM Revised Impact Statement this approach is unlikely to allow a determination of population exposure in those airsheds unless the airsheds are small.

There was general agreement from jurisdictions that the population formula provided sufficient performance monitoring stations to allow a determination as to whether compliance with NEPM standards and goals had been achieved. However, most commented that these sites were only a subset of their total monitoring and on their own would not be sufficient for air quality management purposes.

The monitoring protocol in the NEPM specifies that monitoring is only required in populations of 25,000 people or more. There is flexibility in the NEPM for jurisdictions to conduct monitoring in other areas however in practice it seems as though the population threshold has guided monitoring. Smaller jurisdictions have commented that the threshold makes it difficult for them to obtain resources to monitor in regional centres that have air pollution problems but have populations less than 25,000.

The PRC guidance has focussed on a strict network design to assess compliance with NEPM standards, not to determine population exposure as was intended when the NEPM was made. Most jurisdictions have not been able to estimate what percentage of the population is exposed to air pollution levels currently measured by the existing air monitoring network in their jurisdiction. They are also unable to identify how 'representative' the air quality data that is generated by the NEPM monitoring networks is of exposure of the general population. There is no guidance provided in the NEPM or the PRC technical papers that guides the estimations of either exposure or representativeness. This is information that all jurisdictions say is required.

Internationally there has been a move to establish air monitoring networks to allow population exposure to be determined (e.g. EU, USEPA, WHO). These approaches are based on consideration of population density, sources, distribution of pollutants within an airshed and the concentration of a pollutant relative to air quality standards. A range of sites is recommended including background (urban and rural), peak, rural, urban and suburban. Air quality modelling is also a tool that is used to assist in the siting of air monitoring stations to ensure that an appropriate mix of air monitoring stations is achieved to enable population exposure to be determined. The focus on compliance alone is inconsistent with current international practice.

It would seem that the approaches being used internationally might provide a stronger basis for the design of monitoring networks in Australia that would provide a measure of population exposure. Adoption of these approaches with amendments to account differences in population density and sources is an option for consideration if the focus of the NEPM monitoring changes from strict compliance monitoring to a network that will deliver the original intent of the NEPM – a measure of population exposure.

The population formula in the NEPM, although considered by jurisdictions as providing a guide for NEPM monitoring sites, has no clear basis and is being used in some jurisdictions as the basis for estimating entire monitoring networks.

Feedback from consultation on the Issues Scoping Paper identified that the population formula described in clause 14(1), be amended as it does not provide adequate coverage to determine what the population is exposed to. It was also considered that the 25,000 population threshold did not capture smaller population sub-groups that might be at risk in some jurisdictions. This raised questions of equity in relation to adequate protection of the population.

3.3.1.2 Evaluation of siting of NEPM monitors

The Revised Impact Statement that accompanied the NEPM clearly stated that the intent was to locate stations to give an 'average representation of general air quality and population exposure' . The NEPM monitoring protocols were to establish monitoring that provided air monitoring stations that were located where a range of air pollution levels would be experienced to enable an estimation of the exposure of the population to be determined (*Revised Impact Statement p40*). In developing the airshed monitoring plans, the protocol required assessment and reporting of the spatial and population representativeness of each station to ensure that the exposure of population was adequately considered in the design of the networks and that any data generated could be used to assess population exposure.

In attempting to meet the requirements of the NEPM, the PRC provided interpretation that focussed on measuring compliance with the air quality standards rather than measuring population exposure. It introduced the concept of Generally Representative Upper Bound (GRUB) sites (PRC Technical paper No.3). A broad definition of a GRUB site was provided by the PRC:

> *'GRUB stations are performance monitoring stations (PMS) 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 sources'.*

The PRC paper goes further to state that:

> *'Stations will be at sites where the pollution gradients are generally low, so that they can represent the pollution level across a substantial area and fraction of the population'.*

No guidance is provided on what constitutes a 'substantial' area or what 'fraction' of the population should be represented by air pollution measurements at this site.

In addition to GRUB sites the PRC also recommended that population-average sites also be included in the NEPM air monitoring networks. Population-average sites are defined by the PRC as those sited to ensure adequate monitoring of large portions of the populated area and of the total population within a region. No guidance is provided on what is 'adequate'

and what is meant by a 'large portion' of the population. The PRC guidance recommends that the focus should be on GRUB sites and that the number of GRUB sites should not be reduced to allow population-average sites to be included.

In addition, the paper indicates that:

'In regions where only one PMS is required, it is expected that the PMS will be a GRUB site.'

On the basis of a strict compliance approach, this is useful guidance for regions where there is a good understanding of air quality within an airshed, through preliminary modelling or campaign monitoring. However, as noted elsewhere, the GRUB concept has not always been interpreted consistently by jurisdictions. For example, it is inappropriate to install a single PMS station *ab initio* into a region as a GRUB station, when little or no evidence exists for declaring it to be so. The PRC paper reflects a cautionary approach to network development based solely on the population formula, thus:

'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.'

Such caution is also appropriate in applying labels such as GRUB to a station, particularly a single station that is the source of all air quality data for a region.

The PRC Technical paper no 3 acknowledged the requirement of the NEPM to determine the exposed population that is represented by each monitoring station. However, the PRC advised that because of uncertainty in determining any quantitative measure of the exposed population, that the NEPM requirement would 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 in emissions, meteorology or topography.*'

The question is whether the intent of the original NEPM was to provide a quantitative measure of population exposure or a qualitative one. This is an important issue when conducting exposure assessments for air pollution and health research and for exposure assessments as part of the setting of air quality standards. Internationally approaches have been developed to provide a quantitative assessment of population exposure for the purposes of establishing air monitoring networks.

As monitoring has focussed on upper bound sites, monitoring for NEPM purposes has not generated data from locations that provide an estimate of air pollution exposure experienced at lower levels. Although some jurisdictions conduct additional monitoring to what is required under the NEPM, this is not consistent across jurisdictions and does not occur at sites with lower levels of pollution. The importance of this is explained in the Revised Impact Statement "*…to provide a representative assessment of exposure, monitoring networks include regions of generally high or low air quality levels excluding localised source-related peaks. Understanding the implications of ambient air monitoring data measured in this way requires an understanding of the studies on which the standards are based. Clearly within a region there will be a range of locations with and high and low pollution levels to which individuals are exposed. The general level of protection provided for that region is there for the population on average.*"

The data generated from GRUB only networks will provide a different picture of regional air quality than that generated from a network with a mix of GRUB and population average sites. This issue is further complicated by the inconsistent interpretation of GRUB with some jurisdictions using 'peak' or 'hot spot' sites as GRUB sites and others using generally representative upper bound sites.

Jurisdictions have interpreted the monitoring protocols differently, in particular what is meant by a GRUB site, resulting in inconsistencies in the siting of air monitoring stations. This may mean that data generated from different jurisdictions may not be directly comparable.

In some jurisdictions NEPM monitoring is focussed only on GRUB sites while others have a mix of GRUB and population average sites. The data generated from GRUB only sites will provide a different picture of regional air quality than that generated form a mix of GRUB and population average sites. This issue was raised in the impact statement for the NEPM where the need to have sites that represented average rather than peak concentrations was identified. This issue is further complicated by the inconsistent interpretation of GRUB with some jurisdictions using 'peak' or 'hot spot' sites as GRUB sites and others using generally representative upper bound sites.

The PRC approach to monitoring has provided a good basis for evaluating compliance with standards. However, since the NEPM was made and the PRC guidance prepared, the international trend to establishing air monitoring networks to determine population exposure provides a framework that is likely to deliver on the original intent of the NEPM – estimates of population exposure.

If a variation to the NEPM includes a greater focus on population exposure then a clear and practical protocols must be developed, setting out the methodology to be used to ensure a consistent approach to the assessment of population exposure and representativeness of air quality monitoring data. The protocols should include guidelines on the use of modelling information to facilitate determination of the number, type and location of monitoring stations.

Consideration should also be given to the need for a consistent ''station validation" procedure, based on the data collected from a station subsequent to its establishment and on other pertinent information, to assess the potential for inappropriate location of the station.

There will be a need to establish an agreed understanding of what is meant in practical terms by "population exposure" and "representativeness". A clear and consistent understanding of how to provide usable and useful information on health, social and economic impacts, within the budgetary constraints on jurisdictional monitoring systems will be essential. This implies a need for collaborative project work between health and environmental agencies, to develop a workable approach on which to base the protocols, which should be informed by experience overseas.

3.3.1.3 Assessment of the monitoring methods in Schedule 3

As previously discussed the NEPM requires Australian Standard monitoring methods to be conducted for each specific pollutant. For the monitoring of the gaseous pollutants – NO_2, CO, O_3 and SO_2 – this requirement is not considered to be a major concern. However, for particles (both PM_{10} and $PM_{2.5)}$, concerns have been raised that this requirement restricts the introduction of new and potentially superior methods.

The development of Australian Standards for monitoring air pollution takes several years and is dependent on either:

- Testing and evaluation of equipment in Australia: or
- Evaluations conducted overseas in particular, those conducted by the USEPA to determine their reference and equivalence methods for monitoring.

As the monitoring of PM_{10} and $PM_{2.5}$ is a relatively new science, and the evidence from air pollution and health research increases the pressure to monitor these pollutants more extensively, new instrumentation is being developed at a rapid rate. There are views within some jurisdictions that the current structure of the NEPM, over a ten-year period, does not provide flexibility in the NEPM monitoring protocols to enable adopting newer technologies without the formal process of introducing an Australian Standard for that method.

Internationally, equivalence of alternative particle monitoring methods is measured relative to the reference method using hi-volume samplers. It is necessary to have a benchmark against which any new method is evaluated. The NEPM monitoring protocol specifies the hi-volume sampler as the monitoring method for PM_{10} and low volume samplers for $PM_{2.5}$. Some jurisdictions have raised concerns that the hi-volume air sampler is no longer practical in terms of its operational costs.

An equivalence program was established through the variation to the NEPM to include $PM_{2.5}$ standards to assess whether the continuous methods such as the Tapered Element Oscillating Microbalance (TEOM) could be considered to generate data equivalent to the reference method – the manual gravimetric method. One of the difficulties is lack of shared understanding of what equivalency is trying to achieve. For example, whether equivalency means generating the same number on both instruments, or whether it means that the instrumentation measures the same physical characteristics of the particles.

Given the resource intensiveness of monitoring with hi-volume samplers the PRC approved the use of TEOMs for monitoring of PM_{10} for NEPM purposes. A technical paper was prepared that established how the TEOM was to be operated and data reported. Subsequently an Australian Standard has been developed. It is accepted that due to the heating of the inlet in the TEOM to 50°C there can be significant loss of particle mass due to the loss of volatiles. This is of particular concern in cooler parts of Australia. To address this the PRC commissioned CSIRO to develop a 'correction' or 'adjustment' factor that was to be used by jurisdictions to correct the TEOM data to make it 'equivalent' to data collected by hi-volume samplers.

Concern has been raised that it is not valid to apply one correction factor to all parts of Australia given differences in climate and sources. This has led to inconsistencies in the way that jurisdictions report TEOM data. Some jurisdictions apply the general CSIRO factors, some apply locally derived factors, while others do not apply any correction. There is a recognition that the variability of particle types and composition from place to place, creates complexities that need to be resolved.

In the US and Europe an assessment of the accuracy and precision of the monitoring equipment forms part of the equivalency program. Trying to adjust the data generated from one instrument to be consistent with the data from another may also be flawed. An assessment of the confidence intervals associated with the data generated and a statistical analysis as to whether the data, within the accuracy and precision of the monitoring method, is actually equivalent may be a better way to determine 'equivalency' than deriving an 'adjustment' factor to apply to the data.

Other monitoring methods, using optical counting technologies and light scattering, are becoming increasingly available and more sophisticated and have obtained PM_{10} equivalence in Europe and the USA. It must be acknowledged that all these instruments measure particles differently and therefore determining equivalency is not straightforward.

Introduction of new methods without an agreed assessment of the 'equivalency' of the method may lead to inconsistencies in the data quality and integrity. The introduction of new technology also comes at an increased cost that many jurisdictions will find difficult to meet. These considerations need to be balanced against the need to ensure that the most effective methods for monitoring particles are utilised in the NEPM monitoring.

Views from jurisdictions varied as to whether the current NEPM monitoring protocol was reflective of international best practice for air quality monitoring for both gaseous pollutants and particles. There was general agreement that the methodologies for monitoring gases are in line with international best practice, however, two jurisdictions made the point that the DOAS methodology is regarded as best practice, but not part of the suite of approved methods under the NEPM.

In contrast, measurement of fine particles still provides challenges to authorities and views were quite divergent on the question of whether international best practice is being applied. A large part of the problem is that particle measurement is still evolving internationally, and our understanding of the nature of fine particles is still limited.

All jurisdictions agreed that a level of consistency between jurisdictions has been achieved in monitoring methods due to the NEPM protocol. Although consistent methods for monitoring are being used, differences in interpretation of PRC guidance on siting of monitoring stations and reporting of data raises the question as to whether the data that is being generated is in fact consistent and comparable. This is an issue raised by all jurisdictions that responded to the questionnaires.

The emerging issues of ultrafine particles, particle counting and composition were also raised in submissions to the ISP, but the high cost of methods and their impracticality for use in routine monitoring were seen as impediments to further work. With information required on particle composition and size as well as mass one instrument is unlikely to provide all the information required. Consideration will need to be given to what instruments and monitoring protocols would be required to ensure that all relevant information is collected.

3.3.2 Assessment of the role of the PRC

The PRC has carried out its role since 1998 by actively providing advice on many technical and scientific areas that are a part of air quality monitoring. This includes assistance with the development of jurisdictional monitoring plans, reviewing monitoring plans, reviewing issues on particle monitoring and measurement methodology and comparisons. This activity has improved the state of air monitoring nationally so that comparisons across jurisdictions are now possible. This was a part of the original aim of the NEPM. These activities have centred mainly on Part 4 of the AAQ NEPM, the national environment protection protocol and the schedules of the NEPM.

The PRC under its current terms of reference has taken an approach that has successfully assisted the development of air monitoring networks nationally. In addition it has established a mechanism for regular reporting of data in a consistent manner. This approach, although limited in its scope, was necessary to ensure the implementation of the monitoring and reporting sections of the AAQ NEPM. Concentration on the technical issues and implementation of air monitoring has directed attention to obtaining and reporting of air monitoring data, with less attention to consideration of determining population exposure.

It is seen that the technical role played to date by the PRC will remain critically important in the implementation of the AAQ NEPM. For national consistency of monitoring, data and information it is essential that advice from experts in the field of air monitoring be obtained. Issues of quality control, monitoring methods, ongoing improvements, and consistency will continue to arise over time and will require the attention of relevant experts to ensure they are effectively and efficiently dealt with. The PRC is currently unfunded, affecting it ability to implement its tasks.

Jurisdictions have indicated that there is an ongoing need for a body to support the implementation of the NEPM. If the focus of the NEPM monitoring continues to be on compliance only then the role of such a body would be to oversight the periodic review of aspects of the monitoring methods, national consistency and quality assurance of monitoring data. However, if the focus moves to consider other aspects of the NEPM such as determination of population exposure or to ensure the levels of pollutants are continually improving to reduce the associated health risks and to determine exposure, modelling and requirements for emissions inventories, then the PRC may not have the appropriate expertise to provide guidance on these issues.

3.3.3 Assessment of jurisdictional monitoring plans

Jurisdictional monitoring plans were developed and reviewed by the PRC. Once endorsed by the PRC the monitoring plans were approved by NEPC. Monitoring networks have been established in accordance with the approved monitoring plans.

The monitoring plans also required jurisdictions to identify the monitoring equipment that would be used in each station. Although the NEPM requires the use of Australian standard methods the PRC endorsed the use of TEOMs for monitoring of PM_{10} and provided technical guidance on their use. The jurisdictions have identified some inconsistencies in the use of TEOMs and the reporting of TEOM data.

Some jurisdictions have identified that due to resource constraints they have been unable to fully implement their monitoring plans. This has meant that some air monitoring stations have not been established. Further resource constraints have led to the closure of some NEPM monitoring sites. This means that the NEPM monitoring is not being conducted in accordance with the approved monitoring plans in some jurisdictions.

Concerns have been raised about the lack of independence in the assessment of the monitoring plans. The PRC have the role of providing guidance on the development of the air monitoring plans and the endorsement of the final plans. The members of the PRC also have a role in the development of their own jurisdictional plans. There has been a suggestion that an independent review of the plans may be beneficial.

The focus of the monitoring plans on establishing air monitoring networks for compliance purposes only delivers on one aspect of the NEPM requirements. As was discussed in Section 3.3.1.2 the jurisdictional monitoring plans approved to comply with estimating generally representative upper bound exposure may not provide good estimates of average population exposure.

3.3.4 Assessment of reporting processes

The national environment protection protocol of the AAQ NEPM requires annual reporting to NEPC by each jurisdiction. This report must be submitted in an approved form, including the progress made towards meeting the standards and goals. Clauses 11, 17 and 18 of the AAQ NEPM establish the reporting requirements for jurisdictions. Jurisdictions have been reporting annually under the NEPM since 2000 and NEPC annual reports are available on the EPHC website: www.ephc.gov.au

The implementation of the AAQ NEPM and compliance with the air quality standards is the responsibility of each individual jurisdiction. Under the NEPC Act, the accountability for meeting the standards lies in the public reporting to Parliaments and in the NEPC Annual Report. If the data from performance monitoring stations show some areas in a particular jurisdiction are above the standard then it is entirely at the discretion of that jurisdiction as to what action should be taken to manage the problem.

In addition to the general requirements under Clauses 17 and 18, the Peer Review Committee (PRC) prepared a technical paper (No. 8) which provides guidance to jurisdictions regarding the format for reporting of air quality data. The aim of this document is to achieve a nationally consistent approach to air quality reporting in Australia under the NEPC process.

3.3.4.1 Annual reporting

The current NEPM reporting is based on statistical analysis and strict compliance assessment. It provides a dense, scientific report that has been identified by many stakeholders as being difficult to understand. Some stakeholders have identified that they don't know how to obtain annual reports; others would find a national summary of the data in a less scientific, more descriptive form more useful that than the current reports.

The current reporting format employed to publish the AAQ NEPM annual report does not include detailed descriptive monitoring results or supplementary information to allow comprehensive characterisation or understanding of air quality in regions throughout Australia. The data is predominantly provided in a scientific context that does not always allow for easy interpretation and understanding by the broader community. This issue was raised in submissions on the ISP from a range of stakeholders. Furthermore, the current annual reporting does not provide sufficient information to determine the exposed population 'represented' by the monitoring station.

As the primary aim of the AAQ NEPM is to protect human health and well-being, it is reasonable that appropriate communications strategies are put in place to advise the community of the outcomes of monitoring. Annual reporting is the primary means of communicating with the community about air quality and actions being taken to improve air quality in Australia as a result of the AAQ NEPM. Feedback on the ISP suggests that the current reporting is not an effective tool for communicating with the general population about air quality nor provides the information they require. It is important to note at this point, that AAQ NEPM reporting is only a sub-set of the air quality reporting provided by most jurisdictions. This is discussed in more detail later in the document.

The AAQ NEPM monitoring data is not only used for annual reporting purposes to NEPC, but also assists jurisdictions to assess regional air quality, prioritise policy action and evaluate management programs. Another key use of the data is for research purposes

including studies on the health effects of air pollution. This analysis is based on critical interrogation of the data, rather than simply examining the annual reports.

Based on the submissions, it is clear there is an expectation that NEPM reporting should fulfil several objectives including scientific analysis, political/legal purposes (compliance with the AAQ NEPM), air quality policy development, jurisdictional accountability and communication with, and information to, the community.

3.3.4.2 Compliance reporting

Jurisdictions believe the information provided in the NEPC annual report meets the reporting requirements as specified with the NEPM. However, sub-clause 18(3)(a) of the AAQ NEPM states:

> *"The report must include:*
>
> a. *the evaluation and assessments mentioned in clause 17;…"*

Sub-clause 17(2)(a) of the AAQ NEPM states:

> *"For each performance monitoring station in the jurisdiction or assessment in accordance with subclause 11(b) there must be:*
>
> *(a) a determination of the exposed population in the region or sub-region represented by the station;…"*

Although the representativeness of monitoring stations is discussed in jurisdictional monitoring plans, the above-mentioned sub-clauses require this be assessed annually in NEPM reporting. This is not occurring, but as discussed earlier in this paper, it is not straightforward to determine this with any confidence. Before jurisdictions report annually on estimated population exposures linked to monitoring stations, guidance would need to be developed to ensure this is done with some consistency across Australia.

Jurisdictions generally suggested that the current NEPM reporting would allow limited scientific analysis, but that access to the base data would be required for more complex scrutiny to occur. The uniform National Air Quality Standards do give credible standards against which airshed quality, effectiveness of management programs and the need for action can be gauged.

Under the NEPC Act, the accountability for meeting the standards and goal lies in the public reporting. For smaller jurisdictions the NEPC annual reporting is said to maintain the profile of air quality. This is important to ensure monitoring continues and there is justification to undertake management action where required. In larger jurisdictions, where there may be more anthropogenic pressures on air quality, NEPM reporting is either a subset of regional monitoring networks or a replacement of existing networks. In either case the reporting process, admittedly modified, is often a continuation of reporting already undertaken by jurisdictions. As a result there is reported to be either little or no evidence that the annual NEPC public reporting process has driven change in air quality management.

As current reporting tends to lead to an emphasis on compliance with, or exceedence of, the standards at the expense of overall understanding of the health and environmental impacts of current levels of air pollutants it is not seen as a particularly effective tool to communicate with or educate the community. It is probably ambitious to expect that a single report could both provide the level of detail necessary for scientific analysis while also effectively communicate with the community.

Clause 17 of the NEPM also requires jurisdictions to evaluate their annual performance by evaluating the performance against the standards and goals of the NEPM on a station by station basis. This means that any exceedences of the standards are reported for individual stations not for the air shed as a whole. This is meant to account for local versus regional influences that can impact on air quality monitored within the air monitoring network.

The assessment of exceedences on a station-by-station basis has led to a distorted picture of air quality in some areas within some communities. For example, if a jurisdiction had one day of poor air quality when the air quality standards were exceeded and had fifteen air monitoring stations, this would be recorded as fifteen individual exceedences on that day. However, if they had two air monitoring stations it would be recorded as two exceedences. However they all occurred on one day. The community often perceive these exceedences as being fifteen days of poor air quality, not one. The current approach of reporting exceedences on a station by station basis makes it very difficult to communicate with the broader community on air quality issues.

3.3.4.3 Community reporting of other air quality information

The AAQ NEPM annual reporting is only a sub-set of the air quality data publicly reported by many jurisdictions. The form and frequency upon which this additional air quality information is provided to the community varies between jurisdictions. This information is normally available on Department websites.

For example, Queensland reports monthly air quality bulletins and annual calendar year summary and trend reports encompassing all monitoring network sites (not just AAQ NEPM sites). Real-time web reporting of hourly data also takes place. To assist understanding of the significance of measured levels, web data values are presented against a colour-coded background referenced against the relevant Air NEPM standard. New South Wales reports air quality monitoring via twice daily Regional Air Pollution Indexes that are linked to health outcomes, 24 hour summaries, quarterly reports and triennial State of the Environment reporting. Similarly, Western Australia publishes air quality data twice daily though the provision of graphical outputs for each monitoring station/pollutant and summarises non-NEPM monitoring data on an annual basis in an annual report that is similar in format to that used to report to NEPC.

In Victoria data is available in real time via the EPA Victoria website. Information is available as raw data or expressed as an air quality index. The index is graded relative to the air quality standards in the NEPM. EPA Victoria also publishes annual reports that provide further information on air quality monitoring in Victoria as well as a summary of the information contained in the NEPC annual report.

Jurisdictions also publish reports on specific short-term air quality monitoring programs. This work is often related to the investigation of adverse impacts from specific sources or undertaken to provide additional background information. The difference in reporting is likely to reflect regional air quality, the expectation of the broader community, and departmental resources to provide this addition service.

3.3.6 Assessment of jurisdictional implementation

Air quality is managed by jurisdictions using a variety of tools including a mix of legislative (e.g. statutory policies) and non-legislative actions. As discussed in Section 2.2.6 most jurisdictions have implemented the NEPM under the provisions of the NEPC Act. However

the management of air quality and actions taken to ensure that improvement s in air quality are achieved so that the NEPM standards are met has been undertaken through the development of air quality management plans and strategies.

Most jurisdictions have had air quality management/improvement strategies in place for many years. Most of these had been development prior to the making of the NEPM (e.g. NSW's *Action for Air*, WA's *Perth Air Quality Management Plan*). The focus for jurisdictions since the making of the NEPM has been in implementing these strategies. The NEPM standards are a further driver to assist in the implementation of the strategies. The NEPM standards have also provided a benchmark to assist in evaluating the success of the management actions taken.

Action for Air is the NSW Government 25-year air quality management plan for the Greater Sydney Metropolitan Region (including the lower Hunter and Illawarra regions). When commenced in 1998, *Action for Air* nominated the emerging NEPM standards as crucial to the plan. In subsequent updates and the current review of *Action for Air,* NEPM standards are identified as drivers for air quality improvement in this region. NSW updated *Action for Air* in 2006 and it is currently under further review.

NSW amended the *Protection of the Environment Operations Clean Air (Motor Vehicle and Motor Vehicle Fuels) Regulation 2002* to limit petrol volatility in summer. This action is aimed at reducing ozone levels. NSW has also reviewed their *Protection of the Environment Operations (Clean Air) Regulation.* Although not a direct result of the implementation of the NEPM, the NEPM has provided a further driver for the review.

Victoria has developed a draft Air Quality Improvement Plan that identified actions to be implemented to ensure that the standards and goals of the NEPM would be met by 2008 and to drive continuous improvement in air quality into the future (assessed to 2020). Although AQIP has not been finalised a number of the identified actions have been implemented to drive improvement in air quality. EPA Victoria is currently reviewing and updating AQIP prior to finalisation.

Some actions have been taken around specific source issues. The Australian Government Department of the Environment and Heritage implemented a wood heater replacement program in Launceston, Tasmania to address particle pollution. Further work with jurisdictions in auditing wood heaters to ensure that they comply with Australian Standards has also been undertaken. Victoria developed a Waste Management Policy for Solid Fuel Heaters to ensure that all heaters sold and installed in Victoria comply with Australian standards to assist in managing ambient PM_{10} and $PM_{2.5}$. NSW has also introduced initiatives targeting wood smoke under the *Protection of the Environment Operations (Clean Air) Regulation*, including the requirement that new wood heaters meet the emissions limits in the Australian Standard and enabling local council officers to issue Smoke Abatement Notices where "excessive smoke" is emitted from chimneys on residential premises. Similar regulations exist in WA.

NSW has introduced legally enforceable pollution reduction programs (PRP) that require industry to reduce emissions as part of the strategy for meeting the NEPM standards in NSW. The PRPs are attached to industry licences. The assessment of new industries in the GMR of NSW also includes a consideration of the extent to which they may contribute to ozone formation. WA is using the NEPM PM_{10} standards to drive dust management in regional areas. In December 2006 the Premier of NSW released the NSW State Plan. One of the targets in the State Plan is to meet the AAQ NEPM goals. As the State Plan will be

driving NSW policy directions over the next 10 years, this provides a further illustration of the role of the NEPM in NSW.

In Victoria improvements in industry performance are being driven by implementation of SEPP (AQM). The revised SEPP (AQM) tightened requirements on industry including more stringent design criteria for individual premises. Design criteria, which are modelling tools, are more stringent than the NEPM standards to ensure that emissions from multiple sources within an airshed do not lead to exceedences of the ambient standards. Additionally, Victoria has worked with the printing industry to achieve reduction in the emissions of ozone precursors.

In Tasmania the AAQ NEPM has been a key driver for the following recent policy developments. The *Environment Protection Policy (Air Quality) 2004* has been made, which provides guidance and standards for point and diffuse source emissions. In respect of point sources (mainly industry) the Policy is largely implemented through permit environmental conditions for the operation of sources and in the assessment of proposed new sources. The *Tasmanian Air Quality Strategy 2006* has been published. The Strategy assesses the State's compliance with the NEPM and proposes a Strategy for achieving compliance and to guide the management of air quality generally. New regulations on solid fuel heaters and backyard burning are under development, to be made under the *Environmental Management and Pollution Control Act 1994*. No specific legislation on motor vehicle emissions exists or is proposed, as these emissions are a relatively low priority in Tasmania.

When the AAQ NEPM came into effect, Queensland already had ambient air quality goals for the priority pollutants in its *Environmental Protection (Air) Policy 1997* under the *Environmental Protection Act 1994*. The EPA was implementing a licensing regime that established emission limits for a wide range of industrial activities, and had commenced development of the South East Queensland Regional Air Quality Strategy. No changes were needed to implement the NEPM other than to take the NEPM into account when issuing new licences.

In 2000, Queensland amended the *Environmental Protection Regulation 1998* to establish fuel quality standards that reduced emissions of VOCs, lead and sulfur dioxide from the distribution and use of petrol and diesel. The *South East Queensland Regional Plan 2005-2026* will reduce emissions from transport and energy activities in this rapidly growing region by establishing a planning framework and pattern of development that reduce the demand for transport and energy, and increase the efficiency of the systems that supply these services.

Issues identified in section 3.3

7. The population formula in the NEPM, although considered by jurisdictions as providing a guide for NEPM monitoring sites, has no clear basis and is being used in some jurisdictions as the basis for estimating entire monitoring networks.

8. While there is flexibility in the NEPM for jurisdictions to conduct monitoring in areas other than those that meet the 25,000 population threshold, in practice the population threshold has guided monitoring. Smaller jurisdictions have commented that the threshold makes it difficult for them to obtain resources to monitor in regional centres that have air pollution problems but populations less than 25,000.

9. There is no guidance provided in the NEPM or the PRC technical papers that guides the estimations of either exposure or representativeness. Additionally, jurisdictions have been advised that the assessment of population exposure should be qualitative rather than quantitative as implied by the NEPM.

10. The guidance from the PRC on defining what constitutes a GRUB site is broad in its application and has been interpreted differently by jurisdictions. In addition the definition of GRUB needs clarification to address the issues of what constitutes 'adequate' or 'large portion' of the population, or what is 'substantial' or 'fraction' of the population.

11. The need for greater flexibility in monitoring methods has been identified, especially for particles, being mindful of the need for consistency and comparability.

12. Determination of 'equivalency' in adopting other monitoring methods needs to be made.

13. Inconsistent application of the Correction/Adjustment factor for PM_{10} data raises concerns about the comparability of data between jurisdictions.

14. For various reasons approved monitoring plans have not been fully implemented and not meeting the requirements of the NEPM and there is a perceived lack of independent assessment of monitoring plans.

15. Current monitoring plans and site concept in PRC papers do not deliver requirements for assessing exposure.

16. Annual reporting format repetitive from year to year and does not meet information requirements of all stakeholders and results in loss of accountability.

17. The assessment of exceedences on a station-by-station basis has led to a distorted picture of air quality in some areas.

3.4 ENVIRONMENTAL, ECONOMIC AND SOCIAL IMPACTS OF THE NEPM

3.4.1 Ecological considerations

The following discussion has been taken from a report prepared for the Commonwealth Dept of Environment and Heritage by Assoc. Professor Frank Murray, Murdoch University.

The main objective of air quality standards is the protection of human health. Some countries have a secondary objective of the protection of the environment, including ecosystems, which may include economic and ecological values of crops, forests, natural areas, animals, materials and aesthetic values such as visible distance. They have been developed over several decades. With the exception of standards to protect local visual distance, most secondary air quality standards are designed to protect agricultural or natural ecosystems.

There is no need to develop secondary air quality standards where primary standards provide an adequate level of protection for ecosystems. However, some important ecosystems are more sensitive than human health to some air pollutants. In these cases,

most developed countries have adopted secondary standards to provide an adequate level of protection for ecosystems, usually based on scientific knowledge of dose-response relations for ecological effects of air pollution on sensitive vegetation.

In the US, Europe and elsewhere, the data provide strong evidence that some air pollutants, including ground level ozone, sulfur dioxide, nitrogen and sulfur compounds, and possibly some other air pollutants cause:

- decreased growth and biomass accumulation in annual, perennial and woody plants, including agronomic crops, annuals, shrubs, grasses, and trees;
- decreased yield and/or nutritive quality in a large number of agronomic and forage crops;
- impaired aesthetic quality of many native plants and trees by increased foliar injury;
- Impaired ecological function and processes of terrestrial ecosystems.

In 2000 WHO justified proposed guidelines for the protection of ecosystems on the grounds that, "The effects of air pollutants on the natural environment are of special concern when they occur at concentrations lower than those that damage human health. In such cases, air quality guidelines based only on effects on human health would not allow for environmental damage that might indirectly affect human wellbeing" (WHO, 2000).

Both the US and EU approaches are deeply grounded in use of high quality scientific data and assessments. The US approach and the EU Clean Air for Europe (CAFÉ) approach both involved very substantial public and stakeholder consultations. However, the processes and outcomes differ between the US and EU approaches. The US standards for the protection of vegetation relate to criteria pollutants, mostly ozone, and to a lesser extent sulfur dioxide.

The EU approach considers a wider range of air pollutants known to have substantial ecological impacts including acid deposition (mostly sulfur dioxide and nitrogen dioxide), and ecosystem eutrophication by nitrogen compounds. The US approach focused on individual species. The EU approach focused on broad categories of ecosystems (agricultural, forests, and natural vegetation). Consequently, the outcomes of these processes are also different with the EU having a slightly more detailed form of standards including critical levels and critical load approaches to the protection of ecological values, than the US.

As many other countries and organisations have done, it would be possible to develop Australian air quality standards for the protection of ecological values.

While there is considerable scientific knowledge about the impacts of air pollution on the agricultural crops and some plantation trees, there is much less knowledge about impacts of air pollution on the natural vegetation and natural ecosystems of Australia.

Current information relates effects of a range of air pollutants, especially sulfur dioxide, and ozone in relation to crops and native vegetation of Australia, from studies conducted in Australia and internationally. For crops, there are many studies published internationally, and several dozen internationally-refereed published studies in Australia. For Australian native trees there are significant numbers of studies published internationally, especially on plantation *Eucalyptus, Casuarina, Melaleuca*, etc, as well as in Australia. Much less information is available on acidification and eutrophication of terrestrial ecosystems, by acidifying air pollutants (sulfur dioxide and nitrogen dioxide) and nitrogen deposition (NH_3 and NO_x).

A critical factor in the development of Australian standards for the protection of ecosystems is the need for a high quality review of the published and grey literature relevant to the development of air quality standards. This review would need to critically evaluate and assess the scientific information with the main focus being on evaluating environmental effects of the relevant air pollutants. However, other scientific information must also be discussed in order to provide a better understanding of the nature, sources, distribution, measurement, and concentrations of criteria air pollutants and their precursors in the environment, especially relating to effects of regional air pollutants such as ozone and acidifying compounds on sensitive ecosystems outside the capital cities of Australia.

A second requirement would be for the modeling of the dispersion of regional air pollutants outside the capital cities to predict ambient concentrations and deposition rates. The emissions data and transformations data exist, so this would not be a major task. The results would need to be compared with mapping of ecosystems of Australia to enable a preliminary assessment of key areas potentially at risk. In key areas identified it may be desirable to briefly deploy some passive samplers to be used to validate the modeled predictions.

An economic assessment would also be required of the costs and benefits of adoption of possible draft standards. Other issues relevant to the development of Australian standards for the protection of ecosystems relate to the processes of formulation and review, administration, funding, public and other stakeholder consultation, policy linkages, implementation and other issues.

3.4.2 Cost benefit analysis

As part of the Review process, an indicative cost benefit analysis will be undertaken during 2007 that will examine the impacts of any potential changes to the NEPM. This analysis will inform consideration of any proposed changes in advance of a variation process, should that occur. A NEPM variation requires the preparation of an impact statement, involving a more comprehensive cost benefit analysis to identify and assess the economic and social impact on the community.

The NEPM was made in 1998 with jurisdictional reporting commencing in 2001. This national approach was incorporated into the existing air pollution monitoring and reporting frameworks in the larger jurisdictions and prompted the establishment of new infrastructure in others. Many pollution abatement policies and interventions pre-date the NEPM and consequently it cannot be solely credited with the significant improvements in air quality that have occurred in the last two decades.

For example, a succession of tightened vehicle emission standards and the *Fuel Quality Standards Act 2000* have reduced urban pollution despite increased population, economic growth and vehicle kilometres travelled. The removal of lead from petrol would still have happened without the NEPM, though it is evidenced by NEPM reporting of levels in ambient air so low that some jurisdictions are no longer required to monitor it.

One example of an intervention prompted by the NEPM was the Australian Government's *Launceston Woodheater Replacement Programme* which led to similar state run programs in NSW and WA.

Jurisdictions have provided some information on costs of monitoring and reporting associated with NEPM implementation. The indicative cost benefit analysis will need to establish a baseline to compare possible changes against. This could be defined as the current policy framework in jurisdictions or the current standards (and corresponding policy frameworks which would be considered adequate to achieve compliance by 2008 which is the National Environment Protection Goal of the current Measure). Costs of air pollution are typically estimated on the basis of health impacts and net benefits of changing standards estimated as health costs avoided, less increased abatement costs. Overseas jurisdictions also frequently include costs of impacts on vegetation and on buildings.

Jurisdictions are responsible for their own compliance with the NEPM standards and each airshed is likely to require somewhat different policy responses so marginal abatement costs may vary from city to city. For example, Sydney would be likely to require more stringent measures to meet a possible tighter standard for ozone than other cities but the resulting health benefits would also be likely to be greater.

In estimating the health costs of air pollution it is difficult to establish the effects of individual pollutants and to quantify specific sources. The work done in Australia on health impacts attributable to air pollution considers the association between certain health endpoints, such as mortality and morbidity due to respiratory and cardio-vascular diseases, with the levels of PM_{10}, as an index pollutant. Airshed levels of this pollutant are associated with these endpoints so that for each increase of, say, $10\mu g/m^3$ of PM_{10}, the health impacts can be quantified.

This approach was first used by Kunzli et al (1999) who calculated impacts from particulate pollution in three European countries. It was chosen to avoid double counting from exposure to other pollutants and because of the linear association and an absence of a threshold level below which there are negligible health impacts.

In calculating the costs and benefits of possible changes to the NEPM, community exposure is usually measured by annual average airshed pollution levels and how that might be reduced by managing pollution sources. The calculation would depend on scenarios chosen, including current trends or business as usual and some modelling of exposure effects from projected changes.

There are a number of variables that would affect both costs and benefits. Continued economic growth, rising urban populations and climate change effects imply increases in some pollutants. Changing consumption and lifestyle patterns, transport habits and technology might reduce pollution significantly.

The current NEPM reports on different pollutant levels and annual exceedences but does not encompass the variations within metropolitan areas in terms of proximity to sources and modelling at smaller spatial scales. Moreover, background or non-anthropogenic pollution is not amenable to mitigation and actions to reduce anthropogenic emissions can be overwhelmed by natural events like bushfires. Both ozone and particulate matter are naturally occurring and their presence can contribute substantially to measured levels and exceedences.

Current standards for PM_{10} are occasionally exceeded in Australian cities but urban particulate pollution, which is associated with combustion sources such as motor vehicles, consists of particles that are generally smaller than 1 micrometre (PM_1). The proportion of

this man-made particulate pollution as a component of the measured PM_{10} is small and less variable than the natural fluctuations associated with exceedences. As mentioned above, there have been significant reductions in motor vehicle pollution following improvements in fuel quality and emission standards, but further reductions of the same order are unlikely.

Accordingly, if considerable resources were devoted to further mitigation, the number of exceedences may not be reduced or could even increase were the standards strengthened. A different approach is being taken by the EU which has moved from a strict standards-based approach to Air Quality Limit Values, which are seen as a backstop, and is making efforts to reduce community exposure. The UK is moving to an exposure reduction approach which targets key pollution sources like motor vehicles and attempts to lower their contribution by a certain percentage.

An indicative cost benefit analysis might need to consider this approach given the difficulties involved in reducing pollution as currently measured when those levels, particularly of PM_{10} , comprise a variety of sources, not all of which are manageable. This work will be assisted by recent improvements in jurisdictional emissions inventories and the Australian Government's commissioning of research that will review methodologies for calculating health costs that have been used in studies that have conducted cost-benefit analyses for ambient air pollution (*Clean Air Research Programme 2006-2008*).

3.4.3 Impacts for the community

Exposure to air pollution is known to impact on the health of sensitive individuals within the community. These individuals include people with existing respiratory and cardiovascular disease, children and the elderly. In addition, there is increasing evidence that people in lower socioeconomic groups may be disproportionately impacted by air pollution.

Low socioeconomic groups are more vulnerable to the effects of air pollution for a variety of reasons including:

- They can have a poorer health status and access to medical care can be more difficult for these groups;
- They tend to live in areas with higher pollution levels, eg., next to major roads or industrial facilities, as land/house prices are usually lower; where there is generally less monitoring, and,
- The housing in these areas tend to be of older stock that allow greater infiltration of outdoor air thus increasing exposure to air pollution.

To ensure that the requirement of the NEPC Act of providing equivalent protection for all Australians, consideration should be given to dealing with issues faced by these vulnerable groups. Changes to reporting protocols are required to ensure that information is accessible for all people and to guide actions to improve air quality where vulnerable people are exposed is one option. Incorporating an exposure reduction overlay in addition to air quality standards would ensure that actions are taken to reduce the risk from air pollution across all sectors of the community. This would help to ensure that the aim of equivalent protection is achieved.

Because of the structure of the current NEPM and the scientific nature of the reporting it is difficult for members of the public to understand the limitations of the NEPM, in particular in communities that may be impacted by individual sources such as major roads or industrial facilities. The fact that monitoring in these locations is not conducted for NEPM

purposes and the standards not used to assess air quality data from these areas has created confusion in many sectors of the community.

The reporting under the NEPM is focussed on statutory compliance reporting that is generated in a scientific format and contained within the NEPC annual reports. Feedback from consultation on the ISP was that many stakeholders, including industry as well as community, found that the annual reporting was difficult to find and understand and was not presented in a format that was readily understood. As annual reporting is the primary mechanism for the jurisdictions to be held accountable for improving air quality and providing information to the community about the air quality that they are exposed to, it would seem that changes to the reporting protocol or an additional report each year in a more easily understandable form may provide the community with better information about the air quality in their area.

The publication and distribution of an air quality summary by NEPC in a less compliance-focussed format than the current reporting may provide vulnerable groups with information about the potential risks from air pollution in their area and what actions are being taken to improve air quality.

3.5 RESOURCES FOR AND ADMINISTRATION OF IMPLEMENTING THE NEPM

Information on the costs of implementation and administration of the NEPM was obtained from the jurisdictions, together with comments on whether problems arise with administration of the NEPM.

Note: the costs calculated were those directly related to NEPM implementation not to the overall cost of air quality management in each jurisdiction i.e.

- Costs of developing monitoring plans;
- New monitoring stations or equipment resulting directly from NEPM implementation;

3.5.1 Costs of developing and preparing monitoring plans

The costs varied widely between jurisdictions with some jurisdictions being able to accommodate the requirements for NEPM monitoring within existing air monitoring networks. Other jurisdictions required additional monitoring stations or additional equipment. In a few cases air monitoring stations were closed to enable new NEPM stations to be opened. The costs saved by shutting existing stations have not been factored into the costs of implementing the NEPM. Costs for individual jurisdictions for the establishment and ongoing operation of NEPM monitoring stations varied between no net cost to approximately $1,000,000 over the 8 years since the NEPM was made. Some jurisdictions were unable to provide an estimate of costs. The total estimate provided by jurisdictions is approximately $4 million over 8 years.

These costs are lower than those indicated at the time of making the NEPM *(Revised Impact Statement p45)* which were $2million in the first 3 years, $0.6 million per year recurring (includes monitoring equipment operating costs, reporting and conducting alternatives to monitoring – modelling and emissions inventories) – a total of $5 million over 8 years.

3.5.2 Costs of establishing monitoring networks.

Changes to air monitoring networks have been minimal with most jurisdictions able to accommodate NEPM monitoring within existing networks. Some jurisdictions have opened new stations to fulfil monitoring requirements but the number of new stations has been

small (1-3). In most circumstances when a new station has opened another has closed to allow reallocation of equipment. The provision of adequate resources has been identified as a key issue in the implementation of the NEPM with some jurisdictions unable to fully implement monitoring as approved through the monitoring plans due to resource constraints.

There has been no significant increase in the coverage of air quality monitoring in urban areas as NEPM monitoring plans were developed largely around existing air monitoring stations. One key improvement that is a direct result of NEPM implementation is the increased monitoring in regional areas. Significant monitoring in regional areas in Victoria and NSW has increased knowledge on air quality issues being faced in these regions.

The implementation of the NEPM has led to improvements in air quality monitoring. The Variation to the NEPM for PM2.5 has ensured that PM2.5 monitoring is now being undertaken in all jurisdictions. This is a significant change and is providing data that addresses one of the key concerns of communities. The implementation of the NEPM has also ensured that upgrades of equipment have occurred and new instrumentation added to existing stations. Monitoring of PM_{10} has also increased due to the requirements of the NEPM.

3.5.3 Identification of any problems arising from implementing the NEPM.

Most jurisdictions responded that they had not experienced any difficulties in implementing the NEPM. Western Australia responded that implementation of the NEPM had resulted in political and community concern when a NEPM standards is exceeded. These exceedance events are often perceived to pose a significant risk to health whilst any value below the NEPM standard (no matter how close to the standard) is perceived to be 'safe'. Western Australia has also seen problems with interpretation of the NEPM standards, where these apply and how they relate to other air quality management values. Western Australia comments that this is further complicated but the fact that jurisdictions apply these standards and management values differently. These differences are a result of different legislative frameworks in the various jurisdictions.

3.6 REGIONAL ENVIRONMENTAL DIFFERENCES

In making any NEPM or variation to an existing NEPM, the National Environment Protection Council must have regard to, *inter alia*, "any regional environmental differences in Australia" (Section 15(g) of the *National Environment Protection Council Acts*). In addition, Section 17(b)(v) of the Acts requires that the Impact Statement to be prepared with the draft variation include "a statement of the manner in which any regional environmental differences in Australia have been addressed in the development of the proposed Measure".

While the Acts do not provide any explicit definition of the term "regional environmental differences", Sections 15 and 17 provide a clear indication that the term is not intended to encompass regional economic and social differences.

The term "regional environmental differences" recognises that fundamental environmental characteristics of different regions may be very different, and that to apply uniform standards would not necessarily further the desired outcome of equivalent protection espoused in the legislation. For example, the issue of salinity in water bodies would provide a clear need for regional environmental differences to be taken into account in developing NEPM standards and goals for water quality.

For ambient air quality, there are no clear-cut differences in the natural state of the atmosphere that could meaningfully be reflected in different ambient air quality standards for the protection of human health. While atmospheric conditions can change rapidly and dramatically across Australia, this provides a challenge for air quality management strategies but cannot, in any practical sense, be reflected in standards. In determining appropriate standards for the protection of human health, available evidence suggests that the variation in physiological response to pollutants within any population is likely to be significantly greater than any potential variation in impact due to meteorological or other differences across Australia.

Air quality standards relate to the protection of human health. It is difficult to argue air quality standards in the AAQ NEPM should differ for individual jurisdictions given that physiological response to exposure to air pollution will be the same. Although there may be some differences in the frequency of pollution episodes in some jurisdictions, e.g. the duration of ozone events, the same standards should apply uniformly across Australia and these differences should be taken into account in the exposure assessment as part of the derivation of the national standards.

Arguments have been put forward to suggest that the composition of particles may differ in rural areas dominated by windblown dust compared urban areas in Australia and that different standards for particles could be considered. The evidence from epidemiological studies indicates that there are health effects associated with crustal particles as well as combustion particles. However, at this time there is not sufficient evidence to set separate standards based on particle composition.

Air quality objectives have been applied uniformly in several overseas jurisdictions that have far more diversity in climate than does Australia. Primary Air Quality Standards legislated in the United States of America apply in all states of that country. They do not make allowances for regional climatic differences. Neither does the European Union in determining its air quality objectives.

Visual amenity, where the special scenic value of an area or its use for astronomical observations depends on a high level of air clarity, is an associated environmental benefit arising from application of health based air quality standards. In addition to the ambient air quality standards in the NEPM, several states also have visibility objectives in their legislation. On the other hand it has been suggested that sub-regional differences or mesoclimates may be important. Where these are found to be significant in protecting human health, the impacts are most practically addressed through implementation programs developed by jurisdictions.

3.7 LINKS BETWEEN AAQ NEPM AND OTHER POLICY OBJECTIVES

3.7.1 Sustainability objectives

Consideration of sustainability issues is fundamental to the approaches that Governments are taking to environmental management, including the management of air quality and associated health impacts. Sustainability issues were not explicitly addressed at the time of developing and making the NEPM, perhaps because consideration of sustainability may best be viewed as imperative at a jurisdictional level when developing implementation strategies.

Incorporation of sustainability considerations in the NEPM review requires discussion of what is meant by sustainability in this context. Many definitions of sustainable development have been proposed. Most definitions embody two central ideas. Firstly, development is not sustainable unless it takes a long-term perspective that aims to get the best possible quality-of-life for both present and future generations. Secondly, economic and social development and environmental quality are interconnected objectives, requiring the integration of economic, social and environmental policies and decision-making.

While there is no universally accepted definition of ecologically sustainable development, in 1990 the Commonwealth Government suggested the following definition for ecologically sustainable development in Australia:

Using, conserving, and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.

More recently, the OECD put forward this definition of sustainable development:

Development that lasts – a path along which the maximization of human well-being for today's generations does not lead to declines in future well-being. Human well-being includes the satisfaction of economic needs, aspirations for a clean and healthy environment, and preferences in terms of social development.

The Intergovernmental Agreement on the Environment documents that the development and implementation of environmental policy and programs by all levels of Government should be guided, *inter alia*, by the following considerations:

- The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations; and,
- Conservation of biological diversity and ecological integrity should be a fundamental consideration.

Contributions to sustainability objectives are being made by a number of NEPC/EPHC initiatives and strategies. These initiatives include legislative measures (eg NEPMs) and management strategies for improvements to air quality, water quality, soil quality, and waste management practices, to name a few.

This review examines the extent to which the current AAQ NEPM has contributed to air quality sustainability goals and assess whether further actions are required to support sustainability goals.

For the purpose of the review of the Ambient Air Quality NEPM it has been agreed by NEPC that the NEPM's contribution to sustainability objectives will be assessed by consideration of the following:

1. a framework that will lead to cleaner air and reductions in health risk;
2. natural resource issues (eg fuel, wood) and their subsequent impact on air quality
3. social and economic factors.

3.7.1.1 A framework that will lead to cleaner air and reductions in health risk.

The NEPM establishes indicators (the criteria pollutants) to assess the quality of the air in Australian cities. It can be argued that these pollutants are reasonable indicators of ambient air quality.

The NEPM provides a framework for monitoring and reporting air quality and standards against which air quality is assessed. Air quality management strategies are developed and implemented by individual jurisdictions in accordance with legislation in the respective State/Territory. Therefore it is reasonable to suggest that actions taken to improve air quality contribute to sustainability objectives by reductions in human health risk and reduced impacts of the use and management of resources, contributing to the attainment of intergenerational equity.

3.7.1.2 Natural resource issues and their subsequent impact on air quality.

Natural resource use can have significant impacts on air quality. The use of wood for domestic heating has a significant effect on air quality in many parts of Australia and can also impact on our forests. Although the use of firewood may have marginal greenhouse benefits these are outweighed by the significant negative impact wood heating can have on air quality. Emissions from mining and extractive industries can also have a significant impact on air quality yet the extraction of these resources is important for economic growth and development. The use of water to control dust emissions from these industries is becoming an issue of concern due to prolonged drought conditions in many areas of Australia. However, uncontrolled emissions can lead to high particle levels and potential health issues in local communities.

The use of coal for electricity generation and fossil fuels for motor vehicles also has a significant impact on air quality, the latter on a regional scale. In examining options for alternative fuels the impacts on air quality (and ultimately health of the Australian population) from theses alternatives need to be considered and balanced against the natural resource and economic considerations.

An effective response to climate change is emerging as a key area for sustainability. Given that carbon dioxide is a key contributor to climate change as a greenhouse gas, it has been suggested that consideration could be given to including carbon dioxide in the NEPM. This would provide a benefit of gathering data about carbon dioxide levels across Australia. However, given that CO_2 and its impact on climate change is a global issue and not one that relates to regional air quality, monitoring and reporting on daily/yearly levels of carbon monoxide in urban areas in Australia, as required under the NEPM, may not provide the best information to assess and address the issue of climate change. Monitoring at locations where clear long-tern trends in CO_2 levels can be determined, for example Cape Grimm, are likely to be far more informative to the issue of climate change than inclusion within the framework of the AAQ NEPM. (Any consideration to include carbon dioxide in the NEPM would require a review of what current monitoring systems are in place, what information is required to inform the climate change debate, the most appropriate mechanisms to generate that data and mapping the relationship to other climate change activities in Australia.)

The impact of climate change may also affect air quality. Increases in temperature are predicted to lead to an increase in ozone levels in Australian cities. Drought conditions have increased particle levels in most parts of Australia and have led to an increase in the frequency and severity of bushfires that also impact on air quality. Hazard reduction burning is a critical practice to reduce the risk of bushfires but can in itself impact on air quality. It is important when considering sustainability in the context of the NEPM that air quality issues be considered in the context of these other programs.

Prescribed burning is a management tool used by fire authorities and land managers to reduce the likelihood and impact of bushfires. The strategic use of prescribed burning for fuel reduction assists in the protection of human life, community assets, private property and habitats, and promotes biological diversity. Fire management practices in Australia have been developed in the context that fire is a natural and vital part of the landscape, and is required for the long-term survival of our unique flora and fauna.

Bushfires, in addition to their potential immediate threat to life and property, can generate substantial peak $PM_{2.5}$ and PM_{10} emissions when they occur, with potential for indiscriminate exposure to communities. In recent years the frequency of severe bushfires has increased. With prolonged periods of drought likely to become more common as a result of the impact of climate change in Australia, the trend of increasing bushfire activity is likely to continue or even increase into the foreseeable future.

Prescribed burning provides a practical means available to modify the type and amount of fuel available for bushfires, particularly in forested areas or other areas where access is constrained. The resultant moderation of fire behaviour provides opportunities for safer and earlier control of bushfires, and therefore reduces the potential amount of smoke emissions and exposure of communities as well as reducing the direct threat to life and property. The $PM_{2.5}$ and PM_{10} emissions from strategically planned prescribed burning programs can at times be of significance. However they generally comprise only a small fraction of those produced during a single significant bushfire event. Fire also plays a significant role in the life cycle of much of the Australian biota and prescribed fire is often the only safe method of introducing fire, at the right time and under controlled conditions, to achieve desired ecological objectives.

While prescribed burning is important, the impacts on air quality can be significant in the areas surrounding the burns and, occasionally, on a wider regional scale. Concerns over health and visibility impacts associated with burning of large areas for fire risk management has led to pressure on fire management authorities to include smoke management considerations in planning and implementing prescribed burning. The challenge is to ensure adequate levels of prescribed burning, under controlled conditions, to reduce the impacts of major bushfires on life and property, while minimising the exposure of communities to smoke impacts from planned burning activities. The aim must continue to be to find the balance between the risks of smoke impacts from prescribed burning on community health, and the risk of major bushfires that threaten life and property.

Fire management authorities across Australia have increased their focus on the management of smoke impacts. Research into meteorological factors that influence the transport and dispersion of smoke plumes has lead to advanced weather forecasting systems that are used for scheduling burns to avoid or reduce smoke impacts. Fire management and environment authorities are now working together in most jurisdictions to address air quality issues associated with prescribed burning operations.

Regeneration and waste disposal burning by the forestry industry is also an air quality issue in some locations. The policy context for regeneration and waste disposal burning by the forestry industry is quite different to that of hazard reduction burning, as human safety and property protection are not the objectives. Current levels of forestry burning of this category could be examined, in the public interest, and research conducted on levels of population exposure to particle pollutions from planned burning in general.

The introduction of the PM_{10} standard and $PM_{2.5}$ advisory reporting standard in the NEPM has in part contributed to a shift in the focus of fire authorities to consider the management of smoke impacts. When the PM_{10} standard was adopted into the NEPM an allowance was made in the goal for 5 exceedences of the standard per year. These exceedences were not provided for general air quality management in urban airsheds but were set as an acknowledgement that bushfires, prescribed burning, and dust storms do impact on air quality in Australian cities but, especially in the case of bushfires and dust storms, are largely natural sources that are not readily dealt with by the usual tools of urban airshed management. The form of the NEPM standards, and whether exceedences are the best way to assess air quality, will be considered in detail in the review of the air quality standards to be conducted during 2007.

Potential particle emission impacts from land development include the clearing of vegetation and/or topsoil, bulk earthworks, trenching and road construction. Vegetation may be cleared and burnt. Impacts are generally confined to the local scale; however, development of large sites may result in broader impacts.

Agricultural burning refers to the burning of crop stubble to prepare the land for re-sowing, or burning to remove pest plants or dead vegetation. Burning during fire restriction periods requires a permit, generally provided by local council officers. Burning is otherwise unregulated during non-permit periods except where local laws or other legislation come into effect.

Impacts of particles from agricultural burning are generally localised, however, a number of burns taking place at the same time within a region may have more widespread impacts. Burning in unsuitable conditions (e.g. wet stubble) also increases emissions of smoke.

Some local councils and state agricultural organisations are proactive in reducing the potential for smoke impacts from agricultural burning. Activities include the promotion of alternative farming methods (eg zero tillage) and providing advice on optimum burn conditions.

With the expansion of Australian cities and growth of regional centres agricultural burning can impact on urban fringe areas. There is the need for greater dialog between environment agencies and agricultural organisations to ensure that the appropriate balance between sustainable framing practices and the impact of smoke on population centres is achieved.

Traditional cultural burning practices are carried out across extensive areas of northern Australia and are usually part of land management regimes designed to provide environmental resources for communities. However, little research has been undertaken to document the characteristics of cultural burning practices in different regions.

Burning of vegetation through cultural burns may be an important source of particles in rural areas and on the urban fringe. Particles from these sources can be transported over significant distances, impacting on both rural and urban areas.

It is acknowledged that any management strategies that affect these practices may have impacts on the communities by reducing the availability of particular resources, such as bush foods. However, it should be noted that the particles standards are not intended to be measured near source events as these are outside of the scope of the Ambient Air Quality NEPM.

3.7.1.3 Social and economic factors.

Economic growth provides a basis for increasing the quality-of-life of Australians. At the same time the long-term sustainability of economic growth depends on maintaining ecosystem services and cohesive societies, both in Australia and the rest of the world. In many societies, there is an increasing role for the private sector in areas which have traditionally been the province of governments, due to increasing use of market mechanisms, privatization of government operations, and deregulation.

Economic growth, social advancement and environmental protection are interconnected goals. Industry and business can contribute to environmental sustainability in various ways including:

- Making sustainability a key part of the corporate culture and policies;
- Systematic consideration of sustainability impacts in corporate decision making;
- Consultation before making decisions with significant economic, social and environmental impacts, with governments, NGOs and communities;
- Public reports on outcomes[1].

Many countries have developed sets of indicators to measure their achievement of sustainability. In 2001, Australia published a set of headline sustainability indicators (HSI). The indicator for air quality is: *The number of occasions where concentrations of pollutants exceeded NEPM standards for ambient air quality in major urban areas.*

Indicators like the HSIs can only be used to measure the achievement of sustainability if specific sustainability thresholds can be established for each indicator. This is a complex and difficult task and in many cases requires a degree of judgment. It is easier to use indicators to measure progress towards or away from sustainability, than to measure the achievement of sustainability itself.

In April 2002, the Australian Bureau of Statistics (ABS) produced a report called "Measuring Australia's Progress", which addresses the question, "Has life in our country got better, especially during the past decade?" This publication includes 14 indicators (plus supplementaries) covering human, natural, social, produced and financial capital. This indicator set includes measurable indicators and generates trend data. For air quality, the indicator is based on the concentration of fine particles. Both the HSI and the ABS indicators for air quality are based on compliance with the AAQ NEPM.

[1] A number of international and the national guides published in recent years have contributed to increased corporate sustainability reporting in Australia. The *Global Reporting Initiative's Sustainability Reporting Guidelines* enjoy wide international support. In June 2003, the Government published *Triple Bottom Line Reporting in Australia – a Guide to Reporting against Environmental Indicators*, which provides methodologies for measuring performance against key indicators.

While the current NEPM appears to be focussed on compliance achievement, there is capacity for jurisdictions to consider sustainability objectives in developing and applying management actions involving industry, business and community to address air quality issues.

3.7.2 Air Toxics NEPM

Integrating the AAQ NEPM with the Air Toxics NEPM was raised as an option by some submitters on the ISP. For this to be possible the framework for one of the NEPMs would have to change considerably to fit within a consistent structure.

The Ambient Air Quality NEPM applies to the criteria pollutants that arise from multiple sources and are widely spread in the air environment. The criteria pollutants have been monitored by Environment agencies on a routine basis for many years and large databases of monitoring data exist. The health effects arising from exposure to these pollutants are well documented and although they are associated with small individual risks they have the potential to create a large public health burden due to the fact that the entire population is exposed. Similar health effects are observed for most of the pollutants e.g. increases in mortality or hospital admissions, exacerbation of asthma etc. Groups that are more susceptible to the effects of these pollutants have been identified.

The Air Toxics NEPM applies to hazardous pollutants that arise from specific sources and are generally more localised in distribution in the air shed. This means that there are groups within the population that are more exposed than others. The exception to this is benzene and PAHs. The major source of benzene in the environment is motor vehicles and monitoring suggests that benzene is ubiquitous in ambient air in our cities. PAHs arise primarily from combustion processes that include motor vehicles and domestic wood heating. PAHs are also ubiquitous in the air environment.

Although toluene, xylenes and formaldehyde also arise from motor vehicles their primary sources still remain industrial emissions (small and large industries) and their impacts are more localised in nature. Unlike benzene and PAHs, monitored levels of toluene, xylenes and formaldehyde are low across airsheds and significant levels are only observed in 'hot-spots' close to the sources of these pollutants.

Levels of benzene and PAHs in ambient air are elevated close to the source but are also found at elevated levels at locations away from the source. This highlights the more diffuse nature of the major sources of these pollutants compared to other air toxics. Similarly lead and SO_2, pollutants included in the AAQ NEPM, are now only of concern in communities close to industrial sources of these pollutants. It may be that these pollutants may be better incorporated in the Air Toxics NEPM that would enable the focus of monitoring to be at locations where levels are likely to pose the greatest risk to the community.

Prior to the making of the Air Toxics NEPM Environment agencies did not routinely monitor air toxics and limited monitoring data was available. Dose-response data (including unit risk factors) are derived largely from occupational or animal studies and extrapolation to humans involve significant uncertainty. Air toxics cover a large group of substances that are associated with a variety of health effects (cancer, respiratory irritation, developmental and reproductive effects etc).

Because of the differing distribution of air toxics and the criteria pollutants in the air environment, different policy frameworks and monitoring protocols were developed.

The monitoring conducted under the AAQ NEPM is intended to be focussed on sites away from the influence of major sources and is not meant to be conducted at peak sites. Monitoring networks have generally been established on this basis. However, given the limited distribution of most air toxics in the environment, the monitoring protocols in the Air Toxics NEPM is focussed on peak sites or 'hot-spots' where people may be exposed. The focus of the two NEPMs is very different making it very difficult to integrate them unless significant changes were made to the policy framework of one of the NEPMs. Also, the available data on air toxics in Australia is still limited making it difficult to assess where monitoring stations should be located for fixed site monitoring. The costs associated with establishing fixed site monitoring and the resources required to conduct such monitoring are likely to be cost prohibitive for most jurisdictions. Although benzene and PAHs could be considered for inclusion in the AAQ, the costs and resources required for ongoing fixed site monitoring would be considerable using current technology.

Although the standards in the AAQ NEPM and the monitoring investigation levels in the Air Toxics NEPM are based on the protection of human health there are significant differences in these 'standards' and how they apply. There are also considerable differences in the 'standards' contained with the two NEPMs. The compliance standards in the NEPM are based on an understanding of the health effects arising from exposure to these pollutants. The value at which they were set and the number of allowed exceedences took into account existing air quality in Australia and the achievability of meeting those standards within a ten year time frame.

By contrast, compliance standards for the air toxics were unable to be developed due to lack of data in Australia making an assessment of the achievability of any standards, and the costs and benefits associated with these standards, impossible to determine. Monitoring investigation levels were established as trigger levels for further investigation and a different approach was used in establishing these values than was used in developing the compliance standards for the criteria pollutants. The intent of the Air Toxics NEPM was to facilitate the collection of data to enable the setting of compliance standards in 2011.

Since the making of the Air Toxics NEPM insufficient data has been collected to allow consideration of developing compliance standards for these pollutants. This will need to be considered in deciding whether benzene and PAHs are included in the AAQ NEPM or left in the Air Toxics NEPM. Review of the pollutants in each of the NEPMs may be beneficial to ensure that the most appropriate set of indicators is incorporated in each of the NEPMs while maintaining the different policy frameworks to account for differences in the distribution of the pollutants in the air sheds and the practicability of monitoring.

It has been suggested that an alternative approach may be to have a NEPM for Air Quality that has two components – a statutory compliance component (i.e. the AAQ NEPM) and a second section that establishes protocols to collect data on pollutants that could be incorporated at a later stage into the compliance section of the NEPM. This section could incorporate the Air Toxics NEPM and could also include research requirements or equivalency programs for monitoring methods. Given the differences in monitoring approaches for these pollutants and the differences in the distribution of air toxics and criteria pollutants within an air shed, it would be very difficult to merge these NEPMs into one compliance framework. The benefits of merging the two NEPMs have not been fully articulated.

Issues arising from section 3.7

19. There is a need to address the integration of other government policies and programs with the NEPM.

5

4. INTERNATIONAL TRENDS IN AIR QUALITY MANAGEMENT

Although different countries have their own legislative frameworks and policies for air quality management, there is an international focus on harmonising approaches as far as possible. This has been the subject of several international conferences.

4.1 A TIERED APPROACH TO IMPROVED AIR QUALITY: EXPOSURE REDUCTION

There is a general acceptance, based on the results of epidemiological studies, that the criteria pollutants (NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$, O_3) have no identified threshold below which adverse health effects are not observed and therefore any standards will have some level of risk associated with them. This has led many international agencies to adopt an 'exposure – reduction' or 'risk – reduction' approach to air quality management. In these approaches the attainment of the standards is considered as a minimum target.

The World Health Organization (WHO) establishes air quality guidelines for the criteria pollutants and a limited range of air toxics. These guidelines are based solely on health considerations. Economic and social considerations are not taken into account when developing the guidelines and WHO recommends that these issues need to be considered when converting the guidelines to standards in individual countries.

Previously the WHO guidelines (WHO, 2000) have been developed for Europe and have been based on health and air pollution data from Europe. The recent review of the guidelines for particles, ozone, nitrogen dioxide and sulfur dioxide (WHO, 2006) has focussed on the globalisation of the guidelines and has considered information from various locations around the world, including Australia. Guidelines have been developed that establish the main target for air pollution levels that would be protective of health world-wide.

Although air pollution levels can be significantly higher in developing countries than those experienced in developed countries, the economic situation in these countries makes it difficult to implement air quality management actions to achieve the air quality guidelines. Economic growth is a critical consideration that has to be weighed against potential health risks arising from exposure to air pollution. To address this, the WHO has introduced interim target values that provide benchmarks for developing countries to work toward that will achieve improvements in air quality without enormous economic burden. These targets are not intended to be applied in developed countries. They are not appropriate for use as national air quality standards in Australia, but where compliance is problematic this approach may provide interim targets for jurisdictional air quality management programs.

In the European Union (EU) the WHO guidelines are usually adopted into the Daughter Directives for air quality as limit values. These limit values are legally binding on all member states of the EU. In the recent review of the daughter directives, the EU is adopting, in addition to the air quality limit values, an exposure reduction approach where all member states must achieve a 20% reduction in exposure by a fixed date (i.e. 10 year timeframe). This exposure-reduction approach takes into account the fact that the WHO consider that the criteria pollutants do not have an identified threshold for effect and applies to all member states whether they already meet the limit values or not. Compliance with the limit values is considered as the minimum requirement for air quality management in the EU.

The exposure reduction approach requires individual member states to reduce emissions from all sources to ensure that the exposure of the population to these pollutants is reduced by 20% within 10 years. This approach applies uniformly across a region irrespective of whether the air quality standards/limit values are met or not. How a member state achieves that reduction and the sources targeted is a judgement for that state and allows flexibility in the approaches taken and targeting of major sources in each area.

In the UK the Department for the Environment, Food and Rural Affairs (DEFRA) has developed a national air quality management strategy (AQMS) in partnership with the Scottish Executive, the National Assembly for Wales and the Department for the Environment for Northern Ireland and has recently released a consultation draft of the next stage of the AQMS that sets out options for further improvements in air quality. The approach being proposed is similar to that being adopted in the EU. The EU limit values are legally binding in the UK and are considered to be the minimum standards. The UK are moving away from a strict compliance approach to managing air quality and are focusing on reducing exposure across the whole population to achieve maximal health benefits.

The exposure-reduction approach in the UK is formed by two closely linked components. These are:

1. air quality objectives/limit values (often called 'backstop objectives' or 'concentration cap') to ensure some basic level or quality of air which all citizens should experience, embodying the 'environmental justice' concept, and
2. an objective based on reducing average exposures across the most heavily populated areas of the country (often called 'percentage reduction' or 'exposure reduction' objective), in order to generate further cost effective public health improvements over and above the basic level of protection generated by the air quality objective.

While the percentage reduction objective is a relative measure of improvement (e.g. 10% reduction in average concentrations in urban background areas between 2010 and 2020), the backstop objective (or concentration cap) is designed to deliver a minimum level of protection applicable to all areas in a country.

Although the UK has developed air quality standards separate to the EU limit values, the UK standards are not legally binding. They can be used as targets for air quality management purposes however there is a legal obligation on the UK to meet the EU limit values.

In the US the Federal EPA established national ambient air quality standards (NAAQS) for the criteria pollutants. The implementation of strategies for the management of air quality to meet the NAAQS is the responsibility of individual States. States must submit State Implementation Plans (SIPS) that set out the actions that will be taken to ensure that the NAAQS are met within a set time frame. Individual States may set their own air quality standards if they are more stringent than the NAAQS (eg. California). The USEPA also consider the criteria pollutants as non-threshold pollutants based primarily on the inability of epidemiological studies to identify a threshold for effect.

In addition to establishing NAAQS, the USEPA also develop emission limits for industries and have adopted risk reduction approaches to the management of major sources in the US.

4.2 AUSTRALIA'S POSITION

The current approach to the implementation of the NEPM, which focuses strictly on compliance with the standards, may not be consistent with some international directions in air quality policy although the original intent of the NEPM to monitor and assess population exposure may be more closely aligned with some international trends. The strict compliance approach has been interpreted to mean that the air quality standards are 'safe' and can lead to confusion among stakeholders about the level of risk that is associated with the standards. Minor excursions beyond a standard may be seen to have substantial health effects.

The general approach that is being pursued in many overseas countries to reduce exposure (and ultimately risk) of the general population to air pollution is focussed on achieving increasing health benefits within a population in a cost effective manner. It also acknowledges that the pollutants that have been selected as indicators of our air quality are now considered to be non-threshold pollutants and that any air quality standards that are set have some level of risk associated with them.

The NEPM has been established to ensure 'adequate' protection of human health from the impact of air pollution. Although the decision to adopt national air quality standards implies that in meeting the standards adequate protection would be achieved, adopting a national framework to drive continuous improvement or pursuing an exposure-reduction option similar to the approach being adopted in Europe and the UK, would go one step further to ensure that the health of the Australian population is protected from the adverse effects of exposure to air pollution. The aims of an exposure reduction approach and any associated goals and targets would need to be well defined and are discussed further in section 5, Discussion of Options.

Taking a strict compliance approach implies that the air quality standards are 'safe' and can lead to confusion among stakeholders about the level of risk that is associated with the standards. Focussing on compliance may also lead to a situation where air quality management actions are focussed on particular local issues that may have fewer health benefits than actions that are focussed on reductions in 'average' air quality to which a larger portion of the population may be exposed.

The exposure-reduction approaches being used in some overseas countries appear to be more consistent with the original intent of the NEPM. The exposure reduction approach is consistent with continuous improvement approaches being implemented in several jurisdictions in Australia (eg Western Australia, Victoria).

Issues arising from Section 4.

20. The current approach to monitoring, focussed on compliance with air quality standards, is not consistent with international trends to reduce exposure to these pollutants irrespective of whether the air quality standards are met or not.

5. DISCUSSION OF OPTIONS

5.1 PROCESS

Section 5 contains discussion of the options to address the issues arising from the assessment of the subjects of the terms of reference (i) to (vi) and which fulfil the requirements of terms of reference (vii);

"The need, if any, for varying the Measure, (in accordance with the Act) including:

- whether any changes should be made to the Schedules;
- whether any changes should be made to improve the effectiveness of the Measure in achieving the desired environmental outcome set out within it;
- the potential costs and benefits of any proposed changes."

5.2 ISSUES IDENTIFIED FROM ASSESSMENT

The AAQ NEPM has been a positive step forward in the management and assessment of air quality in Australia. The NEPM has provided a nationally consistent framework for the monitoring and reporting of air quality and has provided the incentive for increased monitoring of air quality in smaller jurisdictions and has also promoted increased monitoring of particles – both PM_{10} and $PM_{2.5}$. The air quality standards contained in the NEPM have provided nationally consistent benchmarks against which the quality of our air and the risk posed by air pollution to the Australian population can be assessed.

The desired environmental outcome of the NEPM - ambient air quality that allows for the adequate protection of human health and well-being – appears to still be appropriate to meet the requirements of the NEPC Act for equivalent protection for all Australians and provides a consistent objective for all jurisdictions to achieve. The original intent of the NEPM – to assess air quality that is representative of the exposure of the Australian population – is still appropriate and consistent with international policies and trends in air quality management.

This is the first review of the AAQ NEPM since it was made in 1998. Although overall the NEPM has been successful in providing a national approach to the monitoring and assessment of air quality in Australia, the review process has revealed some issues in the implementation of the NEPM that need to be addressed. These include:

Intent of the NEPM

Original intent of the NEPM is not yet met and the current approach is not consistent with emerging international approaches, as the implementation of the NEPM has focussed on compliance with air quality standards and not on assessing population exposure.

1. There is no shared understanding of what "adequate protection" means. (section 3.2)
2. Some of the criteria pollutants have no identified thresholds for human health effects and exposures below the standards still represent a health risk to Australian communities. (section 3.2)
3. Monitoring has been established to provide assessment of compliance, but less attention has been given to the assessment of population exposure as a goal of monitoring (section 3.2).
4. Current monitoring plans and site concept in PRC papers do not deliver requirements for assessing exposure (section 3.3).
5. The current approach to monitoring, focussed on compliance with air quality standards, is not consistent with international trends to reduce exposure to these pollutants (section 4).

Interpretation of monitoring requirements and siting of air monitoring stations.

1. The population formula in the NEPM, although considered by jurisdictions as providing a guide for NEPM monitoring sites, has no clear basis and is being used in some jurisdictions as the basis for estimating entire monitoring networks. (section 3.3)
2. While there is flexibility in the NEPM for jurisdictions to conduct monitoring in areas other than those that meet the 25,000 population threshold, in some cases the population threshold has limited monitoring. Smaller jurisdictions have commented that the threshold makes it difficult for them to obtain resources to monitor in regional centres that have air pollution problems but have populations less than 25,000. (section 3.3)
3. There is no guidance provided in the NEPM or the PRC technical papers that guides the estimations of either exposure or representativeness. Jurisdictions have been advised by the PRC that the assessment of population exposure should be qualitative rather than quantitative as implied by the NEPM (PRC Technical papers 2 and 7). (section 3.3)
4. The guidance from the PRC on defining what constitutes a GRUB site is broad in its application and has been interpreted differently by jurisdictions. In addition clarification is needed to address the issues of what constitutes 'adequate' or 'large portion' of the population, and what is 'substantial' or 'fraction' of the population. (section 3.3)
5. For various reasons approved monitoring plans have not been fully implemented and in some cases do not meet the requirements of the NEPM. Comments from stakeholders suggested a perceived lack of independent assessment of monitoring plans. (section 3.3)
6. Changes in requirements for a support body to assist in the implementation of the NEPM. (section 3.3)

Appropriateness of the indicators of air quality i.e. pollutants included in the NEPM

1. Compliance standards are contained within the NEPM however, lead levels are now below detectable levels (except in areas that are impacted by industrial sources). Many jurisdictions have gained approval to cease NEPM lead monitoring in urban areas as it is no longer a pollutant that is ubiquitous in the air environment. (section 3.2)

Difficulties in monitoring particles

1. The need for greater flexibility in monitoring methods has been identified, especially for particles, being mindful of the need for consistency and comparability. (section 3.3)
2. Determination of 'equivalency' in adopting other monitoring methods needs to be made. (section 3.3)
3. Inconsistent application of the Correction/Adjustment factor for PM_{10} data raises concerns about the comparability of data between jurisdictions. (section 3.3)

Appropriateness of reporting format for key stakeholders

1. Annual reporting format repetitive from year to year and does not meet information requirements of all stakeholders and results in loss of accountability. (section 3.3)
2. The assessment and reporting of exceedences on a station-by-station basis has led to a distorted picture of air quality in some areas. (section 3.3)

Integration with other government policies and programs

1. Increase in temperature predicted under climate change scenarios likely to increase ozone and secondary particle levels. (section 4)
2. Actions taken to address climate change may result in negative effects for air quality in some cases. (section 4)
3. Merging of the air toxics NEPM into the AAQ NEPM to have one overarching NEPM for air quality. (section 4)

5.3 FRAMEWORK AND STRUCTURE OF THE NEPM

The NEPM contains:

1. National environment protection goal
2. National environment protection standards
3. National environment protection protocols that establish monitoring and reporting requirements, and
4. Schedules that contain air quality standards and methods for monitoring air quality under the NEPM.

In addition a series of guidance documents have been prepared by the PRC to assist in the establishment of NEPM monitoring and reporting.

In making a variation to the NEPM changes can be made to any of these parts of the NEPM. Six broad options are presented, for stakeholder consideration and comment, to address the issues raised in the review of the policy framework, monitoring and reporting protocols of the AAQ NEPM. The proposed options are presented in overview below, followed by discussion of the details of each option.

OPTION A

Make no changes to the current NEPM policy framework or protocols.

OPTION B

Vary only the monitoring and reporting protocols that would address specific issues raised with the existing NEPM policy framework.

OPTION C

Include an exposure reduction overlay in the current NEPM policy framework or protocols.

OPTION D

Vary the monitoring and reporting protocols that would address specific issues, and vary the existing NEPM policy framework to include an exposure reduction overlay incorporating procedures to determine reduction targets or goals and required monitoring and reporting protocols.

OPTION E

Vary the monitoring and reporting protocols that would address specific issues, and vary the existing NEPM policy framework to include the Air Toxics NEPM monitoring and reporting protocols for air toxics.

OPTION F

Vary the monitoring and reporting protocols which address specific issues, vary the existing NEPM policy framework to include an exposure reduction overlay with any targets or goals and required monitoring and reporting protocols, and vary the existing NEPM policy framework to include the Air Toxics NEPM monitoring and reporting protocols for air toxics.

5.4 DISCUSSION OF OPTIONS AND WHAT IT MEANS FOR THE REVIEW OF THE NEPM

The NEPM implementation has focussed on an approach that enables assessment of compliance with air quality standards with monitoring sites located primarily at upper bound locations. The original intent of the NEPM was to generate information that enabled the estimation of the exposure of the general population to air pollution (Impact Statement p40)

Although there are standards and goals in the current AAQ NEPM they do not mean that attainment implies no health risk. Since some pollutants have no identified lower threshold of effect, exposure reduction strategies will reduce the risk posed by air pollution to the health of the Australian population.

Internationally there has been a move to establish air monitoring networks to allow population exposure to be determined (e.g. EU, USEPA, WHO). These approaches are based on consideration of population density, sources, distribution of pollutants within an airshed and the concentration of a pollutant relative to air quality standards. A range of sites is recommended including background (urban and rural), peak, rural, urban and suburban. Air quality modelling is also a tool that is used to assist in the siting of air monitoring stations to ensure that an appropriate mix of air monitoring stations is achieved to enable population exposure to be determined.

It would seem that the approaches being used internationally might provide a stronger basis for the design of monitoring networks in Australia that would provide a measure of population exposure. Adoption of these approaches with amendments to account differences in population density and sources is an option for consideration if the focus of the NEPM monitoring changes from strict compliance monitoring to a network that will deliver the original intent of the NEPM – a measure of population exposure. Under this approach, the standards become important targets for management rather than absolute measures of air quality.

The other obvious impact of a population exposure approach is that it may influence the design of monitoring systems, and perhaps obviate the need for "generally representative upper bound" (GRUB) stations, introduced into the technical literature developed for implementation of the NEPM, but which was never well-defined.

5.4.1 Intent of the NEPM.

1. NEPM framework status quo (Option A)

a. Discussion

It is clear from section 3 in this paper that there are issues with the current framework, including monitoring protocols and technical guidance papers that make an assessment of the exposure of the population difficult to determine. If the original intent of the NEPM is still considered to be valid then maintaining the status quo will mean that the issues identified continue to be a barrier to meeting this intent.

b. Benefits

No changes would be required to the existing NEPM and monitoring networks established in jurisdictions**.**

c. Disadvantages

The NEPM implementation will continue to focus on compliance with standards and not exposure of the population. The focus of the NEPM on compliance with standards would be inconsistent with international trends in air quality management and would fail to recognise that there are still potential health risks associated with air pollution levels below the standards. Australia would have no flexibility to change to a different approach on a national basis without a further review and variation to the NEPM.

2. NEPM framework status quo – amend schedules and guidance documents (Option B)

a. Discussion

This option would retain the current NEPM framework with a focus on compliance with the air quality standards and goals but would entail changes to the monitoring schedules and guidance documents to enable air monitoring networks to be developed that would enable an assessment of the exposure of the population to air pollution. Guidance on the use of modelling to assist in the exposure assessment would need to be developed.

b. Benefits

This option would provide changes that would enable the original intent of the NEPM to be achieved with a greater focus on generating air monitoring data that is representative of the exposure of the general population.

c. Disadvantages

The focus of the NEPM would still be on compliance with the air quality standards and goals without acknowledgement that there are still potential health risks associated with air pollution levels below the standards. This approach would only go part of the way in harmonising the NEPM with current international policy trends. Changes may be required to existing air monitoring networks to establish sites that were representative of population exposure.

3. NEPM framework status quo - add exposure reduction overlay (Option C)

a. Discussion

Adding an exposure reduction overlay to the existing NEPM would go part of the way in harmonising the NEPM with current international policy trends and would overcome the issue of potential health risks associated with air pollution levels below the standards. Although NEPM monitoring networks would still be established to measure compliance with air quality standards, actions would be taken to reduce exposure of the population to air pollution. These actions would reduce exposure across the entire population not just the population whose air quality is represented by data collected at the current upper bound stations unless the actions taken had only a localised impact. Air quality modelling would play an important role in any exposure reduction approach.

An exposure reduction overlay would apply whether air quality standards are met or not. The approach could entail the setting of exposure reduction targets that would need to be met within a given timeframe (eg., 5% reduction in exposure of the population to pollutant X within 8 years). The focus of this approach would be reducing exposure to gain the greatest health benefits across the entire population not just in areas where air pollution levels would be elevated. For example reducing exposure to PM_{10} across the whole of Melbourne would provide benefits to approximately 3.5 million people whereas focussing only on areas where air quality standards may be exceeded may only benefit 100,000. Taking a broader approach provides health benefits to the population as a whole. It is likely that different reductions targets would be required for each pollutant and potentially in each jurisdiction.

Although action would be taken to reduce exposure across entire populations there may be some additional benefits for people who in 'hot-spots'. For example, reduction of benzene in fuels will reduce benzene levels across entire airsheds. However, there are

greater reductions and associated health benefits experienced by populations who live adjacent to major roads, who have a higher exposure to motor vehicle related pollutants.

Exceedances of standards may become less important if an exposure reduction approach is incorporated into the NEPM. Actions to reduce exposure would have benefits for the entire population and would go toward meeting the requirements of the NEPC Act for equivalent protection for all Australians. The introduction of an exposure-reduction overlay may obviate the need to include exceedances in the NEPM. The benefits of reducing overall exposure are likely to be greater than the current focus on peak events, which is reflected in the use of exceedances.

In establishing an exposure reduction overlay clear protocols and exposure reduction targets would have to be developed to provide some certainty for government and stakeholders, including industry and the community). The exposure reduction targets are likely to differ for each pollutant and would be subject to cost benefit analyses prior to incorporation into any Variation to the NEPM. Although the actions taken to reduce exposure would be determined and implemented by the jurisdictions, addressing the issues where maximum benefit can be achieved within their own jurisdiction, there may be some instances where a national approach may be beneficial (eg., emissions from motor vehicles and fuels).

Annual reporting would include progress towards meeting the exposure reduction target and actions taken by jurisdictions to meet the targets.

b. Benefits

Adding an exposure reduction overlay to the existing NEPM would go part of the way in harmonising the NEPM with current international policy trends and would overcome the issue of potential health risks associated with air pollution levels below the standards. Although NEPM monitoring networks would still be established to measure compliance with air quality standards any actions taken to reduce exposure of the population to air pollution would reduce exposure across the entire population not just the population whose air quality is represented by data collected at the current upper bound stations unless the actions taken had only a localised impact. This would deliver health benefits across the broader population even if air quality standards are met.

This approach would also assist jurisdictions where air quality standards are currently exceeded and are likely to continue to be exceeded in the foreseeable future. The focus on exceedances would be less important as reduction in exposure delivers health benefits across the population. This would enable communities to see where improvements in air quality are being made to reduce the risk to the health of the population not just the population whose air quality is measured at monitoring sites.

c. Disadvantages

Without changes to the monitoring protocol, schedules and guidance documents the focus of monitoring would still be on the upper bound monitoring and not determination of population exposure. The original intent of the NEPM would not be achieved and the inconsistencies identified in the siting of air monitoring stations between jurisdictions not addressed. The issue of whether the data collected is consistent and comparable across Australia would still be a concern.

4. NEPM framework status quo - amend schedules and guidance documents and add exposure reduction overlay (Option D)

a. Discussion

This option would retain the current NEPM framework with a focus on compliance with the air quality standards and goals but would entail changes to the monitoring schedules and guidance documents to enable air monitoring networks to be developed that would focus more clearly on assessing the exposure of the population to air pollution. The addition of the exposure reduction overlay together with monitoring for population exposure would harmonise the NEPM with international policy trends and address the issue of potential health risks associated with air pollution levels below the standards. Guidance on the use of modelling to assist in the exposure assessment would need to be developed.

b. Benefits

Would harmonise the NEPM with international policy trends and address the issue of potential health risks associated with air pollution levels below the standards. This approach would deliver on the original intent of the NEPM. It would expose opportunities to achieve significant health benefits (and reduced health costs) on a case-by-case basis.

c. Disadvantages

Changes may be required to existing air monitoring networks to establish sites that were representative of population exposure. This may entail costs for Government and there is potential loss of continuity in NEPM monitoring.

5.4.2 Interpretation of monitoring requirements and siting of air monitoring stations.

The aim of the NEPM was to establish a framework that would provide for the generation of nationally consistent air quality data and reporting. The PRC was established to provide support to the jurisdictions in the development of air monitoring networks and reporting protocols to deliver on the aim of the NEPM. The original intent of the NEPM was to monitor air quality that was representative of the exposure of the population (Impact Statement p40).

The monitoring under the NEPM and guidance provided by the PRC has focussed on a strict compliance approach and not on the original intent of the NEPM. This focus is an important first step in the implementation of the NEPM but through this review is clear that there is still a need to meet the original intent – providing data that is representative of population exposure. As discussed above, assessing population exposure rather than just strict compliance would be consistent with current international policy trends.

Internationally air monitoring networks are established to allow population exposure to be determined. These approaches are based on consideration of population density, sources, distribution of pollutants within an airshed and the concentration of a pollutant relative to air quality standards. A range of sites is recommended including background (urban and rural), peak, rural, urban and suburban. Air quality modelling is also a tool that is used to assist in the siting of air monitoring stations to ensure that an appropriate mix of air monitoring stations is achieved to enable population exposure to be determined. The focus on population alone is inconsistent with current international practice.

It would seem that the approaches being used internationally might provide a stronger basis for the design of monitoring networks in Australia that would provide a measure of population exposure. Adoption of these approaches with amendments to account differences in population density and sources is an option for consideration if the focus of the NEPM monitoring changes from strict compliance monitoring to a network that will deliver the original intent of the NEPM – a measure of population exposure. Such an approach may also assist jurisdictions overcoming some of the barriers they have experienced in implementing the NEPM because of the population formula and threshold.

There is clearly still a need for a support group to assist jurisdictions in implementing the NEPM, however if there is a move through a NEPM variation to focus on population exposure and exposure reduction approaches then it is important to ensure that any support body has the appropriate set of skills to provide the support to jurisdictions that will be required.

To change to a population exposure approach will require changes to the current monitoring protocols and guidance documents. Air quality modelling will play a much greater role. Such a change may provide smaller jurisdictions with an approach that will overcome some of the problems that they have identified with the population threshold and formula for establishing monitoring stations. An agreed approach to modelling for population exposure will provide a mechanism whereby air pollution levels and associated health risk can be estimated even in centres where populations are small.

The inconsistencies identified in the implementation of the NEPM by individual jurisdictions needs to be addressed to ensure consistency in the data collected – the aim of the NEPM monitoring protocol. More guidance providing clearer and more unambiguous definitions of concepts such as "GRUB", "representativeness" would be desirable and changes to the current PRC guidance documents are required to ensure that these issues are resolved.

Options to address

1. **NEPM monitoring protocols status quo (Option A)**
   a. **Discussion**

   This option would require no change to the current NEPM and would not address the inconsistencies in implementation that have been identified in this review. The focus of the monitoring would remain on strict compliance and not on population exposure thereby not delivering on the original intent of the NEPM (Impact Statement p40)

   b. Benefits

   No changes would be required to the existing NEPM and monitoring networks established in jurisdictions**.**

   d. Disadvantages

   Issues will not be addressed meaning that the NEPM implementation will continue to focus on compliance with standards and not exposure of the population. The inconsistencies identified in the siting of stations would continue impacting on the consistency of data being collected nationally and making comparisons between jurisdictions difficult. The issues with the population formula and threshold would not be addressed.

2. NEPM monitoring protocols status quo – amend schedules and guidance documents (Option B).

a. Discussion

This option would keep the current NEPM monitoring protocol that establishes the population formula and threshold but would enable the schedules to the NEPM and guidance documents to be amended to address issues of population exposure and to provide greater clarity for jurisdictions on the concepts such as GRUB and representativeness overcoming some of the inconsistencies identified in the implementation of the NEPM.

b. Benefits

Amending the schedules to provide guidance on monitoring and modelling for population exposure would enable jurisdictions to implement the NEPM to meet the original intent. If an exposure reduction overlay is incorporated into the NEPM such guidance becomes critical to determining the appropriate actions to reduce exposure of the population. Providing greater clarity on concepts such as GRUB and representativeness would help to overcome the inconsistencies that have occurred in the implementation of the current NEPM and ensure greater consistency in the data collected. Providing guidance in modelling for population exposure may provide smaller jurisdictions an alternative to monitoring to assess air quality in towns that fall under the population threshold for monitoring.

c. Disadvantages

Without changes to the monitoring protocol in the NEPM the issue of the adequacy of the population formula and the difficulties experienced in smaller jurisdictions with the population threshold will not be addressed. Changes to the schedules and guidance documents may lead to changes in existing monitoring networks.

3. Review role of support body (Option A)

The PRC was established to assist the jurisdictions with the development of monitoring plans as part of the implementation of the NEPM. The PRC is comprised primarily of monitoring experts from the jurisdictions with community and industry representation. The PRC has focussed guidance on developing air monitoring networks to assess compliance with air quality standards and goals. If the NEPM were varied to shift focus to assessing population exposure and the introducing an exposure reduction overlay the support required by jurisdictions to implement the NEPM may differ from the current PRC. For example, instead of only monitoring experts it may important to have a group with broader expertise such as air quality modelling, risk and exposure assessment and a representative from the health sector. Such a mix of skills may help to overcome the perceived lack of independence in the assessment of the monitoring plans that has been raised as an issue through this review. It has been identified that there is a continued need for a support body to assist in the implementation of the NEPM. The options for such a support body are discussed below.

a. Maintain PRC

Maintaining the PRC would provide continuity in advice provided to assist in the implementation of the NEPM and would continue to provide strong expertise in air quality monitoring. However, if the focus of the NEPM changes to population exposure and exposure reduction, then additional skills may be required to provide the appropriate advice and understanding of the issues.

b. Maintain PRC with revised membership

This option would maintain the current PRC but revise the membership to include the some of the additional skills required if the focus of the NEPM is to change. This approach could result in a large group that is still comprised mainly of monitoring experts. This may make it difficult for the group to meet and to obtain funding to continue its role.

c. Create new group with broader expertise

This option would create a new body that would be selected based on the required skills to provide advice on key issues to implement the NEPM. If the NEPM was varied to focus on population exposure and exposure reduction this group could be made up of monitoring experts, exposure and risk assessors, health sector representation and possible a policy member to assist in the interpretation of the NEPM. The final set skills and therefore membership would be determined once the final form of the NEPM was agreed by NEPC. The benefit of forming a new group with broader expertise is that the core group could remain small while still ensuring that the right set of skills are available to assist in the implementation of the NEPM. It would also help to overcome the perceived lack of independence in the assessment of the monitoring plans that has been raised as an issue through this review.

5.4.3 Appropriateness of the indicators of air quality

When the NEPM was made the pollutants included in the NEPM were those that were considered to describe ambient air quality – the criteria air pollutants. These pollutants arose from multiple sources and were widely distributed in ambient air. Since that time changes to fuels and motor vehicles emissions has led to a change in the distribution of some pollutants in ambient air. The phasing out of leaded petrol has meant that lead is no longer widely distributed in ambient air. Due to very low of lead in the air all jurisdictions have ceased monitoring lead in urban areas except where industrial sources still provide a source of lead.

Options to address

1. NEPM indicator status quo (Option A)

a. Discussion

This option would require no change to the current indicators in the NEPM. The indicators would remain consistent with international indicators for air quality.

b. Benefits

No changes required to the NEPM. Indicators remain consistent with international indicators of ambient air.

c. Disadvantages

An air quality standard for lead would be retained when no monitoring under the NEPM is being conducted. This may lead to confusion in the community or an expectation that lead should be monitored.

2. Change NEPM indicators – remove lead (Option B)

a. Discussion

This option would update the current indicators to reflect the criteria pollutants that are currently of concern in Australian cities. Although the removal of lead would

require an amendment to the NEPM, no changes would be required to the existing NEPM monitoring networks as jurisdictions have already ceased monitoring lead.

b. Benefits

Removing lead would mean that the NEPM addresses the criteria pollutants that are currently of concern in Australian cities. It would remove any confusion or expectation that lead should be monitored and results reported. It would highlight an area of environmental improvement that has resulted from the years of action to improve air quality.

c. Disadvantages

Including lead in the NEPM and maintaining air quality standard provides jurisdictions with a benchmark to use in informing local communities in areas where lead is emitted from industrial sources. Removing lead may result in communication difficulties for some jurisdictions for this reason although the option of including lead in the air toxics NEPM exists.

5.4.4 Difficulties in monitoring particles

Monitoring of particles continues to pose significant challenges for jurisdictions. The use of different techniques and inconsistent application of the agreed 'adjustment' factor has raised concerns about the comparability of reported data. The challenges being faced in Australia are also being addressed overseas and approaches to particle monitoring are constantly evolving.

The current NEPM monitoring protocol requires the use of methods that comply with Australian Standards or alternative methods if equivalency with standard methods can be demonstrated. However, equivalency is difficult to determine and can take several years to resolve. Overseas agencies, such as the USEPA, run exhaustive program to demonstrate equivalency between monitoring methods. It may be appropriate that the NEPM be varied to allow use of monitoring methods that have been designated by international agencies without requiring an Australian Standard to be developed or further testing.

Given that particles continue to be one of the main pollutants of concern in Australian cities, greater flexibility in monitoring methods to enable international advances to be adopted in Australia without a review of the NEPM, is desirable. The aim of the NEPM to generate consistent air monitoring data needs to be balanced against the need for greater flexibility. However, allowing adoption of methods that have been tested and designated by international agencies as equivalent methods should provide some assurance of generating consistent data. Guidelines around the operation of these instruments would need to be developed in the NEPM monitoring protocol is changed.

1. NEPM monitoring protocol status quo (Option A)

a. Discussion

This option would continue to require the use of methods that comply with Australian Standards or alternative methods if equivalency with standard methods can be demonstrated. Although this provides some confidence in the consistency of the data being generated it does not allow for the introduction of new and potentially superior methods without a review of the NEPM.

b. Benefits

A framework that will provide some confidence in the consistency of the data being generated. No changes to the current NEPM monitoring for particles.

c. Disadvantages

Does not allow for the introduction of new and potentially superior methods without a review of the NEPM. Does not overcome the inconsistencies and difficulties currently experienced in the monitoring of particles.

2. Amend NEPM monitoring protocol, schedules and guidance documents (Option B)

a. Discussion

Amending the monitoring protocol in the NEPM would allow greater flexibility to account for advances in particle monitoring. This would also involve changes to the schedules and guidance documents ensure that the greater flexibility would not result in inconsistency in the data collected. Changes to the protocol could involve a clause that allowed adoption of methods approved by international agencies without additional testing or development of Australian standards in Australia. A variation to the NEPM to allow a streamline adoption of new methods that could be adopted by NEPC on the recommendation of an expert body would provide this flexibility. Changes to guidance documents may also involve the development of an agreed understanding of what is meant by equivalence and a review of the need of an 'adjustment' factor to adjust data obtained from method to be the same as that obtained from a standard or alternative method. It needs to be recognised that no one method for particle monitoring is likely to provide all the information required on particles and that a particle monitoring program may consist of a number of monitoring methods.

b. Benefits

Greater flexibility would enable the recent advances in particle monitoring to be adopted without a NEPM review and variation process being required.

c. **Disadvantages**

Greater flexibility could lead to inconsistencies in particle monitoring and the data generated.

5.4.5 Appropriateness of reporting format for key stakeholders

The current NEPM reporting is scientific in nature and is focussed on compliance with air quality standards. The data is reported in the NEPC annual reports and is difficult for stakeholders to access. As annual reporting is the process of public accountability it is important that the data is readily accessible and easily understood by all stakeholders.

The development of a national summary document by NEPC may help to alleviate some of the issues that have been raised. In addition, changes could be made to the current reporting that provides access scientific presentation of the data within the current annual reporting.

The current reporting of exceedances on a station-by- station basis has in some cases led to a distorted picture of air quality (eg., 15 station exceedances on one day is reported a 15 separate exceedances). Changes to the reporting protocols to report on days of exceedances and maybe secondary reporting of the stations at which the exceedances occurred may overcome some of this misunderstanding of the data. The inclusion of an exposure reduction overlay may also assist in the reporting and understanding of the risk posed by exceedances of air quality standards.

1. **NEPM reporting status quo (Option A)**

a. Discussion

Under this option the NEPM reporting would continue to be a scientific assessment of compliance with air quality standards and goals. Exceedances would still be reported on a station-by-station basis.

b. Benefits

No changes to the reporting protocols and current reporting templates would be required**.**

c. Disadvantages

The issues raised by stakeholders would not be addressed. The continued reporting of exceedances on a station-by-station basis will continue to provide a distorted picture of air quality.

2. **Change NEPM reporting schedules and guidance documents (Option B)**

a. Discussion

This option would allow a mechanism whereby data could be reported in a way to meet stakeholder needs and provide a mechanism whereby the data, including exceedances, could be reported in a way that makes the data more useable for a wide range of people. This would also provide a mechanism to provide greater accountability by jurisdictions to the community as the information could be provided in a way that is more readily accessible and understood.

b. Benefits

There would be greater transparency and accountability in reporting. Information presented to meet stakeholder needs.

c. **Disadvantages**

Changes required to the NEPM reporting protocols and templates. This may involve additional work for jurisdictions in developing annual reports. Simplifying air quality information may also lead to loss of scientific credibility in the reporting.

3. **Change NEPM reporting schedules and guidance documents to include a requirement for a national summary report for stakeholders (Option B)**

a. Discussion

This option would be that same as (2) but include the development of a national summary document that could be made available separate to the main NEPC annual reports on the EPHC website. The national summary document would be less scientific in nature that the current annual reporting and provide a way for stakeholders to access information in an easy and readily accessible way. The summary report may not be required each year but could be produced at regular intervals eg., 2 or 5 yearly cycles.

b. Benefits

There would be greater transparency and accountability in reporting. Information presented to meet stakeholder needs.

c. **Disadvantages**

Changes required to the NEPM reporting protocols and templates. This may involve additional work for jurisdictions in developing annual reports. Additional resources required to develop the summary report.

5.4.6 Integration with other government policies and programs

The issues of climate change and sustainability are providing significant challenges and new directions for Governments in environmental management. Predictions under climate change scenarios indicate increased temperatures into the future. This is likely to increase the concentrations of secondary pollutants such as ozone and secondary particles. The increases are likely to be experienced both in background concentrations and the contribution from anthropogenic sources. Some of the actions taken to address the climate change issues may also have a negative impact on air quality providing a greater challenge in integrated environmental management.

Government policies on economic development may also impact on air quality. For example, developments that may increase population in urban centres will increase motor vehicle use and air pollution generated by these sources. Consideration of air quality as part of living sustainably and cost benefit analyses around sustainable development needs to consider air quality. Government policies must deliver an overall benefit for the community.

The predicted increases in background ozone and secondary particles will have an impact on the achievability of air quality standards and may have an impact on the health of the Australian population. It is important that any actions to address climate change and to improve air quality consider the impacts on other segments of the environment. The approaches must take an integrated approach to environmental management to ensure that an overall positive outcome for the environment as a whole.

As the NEPM is a framework for monitoring and reporting of air quality and the management of air quality is the responsibility of individual jurisdictions, it is not clear how the NEPM would integrate climate change policy initiatives without a significant change to the current policy framework of the NEPM. A Clause requiring jurisdictions to take an integrated environmental management approach to air quality and to consider climate change policy initiatives could be included. This could also require reporting about how these issues have been considered in actions taken to meeting air quality standards.

As discussed in section 4 the Air Toxics NEPM has a different policy framework from the AAQ NEPM. However, some stakeholders have commented that it would be beneficial to combine the two NEPMs and have one NEPM for air quality. One option may be to have the air toxics NEPM as a second part to the AAQ NEPM. This section could provide a section that is binding on jurisdictions but facilitates the generation of information to assist in the collection of data to develop air quality standards and move some pollutants from this section into the main compliance section of the NEPM (e.g. benzene and PAHs). The second, non-compliance section of the NEPM, could also establish any future actions that might be required to inform any later reviews of the NEPM. Integrating the air toxics NEPM into the AAQ NEPM would require significant changes to the current AAQ NEPM framework. The benefits of making these changes would need to be weighed against the disadvantages of keeping two separate NEPMs.

1. **NEPM framework status quo (Option A)**
   a. **Discussion**

   This option would not explicitly integrate climate change considerations or the air toxics NEPM into the AAQ NEPM. The responsibility for considering climate change issues would be left to the individual jurisdictions. The air toxics NEPM would continue to be implemented by jurisdictions as a separate policy.

b. Benefits

No changes required to the existing NEPM framework. Jurisdictions would be left to address these issues within their own policy frameworks. Priorities would be determined on a jurisdictional basis focussing actions to gain the best overall outcome for that jurisdiction.

c. Disadvantages

No nationally agreed approach to integrating climate change issues in air quality management decisions and policies.

2. NEPM framework status quo – incorporate clause relating to integrated environmental management (Option B)

a. Discussion

This option would provide a national framework to ensure that any actions taken to improve air quality under the AAQ NEPM would also consider the impact of climate change policy. This would provide some national consistency in approaches being taken by individual jurisdictions.

b. Benefits

The link between climate change and air quality would be highlighted. Some national consistency in approaches being taken by individual jurisdictions to integrate climate change and air quality considerations may be achieved.

c. Disadvantages

Would require a change to the NEPM framework to include environmental management considerations.

3. NEPM framework status quo – incorporate air toxics NEPM (Option D)

a. Discussion

This option would provide a mechanism whereby there is only one NEPM that covers air quality. This would require significant changes to the framework of the NEPM to account for the different aims and protocols in the two NEPMs.

b. Benefits

There would only be one NEPM for air quality removing artificial distinctions between pollutants that are present in ambient air.

c. Disadvantages

Significant changes required to the NEPM framework to account for the different aims and protocols in the two NEPMs.

4. NEPM framework status quo - incorporate clause relating to integrated environmental management and incorporate the air toxics NEPM (Option D)

a. Discussion

This option would potentially provide an exhaustive policy document that aims to address key issues in air quality and integrating with other Government initiatives. However, in doing this the changes may result in the weakening of some aspects of the existing NEPM and may be confusing to stakeholders about what the NEPM is aiming to achieve.

b. Benefits

There would only be one NEPM for air quality removing artificial distinctions between pollutants that are present in ambient air. The link between climate change and air quality would be highlighted. Some national consistency in approaches being taken by individual jurisdictions to integrate climate change and air quality considerations may be achieved.

c. Disadvantages

Significant changes required to the NEPM framework to account for the different aims and protocols in the two NEPMs. Would require a change to the NEPM framework to include environmental management considerations. May be confusing to stakeholders about what the NEPM is aiming to achieve.

6. WHERE TO FROM HERE

6.1 THE NEXT STEPS

This discussion paper explores the issues raised through consultation on the Issues Scoping Paper and provides a range of options for potential changes to the policy framework, monitoring and reporting protocols to address these issues. Stakeholder comments are invited on the issues raised and the proposed options and this feedback will be used to inform any recommendations made to NEPC about the need to vary any aspects of the AAQ NEPM and its supporting structures.

Four advisory groups have been formed to assist NEPC in the review of the NEPM - the Non-government Organisations Advisory Group (NGO), the Jurisdictional Reference Network (JRN), the Health Advisory Group (HAG) and the Technical Advisory Group (TAG) and have provided input to the development of this discussion paper. In addition, broader stakeholder input is being sought at this time. (A separate Discussion Paper will also be developed in 2007 for consultation on air quality standards issues.)

Once consultation on the two discussion papers is completed a report will be prepared for consideration by NEPC that will identify what aspects of the NEPM need to be varied and the options to vary the NEPM. It is anticipated that the review recommendations will be finalised for consideration by Ministers during 2008. If supported a variation to the NEPM will be initiated at that time.

The final step prior to varying the NEPM (if required) will involve the preparation of a draft of the variation and an Impact Statement (as required by Section 20 of the NEPC Acts). The Impact Statement must include an assessment of environmental, economic and social impacts. In accordance with the NEPC Acts and the NEPC Consultation Protocol, both the draft variation and the Impact Statement must be made available for public consultation. NEPC must then have regard to the Impact Statement and submissions received during the statutory consultation period in deciding whether to adopt a proposed variation to the NEPM.

6.2 TIMEFRAME FOR THE REVIEW

The anticipated process, timeframe and milestones for the review is as summarised below:

Process and milestones	**Timeframe**
Establish review team, JRN and NGO	July 2006
Review of NEPM policy framework, monitoring and reporting protocols and implementation. Discussion paper released by NEPC Committee for consultation	July 2006 – March 2007 April 2007
Review of air quality standards Discussion paper released by NEPC Committee for consultation	February 2007 – February 2008 March 2008
Preliminary cost benefit analysis	July '07 – Jan 08
Review report to NEPC Committee	September 2008
Review report to NEPC NEPC considers initiation of a variation	October 2008

6.3 SUBMISSIONS

This discussion paper is available on the EPHC website <www.ephc.gov.au> for comment from Monday 4 June 2007 for a period of eight weeks.

No formal response will be provided on submissions to the discussion paper. All submissions will be considered public documents unless clearly marked "confidential" and may be made available to other interested parties, subject to Freedom of Information Act provisions.

Submissions should be received by the NEPC Service Corporation by close of business Friday 27 July 2007. To allow ease of photocopying, hardcopy submissions should be unbound. Electronic submissions should preferably be provided as a Word for Windows file.

An electronic form for lodging comments is preferable. The form can be emailed to you by the NEPC Service Corporation or downloaded from the EPHC website <www.ephc.gov.au>. This form can be filled out and submitted electronically.

Should you wish to provide your comments in another format, submissions may be made by:

email to **kscott@ephc.gov.au**

CD Rom, or

in hardcopy to:

Ms Kerry Scott
Project Manager
NEPC Service Corporation
Level 5/81 Flinders Street
ADELAIDE SA 5000

Fax (08) 8224 0912

GLOSSARY

AAQ	Ambient Air Quality
ADR	Australian Design Rules
ANZECC	Australian and New Zealand Environment and Conservation Council
AQM	Air Quality Management
BAM	Beta Attenuation Monitors
CAFE	Clean Air For Europe
CASAC	Clean Air Scientific Advisory Committee
CO	Carbon Monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EAP	Environmental Action Programme
EC	European Commission
EPHC	Environment Protection and Heritage Council
EU	European Union
GMR	Greater Metropolitan Region
GRUB	Generally Representative Upper Bound
HSI	Headline Sustainability Indicator
IGAE	Inter-governmental Agreement on the Environment
ISP	Issues Scoping Paper
JRN	Jurisdictional Reference Network
NAAQS	National Ambient Air Quality Standards
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NGO	Non Government Organisations Advisory Group
NHMRC	National Health and Medical Research Council
NO_2	Nitrogen dioxide
OAQPS	Office of Air Quality Planning and Standards
OECD	Organisation for Economic Co-operation and Development
O_3	Ozone
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PRC	Peer Review Committee
PRP	Pollution Reduction Programme
PMS	Performance Monitoring Station
PM_{10}	Particles which have an aerodynamic diameter less than 10μm
PM_5	Particles which have an aerodynamic diameter less than .05μm
SEPP	State Environment Protection Policy
SO_2	Sulfur Dioxide
TEOM	Tapered element Oscillating Microbalance
TOR	Terms of Reference
Ug/m3	Micrograms per cubic metre
US EPA	United States Environment Protection Agency
VKT	Vehicle Kilometres Travelled
WA CALM	Western Australia Dept. Conservation and Land Management
WHO	World Health Organization

APPENDIX 1: NEPC AND EPHC

National Environment Protection Council (NEPC)

The National Environment Protection Council (NEPC) is a national body established by State, Territory and Commonwealth Governments. The objective of the NEPC is to work cooperatively to ensure that all Australians enjoy the benefits of equivalent protection from air, water, soil and noise pollution and that business decisions are not distorted nor markets fragmented by variations in major environment protection measures between member Governments.

The NEPC stems from the Inter-Governmental Agreement on the Environment 1992, which agreed to establish a national body with responsibility for making National Environment Protection Measures (NEPMs). The NEPC and its operations are established by the National Environment Protection Council Act 1994 (Commonwealth) and corresponding State and Territory Acts.

NEPMs are broad framework-setting statutory instruments, which, through a process of inter-governmental and community/industry consultation, reflect agreed national objectives for protecting particular aspects of the environment. NEPMs may consist of any combination of goals, standards, protocols, and guidelines, although for the assessment of site contamination, the NEPC Acts specify that guidelines may be developed.

Implementation of NEPMs is the responsibility of each participating jurisdiction. A NEPM will take effect in each participating jurisdiction once it is notified in the Commonwealth of Australia Gazette, but is subject to disallowance by either House of the Commonwealth Parliament. Any supporting regulatory or legislative mechanisms that jurisdictions might choose to develop to assist in implementation of proposed NEPMs go through appropriate processes in those jurisdictions.

Environment Protection And Heritage Council (EPHC)

The Council of Australian Governments (COAG) agreed in June 2001 to the establishment of the Environment Protection and Heritage Council. The scope of activities of the EPHC incorporates the National Environment Protection Council (NEPC).

Since May 2002, NEPC has met in conjunction with the Environment Protection and Heritage Council. The functions of the statutory NEPC will continue under the EPHC as NEPC remains the legal entity for developing and making NEPMs.

APPENDIX 2: CLAUSES 17 AND 18 OF THE AAQ NEPM

17. Evaluation of performance against standards and goal

(1) Each participating jurisdiction must evaluate its annual performance as set out in this clause.

(2) For each performance monitoring station in the jurisdiction or assessment in accordance with subclause 11(b) there must be:

- (a) a determination of the exposed population in the region or sub-region represented by the station; and
- (b) an evaluation of performance against the standards and goal of this Measure as:
  - (i) meeting; or
  - (ii) not meeting; or
  - (iii) not demonstrated.

(3) Jurisdictions may provide an evaluation of a region as a whole against the standards using appropriate methodologies that provide equivalent information for assessment purposes.

(4) Performance must be evaluated as "not demonstrated" if there has been no monitoring or no assessment by an approved alternative method as provided in clause (11).

18. Reporting

(1) Each participating jurisdiction must submit a report on its compliance with the Measure in an approved form to Council by the 30 June next following each reporting year.

(2) In this clause "reporting year" means a year ending on 31 December.

(3) The report must include:

- (a) the evaluations and assessments mentioned in clause 17; and
- (b) an analysis of the extent to which the standards of this Measure are, or are not, met in the jurisdiction; and
- (c) a statement of the progress made towards achieving the goal.

(4) The description of the circumstances which led to exceedences, including the influence of natural events and fire management, must be reported to the extent that such information can be determined.

(5) A report for a pollutant must include the percentage of data available in the reporting period.