Preliminary Work on Ozone for the Review of the Ambient Air Quality NEPM

Review of the Ambient Air Quality NEPM Ozone Standard

Ozone Workshop 18 May 2004

Summary of Outcomes

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The Ambient Air Quality National Environment Protection Measure (NEPM) sets standards for a number of criteria pollutants including ozone. In setting the standards in 1998, the National Environment Protection Council (NEPC) agreed to commence a review of the Air NEPM in 2005. The standards which apply for ozone are 0.10 parts per million for a 1 hour averaging period and 0.08 parts per million for a 4 hour averaging period.

NEPC has established a review team, chaired by NSW, to conduct preliminary work on the ozone standard to feed into the 2005 review of the NEPM. As part of this preliminary work, the review team is gathering up-to-date health information and is conducting analysis of the most appropriate averaging period/s for a national ozone standard.

A workshop was held in Sydney on 18 May 2004 to obtain advice from health experts about health information which will need to be taken into account in assessing the appropriateness of the current ozone standard. A list of participants is at Attachment A.

The workshop commenced with a number of background presentations on topics such as overseas ozone standards, ozone episodes in Sydney and Melbourne and the Multi City Mortality and Morbidity Study. It also included a presentation from the Woolcock Institute of Medical Research on the findings of the Institute's recent literature review on the current state of knowledge on the health impacts of ozone. A copy of the workshop agenda is at Attachment B.

A series of questions was discussed by the participants both in small groups and in the workshop as a whole which covered issues including:

- The appropriate health outcomes, both acute and chronic, which should be considered in setting an ozone standard;
- The use of controlled exposure and epidemiological data for ozone standard setting;
- The susceptible subgroups which should be protected and the existence of dose-response relationships for the health effects of ozone;
- Averaging times which, from a health perspective, are most appropriate for an ozone standard; and
- The use of information on ozone formation patterns in Australian cities and time activity data in standard setting.

A summary of discussion outcomes is at Attachment C. While most of the comments reflect the views of the workshop as a whole, some of comments were raised by particular groups.

Attachment A

Ozone workshop 18 May - Participants

Dr Steve Corbett (facilitator)

Mr Mark Feldwick
Principal Toxicologist, WA Department of Health

Mr Leo Heiskanen
Scientific Adviser, Commonwealth Department of Health and Ageing

Prof Bin Jalaludin
Deputy Director, Epidemiology Unit, Western Sydney Area Health Service

Ms Vikki Lynch
Victorian Department of Human Services

Dr Guy Marks
Woolcock Institute of Medical Research

Mr Ian Marshall
Qld Health

Dr Geoff Morgan
Northern Rivers Department of Rural Health

Dr Tim O'Meara
Woolcock Institute of Medical Research

Prof Michael Pain
Consultant, Respiratory Medicine, Royal Melbourne Hospital

Prof Louis Pilotto
Head, Department of General Practice, Flinders University

Prof Brian Priestly
Head, Australian Centre for Human Health Risk Assessment, Monash University

Dr Tina Runnion
WA Department of Environment

Dr Vicky Sheppeard
NSW Health

Dr David Simon
Principal Scientific Officer, SA Department of Human Services

Dr Jonathon Streeton
Respiratory physician

Mr Tim Armstrong
Commonwealth Department of Environment and Heritage

Ms Ann-Louise Crotty
NSW Department of Environment and Conservation

Dr Lyn Denison
Principal Scientist, Vic EPA

Dr Mark Hibberd
Principal Research Scientist, CSIRO

Ms Bronwyn Isaac
NSW Department of Environment and Conservation

Mr Ian Newbery
NEPC Service Corporation

Mr Nigel Routh
NSW Department of Environment and Conservation

Dr Shannon Rutherford
Scientific Advisor, Qld Health

Mr Tom Whitworth
SA EPA

Attachment B

Review of the Ambient Air Quality NEPM ozone standard - Workshop with health experts

Tuesday 18 May 2004
9.30am – 4.00pm

The Australian Museum
6 College Street, Sydney (opposite Hyde Park)

Agenda

9.30am	**Welcome and aims of workshop** *Ann-Louise Crotty NSW DEC*
9.40 – 11.00am	**NEPM and overseas ozone standards** *Tom Whitworth SA EPA*
	Time activity study and exposure to ozone *Lyn Denison Vic EPA*
	What do we know about ozone in Australia - **Sydney** *Suzanne Quigley NSW DEC* - **Melbourne** *Lyn Denison Vic EPA*
	Multi City Mortality and Morbidity Study *Lyn Denison Vic EPA*
	Literature review of the health impacts of ozone *Tim O'Meara Woolcock Institute of Medical Research*
	Questions and discussion
11 - 11.15am	**Morning tea**
11.15am – 12.45pm	**Introduction and break out for discussion of workshop questions – Session 1**
12.45 – 1.30pm	**Lunch**
1.30 – 2.45pm	**Discussion of workshop questions – Session 2**
2.45 – 3.15pm	**Afternoon tea**
3.15 – 4.00pm	**Summary of discussion and next steps**
4pm	**Close**

Attachment C

Summary of Responses to Ozone Workshop Questions

Question 1: Are there different health outcomes for different averaging periods (1 hour, 4 hour, 8 hour, annual)?

- The types of health outcomes for ozone exposure (eg premature mortality, increased hospital admissions and reductions in lung function) are similar for 1 hour, 4 hour and 8 hour averaging times.

- Challenge chamber studies show that duration and level of exposure are both significant factors in determining health impacts of ozone. Longer exposure times do not result in different symptoms, but do result in more severe symptoms for the same concentration.

- There is considerable uncertainty about the health outcomes for long-term (related to annual averages) or repeated exposure, such as permanent decrease in lung function. Further evidence is required.

Question 2: What has changed in knowledge in relation to the health impacts of ozone since 1998 when the Ambient Air Quality NEPM was introduced? What is the latest evidence from controlled exposure and epidemiological data?

- There have not been any significant shifts in our knowledge about the health impacts of ozone since the introduction of the Ambient Air Quality NEPM. Further studies have confirmed earlier evidence of health impacts (as summarised in the Woolcock Institute of Medical Research report on the health impacts of ozone).

- Australian data is now available which confirms the results of overseas studies. This has led to an increased confidence in the findings about impacts from time series studies where the odds ratios are close to one. The Australian studies help develop confidence around small effect estimates.

- There is now improved Australian information for exposure assessment, eg. the results of the Time Activity Study and more information about Australian ozone levels and formation patterns. Some participants raised issues about the applicability of the results of the Time Activity Study in standard setting.

- Information about health impacts is obtained by using both epidemiological (observational) and exposure chamber (experimental) studies. Epidemiological data are more generalisable than exposure chamber studies, most of which have been conducted on highly selected subjects. However, there are difficulties in attributing outcomes to specific causes in epidemiological studies because of correlation among the air pollutants and, particularly in cross-sectional studies, the effects of other confounding factors. Epidemiological studies usually do not

lend themselves to establishing lowest (or no) observed effect levels which may be needed for standard setting purposes.

- There are limitations in both epidemiological and controlled exposure studies in assessing "real" ozone impacts and the truth about health impacts probably lies between the two (Group 2).

- There is now evidence that health effects related to exposure to ozone occur in cities with low levels of ozone as well as in cities with high levels such as Los Angeles. There is no evidence from epidemiological studies for a threshold for adverse health effects.

Question 3: Which susceptible subgroups should be protected?

- There are three issues to be considered in assessing which subgroups should be protected: susceptibility, significance of harm and likelihood of exposure.

- There is 100-fold variability in response to ozone across the entire population. Around 10% of the population are particularly sensitive to ozone ie. ozone-responders.

- Susceptibility is not predictable across the population - ie. those who 'respond' to ozone do not fall into pre-defined groups such as 'asthmatics' or 'people with respiratory disease'. However, 'ozone-responders' with asthma and pre-existing respiratory disease are more likely to suffer significant health impacts when exposed to ozone (ie, requirement for medical care versus reversible reduction in lung function).

- Those likely to require medical treatment when exposed to ozone include children with asthma and the elderly with existing respiratory disease.

- Consideration should be given to an index of harm for ozone and whether a transient effect in a healthy person such as a short term reduction in FEV1 by 10% constitutes a significant health impact.

- It is possible that people with asthma and pre-existing respiratory disease are the only groups in the population who suffer significant harm from ozone. However, there is uncertainty about potential longer-term effects on lung-function from repeated exposures to ozone – this would be considered a significant health impact and would be expected to have impacts across the population more broadly.

- Groups more likely to be exposed include those exercising outdoors and outdoor workers.

- There is a divergence in the results in relation to the impacts of ozone on asthmatics in chamber studies compared to time-series studies. Chamber studies do not show greater impacts of ozone exposure for asthmatics compared to non-asthmatics, while time-series studies show increased impacts on hospital

admissions for asthmatics and those with pre-existing respiratory disease. This relates to the concepts of sensitivity and harm discussed above: the more unstable asthmatics are unlikely to participate in challenge chamber studies. However, the ozone-responders among the unstable asthmatics will be most likely to develop the adverse health effects detected by time-series studies. Participants in chamber studies who have no respiratory illness but demonstrate sensitivity to ozone are unlikely to develop enough respiratory compromise to be detected in time series studies.

- A common approach to standard setting has been to base a standard on chamber study results and to build in uncertainty factors to protect more sensitive individuals in the population (Group 3).

Question 4: What are the appropriate health outcomes for ozone standard setting – are there identified no-observed-adverse-effects levels (NOAEL) or lowest-observed-adverse-effect levels (LOAEL) for these health outcomes?

- There is no threshold for the health effects of ozone – or if there is a threshold it would be below background ozone levels. NOAEL and LOAEL are probably not useful concepts for setting ozone standards.

- Challenge chamber studies show that duration and level of exposure are both significant factors in determining health impacts of ozone. A useful way to report health impacts of ozone is through a dose (time+concentration)-response curve, as used for example by McDonnell et al (1995). The significance of duration of exposure is not necessarily revealed in time-series studies. This could be because elevated 1 hour, 4 hour and 8 hour levels are probably highly correlated. (Group 2)

- It would be appropriate to use attributable risk and/or benchmark dose approaches to risk assessment to determine levels and potential benefits of ozone standards. Considering the attributable risk for a particular health outcome helps to identify cost benefits.

- It is important to recognise the variation in severity of impacts of ozone when setting an ozone standard. For example, while healthy people may need to stop exercising due to chest-tightness when exposed to ozone, this may be of less concern than asthmatics being admitted to hospital due to ozone exposure.

- The following health outcomes would be appropriate for standard setting: FEV1 reduction in people with respiratory disease; emergency department visits; hospital admissions; and mortality.

- In terms of reporting effects from ozone changes in FEV1 may be the most reliable and objective measure (10% reduction considered to be clinically significant). However, changes in FEV1 are not necessarily the best indicator of harm. It is still important to look at symptoms such as cough, medication use, hospital admissions and mortality.

Session 2

Question 1: What are the most appropriate averaging times for ozone standards?

Question 2: Is additional protection provided by setting standards for more than 1 averaging period?

- Significant factors to be considered in determining averaging times include: the cumulative nature of the health impacts of ozone; patterns of ozone episodes; and patterns of exposure.

- There were a number of different approaches to averaging times:

  - Group 1 favoured a 1 hour and another longer-term (4 or 8 hour) standard.

  - Group 2 favoured an efficient combination of levels and averaging periods, based on concentration and time and an examination of ozone data across different jurisdictions and sites. The need for one or more averaging time would depend on the correlation of peaks at different averaging times across monitoring networks. Group 2 considered there is a presumption in favour of an 8 hour standard given the cumulative impacts of ozone. In theory, if a very strict ozone standard is set at one averaging time, this may be all that is required.

  - Group 3 favoured a combination of 8 hour and 1 hour standards. Given that impacts of ozone are cumulative with exposure duration, it was considered important to set an 8 hour standard to guard against health impacts at relatively low levels. However, it may still be important to have a 1 hour standard as 1 hour spikes may still occur at acceptable 8 hour average levels.

- Different jurisdictions may have ozone episodes with different profiles. A combination of ozone standards may be appropriate to fit the different profiles of ozone episodes of different states. An airshed which may struggle to meet a 4 hour standard may, because of its topography and meteorology, easily meet an 8 hour standard, and vice versa.

Question 3: If the 1 hour standard were reduced from 0.1 parts per million to 0.08 parts per million, would that protect against longer term exposure effects (4 hour and 8 hour)?

- The tightening of the 1 hour standard would not necessarily protect against longer term exposure effects. It would depend on episode durations in different jurisdictions.

- Reducing 1 hour levels should reduce risk of longer-term peaks but may not reduce levels sufficiently to protect against health impacts from 4-8 hour exposures.

- The Melbourne data presented at the workshop was cited as evidence that it was possible to have unacceptably high 4 and 8 hour average levels at the same time as having acceptable 1 hour levels.

Question 4: How should formation patterns and time activity data be taken into account in determining appropriate averaging times for ozone standards for Australia?

- It is vital to take account of ozone formation patterns from different Australian cities in the standard setting process. It would be useful to have further information on this for the next stage of the review.

- Policy makers should not only use average time activity patterns for setting standard. Standards need to take into account maximum likely exposure – such as people working outdoors all day.

- Some considered that standards should be set to protect those at risk of maximum exposure – rather than just for those who would have the average amount of exposure.

- Information about average time activity patterns may be more useful for risk assessment and risk communication than determining averaging times.

Other Issues raised in group discussions

Ozone standard setting should be linked with other strategies such as education. If ozone is at its peak at around 3 pm an education campaign / message could discourage people from exercising outside at that time on high ozone days (Group 2).