AIR QUALITY MONITORING Hot Spot No 4

near the Castalloy Foundry, North Plympton

South Australia

AIR

Government
of South Australia

Air Quality Monitoring
Hot Spot Report No 4

near the Castalloy Foundry, North Plympton

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Hot Spot Report No. 4

Environment Reporting (Air Quality): *www.environment.sa.gov.au/reporting*

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Glossary

DOAS	differential optical absorption spectrometry
EPA	Environment Protection Authority
EPAQS	Expert Panel on Air Quality Standards
NDIR	non-dispersive infrared
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory
TEOM	tapered element oscillating microbalance
WHO	World Health Organization

SUMMARY

Castalloy Manufacturing Pty Ltd is located on Mooringe Avenue, North Plympton. The Castalloy foundry is authorised under the *Environment Protection Act 1993* (Schedule 1 Part A Activities) to undertake the environmentally significant activities of 'ferrous and non-ferrous metal melting', 'surface coating' and 'fuel burning'. In practice, these activities refer to aluminium melting and casting, spray painting, powder coating, electroplating, fuel burning operations and the bi-production of waste substances.

Air quality monitoring was conducted in two locations adjacent to residential properties on the northern side of the foundry: a vacant block on Streeters Road, and Sandringham Reserve on Kinkaid Avenue. Monitoring commenced after complaints were lodged with the Environment Protection Agency[1] (EPA) regarding strong odours emanating from the foundry. A number of smaller industries that produce emissions to air surround the foundry and the monitoring sites.

This report describes the results of air quality testing at the two sites. The assessment did not include odour measurements.

Chemical and particulate parameters were continuously measured, starting 26 November 2001 at Site 1 (Streeters Road) until 6 December 2001. At this point a request to move from the property was made and a second location was sought. Monitoring at Site 2 (Sandringham Reserve) commenced on 14 December and monitoring was completed on 6 March 2002. The parameters measured included oxides of nitrogen, ozone, sulfur dioxide, carbon monoxide, benzene, toluene, formaldehyde, naphthalene and particulate matter less than 10 micrometers in diameter (PM_{10}).

All measurements were compared to the National Environment Protection Measure (NEPM) standards and other recognised health related guidelines.

The Department for Human Services advises that for all NEPM pollutants tested, health impacts would not be expected. Risks to health from benzene would not be anticipated based on the UK ambient air criteria. Toluene and formaldehyde were also well within World Health Organisation (WHO) air quality guidelines, including results from shorter time-averaged periods that can identify shorter elevated peaks in the data. Ongoing inspections of small industry in the area surrounding the Castalloy foundry will identify whether there are additional naphthalene sources. Investigations are continuing for naphthalene as there are limited ambient air standards for this pollutant.

[1] From 1 July 2002, the Environment Protection Agency was made independent of the Department for Environment and Heritage, and re-named Environment Protection Authority.

INTRODUCTION

The EPA began continuous monitoring of chemical and particulate parameters on 26 November 2001 and completed monitoring on 6 March 2002.

Monitoring was conducted to determine whether a significant air pollution problem in the North Plympton area existed due to a small number of pollutants measured near the Castalloy foundry. Residential premises are located predominately north, south and east of the foundry while industrial buildings are located to the west.

The first monitoring site was located on Streeters Road, on a vacant block between houses approximately 100 metres from the foundry. The second site was at Sandringham Reserve, next to the foundry.

PM_{10} concentrations at the two hot spot sites were compared with those measured at the EPA's Netley monitoring station, which served as a reference site for the study.

Parameters that were measured continuously included:

- particulate matter (PM_{10}), measured using the tapered element oscillating microbalance (TEOM)
- carbon monoxide (CO), measured using non-dispersive infrared (NDIR) absorption
- nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), benzene (C_6H_6), formaldehyde (CH_2O), toluene (C_7H_8), and naphthalene ($C_{12}H_8$), measured using differential optical absorption spectrometry (DOAS)
- meteorological data (including wind speed, wind direction and temperature).

These parameters (excluding naphthalene) were selected because there are national air quality standards either in place or being developed. Naphthalene was included because it was detected during the course of monitoring and is a known irritant.

The air pollutants chosen in this study are commonly emitted from foundry operations (but also many other sources such as motor vehicles and smaller industries). Many studies have related time–concentration exposures of these pollutants to effects on human health (NEPC 1998, Holgate *et al* 1999 and Peach 1997 and USEPA).

Based on data provided by the foundry, the National Pollutant Inventory estimated that Castalloy foundry's activities emit to air each year 3000 kg of carbon monoxide, 3600 kg of nitrogen oxides, 7800 kg of PM_{10} (particulate matter), 210 kg of sulfur dioxide and 0.020 kg of polylclic aromatic hydrocarbons (PAH). PAHs were not considered in this assessment.

'Hot Spot' air quality monitoring

Ambient air quality refers to the quality of the surrounding outdoor air and its background parameters. The EPA conducts ambient monitoring at a number of permanent sites throughout Adelaide (EPA 2001a). The air quality at these sites is assessed to determine trends of urban air quality for the whole of Adelaide.

The EPA also conducts 'hot spot' monitoring using a mobile monitoring station. 'Hot spot' refers to monitoring that is designed to investigate pollution sources on a local scale. This allows for the assessment of air quality emanating from a point source, but rather than emissions being monitored directly from a stack or chimney, the air is measured as it moves towards areas where it may impact on human health or quality of life.

Air quality monitoring does not include the measurement of odour, which is a subjective process. Chemical analytical methods seldom reveal any association between concentrations and strength of odours as perceived by the human nose.

Pollutant information

In the following pages each pollutant is assessed with a description of its health effects and general sources. The information summarises some impacts to health. More detailed information can be obtained from Peach (1997), the National Pollutant Inventory, the United States EPA IRIS database and the NEPC's Air Toxics web site. See bibliography for internet links.

SAMPLING SITE

The diagram below describes the location of the two monitoring sites in relation to the foundry. The area contains a mix of planning zones (commercial, industrial and residential) that are all sources of air pollutants. At each site the DOAS method for measuring pollutants was conducted on two 'paths'. The direction of each path is described.

Figure 1 The Castalloy foundry air monitoring sites

RESULTS

Nitrogen dioxide (NO_2)

Health effects

At relatively high concentrations, nitrogen dioxide causes inflammation of the airways. Long-term exposure to nitrogen dioxide may affect lung function and enhance the response to allergens in some individuals. The National Environment Protection Measure (NEPM) short-term air quality standard is 0.120 ppm, measured as an hourly average. There is also a longer-term NEPM standard of 0.03 ppm measured over one year.

Sources

All combustion processes in air produce oxides of nitrogen. Nitrogen dioxide (NO_2) and nitric oxide (NO) are both oxides of nitrogen, together referred to as NO_x. Motor vehicles account for about 70% of total Adelaide emissions of NO_x. Other sources include electricity generation and domestic wood burning. The Castalloy foundry, through its aluminium casting activities, emits to air approximately 3600 kg of NO_x each year. NO_x is also a precursor in the production of ozone and photochemical smog.

Monitoring results

One-hour averages for nitrogen dioxide for the two paths and sites were within the range of 0 to 0.051 ppm (path 1) and 0 to 0.049 ppm (path 2). These are well within the NEPM air quality standard of 0.12 ppm (one-hour average). The average concentration for the sampling period was 0.011 and 0.010 ppm for paths 1 and 2 respectively. If these values are representative of a whole year, then results would comply with the annual NEPM standard of 0.03 ppm.

The Department of Human Services advises that health impacts are not expected at this level of pollution.

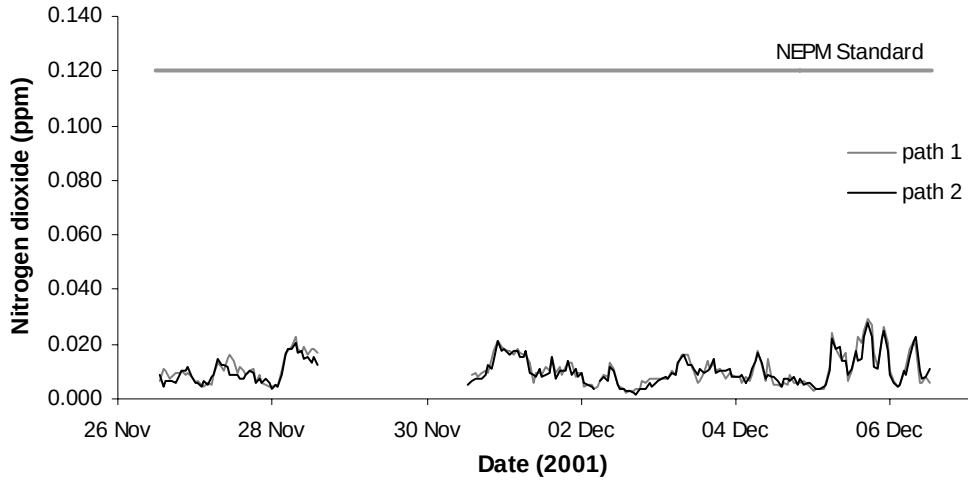

Figure 2 One-hour nitrogen dioxide concentrations at site 1

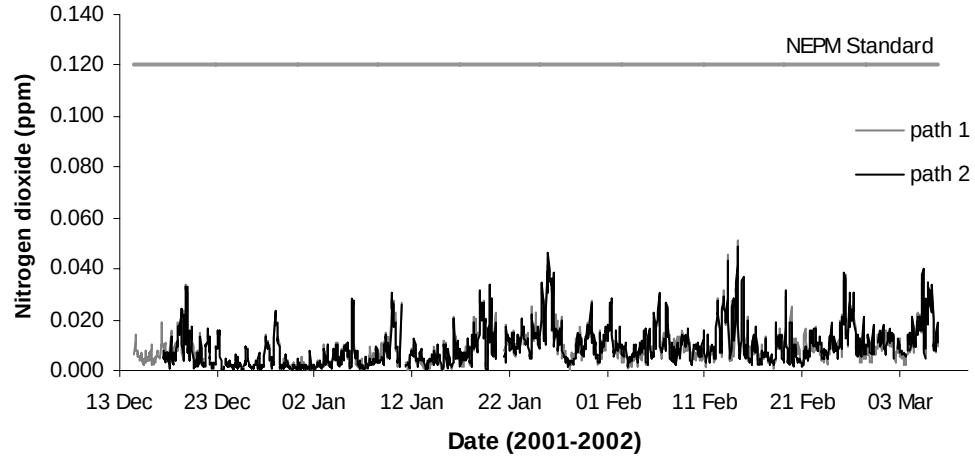

Figure 3 One-hour nitrogen dioxide concentrations at site 2

Ozone (O_3)

Health effects

Exposure to elevated concentrations of ozone may cause slight irritation to the eyes and nose. With very high levels of exposure (0.5 to 1 ppm) over several hours, damage to the airway lining may occur, followed by inflammatory reactions. Minor changes in the airways may occur at lower concentrations, down to about 0.08 ppm. The NEPM air quality standard for ozone is 0.1 ppm as a one-hour average. A four-hour standard at 0.08 ppm has also been set—a level at which effects on healthy individuals have been demonstrated.

Sources

Ozone at ground level is primarily formed by a series of chemical reactions initiated by sunlight. Oxides of nitrogen and volatile organic compounds (VOCs), derived mainly from artificial sources, react in sunlight to form ozone. Combustion, industrial processes, and activities such as solvent use and petrol handling and distribution produce these substances. Oxides of nitrogen and VOCs are the most important precursors for the generation of ozone. Emissions from motor vehicles account for 40% of Adelaide's VOCs. Carbon monoxide, methane, and other VOCs that arise from plants, trees and other natural sources can also promote ozone production.

These chemical reactions do not take place instantaneously but over several hours or even days, depending on the VOCs and meteorological conditions. Once ozone has been produced it may persist for several days. Ozone measured at a particular location may therefore have arisen from VOC and NO_x emissions many kilometres away. Maximum concentrations of ozone generally occur downwind of the source areas of the precursor pollutant emissions. Therefore, ozone measured at North Plympton is not attributed to local industry. However, the pollutant was measured to assist the EPA in looking at overall local air quality issues at North Plympton.

Monitoring results

One-hour averages for ozone were, for the two paths and sites, within the range of 0 to 0.090 ppm (path 1) and 0 to 0.071 ppm (path 2)—within the NEPM air quality standard of 0.1 ppm (one-hour average). The average concentration for the sampling period from both monitoring sites was 0.023 and 0.020 ppm for paths 1 and 2 respectively.

The Department of Human Services advises that health impacts are not expected at the current level of pollution.

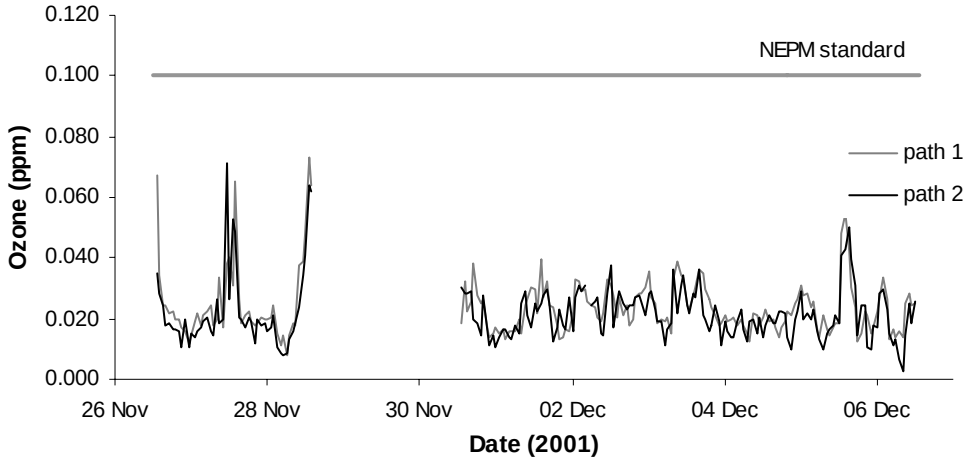

Figure 4 One-hour ozone concentrations at site 1

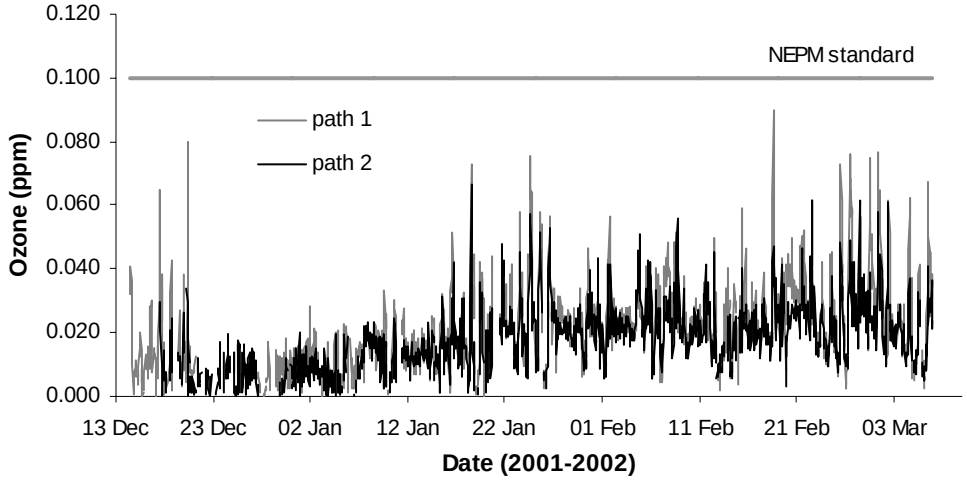

Figure 5 One-hour ozone concentrations at site 2

Four-hour averages for ozone were, for the two paths and sites, within the range of 0.001 to 0.069 ppm (path 1) and 0.001 to 0.054 ppm (path 2)—within the NEPM air quality standard of 0.08 ppm (four-hour average).

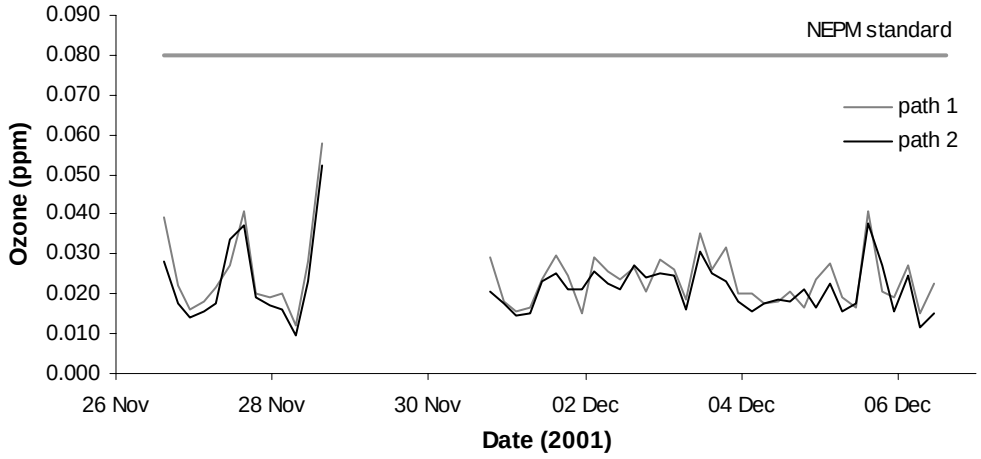

Figure 6 Four-hour ozone concentrations at site 1

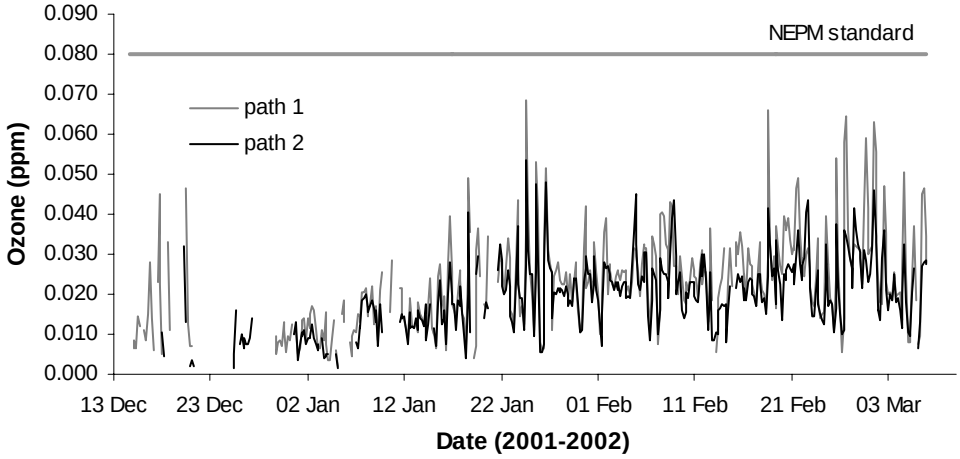

Figure 7 Four-hour ozone concentrations at site 2

Sulfur dioxide (SO_2)

Health effects

Sulfur dioxide causes constriction of the airways by stimulating nerves in the lining of the nose, throat and bronchial tubes. The constriction is particularly likely to occur in those suffering from asthma or other chronic lung disease. The NEPM air quality standard is 0.20 ppm measured over a one-hour averaging period. This standard is intended to reduce the exposure of the population, including individuals who may be particularly sensitive to sulfur dioxide, to a level at which harmful effects are unlikely to occur.

Sources

Motor vehicles contribute about 90% of sulfur dioxide in Adelaide. Other sources include fossil fuel combustion, particularly from coal–burning power plants, and industrial processes such as wood pulping, paper manufacture, petroleum and metal refining and metal smelting, particularly from ores containing sulfide. However, many of these activities do not occur in the Adelaide airshed. Other sources of SO_2 include the manufacture of fumigants, the use of food preservatives, bleaches, and wine making. Small amounts can be ingested by eating preserved foods. The Castalloy foundry once emitted approximately 210 kg of sulfur dioxide per year; however, the process using sulfur dioxide has been discontinued.

Monitoring results

One-hour averages for sulfur dioxide for the two paths and sites were within the range of 0 to 0.011 ppm for paths 1 and 2 and well below the NEPM air quality standard of 0.20 ppm (one-hour average). The average concentration for the sampling period was 0.001 ppm for both paths. Daily averages ranged between 0 and 0.002 ppm, well below the NEPM air quality standard of 0.08 ppm (daily average).

The Department of Human Services advises that health impacts are not expected at these levels.

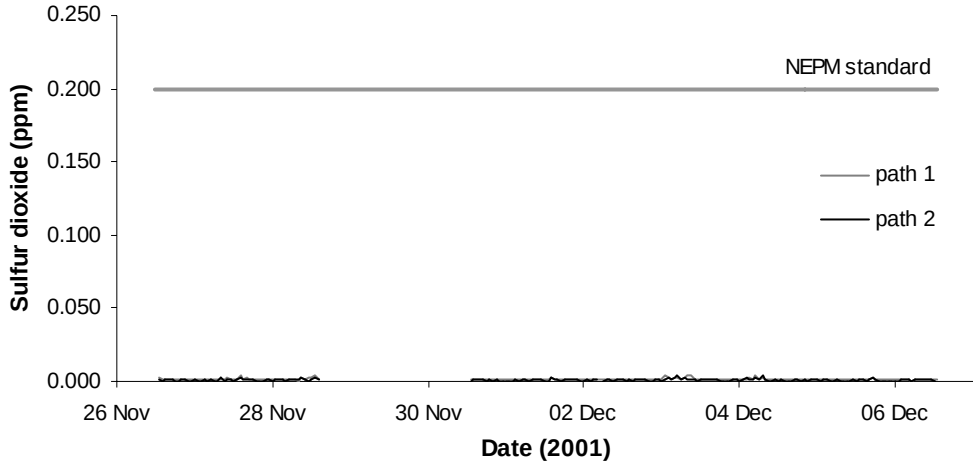

Figure 8 One-hour sulfur dioxide concentrations at site 1

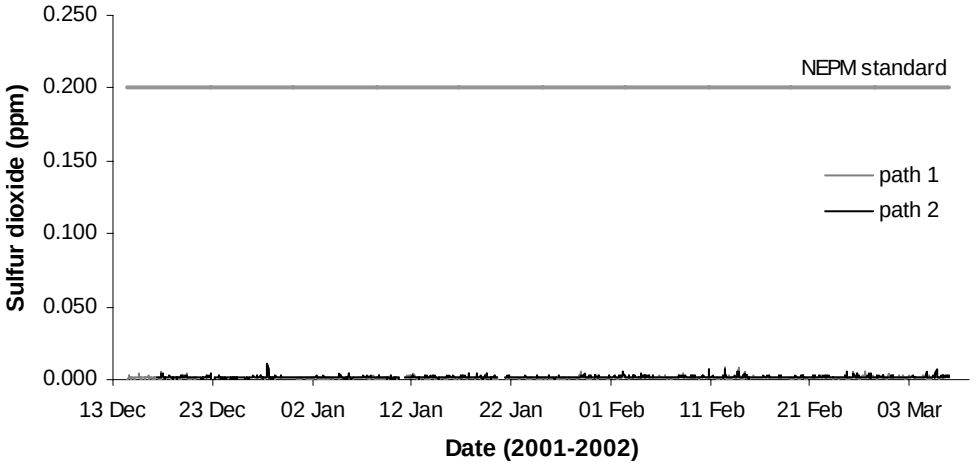

Figure 9 One–hour sulfur dioxide concentrations at site 2

Benzene (C_6H_6)

Health effects

Benzene is a recognised human carcinogen. Studies of industrial workers exposed to high levels of benzene have demonstrated a greater risk of leukaemia, which increased in relation to their working lifetime exposure. Because it is a carcinogen, no absolutely safe level can be specified for ambient air concentrations of benzene and, as yet, there is no ambient standard for benzene in Australia. The Expert Panel on Air Quality Standards (EPAQS) has recommended an air quality standard of 0.005 ppm (16.25 μg / m^3) as an annual average, a level which they concluded represents an exceedingly small risk to health. In their report, EPAQS considered the advice of the Department of Health's Committee on Carcinogenicity, that exposure to benzene should be kept as low as practicable (Department of the Environment, Transport and the Regions 1994).

Sources

Benzene is a volatile organic compound. In Adelaide, the main source is the distribution and combustion of petrol, of which benzene is a minor constituent. Benzene is also formed during the combustion process from aromatics in the petrol; motor vehicles contribute up to 70% of emissions. Smoke from domestic wood fires and emissions from lawn mowers and some industries, such as foundries, are also significant contributors.

Monitoring results

One-hour averages for benzene for the two paths and sites were within the range of 0 to 33.8 μg / m^3 for path 1 and 0 to 28.8 μg / m^3 for path 2. The average for the entire sampling period for path 1 was 10.1 μg / m^3, and for path 2, 9.7 μg / m^3. The UK air quality guideline (Department of the Environment, Transport and the Regions 1994) for benzene is 16 μg / m^3 (measured as an annual average). The annual guideline was not included on the graph (figure 11) opposite, as monitoring was conducted over only four months. The average concentration measured in this study is lower than the average of 31.4 μg / m^3 measured by an EPA hot spot monitoring study alongside a major Adelaide road (EPA 2001b).

Benzene was monitored at the same time at the EPA's air quality monitoring station at Netley. One-hour averages for benzene at the Netley site between 26 November 2001 and 6 March 2002 were within the range of 0 to 24.4 μg / m^3. The average for the entire sampling period was 4.6 μg / m^3. The site is regarded by EPA as a representative ambient site for western Adelaide suburbs. The Castalloy averaged results are about double those at Netley.

Ambient concentrations of benzene are expected to fall by 2005 after the introduction of the national fuel quality standard and motor vehicle Australian Design Rules (Environment Australia 2001).

The Department of Human Services advises that should the measured one-hour averaged values be reflective of annual averages then risks to health would not be anticipated, based on the UK ambient air criteria. The uncertainties associated with this extrapolation are embodied in this conclusion.

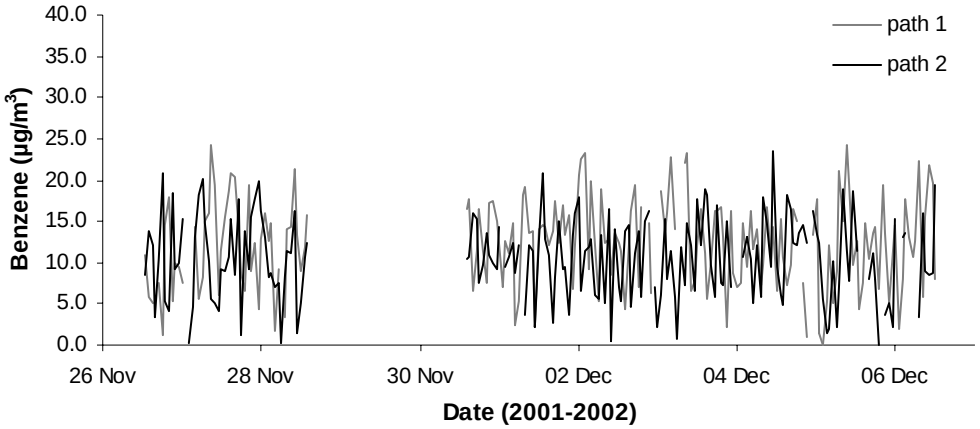

Figure 10 One-hour benzene concentrations at site 1

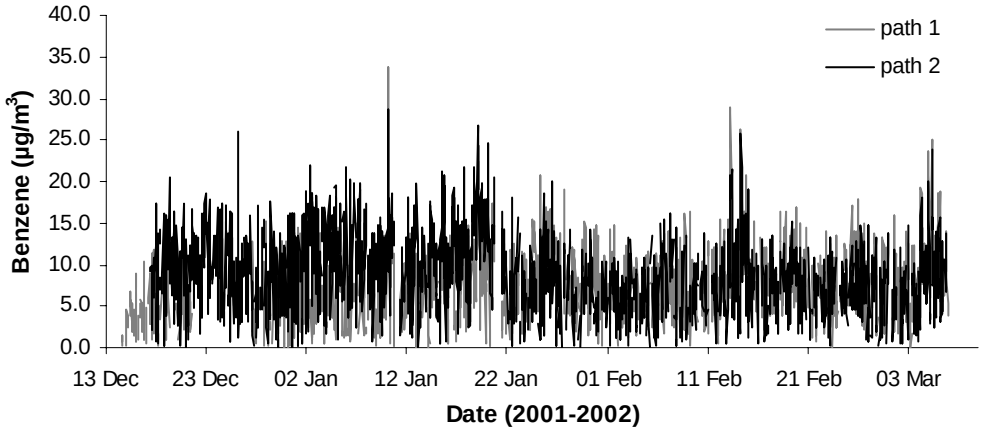

Figure 11 One-hour benzene concentrations at site 2

Toluene (C_7H_8)

Health effects

Low to moderate levels of long-term exposure can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, loss of appetite and hearing loss. Inhaling a high level of toluene in a short time can make you feel light-headed, dizzy, or sleepy. Repeated exposure to high levels can cause permanent brain and speech damage, vision and hearing problems, loss of muscle control, and poor balance. The threshold for smelling toluene is about 8 ppm. The WHO guideline is 0.27 ppm (1000 $\mu g / m^3$) measured as a thirty-minute average.

Sources

Toluene is a colourless liquid with a distinctive sweet and pungent smell. It occurs naturally in crude oil and is produced during the refining of crude oil to make fuel. Toluene is a by-product of converting coal to coke and in the manufacture of styrene; it is also used in making paints, paint thinners, fingernail polish, lacquers, adhesives, rubber, and in some printing and leather tanning processes.

Monitoring results

Thirty-minute averages for toluene were within the range of 2.7 to 139.3 $\mu g / m^3$ (path 1) and 0.3 to 156.9 $\mu g / m^3$ (path 2). The average for the entire sampling period was 31.7 $\mu g / m^3$ (path 1) and 30.2 $\mu g / m^3$ (path 2). The WHO (2000) air quality guideline is 1000 $\mu g / m^3$ (30-minute average). Although there is considerable variability in the measurements, the peak result of 156.9 $\mu g / m^3$ is an order of magnitude lower than the WHO guideline.

The Department of Human Services advises that toluene levels are well within the WHO air quality guidelines, including results from shorter time-averaged periods that are able to identify shorter elevated peaks in the data.

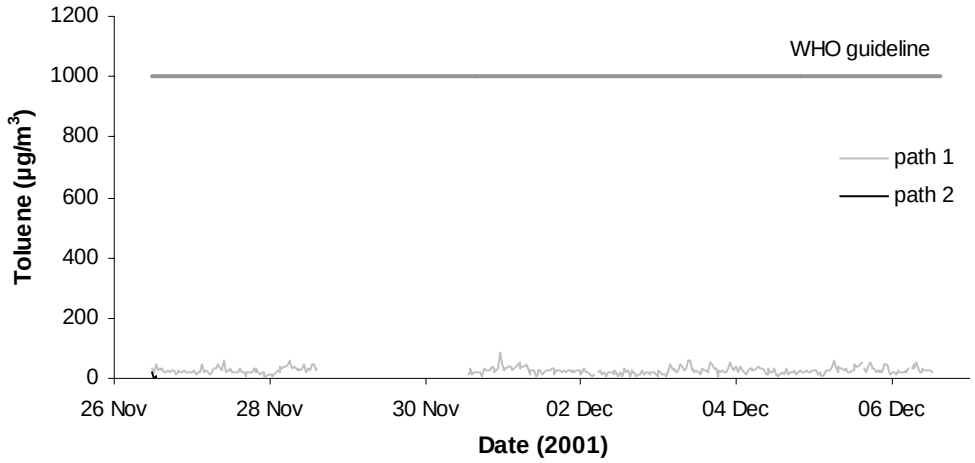

Figure 12 Thirty-minute toluene concentrations at site 1

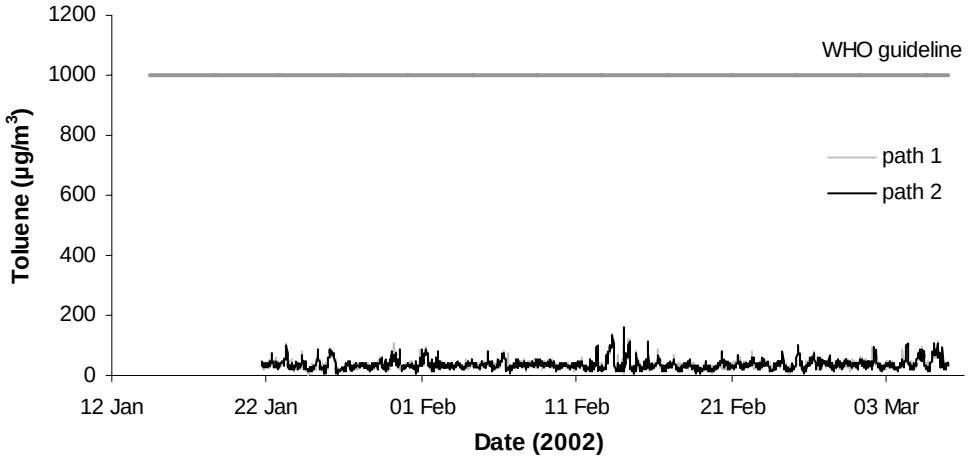

Figure 13 Thirty-minute toluene concentrations at site 2

Formaldehyde (CH_2O)

Health effects

When formaldehyde is present in the air at levels at or above 0.1 ppm, acute health effects can occur. These include watery eyes; burning sensations in the eyes, nose and throat; nausea, coughing, chest tightness and wheezing; skin rashes; and other irritating effects. Sensitive people can experience symptoms at levels below 0.1 ppm. The World Health Organization's guideline is 0.08 ppm (100 $\mu g / m^3$) measured as a thirty-minute average.

Sources

Formaldehyde is an important industrial chemical used to make other chemicals, building materials, and household products. It is used in glues, wood products, preservatives, permanent press fabrics, paper product coatings, and certain insulation materials. Formaldehyde is released by incomplete combustion of fuel in motor vehicles, cigarette smoking, and burning wood, kerosene and natural gas.

Monitoring results

Thirty-minute averages for formaldehyde were within the range of 3 to 46.2 $\mu g / m^3$ (path 1) and 2.3 to 54.4 $\mu g / m^3$ (path 2). The average measurement for the entire sampling period was 19.7 $\mu g / m^3$ (path 1) and 24.3 $\mu g / m^3$ (path 2). The WHO (2000) guideline has been established at 100 $\mu g / m^3$ (30-minute average). The results are well below this WHO guideline.

The Department of Human Services advises that formaldehyde levels are well within the WHO air quality guidelines, including results from shorter time-averaged periods that are able to identify shorter elevated peaks in the data.

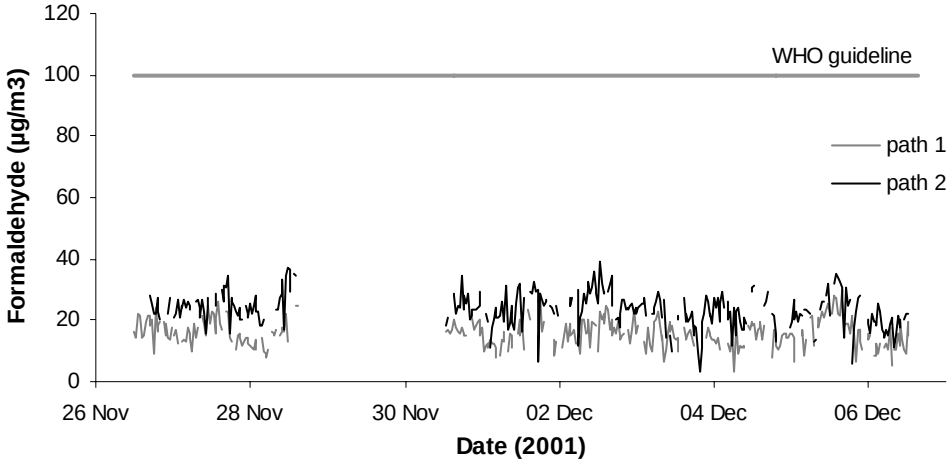

Figure 14 Thirty-minute formaldehyde concentrations at site 1

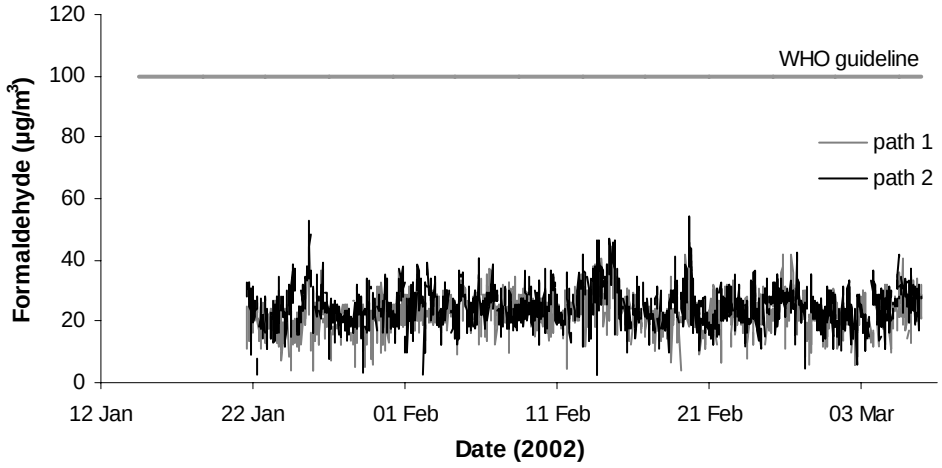

Figure 15 Thirty-minute formaldehyde concentrations at site 2

Naphthalene ($C_{10}H_8$)

Health effects

Currently there are no available health guidelines for naphthalene in ambient air. Readily available information indicates health effects may vary from irritation of eyes, skin and the respiratory system to chronic effects, including cataracts, inflammation of the lungs, anaemia and some forms of cancer, depending on exposure. This information, however, appears inconclusive as relevant studies are scarce and may be inadequate due to methodology (USEPA).

Sources

Naphthalene is used in mothballs, and is produced during coal tar production, wood preserving, tanning, and ink and dye production. It is also released from the burning of coal and oil and other industries. Typical concentrations in air are about 1 μg / m^3 in ambient air and 1 to 3 μg / m^3 in indoor air (USEPA).

Once in the atmosphere, naphthalene rapidly photodegrades (half-life 3–8 hours).

Monitoring results

Thirty-minute averages for naphthalene were within the range of 0 to 156.4 μg / m^3 (path 1) and 1.2 to 174.5 μg / m^3 (path 2). The average for the entire sampling period was 17.8 μg / m^3 (path 1) and 12.7 μg / m^3 (path 2). These results are higher than expected from ambient background levels according to USEPA information.

The Department of Human Services advises that there are limited ambient air standards for naphthalene. Acceptable ambient air concentrations have been established by a number of US states, with three states establishing annual average concentrations of 14.3, 50 and 120 μg / m^3. The most conservative value of 14.3 μg / m^3 is considerably lower than a cited odour threshold of 440 μg / m^3. The USEPA RfC (inhalation reference concentration) for naphthalene is 3 μg / m^3, based on nasal effects in rodents. Further investigation into an acceptable ambient air value is warranted, considering the measured averages at the two sites were 12.7 and 17.8 μg / m^3 over the monitoring periods, with the latter result reflecting a longer monitoring period with many short-term peak exposures exceeding 100 μg / m^3.

The EPA is conducting an investigation of smaller industries near the Castalloy foundry; it is almost certain that some of these industries are contributing to the elevated ambient concentrations of naphthalene. Inspections, stack emission testing and measures to reduce naphthalene concentrations are being employed by EPA to improve air quality in the area.

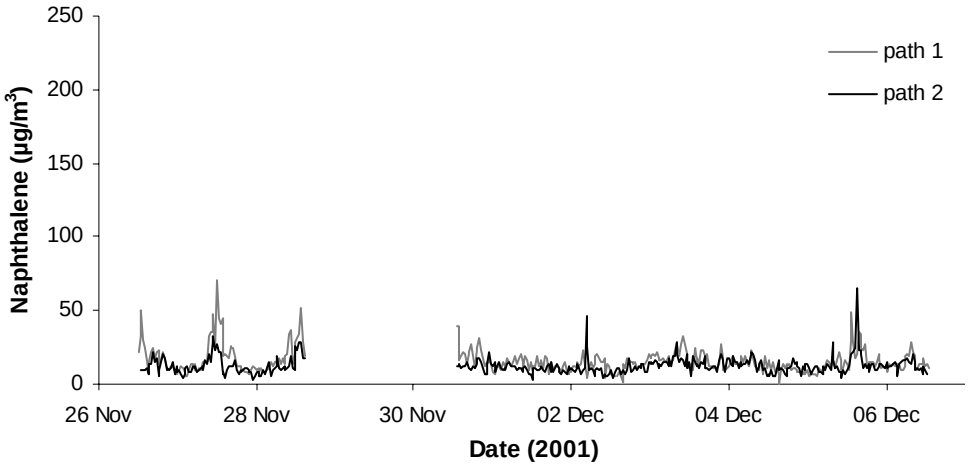

Figure 16 Thirty-minute naphthalene concentrations at site 1

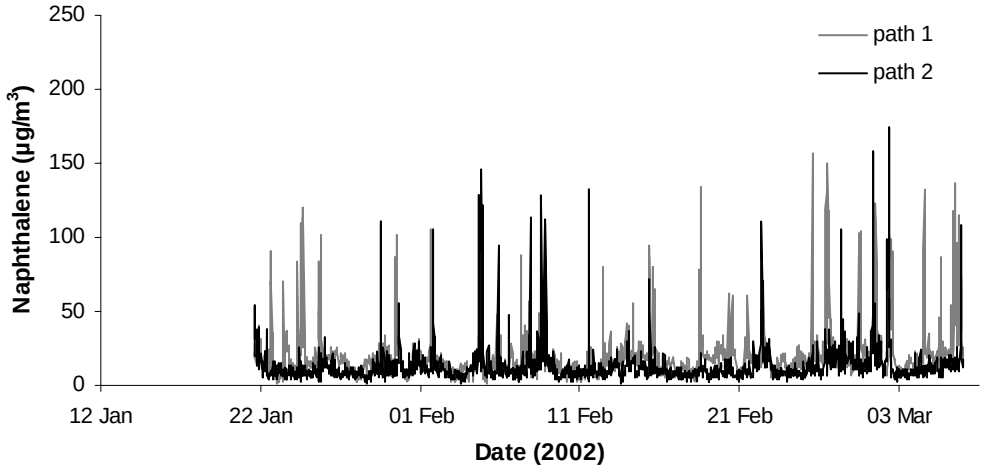

Figure 17 Thirty-minute naphthalene concentrations at site 2

Carbon monoxide (CO)

Health effects

The main threats to health from exposure to carbon monoxide are the formation of carboxyhaemoglobin, which substantially reduces the capacity of the blood to carry oxygen and deliver it to the tissues, and the blockage of important biochemical reactions in cells. People with an existing disease affecting the delivery of oxygen to the heart or brain, such as coronary artery disease or angina, are likely to be at particular risk if these delivery systems are further impaired by carbon monoxide. The NEPM air quality standard of 9 ppm as a running 8-hour average is intended to limit the exposure of the population, including susceptible individuals.

Sources

Carbon monoxide is a gas formed by the incomplete combustion of fuels containing carbon. The main outdoor source of carbon monoxide is currently motor vehicles, in particular petrol vehicles, which in Adelaide account for almost 90% of emissions.

Industrial sources include steel plants, foundries, oil refining, and chemical manufacturing operations such as the making of lime.

Monitoring results

Eight-hour averages of carbon monoxide were within the range of 0.2 to 2.1 ppm, with an average for the entire sampling period of 0.5 ppm—well below the NEPM air quality standard of 9.0 ppm (eight-hour average).

The Department of Human Services advises that health impacts are not expected at this level of pollution.

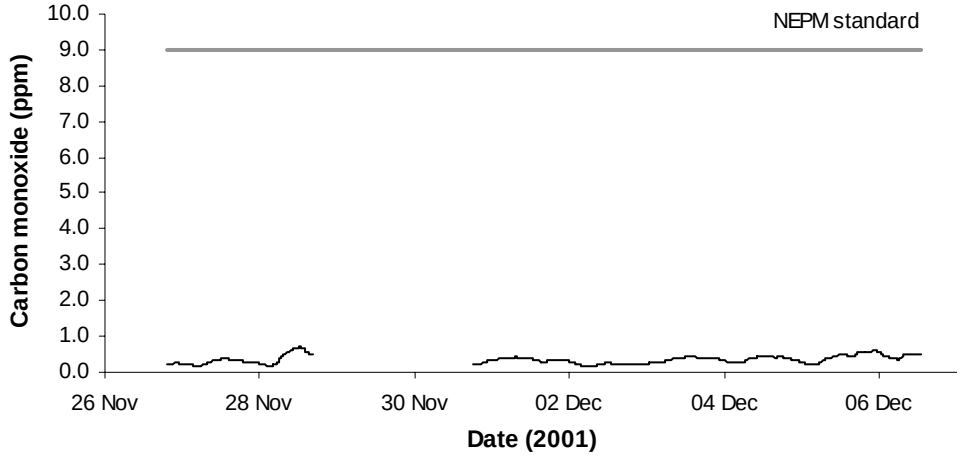

Figure 18 Eight-hour carbon monoxide concentrations at site 1

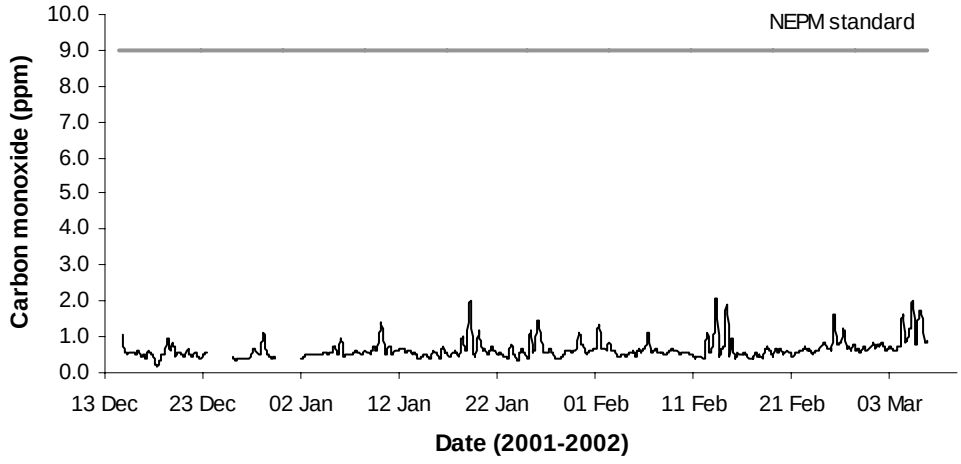

Figure 19 Eight-hour carbon monoxide concentrations at site 2

Particulate matter (PM_{10})

Health effects

PM_{10} refers to particulate matter less than ten micrometres (μm) in diameter. Particulate air pollution is associated with a range of effects on health, including respiratory and cardiovascular difficulties, asthma and mortality.

Since the most applicable evidence relates daily average concentrations of particles to effects on health, the PM_{10} NEPM is also measured over 24 hours. The NEPM air quality standard is 50 μg / m^3 as a 24-hour average.

Sources

Unlike the individual gaseous pollutants that are single, well-defined substances, particles less than 10 microns in size (PM_{10}) in the atmosphere are composed of a wide range of materials arising from a variety of sources. They include coarse particles such as suspended soils and dusts, sea-salt, biological particles and particles from construction work; smaller particles arising from combustion sources (mainly motor vehicles—in Adelaide motor vehicles contribute 40% of PM_{10}); and fine particles, mainly sulfate and nitrate, that are formed by chemical reactions in the atmosphere.

The relative contribution of each source type varies from day to day, depending on meteorological conditions and quantities of emissions from mobile and static sources.

Monitoring results

One-day averages for PM_{10} particles were within the range of 7.4 to 43.8 μg / m^3, with a one-day average, over the entire monitoring period, of 19.3 μg / m^3. This is below the NEPM air quality standard of 50 μg / m^3.

Concentrations of PM_{10} at Castalloy were comparable to concentrations measured at the Netley ambient air monitoring site.

There were no exceedences of the NEPM for particles at either the Castalloy or Netley site during the monitoring period. The Department of Human Services advises that health impacts are not expected at these levels.

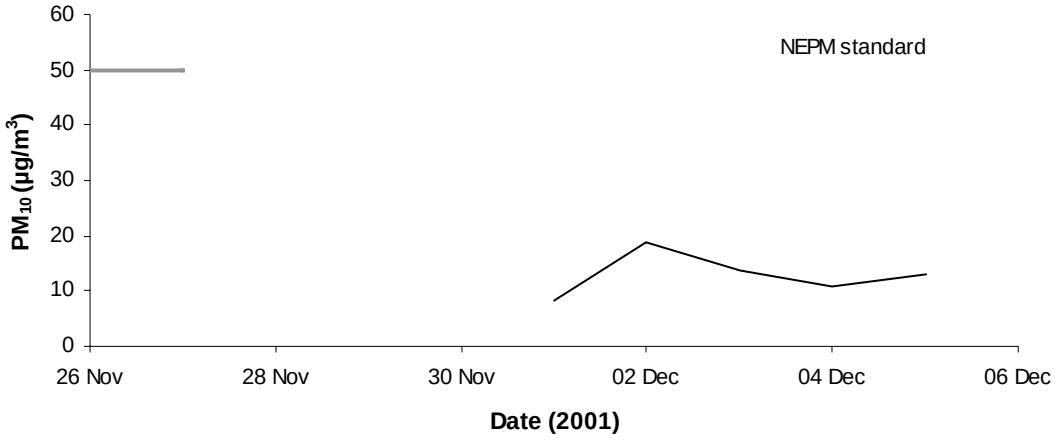

Figure 20 One-day particulate matter (PM_{10}) concentrations at site 1

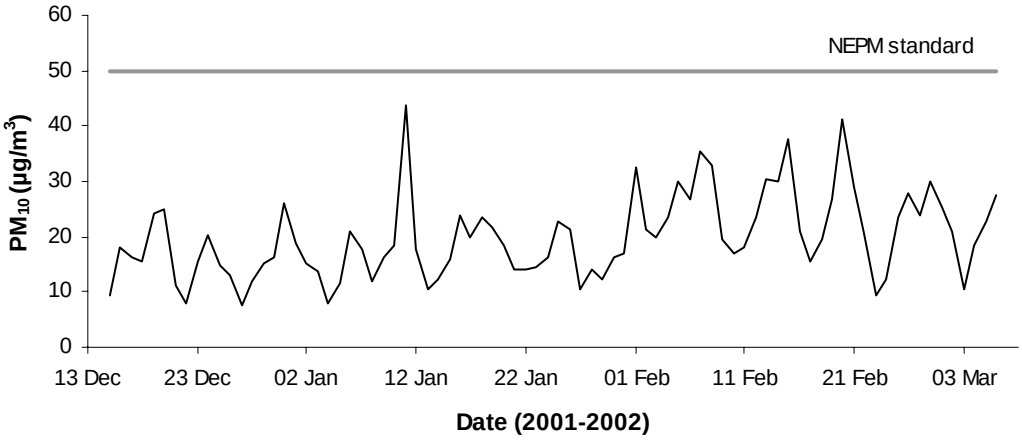

Figure 21 One-day particulate matter (PM_{10}) concentrations at site 2

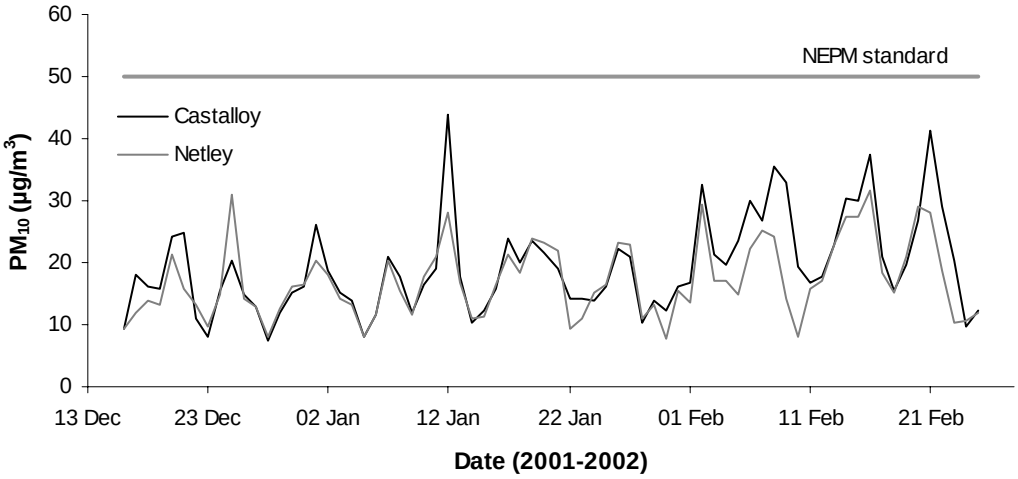

Figure 22 Comparison of one-day particulate matter (PM_{10}) concentrations at Netley and Castalloy

CONCLUSION

Monitoring was based at two sites located within 100 metres of the Castalloy plant and provided data over a three-month period. Monitoring was not concurrent at the two sites but was based on a need to relocate the mobile monitoring unit. Monitoring at the initial site occurred for only one week. Results between the two sites are comparable.

With the exception of naphthalene, the monitoring results show that concentrations of measured pollutants at North Plympton were below the NEPM air quality standards and other available air quality guidelines.

- Concentrations of NEPM pollutants, including nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone and PM_{10}, were all below the NEPM standards. The Department of Human Services advises that health impacts would consequently not be expected.
- The Department of Human Services advises that concentrations of toluene and formaldehyde were well within the WHO air quality guidelines, including results from shorter time-averaged periods that are able to identify shorter elevated peak exposures.
- Benzene levels for the three-month period of monitoring averaged 10.1 and 9.7 $\mu g / m^3$ (for two paths). The Department of Human Services advises that, should these values be reflective of annual averages, risks to health would not be anticipated, based on the UK ambient air criteria.
- Measured levels of naphthalene were elevated against other background information.

It is almost certain that smaller industries surrounding the foundry are contributing to the elevated ambient concentrations of naphthalene. Inspections, stack emission testing and measures to reduce naphthalene concentrations are being employed by EPA to improve air quality in the area.

The Department of Human Services advises that the lack of Australian NEPMs for hazardous air pollutants encompassing many organic chemicals increases the uncertainties of any health risk assessment of local ambient air monitoring results. Uncertainties arise, too, from default comparisons with overseas criteria that may not truly reflect Australian factors implicit in ambient air guideline development. It is anticipated that the development of the Air Toxics NEPM will reduce such uncertainties.

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Note: the internet links in this reference list were accurate at the time of publication; given the ephemeral nature of the internet the EPA cannot guarantee that they will remain so.

APPENDIX 1 SAMPLING METHODS

Differential optical absorption spectrometry (DOAS)

Gaseous compounds such as ozone, nitrogen dioxide, sulfur dioxide and hydrocarbons were measured using the OPSIS (DOAS) analyser. The system uses the light absorbing properties of gaseous species to determine concentrations along a designated path. A beam of light is projected across a path where the pollutants in the path adsorb light at particular wavelengths. A comparison is made between the adsorption wavelength with the known adsorption properties of measured compounds. The concentration of the gaseous species is then determined. The almost simultaneous measurement of many pollutants is possible using this technique.

Tapered element oscillating microbalance (TEOM)

The TEOM mass measurement system was used for the continuous measurement of particulate mass (PM_{10}) concentrations. It relies on an instrument that draws air through a filter at a constant flow rate and constant temperature, continuously weighing the filter and calculating the mass concentration. Mass is determined from the measured change in frequency at which the element attached to the filter is oscillating.

The TEOM is an instrument that measures PM_{10} as an equivalent aerodynamic diameter (EAD) as it uses an impacting mechanism to separate particles.

Non-dispersive infrared (NDIR)

Carbon monoxide is measured using a non-dispersive infrared (NDIR) analyser of the gas filter correlation type. A pre-filtered air sample is drawn through a sample cell. Infrared radiation is passed through the sample cell and a carbon monoxide-free reference cell. The detector measures the infrared light absorbed by carbon monoxide in the sample. By comparing the light intensity received by the detector through the cell with a similar cell containing reference gas, the concentration of carbon monoxide is determined.

APPENDIX 2 SITE METADATA

Metadata for Castalloy Foundry, North Plympton—Site 1: Streeters Road (continuous sampling site)

Site Information (Metadata)		Notes on data validation and assessment
Site name:	Castalloy, North Plympton	Zero, span, calibration equation parameters & quality assurance procedures
Site Details		Zero corrections: (CO 22/3/01–6/4/01 +0.2 ppm) (SO_2 12/4/01–23/5/01 –2 μg/m³) (NO_2 22/3/01–12/4/01 +23 μg/m³– 12/4/01–23/5/01 +65 μg/m³) (O_3 22/3/01–23/5/01 +12 μg/m³) (FOR 22/3/01–12/401 –30 μg/m³– 12/4/01–23/5/01 –133 μg/m³) (TOL 10/4/01–23/5/01 +12 μg/m³)
Street address	Streeters Road, North Plympton	
Date established	26/11/2001	
Date terminated	6/12/2001	Correcting measurement results from μg/m³ to ppm. See OPSIS (1999) *Analyser Software, version 7.2 User's Guide*. OPSIS, Sweden.
Siting guidelines (AS 2922-1987) exceptions	None	
Description of surrounding land use	Residential and industrial.	Data validated and checked in accordance with the National Environment Protection (Ambient Air Quality) Measure—Peer Review Committee (2001) *Technical Paper No. 5: Data Collection and Handling*. NEPC, Canberra.
Description of nearby emission sources	Aluminium foundry, motor vehicles, small industry	
Map Coordinates		Notes of time and nature of events that may influence data validation or interpretation:
Datum	GDA 94	No events that influenced data.
Projection	AMG Zone 54	Time frame at this location was reduced due to logistical issues.
Easting		
Northing		

Pollutants Measured					
NO, NO_2, SO_2, O_3, benzene, toluene, formaldehyde, naphthalene		Particulate matter (PM_{10})		Carbon monoxide (CO)	
Instrument Types					
Make	OPSIS	Make	Rp	Make	Thermo Electron
Model	ER130 & AR500	Model	TEOM PM_{10}	Model	NDIR analyser
Serial number	E672	Serial number	140AB221849807	Serial number	48-16574-162
Minimum detection level	1-10 ppb (dependent on path length 340m & 134m)	Minimum detection level	N/A	Minimum detection level	0.05 ppm or 2%
Units	μg/m³ (converted to ppm where applicable)	Units	μg/m³	Units	ppm
Measurement cycle	10 minutes	Sampling rate	10 minutes	Sampling rate	20 seconds
Logging interval of raw data	10 minutes	Logging interval of raw data	10 minutes	Logging interval of raw data	10 minutes
Data return	%	Data return	%	Data return	%
Clock adjustment	Period ending	Clock adjustment	Period ending	Clock adjustment	Period ending

Metadata for Castalloy Foundry, North Plympton—Site 2: Sandringham Reserve (continuous sampling site)

Site Information (Metadata)		Notes on data validation and assessment
Site name:	Castalloy, North Plympton	Zero, span, calibration equation parameters & quality assurance procedures
Site Details		Zero corrections: (CO 22/3/01–6/4/01 +0.2 ppm) (SO_2 12/4/01–23/5/01 –2 μg/m³) (NO_2 22/3/01–12/4/01 +23 μg/m³– 12/4/01–23/5/01 +65 μg/m³) (O_3 22/3/01–23/5/01 +12 μg/m³) (FOR 22/3/01–12/401 –30 μg/m³– 12/4/01–23/5/01 –133 μg/m³) (TOL 10/4/01–23/5/01 +12 μg/m³)
Street address	Kinkaid Avenue, North Plympton	
Date established	26/11/2001	
Date terminated	6/12/2001	Correcting measurement results from μg/m³ to ppm. See OPSIS (1999) *Analyser Software, version 7.2 User's Guide*. OPSIS, Sweden.
Siting guidelines (AS 2922-1987) exceptions	None	
Description of surrounding land use	Residential and industrial.	Data validated and checked in accordance with the National Environment Protection (Ambient Air Quality) Measure—Peer Review Committee (2001) *Technical Paper No. 5: Data Collection and Handling*. NEPC, Canberra.
Description of nearby emission sources	Aluminium foundry, motor vehicles	
Map Coordinates		Notes of time and nature of events that may influence data validation or interpretation:
Datum	GDA 94	No events that influenced data.
Projection	AMG Zone 54	Encountered some trouble with maintaining the light on the reflective mirror, due to technical issues. Some data was lost using the OPSIS for this reason.
Easting		
Northing		

Pollutants Measured					
NO, NO_2, SO_2, O_3, benzene, toluene, formaldehyde, naphthalene		Particulate matter (PM_{10})		Carbon monoxide (CO)	
Instrument Types					
Make	OPSIS	Make	Rp	Make	Thermo Electron
Model	ER130 & AR500	Model	TEOM PM_{10}	Model	NDIR analyser
Serial number	E672	Serial number	140AB221849807	Serial number	48-16574-162
Minimum detection level	1-10 ppb (dependant on path length 340m & 134m)	Minimum detection level	N/A	Minimum detection level	0.05 ppm or 2%
Units	μg/m³ (converted to ppm where applicable)	Units	μg/m³	Units	ppm
Measurement cycle	10 minutes	Sampling rate	10 minutes	Sampling rate	20 seconds
Logging interval of raw data	10 minutes	Logging interval of raw data	10 minutes	Logging interval of raw data	10 minutes
Data return	%	Data return	%	Data return	%
Clock adjustment	Period ending	Clock adjustment	Period ending	Clock adjustment	Period ending