NATIONAL ENVIRONMENT PROTECTION MEASURE FOR AMBIENT AIR QUALITY

AMBIENT AIR QUALITY MONITORING PLAN

FOR THE

AUSTRALIAN CAPITAL TERRITORY

JANUARY 2001

1. Summary

This monitoring plan has been prepared with reference to the Peer Review Committee's series of ambient air quality Measure guideline papers.

The ACT contains one region (Canberra) as defined by the Measure and using the population based formula in Clause 14 of the Measure this region only requires one performance monitoring station.

This requirement will be met by an existing ambient air quality monitoring station situated in the southern Canberra suburb of Monash. This station will also be used as the Measure trend station.

The ACT's annual report to NEPC will only be based on five of the six criteria pollutants, namely photochemical oxidants as ozone, nitrogen dioxide, particle matter as PM_{10}, carbon monoxide and lead. Due to a lack of industry the need to monitor SO_2 has been screened out based on Measure compliant monitoring data for the Sydney airshed.

2. Introduction

On 26 June 1998 the National Environment Protection Council (NEPC), consisting of Commonwealth, State and Territory Ministers, made the National Environment Protection (Ambient Air Quality) Measure (the "Measure").

The desired environmental outcome of the Measure is ambient air quality that allows for the adequate protection of human health and well-being. To achieve this the Measure sets standards and goals for six air pollutants, and outlines the methods by which these pollutants are to be measured, assessed and reported.

Under the Measure, each participating jurisdiction must establish monitoring procedures and commencement of assessment and reporting, in accordance with the protocols of the Measure, within three years after its commencement.

After making the Measure, the Ministers resolved to establish a Peer Review Committee (PRC) to advise on jurisdictional monitoring plans. Under its terms of reference, the PRC has two complementary roles. First, the PRC is required to advise the NEPC on the adequacy of monitoring plans submitted by jurisdictions. Secondly, it provides advice on technical issues related to the consistent implementation of the Measure's monitoring protocol.

The PRC has developed a series of strategy papers that provide a basis for both the preparation of individual jurisdiction monitoring plans and the technical assessment of monitoring plans by the PRC.

This report represents the ACT's submission on how it plans to monitor, assess and report air quality for the purposes of the Measure. The report is structured according to the format specified by the PRC.

Please note that monitoring undertaken by a jurisdiction for Measure purposes may only be a sub-set of a its larger monitoring program.

3. Selection of Regions

3.1. Measurement and Assessment Methodology

Part 4 of the Measure sets out the monitoring protocol to be followed by jurisdictions for the purpose of evaluating performance against the standards.

Under Clause 11 of the Measure this can be done by either monitoring ambient air quality directly at performance monitoring stations or indirectly by other means that provide information equivalent to measurements which would otherwise occur at a performance monitoring station.

The ACT Government currently operates an ambient air quality monitoring network and will undertake measurement and assessment of pollutants using performance monitoring stations.

3.2 Identification of regions

A region is defined under the Measure as '*an area within a boundary surrounding population centres as determined by the relevant participating jurisdiction*'. This definition is very broad and could be open to widely varying interpretations. To avoid ambiguity and have a consistent application across jurisdictions the PRC has accepted the following definition of a region:

> 'a region for the purposes of performance monitoring is a geographic area where the air quality (for a particular pollutant) is determined either entirely or in large part by the influences of a common collection of anthropogenic emission sources'

The PRC also adopted the following definitions of different region types:

Type 1 A large urban or town complex with a population in excess of 25,000 requiring direct monitoring and contained within a single airshed;

Type 2 A region with no one population centre above 25,000 but with a total population above 25,000 and with significant point source or area based emissions as to require a level of direct monitoring; and

Type 3 A region with a population in excess of 25,000 but with no significant point or area based emissions, so that ancillary data can be used to infer that direct monitoring is not required.

The PRC has adopted the use of Australian Bureau of Statistics (ABS) population figures, specifically the "Urban Centre / Locality" data, as the most objective estimates for identification of potential Type 1 regions. Relegation of a Type 1 to Type 3 region must be supported by arguments based on local knowledge. Identification of Type 2 regions is also reliant on local knowledge of emission sources and airshed characteristics.

3.3 ACT Regions

Using the ABS data contained in Table 1 of the PRC "Selection of regions" guideline paper (PRC, 2000b) the ACT only contains one urban centre (Canberra) with a population over 25000. This is a Type 1 region.

4.0 Performance Monitoring Requirements

Part 4 of the Measure sets out the monitoring protocol to be followed by jurisdictions for the purpose of evaluating performance against the standards.

Moreover Clause 14 of the Measure defines the number of performance monitoring stations required as follows:

(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.

Sub-clauses (1) and (2) are self-explanatory. Sub-clause (3) provides jurisdictions with the opportunity to demonstrate that for a given region fewer monitoring stations than that indicated by the formula (possibly zero) are required. The PRC refers to this process as "screening".

The PRC has prepared a guideline to ensure a reasonable degree of consistency and rigour in the screening assessments undertaken by jurisdictions (PRC 2000d). The guideline identifies a range of screening procedures which might be used for particular pollutants and assign an acceptance limit to each procedures reflecting the confidence attached to the procedure.

The following extract from the PRC "Monitoring Strategy" guideline paper (PRC 2000c) provides the rationale for siting of performance monitoring stations:

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

An examination of the distribution of GRUB stations relative to the distribution of population and pollutants will determine the need for, and location of, additional stations to achieve adequate representation of population-average concentrations.

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

4.1 Canberra Region

4.1.1 Overview

4.1.1.1 Region Boundaries

The ACT is approximately 2400 km^2 and is land locked inside NSW. Its situated in the southern tablelands and lies between latitude 35^o and 36^o south, approximately 130 km from the coast (Refer insert in Figure 1).

Site specific meteorological data has only been collected since early 1997 with co-location of Bureau of Meteorology facilities. Complex interactions of climate and topography make modelling of the Canberra airshed difficult. For these reasons the extent of the Canberra airshed is unclear.

For the purpose of this plan the Canberra region boundaries are defined as shown in Figure 2.

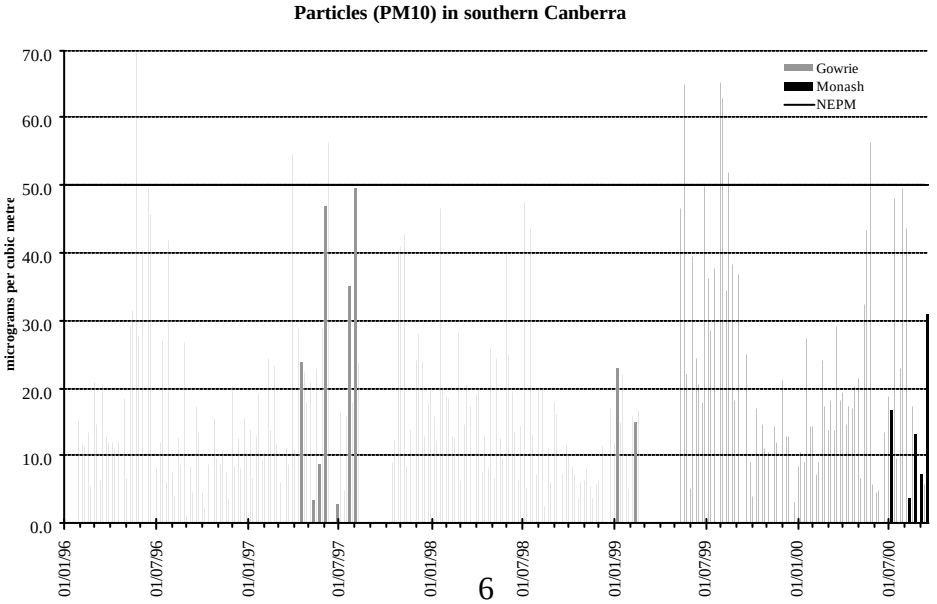
4.1.1.2 Population and Topography

Figure 3 shows population density (persons per square kilometre) based on 1996 ABS Census data.

The ACT contains very diverse terrain (Refer Figure 1 and Figure 2). Elevation ranges from 450m above sea level in the north-east to 1900m above sea level (Mt Bimberi) in the south. The Canberra urban area is primarily located on the undulating country and plains of north-east, with local hills and valleys dominating air flow patterns, particularly in winter where katabatic flow and mountain winds bring about the formation of temperature inversions.

4.1.1.3 Emissions

There is no existing inventory of air emissions for the Canberra region. Due to a small industrial base air pollutant emissions in the Canberra region are dominated by motor vehicles with the exception of particles less than 10 microns (PM_{10}), which has a seasonal increase during winter due to emissions from wood heaters. This is illustrated by the graph below which shows particle concentrations for Tuggeranong measure at Gowrie (Jan 96 – Feb 99) and Monash (May 99 – Sept 00).



4.1.1.4 Meteorology

The weather in Canberra, along with the rest of south eastern Australia, is strongly influenced by high pressure systems, particularly during winter. These systems bring light winds, calm conditions and clear skies, resulting in cold frosty nights, which are almost a nightly occurrence in Canberra during winter, with about a 100 frost a year recorded in Canberra.

These stable conditions can lead to the formation of temperature inversions. While inversions are quite common during spring the main problem for air pollution dispersion occurs during winter when smoke pollution from wood heaters is trapped close to ground level causing an increase in particle levels. This problem is particularly prevalent in the Tuggeranong valley.

An analysis of wind direction in Canberra indicates a high frequency of north-west winds over the greater part of the year, with a higher frequency of east to south–east winds during the warmer months of January, February and March.

The prevailing north-west wind direction over most of the year appears to be largely due to topographic channelling of winds with westerly components down the broad valley of the Murrumbidgee and Molonglo. The low frequency of winds from the south-west quarter is also due to shielding by the Brindabella ranges.

In the three warmer months of January, February and March, and to some extent in the transition months of December and April, the notable feature of the wind regime is the high frequency of east south-east winds. At this time of year the south-east trade winds extend further to the south along the east coast of Australia and begin to penetrate well inland. This effect is further assisted by the development of strong sea breeze circulations in the summer months which have the strength to extend inland as far as Canberra. These cooler easterly winds from the coast provide a welcome relief on the hotter summer days, usually being most frequent in the late afternoon or evening. On the average the sea breeze arrives at Canberra close to 6.30pm.

4.1.1.5 Air Quality Monitoring History

The ACT Government has been undertaking ambient air quality monitoring in Canberra for over a decade. The ACT's existing ambient air quality monitoring network, operated by the Department of Health and Community Care, consists of two major sites and a third minor site.

The two major sites are located in Civic, at the northern end of the Bunda Street car park, and Monash, approximately 150 metres West of Cockcroft Avenue in the Monash district playing fields. These facilities contain instrumentation that continuously monitors carbon monoxide, ozone, oxides of nitrogen, light scattering and temperature. Lead, total suspended particulate matter (TSP) and PM_{10} are monitored every sixth day.

The third minor monitoring site is at the Woden ambulance station where lead, TSP and PM_{10} data is collected. TSP monitors particle concentrations in the air for particles having an aerodynamic equivalent diameter of 150 microns or less. The geographic location of the ACT's current monitoring stations, along with the former Gowrie Station, are shown in Figure 2.

Historical monitoring indicates no exceedences of the Measure goals for nitrogen dioxide, ozone, lead or PM_{10}, although particle emissions from slow combustion heaters continue to receive attention each winter in the Tuggeranong area. This is associated with temperature inversions and drainage patterns caused by the topography of the region.

4.1.2 Number of Performance Monitoring Stations

Using the population based formula in Clause 14(1) of the Measure the Canberra region only requires **one** performance monitoring station. This calculation is based on a current population of 311 000[1].

4.1.3 Photochemcial Oxidants (as Ozone).

4.1.3.1 Review of Data

Monitoring for ozone has been undertaken at Civic since the early 1990's and at Monash since 1996. Prior to the establishment of the Monash station ozone levels in Tuggeranong were measured in the adjacent suburb of Gowrie from mid 1991 to 1995.

For the purpose of determining the location of the Canberra region's performance monitoring station data collected previously at the former Gowrie Station has been coalesced with data collected at the Monash station.

Figure A1.1 shows the highest, 2nd, 90th and 95th percentile daily maximum 1-hour averages of ozone for each of several calendar years at Civic and Gowrie & Monash.

With the exception of 1999, the maximum ozone concentrations measured in any given year in the region has been in Tuggeranong at either Gowrie or Monash. Maximums recorded in Tuggeranong have generally been between 0.06 ppm & 0.08ppm and in Civic between 0.04ppm & 0.06ppm. The only exceedence of the standard was recorded at Monash in 1997 with a level of 0.107ppm.

4.1.3.2 Nominated performance monitoring station and trend station

According to clause 13 (2) a performance monitoring stations *"..must be located in a manner such that they contribute to obtaining a representative measure of the air quality likely to be experienced by the general population in the region or sub-region."*

In regions, such as Canberra, where only a single performance monitoring station is required under the populations based formula of the Measure, the PRC recommends that such a station be located to be generally representative of upper bound concentrations.

The maximums measured at Monash, including the only recorded exceedence of the standard, are at the upper bound of levels historically recorded in Canberra and it will be used as the ACT's ozone performance monitoring station.

[1] Source: Planning and Land Management, Department of Urban Services.

The Monash station will also be used as the ACT's trends station for ozone. It has been operational since 1996 and it is intended that it remain a permanent monitoring site. The Civic Station will not be used as a trend station as due to redevelopment pressures it is to be relocated sometime in 2001.

4.1.4 Nitrogen dioxide

4.1.4.1 Review of Data

Monitoring for nitrogen dioxide has been undertaken at Civic since the mid 1980's and at Monash since 1996. Prior to the establishment of the Monash levels in Tuggeranong were measured in the adjacent suburb of Gowrie from mid 1991 to 1995.

Figure A1.2 shows the highest, 2^{nd}, 90^{th} and 95^{th} percentile daily maximum 1-hour averages of nitrogen dioxide for each of several calendar years at Civic and Monash.

With the exception of the exceedence of 0.124ppm at Civic in 1991, the maximum measured nitrogen dioxide concentrations in the region are well below the standard. Maximums recorded in Tuggeranong have been between 0.03 ppm & 0.06ppm and in Civic between 0.045ppm & 0.08ppm.

4.1.4.2 Nominated performance monitoring station and trend station

With the exception of the exceedence recorded at Civic in 1991 the maximum level of NO_2 measured at both Civic and Monash is well below the standard. While either of these stations could be used for Measure reporting purposes Monash will be used as the ACT's performance monitoring station. This decision is based on the fact that the Civic station is to be relocated sometime in 2001.

The Monash station will also be used as the ACT's trends station.

4.1.5 Particles as PM_{10}

4.1.5.1 Review of Data

Monitoring on a permanent basis for PM_{10} in Canberra started mid 1995. It has been measured continually in Civic since this date, continually in Woden since October 1996 and in Monash since March 1999. Prior to the establishment of the Monash station levels in Tuggeranong were measured in the adjacent suburb of Gowrie from April 1995 to February 1999.

Figure A1.3 shows the 1^{st}, 2^{nd} and 6^{th} highest readings for PM_{10} for each of several calendar years at Civic, Woden and Gowrie & Monash.

Whilst all stations have recorded exceedences of the standards in the past it is clear from Figure A1.3 that the maxima and frequency of these exceedences is the highest in Tuggeranong. As an example the standard was exceeded 4 times at Monash in 1999 and the concentration of the 6^{th} highest reading was 46.6 micrograms per cubic metre.

However, historical monitoring indicates no exceedences of the Measures goals for PM_{10}, although particle emissions from slow combustion heaters continue to be a problem each winter in the Tuggeranong area.

4.1.5.2 Nominated performance monitoring station and trend station

Given the maxima and frequency of exceedences measured at Monash it will be used as the ACT's performance monitoring station.

The Monash station will also be used as the ACT's trends station.

4.1.6 Carbon monoxide

4.1.6.1 Review of Data

Monitoring for carbon monoxide has been undertaken at Civic since the mid 1980s and at Monash since 1996. Prior to the establishment of the Monash station levels in Tuggeranong were measured in the adjacent suburb of Gowrie from 1992 to 1995.

Figure A1.4 shows the highest, 2nd, 90th and 95th percentile daily maximum rolling 8-hour average of carbon monoxide for each of several calendar years at Civic and Monash.

The highest CO values measured in Canberra have been at the Civic station. This station is located at the end of a carpark in the CBD and on average will record one or two exceedences each year. Invariably this occurs in winter when temperature inversions cause non-dispersion of pollutants.

4.1.6.2 Nominated performance monitoring station and trend station

As the Civic station is located in a carpark within the CBD it would be classified as a 'peak station' using the PRC "Monitoring Strategy" guideline paper (PRC 2000c) and does not satisfy the requirements of clause 13(2) of the Measure.

The maximums measured at Monash are at the upper bound of levels historically recorded else where in Canberra and it will be used as the ACT's CO performance monitoring station.

The Monash station will also be used as the ACT's trends station.

4.1.7 Sulfur dioxide

4.1.7.1 Review of Data

Ambient air quality monitoring for sulfur dioxide has never been undertaken in Canberra airshed.

4.1.7.2 Screening

Due to a lack of heavy industry the ACT will not be monitoring sulfur dioxide. This decision is supported by the use of screening procedure F from Table 1 of the PRC screening paper.

F. In a region with no performance monitoring, comparison with a NEPM compliant region with greater population, emissions and pollution potential.	35%

The Measure compliant region being used for the screening procedure is Sydney. Its population is more than 10 times that of Canberra and therefore has a greater emission and pollution potential.

Monitoring data collected by the NSW EPA for Sydney (see below) confirms that sulfur dioxide levels are measured at levels much lower than the Measure standard. The maximum peak 1-hour level of 0.04ppm is 21% of the Measure standard and well below the screening procedure F's acceptance limit of 40%.

SYDNEY SULFUR DIOXIDE LEVELS FOR PERIOD 1996-1998

SITE[1]	Average of monthly maximums	1 hour levels (ppm)		Months of valid data over 3-year period[2]
		Peak	2nd highest	
Randwick	0.02	0.04	0.03	32
Lindfield	0.02	0.04	0.03	28
Wollongong	0.02	0.03	0.03	29
Woolooware	0.01	0.03	0.03	34
Blacktown	0.01	0.02	0.02	28
Vineyard	0.01	0.02	0.02	35
Richmond	0.01	0.02	0.02	31
Bargo	0.01	0.01	0.01	27
Bringelly	0.01	0.01	0.01	33

1 Sites ranked on basis of measurements made during period Jan 1996 to Dec 1998
2 Some stations were not operational until some number of months into 1996
Source: NSW Draft Monitoring Plan – November 2000.

4.1.8 Lead

4.1.8.1 Review of Data

Monitoring for air-borne lead (Pb) has been undertaken at various locations in Canberra since the 1990's.

Figure A1.5 shows that Pb levels have decline markedly since the 1990's at all locations. The maximum levels now recorded at peak (Civic and Woden) and GRUB (Gowrie and Monash) stations are less than 20% and10% of the standard respectively. This level of reduction has been recorded nationally and is due to a decrease in the use of leaded fuel.

4.1.8.2 Nominated performance monitoring station and trend station

While any of the three existing stations could be used for reporting purposes the ACT will use Monash as its performance monitoring station.

The Monash station will also be used as the ACT's trends station. It is envisaged that monitoring for airborne lead will gradually be phased out over the next few years to coincide with the national phase out of leaded petrol.

5 Siting and Instrumentation

5.1 Details of Monitoring Station

The ACT's performance monitoring station will be located in the suburb of Monash (Refer Figure 2). It has been operational since 1996 and it is intended that this site becomes a permanent monitoring site for the ACT.

The Monash station is sited in accordance with AS2922-1987 (Ambient Air - Guide for Siting of Sampling Sites).

The table below presents an assessment of the Monash station against the criteria of AS2922-1987.

Monash Station	Compliant
Height above ground	□
Minimum distance to support structure	□
Clear sky angle of 120?	□
Unrestricted airflow of 270?/360?	□
20m from trees	□
No boilers or incinerators nearby	□
Minimum distance from road or traffic	□

A Bureau of Meteorology weather station is also co-located at the Monash Site. Where necessary the ACT will use data from this facility to assist in evaluating exceedences of standards, as required under Clause 18(3) of the Measure.

5.2 Monitoring Methods

Schedule 3 of the Measure sets out the Australian Standard methods to be used for pollutant monitoring. The methods relevant to the ACT are listed in the table below.

Pollutant	Method title	Method number
Carbon monoxide	Determination of Carbon Monoxide-Direct Reading Instrumental Method	AS3580.7.1-1992
Nitrogen dioxide	Determination of Oxides of Nitrogen-Chemiluminescence Method	AS3580.5.1-1993
Photochemical oxidants (as ozone)	Determination of Ozone-Direct Reading Instrumental Method	AS3580.6.1-1990
Lead	Determination of Particulate Lead-High Volume Sampler Gravimetric Collection-Flame Atomic Absorption Spectrometric Method Determination of Total Suspended Particulates (TSP) – High Volume Sampler Gravimetric Method	AS2800-1985 AS2724.3-1984
Particles as PM_{10}	Determination of Suspended Particulate Matter-PM_{10} High Volume Sampler with Size Selective Inlet-Gravimetric Method Determination of Suspended Particulate Matter-PM_{10} Dichotomous Sampler-Gravimetric Method	AS3580.9.6-1990 AS3580.9.7-1990

In relation to PM_{10} it should be noted that Schedule 3 of the Measure specifies that measurements should be carried out using HiVol (or Dichotomous) samplers. However, Schedule 2 of the Measure sets a 1 day (continuous) averaging period.

As the ACT uses HiVol samplers on a 1 in 6 day cycle it will not be able to report continuous data in accordance with Schedule 2. While the ACT will continue to use HiVol samplers for the immediate future it proposes to purchase a beta attenuation monitor for continuous particle measurements. As there is no Australian Standard for this instrument the Measure requires that its equivalence with a HiVol sampler be proven. The ACT does not have the available resources to undertake this task and will be seeking the cooperation of both the PRC and Environment Australia to establish equivalence.

5.3 Data Handling

The ACT is committed to data handling in a manner that is consistent with PRC guideline paper "Procedures for the Collection and Handling of Monitoring Data for Reporting Under the Ambient Air Measure".

5.4 Accreditation

The Department of Health and Community Care (HaCC) undertakes the ACT Government's ambient air quality monitoring. HaCC is committed to maintaining appropriate management systems to ensure the adequate monitoring, quality assurance and validation procedures. HaCC currently maintains ISO9000 quality assurance certification and is working towards NATA (National Association of Testing Authorities) accreditation.

6.0 Reporting and Evaluation

6.1 Annual Reports

In accordance with Clause 18 of the Measure the ACT will report on its compliance with the Measure to NEPC Council by 30 June next following each calendar reporting year.

This report will be submitted in an approved format and will include:

? the evaluations and assessments mentioned in Clause 17;
? an analysis of the extent to which the standards of the Measure have or have not been met by the ACT; and
? a statement of the progress made towards achieving the goal.

6.2 Evaluation of Performance

In accordance with Clause 17 of the Measure jurisdictions are required to evaluate their annual performance against the standards and goal.

For the Monash performance monitoring station this will mean:

? a determination of the exposed population represented by the station; and
? an evaluation of performance against the standards and goal of the Measure as either meeting, not meeting or not demonstrated.

Given the inherent uncertainty in determining the exposed population represented by the Monash station the ACT will simply be reported the cumulative population within a 5 kilometre radius of the station. Based on 1996 Census data the cumulative population within a 5 kilometre radius of Monash is 75 243. Refer figure 4.

Appendix A

Plots of pollutant concentration

Ozone

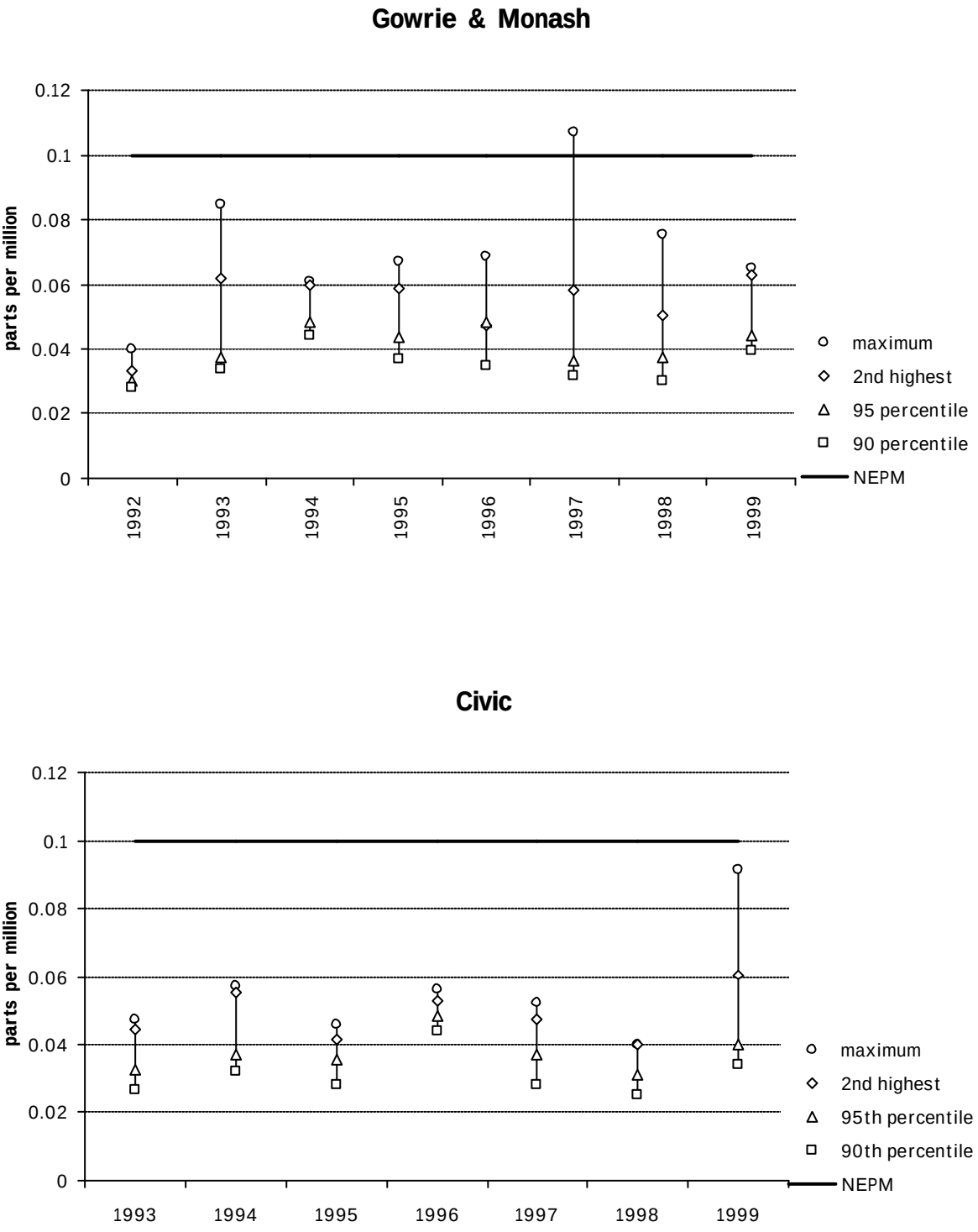


Figure A1.1 - Maximum, 2nd highest, 95th & 90th percentile for daily maximum 1-hour averages for ozone.

Nitrogen dioxide

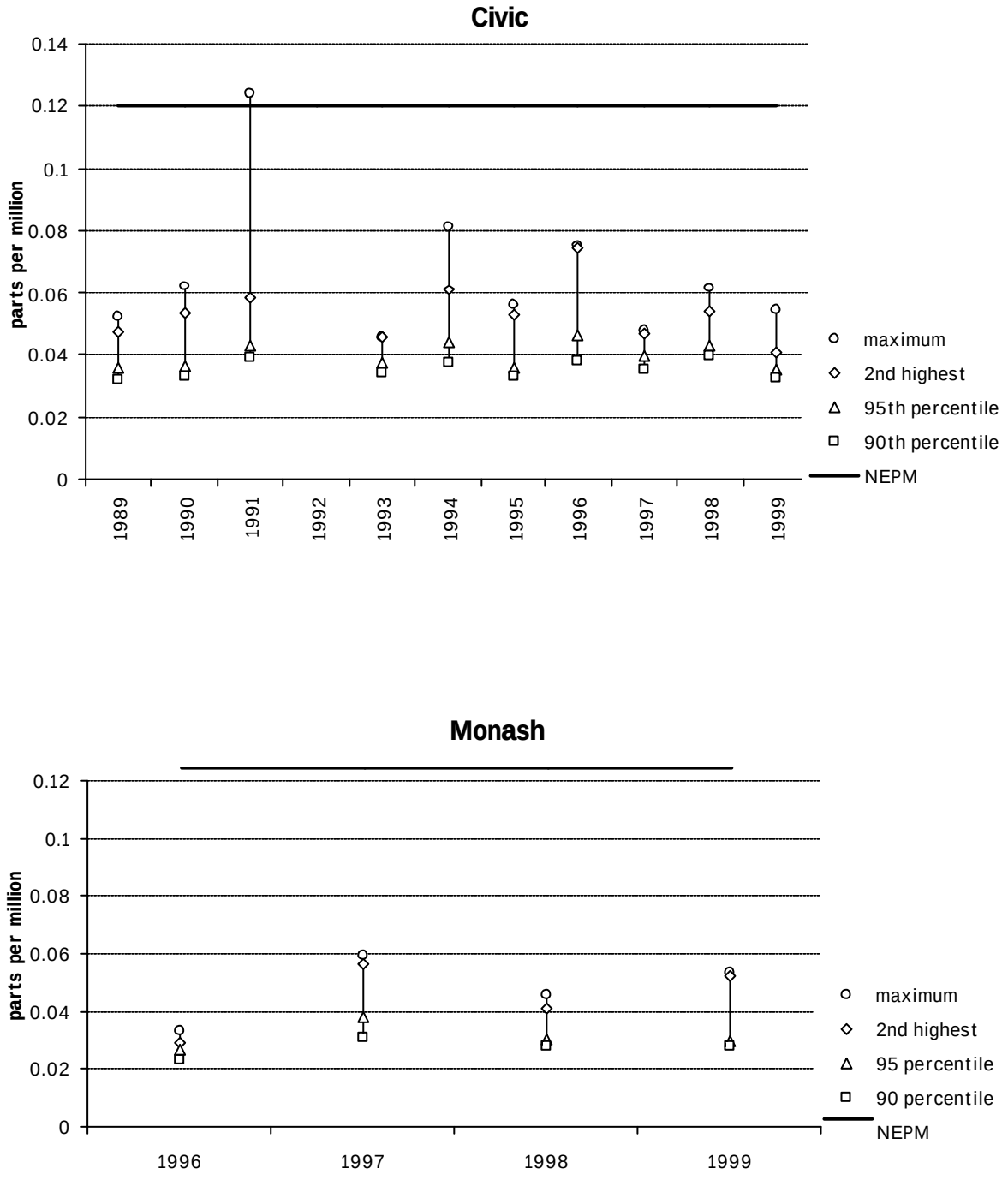


Figure A1.2 - Maximum, 2nd highest, 95th & 90th percentile for daily maximum 1-hour averages for nitrogen dioxide.

PM_{10}

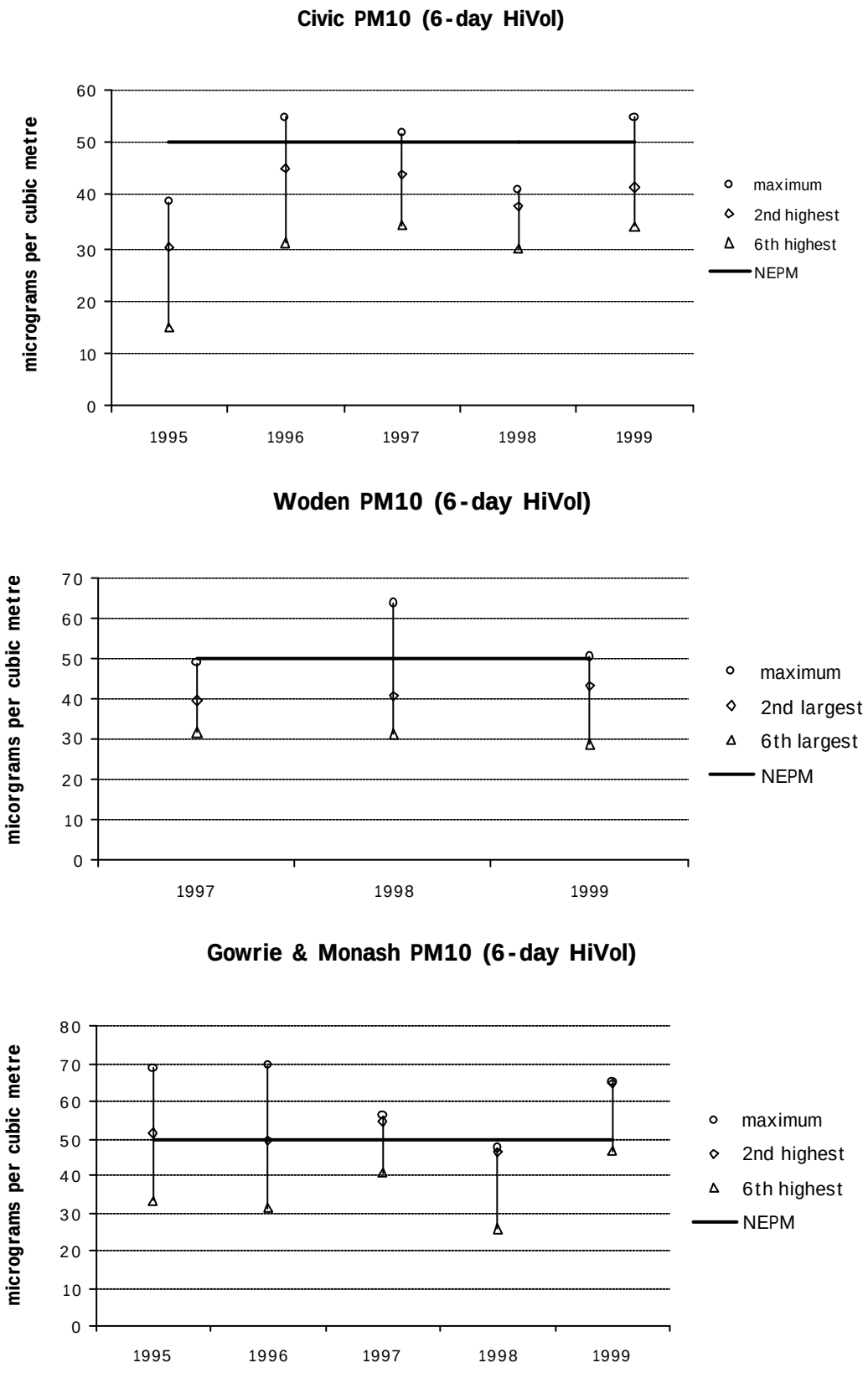


Figure A1.3 - Maximum, 2nd and 6th highest for 1 day averages for Pm_{10}.

Carbon Monoxide 8-hour

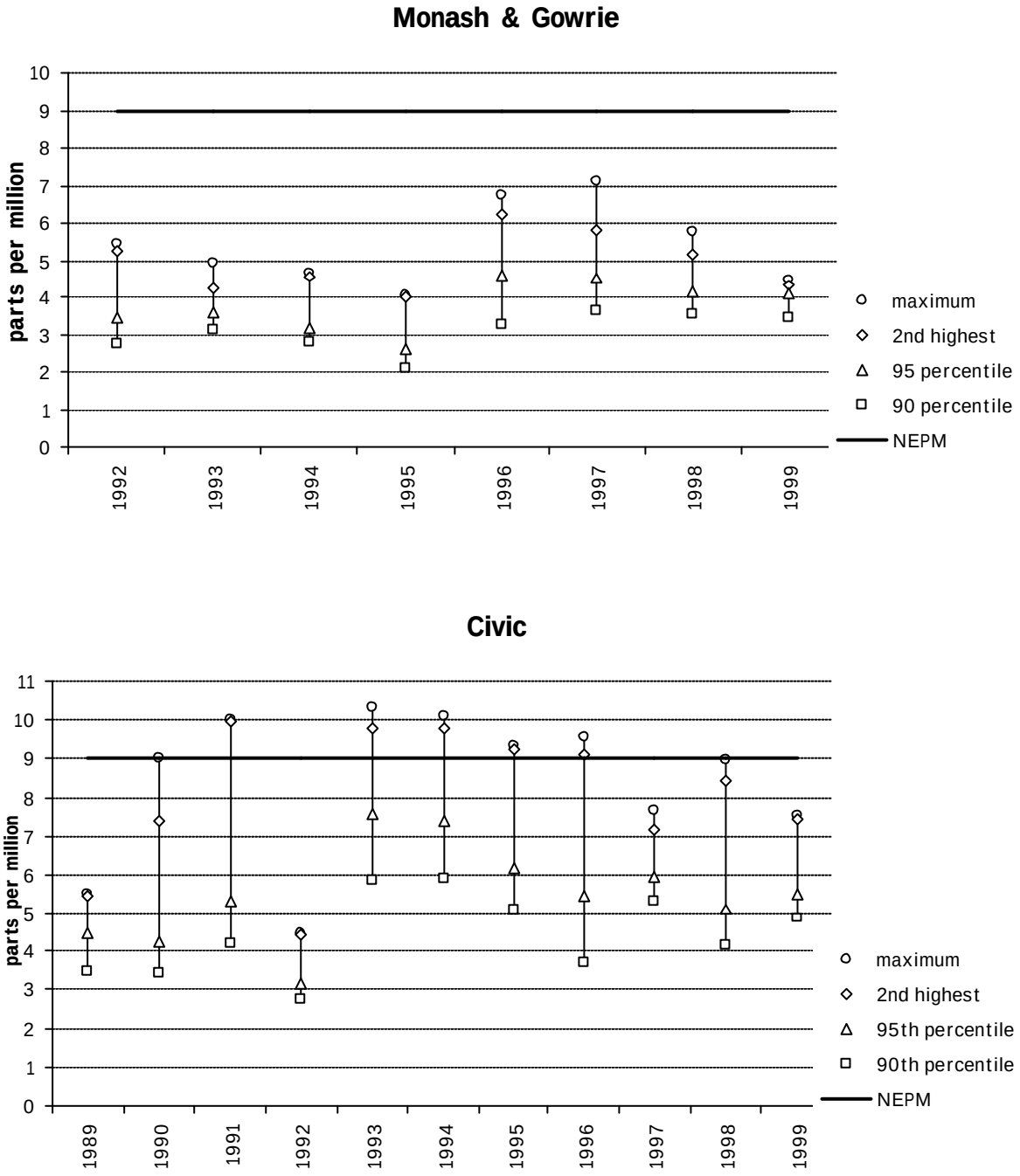


Figure A1.4 - Maximum, 2nd highest, 95th & 90th percentile for daily maximum 8-hour averages for carbon monoxide.

Lead

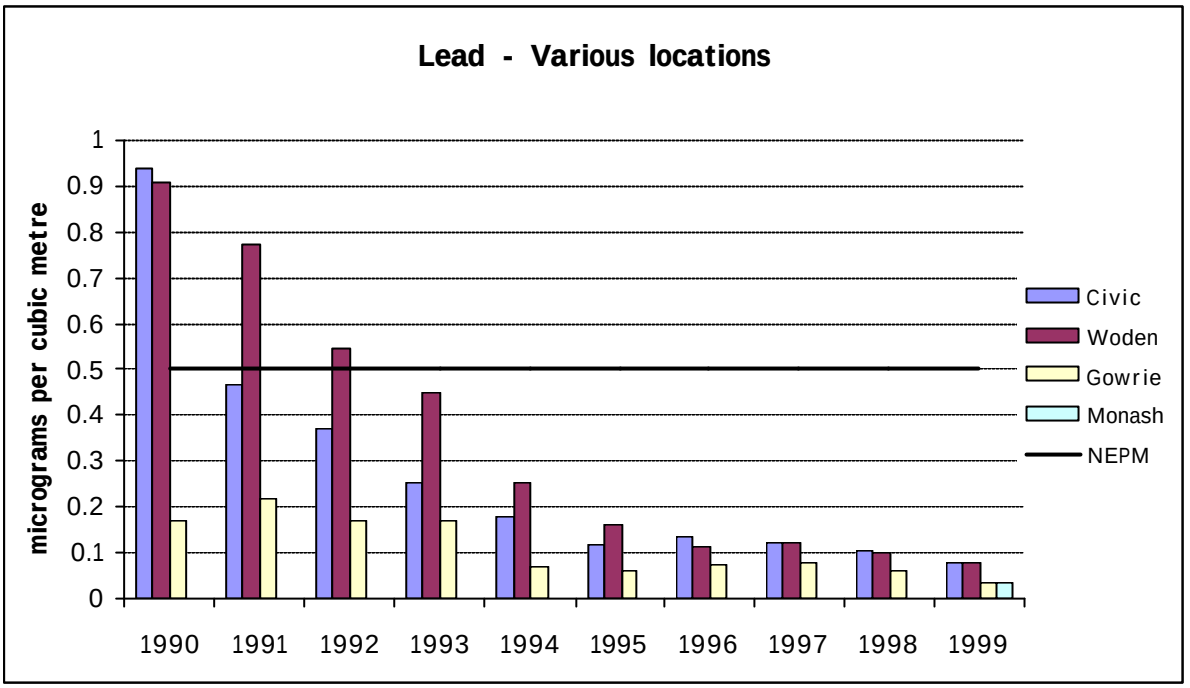


Figure A1.5 – 1-year averages of lead concentrations measured at various locations.